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Early Works Project - CNVMP

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1 INTRODUCTION

This report has been prepared as part of a Review of Environmental Factors for the Early Works Project at Westmead Hospital which proposes a series of infrastructure improvements to accommodate the future development of the Integrated Mental Health Complex (proposed separately as part of State Significant Development Application SSD-44034342).

This report is prepared to address the requirements of the following documents:

- NSW EPA/DECC – 'Interim Construction Noise Guideline' ("ICNG") July 2009.
- NSW Department of Environment and Conservation NSW "Assessing Vibration: A Technical Guideline" (Feb 2006).
- Australian Standard AS2436:2010 "Guide to Noise Control on Construction, Maintenance and Demolition Sites.
- German Standard DIN 4150-3 (1999-02)

The principal objective of this study is to undertake an evaluation of work to be performed during construction phases and forecast potential impacts of noise and vibration. The evaluation will be used to formulate and streamline effective regulation and mitigation measures.

The principal issues which will be addressed in this report are:

- Specific activities that will be conducted and the associated noise/vibration sources.
- Identification of potentially affected noise/ vibration sensitive receivers.
- The development, hours of work and excavation period.
- The construction noise and vibration requirements of relevant guidelines.
- Noise/ vibration response procedures,
- Assessment of potential noise/ vibration from the proposed construction activities; and
- Contingency plans to be implemented in the event of non-compliances and/or complaints.

2 SITE DESCRIPTION & PROPOSAL

The proposal involves primarily demolition, excavation and civil works at the Westmead Hospital Integrated Mental Health Centre (IMHC) site. We note the main works are under separate approval (SSDA No.44034342).

The work generally involves demolition of existing structures, bulk excavation, flood mitigation works, regrading of surfaces, in ground services diversion and other associated civil works to the site surrounds.

Site investigation indicates that the site is bounded by:

- Dragonfly Drive to the west.
- Redbank Road to the south.

Each of these roadways carrying low to moderate volumes of traffic.

An investigation of site and surrounds provides that the site is bounded by developments part of the hospital precinct. Nearest external sensitive noise receivers are as follows:

- **R1:** A combination of medical and residential receivers to the west.
- **R2:** Residential receivers to the south-east along and beyond Hawkesbury Road.
- **R3:** Educational uses across Darcy Road.
- **R4:** Residential receivers north of Redbank Creek.
- **R5:** Industrial uses and active recreation (Redbank Track)

Sensitive uses within the Westmead Hospital precinct in the vicinity of site are identified as:

- **H1:** Redbank House & Redbank School to the north – mix of medical consultation and educational areas.
- **H2:** Children's Hospital at Westmead Childcare & Westmeadow Day Care Centre to the east.
- **H3:** Westmead CASB and PSB (future) to the south across Redbank Road.
- **H4:** Westmead ICPMR/Pathology/Entomology Building

A site map, measurement description and surrounding receivers are presented in Figure 1.

The risk of adverse noise and vibration impacts primarily occurs in relation to noise sensitive developments on the Westmead Hospital site.

The residential receivers to the south-east (R2) are closest (approx. 280m from the site) but the loudest works will screened from these receivers by Hospital buildings. The nearest residential uses to the west, north and south are more than 400m from the site and the loudest stages of the works near ground level will largely be screened by other buildings on the hospital site.

Figure 1 – Site & Surrounds including Surrounding Receivers

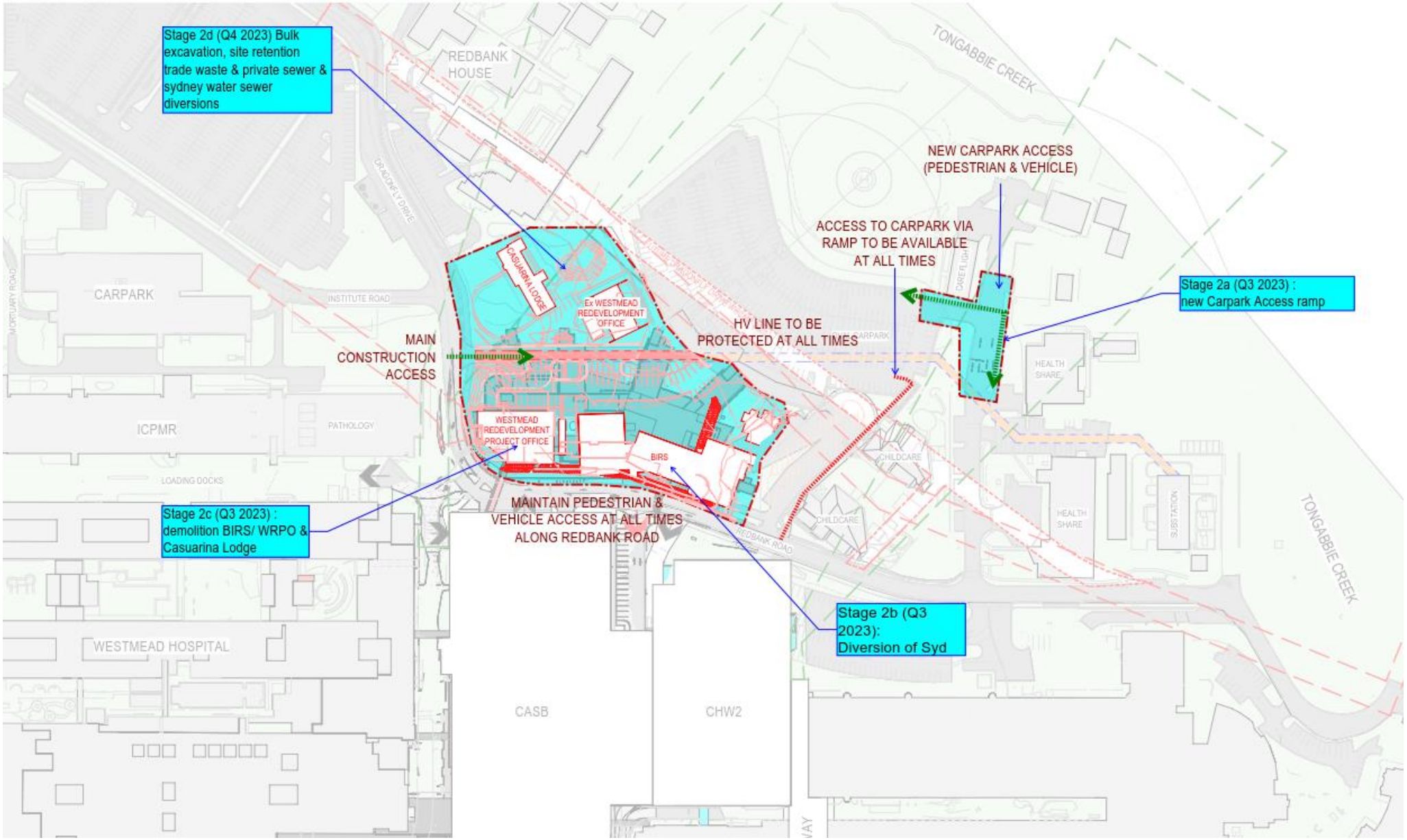


Figure 2 – Westmead Hospital Early Works Site Plan

3 ACTIVITIES TO BE CONDUCTED AND ASSOCIATED NOISE SOURCES

The construction period has been divided into the main work phases along with the primary noise producing equipment and activities likely to occur in each phase.

3.1 DEMOLITION OF EXISTING STRUCTURE

This stage will include the following noise intensive works/plant:

- Excavator (up to 20 tonnes) to carry waste material from site.
- Excavator with hammer or ripper attachment.
- Concrete saw.
- Hand tools – Saw cutters, Impact drills, electric drills, hammering (jack hammers) and angle grinders.
- Materials handling and removal – trucks, trailers, and forklifts.
- Vehicular access to and from the site.

3.2 GROUND WORKS

This stage will include the following noise intensive works:

- Excavator (up to 20 tonnes)
- Piling
- Hand tools – Saw cutters, Impact drills, electric drills, hammering (jack hammers) and angle grinders.
- Materials handling.
- Vehicular access to and from the site.
- Compacting
- Use of mobile plant such as bobcats for earthmoving and tree removal duties.

4 HOURS OF WORK AND DURATION

4.1 HOURS OF WORK

Construction will be undertaken during recommended standard hours as defined by EPA Interim Construction Noise Guideline. These are summarised as follows:

- Monday to Friday: 7am – 6pm
- Saturday: 8am – 1pm
- Sundays or Public Holiday No work.

5 EXISTING BACKGROUND NOISE LEVELS

Long term unattended noise logging was undertaken by this office as part of the main works *'Noise and Vibration Impact Assessment*' under SSDA No.44034342 (ref 20210938.1/0808A/R2/TH).

Supplementary noise monitoring data has been adopted from the following documents:

- *Noise Impact and Vibration Assessment'* for the Central Acute Services Building (CASB) prepared by Acoustic Studio (Report Reference: CASB-ACS-AC-RT-0020-02, dated 6th July 2016) - SSDA approved.
- "Paediatric Services Building, The Children's Hospital at Westmead Acoustic Report" prepared by Stantec dated 17 March 2021 (ref: 44311-1).

The following table summarises the rating background noise levels determined for the day, evening and night periods as defined in the NSW EPA's NPfI.

Table 1 – NPfI Rating Background Noise Levels

Location	**Assessment Background Noise Level (dB(A) L_{90})**		
	Day	Evening	Night
Mons Road & Darcy Road Receivers (R1 & R3)	45	45 (46*)	45
Hawkesbury Road Receivers (R2)	42	42	39
North of Redbank Creek Receivers (R4 & R5)	43	43 (44*)	42

*Measured noise level.

6 CONSTRUCTION NOISE AND VIBRATION EMISSION MANAGEMENT LEVELS

6.1 NOISE MANAGEMENT LEVELS

Noise emissions associated with construction activities on the project site to external areas of receivers will be assessed in with reference to the following:

- NSW EPA's I*nterim Construction Noise Guideline (DECC, 2009),*
- Protection of the Environment Operations Act 1997,
- Australian Standard AS2436:2010 "Guide to Noise Control on Construction, Maintenance and Demolition Sites.

6.1.1 2009 NSW Environmental Protection Authority (EPA) document – *"Interim Construction Noise Guideline (ICNG) 2009"*

The EPA's ICNG assessment requires:

- Review of noise levels at nearby development
- If necessary, recommendation of noise control strategies in the event that compliance with noise emission goals is not possible.

EPA guidelines adopt differing strategies for noise control depending on the predicted noise level at the nearest residences for construction during the recommended standard hours:

- "*Noise Affected" level* – Where construction noise is predicted to exceed the "noise affected" level at a nearby residence, the proponent should take reasonable/feasible work practices to ensure compliance with the noise affected level. For residential properties, the noise affected level occurs when construction noise exceeds the rating background noise level by more than 10dB.
- "*Highly Noise Affected" level* – Where noise emissions are such that nearby properties are "highly noise affected", noise controls such as respite periods should be considered. For residential properties, the highly noise affected level occurs when construction noise exceeds 75dB(A)$L_{eq(15min)}$ at nearby residences.

The guideline also provides external management levels for land used for commercial or industrial purposes to be assessed at the most affect occupied point of the premises. EPA guidelines recommend a construction noise management level for industrial receivers of 75dB(A)$L_{eq(15\text{-}minute)}$.

Section 4.1.2 of the guideline provides that, for other sensitive land uses such as classrooms at educational institutions, the noise management level should not exceed 45 dB(A) internally.

6.1.2 Construction Noise Management Levels Summary

Nosie management levels applicable to the development site and surrounding receivers are summarised in the following tables.

Table 2 – Construction Noise Emission Noise Management Levels - Residential

Location	"Noise Affected"/"Noise Management Level" – dB(A)$L_{eq(15min)}$	"Highly Noise Affected" Level – dB(A)$L_{eq(15min)}$
R1 Receivers – Mons Road	55 (Standard Construction Hours)	75
R2 Receivers – Hawkesbury Road	52 (Standard Construction Hours)	75
R4 Receivers – North of Redbank Creek	53 (Standard Construction Hours)	75

Table 3 – Construction Noise Emission Noise Management Levels – Other Receiver Types

Location	"Noise Management Level" – dB(A)$L_{eq(15min)}$
R3– Darcy Rd Educational	45 internal (when in use)
R5- Industrial Receivers	75
R5- Active Recreation Areas	65 (when in use)
H1 – Redbank House & Redbank School	45 internal (when in use)
H2 - Childcare Facilities	65 - Outdoor Play Areas (Based on ICNG guidelines for active recreation)
H3 & H4 -Hospital Buildings	45 internal

6.1.3 Australian Standard AS2436:2010 "Guide to Noise Control on Construction, Maintenance and Demolition Sites

Australian Standard AS2436 does not provide specific noise management targets. The guideline focuses on strategies for developing feasible and reasonable mitigation methodologies, management controls and community liaison to reach realistic compromises between the needs of construction activities and potentially affected receivers.

For the control and regulation of noise from construction sites AS2436:2010 *Guide to noise control on construction, maintenance and demolition sites* nominates the following:

- That reasonable suitable noise management objectives are established.
- That all practicable measures be taken on the building site to regulate noise emissions, including the siting of noisy static processes to locations of the site where they can be shielded, selecting less noisy processes, and if required regulating demolition hours, and

6.2 VIBRATION OBJECTIVES

Vibration caused by construction at any residence or structure outside the subject site must be limited to:

- For structural damage vibration, German Standard DIN 4150-3 Structural Vibration: Effects of Vibration on Structures; and
- For human exposure to vibration, the evaluation levels presented in the British Standard BS 6472:1992 Guide to Evaluate Human Exposure to Vibration in Buildings (1Hz to 80Hz) for low probability of adverse comment.

6.2.1 German Standard DIN 4150-3 (1999-02) - Ground Borne Vibrations and Damage Limits

German Standard DIN 4150-3 (1999-02) provides vibration velocity guideline levels for use in evaluating the effects of vibration on structures. The criteria presented in DIN 4150-3 (1999-02) are presented in Table 4.

It is noted that the peak velocity is the absolute value of the maximum of any of the three orthogonal component particle velocities as measured at the foundation, and the maximum levels measured in the x- and y-horizontal directions in the plane of the floor of the uppermost storey.

6.2.2 Structure Borne Vibrations (Building Damage Levels)

German Standard DIN 4150-3 (1999-02) provides vibration velocity guideline levels for use in evaluating the effects of vibration on structures. The vibration levels presented in DIN 4150-3 (1999-02) are detailed in Table 4. It is noted that the peak velocity is the value of the maximum of any of the three orthogonal component particle velocities as measured at the foundation, and the maximum levels measured in the x- and y-horizontal directions in the plane of the floor of the uppermost storey.

Table 4 – DIN 4150-3 (1999-02) SAFE LIMITS FOR BUILDING VIBRATION

Type of structure		PEAK PARTICALE VELOCITY (MMS^{-1})			
		At Foundation at a frequency			Plane of Floor of Uppermost Storey
		<10Hz	*10Hz to 50Hz*	*50Hz to 100Hz*	*All Frequencies*
1	Buildings used in commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under preservation order)	3	3 to 8	8 to 10	8

6.2.3 Assessing Amenity

Vibration goals for the amenity of nearby land users are those recommended by the EPA document *Assessing Vibration: A technical guideline*. These levels are presented below:

Table 5 – Construction Vibration Goals

Place	Time	RMS acceleration (m/s^2)		RMS velocity (mm/s)		Peak velocity (mm/s)	
		Preferred	Maximum	Preferred	Maximum	Preferred	Maximum
Continuous Vibration							
Critical Working Areas (e.g. Hospital Operating Theatres)	**Daytime**	0.005	0.01	0.1	0.2	0.14	0.28
Residences		0.01	0.02	0.2	0.4	0.28	0.56
Offices		0.02	0.04	0.4	0.8	0.56	1.1
Workshops		0.04	0.08	0.8	1.6	1.1	2.2
Impulsive Vibration							
Critical Working Areas (e.g. Hospital Operating Theatres)	**Daytime**	0.005	0.01	0.1	0.2	0.14	0.28
Residences		0.3	0.6	6.0	12.0	8.6	17.0
Offices		0.64	1.28	13.0	26.0	18.0	36.0
Workshops		0.64	1.28	13.0	26.0	18.0	36.0

6.2.4 Sensitive Equipment

Where sensitive equipment is located within nearby buildings (i.e CASB), criteria are to be determined based on data provided by the manufacturer/supplier/operator. These are to be determined prior to the commencement of any works.

7 ASSESSMENT OF NOISE EMISSIONS

7.1 ACTIVITIES TO BE CONDUCTED AND THE ASSOCIATED NOISE SOURCES

Typical equipment/processes anticipated to be used on the project site. Noise impacts from these activities on the amenity of the surrounding identified sensitive receivers will be predicted based on the A-weighted sound power levels outlined in the table below.

Table 6 – Equipment Sound Power Levels

EQUIPMENT /PROCESS	SOUND POWER LEVEL dB(A)
Excavator with Bucket (up to 20 tonnes)	100
Excavator with Hammer Attachment	120
Concrete Saw	105
Bobcat	100
Heavy Trailers (idling)	95
Piling Plant	103
Pump plant	105
Concrete Vibrators	100
Powered Hand Tools (Used Externally)	100
Work Zone (Forklifts, Trucks, etc.)	95
Compactor (Roller)	105
Asphalting	110

***Noise levels take into account correction factors (for tonality, intermittency where necessary).**

The noise levels presented in the above table are derived from the following sources:

1. On-site measurements;
2. Table D2 of Australian Standard 2436-1981 & Table A1 of Australian Standard 2436-2010; and
3. Data held by this office from other similar studies.

7.2 NOISE EMISSION PREDICTIONS AND ASSESSMENT

7.2.1 Methodology

Noise generated by plant and equipment will be managed to generally comply with the nominated noise management levels, and where this noise goal may be exceeded, noise will be managed based on principles consistent with Australian Standard 2436.

Predictions of noise levels at the sensitive receivers identified have been made of the construction processes with the potential to produce significant noise.

7.2.2 Predicted Noise Levels

An assessment of the principal sources of noise emission has been undertaken to identify the activities that may produce noise and/or vibration impacts so that appropriate ameliorative measures can be formulated.

Noise levels from construction works have been predicted at the surrounding receivers and assessed against the construction noise management levels set out in Section 6. Refer to tables below for predicted noise levels for each receiver.

It is noted that:

- Many of the noise sources are present over a small period of the day or may be present for a few days with a significant intervening period before the activity occurs again. This assessment assumes all items of plant operate continuously over a 15minute period. As such, this is a decidedly conservative assessment.
- Noise levels have been corrected for:
    - The distance between the noise source and the receiver.
    - The screening effect provided by any surrounding building structure/shell and topography.
    - The screening effect provided by A class perimeter hoarding.

Table 7 – Predicted Noise Emissions to R1 Residential Receivers

Activity	Predicted Level dB(A)$L_{10(15\text{-minute})}$	Noise Management Level	Comment
Excavator with Bucket (up to 20 tonnes)	36 to 39	**NSW EPA *Interim Construction Noise Guideline*** **Residential Areas** Noise Affected Level: 55 dB(A)$L_{eq(15min)}$ Highly Noise Affected Level: 75dB(A)$L_{eq(15min)}$ (Assessed at property boundary)	Activities are not predicted exceed the 'Noise Affected Level' with exception of rock breaking.
Excavator with Hammer Attachment	59 to 62		
Concrete Saw	41 to 44		
Bobcat	36 to 39		
Heavy Trailers (idling)	31 to 34		
Piling Plant	39 to 42		
Pump plant	41 to 44		
Concrete Vibrators	36 to 39		
Hand Tools (Used Externally)	36 to 39		
Work Zone (Forklifts, Trucks, etc.)	31 to 34		
Compactor (Roller)	41 to 44		
Asphalting	46 to 49		

Table 8 – Predicted Noise Emissions to R2 Residential Receivers

Activity	Predicted Level dB(A)$L_{10(15\text{-minute})}$	Noise Management Level	Comment
Excavator with Bucket (up to 20 tonnes)	36 to 39	**NSW EPA *Interim Construction Noise Guideline*** **Residential Areas** Noise Affected Level: 52 dB(A)$L_{eq(15min)}$ Highly Noise Affected Level: 75dB(A)$L_{eq(15min)}$ (Assessed at property boundary)	Activities are not predicted exceed the 'Noise Affected Level' with exception of rock breaking.
Excavator with Hammer Attachment	63 to 67		
Concrete Saw	41 to 44		
Bobcat	36 to 39		
Heavy Trailers (idling)	31 to 34		
Piling Plant	39 to 42		
Pump plant	41 to 44		
Concrete Vibrators	36 to 39		
Hand Tools (Used Externally)	36 to 39		
Work Zone (Forklifts, Trucks, etc.)	31 to 34		
Compactor (Roller)	41 to 44		
Asphalting	46 to 49		

Table 9 – Predicted Noise Emissions to R3 Educational Receiver

Activity	Predicted Level dB(A)$L_{10(15\text{-minute})}$	Noise Management Level	Comment
Excavator with Bucket (up to 20 tonnes)	≤25	**NSW EPA *Interim Construction Noise Guideline*** **Educational Institutions** 45 dB(A)$L_{eq(15min)}$ (Assessed internally when in use)	Activities are not predicted exceed the 'Noise Affected Level' with exception of rock breaking.
Excavator with Hammer Attachment	40 to 43		
Concrete Saw	≤25		
Bobcat	≤25		
Heavy Trailers (idling)	≤25		
Piling Plant	≤25		
Pump plant	≤25		
Concrete Vibrators	≤25		
Hand Tools (Used Externally)	≤25		
Work Zone (Forklifts, Trucks, etc.)	≤25		
Compactor (Roller)	≤25		
Asphalting	25 to 30		

Noise levels above assume windows at the school are open and there is a 10dB(A) noise level reduction across the open façade.

Table 10 – Predicted Noise Emissions to R4 Residential Receiver

Activity	Predicted Level dB(A)$L_{10(15\text{-minute})}$	Noise Management Level	Comment
Excavator with Bucket (up to 20 tonnes)	38 to 43	**NSW EPA *Interim Construction Noise Guideline*** **Residential Areas** Noise Affected Level: 53 dB(A)$L_{eq(15min)}$ Highly Noise Affected Level: 75dB(A)$L_{eq(15min)}$ (Assessed at property boundary)	Activities are not predicted exceed the 'Noise Affected Level' with exception of rock breaking.
Excavator with Hammer Attachment	61 to 66		
Concrete Saw	43 to 48		
Bobcat	38 to 43		
Heavy Trailers (idling)	33 to 38		
Piling Plant	41 to 46		
Pump plant	43 to 48		
Concrete Vibrators	38 to 43		
Hand Tools (Used Externally)	38 to 43		
Work Zone (Forklifts, Trucks, etc.)	33 to 38		
Compactor (Roller)	43 to 48		
Asphalting	48 to 53		

Table 11 – Predicted Noise Emissions to H1 Receiver

Activity	Predicted Level dB(A)$L_{10(15\text{-minute})}$ (Internal)	Noise Management Level	Comment
Excavator with Bucket (up to 20 tonnes)	18 to 40	**NSW EPA *Interim Construction Noise Guideline*** **Educational Institutions** 45 dB(A)$L_{eq(15min)}$ (Assessed internally when in use)	See discussion in Section 7.3.
Excavator with Hammer Attachment	41 to 63		
Concrete Saw	23 to 45		
Bobcat	18 to 40		
Heavy Trailers (idling)	13 to 35		
Piling Plant	21 to 43		
Pump plant	23 to 45		
Concrete Vibrators	18 to 40		
Hand Tools (Used Externally)	18 to 40		
Work Zone (Forklifts, Trucks, etc.)	13 to 35		
Compactor (Roller)	23 to 45		
Asphalting	28 to 50		

Noise levels above assume a minimum 30db(A) noise level reduction across a closed/fixed façade and A-Class perimeter hoarding.

Table 12 – Predicted Noise Emissions to H2 Receiver

Activity	Predicted Level dB(A)$L_{10(15\text{-minute})}$	Noise Management Level	Comment
Excavator with Bucket (up to 20 tonnes)	47 to 64	65 dB(A)$L_{eq(15min)}$ (Assessed at outdoor areas)	See discussion in Section 7.3.
Excavator with Hammer Attachment	67 to 84		
Concrete Saw	52 to 69		
Bobcat	47 to 64		
Heavy Trailers (idling)	42 to 59		
Piling Plant	50 to 67		
Pump plant	52 to 69		
Concrete Vibrators	47 to 64		
Hand Tools (Used Externally)	47 to 64		
Work Zone (Forklifts, Trucks, etc.)	42 to 59		
Compactor (Roller)	52 to 69		
Asphalting	57 to 74		

Table 13 – Predicted Noise Emissions to H3 & H4 Receivers

Activity	Predicted Level dB(A)$L_{10(15\text{-minute})}$ (Internal)	Noise Management Level	Comment
Excavator with Bucket (up to 20 tonnes)	21 to 42	**NSW EPA *Interim Construction Noise Guideline*** **Hospital Areas** 45 dB(A)$L_{eq(15min)}$ (Assessed internally)	See discussion in Section 7.3.
Excavator with Hammer Attachment	41 to 62		
Concrete Saw	26 to 47		
Bobcat	21 to 42		
Heavy Trailers (idling)	16 to 37		
Piling Plant	24 to 45		
Pump plant	26 to 47		
Concrete Vibrators	21 to 42		
Hand Tools (Used Externally)	21 to 42		
Work Zone (Forklifts, Trucks, etc.)	16 to 37		
Compactor (Roller)	26 to 47		
Asphalting	31 to 52		

Noise levels above assume a 30db(A) noise level reduction across a closed/fixed façade.

7.3 DISCUSSION – NOISE

Predicted construction noise levels to surrounding receivers, as presented in tables above, are summarised and discussed below:

With respect to receivers external of the hospital site (R1-R4), noise management levels will typically not be exceeded given the distance to site and, in most cases, screening provided by surrounding hospital buildings.

The loudest activity is likely to be the excavation of rock using excavator mounted hydraulic hammers. In this regard we note:

- For external receivers, noise from rock breaking is predicted to exceed noise management levels but be below the highly noise affected level.
- Within the hospital site, these may be located as close as 10m from the façade of the adjacent buildings. This activity could therefore produce 92 dB(A) noise level outside the adjacent buildings when operating 10m of the building façade. The noise level reduction (depending on the building impacted) Is estimated to be between 25 and 35 dB(A).
- The expected internal noise level is therefore 57-67 dB(A), which exceeds the internal noise management level of 45 dB(A).
- Noise to H2 external play areas has been assessed on the basis that all proposed construction activities may occur at the north-west 'Carpark Access ramp' site (refer to Figure 2). It is expected that the extent of high noise works in this area will be over a shorter period of time than for the main site. For works occurring on the main IMHC site, A-class perimeter hoarding will typically reduce noise levels a further 5-10dB (A) depending on the location of plant.
- It is estimated that exceedances of the ICNG NML will occur with hydraulic hammer equipment operating between 40 to 70m from the building façade.

Other plant and processes with potential to exceed noise management levels near to site boundaries are:

- Asphalting
- Compactor (roller)
- Concrete Saw
- Pump Plant
- Piling

Mitigation strategies for high noise activities could involve:

- Using smaller, quieter plant closer to the buildings.
- The use of sawing and ripping techniques (instead of use of hydraulic hammer plant).
- Time scheduling works close to other buildings in the early morning or late afternoon when they are not occupied, and children are not sleeping in the nearby childcare facilities.

Other activities are significantly quieter and are not expected to produce exceedances of the NML's. Notwithstanding, noise impacts should be minimised by adopting the general methodology for minimising impacts (refer below).

7.3.1 Noise to Hospital Receivers Generally

A range of occupations and uses are located within surrounding hospital buildings (H1-H4). Each having a different sensitivity to noise and façade performance. In the case of the CASB, these vary across levels of the same building. As such, internal noise levels from construction are to be assessed on a case-by-case basis and managed internally by hospital procedures.

Specific construction activities and their likely impact is to be addressed by a detailed noise management plan prior to the commencement of site works.

8 GROUND VIBRATION IMPACTS

Given the distance of the development site from residential receivers to the north, vibration levels a highly unlikely to exceed structural damage or amenity vibration criteria at these locations.

The greatest risk of vibration to nearby buildings within the hospital site will occur from (in order of likely significance):

- Excavation using excavator mounted hydraulic hammers
- Ground compaction.
- Interface works with other buildings.
- Ripping using bulldozer mounted rippers.
- Dropping of demolished structure.

The prediction of actual vibration levels is difficult because receiver vibration levels are affected by a number of factors including the vibration force imparted, sub-soil propagation conditions, building footings and building structural design.

Vibration monitoring of these activities is recommended.

8.1 SAFEGUARDS TO PROTECT SENSITIVE STRUCTURES & EQUIPMENT

It is impossible to predict the vibrations induced by the excavation/construction operations on site at potentially affected receivers. This is because vibration level is principally proportional to the energy impact which is unknown nature of terrain in the area (type of soil), drop weight, height etc.

A suitably qualified acoustic consultant/vibration expert should undertake monitoring of initial excavation process when conducted near potentially affected receivers to ensure that vibration criteria set out in section 6.2 are not exceeded.

In locations where sensitive equipment is housed within nearby buildings (i.e CASB), the specific location and applicable vibration criteria are to be advised to the project acoustic/vibration consultant prior to the commencement of any works.

8.2 VIBRATION MONITORING

In the event of complaints or concern for structural damage to nearby buildings, vibration monitors can be installed during the key stages.

The monitors are proposed to be fitted with GSM modem and remotely signal up to five mobile phones indicating any exceedance of the prescribed vibration criteria to enable immediate notification to be sent to the contractor when vibration thresholds are approached.

Whilst it is impossible to predict the vibrations induced by the excavation/construction operations on site at potentially affected receivers, the total vibration emissions are to be limited with real-time alarm notification given to the plant operators. Based on feedback from the real-time monitoring system, the plant operators will be able to modify their operations to ensure the vibrations are kept within acceptable limits.

8.2.1 Vibration Monitoring Download

Downloading of the vibration logger will be conducted on a regular basis. In the event exceedance of vibration criteria or alarms occur, downloading of the logger will be conducted more frequently. Results obtained from the vibration monitor will be presented in a graph format and will be forwarded to the client for review. It is proposed

that reports are provided fortnightly with any exceedance in the vibration criteria reported as detailed in this report.

8.2.2 Vibration Monitoring Reports

A fortnightly report will be submitted to the client via email summarising the vibration events. The vibration exceedance of limit is recorded the report shall be submitted within 24 hours. Complete results of the continuous vibration logging will be presented in fortnightly reports including graphs of collected data.

9 SPECIFIC NOISE CONTROLS

9.1 STATIC PLANT

If required, additional noise reduction can be achieved by erecting solid barriers around static plant such as diesel generators and any stationary concrete pumps.

9.2 PUMPS, PILING PLANT

Noise from pump plant and piling rigs have the potential to result in intermittent exceedances of allowable noise levels. Screw piling is recommended above hammer or vibro-piling which pose greater risk of exceeding vibration criteria and noise management levels.

Concrete/water pumps should not be operated prior to 7:30 am and be placed as close as possible to the middle of the site (where feasible) to reduce proximity to the nearby receivers or otherwise near to site boundary hoardings which will also maximise noise reduction from screening.

9.3 VIBRATORY ROLLERS & COMPACTORS

We recommend that only non-vibratory rollers be used on site. If alternative plant selections are not practicable, the use of this plant is only to be accepted where vibration measurements confirm compliance with DIN 4150-3 and EPA criteria prior to the use.

9.4 ACOUSTIC BARRIERS

The placement of barriers at the source is generally only effective for static plant (i.e. diesel generators). Equipment which is on the move or working in rough or undulating terrain cannot be effectively attenuated by placing barriers at the source. Barriers can also be placed between the source and the receiver.

The degree of noise reduction provided by barriers is dependent on the amount by which line of sight can be blocked by the barrier. If the receiver is totally shielded from the noise source reductions of up to 15 dB(A) can be affected. Where only partial obstruction of line of sight occurs, noise reductions of 5 to 8 dB(A) may be achieved. Where no line of sight is obstructed by the barrier, generally no noise reduction will occur.

Screens around work areas will provide little material benefit for receivers at higher levels as these will overlook screening. This is most relevant when considering noise to CASB (H3). Notwithstanding, A-class perimeter hoarding is required at boundaries separating site from Childcare receivers (H2) and Redbank School/House (H1) to reduce noise impacts at these locations.

Where high noise producing works are expected to occur at the satellite work site 'Carpark access ramp' for extended periods, consideration is to be given for installing solid hoarding at the adjacent childcare facility boundary.

9.5 OTHER ACTIVITIES

In the event of complaint, noise management techniques identified in this report should be employed to minimise the level of noise impact if management levels are found to be exceeded. This may include additional community consultation and re-scheduling of loud construction processes.

Notwithstanding above, general management techniques and acoustic treatments are included in Section 9.6 which may be implemented on a case-by-case basis to reduce noise emissions to surrounding receivers.

9.6 GENERAL RECOMMENDATIONS

Other noise management practices which may be adopted are discussed below. In addition, notification, reporting and complaints handling procedures should be adopted as recommended in this report.

9.6.1 Treatment of Specific Equipment

Where construction process or appliances are noisy, the use of silencing devices may be possible. These may take the form of engine shrouding, or special industrial silencers fitted to exhausts.

9.6.2 Material Handling

The installation of rubber matting over material handling areas can reduce the sound of impacts due to material being dropped by up to 20dB(A).

9.6.3 Selection of Alternate Appliance or Process

Where a particular activity or construction appliance is found to generate excessive noise levels, it may be possible to select an alternative approach or appliance. For example; the use of a hydraulic hammer on certain areas of the site may potentially generate high levels of noise. By carrying out this activity by use of bulldozers ripping and/or milling machines lower levels of noise will result.

9.6.4 Establishment of Site Practices

This involves the formulation of work practices to reduce noise generation. This includes locating fixed plant items as far as possible from residents as well as rotating plant and equipment to provide respite to receivers. Construction vehicles accessing the site should not queue in residential streets and should only use the designated construction vehicle routes. Loading of these vehicles should occur as far as possible from any sensitive receiver.

9.6.5 Management Training

All site managers should be aware of noise and vibration limits, applicable control measures and methods. They should ensure that all agreed noise and vibration measures are carried out by employees and sub-contractors.

A copy of the Noise Management Plan is to be available to contractors, and site inductions should detail the site contact in the event of noise complaints.

9.6.6 Consultation with Affected Parties

Ongoing communication with the affective parties can in many cases resolve potential conflicts, with the parties working together. An understanding of the constraints, the available mitigation, period of noise impact can in many cases minimise adverse community reaction.

9.6.7 Time Management

When operating close to sensitive receivers, activities may be able to be scheduled to avoid critical periods during the day. Respite periods can also be used when highly affected management levels are exceeded and there is no other reasonable or feasible management available.

9.6.8 Noise Monitoring

Noise monitoring can be undertaken to determine the effectiveness of measures which are been implemented, whilst the results of monitoring can be used to devise further control measures.

Attended noise measurements can be undertaken at key stages (i.e; piling, first major concrete pour) when particularly noise generating activities are undertaken or specific items of plant are in operation.

Attended noise measurements are to be conducted in accordance with Australian Standard AS1055: 2018 *'Acoustics- Description and measurement of environmental noise'*, and should include the following:

- Type 1 or 2 sound meter (calibrated)
- Use of appropriate noise descriptor (in this case, $L_{eq(15min)}$).
- Detail of measurement position and proximity to reflecting surface if any (building or similar). Measurement positions will typically be a residential property boundary.

Monitoring should not be conducted under adverse weather conditions. The conditions applying at the time of the measurements should be indicated in the reporting.

9.6.9 Vibration Monitoring

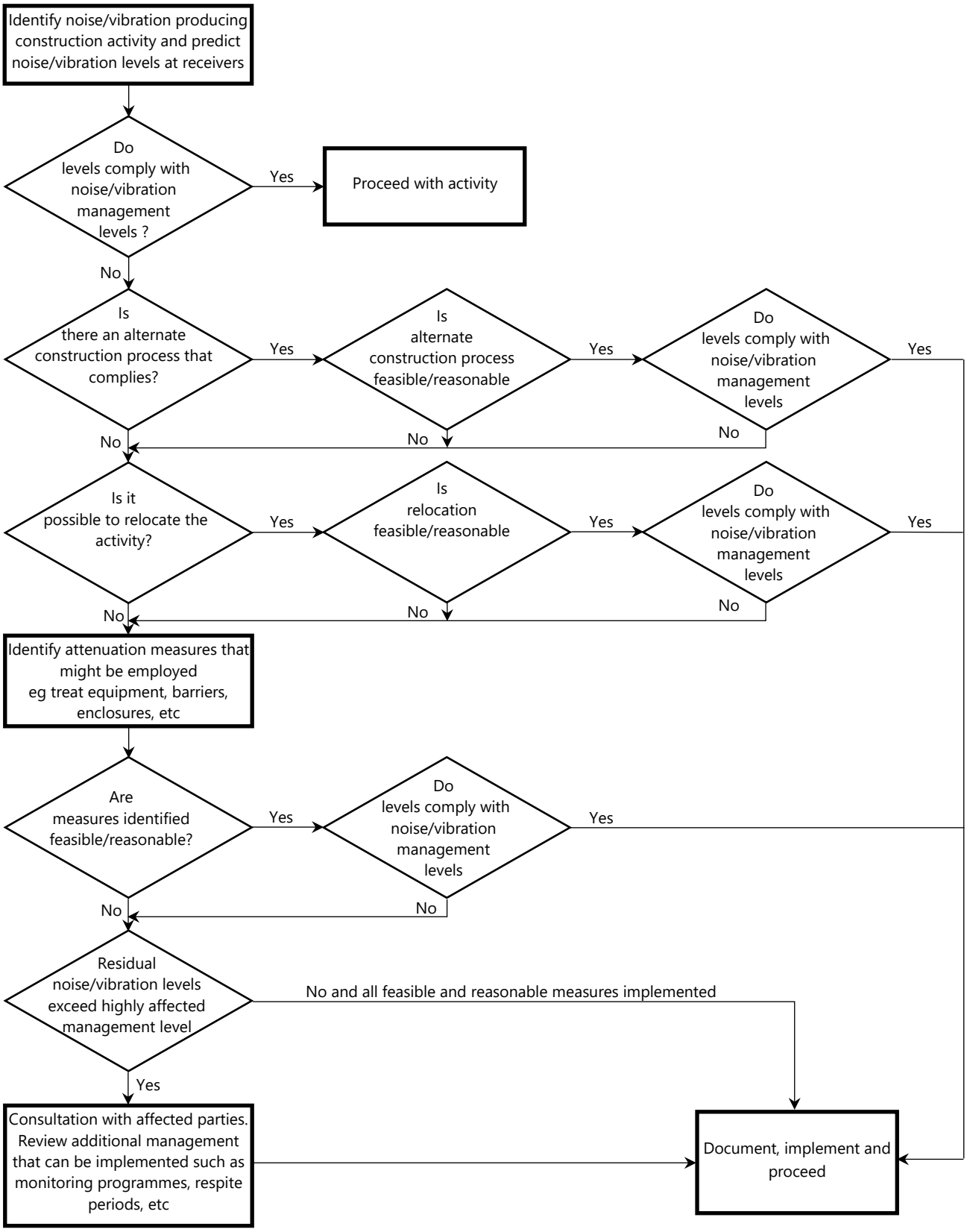
Vibration monitoring should occur at surrounding at surrounding Westmead Hospital buildings H1, H2 and H3 during demolition, bulk excavation until which time it can be determined there is no further risk for vibration criteria exceedance. This would be determined by the project acoustic/vibration consultant or other suitably qualified vibration expert.

The monitoring locations should be near the middle of the common boundary between the two properties, or as otherwise determined from time to time to best measure representative vibration levels. The monitor used should log the peak particle velocities and also transmit SMS warnings to the contractor and acoustic expert if a pre-determined threshold is exceeded. Regular reports should be provided (twice monthly) showing the vibration levels recorded and comparing these to the criteria.

Attended or unattended monitoring should also be undertaken at other locations in response to complaints, or as needed to confirm the use of additional plant/processes with the potential to exceed vibration criteria.

9.7 CONTROL OF CONSTRUCTION NOISE AND VIBRATION – PROCEDURAL STEPS

The flow chart presented below illustrates the process that should be followed in assessing construction activities.



9.8 DEALING WITH OFFENSIVE NOISE LEVELS

Should ongoing complaints of excessive noise occur, immediate measures shall be undertaken to investigate the complaint, the cause of noise exceedances and identify the required changes to work practices.

The effectiveness of any changes shall be verified before continuing. Documentation and training of site staff shall occur to ensure the practices that produced the exceedances are not repeated.

All complaints or offensive noise received should be fully investigated and reported to management. The complainant should also be notified of the results and actions arising from the investigation.

The investigation of offensive noise shall involve where applicable:

- noise measurements at the affected receiver.
- an investigation of the activities occurring at the time of the incident.
- inspection of the activity to determine whether any undue noise is being emitted by equipment.
- Whether work practices were being carried out either within established guidelines or outside these guidelines.

Where an item of plant is found to be emitting excessive noise, the cause is to be rectified as soon as possible. Where work practices within established guidelines are found to result in excessive noise being generated then the guidelines should be modified to reduce noise emissions to acceptable levels. Where guidelines are not being followed, the additional training and counselling of employees should be carried out.

Measurement or other methods shall validate the results of any corrective actions arising from a complaint where applicable.

10 COMMUNITY INTERACTION AND COMPLAINTS HANDLING

10.1 ESTABLISHMENT OF DIRECT COMMUNICATION WITH AFFECTED PARTIES

In order for any construction noise management programme to work effectively, continuous communication is required between all parties, which may be potentially impacted upon, the builder and the regulatory authority. This establishes a dynamic response process which allows for the adjustment of control methods and criteria for the benefit of all parties.

The objective in undertaking a consultation process is to:

- Inform and educate the groups about the project and the noise controls being implemented.
- Increase understanding of all acoustic issues related to the project and options available.
- Identify group concerns generated by the project, so that they can be addressed; and
- Ensure that concerned individuals or groups are aware of and have access to the Site Complaints Register which will be used to address any construction noise related problems should they arise.

To ensure that this process is effective, regular scheduled meetings will be required for a finite period, until all issues have been addressed and the evidence of successful implementation is embraced by all parties.

An additional step in this process is to produce a newsletter informing nearby residents of upcoming activities that are likely to generate higher noise/vibration levels.

For receivers within the hospital site, consultation is to be undertaken with the relevant government organisations and surrounding stakeholders.

10.2 DEALING WITH COMPLAINTS

Should ongoing complaints of excessive noise or vibration occur, immediate measures shall be undertaken to investigate the complaint, the cause of the exceedances and identify the required changes to work practices. In the case of exceedances of the vibration limits all work potentially producing vibration shall cease until the exceedance is investigated.

The effectiveness of any changes shall be verified before continuing. Documentation and training of site staff shall occur to ensure the practices that produced the exceedances are not repeated.

If a noise complaint is received the complaint should be recorded on a Noise Complaint Form. The complaint form should list:

- The name and address of the complainant (if provided);
- The time and date the complaint was received;
- The nature of the complaint and the time and date the noise was heard;
- The name of the employee who received the complaint;
- Actions taken to investigate the complaint, and a summary of the results of the investigation;
- Required remedial action, if required;
- Validation of the remedial action; and
- Setup vibration monitoring system at the location represents the nearest vibration receiver location with alarm device which can inform the project manager on site if the vibration exceedance happened.
- Summary of feedback to the complainant.

A permanent register of complaints should be held.

All complaints received should be fully investigated and reported to management. The complainant should also be notified of the results and actions arising from the investigation.

The investigation of a complaint shall involve where applicable;

- noise measurements at the affected receiver;
- an investigation of the activities occurring at the time of the incident;
- inspection of the activity to determine whether any undue noise is being emitted by equipment; and
- Whether work practices were being carried out either within established guidelines or outside these guidelines.

Where an item of plant is found to be emitting excessive noise, the cause is to be rectified as soon as possible. Where work practices within established guidelines are found to result in excessive noise being generated then the guidelines should be modified so as to reduce noise emissions to acceptable levels. Where guidelines are not being followed, the additional training and counselling of employees should be carried out.

Measurement or other methods shall validate the results of any corrective actions arising from a complaint where applicable.

11 CONTINGENCY PLANS

Where non-compliances or noise complaints are raised the following methodology will be implemented.

1. Determine the offending plant/equipment/process.
2. Locate the plant/equipment/process further away from the affected receiver(s) if possible.
3. Implement additional acoustic treatment in the form of localised barriers, silencers etc. where practical.
4. Selecting alternative equipment/processes where practical
5. Setup noise monitoring devices at locations represent nearest noise receivers and provide noise data for each complain time period. Analysis is required and determine suitable noise mitigation measures.

Complaints associated with noise and vibration generated by site activities shall be recorded on a Noise Complaint Form. The person(s) responsible for complaint handling and contact details for receiving of complaints shall be established on site prior to construction works commencing. A sign shall be displayed at the site indicating the Site Manager to the general public and their contact telephone number.

12 CONCLUSION

This document presents a noise and vibration management plan for construction activities associated with Westmead Hospital Early Works Project.

The principal issues which addressed in this report are:

- Specific activities that will be conducted and the associated noise/vibration sources;
- Identification of potentially affected noise/ vibration sensitive receivers;
- The development, hours of work and excavation period;
- The construction noise and vibration requirements specified in development conditions of consent.
- Noise/ vibration response procedures;
- Assessment of potential noise/ vibration from the proposed construction activities; and
- Contingency plans to be implemented in the event of non-compliances and/or noise complaints.

The assessment of noise and vibration indicates that construction actives associated with the project development may generate noise levels that will require additional management. Adoption of the controls detailed in Section 9 of this report will ensure that noise impacts will be minimised.

Vibration goals have also been set in this report to minimise structural damage risk for existing structures close to the project site and to protect human comfort.

Please contact us should you have any further queries.

Yours faithfully,

Acoustic Logic Pty Ltd
Thomas Hutchens