



The Sutherland Hospital, Operating Theatre Upgrade

SSD-11099584

Construction Noise and Vibration Management Sub-Plan

Hindmarsh

Report number: 210507-Sutherland Hospital, Operating Theater Upgrade-CNVMSP-R1
Date: 20 October 2021
Version: For Information

DOCUMENT CONTROL

Project Name	The Sutherland Hospital, Operating Theatre Upgrade
Project Number	210182
Report Reference	210507-Sutherland Hospital, Operating Theater Upgrade-CNVMSP-R1
Client:	Hindmarsh

Revision	Description	Reference	Date	Prepared	Checked	Authorised
1	For Information	210507-Sutherland Hospital, Operating Theater Upgrade, CNVMSP-R1	20 October 2021	Ben White	Matt Furlong	Ben White

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1 INTRODUCTION

Pulse White Noise Acoustics has been engaged to undertake the acoustic assessment of the noise and vibration impacts during the construction stages of the Sutherland Hospital, Operating Theatre Upgrade project within the existing hospital and located at Kingsway and Kareena Road, Caringbah.

The assessment has been undertaken in conjunction with the requirements of Item B16 of the projects *Conditions of Consent* including the SSD-11099584 and the EPA's Interim Construction Noise Guideline which is detailed in this report.

This report includes the noise and vibration mitigations and management controls for the operation of construction activities on the site to ensure impacts to surrounding receivers are minimised in accordance with the relevant requirements.

The report has been undertaken in accordance with Item B16 of the *Conditions of Consent* including the summary matrix below:

Condition of Consent Number	Part	Condition Summary	Comments
B16	(a)	Be prepared by a Suitably qualified noise expert;	Ben White is a director of Pulse White Noise Acoustics with over 20 years of experience. Ben is a member of the Australian Acoustical Society and his membership certificate is included in Appendix B.
	(b)	describe procedures for achieving the noise management levels in EPA's <i>Interim Construction Noise Guideline</i> (DECC, 2009)	Details of the assessment for the proposed construction activities are including in this report, including Sections 8.
	(c)	describe the measures to be implemented to manage high noise generating works such as piling, in close proximity to sensitive receivers;	See recommendations for required respite for high noise affected level within Section 8.1.1.
	(d)	include strategies that have been developed with the community for managing high noise generating works;	Noise management and community engagement detailed in Section 9
	(e)	describe the community consultation undertaken to develop the strategies in condition B16(d);	Recommended community consultation included in Section 9.
	(f)	include a complaints management system that would be implemented for the duration of the construction; and	Recommended management system included in Section 9.1 and 9.2
	(g)	Include a program to monitor and report on the impacts and environmental performance of the development and the effectiveness of the implemented management measures in accordance with the requirements of condition B13	Report includes recommended monitoring requirements within Section 7

2 DEVELOPMENT DESCRIPTION

The development includes the alterations and additions to the operating facilities Sutherland Hospital located at the Kingsway and Kareena Road, Caringbah. The required construction of the project will include limited demolition and excavation activities as well as construction of the new facility.

The surrounding receivers to the site include residential receivers located to the north and west of the site as well as Kareena Private Hospital located to the north of the site.

The site location, in relation to surrounding buildings, is shown in Figure 1 below.



Figure 1 Site Location and Surrounding Receivers

3 CONDITIONS OF CONSENT

The management of noise and vibration associated with the required construction works to be undertaken as part of the project will be undertaken in conjunction with the requirements of the SSD-11099584 consent, including Item C16 that requires the construction of the project to comply with NSW Dept of Env & Climate Change "*Interim Construction Noise Guideline*" 2009 and includes the following:

- B16. The Construction Noise and Vibration Management Sub-Plan must address, but not be limited to, the following:
- (a) be prepared by a suitably qualified and experienced noise expert;
 - (b) describe procedures for achieving the noise management levels in EPA's *Interim Construction Noise Guideline* (DECC, 2009);
 - (c) describe the measures to be implemented to manage high noise generating works such as piling, in close proximity to sensitive receivers;
 - (d) include strategies that have been developed with the community for managing high noise generating works;
 - (e) describe the community consultation undertaken to develop the strategies in condition B16(d);
 - (f) include a complaints management system that would be implemented for the duration of the construction; and
 - (g) include a program to monitor and report on the impacts and environmental performance of the development and the effectiveness of the implemented management measures in accordance with the requirements of condition B13.

4 EXISTING ACOUSTIC ENVIRONMENT

The proposed works associated with the Operating Theatre Upgrade are located within Sutherland Hospital. The hospital is located with the Kingsway to the north of the site and Kareena Road to the west. As detailed in Figure 1 above.

Existing environmental noise levels at the site are dominated by traffic noise generated predominantly from surrounding roadways and existing environmental noise levels.

As part of the SSD-11099584 approval of the site JHA Services has undertaken a *Noise and Vibration Impact Assessment for SSDA (SSD-11099584)* of the site which is included in their report dated 30/6/2021 revision E. As part of the *Noise and Vibration Impact Assessment for SSDA* a background noise survey of the site has been undertaken, the results of which have been used as the basis of this report.

4.1 Noise Survey Results

The JHA Services *Noise and Vibration Impact Assessment for SSDA* includes a noise survey of the site. The survey undertaken by JHA services includes long term monitoring locations undertaken in accordance with the requirements of the EPA. The results of the survey undertaken by JHA Services has been used as the basis of this assessment, a summary of the background noise levels within the JHA Services *Noise and Vibration Impact Assessment for SSDA* are included in Table 1 below.

Table 1 Results of Noise Survey at the Site

Measurement Location	Time of Measurement	L _{Aeq} , 15min dB(A)	L _{A90} , 15min dB(A)	Comments
Location 1 – Kingsway to the north	Day	62	60	Noise level at the site dominated by vehicle movements on surrounding roadways and natural noise levels
	Evening	59	53	
	Night	56	39	
Location 2 – To the east of Sutherland Hospital	Day	54	47	
	Evening	50	45	
	Night	45	39	
Location 3 – to the west of the site on Kareena Road	Day	59	48	
	Evening	57	45	
	Night	52	40	

The results of the noise survey previously undertaken at the site (and detailed above) have been used as the basis of this report.

5 CONSTRUCTION NOISE ASSESSMENT

This section of the report details the assessment of noise associated with the construction activities associated with the development. The assessment has been undertaken to assess the potential noise impacts from construction on surrounding receivers to the site.

The construction activities to be undertaken on the site include the ground works and construction of the site. The construction of the project does not include major demolition or excavation on the site.

5.1 Construction Noise

The assessment of construction noise impacts generated from the site has been undertaken in accordance with the requirements of the EAP Interim Construction Noise Guideline.

The EPA's Interim Construction Noise Guideline defines normal day time hours as the following:

2.2 Recommended standard hours

The recommended standard hours for construction work are shown in Table 1; however, they are not mandatory. There are some situations, as described below, where construction work may need to be undertaken outside of these hours. The likely noise impacts and the ability to undertake works during the recommended standard hours should be considered when scheduling work.

Table 1: Recommended standard hours for construction work

Work type	Recommended standard hours of work*
Normal construction	Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays
Blasting	Monday to Friday 9 am to 5 pm Saturday 9 am to 1 pm No blasting on Sundays or public holidays

* The relevant authority (consent, determining or regulatory) may impose more or less stringent construction hours.

5.1.1 Approved Hours of Work

Works on the site will be undertaken in accordance with the requirements of Items C5, C6, C7, and C8 of the SSD-11099584 which includes the following.

Construction Hours

- C4. Construction, including the delivery of materials to and from the site, may only be carried out between the following hours:
 - (a) between 7am and 6pm, Mondays to Fridays inclusive; and
 - (b) between 8am and 1pm, Saturdays.
 No work may be carried out on Sundays or public holidays.
- C5. Notwithstanding condition C4, provided noise levels do not exceed the existing background noise level plus 5dB, works may also be undertaken during the following hours:
 - (a) between 6pm and 7pm, Mondays to Fridays inclusive; and
 - (b) between 1pm and 4pm, Saturdays.
- C6. Construction activities may be undertaken outside of the hours in condition C4 and C5 if required:
 - (a) by the Police or a public authority for the delivery of vehicles, plant or materials; or
 - (b) in an emergency to avoid the loss of life, damage to property or to prevent environmental harm; or
 - (c) where the works are inaudible at the nearest sensitive receivers; or
 - (d) for the delivery, set-up and removal of construction cranes, where notice of the crane-related works is provided to the Planning Secretary and affected residents at least seven days prior to the works; or
 - (e) where a variation is approved in advance in writing by the Planning Secretary or his nominee if appropriate justification is provided for the works.
- C7. Notification of such construction activities as referenced in condition C6 must be given to affected residents before undertaking the activities or as soon as is practical afterwards.
- C8. Rock breaking, rock hammering, sheet piling, pile driving and similar activities may only be carried out between the following hours:
 - (a) 9am to 12pm, Monday to Friday;
 - (b) 2pm to 5pm Monday to Friday; and

- (c) 9am to 12pm, Saturday.

5.2 Construction Appliances

As part of the proposed construction activities to be undertaken on the site the following is discussed:

1. Demolition – Limited demolition including internal strip out with limited removal of concrete or structural elements.
2. Inground Works – Limited in ground works including trenching and services installation. No bulk earth works including removal of rock is required as part of the project.
3. Construction – Construction of the project including standard construction activities.

The construction appliances which will be used as part of the construction of the project are detailed in the table below.

Table 2 Noise Level from Expected Demotion Appliances

Tasks	Equipment	Sound Power Levels per task dB(A) L ₁₀	Aggregate Sound Power Level per Task dB(A) L ₁₀
Demolition	Excavators	112	115
	Hand Held Jack Hammers	111	
	Masonry Sawing	114	
	Power Hand Tool	109	
	Trucks	104	
Ground Works	Saw cutting and trenching	114	114
	Materials Movements	105	
	Excavators	112	
	Trucks	104	
Construction Works	Concrete pouring	108	110
	Welding	101	
	Saw cutter	109	
	Dump truck	109	
	Power hand tools	109	
	Cranes	110	

Note: Noise levels of proposed equipment to be used on the site based on the Australian Standard AS2436-2010 and noise level measurements previously undertaken of similar equipment on construction sites.

5.3 Construction Noise Criteria

This section of the report details the relevant construction noise criteria which is applicable to the site including the EPA's *Interim Construction Noise Guideline* (ICNG).

5.3.1 Interim Construction Noise Guideline

Noise criteria for construction activities are discussed in the *Interim Construction Noise Guideline* (ICNG). The ICNG also recommends procedures to address potential impacts of construction noise on residences and other sensitive land uses. The main objectives of the ICNG are summarised as follows:

- 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 in order to minimise noise impacts.

The ICNG contains a quantitative assessment method which is applicable to this project. Guidance levels are given for airborne noise at residences and other sensitive land uses.

The quantitative assessment method involves predicting noise levels at sensitive receivers and comparing them with the Noise Management Levels (NMLs). The NML affectation categories for receivers have been reproduced from the guideline and are listed in the table below.

Table 3 EPA Noise Management Levels from Construction

Receiver Type	Time of Day	Noise Management Level $L_{Aeq(15minute)}^{1,2}$	How to Apply
Residential	During approved working hours detained with the conditions of consent	Noise affected RBL + 10 dB	<p>The noise affected level represents the point above which there may be some community reaction to noise.</p> <p>Where the predicted or measured $L_{Aeq(15minute)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level.</p> <p>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.</p>
		Highly noise affected 75 dBA	<p>The highly noise affected level represents the point above which there may be strong community reaction to noise.</p> <p>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:</p> <ol style="list-style-type: none"> 1. 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). 2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
	Outside recommended standard hours	Noise affected RBL + 5 dB	<p>A strong justification would typically be required for works outside the recommended standard hours.</p> <p>The proponent should apply all feasible and reasonable work practices to meet the noise affected level.</p> <p>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.</p>

Table 3 Continued

Receiver Type	Time of Day	Noise Management Level $L_{Aeq}(15\text{minute})^{1,2}$	How to Apply
offices, retail outlets: external	When in use	$L_{Aeq}(15\text{ min})$ 70 dB(A)	During construction, the proponent should regularly update the occupants of the commercial and industrial premises regarding noise levels and hours of work.
Hospital Wards and operating theatres	When in use	$L_{Aeq}(15\text{ min})$ 45 dB(A) Interannally	During construction, the proponent should regularly update the occupants of the commercial and industrial premises regarding noise levels and hours of work.
<p><i>Note 1</i> 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><i>Note 2</i> 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>			

Based on the table above the suitable construction noise management levels for works undertaken on the site is detailed in Table 6 below.

Table 4 Site Construction Noise Management Levels

Noise Source	Time Period	Receiver Type	Construction Noise Management Level ¹	'High Noise Affected' Level ¹
Construction Noise	During period of approved hours of works as detailed within of the SSD-11099584	Residential Receivers to the north	70 dB(A) L _{Aeq} (15min)	75 dB(A) L _{Aeq} (15min)
		Residential Receivers to the west	58 dB(A) L _{Aeq} (15min)	75 dB(A) L _{Aeq} (15min)
		Kareena Private Hospital to the north	45 dB(A) L _{Aeq} (15 min) internally	-
Note 1: Construction noise management levels based on the Interim Construction Noise Guideline				

5.4 Construction Noise Management – Qualitative Assessment

Based on the assessment conducted of the expected construction noise levels generated from the site, levels are generally expected to require the building contractor to engage in management of activities on the site and engagement with the local community.

Notwithstanding, the following management controls are to be implemented to mitigate construction noise levels on the site:

1. Construction to be undertaken within the approved hours detailed within the SSD-11099584 and detailed in Section 5.1.1.
2. All plant and equipment are to be maintained such that they are in good working order.
3. A register of complaints is to be recorded in the event of complaints being received, including location, time of complaint, nature of the complaint and actions resulting from the complaint.
4. If required a noise level measurement of the offending plant item generating complaints is to be conducted and noise mitigations undertaken to reduce noise levels to within Noise Management levels in the event magnitude of noise levels is found to be above suitable levels.
5. The use of percussive and concrete sawing required as part of the internal strip out should be undertaken behind a closed façade when possible.
6. The use of percussive equipment including hydraulic hammering should be limited as required by the SSD-11099584 and included in Section 5.1.1.
7. Any removal of concrete or rock is to be undertaken on the site using ripping and munching where possible.

In the event noise levels are found to require additional noise reduction then all possible and practical mitigations are required to be included in the construction of the project. Possible acoustic treatments and controls may include the following:

1. Use of alternative appliances to complete the required works which result in reduced noise impacts on surrounding neighbours.
2. Period when noisy appliances are undertaken, such as undertaking noisy works on locations with the greatest distance to residential receivers during morning periods.
3. Construction of acoustic screening to permanently located high noise generating equipment such as pumps and generators if they are required on the site.
4. Other site specific treatments and controls which may become possible once works commence.

5.5 Construction Noise Assessment – Quantitative Assessment

A quantitative assessment of the construction noise levels resulting from the works to be undertaken as part of the project on surrounding receivers has been undertaken.

The assessment has been based on the expected noise levels to be generated on the site including those detailed in Section 4.3.1 above. Calculations of the resulting construction noise levels of the receivers within proximity to the site is detailed in the table below.

**Table 5 Quantitative Assessment of Construction Noise**

Source Noise	Equipment	Sound Power Levels dB(A) L ₁₀	Site Cumulative Sound Power Level dB(A) L ₁₀	Calculated Construction Noise Level – Residential Receivers	Noise Management Level	High Noise Affected Level	Comments
Residence to the North – Approximately 100m from the site							
Demolition and Strip Out	Excavators	112	115	Up to 62 dB(A) when used externally Up to 47 dB(A) if used internally within the existing building structure.	70 dB(A) L _{Aeq} (15min)	75 dB(A) L _{Aeq} (15min)	Construction noise levels generally expected to be within noise management levels and less than High Noise Affected Level
	Hand Held Jack Hammers	111					
	Masonry Sawing	114					
	Power Hand Tool	109					
	Trucks	104					
Ground Works	Saw cutting and trenching	114	114	Up to 61 dB(A)	70 dB(A) L _{Aeq} (15min)	75 dB(A) L _{Aeq} (15min)	
	Materials Movements	105					
	Excavators	112					
	Trucks	104					
Construction Works	Concrete poring	108	110	Up to 57 dB(A)	70 dB(A) L _{Aeq} (15min)	75 dB(A) L _{Aeq} (15min)	
	Welding	101					
	Saw cutter	109					
	Dump truck	109					
	Power hand tools	109					
	Cranes	110					
Note 1: Calculated qualitative noise levels are based on the overall Aggregate Sound Power Level for the expected construction works to be undertaken in the site.							



Source Noise	Equipment	Sound Power Levels dB(A) L ₁₀	Site Cumulative Sound Power Level dB(A) L ₁₀	Calculated Construction Noise Level – Residential Receivers	Noise Management Level	High Noise Affected Level	Comments
Residence to the West - Approximately 60m from the site							
Demolition and Strip Out	Excavators	112	115	Up to 66 dB(A) when used externally Up to 51 dB(A) if used internally within the existing building structure.	58 dB(A) L _{Aeq} (15min)	75 dB(A) L _{Aeq} (15min)	Construction noise levels may be above noise management levels. Management of construction required as detailed in this report. Construction noise levels expected to be within High Noise Affected Levels
	Hand Held Jack Hammers	111					
	Masonry Sawing	114					
	Power Hand Tool	109					
	Trucks	104					
Ground Works	Saw cutting and trenching	114	114	Up to 65 dB(A)	58 dB(A) L _{Aeq} (15min)	75 dB(A) L _{Aeq} (15min)	
	Materials Movements	105					
	Excavators	112					
	Trucks	104					
Construction Works	Concrete poring	108	110	Up to 61 dB(A)	58 dB(A) L _{Aeq} (15min)	75 dB(A) L _{Aeq} (15min)	
	Welding	101					
	Saw cutter	109					
	Dump truck	109					
	Power hand tools	109					
	Cranes	110					
Note 1: Calculated qualitative noise levels are based on the overall Aggregate Sound Power Level for the expected construction works to be undertaken in the site.							



Source Noise	Equipment	Sound Power Levels dB(A) L ₁₀	Site Cumulative Sound Power Level dB(A) L ₁₀	Calculated Construction Noise Level – Residential Receivers	Noise Management Level	High Noise Affected Level	Comments
Kareena Private Hospital to the north - Approximately 100m from the site – Internal noise level including faced correction of the Kareena Private Hospital							
Demolition and Strip Out	Excavators	112	115	Up to 42 dB(A) within the hospital when used externally Up to 27 dB(A) within the hospital if used internally within the existing building structure.	45 dB(A) L _{Aeq} (15min) Internally	-	Construction noise levels generally expected to be within noise management levels internally of the hospital receiver
	Hand Held Jack Hammers	111					
	Masonry Sawing	114					
	Power Hand Tool	109					
	Trucks	104					
Ground Works	Saw cutting and trenching	114	114	Up to 41 dB(A) Within the hospital	45 dB(A) L _{Aeq} (15min) Internally	-	
	Materials Movements	105					
	Excavators	112					
	Trucks	104					
Construction Works	Concrete poring	108	110	Up to 37 dB(A) Within the hospital	45 dB(A) L _{Aeq} (15min) Internally	-	
	Welding	101					
	Saw cutter	109					
	Dump truck	109					
	Power hand tools	109					
	Cranes	110					
Note 1: Calculated qualitative noise levels are based on the overall Aggregate Sound Power Level for the expected construction works to be undertaken in the site.							

6 CONSTRUCTION VIBRATION ASSESSMENT

This section of the report details the assessment of construction vibration impacts on surrounding receivers.

Effects of ground borne vibration on buildings may be segregated into the following three categories:

- Human comfort – vibration in which the occupants or users of the building are inconvenienced or possibly disturbed. Refer to further discussion in Section 6.1.
- Effects on building contents – where vibration can cause damage to fixtures, fittings and other non-building related objects. Refer to further discussion in Section 6.2.
- Effects on building structures – where vibration can compromise the integrity of the building or structure itself. Refer to further discussion in Section 6.3.

6.1 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 further categorised and assessed using the appropriate criterion as follows:

- 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 Values	Maximum Values	Preferred Values	Maximum Values
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

6.2 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).

6.3 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 the Figure below.

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

Line in Figure 2	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 the Figure below).

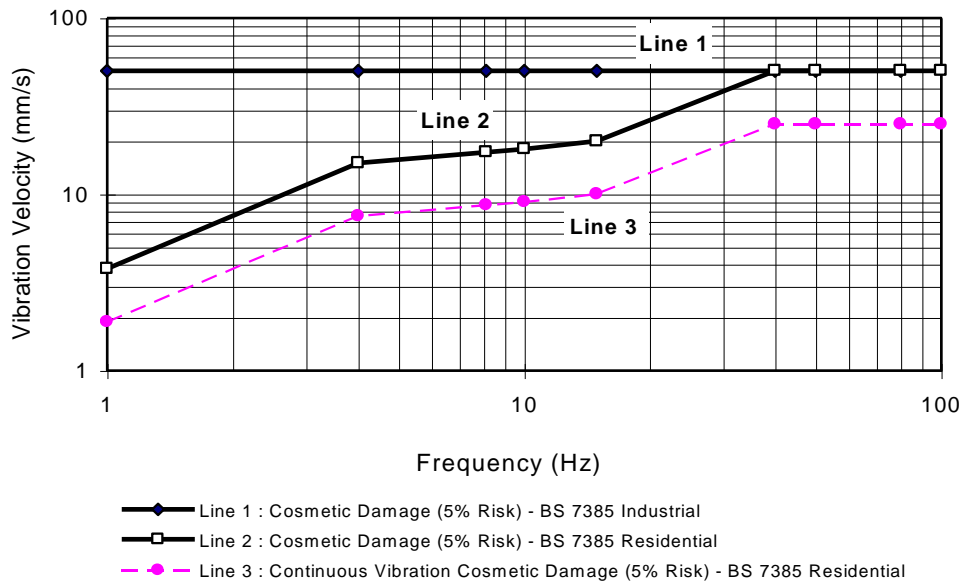


Figure 2 BS 7385 Part 2 – 1993, graph of transient vibration values for cosmetic damage

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 8, 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 8 should not be reduced for fatigue considerations.

6.3.1 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 of horizontal plane of highest floor at all frequencies
	Vibration at the foundation at a frequency of 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
<i>Note 1: For frequencies above 100Hz, at least the values specified in this column shall be applied.</i>				

6.4 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:

1. Project construction vibration criteria at all surrounding building structures – 7 mm/s

6.5 Construction Vibration Impacts

An assessment of the potential for vibration generated as part of the required construction activities on the project (including ground works and construction) has been undertaken.

As the development does not include any major demolition on the site and the proximity of neighbouring structures to the development site (which include residential receives) vibration levels generated from the construction on the site are expected to comply with all vibration criteria detailed in this report without additional treatments or mitigations.

6.6 Vibration Assessment

In order to maintain compliance with the vibration criteria discussed in this section of the report, the indicative safe distances listed in Table 11 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.

Table 11 Indicative safe working distances for vibration intensive plant

Plant	Rating / Description	Safe Working Distances (m)	
		Cosmetic Damage (BS 7385: Part 2 DIN 4150: Part 3)	Human Comfort (AVTG)
Small hydraulic hammer	300 kg, typically 5 – 12 tonnes excavator	2	7
Medium hydraulic hammer	900 kg, typically 12 – 18 tonnes excavator	7	23
Large hydraulic hammer	1600 kg, typically 18 – 34 tonnes excavator	22	73
Jackhammer	Hand held	1	Avoid contact with structure and steel reinforcements

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.

To ensure the vibration impact criteria detailed in this report are complied with the following safe working mitigations and/or working distances should be implemented as detailed in the table below.

Table 12 Vibration Mitigation Requirements

Construction Phase	Activity	Vibration Mitigation
In ground works	Removal of Rock	Based on the existing distance separation to receiver's compliance with construction vibration criteria is expected to be achieved without additional mitigations based on the required equipment to undertake the limited demolition and in ground works for the project.
Construction	General activities	General construction activities are not expected to exceed project vibration limits detailed in this report.

7 NOISE AND VIBRATION MEASUREMENTS AND MONITORING

As part of the management of noise from the construction activities to be undertaken on the site the following noise and vibration measurements are to be undertaken:

1. Noise – Attended noise level monitoring of typical ground works and construction activities should be undertaken at site on inception to confirm expected construction noise levels.

Attended construction noise monitoring of the site and surrounding impacts on neighbours should be undertaken during the following as a minimum:

- a. In response to any ongoing complaints received from neighbours.
2. Vibration – Based on the proximity of the surrounding receivers to the works attended vibration measurements of typical ground works and construction activities are expected to comply with all vibration criteria detailed in this report without additional treatments or mitigations and therefore on going vibration measurements or monitoring is not recommended.

8 NOISE AND VIBRATION MANAGEMENT PLAN

Table 13 below summarises the management procedures for airborne noise and vibration impact. These procedures are further discussed in the report. Hence, where applicable, links to further references are provided in Table 13.

Table 13 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 8.2.3 For vibration impact, also refer to section 6.6
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 9
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 5. For vibration impact, refer to Section 6.6
Complaints Management System	CMS	Implement a management system which includes procedures for receiving and addressing complaints from affected stakeholders	Refer to Section 9.1
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 in regards to the noise impact and the mitigation measures that will be implemented.	Refer to Section 9
Respite Offer	RO	Offer provided to stakeholders subjected to an ongoing impact. The offer could include movie tickets, meal vouchers, gift cards or equivalent measures.	-
Alternative Construction Methodology	AC	Contractor to consider alternative construction options that achieve compliance with relevant criteria. Alternative option to be determined on a case-by-case basis. It is recommended that the selection of the alternative option should also be determined by considering the assessment of on-site measurements (refer to Verification Monitoring above).	-

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 8.1.

8.1 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 5.5). The allocation of these procedures is summarised in Table 14 below.

Table 14 Allocation of noise management procedures

Construction Hours	Exceedance over NML (dB)	Management Procedures (see definition above)
Standard Hours Including Approved working hours	0 - 3	GMM
	4 - 10	GMM, PN, V ¹ , CMS, AC
	> 10	GMM, PN, V, CMS, SN, AC
	Above High Noise Affected Levels	RO
Mon – Fri: 7:00 am to 8:00 am Sat: 7:00 am to 8:00 am	0 - 10	GMM, AC
	11 - 20	GMM, PN, V ¹ , CMS, AC
	> 20	GMM, PN, V, CMS, SN, RO, AC
<i>Notes</i>		
1. <i>Verification monitoring to be undertaken upon complaints received from affected receivers</i>		

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.
- 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.

Based on the prediction of noise levels from the construction activities the management procedures are to be implemented during various stages of the project are included in the following table.

Table 15 Implementation of Noise Management Procedures

Construction Period	Proposed Appliances	Management Procedures to be Implemented
Demolition and Inground Works	<p>General in ground works including:</p> <p>High noise generating equipment including piling, bulldozers saw cutting and excavators</p>	<ol style="list-style-type: none"> 1. All works to be undertaken within the projects approved Working Hours. 2. Ensure best practice working practices and maintained equipment used. 3. Undertake notification when works are to be undertaken in neighbouring stakeholders. 4. Ensure separation of structures and materials being removed using saw cut if within safe work distances. 5. Undertake attended noise and vibration measurements at the commencement of high noise and or vibration generating activities on the site. 6. Implement the required complaints management system detailed in section below. 7. Assess if alternative construction activities can be implemented to mitigate noise levels where possible.
General Structure Works	<p>General construction activities including:</p> <p>Structural Steel, Precast, Cladding Works – Scissors, Mobile Cranes, Boom Lifts, Concrete Boom Pump, Somero Machine, Concrete Agitators, and the like</p>	<ol style="list-style-type: none"> 1. All works to be undertaken within the projects approved Working Hours. 2. Ensure best practice working practices and maintained equipment used. 3. Undertake notification when works are to be undertaken in neighbouring stakeholders. 4. Undertake attended noise and vibration measurements at the commencement of high noise and or vibration generating activities on the site. 5. Implement the required complaints management system detailed in section below. 6. Assess if alternative construction activities can be implemented to mitigate noise levels where possible.

8.1.1 High Noise Affected Level - Respite Periods

In the event noise levels resulting from construction works on the site are above high noise affected levels the offer of respite periods in accordance with the EPA *Interim Construction Noise Guideline* and the projects conditions of consent should be provided. In accordance with Condition C8 respite periods are recommended for activities which include rock breaking, rock hammering, sheet pile driving and the like. As such the following respite conditions are recommended in accordance with C8 or when works extended periods of noisy works are affecting a surrounding receiver above the high noise affected level. See details in the table below.

Table 16 Recommended Respite Periods

Monday to Friday	Saturday
7:00am to 9:00am – No rock breaking, rock hammering, sheet pile driving and similar activities. <u>(Respite Period)</u>	8:00am to 9:00am – No rock breaking, rock hammering, sheet piling, pile driving and similar activities. <u>(Respite Period)</u>
9:30am to 12:00pm – Works	9:00am to 12:00pm – Works
12:00pm to 2:00pm – No rock breaking, rock hammering, sheet piling, pile driving and similar activities. <u>(Respite Period)</u>	After 12:00pm – No rock breaking, rock hammering, sheet piling, pile driving and similar activities. <u>(Respite Period)</u>
2:00pm to 5:00pm – Works	
5:00pm to 7:00pm – No rock breaking, rock hammering, sheet piling, pile driving and similar activities. <u>(Respite Period)</u>	

Note: Recommended respite periods for noisy works has been formulated in accordance with Condition C8 from the *Notice of Determination – Approval*.

8.2 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.

8.2.1 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 difference 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.

8.2.2 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 possible to mitigate, 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).

8.2.3 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.

8.2.4 Adoption of Universal Work Practices

- Tool box meetings informing the works force of requirements to mitigate noise and vibration from the construction of the site is required to be included prior to starting works on the site.
- 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.

8.2.5 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.

8.2.6 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.

8.2.7 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.

8.2.8 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.

Communication with the surrounding receivers should be undertaken such that high noise generating activities can be scheduled outside of any noise sensitive periods resulting from uses on the site.

8.3 Vibration Mitigation Measures

Based on the existing distance separation to receiver's compliance with construction vibration criteria is expected to be achieved without additional mitigations.

9 COMMUNITY ENGAGEMENT

Active community consultation and the maintenance of positive relations with local residents and businesses would assist in alleviating concerns and thereby minimising complaint. Community notification and consultation is being undertaken for the site by Hindmarsh as required by the SSD-11099584

This form of notification should provide specific notification of the duration and timing of the construction activities so that residents are informed about the 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.

Prior to the works onsite being undertaken, community consultation with the neighbouring affected parties be undertaken. Community engagement and consultation 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 construction of the project (including excavation and construction) the building contractor is required to engage in community interaction. The community interaction and notification is required to include the following:

1. Notification of the works to be undertaken on the site and the periods when works will be conducted, including information regarding the programme of works such as excavation activities. This should include the expected period when activities such as hydraulic hammering, rock breaking, concrete or rock sawing is required to be undertaken. A letter box drop will be undertaken prior to works commencing on the site and additional drops in the event high noise generating equipment will be used will be undertaken.
2. Details of the relevant site representative where complaints can be registered.
3. Details of the methodology to respond to complaints raised from the surrounding receivers.
4. 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.

As a minimum notification of the works to be undertaken is to include all areas included in the figure below.



Figure 3 Required Area of Community Notification

9.1 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.

A Noise and Vibration Checklist regarding the process which will be undertaken in the event of a complaint is included in Appendix C.

9.2 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.
- Respite periods to be scheduled during potentially noise sensitive periods of the surrounding receivers.

10 CONCLUSION

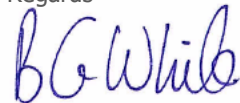
This report details the construction noise and vibration assessment of the construction stages of the Sutherland Hospital, Operating Theatre Upgrade project within the exiting hospital and located at Kingsway and Kareena Road, Caringbah.

An assessment of noise and vibration impacts from the required processes to be undertaken during the construction period of the project (including demolition, ground works and construction) has been undertaken and suitable treatments, management controls, perioding measurements and community engagement has been detailed in this report.

Providing the recommendations in this report are included in the construction of the site, compliance with the relevant EPA's Interim Construction Noise Guideline and SSD-11099584 consent, including Item C16 will be achieved.

For any additional information please do not hesitate to contact the person below.

Regards

A handwritten signature in blue ink that reads "BG White".

Ben White
Director

Pulse White Noise Acoustics



11 APPENDIX A – GLOSSARY OF TERMS

<i>Ambient Sound</i>	The totally encompassing sound in a given situation at a given time, usually composed of sound from all sources near and far.																				
<i>Audible Range</i>	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.																				
<i>Character, acoustic</i>	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.																				
<i>Decibel [dB]</i>	The level of noise is measured objectively using a Sound Level Meter. The following are examples of the decibel readings of every day sounds; <table> <tr><td>0dB</td><td>the faintest sound we can hear</td></tr> <tr><td>30dB</td><td>a quiet library or in a quiet location in the country</td></tr> <tr><td>45dB</td><td>typical office space. Ambience in the city at night</td></tr> <tr><td>60dB</td><td>Martin Place at lunch time</td></tr> <tr><td>70dB</td><td>the sound of a car passing on the street</td></tr> <tr><td>80dB</td><td>loud music played at home</td></tr> <tr><td>90dB</td><td>the sound of a truck passing on the street</td></tr> <tr><td>100dB</td><td>the sound of a rock band</td></tr> <tr><td>115dB</td><td>limit of sound permitted in industry</td></tr> <tr><td>120dB</td><td>deafening</td></tr> </table>	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
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120dB	deafening																				
<i>dB(A)</i>	<i>A-weighted decibels</i> The 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 dB(A). Practically all noise is measured using the A filter. The sound pressure level in dB(A) gives a close indication of the subjective loudness of the noise.																				
<i>Frequency</i>	Frequency is synonymous to <i>pitch</i> . 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.																				
<i>Loudness</i>	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																				
<i>L_{Max}</i>	The maximum sound pressure level measured over a given period.																				
<i>L_{Min}</i>	The minimum sound pressure level measured over a given period.																				
<i>L₁</i>	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.																				
<i>L₁₀</i>	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.																				
<i>L₉₀</i>	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L ₉₀ noise level expressed in units of dB(A).																				
<i>Leq</i>	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.																				
<i>Background Sound Low</i>	The average of the lowest levels of the sound levels measured in an affected area in the absence of noise from occupants and from unwanted, external ambient noise sources. Usually taken to mean the L _{A90} value																				
<i>Ctr</i>	A frequency adaptation term applied in accordance with the procedures described in ISO 717.																				
<i>dB (A)</i>	'A' Weighted overall sound pressure level																				



<i>Noise Reduction</i>	The difference in sound pressure level between any two areas. The term "noise reduction" does not specify any grade or performance quality unless accompanied by a specification of the units and conditions under which the units shall apply
<i>NR Noise Rating</i>	Single number evaluation of the background noise level. The NR level is normally around 5 to 6 dB below the "A" weighted noise level. The NR curve describes a spectrum of noise levels and is categorised by the level at 1000 Hz ie the NR 50 curve has a value of 50 dB at 1000 Hz. The NR rating is a tangential system where a noise spectrum is classified by the NR curve that just encompasses the entire noise spectrum consideration.
<i>R_w</i>	Weighted Sound Reduction Index - Laboratory test measurement procedure that provides a single number indication of the acoustic performance of a partition or single element. Calculation procedures for R _w are defined in ISO 140-2:1991 "Measurement of Sound Insulation in Buildings and of Building Elements Part 2: Determination, verification and application of precision data".
<i>R'_w</i>	Field obtained Weighted Sound Reduction Index - this figure is generally up to 3-5 lower than the laboratory test determined level data due to flanked sound transmission and imperfect site construction.
<i>Sound Isolation</i>	A reference to the degree of acoustical separation between any two areas. Sound isolation may refer to sound transmission loss of a partition or to noise reduction from any unwanted noise source. The term "sound isolation" does not specify any grade or performance quality and requires the units to be specified for any contractual condition
<i>Sound Pressure Level, L_p dB</i>	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.
<i>Sound Power Level, L_w dB</i>	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 picoWatt
<i>Speech Privacy</i>	A non-technical term but one of common usage. Speech privacy and speech intelligibility are opposites and a high level of speech privacy means a low level of speech intelligibility. It should be recognised that acceptable levels of speech privacy do not require that speech from an adjacent room is inaudible.
<i>Transmission Loss</i>	Equivalent to Sound Transmission Loss and to Sound Reduction Index in terminology used in countries other than Australia. A formal test rating of sound transmission properties of any construction, by usually a wall, floor, roof etc. The transmission loss of all materials varies with frequency and may be determined by either laboratory or field tests. Australian Standards apply to test methods for both situations.



12 APPENDIX B – BEN WHITE, AAS MEMBERSHIP CERTIFICATE

AUSTRALIAN ACOUSTICAL SOCIETY



This is to certify that

BENJAMIN WHITE

was admitted to the grade of

MEMBER

of the Australian Acoustical Society

on 27th October 2020

and is entitled to use the letters

M.A.A.S.

issued on 26th November 2020



President



General Secretary



This certificate remains the property of the Australian Acoustical Society

13 APPENDIX C – NOISE AND VIBRATION INVESTIGATION CHECKLIST

Southerland Shire Hospital Operating Theatre Upgrade – Noise & Vibration Investigation Checklist

210507 -SHOTU-Noise & Vibration Investigation Checklist-R1



Pulse White Noise Acoustics (PWNA) and Hindmarsh have prepared the following noise and vibration investigation checklist to assist the onsite construction team in investigation any received noise and vibration complaint or identifying an exceedance over the management levels. This checklist should be completed in conjunction with the *Construction Noise Vibration Management Sub Plan* prepared by PWNA.

Should any noise and vibration complaint be received, Hindmarsh must complete the following steps:

Exceedance/ Complaint Information

Complaint reference number:

Date Received:

Location of Complaint:

Complainant Contact Details:

Step	Task	Completed Response
1	Pause onsite works	
2	Identify the main source(s) construction noise and/or vibration within specific areas of the site which is impacting the most at the sensitive receiver.	
3	Review the identified equipment and determine if an alternate piece of equipment can be used or the process can be altered. <i>(If no, skip to step 5)</i>	
4	In the event an alternate piece of equipment or process can be used, works can re-commence incorporating possible and practical mitigation measures.	
5	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. This may include additional respite periods.	