LENDLEASE BUILDING PTY LTD | 97 000 098 162

RANDWICK CAMPUS REDEVELOPMENT MANAGEMENT PLAN - NOISE AND VIBRATION

17/12/2020 | Revision No: 2.8

Sub- Plan Revision Status				
Date	Revision (in numbers)	Purpose and Summary of Amendments	Reviewed by	Approved by
30/11/16	2	General update including LLB GMR and legislative amendments.	[redacted]	[redacted]
4/12/18	2.1	New Project	[redacted]	
21/05/19	2.2	Regular three month review, updated EMD	[redacted]	
12/09/19	2.3	Regular three month review, updated EMD	[redacted]	
12/12/19	2.4	Regular three month review, updated EMD	[redacted]	
18/03/20	2.5	Regular three month review, updated EMD	[redacted]	
17/06/20	2.6	Regular three month review, updated EMD	[redacted]	
17/09/20	2.7	Regular three month review, updated EMD	[redacted]	
17/12/20	2.8	Regular three month review, updated EMD	[redacted]	

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1. SCOPE OF PROJECT AND SUB PLAN

Project Details	
Scope of the Sub Plan	This Noise and Vibration Management Sub Plan provides strategies and measures to minimise and control the generation of noise and vibration. It outlines appropriate measures to ensure that identification of noise and vibration, are managed appropriately during the construction phase including the site establishment, demolition, construction, fit out and commissioning of a project. It describes measures to be implemented during relevant construction activities, which enables control of the impacts of construction activities on potentially affected receivers, and contingency measures that may be implemented if complaints are received or measured limits exceeded. Refer to Section 1.1 and 3.1 of the Project EHS Management Plan for clarification on how the EHS Sub Plans form part of the Lendlease Building (LLB) EHS management system.
Objectives of the Sub Plan	● To achieve compliance with regulatory requirements and standards for noise and vibration management. ● To avoid excessive noise and vibration generation through site planning and the adoption of appropriate work methods and site management practices. ● To prevent or minimise to the greatest extent, the impact of construction noise and vibration on neighbours and the community. ● To establish and maintain positive relationships with project stakeholders.
Scope of Works	This Sub Plan has been prepared based on consideration of the following scope of works: ● Site establishment including ATF and A Class hoarding installation, office and compound setup; ● Demolition of 92 existing residences and Eurimbla Avenue situated between High Street, Magill Street, Botany Street and Hospital Road and tree chipping and removal ● Infrastructure diversions and/or upgrades including sewer and stormwater diversions, ● Site establishment including vegetation removal, topsoil stripping, ● Excavation of pits for sewer diversion work, trenching and drilling work. Bulk excavation works will work from the North-East corner of basement excavation pushing the soil to the south west corner, ● A contiguous pile wall along grid 14,

Project Details	
	● Construction of a 13 level Acute Services Building adjacent to the existing Prince of Wales Hospital in Randwick. This new build will include a new emergency department, helipad, IPUs, ICU, MAU, expanded rehab and ambulatory care facilities and operating theatres ● Hospital Road Lowering and Construction of the UNSW extension building to the ASB.
Key Issues and Risks	The works described above have the potential to generate noise and vibration at levels, or at times, that may affect nearby residents, businesses and other community facilities. The closest sensitive receivers to the site have been identified as: ● Randwick Hospital Campus (including Sydney Children's Hospital, Royal Women's Hospital, Prince of Wales Public Hospital, Prince of Wales Private Hospital ● UNSW ● Local residents, including High Street and Magill Street The activities with the greatest potential to create noise and/or vibration include: ● Demolition of structures and removal and chipping of trees ● Land clearing including vegetation removal, topsoil stripping; ● Bulk excavation work from the North-East corner of basement excavation pushing the soil to the south west corner. ● Contiguous piling, temporary sheet piles, bored piles; ● The loading and haulage of materials off-site; ● The transport of materials to and from site on local roads; ● Servicing of waste management and storage areas; ● The use of hand tools, small generators and compressors; ● Concreting works; and ● Out of hour works. High or prolonged levels of construction noise and vibration can cause annoyance to local receivers and damage to adjacent structures. The main risks associated with the works that will be conducted on this site are identified as: ● Noise affecting residents' use of their property or causing annoyance and resulting in complaints and negative comment; ● Noise disrupting local events, the use of public facilities or educational programs and exams;

Project Details	
	• Vibration affecting medical equipment located at the Randwick Hospital Campus i.e. calibration; • Noise affecting local businesses including cafes with outdoor areas; and • Noise occurring outside of normal or approved construction hours; • Vibration affecting structures or causing concerns/fright within the community. A noise/acoustic assessment including background noise monitoring has been prepared for this project. The assessment concluded that: • Noise associated with early and enabling works activities is expected to have an impact on the surrounding areas and the recommendations of the assessment have been addressed in this Sub Plan; The implementation of the control measures identified in the EHS Plan and this Sub Plan are intended to mitigate the risks and any potential impacts of noise and vibration on the environment and local community.
Legislation, Approval and Guidelines	**Federal/National:** ANZECC Guidelines Technical Basis for Guidelines to minimise Annoyance due to Blasting Over pressure and Ground Vibration Australian Standard AS2436 (1981) Guide to Noise Control on Construction, Maintenance and Demolition Sites Australian Standard AS2601 (1991) Demolition of Structures. AS 1055.1-1997 Acoustics – Description and measurement of environmental noise – General Procedures AS 1055.2-1997 Acoustics – Description and measurement of environmental noise – Application to specific situations **State:** Project Approval: SSD 9113 ASB 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 5pm, Saturdays. No work may be carried out on Sundays or public holidays.

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	C7. 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. Project Approval: SSD 10339 UNSW Ext & HRL 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 5pm, Saturdays. No work may be carried out on Sundays or public holidays. C7. Construction activities may be undertaken outside of the hours in condition C4, in accordance with the schedule of out of hours work nominated at section 3.4.2 and table 3.3 of the EIS to maintain operation of the hospital loading dock, unless directed otherwise by the Planning Secretary, and must be restricted to the following times and type of works: (a) Friday: 6:00 pm to 10:00 pm (limited to site establishment activities in preparation for weekend works).

Project Details	
	(b) Saturday: 5:00 pm to 10:00 pm (general construction activities excluding excavation, sawing of rock, jack hammers, pile drivers, vibratory rollers/compactors of the like). (c) Sunday: 8:00 am to 5:00 pm (general construction activities including excavation, sawing of rock, jack hammers, pile drivers, vibratory rollers/compactors of the like). (d) Sunday: 5:00 pm to 10:00 pm (general construction activities excluding excavation, sawing of rock, jack hammers, pile drivers, vibratory rollers/compactors of the like). Interim Construction Noise Guideline NSW EPA 2009 Acoustic Logic construction Noise & Vibration Management Plan **Local**: • Local Government Act 1993 Lendlease Requirements: • 4.13 Degradation or Pollution of the Environment • 4.15 Uncontrolled Release of Stored Energy (non-electrical)) • Lendlease Building Workplace Delivery Code (WDC)
Summary of Site Controls	This Sub Plan must be read in conjunction with the Lendlease GMRs, Project Environmental Impacts and Hazards Assessment (IHRA), the Project EHS Plan, and the Lendlease Building WDC. These documents detail Lendlease's approach and commitment to pro-active and responsible site management. Site specific controls, monitoring, reporting and performance measurements have been identified in this Sub Plan to minimise and where possible prevent, the impacts of construction noise and vibration on the environment and community. These include but are not limited to: ● Performing and monitoring works in accordance with the project approval; ● Restricting works to approved construction hours; ● Assessing the potential impact of works that may be required or extend outside of approved construction hours (e.g. delivery of plant, large concrete pour) and seeking approval; ● Selecting appropriately sized plant, equipment and tools;

Project Details	
	• Retrofitting plant with noise silencing devices; • Substituting noisy processes or plant with less noisy options; • Restricting the times and/or duration of noisy works; • Communicating with project neighbours on a regular basis and providing advanced notification of noisy works; and • Installing acoustic barriers or enclosures where they are deemed to be feasible and effective. **Vibration**: The project will make all practical efforts to protect vibration sensitive buildings and the amenity of the occupiers of the buildings. The project will apply a practical and economical combination of vibration control measures to manage vibration impacts such as: • Substitution by an alternative process • Restricting times when work is carried out • Screening or enclosures • Consultation with affected residents. During leisure hours, vibration disturbance from construction operation must be kept to a minimum. The basis for this vibration management strategy will be to limit the times that certain vibration producing activities may be carried out. Generally, this will be accomplished by performing such work during (nominate daylight or after hours) No construction or demolition works is permitted within 50m vicinity of any heritage listed items or features of cultural significance. Any activities potentially resulting in vibrations should be at greater distances to avoid disturbance to any protected items located on the site. A Noise and Vibration Impact and Monitoring Environmental Management Diagram will be prepared prior to any site activities commencing (Appendix 1). Construction stage noise and vibration minimisation and monitoring requirements will be included in relevant specifications, contract agreements, plant supply agreements, quality assurance documents, and subcontractor work method statements. Site inspections, monitoring and reporting will be undertaken by Lendlease and subcontractors as detailed in the EHS Plan and the following implementation table. Acoustic Logic has been engaged as a specialised Consultant to develop a specific Construction Noise & Vibration Management Plan to provide compliance with DoP conditions. Refer to appendix.

2. IMPLEMENTATION OF THE SUB PLAN

Control Measure	Timing	Methodology	Responsibility	Monitoring and Reporting	Performance Measurement
Planning and Site Establishment					
Undertake dilapidation surveys of nominated properties, utilities and structures.	Prior to works commencing	Appoint a consultant to undertake dilapidation surveys pre- and post-construction and review findings.	CM/SM	Surveys reviewed and works planned with consideration of the findings (as relevant).	No damage to properties or buildings.
Address noise minimisation, management, plant noise monitoring and maintenance as part of risk assessments and work planning.	Prior to commencing works	WMSs prepared by major subcontractors to identify high noise and vibration generating activities, compliance with approved work hours, the duration of works, and the selection, substitution and use of appropriate plant.	SM	Discussion in planning sessions. Addressed in IHRA and WMS. Inspection of work activities. Noise monitoring results. Complaints.	No complaints from the community. No work outside of hours without approval.
Prepare a Noise and Vibration Impact and Monitoring Environmental Management Diagram (EMD) identifying the location of potentially affected receivers, monitoring locations and work areas where noise will be generated.	Prior to works commencing	Prepare EMD. Plan works with consideration to the location of sensitive receivers. Position noisy plant and equipment away from sensitive receivers and as far apart as practicable. Assess whether altering the orientation and/or location of the plant will reduce noise impacts.	PM/CM	Diagram prepared and communicated.	Sensitive receptors identified so that communication can be maintained.

Include information in the Site Induction about noise and vibration minimisation, management and monitoring.	Prior to works commencing	Revise Lendlease induction package to include site specific risks and information. Deliver induction material.	CM/SM	WMSs prepared by subcontractor's address noise and vibration minimisation, work hours, duration and the selection and use of plant.	Site induction delivered to all workers on site.
Install a noise barrier/hoarding along project boundaries (as feasible).	Prior to works commencing	Identify the location of project neighbours and assess the feasibility and benefits of installing a barriers/hoarding to reduce noise transmission.	CM/SM	Noise monitoring results. Number of complaints.	No complaints. No exceedances of predicted levels.
Design the site entry and internal roads to minimise and regulate truck movements and ensure vehicles enter and exit in a forward direction (to reduce noise from travel alarms).	Prior to works commencing	Address in site setup design. Include this requirement in the Traffic Management Plan.	CM/SM	Continuous monitoring of traffic movements during construction.	No complaints from adjoining residents or authorities.
Provide advanced notification of the commencement of work.	Prior to works commencing	Establish a list of project stakeholders including potentially affected neighbours, community, health and business facilities Prepare appropriate information and distribute to the community.	CM/SM	List established and maintained. Feedback recorded.	No community complaints. Positive relationship established with project neighbours.
Issue appropriate PPE for use on site where noise exceeds 85dB(A).	Prior to commencing and at all times	Identify areas of the site where PPE is required. Install appropriate signage. Monitor compliance.	SM	Daily surveillance. Weekly inspection checklist.	PPE consistently worn.
Establish a Plant & Equipment Register with details of approved equipment, noise compliance certificates and relevant restrictions/conditions of use (if any) if applicable.	Prior construction	Subcontractor to address in WMS and submit Plant & Equipment Register or service records.	GF	Included in subcontractor work method statements. Sub-contractor audit.	All operators licensed. No inappropriate use of plant or equipment.

Work Hours					
Comply with approved work hours. **Activity** / **Permitted working hours** All demolition, site vegetation clearance, remediation and site works, including site deliveries (except as detailed below): • Monday to Friday - 6.00am to 6.00pm • Saturday - 8.00am to 5.00pm • Sunday & public holidays - No work permitted Excavating or sawing of rock, use of jack-hammers, pile-drivers, vibratory rollers/compactors or the like: • Monday to Friday - 8.00am to 5.00pm only • Saturday No work permittedSunday & public holidays - No work permitted Additional requirements for all development: • Saturdays and Sundays where the preceding Friday and/or the following Monday is a public holiday - No work permitted **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 5pm, Saturdays. No work may be carried out on Sundays or public holidays. C5. Construction activities may be undertaken outside of the hours in condition C4 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. C6. Notification of such construction activities as referenced in condition C5 must be given to affected residents before undertaking the activities or as soon as is practical afterwards. C7. Construction activities may be undertaken outside of the hours in condition C4, in accordance with the schedule of out of hours work nominated at section 3.4.2 and table 3.3 of the EIS to maintain operation of the hospital loading dock, unless directed otherwise by the Planning Secretary, and must be restricted to the following times and type of works: (a) Friday: 6:00 pm to 10:00 pm (limited to site establishment activities in preparation for weekend works).	At all times	Identify and communicate approved work hours/days. Plan works and complete within approved hours. Provide notification to the community.	CM/SM	Documented approval received for work outside of approved hours. Monitoring of work outside of approved hours.	Timely approval of work outside of hours. No complaints. No work outside of approved hours without prior impact assessment and approval from the relevant regulatory authority. No fines.

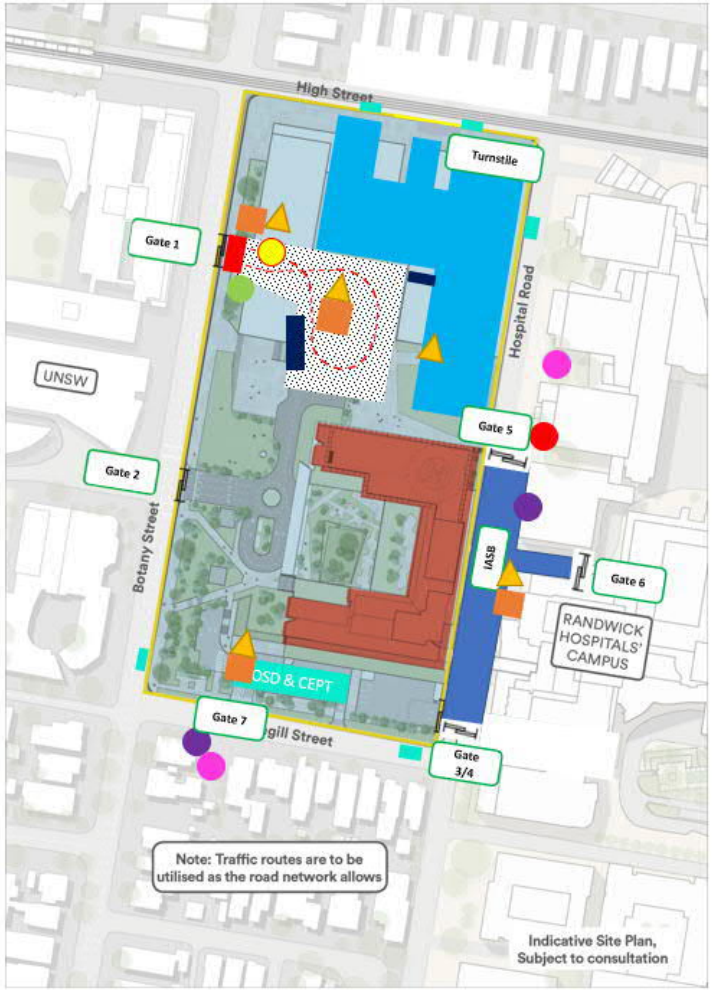
(b) Saturday: 5:00 pm to 10:00 pm (general construction activities excluding excavation, sawing of rock, jack hammers, pile drivers, vibratory rollers/compactors of the like). (c) Sunday: 8:00 am to 5:00 pm (general construction activities including excavation, sawin of rock, jack hammers, pile drivers, vibratory rollers/compactors of the like). (d) Sunday: 5:00 pm to 10:00 pm (general construction activities excluding excavation, sawing of rock, jack hammers, pile drivers, vibratory rollers/compactors of the like). C8. The work permitted under condition C7: (a) may be undertaken for a trial period of four weekends to monitor the effectiveness of the Construction Noise Vibration Management Plan (CNVMP) for the out-of-hour works required by condition C9, with a start date and the weekends notified in writing to the Planning Secretary 14 calendar days prior to commencement. At the conclusion of the trial period, the Applicant must submit a written report as required by condition C11 with 14 calendar days. (b) may continue in accordance with the schedule in accordance with C7 if the Planning Secretary does not advise within two weeks of submission of the trial period report that the works must cease. (c) must be supported by respite days where continuous days of construction exceed 13 days. A respite day must be provided after 14 consecutive days of working. C9. In undertaking any out-of-hours works under condition C7, the Applicant must comply with the following: (a) prepare a CNVMP for the out-of-hours work that is to include: (i) a description of the proposed out-of-hours works; (ii) predictions of LAeq (15 minute) noise levels at noise sensitive receivers from thes works and activities, where noise levels are predicted to be greater than the construction noise management level s in EPA's *Interim Construction Noise Guideline* (DECC, 2009); and (iii) a monitoring plan to validate the noise predictions, based on monitoring at the boundary of representative sensitive receivers during noise generating activities that are representative of the out-of-hours works; (b) the Applicant must submit the CNVMP to the Planning Secretary 14 calendar days prior to any work commencing for the duration of the trial period; and C10. In undertaking any out-of-hours works under condition C7, the Applicant must notify potentially affected noise sensitive receivers of works outside of standard construction hours not less thar five calendar days and not more than 14 calendar days before those works are to be undertaken. (a) the notification must be: (i) undertaken by letterbox drop or email; and (ii) be detailed on the project website. (b) the notification required by this condition must: (i) clearly outline the reason that the work is required to be undertaken outside the hours specified in condition C7; (ii) include a diagram that clearly identifies the location of the proposed works in relation to nearby cross streets and local landmarks; (iii) include details of relevant time restrictions that apply to the proposed works; (iv) clearly outline in plain English, the location, nature, scope and duration of the proposed works; (v) detail the expected noise impact of the works on noise sensitive receivers; (vi) clearly state how complaints may be made and additional information obtained; and					

(vii) include the number of the telephone complaints line, which must also be the after hours contact phone number specific to the works undertaken outside the hours specified in condition C7, and the project website address. C11. For out-of-hours works permitted under condition C7, a validation report must be submitted to the Planning Secretary within 14 calendar days of the completion of the trial that includes the following detail: (a) a copy of the community notification required under condition C10; and (b) noise monitoring undertaken during the out of hours works; and (c) details of any exceedances of noise levels predicted in the CNVMP; and (d) details of the noise and vibration mitigation measures that were implemented during the out-of-hours works; and (e) a summary of any community complaints received by the project during the trial period. C12. 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. C13. Where high noise impact activities are undertaken in accordance with the schedule of weekend closures of the loading dock nominated at section 3.4.2 and table 3.3 of the EIS to maintain operation of the hospital loading dock, the requirements of condition C12 do not apply provided that all high noise impact activities are undertaken prior to 5pm where reasonable and feasible.					
If work needs to be performed due to unforeseen circumstances (e.g. concrete pour) outside the hours nominated, consent from the Sydney Eastern City Planning Panel must be obtained.	At all times	Prior notice and approval from the Sydney Eastern City Planning Panel must be sought.	GF	Continuous as required.	No complaints from public or adjoining residents or authorities.
Provide advanced notification to potentially affected community stakeholders of out of hour's work/deliveries and high noise or vibration activities.	Prior to works commencing	Prepare appropriate information and distribute to the community at least 3 days prior to the works occurring.	CM/SM	Feedback recorded.	No community complaints. Positive relationship established with project neighbours.
Where applicable if work activities involve noisy works, controls measure MUST be detail as part of the Work Method Statement	Prior to works commencing	In accordance with the Noise and Vibration Management Plan.	Contractor	Continuous	Work Method Statement to contain details of schedule of work and equipment being used.
Noise and Vibration Minimisation – Plant and Equipment					
Ensure that public address systems are not used (except in emergencies)	During construction	Orientate speakers away from sensitive receivers.	SM	Monthly inspection. Review of effectiveness during emergency drills.	No complaints.
Operate plant and equipment in a proper and efficient manner and avoid unnecessary idling or engine noise.	At all times	WMS prepared by subcontractor to address proper operation of plant and	SM	Ongoing inspection of operators and operations.	All operators are licensed.

		equipment and education of operators.	Sub-contractor		No inappropriate use of plant or equipment.
Ensure plant is fitted with silencers, acoustical enclosures or other noise attenuation measures.	At all times	Subcontractor to address the risk based selection of appropriate plant and equipment in WMS. Include requirement in subcontracts. Subcontractor to submit Plant & Equipment Register or service records.	SM/ Foreman	Ongoing inspection of operators, activities and plant. Daily surveillance of noise levels.	All operators are licensed. No inappropriate use of plant or equipment.
Avoid rock-hammering where feasible and use alternative methods such as rock-saws and rippers where possible.	At all times	Subcontractor to address in WMS. If the use of rock-hammers is unavoidable, use smaller rock breakers with quiet 'city hammers'.	SM/ Foreman	Detailed SWMS prepared and communicated. Ongoing inspection of operators, activities and plant. Weekly inspection checklist	All operators are licensed. No inappropriate use of plant or equipment.
Consider the merits of different construction activities (e.g. piling techniques) in relation to noise and vibration impacts.	At all times	Subcontractor to address in WMS and submit Plant & Equipment Register or service records. E.g. Use non-percussive piling techniques where practicable. If impact piling is required, consider hours of operation, lowering hammer height, shielding with equipment or using acoustic shrouding and resilient dollies.	SM/ Foreman	Detailed SWMS prepared and communicated. Ongoing inspection of operators, activities and plant. Weekly inspection checklist.	All operators are licensed. No inappropriate use of plant or equipment.

Ensure that vibratory compactors are not used closer than 30 metres from residential buildings unless vibration monitoring confirms compliance with specified criteria.	At all times	Included in subcontractor tenders. Subcontractor to submit Plant & Equipment Register or service records. 'Buffer zones' clearly marked out to prevent entry of plant.	SM/ Foreman	Ongoing surveillance.	All operators licensed. No inappropriate use of plant or equipment.
Turn off vehicles and plant when not in use and avoid queuing and idling outside the site, particularly prior to the construction start time.	At all times	Address in site induction. Subcontractors to address in WMS and communicate to all personnel.	SM/ Foreman	Daily surveillance Weekly inspection checklist.	No complaints from local community.

ENVIRONMENTAL MANAGEMENT DIAGRAM– RANDWICK CAMPUS REDEVELOPMENT PROJECT



EXTENT MAP

KEY ENVIRONMENTAL ISSUES

- Dust both within site and leaving the site perimeter
- Unexpected finds
- Noise to general public
- Water Run Off
- Sediment Run Off

SENSITIVE RECEPTORS

- UNSW
- Randwick Hospital Campus (including Sydney Children's Hospital, Royal Women's Hospital, Prince of Wales Public & Private Hospital
- Local Residents (High Street & Magill Street)

KEY CONTROL MEASURES

- Soil is to be managed in accordance with the RAP
- Silt barriers consisting of geotextiles with secondary filtering material will be established at one meter offsets from drains
- Geotextile to cover over drains to filter water along with sand bags when required
- Additional dust monitors in place within the Hospital Buildings along Hospital Road
- Sprinklers and water carts to reduce dust Ring main water around inside of hoarding with hose connections to control work zones
- Sprinklers set up over waste bins for dust suppression when emptying smaller bins
- Sealed hard stand area for materials handling
- Coconut logs for sediment control on Hospital Rd works

[redacted]

LEGEND

Icon	Descriptions
	Perimeter A-Class Hoarding
	Vehicle Entry Gate
	Site Accommodation and Offices
	Spill Kits
	Tyre cleaning run off pond (inclement weather)
	Vibration Monitors
	Acoustic Monitors
	Stormwater inlet
	Delivery vehicle movement
	Shaker grid
	Hazardous Materials and Dangerous Good Storage
	Dust Monitor
	Two coat chip seal hard stand area
	Refuel area for wheeled vehicles
	Waste bins

APPENDIX 2: Typical Noise Levels of Major Plant

Item	Typical Plant or Equipment	Max Noise Level (at 7 metres)
Bulldozer	Caterpillar D7, D9	88
Bulldozer	Caterpillar D10	93
Front End Loader	Wheeled	90
Jack Hammers	With silencing bags	85
Air Track Drill	800 CFM Compressor	96
Scraper	Caterpillar 631	89
Scraper	Caterpillar 651	85
Grader	Caterpillar 16	85
Compactor	Caterpillar 825	85
Compactor	Vibrating Plate	92
Vibratory Roller	10-12 Tonne	89
Water Cart	Diesel	88
Dump Trucks	35 Tonne	96
Excavator	Kato 750	86
Rock Breaker	Hydraulic on Kato 750	97
Truck	Diesel	80
Crane	Truck Mounted	85
Compressor	600 CFM	75
Compressor	1500 CFM	80
Backhoe	Diesel	88
Spreader	Asphalt, concrete	70
Asphalt Truck	Diesel	92
Asphalt Paver	Diesel	89
Tip Truck	Diesel	83
Generator	Diesel	79
Spraying Machine	Diesel	75
Mechanical Broom	Diesel / LPG	83
Piling Hammer	For piles and casing	93
Concrete truck	Diesel	83
Concrete Pump	Diesel	84
Concrete Vibrators	Petrol	80
Drill	Air	85
Drill	Pneumatic	85
Welders	Diesel	85

APPENDIX 3: Guideline for Roller Use near Structures

Roller Class & Weight Range	Centrifugal Force Range	Example of Rollers	Distance from Building A	Distance from Building B	Remarks
Very Light Less than 1.25 tonnes	10-20kN	Coates 32RD tandem Daveco 32CR tandem	3m	--	Maintenance and patching rollers. Generally not restricted for normal
Light 1 to 2 tonnes	20-50kN	Coates 42RD tandem Pannell 54T drawn	5m	--	Generally not restricted for normal road use.
Medium 2 to 4 tonnes	50-100kN	Coates 66Tdrawn Daveco 66 drawn	6m	12m	
Medium-Heavy 4 to 6 tonnes	100-200kN	Coates 72Tdrawn Daveco 72 drawn Pacific V12 drawn Raypo Rascal 400	12m	24m	Not advised for city and suburban streets.
Heavy 7 to 11 tonnes	200-300kN	Coates 78Tdrawn Pacific V24D drawn Raypo Rascal 600	25m	50m	Restricted. Not advised built-up areas.
Very Heavy 12 tonnes and over	Over 300kN	Coates 96Tdrawn Pacific V36D drawn	25m	50m	Restricted to major construction areas away from structures and buildings.

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Randwick Hospital Redevelopment

Main Works Construction Noise and Vibration Managment Plan

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1	11/05/2020	20191464.6/1105A/R1/GK	GK		GK
2	13/05/2020	20191464.6/1305A/R2/GK	GK		GW

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1 INTRODUCTION

This Construction Noise and Vibration Management Plan applies to the Prince of Wales Hospital Expansion Stage 1, comprising:

- Bulk earthworks;
- Construction and operation of a 13 level Acute Services Building, including the following facilities: an emergency department; operating theatres; central sterilising service department; intensive care unit; patient units; and ambulance bays;
- Overhead pedestrian links to existing hospital buildings;
- A helipad on the uppermost roof of the building;
- Magill Street road works, Botany Street signalised intersection, internal roads and drop-off/pick up areas; and
- Utility, site infrastructure and landscaping works.

1.1 PURPOSE OF THIS MAIN WORKS CNVMP

Development consent for this project is subject to conditions. The consent states that the conditions are required to:

- Prevent, minimise or offset adverse environmental impacts;
- Set standards and performance measures for acceptable environmental performance;
- Require regular monitoring and reporting; and
- Provide for the ongoing environmental management of the development. Condition B33 of the development consent requires NSW Health Infrastructure, on behalf of Health Administration Corporation, as the applicant, to prepare a Construction Environmental Management Plan (CEMP). The CEMP must include a Construction Noise and Vibration Management Sub-Plan (condition B33 (c)). Condition B37 specifies that the CNVM 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 B37(d); and
f) include a complaints management system that would be implemented for the duration of the construction.

Acoustic Studio has been engaged by NSW Health Infrastructure to prepare this CNVMP Sub-plan. Its purpose is to fulfil the relevant conditions of the development consent.

This document is the Construction Noise and Vibration Management Sub Plan required by approval condition B33 (c). It addresses the requirements specified in approval condition B37.

Table 1 replicates the conditions above, with the corresponding section(s) of this CNVMP where each condition is addressed.

Approval Condition	Completed?	CNVMP Reference
Be prepared by a suitably qualified and experienced noise expert	Yes	Section 1.4
Describe procedures for achieving the noise management levels in EPA's Interim Construction Noise Guideline (DECC, 2009)	Yes	Section 7
Describe the measures to be implemented to manage high noise generating works such as piling, in close proximity to sensitive receivers	Yes	Section 6.2.1
Include strategies that have been developed with the community for managing high noise generating works	Yes	Section 7.6
Describe the community consultation undertaken to develop the strategies in condition B37(d)	Yes	Section 7.6
Include a complaints management system that would be	Yes	Section 7.7

implemented for the duration of the construction.		

Operation of Plant and Equipment

C3. All plant and equipment used on site, or to monitor the performance of the development must be:

a) maintained in a proper and efficient condition; and
b) operated in a proper and efficient manner.

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 5pm, Saturdays.
No work may be carried out on Sundays or public holidays.

C5: Activities may be undertaken outside of the hours in condition C4 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) where a variation is approved in advance in writing by the Planning Secretary or her nominee if appropriate justification is provided for the works.

C6: Notification of such activities must be given to affected residents before undertaking the activities or as soon as is practical afterwards.

C7: 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.

Construction Noise Limits

C15: The development must be constructed to achieve the construction noise management levels detailed in the Interim Construction Noise Guideline (DECC, 2009). All feasible and reasonable noise mitigation measures must be implemented and any activities that could exceed the construction noise management levels must be identified and managed in accordance with the management and mitigation measures identified in the approved Construction Noise and Vibration Management Plan.

C16: The Applicant must ensure construction vehicles (including concrete agitator trucks) do not arrive at the site or surrounding residential precincts outside of the construction hours of work outlined under condition C4.

C17: The Applicant must implement, where practicable and without compromising the safety of construction staff or members of the public, the use audible movement alarms of a type that would minimise noise impacts on surrounding noise sensitive receivers.

C18: Any noise generated during construction of the development must not be offensive noise within the meaning of the Protection of the Environment Operations Act 1997 or exceed approved noise limits for the site.

Vibration Criteria

C19: Vibration caused by construction at any residence or structure outside the site must be limited to:

a) for structural damage, the latest version of DIN 4150-3 (1992-02) Structural vibration - Effects of vibration on structures (German Institute for Standardisation, 1999); and
b) for human exposure, the acceptable vibration values set out in the Environmental Noise Management Assessing Vibration: a technical guideline (DEC, 2006) (as may be updated or replaced from time to time).

C20: Vibratory compactors must not be used closer than 30 metres from residential buildings unless vibration monitoring confirms compliance with the vibration criteria specified in condition C19.

C21: The limits in conditions C19 and C20 apply unless otherwise outlined in a Construction Noise and Vibration Management Plan, approved as part of the CEMP required by condition B37 of this consent.

1.2 RELEVANT CODES AND STANDARDS

In preparing this plan we have considering the following:

- [1] The Development Consent ref: SSD9113.
- [2] Randwick Campus Redevelopment, Noise and Vibration Impact Assessment for State Significant Development (SSD) – Acute Services Building, ref:20180808 AUR.0003.Rep, prepared by Acoustic Studio
- [4] NSW Department of Environment and Climate Change (DECC) "Interim Construction Noise Guideline", 2009
- [5] NSW Department of Environment and Conservation (DEC) "Assessing Vibration: A Technical Guideline", 2006
- [6] Australian Standard "AS 2436: Guide to Noise Control on Construction, Maintenance & Demolition Sites", 1981
- [7] Australian Standard "AS 2670.2: Evaluation of human exposure to whole-body vibration – Part 2: Continuous and shock-induced vibration in buildings (1 to 80 Hz)", 1990
- [8] British Standards Institution "BS 6472 – Evaluation of human exposure to vibration in buildings (1 Hz to 80 Hz)", 1992
- [9] German Institution for Standardisation "DIN 4150.3 : Structural vibration – Effects of vibration on structures", 1999

1.3 OTHER APPROVAL CONDITIONS RELATING TO CONSTRUCTION NOISE AND VIBRATION

The Approval also includes other conditions relating to construction noise and vibration, including plant condition, time restrictions and specific noise and vibration conditions:

Protection of Public and Private Property and Infrastructure

B6. Before the commencement of construction, the Applicant must:

a) consult with the relevant owner and provider of services that are likely to be affected by the development to make suitable arrangements for access to, diversion, protection and support of the affected infrastructure;
b) prepare a dilapidation report identifying the condition of all public infrastructure in the vicinity of the site (including roads, gutters and footpaths);
c) prepare a dilapidation report identifying the condition of all adjoining and nearby premises including the residences on the south side of Magill Street and the heritage item located at 4 Hay Street, Randwick;
d) prepare a report by a professional engineer detailing the proposed methods of excavation, shoring or pile construction, including details of potential vibration emissions, and demonstrating the suitability of the proposed methods of construction to overcome any potential damage to nearby premises including the residences on the south side of Magill Street and the heritage item at no.4 Hay Street, Randwick.
e) submit a copy of the dilapidation report and engineers report to the Certifying Authority and Council.

1.4 QUALIFIED PERSONS PREPARING THIS PLAN

Persons involved in preparation of this plan and their qualifications are in Table 2. Details of their experience is available on request.

Person	Qualifications	Involvement in Plan
[redacted]	[redacted]	Project Director
[redacted]		Project Engineer

Table 2: Qualifications of persons preparing this plan.

1.5 RESPONSIBILITIES

Health Infrastructure and Lendlease are responsible for implementation of this plan:

- Working in accordance with the requirements of this CNVMP.
- Ensuring that any complaints regarding noise and vibration are investigated and appropriately responded to in accordance with the recommendations provided in this document.
- Ensuring project personnel and sub-contractors employed are aware of their responsibilities in regard to the management of noise and vibration during construction and assume the responsibilities assigned to them within this Plan.
- Monitoring and managing noise and vibration impacts on receivers, in accordance with the requirements of the relevant guidelines and standards listed in Section 4.
- Consulting with the occupants of neighbouring premises and buildings to inform them of the nature of the work, to determine any specific noise and vibration sensitivity they may have and to negotiate respite times during noisier works.

2 SUMMARY OF NOISE MANAGEMENT PROCEDURES

No Blasting and no percussive (impact) piling

Construction for this project is typical of infrastructure building sites in the Sydney Urban area. There will be CFA piling but no percussive (impact) piling. There will be no unusual excavation works, such as blasting.

Construction only in approved hours

Construction, including deliveries of materials to and from the site, is to occur only from:

- 6am to 6pm, Mondays to Fridays inclusive; and
- 8am to 5pm, Saturdays.
- No construction is allowed on Sundays or public holidays.

Activities outside of the hours above are allowed only 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

where a variation is approved in advance in writing by the Planning Secretary or her nominee if

Respite for noisy activities (Consent Condition C7)

Rock breaking, rock hammering, sheet piling, pile driving and similar activities may be done only between the following hours:

a) 9am to 12pm, Monday to Friday;
b) 2pm to 5pm Monday to Friday; and
c) 9am to 12pm, Saturday.

Proper and efficient operation and maintenance of plant and equipment

Plant and equipment used on site, or to monitor the performance of the development must be:

a) maintained in a proper and efficient condition; and
b) operated in a proper and efficient manner.

Non-tonal Movement Alarms ("Reversing Beepers")

Where practicable and without compromising the safety of construction staff or members of the public, audible movement alarms on dedicated site plant and equipment will be of a type that will minimise noise impacts on surrounding noise sensitive receivers This could be achieved through the use of broadband alarms, reversing cameras, a combination of these, or a system of work that excludes personnel from the active work area and allows audible reversing alarms to not be used on the site.

Construction vehicles not to arrive outside approved construction hours

Construction vehicles, including concrete agitator trucks, are not to arrive at the site or surrounding residential precincts outside of the approved construction hours. Trucks importing and removing materials from the site will be road-registered vehicles which will travel to and from the site via specific routes, avoiding local roads. They will enter and leave the site in a forward direction, minimising the need for reversing alarms. Trucks will be loaded and unloaded within the site, which will minimise noise from truck loading and unloading.

Noise and Vibration Monitoring

Noise levels and vibration will be monitored at two locations, and the results used to guide management and mitigation of noise and vibration.

Vibratory compactors not to be used within 30 metres of residences.

Vibratory compactors must not be used closer than 30 metres from residential buildings unless vibration monitoring confirms compliance with vibration criteria.

Community to be kept informed

Neighbours are notified and informed at intervals of the project hours, duration and site management contact details.

Workers and drivers to minimise noise

Contractors and visitors to site are required to complete an induction. This includes training and regular tool box talks. These talks include, as relevant, providing awareness of this plan; the approved project hours; specific noise mitigation measures; being respectful and considerate of neighbours and minimising noise. Minimising noise includes trucks avoiding using exhaust braking when approaching the site, not using vehicle horns for signalling, keeping radio volumes to a reasonable level, and not shouting.

Site to be surrounded by solid hoarding

The site is surrounded by solid (plywood) hoarding, to a height of approximately 2 metres, other than for access gates and adjacent to the site offices. This hoarding provides noise barrier attenuation for the ground floors of surrounding buildings and is to be retained and maintained in good condition for the duration of construction.

Vehicles to access the site only via site gates

Construction vehicles are to access the site only via the site gates, two of which is on Botany Street, and another on Hospital Road (Gate 3).

3 OVERVIEW OF MAIN WORKS

Main works, which are the subject of this CNVMP includes:

- bulk earthworks;
- Construction and operation of a 13 level Acute Services Building, including the following facilities: an emergency department; operating theatres; central sterilising service department; intensive care unit; patient units; and ambulance bays;
- overhead pedestrian links to existing hospital buildings;
- Magill Street road works, Botany Street signalised intersection, internal roads and drop-off/pick up areas; and
- utility, site infrastructure and landscaping works.

3.1 CONSTRUCTION HOURS APPROVED IN STATE SIGNIFICANT DEVELOPMENT (SSD) 9113

The work hours for the project (as per Consent Condition C4) are:

- 7:00am to 6:00pm Monday to Friday
- 8:00am to 5:00pm Saturday

Rock breaking, rock hammering, sheet piling, pile driving and similar activities will be restricted to (as per consent Condition C7):

a) 9am to 12pm, Monday to Friday;
b) 2pm to 5pm Monday to Friday; and
c) 9am to 12pm, Saturday.

These hours provide 1 hour of respite for every 3 hours of noise, which is a standard condition of many EPA Environment Protection Licences and Department of Planning and Environment Planning Approvals. Activities will be considered for restriction to these hours if they generate noise greater than 75dBA, including any penalties for potentially annoying characteristics, at any property boundary across Hospital Road or High, Botany, or Magill streets.

Activities outside of the work hours will only occur;

- If required by the Police or a public authority for the delivery of vehicles, plant or materials; or
- in an emergency to avoid the loss of life, damage to property or to prevent environmental harm; or
- where the works are inaudible at the nearest sensitive receivers; or
- where a variation is approved in advance in writing by the Planning Secretary or her nominee if appropriate justification is provided for the works.

This CNVMP will be revised appropriately in the event that a variation is approved by the Planning Secretary.

3.2 SEQUENCE, TIMING AND DURATION OF WORKS

Table 1 is an indicative construction works program from the project EIS that outlines the key activities in each particular location. Based on this, it is anticipated that the key activities to occur for each area / stage are as follows:

Stage of Works (Period)	Main Tasks	Itemised Activities[2]	Typical Plant
Piling (May to August 2019)	Piling works		Piling Rigs
Capping Beam Installation (July to September 2019)	Capping beam installation		Hand tools / drill / mobile crane
Excavation & Foundation (August to December 2019)	Bulk excavation and Detail excavation		Excavators / bobcat / skip trucks
	Foundation		Forklift / demo saw / mobile crane / concrete mixer truck/ concrete vibrator
Structure and Concrete Cores (November 2019 to September 2020)	Structure		Tower crane / mobile crane / hand tools / drill
	Concrete cores		Concrete mixer / concrete pump / concrete vibrator
Floors, Façade & Roof (November 2019 to December 2020)	Stripping floors		Hand tools / angle grinders
	Installation of façade and glazing		Drill / hand tools / mobile crane / tower crane
	Roofing		Hand tools / drills / tower crane / angle grinders / circular saw
Internal Works (April 2020 to June 2021)	Essential services		Hand tools / hammer drill / concrete mixer / demo saw / circular saw / angle grinder
	Fitout and finishes		Cement mixer / masonry saw / Hand tools / circular saw / angle grinders
Landscaping & External Works (June 2020 to August 2021)	Landscaping		Excavators / bobcats / skip trucks
	External works		Demo saw / excavators / hand tools / drills / angle grinders / hammer drill / mobile crane / tower crane

Note: Items shaded in grey are works to be carried out internally within the building

4 ENVIRONMENT SURROUNDING THE SITE

4.1 SITE DESCRIPTION

The site is located within an urban environment in Randwick, characterised by medium to high levels of activity throughout the day / evening and low levels of activity in the night.

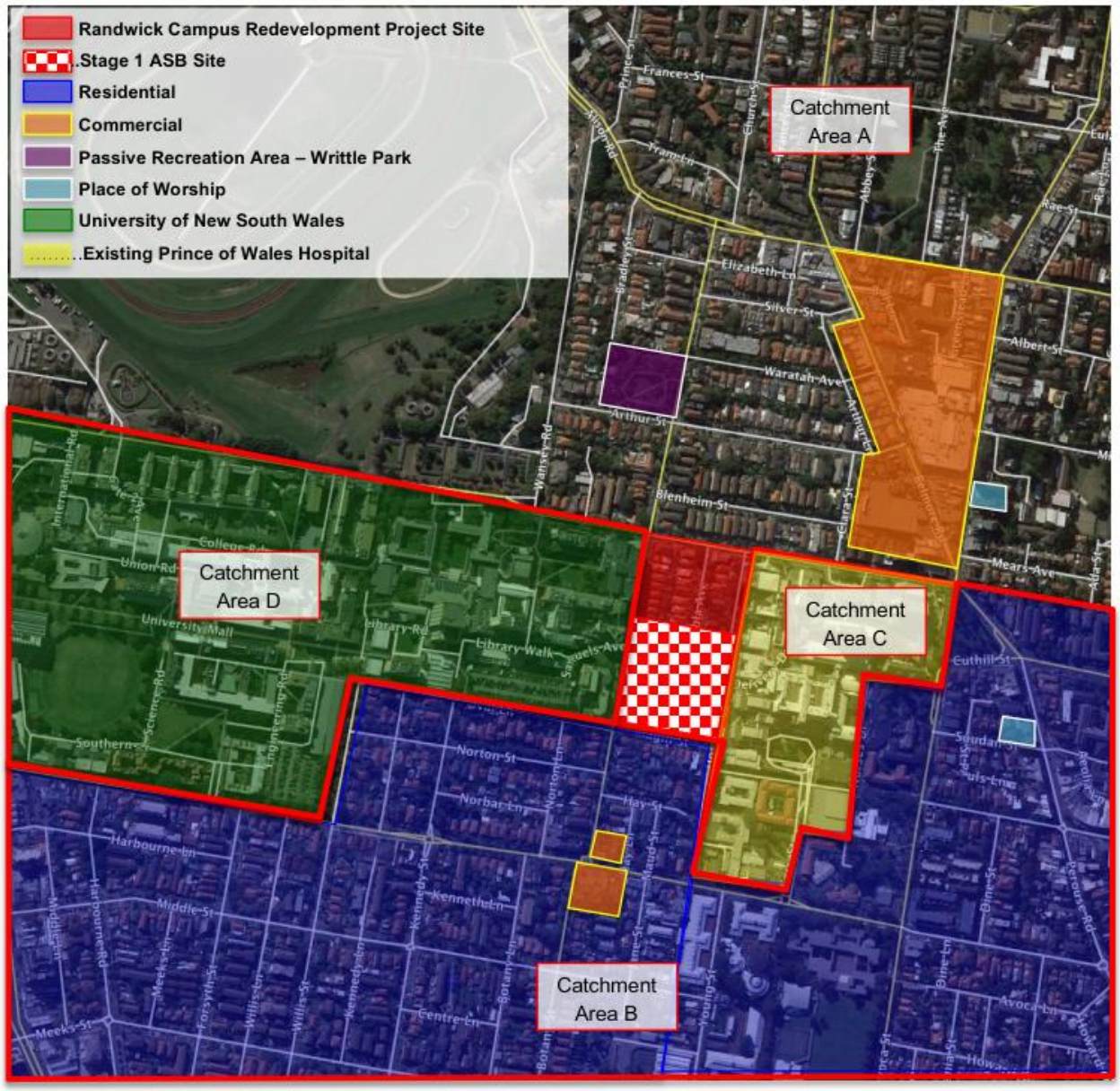


Figure 1: The Project site in relation to noise-sensitive receivers

The following land-uses surround the Project site:

- Catchment Area A
    - Residential dwellings to the north along High Street.
    - Commercial buildings to the northeast.
    - Writtle Park to the north.
    - Our Lady of the Sacred Heart Church to the northeast.
- Catchment Area B
    - Residential dwellings to the south and southwest.
    - Residential dwellings to the east and southeast adjacent to the POW Hospital.
    - Commercial buildings to the south.
    - Randwick Baptist Church to the east.
- Catchment Area C
    - POW Hospital to the east across Hospital Road. This receiver includes sensitive research laboratories and equipment as well as general hospital accommodation and administration activities.
- Catchment Area D
    - UNSW campus to the west. This receiver includes sensitive research laboratories and equipment as well as residential accommodation, learning, teaching and administration activities.

4.1.1 Nearest Noise and Vibration Sensitive Receivers

The nearest sensitive receivers to the Project site that will be potentially affected by noise and vibration are surrounding residential, educational, and hospital premises:

Site investigation indicates that the nearest noise/vibration receivers are below:

Receiver 1 – Randwick prince of Wales Hospital Complex located along the eastern boundary of the project site;
Receiver 2 – UNSW Building situated along the Western Boundary of the project site across Botany Street, Randwick.
Receiver 3 – Residential Dwellings situated along the Northern Boundary of the project site from 46 Botany Street to 18 High Street, Randwick.
Receiver 4 – Residential Dwellings situated along the Southern boundary of the project site from 103 Botany Street to 15 Magill Street, Randwick.

Buildings surrounding the site are set back various distances from their property boundaries but the distances above are from the receiver property boundary to the construction site property boundary.

Please see site map below for further detail.

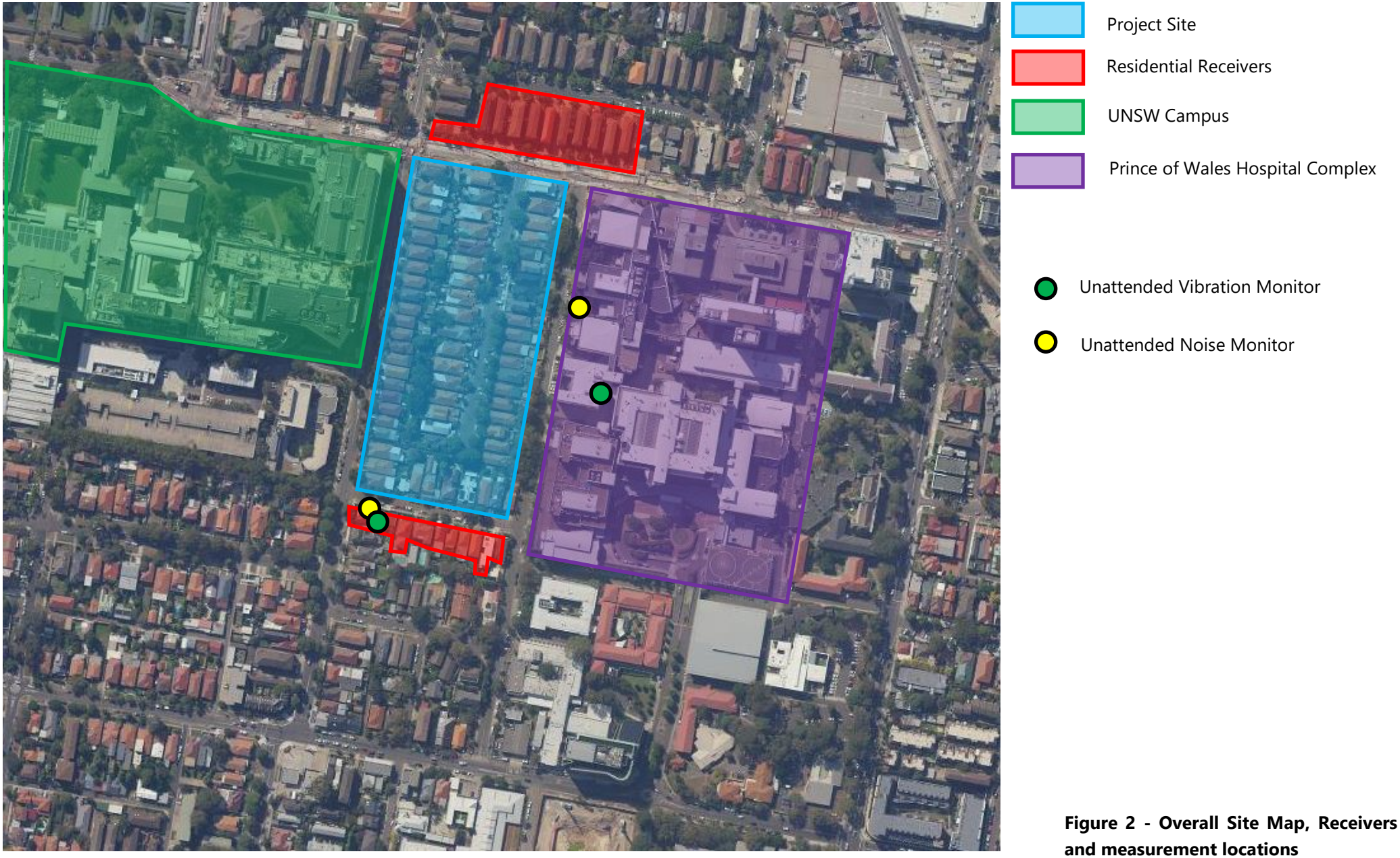


Figure 2 - Overall Site Map, Receivers and measurement locations

5 BACKGROUND NOISE LEVELS

Acoustic Studios background noise logging has been used in conjunction with Acoustic Logic Consultancies background logging data to determine the rating background noise level for the project site and surrounding receivers.

Background Noise levels which will be used as a basis for this assessment are detailed below.

5.1 NOISE ENVIRONMENT

The pre-existing noise environment was measured during the SSD application stage and is documented in Section 4 of the EIS / SSD [2]. This has been used to establish the relevant construction noise criteria for the project.

5.2 MEASUREMENT EQUIPMENT

Unattended noise monitoring was conducting using one Acoustic Research Laboratories Pty Ltd noise logger. The logger was programmed to store 15-minute statistical noise levels throughout the monitoring period. The equipment was calibrated at the beginning and the end of each measurement using a Rion NC-73 calibrator; no significant drift was detected. All measurements were taken on A-weighted fast response mode.

5.3 MEASUREMENT LOCATION

An unattended noise monitor was installed on ground level along the southern boundary of the proposed project site at 103 Botany Street, Randwick.

5.4 MEASUREMENT PERIOD

Acoustic Logic Consultancy conducted unattended noise monitoring from Friday the 22nd of November to Friday the 6th of December 2019.

5.5 MEASURED BACKGROUND NOISE LEVELS

The background noise levels established from the unattended noise monitoring are detailed in the Table below.

NSW EPA's RBL assessment procedure requires determination of background noise level for each day (the ABL) then the median of the individual days as set out for the entire monitoring period.

This report provides detailed results of the unattended noise monitoring. Weather affected data was excluded from the assessment. The processed Rating Background Noise Levels (lowest 10th percentile noise levels during operation time period) are presented in Table below.

Unattended and attended noise measurements have been undertaken as per the procedures outlined in Fact Sheet A and B of the NSW EPA Noise Policy for Industry.

Weather affected data (rain fall and wind speeds above 5m/s) have been excluded from the assessment as per Fact Sheet A and B. Where interval periods (day, evening and night) have 18%, 13% and 11% respectively, these periods have been excluded from the assessment.

Table 1 – Unattended Noise Monitor – Logger Location 1 – Rating Background Noise Level

Date	dB(A)$L_{90(Period)}$ [1]		
	Day (7am-6pm)	**Evening (6pm-10pm)**	**Night (10pm-7am Next Day)**
22nd November 2019	44	45	42
23rd November 2019	44	43	42
24th November 2019	42	43	42
25th November 2019	50	43	43
26th November 2019	48	47	44
27th November 2019	47	43	42
28th November 2019	50	45	42
29th November 2019	48	47	44
30th November 2019	44	48	43
1st November 2019	43	43	41
2nd November 2019	45	44	42
3rd November 2019	44	44	42
4th November 2019	45	44	42
5th November 2019	46	45	43
6th November 2019	45	-	-
Median	**45**	**44**	**42**

Table Notes:

1. Periods marked "-" above did not collect the enough data to be considered valid as the monitor as either installed before, during or after the interval.

The following table provides a summary of the background noise data applicable for the subject site:

Table 2 – Summarised Background Noise Levels

Project Site	Monitor Location	Acoustic Logic Measured Noise Data	Monitor Location	Acoustic Studio Measured Noise Data	Adopted RBL*
Randwick Campus Redevelopment	103 Botany Street, Randwick	Day – 45	7 Magill Street, Randwick	Day – 46	45
		Evening – 44		Evening – 44	44
		Night - 42		Night - 43	42

*Note: The lowest background noise levels have been adopted for this assessment

6 NOISE MANAGEMENT TRIGGER LEVEL

Noise emissions from the bulk earthworks, excavation and construction of should satisfy the following:

- Requirements of the SSD 9113 from the minister of planning and public spaces;
- NSW EPA Interim Construction Noise Guideline (ICNG) 2009; and
- Australian Standard AS2436:2010.

6.1 REQUIRMENTS BY NSW INTERIM CONSTRUCTION NOISE GUIDELINE

The NSW EPA Interim Construction Noise Guideline (ICNG) 2009 details specific construction noise and vibration management levels applicable to construction sites within NSW.

Where feasible and practical measures may be applied to the construction site is to endeavour to comply with the noise management levels outlined in the guideline. A summary of the code is detailed below.

6.1.1 NSW EPA Interim Construction Noise Guideline (ICNG) 2009

NSW EPA INCG adopts different management levels depending on the applicable receiver type, each is discussed below.

6.1.2 Residential Receivers

EPA guidelines adopt differing strategies for noise control depending on the predicted noise level at the nearest residences:

- "Noise affected" level. Where construction noise is predicted to exceed the "noise effected" level at a nearby residence, the proponent should take reasonable/feasible work practices to ensure compliance with the "noise effected level". For residential properties, the "noise effected" level occurs when construction noise exceeds ambient levels by more than:
    - 10dB(A)Leq(15min) for work during standard construction; and
    - 5dB(A)Leq(15min) for work outside standard construction hours.
- "Highly noise affected level". Where noise emissions are such that nearby properties are "highly noise effected", noise controls such as respite periods should be considered. For residential properties, the "highly noise effected" level occurs when construction noise exceeds 75dB(A)Leq(15min) at nearby residences. Highly noise affected level only applies during standard construction hours.

Table 3 – Construction Noise Management Level

Receiver Type	"Noise Affected" Level dB(A)$L_{eq(15\ minutes)}$	"Highly Noise Affected" Level dB(A) $L_{eq(15\text{-}minutes)}$
Residential Receivers	Background + 10dB(A) (Standard Construction Hours)	75
	Background + 5dB(A) (Outside Standard Construction Hours)	-

6.1.3 Other Sensitive

Other sensitive land uses, such as schools and hospitals typically consider noise from construction to be disruptive when the properties are being used. The table below presents management levels for noise at other sensitive land uses based on the principle that the characteristic activities for each of these land uses should not be unduly disturbed.

External noise levels are to be assessed at the most affected point within 50m of the area boundary. Where internal noise levels cannot be measured, external noise levels may be used. A conservative estimate of the difference between internal and external noise levels is 10 dB for buildings other than residences. Some buildings may achieve greater performance, such as where windows are fixed (that is, cannot be opened)

Table 4 – Noise at Sensitive Land Uses

Land Uses	Management Trigger Level $L_{Aeq(15min)}$
Hospital Wards and Operating Theatres	Internal noise level 45dB(A)

6.1.4 Outside Recommended Standard Hours

As outlined in Table 2 of the Interim Construction Noise Guideline 2009 works conducted outside the recommended hours must not exceed the noise trigger level of background plus 5dB(A). The proponent should apply all feasible and reasonable work practises to meet the noise affected level. Where all feasible and reasonable practises have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community.

6.2 AUSTRALIAN STANDARD AS 2436:2010 "GUIDE TO NOISE CONTROL ON CONSTRUCTION, MAINTENANCE AND DEMOLITION SITES"

Australian Standard AS 2436 provides guidance on noise and vibration control in respect to construction and demolition sites, the preparation of noise and vibration management plans, work method statements and impact studies.

The standard states that:

- "Some construction and demolition activities are by their very nature noisy. The authorities responsible for setting noise level criteria for essential works will take note of the constraints imposed by such activities, especially when they are of short duration."
- Construction, demolition and maintenance works pose different problems of noise and vibration control when compared with most other types of industrial activity, since (a) they are mainly carried on in the open; (b) they are often temporary in nature although they may cause considerable disturbance whilst they last; (c) the noise and vibration arise from many different activities and kinds of plant, and their intensity and character may vary greatly during different phases of the work; and (d) the sites cannot be separated by planning controls, from areas that are sensitive to noise and vibration.

The standard provides advice and guidelines for the prediction of impacts and the methods available to manage impacts. The guideline promulgates feasible and reasonable mitigation strategies and controls, and stakeholder liaison, in the effort to reach a realistic compromise between site activities and impacts on neighbouring properties.

6.3 CONSTRUCTION TRAFFIC NOISE

The RNP provides criteria for traffic noise from new roads or additional traffic generated on roads from land use development. The criteria apply to additional traffic generated on public roads from construction vehicles / traffic.

When considering land use redevelopment and the impact on sensitive land uses (residential / schools / hospitals / recreational) the RNP guideline states that ". In assessing feasible and reasonable mitigation measures, an increase of up to 2 dB" in relation to existing noise levels "represents a minor impact that is considered barely perceptible to the average person.

6.4 SUMMARISED CONSTRUCTION NOISE MANAGEMENT TRIGGER LEVELS

Construction noise management levels applicable to the development have been determined based on the minimum background noise level recorded and the construction noise guidelines detailed in 7of this report. Construction noise management levels of the site are detailed in Table 4 below.

Table 5 – External Construction Noise Management Levels

Receiver	Category	Time of Day	Background Noise Level dB(A) $L_{90(Period)}$	Construction Noise Management Trigger Levels dB(A) $L_{eq(15\ Minute)}$
Receiver 3 and 4 (Residential)	Monday to Friday	7am to 6pm (BG + 10)	45	55
	Saturday	8am to 1pm (BG + 10)	44	54
		1pm to 5pm (BG + 5)	44	49
	Sunday	No works on Sunday	-	-
Receiver 1, 2 (Other Sensitive Land Uses)	Monday – Sunday	Applies when properties are being used (Internal)	-	45 (internal)

7 VIBRATION CRITERIA

7.1 CONSTRUCTION VIBRATION

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, British Standard BS 6472 – 'Guide to Evaluate Human Exposure to Vibration Buildings (1Hz to 80Hz).
- For sensitive equipment

The criteria and the application of this standard are discussed in separate sections below.

7.2 STRUCTURE DAMAGE CRITERIA

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 2.

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.

Table 6 – DIN 4150-3 (1999-02) Safe Limits for Building Vibration

Type of Structure		Peak Particle Velocity (mms^{-1})			
		At Foundation at a Frequency of			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 a preservation order)	3	3 to 8	8 to 10	8

7.3 HUMAN EXPOSURE TO VIBRATION

The British Standard BS 6472 – 'Guide to Evaluate Human Exposure to Vibration Buildings (1Hz to 80Hz) will be used to assess construction vibration for human comfort.

This guideline provides procedures for assessing tactile vibration and regenerated noise within potentially affected buildings. The recommendations of this guideline should be adopted to assess and manage vibration from the site. Where vibration exceeds, or is likely to exceed, the recommended levels then an assessment of reasonable and feasible methods for the management of vibration should be undertaken.

Table 7 – BS 6472 Vibration Criteria

		RMS acceleration (m/s^2)		RMS velocity (mm/s)		Peak velocity (mm/s)	
Place	**Time**	**Preferred**	**Maximum**	**Preferred**	**Maximum**	**Preferred**	**Maximum**
Continuous Vibration							
Residences	Daytime	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							
Residences	Daytime	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

Note 1: Continuous vibration relates to vibration that continues uninterrupted for a defined period (usually throughout the daytime or night-time), e.g. continuous construction or maintenance activity. (DECC, 2006)

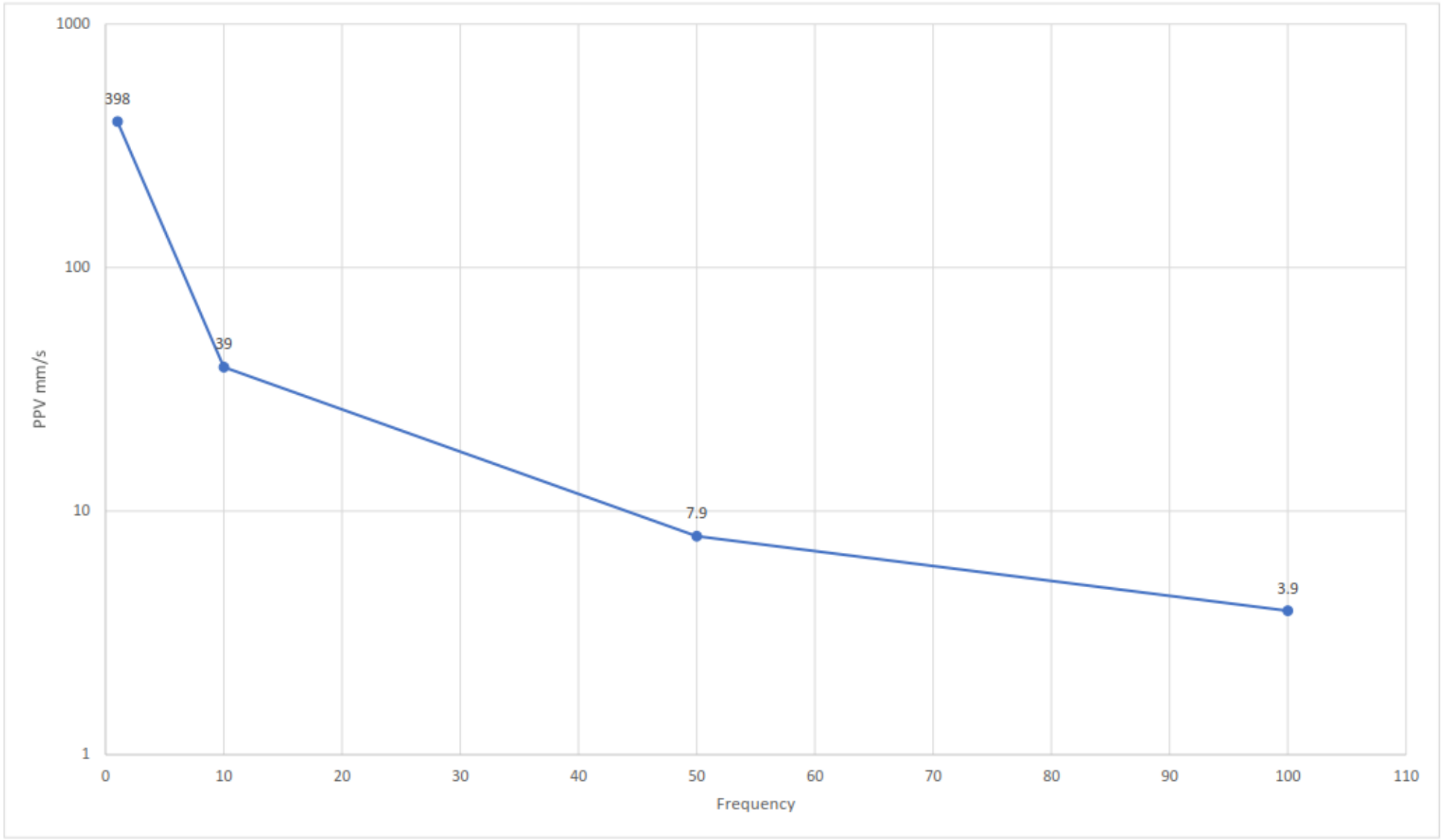
Note 2: Impulsive vibration relate to vibration that builds up rapidly to a peak followed by a damped decay and that may or may not involve several cycles of vibration (depending on frequency and damping), with up to three occurrences in an assessment period, e.g. occasional loading and unloading, or dropping of heavy equipment (DECC, 2006).

7.4 SENSITIVE EQUIPMENT VIBRATION CRITERIA

Acoustic Logic Consultancy have been advised that sensitive equipment is located within The Prince of Wales Hospital Foundation building with a nominated criterion of 2.5 m/s2. The corresponding Peak Particle Velocity has been calculated and is presented in the table and graph below.

Table 8 – Vibration Limit to Vibration Sensitive Machines

Sensitive Equipment	Peak Particle Velocity (mms-1)				
	At a Frequency of				Recommended Limit
	1Hz	10Hz	50Hz	100Hz	
	398	39	7.9	3.9	3.9


Sensitive Equipment Vibration Criteria PPV
1000
100
10
1
PPV mm/s
398
39
7.9
3.9
0
10
20
30
40
50
60
70
80
90
100
110
Frequency

8 MAIN WORKS NOISE AND VIBRATION ASSESSMENT

Potential sources of vibration and ground-borne noise during the Project works include:

- Construction and excavation plant including rock-breakers and jack hammers.
- Grinding, cutting and drilling of building structures.

Vibration and ground-borne noise impacts are likely to be highest during the excavation and piling work stages of the Project, when equipment such as rock breakers, jackhammers and piling rigs are used.

8.1 NOISE AND VIBRATION SOURCES

8.1.1 Construction Noise Assessment Methodology

A preliminary assessment of the likely noise impacts of the proposed works on the most-affected receivers surrounding the site was included in the project EIS <update for revised construction details>.

The assessment considered the following:

- Typical activities considered in the noise impact assessment are as detailed in Section 3.2.
- Noise management levels at sensitive receiver location as outlined in Section 3.2.
- Noise level predictions calculated using the noise data provided in Table 8.
- Noise level predictions considering distance attenuation only. This is appropriate because of the small distances between the site and surrounding receivers.
- The noise level predictions are based on assumptions that represent reasonable worst-case scenarios:
    - LAeq noise levels are predicted for the operations of the nearest works area on the site to each of the nearest sensitive receiver location.
    - The predictions consider a range from individual tasks and associated equipment up to the cumulative noise contribution from all key activities and corresponding equipment with plant running simultaneously for each phase and main task.
    - The predictions assume continuous operation of equipment / plant over the 15-minute assessment period, unless otherwise stated.

8.2 NOISE ASSESSMENT RESULTS

Noise from the worst-case construction works for each phase of the development have been predicted to the nearest most affected sensitive receivers. The predicted noise levels are presented in this section.

The following presents the predicted noise levels for each item of typically louder plant. Noise has been predicted to surrounding sensitive uses. The loudest typical appliances for each phase has been included and presented as a cumulative assessment.

The proposed construction works proposed for the site will include the following:

- Bulk Earthworks;
- Construction Phase.

The proposed works have been divided into a number of main work phase, along with the main noise producing equipment and activities likely to occur in each phase.

Table 9 – Excavation and Construction Activities

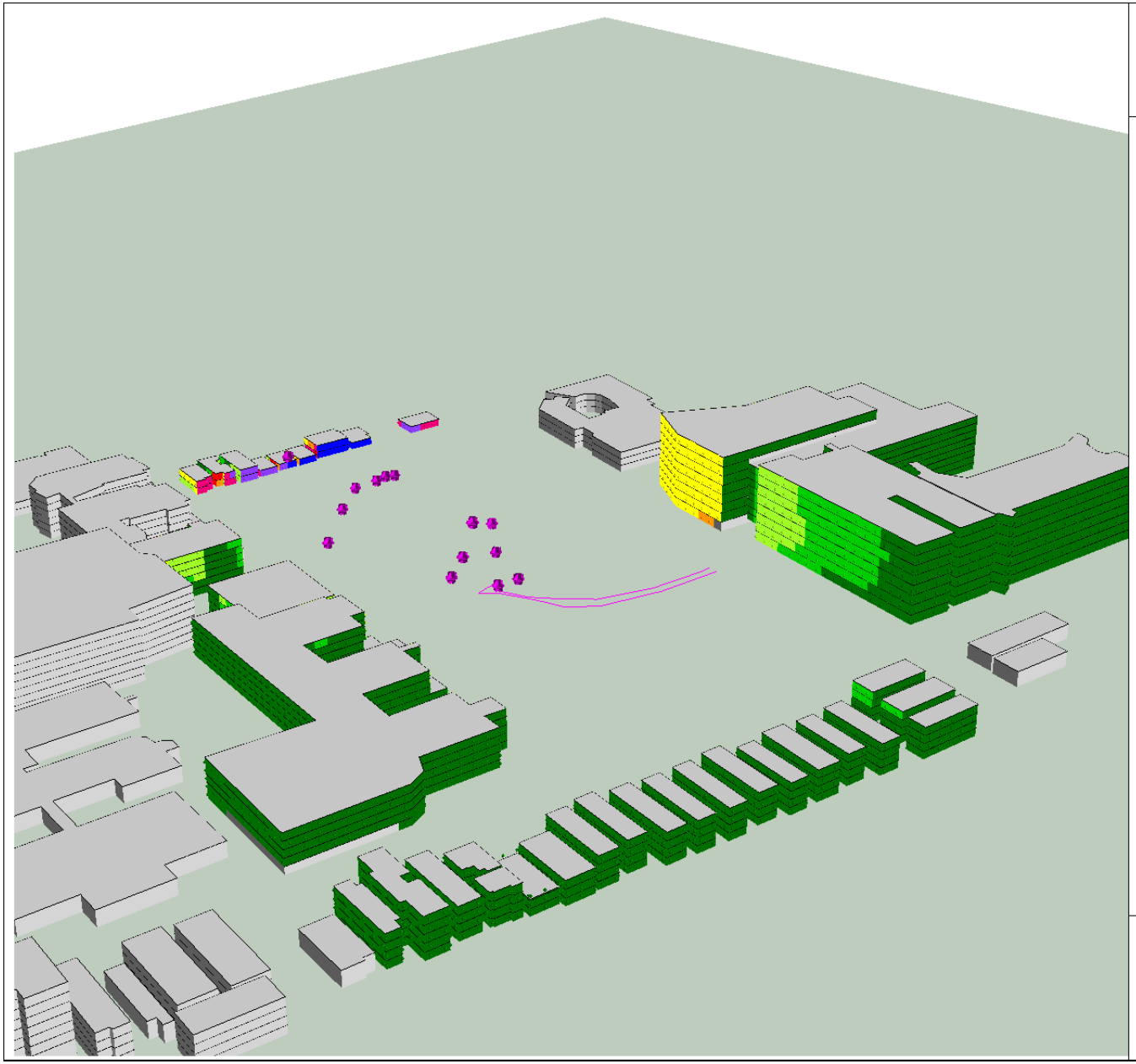
Construction Activity	Equipment	Sound Power Level dB(A)L_{max}
Bulk Excavation/Excavation Phase	Excavator Hydraulic Hammer	120
	Excavator Bucket	110
	Saw Rock Cutting	105
	CFA Piling	105
General Construction Works	Trucks	105
	Concrete Pumps	110
	Crane	105
	Concreting Helicopter	105
	Powered Hand Tools	94

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

1. Table D2 of Australian Standard 2436-1981;
2. Data held by this office from other similar studies.
3. Noise from the worst-case construction works for each phase of the development predicted to the nearest most affected sensitive receiver.

8.3 SOUND PLAN MODELLING

Acoustic Logic Consultancy has undertaken sound plan modelling to predict the noise emitted from the main works on site to the surrounding most affected receivers. Please see the figures below for further detail.



Randwick Campus Redevelopment

7am to 6pm Construction Noise Prediction

1xExcavator Hydraulic Hammer	- 120dB(A) SWL
1xExcavator Bucket	- 110dB(A) SWL
1xConcrete Pump	- 110dB(A) SWL
2xCrane (North & South)	- 105dB(A) SWL
2xConcreting Helicopter	- 105dB(A) SWL
1xTruck Engine @ 10km/h	- 105dB(A) SWL
1x Saw Rock Cutting	- 105dB(A) SWL
1xCFA Piling	- 105dB(A) SWL
4xPowered Hand Tools	- 94dB(A) SWL

Prepared by: S. Giannikopoulos
Date: 16/04/2020

Noise Level
L_{eq}
in dB(A)

- < 65
- 65 - 67
- 67 - 69
- 69 - 71
- 71 - 73
- 73 - 75
- 75 - 77
- 77 - 79
- 79 - 81
- 81 - 83
- 83 - 85
- >= 85

Signs and symbols

- Surface
- Receiver
- Point source

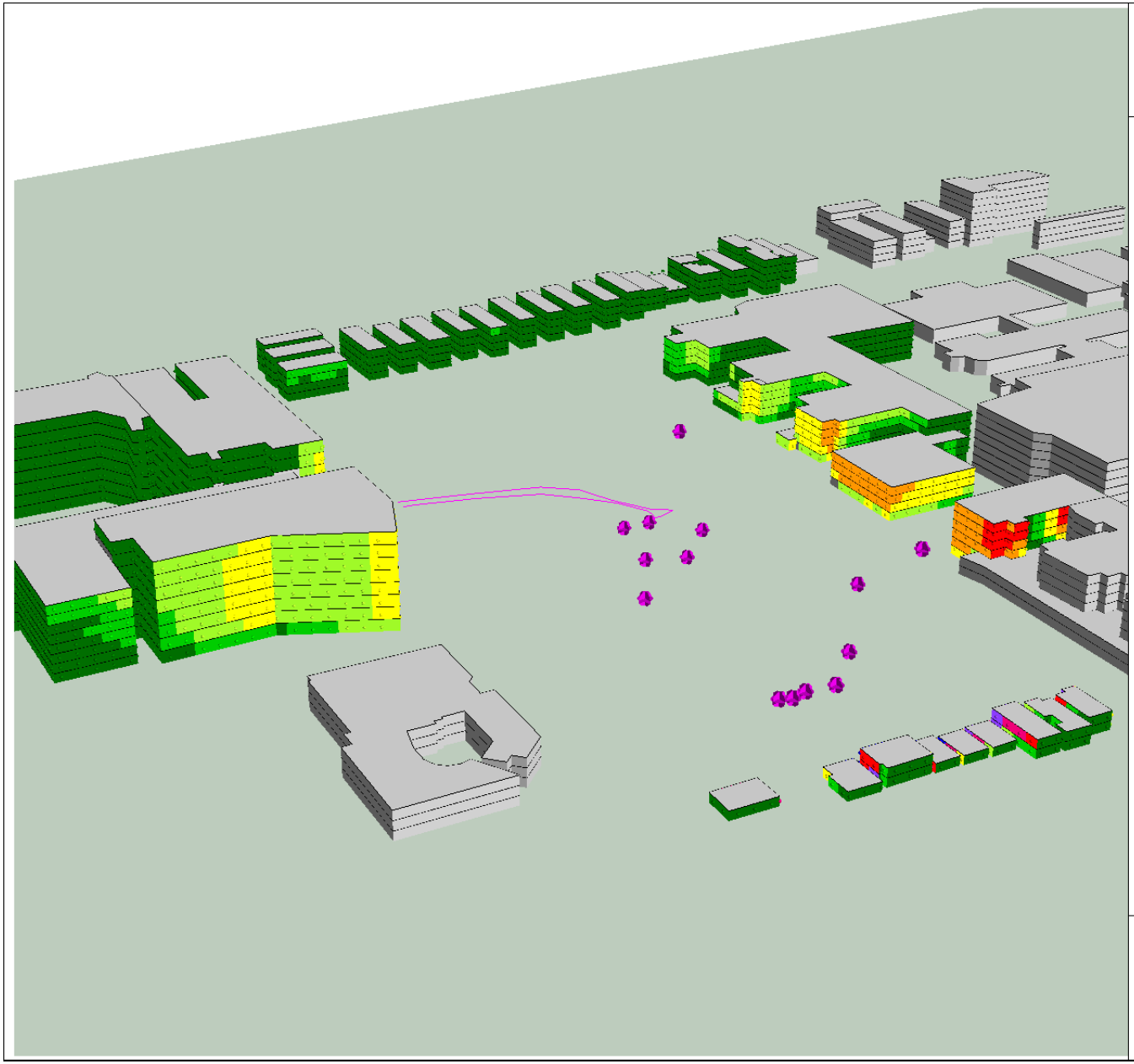
Facade Noise Map

- Facade point
- Line source

Length scale 1:5796

0 30 60 120 180 240 m

ACOUSTIC LOGIC



Randwick Campus Redevelopment

7am to 6pm Construction Noise Prediction

1xExcavator Hydraulic Hammer	- 120dB(A) SWL
1xExcavator Bucket	- 110dB(A) SWL
1xConcrete Pump	- 110dB(A) SWL
2xCrane (North & South)	- 105dB(A) SWL
2xConcreting Helicopter	- 105dB(A) SWL
1xTruck Engine @ 10km/h	- 105dB(A) SWL
1x Saw Rock Cutting	- 105dB(A) SWL
1xCFA Piling	- 105dB(A) SWL
4xPowered Hand Tools	- 94dB(A) SWL

Prepared by: S. Giannikopoulos
Date: 16/04/2020

Noise Level
L_{eq} in dB(A)

- < 65
- 65 - 67
- 67 - 69
- 69 - 71
- 71 - 73
- 73 - 75
- 75 - 77
- 77 - 79
- 79 - 81
- 81 - 83
- 83 - 85
- >= 85

Signs and symbols

- Surface
- Receiver
- Point source

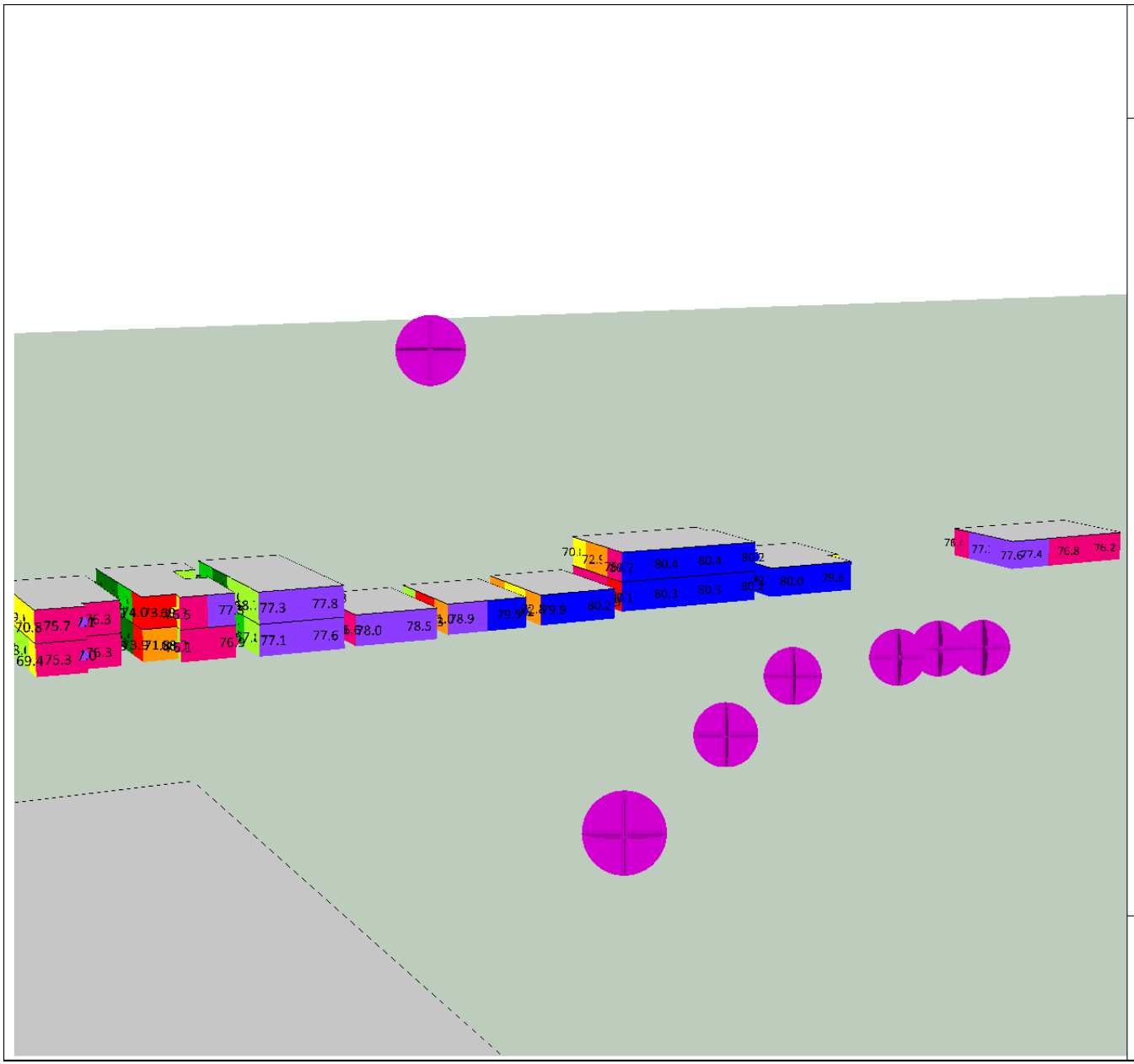
Facade Noise Map

- Facade point
- Line source

Length scale 1:5796

0 30 60 120 180 240 m

ACOUSTIC LOGIC



Randwick Campus Redevelopment

7am to 6pm Construction Noise Prediction

1xExcavator Hydraulic Hammer	- 120dB(A) SWL
1xExcavator Bucket	- 110dB(A) SWL
1xConcrete Pump	- 110dB(A) SWL
2xCrane (North & South)	- 105dB(A) SWL
2xConcreting Helicopter	- 105dB(A) SWL
1xTruck Engine @ 10km/h	- 105dB(A) SWL
1x Saw Rock Cutting	- 105dB(A) SWL
1xCFA Piling	- 105dB(A) SWL
4xPowered Hand Tools	- 94dB(A) SWL

Prepared by: S. Giannikopoulos
Date: 16/04/2020

Noise Level L_{eq} in dB(A)

- < 65
- 65 - 67
- 67 - 69
- 69 - 71
- 71 - 73
- 73 - 75
- 75 - 77
- 77 - 79
- 79 - 81
- 81 - 83
- 83 - 85
- >= 85

Signs and symbols

- Surface
- Receiver
- Point source

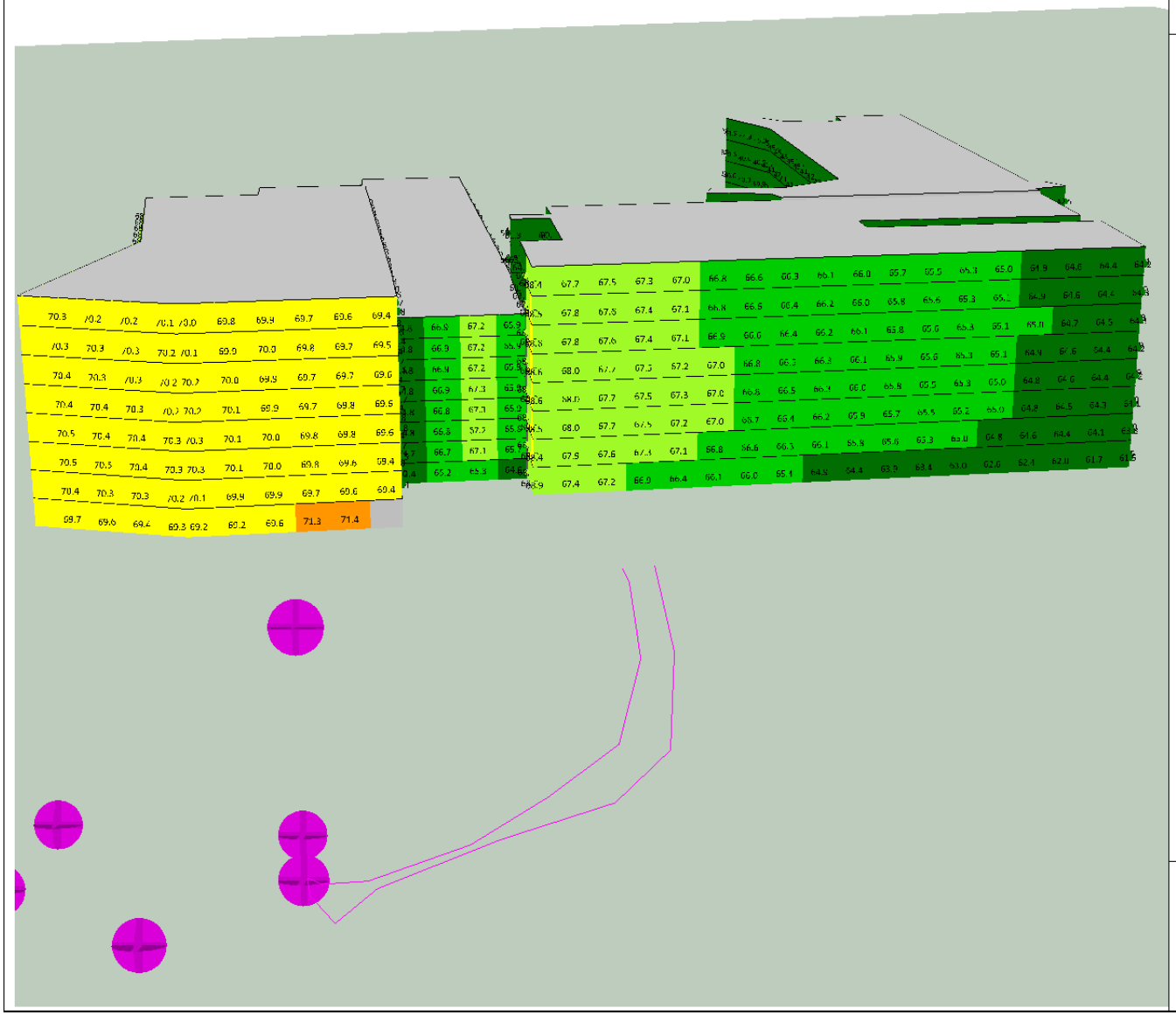
Facade Noise Map

- Facade point
- Line source

Length scale 1:5796

0 30 60 120 180 240 m

ACOUSTIC LOGIC



Randwick Campus Redevelopment

7am to 6pm Construction Noise Prediction

1xExcavator Hydraulic Hammer	- 120dB(A) SWL
1xExcavator Bucket	- 110dB(A) SWL
1xConcrete Pump	- 110dB(A) SWL
2xCrane (North & South)	- 105dB(A) SWL
2xConcreting Helicopter	- 105dB(A) SWL
1xTruck Engine @ 10km/h	- 105dB(A) SWL
1x Saw Rock Cutting	- 105dB(A) SWL
1xCFA Piling	- 105dB(A) SWL
4xPowered Hand Tools	- 94dB(A) SWL

Prepared by: S. Giannikopoulos
Date: 16/04/2020

Noise Level
L_{eq}
in dB(A)

- < 65
- 65 - 67
- 67 - 69
- 69 - 71
- 71 - 73
- 73 - 75
- 75 - 77
- 77 - 79
- 79 - 81
- 81 - 83
- 83 - 85
- >= 85

Signs and symbols

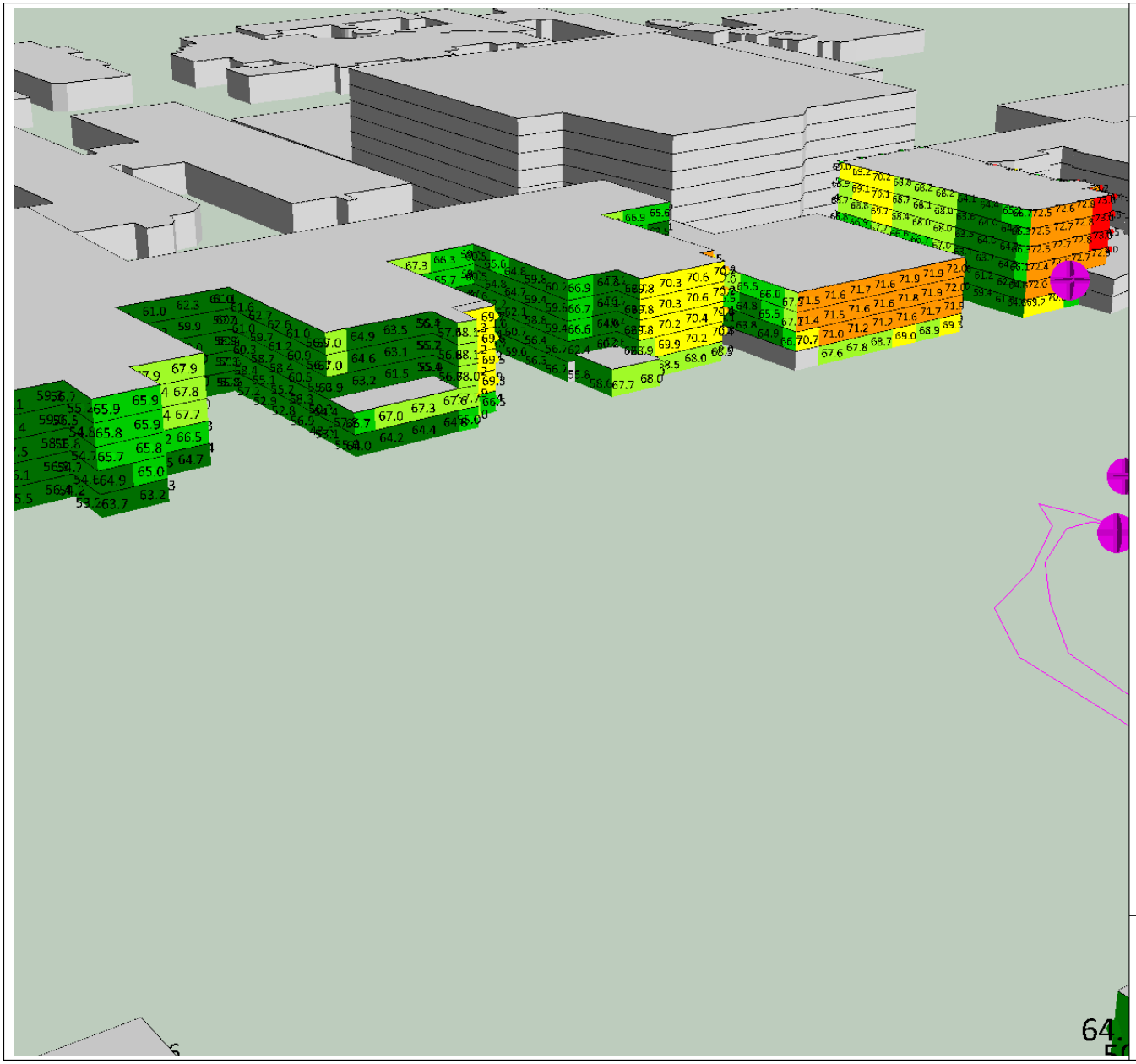
- Surface
- Receiver
- Point source

Facade Noise Map

- Facade point
- Line source

Length scale 1:5796
0 30 60 120 180 240 m

ACOUSTIC LOGIC



Randwick Campus Redevelopment

7am to 6pm Construction Noise Prediction

1xExcavator Hydraulic Hammer	- 120dB(A) SWL
1xExcavator Bucket	- 110dB(A) SWL
1xConcrete Pump	- 110dB(A) SWL
2xCrane (North & South)	- 105dB(A) SWL
2xConcreting Helicopter	- 105dB(A) SWL
1xTruck Engine @ 10km/h	- 105dB(A) SWL
1x Saw Rock Cutting	- 105dB(A) SWL
1xCFA Piling	- 105dB(A) SWL
4xPowered Hand Tools	- 94dB(A) SWL

Prepared by: S. Giannikopoulos
Date: 16/04/2020

Noise Level
L_{eq}
in dB(A)

- < 65
- 65 - 67
- 67 - 69
- 69 - 71
- 71 - 73
- 73 - 75
- 75 - 77
- 77 - 79
- 79 - 81
- 81 - 83
- 83 - 85
- >= 85

Signs and symbols

- Surface
- Receiver
- Point source

Facade Noise Map

- Facade point
- Line source

Length scale 1:5796

0 30 60 120 180 240 m

ACOUSTIC LOGIC

The following tables presented noise levels for each item of typically loudest plant

Table 10 – Noise Emission Assessment Receiver 1 (Prince of Wales Hospital Foundation)

Activity	Sound Power Level	Predicted Internal Noise Level dB(A)$L_{eq(15\ minute)}$	Management Trigger Level dB(A)$_{Leq(15\text{-}minute)}$	Management Required
Excavator Hydraulic Hammer	120	61-51	45 (Internal Criteria)	Yes
Excavator Bucket	110	51-41	45 (Internal Criteria)	Yes
Saw Rock Cutting	105	45-36	45 (Internal Criteria)	No
CFA Piling	105	45-36	45 (Internal Criteria)	No
Builders Hoist	105	45-36	45 (Internal Criteria)	No
Trucks	105	45-36	45 (Internal Criteria)	No
Concrete Pumps	110	51-41	45 (Internal Criteria)	Yes
Crane	105	45-36	45 (Internal Criteria)	No
Concreting Helicopter	105	45-36	45 (Internal Criteria)	No
Powered Hand Tools	94	35-25	45 (Internal Criteria)	No

Table 11 – Noise Emission Assessment Receiver 2 (Educational Facility UNSW Building)

Activity	Sound Power Level	Predicted Internal Noise Level dB(A)$L_{eq(15\ minute)}$	Management Trigger Level dB(A)$_{Leq(15\text{-}minute)}$	Management Required
Excavator Hydraulic Hammer	120	56-38	45 (Internal Criteria)	Yes
Excavator Bucket	110	46-28	45 (Internal Criteria)	Yes
Saw Rock Cutting	105	41-23	45 (Internal Criteria)	No
CFA Piling	105	41-23	45 (Internal Criteria)	No
Builders Hoist	105	41-23	45 (Internal Criteria)	No
Trucks	105	41-23	45 (Internal Criteria)	No
Concrete Pumps	110	46-28	45 (Internal Criteria)	Yes
Crane	105	41-23	45 (internal)	No
Concreting Helicopter	105	41-23	45 (internal)	No
Powered Hand Tools	94	30-12	45 (internal)	No

8.3.1 Managing noise impacts from dominate noise sources and equipment

There will be times / situations when early works demolition activities are likely to exceed the applicable criteria, particularly when works involving the dominant noise sources (as identified in Table 9 for each activity) occur in the areas closest to sensitive receivers and where there is a direct line-of-sight between the work area and the receiver.

Noise monitoring will be undertaken at or near the most affected receiver locations during the early works activities. If these activities are found to exceed the noise criteria, then the noise control measures described in Section 7 will be implemented wherever reasonable and feasible.

For the dominant noise sources or equipment causing exceedances in Table 9, all reasonable and feasible noise controls measures, together with construction best practices presented in Section 8, will be implemented.

Specifically, where reasonable and feasible, the control measures listed below will be implemented:

Excavators / Piling / Jackhammering

- These activities will be behind hoarding around the perimeter of the site. The hoarding will act as a noise barrier except for elevated residences overlooking the site. As excavation progresses the walls of the excavation will provide some noise barrier effect for overlooking residences, depending on the location of the residence and the location of the plant operating within the excavation.
- Regularly inspect and maintain acceptable lubricant levels and engine performance. Use existing and temporary site buildings plus material stockpiles as noise barriers.
- Schedule use of this equipment during periods when people are least affected. Provide respite periods, including restricting very noisy activities to daytime, restricting the number of nights that after-hours work (if required) is conducted near residences, or by determining any specific receiver requirements - particularly those needed for noise sensitive receivers such as sleeping / rest, teaching, study, etc.
- Schedule noisy activities to coincide with high levels of neighbourhood noise (such as traffic noise from Botany Street and High Street) so that noise from the activities is partially masked and not as intrusive.

Truck Traffic Noise Minimisation

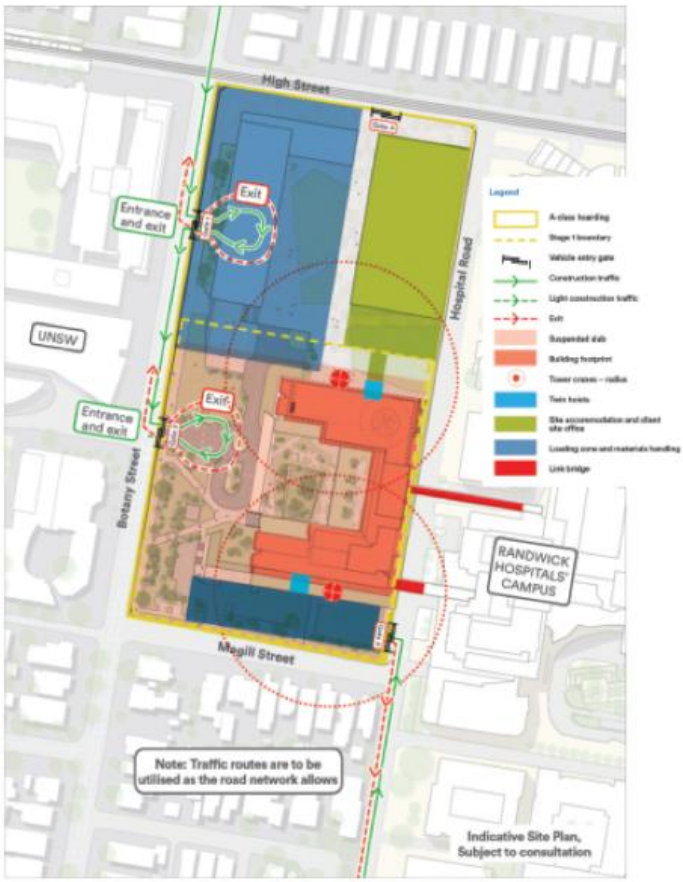
An average 50 trucks per day will access the site for removal of demolition and excavation material. This equates to a maximum of around two trucks per hour, which will result in a negligible increase in road traffic noise levels. Truck loading may be done in campaigns, for example during the one hour respite breaks for noisy works during the demolition and excavation. This will be possible and result in noise less than 75dBA when truck loading is inside the building site for the demolition and Stage 1 of the excavation.

Noise from truck traffic should be dealt with by appropriate management measures that minimise noise impact. This includes:

- Restricting demolition and excavation, and therefore truck traffic, to within appropriate hours;
- Staging and managing arrival of trucks to avoid queueing and idling on public streets;
- Arriving at, and departing from, the site via designated routes that avoid or minimise the use of local roads;
- Minimising reversing to minimise the use of movement alarms ("reversing beepers");
- Reasonable instructions from the project applicant and site manager to minimise the use of engine braking; and to avoid noise actions such as slamming doors, loud radios, shouting or the use of truck horns for signalling.

Traffic routes (green and red lines in Figure 2) for construction vehicles accessing the site will be:

- Entry via Botany Street for all vehicles.
- Exit via Botany Street for heavy vehicles, Hospital Road for light vehicles.



Truck traffic noise impact will be minimised by trucks using the designated routes described above, during project hours only.

8.4 VIBRATION ASSESSMENT RESULTS

The levels of vibration generated by the construction activities will be site-specific and will depend upon the type of activity, the particular equipment used, and the proximity of the construction activity to the nearest occupied spaces within the affected properties and heritage structures.

A detailed vibration assessment has not been carried out at this stage, as actual vibration levels experienced will be dependent upon;

- Site characteristics, and
- Specific construction equipment used.

Vibration monitoring will be carried out at surrounding vibration sensitive receivers, at the nearest affected locations (where practical and accessible).

In addition attended monitoring will be carried out as required for heavy construction activities / equipment determine whether the vibration levels justify a more detailed investigation, confirm monitoring locations or provide transfer functions, and the exact requirements for ongoing vibration monitoring.

The Contractor will carry out an ongoing review of vibration generated by the construction activities, and assess these against the criteria for human comfort, building damage and vibration-sensitive equipment provided in Section 5.5

Vibration will be monitored against trigger levels for damage at two locations. If vibration exceeds the trigger levels works will cease, the building inspected and appropriate action taken, such as changing the work method.

These locations will be relocated as required. At the commencement of works the monitoring locations include:

- 103 Botany Street.
- Ainsworth Building, POW Hospital.

9 NOISE AND VIBRATION MANAGEMENT PROCEDURES

Section 6.2.1 describes the control measures that will be implemented for any noise sources or equipment that is found to exceed the construction noise limits.

Noise and vibration monitoring will be carried out at or near the most affected receiver locations during the main works activities as described in Section 7.5

If any work activities are found to exceed the noise and/or vibration criteria, then the noise and/or vibration control measures detailed in Section 6.2.1 and the following sections will be implemented wherever reasonable and feasible.

9.1 GENERAL CONTROLS FOR NOISE AND VIBRATION

As a general rule, minimising noise and vibration will be applied as universal work practice at any time of day, but especially for noise sources or equipment that is found to exceed the construction noise limits plus any construction works to be undertaken at critical times outside normal daytime/weekday periods.

The reduction of noise and vibration at the source and the control of the transmission path between the construction site and the receiver(s) will be the preferred options for noise minimisation. Providing treatments at the affected receivers will only be considered as a last resort.

When any plant/activity exceeds the noise emission limits (as outlined in Table 9) the following strategies will be implemented, where reasonable and feasible, to manage construction noise and vibration impacts:

- Plant and equipment. In terms of both cost and results, controlling noise and vibration at the sources is one of the most effective methods of minimising the impacts from any work site activities. The following work practices will be implemented to reduce noise and vibration at the source:
- Employ quieter techniques for all high noise activities such as rock-breaking, concrete sawing, and using power and pneumatic tools.
- Use quieter plant and equipment based on the optimal power and size to most efficiently perform the required tasks.
- Where possible, select alternative construction equipment that are quieter in order to avoid the generation of excessive noise, particularly considering the dominant noise sources for the activities identified in Table 9.
- Select plant and equipment with low vibration generation characteristics.
- Operate plant in the quietest and most effective manner.

Where appropriate, limit the operating noise of equipment.

- Regularly inspect and maintain plant and equipment to minimise noise and vibration level increases, to ensure that all noise and vibration reduction devices are operating effectively. The allowable LA avmax (equivalent to LA10) noise levels for construction appliances provided in Page 3 of the City of Sydney "Construction Hours / Noise within the Central Business District – Code of Practice" (1992) will be used as a reference for indicative acceptable noise levels from various construction equipment.
- Where appropriate, obtain acoustic test certificates for equipment.

- On site noise management. Practices that will be implemented to reduce noise from the site include:
    - Maximising the distance between noise activities and noise sensitive receivers. Strategically locating equipment and plant.
    - Undertaking noisy fabrication work off-site where possible.
    - Avoiding the use of reversing beeping alarms or providing for alternative systems, such as broadband reversing alarms, particularly during night or out-of-hours works.
    - Maintaining any pre-existing barriers or walls on the site as long as possible to provide optimum sound propagation control.
    - Constructing barriers that are part of the project design early in the project to afford mitigation against site noise.
    - Using existing and temporary site buildings plus material stockpiles as noise barriers.
    - Installing purpose built noise barriers, acoustic sheds and enclosures wherever possible and where required to ensure construction noise limits are met.
- Work scheduling. Scheduling work during periods when people are least affected will be an important way of reducing adverse impacts. The following scheduling aspects will be implemented to reduce impacts wherever construction activities or equipment are found to exceed the construction noise limits:
    - Provide respite periods - including restricting very noisy activities to daytime, restricting the number of nights that after-hours work (if required) is conducted near residences, and by determining any specific requirements needed for noise sensitive receivers such as sleeping / rest, teaching, study, etc.
    - Schedule activities to minimise impacts by undertaking all possible work during hours that will least adversely affect sensitive receivers and by avoiding conflicts with any other scheduled noise-sensitive events. Works will be scheduled to only occur during the approved hours in accordance with Development Consent Conditions C4 and C7.
    - Where possible schedule noisy activities to coincide with high levels of neighbourhood noise (such peak traffic hours or in the middle of the day) so that noise from the activities is partially masked and not as intrusive.
    - Plan deliveries and access to the site to occur quietly and efficiently and organise parking only within designated areas located away from sensitive receivers.
    - Optimise the number of deliveries to the site by amalgamating loads where possible and scheduling arrivals within designated hours.
    - Designate, design and maintain access routes to the site to minimise impacts.
    - Include contract conditions that include penalties for non-compliance with reasonable instructions by the principal to minimise noise or arrange suitable scheduling.
- Consultation, notification and complaints handling
    - Information will be provided to neighbours before and during construction.
    - Good communication will be maintained between the community and project staff.
    - A documented complaints process will be maintained, along with a register of complaints.
    - Complaints will be given a fair hearing, and a quick response provided.
    - All feasible and reasonable measures to address the source of complaint will be implemented.

As a general approach, when noise goals cannot be met due to safety or space constraints, all reasonable and feasible mitigation measures will be implemented for all works to ensure that any adverse noise impacts to surrounding receivers are minimised.

9.2 SPECIFIC CONTROLS FOR AIRBORNE NOISE

Based on the findings from the noise and vibration assessment, and following discussions with Lendlease and HI, some specific airborne noise controls have already been agreed to be implemented and are included in the CMP:

- In accordance with Condition C7, heavy noise and vibration intensive works (Rock breaking, rock hammering, sheet piling, pile driving and similar activities) will be restricted to:
    - (a) 9am to 12pm, Monday to Friday;
    - (b) 2pm to 5pm Monday to Friday; and
    - (c) 9am to 12pm, Saturday.
- Where practical and available for equipment and without compromising the safety of staff or members of the public, audible movement alarms of the type that minimise noise impacts at surrounding receivers will be used (such as broadband or "quacker" alarms instead of beepers).
- Hoarding is provided around the site to provide screening however due to topography of site, some areas will have a direct line of site with residential receivers. For the majority of the intensive works (excavation and piling) the hoarding will provide shielding to the noise-sensitive receivers.
- The following works will be carried out in locations such that the existing hoarding will provide shielding to the nearest receivers:
    - Parking and loading of tipper trucks / skip trucks
    - Works that can easily be strategically located (including, carpentry areas, temporary works, etc)
- Employees will receive training which will enable them to recognise areas where noise levels are likely to exceed 85dBA;
- A noise assessment of the site will be undertaken prior to or at the commencement of works on site with ongoing monitoring in strategic locations determined through consultation with HI during the construction period;
- As the work environment changes, additional assessments may be conducted, the timing of which will be determined in consultation between the site management, Site Safety Committee and the Principal;
- Use of acoustic barriers during concrete pours, demolition works, in particular at façade break ins required for installation of new link bridges at the Women's Hospital and Randwick Hospital.
- Implementing acoustic mufflers to impact driven equipment;
- Use of core holing rather than impact hammer drilling into concrete structures of existing buildings, in particular at façade break ins
- Introduce engineering controls within the methodology, such as acoustic panels to surround concrete pumps for attenuation;
- In conjunction with HI NSW, developing acceptable periods when specific "noisy works" can occur;
- Managing works within the approved site working hours;
- Planning and notification of noisy works via the Disruptive Works Notice procedure and in general consultation with HI;
- Warning signs shall be erected in areas where 85dBA is exceeded; and
- Where additional personnel protection equipment is required, the areas shall be identified by signage. The appropriate noise protection devices are to be issued to the effected personnel.
- Noise emissions will be managed in accordance with the regulatory requirements and Lendlease management procedures, complying with the following:
    - National Code of Practice for Noise
    - Management and Protection of Hearing at Work [NOHSC:2009];
    - AS/NZS 1269.0:2005: Occupational noise management – Series ofseveral Standards;
    - AS 2012.2: Acoustics - Measurement of airborne noise emitted by earth-moving machinery and agricultural tractors - Stationary test condition - Operator's position;
    - AS 2436: Guide to noise control on construction, maintenance and demolition sites;

- AS 2221.1: Methods for measurements of airborne sound emitted by compressor units including prime movers and by pneumatic tools and machines;
- AS 3781: Acoustics – Noise labelling of machinery and equipment.

9.3 SPECIFIC CONTROLS FOR VIBRATION

We do not consider that controls will be required to control vibration to surrounding off-site buildings. The need to control vibration to the heritage buildings on site (plus the associated mitigation measures) is expected to ensure that vibration to surrounding off-site buildings will meet the relevant limits / criteria.

Notwithstanding the above, the Contractor will carry out a preliminary attended vibration assessments at the commencement / during use of intensive vibration generating plant to determine whether the existence of significant vibration levels justifies a more detailed investigation or vibration measurements / monitoring in areas other than those identified in this plan (refer to Section 7.5 for monitoring program).

If a more detailed investigation is required, this will involve methods of constraining activities generating high vibration levels. A method of monitoring vibration levels will then be put in place. Vibration mitigation measures and a review of vibration criteria may then be necessary.

Notwithstanding the above, all practical means will be used to minimise impacts on the affected buildings and occupants from activities generating significant levels of vibration on site.

Where vibration levels are found to exceed the relevant criteria, one or more of the following measures will be taken:

- Modifications to demolition equipment used.
- Modifications to methods of demolition.

If the measures given above cannot be implemented or have no effect on vibration levels or impact generated, a review of the vibration criteria will be undertaken and the vibration management strategy amended.

The following considerations will be taken into account:

- The layout of the site, including the location of static sources of vibration.
- Modifications to construction equipment used.
- Techniques used in construction to minimise generated vibration levels, including saw cutting and removal of structure wherever possible – as an alternative to hammers and hydraulic crushers.

- Hours of work with regard to the nature of operations in the affected buildings and the duration of the works.

As per the Consent Conditions, the following will be adhered to:

- B6.Before the commencement of construction, the Applicant must:
  (a) consult with the relevant owner and provider of services that are likely to be affected by the development to make suitable arrangements for access to, diversion, protection and support of the affected infrastructure;
  (b) prepare a dilapidation report identifying the condition of all public infrastructure in the vicinity of the site (including roads, gutters and footpaths);
  (c) prepare a dilapidation report identifying the condition of all adjoining and nearby premises including the residences on the south side of Magill Street and the heritage item located at 4 Hay Street, Randwick;
  (d) prepare a report by a professional engineer detailing the proposed methods of excavation, shoring or pile construction, including details of potential vibration emissions, and demonstrating the suitability of the proposed methods of construction to overcome any potential damage to nearby premises including the residences on the south side of Magill Street and the heritage item at no.4 Hay Street, Randwick.
  (e) submit a copy of the dilapidation report and engineers report to the Certifying Authority and Council. This Consent Condition was addressed prior to demolition works.
- Consent Condition C30, vibratory compactors (if used) will not be used closer than 30 m from residential buildings – unless vibration monitoring confirms compliance with the vibration criteria in Section 5.5.

If the measures given above cannot be implemented or have no effect on vibration levels or impact generated, a review of vibration criteria will be undertaken and the vibration management strategy amended.

9.4 PLANT AND EQUIPMENT MAINTENANCE PROGRAM

The Contractor will prepare and implement a regular plant and equipment inspection and maintenance program to ensure that "noisy" equipment or tools are not used. "Noisy" equipment or tools are those with defective mufflers or other fitted noise attenuation features or devices that are not working as intended.

9.5 MONITORING PROGRAM

9.5.1 Noise monitoring

The builder will monitor environmental noise and vibration at or near the most affected noise receivers at locations to assess noise levels against those predicted in this document.

Noise is to be monitored continuously at 2 locations, with access to be obtained by Health Infrastructure, as follows:

- 103 Botany Street.
- Ainsworth Building, POW Hospital.

As works progress and work locations change, the noise monitors will need to be relocated close to the most affected noise sensitive receiver as appropriate. If the noise monitoring indicates noise levels exceeding the levels predicted in this document, mitigation measures will be reviewed. Also, if noise monitoring indicates noise levels are less than the levels predicted in this document then opportunities will be considered to increase activity and reduce the overall duration of the works.

9.5.2 Vibration Monitoring

Vibration monitoring is critical to the success of this plan. Monitoring of vibration at the nearest affected receivers should be carried out at the commencement of heavy main works.

The purpose of this monitoring is to assess the risk of potential structural damage to the buildings of concern.

This monitoring will be used for specific activities generating significant levels of vibration, in situations where there are changes in equipment and activities or work procedures that might affect existing vibration control measures.

Vibration is to be monitored continuously at 2 locations, with access to be obtained by Health Infrastructure, as follows:

- 103 Botany Street
- Ainsworth Building, POW Hospital

As works progress and work locations change, the vibration monitors will need to be relocated close to the most affected vibration sensitive receiver as appropriate. These locations will be supplemented with attended monitoring required for heavy construction activities / equipment to determine whether the vibration levels justify a more detailed investigation, confirm monitoring locations or provide transfer functions, and the exact requirements for ongoing vibration monitoring (including relocation with progression of works). Ongoing vibration monitoring requirements to be reviewed following each stage of works.

Measured levels will be compared to the trigger levels nominated in this plan to assess whether additional respite or mitigation measures should be considered.

If vibration levels generated by the works approach the trigger values, then Lendlease shall monitor the situation and carry out the following:

- Liaise with plant operators and advise that criteria is being approached. Try to understand the cause of the vibration level and mitigate where practical.

Where the trigger value is exceeded the following process will be applied:

- Work shall stop as soon as practicable.
- Values reviewed to confirm frequency content against relevant targets and standards.
- Nearby properties will be inspected for cracks or other signs of damage against dilapidation reports.
- If no damage is identified, then the criteria may be increased to be agreed with Acoustic Logic, Lendlease and the engaged structural engineer.
- If there are signs of damage then:
    - the work method will be reviewed for an alternative method generating less vibration; or
    - the work method will continue and the situation monitored to ensure damage remains at a level that is repairable (minor cracks and other cosmetic effects).

9.5.3 Reporting

Lendlease will maintain records on site of:

- Noise and vibration monitoring;
- Remedial actions taken to minimise, reduce or eliminate noise and vibration;
- Daily and weekly inspections of plant and equipment, hoarding and other noise management measures;
- A monthly Construction Noise and Vibration report will be prepared by Acoustic Logic.

9.6 COMMUNITY CONSULTATION AND ENGAGEMENT REGARDING NOISE AND VIBRATION

The project team is committed to an early, coordinated, proactive and transparent communications and consultation whilst developing strategies to manage noise and vibration (as required by Condition B37).

The project identified a broad range of stakeholders and community members who had varying degrees of involvement and interfaced with the project staging and associated construction activity.

With a strong commitment to stakeholder and community consultation, the project has benefited from stakeholder input into the design and planning of the ASB. The following activities have been undertaken to inform the community, build relationships and provide an opportunity for input and feedback into project delivery.

Prior to any construction activities the following strategies were put into place:

- Community information sessions held.
- Formal and informal briefings and feedback sessions held.
- Where required face-to-face engagement with neighbouring residents and businesses.
- Distribution of project community information resources
- Established communication channels for feedback including project community contact number and project email account

The following highlights stakeholder and community consultation outcomes for managing high noise generating works (Condition B37):

- Stop works procedures and lines of communication where works may affect sensitive receivers or continuity of Hospital Campus operations
- Programming of works to acknowledge periods of increased sensitivity for receivers i.e. exam periods for UNSW and local schools
- Identification of sensitive receivers within neighbouring buildings to inform mitigation planning i.e. sensitive medical or research equipment
- Consultation with Hospital Campus on appropriate location for noise and vibration monitoring devices
- Complaints management processes for noise and vibration
- Identification of preferred communication channels with key stakeholders and neighbouring residents for works notification

The noise sensitive receivers listed and described in the CNVMP: Section 4.1.1 – Nearest Noise & Vibration Sensitive Receivers and any other impacted stakeholders have been notified of the project. They will be kept informed of the project status and key activities throughout the project duration.

- Construction briefings – regular briefings and presentations to affected stakeholders to provide advance notice of noise generating works, work hours and construction impacts management strategies. Construction briefings are utilised to gain feedback and input into construction planning and minimise impacts to stakeholders.
- Community notification – notifications circulated via letter box drop, email and project website to communicate upcoming construction activity to the local community and affected stakeholders.

- Construction Interface Meetings – regular meetings with key project stakeholders to communicate upcoming works, impacts and mitigate strategies.
- Site hoarding or notices on the hoarding will also identify Health Infrastructure and Lendlease as the site operators.

These channels will be used to inform residents and business owners, describing the construction hours, potential high noise works/hours, the noise management measures being implemented and providing contact details for further information or complaints.

9.7 COMPLAINTS AND NON-COMPLAINTS

The development of the CNVMP has been consulted with the project stake holders in accordance with the projects Community Communication strategy. This strategy outlines the key consultation that has been and continues to be undertaken

Complaints will be logged and response actions documented.

Upon receipt of a complaint the Contractor will decide whether the complaint is in relation to offensive noise. Offensive noise is described in legislation and discussed in the Noise Guide for Local Government. In the context of this proposal, offensive noise is noise from this proposal that is as a result of:

- Works outside the work hours in Section 6.1. Offensive noise includes noise outside of the work hours as a result of arrival or departure of trucks and any site personnel or contractors parking on the surrounding streets and not entering or leaving the hotel parking, dedicated to project vehicles.
- Works generating noise above 75dBA that extends for longer than 3 hours without a minimum one hour respite break.
- Works generating noise above the levels predicted in this document;
- plant or equipment not maintained or operated in a proper and efficient manner, for example with defective mufflers or other fitted noise attenuation devices;
- loud radios, shouting (particularly swearing), and other unnecessary noise;
- site gates left open other than for entry or exit of a vehicle.

On receipt of a complaint of offensive noise, or of becoming aware of offensive noise, the contractor will take immediate action to stop the offensive noise.

For complaints about noise from this proposal other than offensive noise, the contractor will;

- Direct consultation with any affected stakeholders where noise and vibration is a planned part of construction activity. Timely communication provides stakeholder awareness, opportunity for forward community and implementation of mitigations prior to works occurring. The project team remains cognisant of nearby sensitive receivers and vigilant in providing advanced notification.
- Ongoing consultation with key stakeholders to understand and document the location of any sensitive receivers including medical and research equipment.
- Consultation with key project stakeholders to determine suitable locations for loggers that provide effective readings and limit disruption to Hospital Campus.
- Regular doorknocking of neighbouring residents to notify of planned construction activity and associated impacts.
- Construction Community Notices distributed to local businesses and residents to notify of planned construction activity and potential impacts. Noise and vibration generating activities are communicated in a timely fashion through Construction Community Notices.
- Maintenance of 24/7 Community Contact phone number and project email address for stakeholder contact and complaints.
- Maintenance of project Complaints Register detailing complaints related to noise and vibration and project response. The Complaints register is updated monthly and remains accessible via the project's website.
- Circulation and approval of Disruptive Works Notification detailing planned construction activity, associated impacts and mitigations.
- Try to ascertain from the complainant which activity is causing the problem (i.e. inside or outside the site and in what position).
- If required, establish from the monitoring equipment and or attended noise monitoring if the predicted noise levels have been exceeded. Attended noise monitoring may be required to determine this.
- Check that the activity and equipment are being operated in a proper and efficient manner.

- Immediately rectify any faulty equipment.

9.8 TRAINING AND AWARENESS

The Contractor shall provide all project personnel and subcontractors with training on the environmental obligations through project inductions, toolbox talks and through Safety Works Methods (SWMS).

Project personnel and subcontractors shall undergo a general project induction prior to commencing work. This will include a noise component reinforcing that works should be done in a manner that minimises noise and is respectful of neighbours and mindful of their amenity.

10 CONCLUSION

This report presents an assessment of noise and vibration impacts associated with the bulk earthworks and construction activities to be undertaken for the potential noise and vibration impacts associated with the Randwick Hospital Redevelopment to satisfy the requirements of the development consent from the Minister of Planning and Public spaces – SSD9113.

The assessment of construction noise and vibration indicated that management and engineering measures will be required to limit the buildings adjacent to the site.

We trust this information is satisfactory. Please contact us should you have any further queries.

Yours faithfully,

Acoustic Logic Consultancy Pty Ltd
George Kinezos

MATTHEW PALAVIDIS
VICTOR FATTORETTO
MATTHEW SHIELDS

Randwick Hospital Redevelopment

Construction Noise and Vibration Managment Plan - Proposed Extended Hours

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Project ID	20191464.21
Document Title	Construction Noise and Vibration Managment Plan
Attention To	Lend Lease Building Pty Ltd ABN: 97 000 098 162

Revision	Date	Document Reference	Prepared By	Checked By	Approved By
0	17/04/2020	20191464.21/1704A/R0/GK	GK		GW

TABLE OF CONTENTS

1 INTRODUCTION

This report presents our assessment for the noise emission from construction work during the proposed extended hours for the Prince of Wales Hospital Expansion Stage 1. The proposed extended hours are below:

Table 1 – Proposed Extended Hours

Week Day	Proposed Extended Hours
Monday - Friday	6:00am – 7:00am
Monday – Friday	6:00pm – 10:00pm
Saturday	7:00am – 8:00am
Sunday	No Works

NSW Movement Minister for Planning and Public Spaces Media Release date 2 April 2020 states:

"The extended hours allow the industry to facilitate social distance on construction sites, while minimising the potential for lost productivity during the pandemic"

The current approved consent states that the conditions are required to:

- Prevent, minimise or offset adverse environmental impacts;
- Set standards and performance measures for acceptable environmental performance;
- Require regular monitoring and reporting; and
- Provide for the ongoing environmental management of the development. Condition B33 of the development consent requires NSW Health Infrastructure, on behalf of Health Administration Corporation, as the applicant, to prepare a Construction Environmental Management Plan (CEMP). The CEMP must include a Construction Noise and Vibration Management Sub-Plan (condition B33 (c)). Condition B37 specifies that the CNVM 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 B37(d); and
f) include a complaints management system that would be implemented for the duration of the construction.
g) Proposed extended hours of works.

This document is the Construction Noise and Vibration Management Sub Plan required by approval condition B33 (c). It addresses the requirements specified in approval condition B37.
Table 1 replicates the conditions above, with the corresponding section(s) of this CNVMP where each condition is addressed.

Approval Condition	Completed?	CNVMP Reference
Be prepared by a suitably qualified and experienced noise expert	Yes	Section 1.4
Describe procedures for achieving the noise management levels in EPA's Interim Construction Noise Guideline (DECC, 2009)	Yes	Section 9
Describe the measures to be implemented to manage high noise generating works such as piling, in close proximity to sensitive receivers	Yes	Section 10.2
Include strategies that have been developed with the community for managing high noise generating works	Yes	Section 10.6
Describe the community consultation undertaken to develop the strategies in condition B37(d)	Yes	Section 10.7
Include a complaints management system that would be implemented for the duration of the construction.	Yes	Section 10.7

2 REQUIREMENTS BY THE EXISTING CONSENT

Operation of Plant and Equipment

C3. All plant and equipment used on site, or to monitor the performance of the development must be:

a) maintained in a proper and efficient condition; and
b) operated in a proper and efficient manner.

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 5pm, Saturdays.
No work may be carried out on Sundays or public holidays.

C5: Activities may be undertaken outside of the hours in condition C4 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) where a variation is approved in advance in writing by the Planning Secretary or her nominee if appropriate justification is provided for the works.

C6: Notification of such activities must be given to affected residents before undertaking the activities or as soon as is practical afterwards.

C7: 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.

Construction Noise Limits

C15: The development must be constructed to achieve the construction noise management levels detailed in the Interim Construction Noise Guideline (DECC, 2009). All feasible and reasonable noise mitigation measures must be implemented and any activities that could exceed the construction noise management levels must be identified and managed in accordance with the management and mitigation measures identified in the approved Construction Noise and Vibration Management Plan.

C16: The Applicant must ensure construction vehicles (including concrete agitator trucks) do not arrive at the site or surrounding residential precincts outside of the construction hours of work outlined under condition C4.

C17: The Applicant must implement, where practicable and without compromising the safety of construction staff or members of the public, the use audible movement alarms of a type that would minimise noise impacts on surrounding noise sensitive receivers.

C18: Any noise generated during construction of the development must not be offensive noise within the meaning of the Protection of the Environment Operations Act 1997 or exceed approved noise limits for the site.

Vibration Criteria

C19: Vibration caused by construction at any residence or structure outside the site must be limited to:

a) for structural damage, the latest version of DIN 4150-3 (1992-02) Structural vibration - Effects of vibration on structures (German Institute for Standardisation, 1999); and
b) for human exposure, the acceptable vibration values set out in the Environmental Noise Management Assessing Vibration: a technical guideline (DEC, 2006) (as may be updated or replaced from time to time).

C20: Vibratory compactors must not be used closer than 30 metres from residential buildings unless vibration monitoring confirms compliance with the vibration criteria specified in condition C19.

C21: The limits in conditions C19 and C20 apply unless otherwise outlined in a Construction Noise and Vibration Management Plan, approved as part of the CEMP required by condition B37 of this consent.

3 NSW GOVERNMENT MEDIA RELEASE

NSW GOVERNMENT

Rob Stokes
Minister for Planning and Public Spaces

MEDIA RELEASE

Thursday, 2 April 2020

CONSTRUCTION HOURS EXTENDED TO SUPPORT INDUSTRY DURING COVID-19

Construction sites can now operate on weekends and public holidays under new rules introduced today by the NSW Government to support the industry during the COVID-19 pandemic.

Planning and Public Spaces Minister Rob Stokes said the move allows workers to abide by social distancing rules while keeping construction projects progressing by allowing building work to be spread across more days of the week.

"The construction and development sectors, which make up almost 10 per cent of NSW's economy, will be vital in keeping people in jobs and keeping investment flowing over the coming weeks and months," Mr Stokes said.

"We're doing what we can to support the industry in line with the current medical advice by extending weekday construction site operating hours to weekends and public holidays.

"The extended hours allow the industry to facilitate social distancing on contruction sites, while minimising the potential for lost productivity during the pandemic."

The *Environmental Planning and Assessment (COVID-19 Development – Construction Work Days) Order 2020* is now in place and will continue until the COVID-19 pandemic is over, or the advice of NSW Health changes.

"In NSW there are almost 400,000 people employed in the property and construction industry and we are committed to doing everything we can to keep each of them in work, but most importantly, to keep them safe and healthy," Mr Stokes said.

The *Environmental Planning and Assessment Act 1979* was amended on 24 March to enable Mr Stokes to issue orders that override normal planning controls during the COVID-19 pandemic to ensure the health, safety and welfare of communities.

Compliance with this Order will be monitored and reviewed if there any adverse impacts on the community or from a public health perspective.

3.1 RELEVANT CODES AND STANDARDS

In preparing this plan we have considering the following:

- [1] The Development Consent ref: SSD9113.
- [2] Randwick Campus Redevelopment, Noise and Vibration Impact Assessment for State Significant Development (SSD) – Acute Services Building, ref:20180808 AUR.0003. Rep, prepared by Acoustic Studio
- [3] Environmental Planning and Assessment (COVID-19 Development-Construction Work Days) Order 2020,
- [4] NSW Department of Environment and Climate Change (DECC) "Interim Construction Noise Guideline", 2009
- [5] NSW Department of Environment and Conservation (DEC) "Assessing Vibration: A Technical Guideline", 2006
- [6] Australian Standard "AS 2436: Guide to Noise Control on Construction, Maintenance & Demolition Sites", 1981
- [7] Australian Standard "AS 2670.2: Evaluation of human exposure to whole-body vibration – Part 2: Continuous and shock-induced vibration in buildings (1 to 80 Hz)", 1990
- [8] British Standards Institution "BS 6472 – Evaluation of human exposure to vibration in buildings (1 Hz to 80 Hz)", 1992
- [9] German Institution for Standardisation "DIN 4150.3: Structural vibration – Effects of vibration on structures", 1999

3.2 OTHER APPROVAL CONDITIONS RELATING TO CONSTRUCTION NOISE AND VIBRATION

The Approval also includes other conditions relating to construction noise and vibration, including plant condition, time restrictions and specific noise and vibration conditions:

Protection of Public and Private Property and Infrastructure

B6. Before the commencement of construction, the Applicant must:

a) consult with the relevant owner and provider of services that are likely to be affected by the development to make suitable arrangements for access to, diversion, protection and support of the affected infrastructure;
b) prepare a dilapidation report identifying the condition of all public infrastructure in the vicinity of the site (including roads, gutters and footpaths);
c) prepare a dilapidation report identifying the condition of all adjoining and nearby premises including the residences on the south side of Magill Street and the heritage item located at 4 Hay Street, Randwick;
d) prepare a report by a professional engineer detailing the proposed methods of excavation, shoring or pile construction, including details of potential vibration emissions, and demonstrating the suitability of the proposed methods of construction to overcome any potential damage to nearby premises including the residences on the south side of Magill Street and the heritage item at no.4 Hay Street, Randwick.
e) submit a copy of the dilapidation report and engineers report to the Certifying Authority and Council.

3.3 QUALIFIED PERSONS PREPARING THIS PLAN

Persons involved in preparation of this plan and their qualifications are in Table 2. Details of their experience is available on request.

Table 2 – Qualifications of Engineers

Person	Qualifications	Involvement in Plan
[redacted]		Project Director
[redacted]		Project Engineer

3.4 RESPONSIBILITIES

Health Infrastructure and Lendlease are responsible for implementation of this plan:

- Working in accordance with the requirements of this CNVMP.
- Ensuring that any complaints regarding noise and vibration are investigated and appropriately responded to in accordance with the recommendations provided in this document.
- Ensuring project personnel and sub-contractors employed are aware of their responsibilities in regard to the management of noise and vibration during construction and assume the responsibilities assigned to them within this Plan.
- Monitoring and managing noise and vibration impacts on receivers, in accordance with the requirements of the relevant guidelines and standards listed in Section 4.

- Consulting with the occupants of neighbouring premises and buildings to inform them of the nature of the work, to determine any specific noise and vibration sensitivity they may have and to negotiate respite times during noisier works.

4 PROPOSED WORK DURING THE EXTENDED HOURS

It is proposed that the following works occur during the specified hours;

- 6am to 7am – The material handling zone will be utilised which includes formwork deliveries, concrete deliveries, steel reinforcement deliveries, façade panel deliveries, fit out material deliveries. All of these will be unloaded by northern tower crane or forklift.
- 6pm to 10pm - The material handling zone will be utilised which includes formwork deliveries, concrete deliveries, steel reinforcement deliveries, façade panel deliveries, fit out material deliveries. All of these will be unloaded by either tower crane or forklift.

5 SUMMARY OF NOISE MANAGEMENT PROCEDURES

No blasting and no percussive (impact) piling

Construction for this project is typical of infrastructure building sites in the Sydney Urban area. There will be CFA piling but no percussive (impact) piling. There will be no unusual excavation works, such as blasting.

Limited equipment

- No concrete helicopter is allowed before 7am.
- No high noise activities such as rock hammering or piling is allowed before 7am or after 10pm.

Proper and efficient operation and maintenance of plant and equipment

Plant and equipment used on site, or to monitor the performance of the development must be:

a) maintained in a proper and efficient condition; and
b) operated in a proper and efficient manner.

Non-tonal Movement Alarms ("Reversing Beepers")

Where practicable and without compromising the safety of construction staff or members of the public, audible movement alarms on dedicated site plant and equipment will be of a type that will minimise noise impacts on surrounding noise sensitive receivers This could be achieved through the use of broadband alarms, reversing cameras, a combination of these, or a system of work that excludes personnel from the active work area and allows audible reversing alarms to not be used on the site.

Construction vehicles not to arrive outside approved construction hours

Construction vehicles, including concrete agitator trucks, are not to arrive at the site or surrounding residential precincts outside of the approved construction hours. Trucks importing and removing materials from the site will be road-registered vehicles which will travel to and from the site via specific routes, avoiding local roads. They will enter and leave the site in a forward direction, minimising the need for reversing alarms. Trucks will be loaded and unloaded within the site, which will minimise noise from truck loading and unloading.

Noise and Vibration Monitoring

Noise levels and vibration will be monitored at two locations, and the results used to guide management and mitigation of noise and vibration.

Vibratory compactors not to be used within 30 metres of residences.

Vibratory compactors must not be used closer than 30 metres from residential buildings before 7am or after 10pm unless vibration monitoring confirms compliance with vibration criteria.

Community to be kept informed

Neighbours are notified and informed at intervals of the project hours, duration and site management contact details.

Workers and drivers to minimise noise

Contractors and visitors to site are required to complete an induction. This includes training and regular tool box talks. These talks include, as relevant, providing awareness of this plan; the approved project hours; specific noise mitigation measures; being respectful and considerate of neighbours and minimising noise. Minimising noise includes trucks avoiding using exhaust braking when approaching the site, not using vehicle horns for signalling, keeping radio volumes to a reasonable level, and not shouting.

Site to be surrounded by solid hoarding

The site is surrounded by solid (plywood) hoarding, to a height of approximately 2 metres, other than for access gates and adjacent to the site offices. This hoarding provides noise barrier attenuation for the ground floors of surrounding buildings and is to be retained and maintained in good condition for the duration of construction.

Vehicles to access the site only via site gates

Construction vehicles are to access the site only via the site gates, two of which is on Botany Street, and another on Hospital Road (Gate 3).

6 OVERVIEW OF MAIN WORKS

Main works, which are the subject of this CNVMP includes:

- Bulk earthworks;
- Construction and operation of a 13 level Acute Services Building, including the following facilities: an emergency department; operating theatres; central sterilising service department; intensive care unit; patient units; and ambulance bays;
- Overhead pedestrian links to existing hospital buildings;
- Magill Street road works, Botany Street signalised intersection, internal roads and drop-off/pick up areas; and
- Utility, site infrastructure and landscaping works.

7 ENVIRONMENT SURROUNDING THE SITE

7.1 SITE DESCRIPTION

The site is located within an urban environment in Randwick, characterised by medium to high levels of activity throughout the day / evening and low levels of activity in the night.

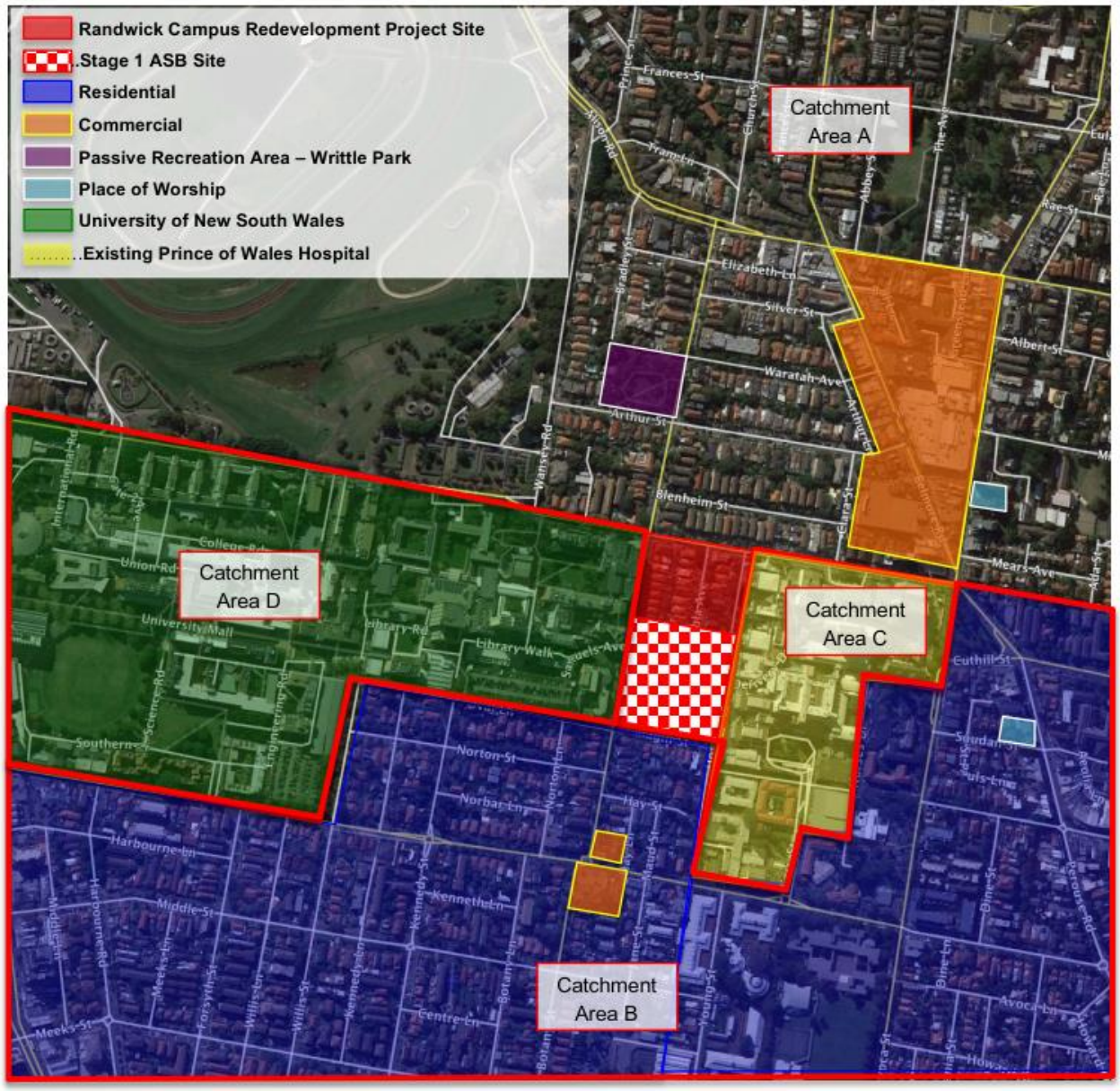


Figure 1: The Project site in relation to noise-sensitive receivers

The following land-uses surround the Project site:

- Catchment Area A
    - Residential dwellings to the north along High Street.
    - Commercial buildings to the northeast.
    - Writtle Park to the north.
    - Our Lady of the Sacred Heart Church to the northeast.
- Catchment Area B
    - Residential dwellings to the south and southwest.
    - Residential dwellings to the east and southeast adjacent to the POW Hospital.
    - Commercial buildings to the south.
    - Randwick Baptist Church to the east.
- Catchment Area C
    - POW Hospital to the east across Hospital Road. This receiver includes sensitive research laboratories and equipment as well as general hospital accommodation and administration activities.
- Catchment Area D
    - UNSW campus to the west. This receiver includes sensitive research laboratories and equipment as well as residential accommodation, learning, teaching and administration activities.

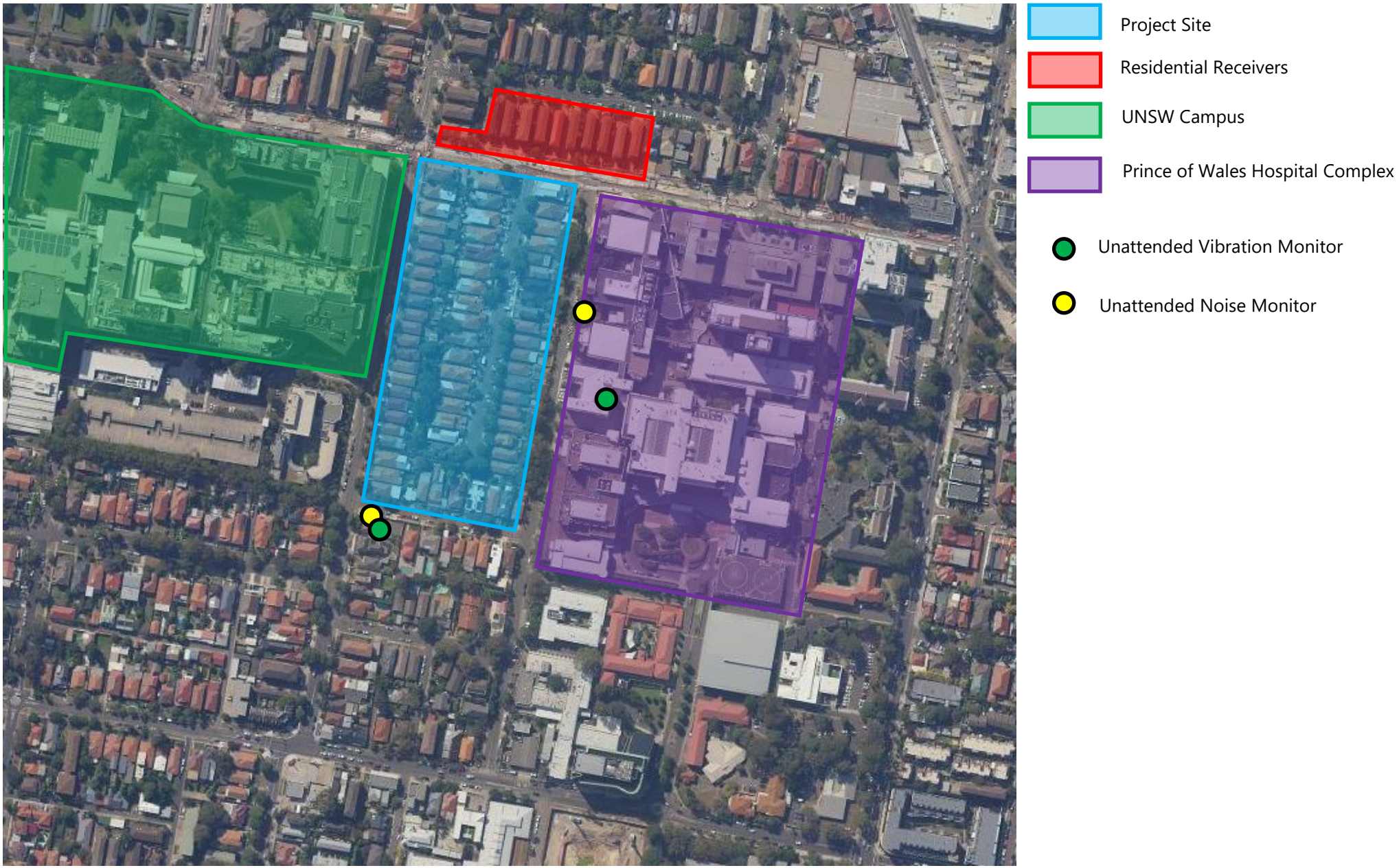
7.1.1 Nearest Noise and Vibration Sensitive Receivers

The nearest sensitive receivers to the Project site that will be potentially affected by noise and vibration are surrounding residential, educational, and hospital premises:

Site investigation indicates that the nearest noise/vibration receivers are below:

Receiver 1 – Randwick prince of Wales Hospital Complex located along the eastern boundary of the project site;
Receiver 2 – UNSW Building situated along the Western Boundary of the project site across Botany Street, Randwick.
Receiver 3 – Residential Dwellings situated along the Northern Boundary of the project site from 46 Botany Street to 18 High Street, Randwick.
Receiver 4 – Residential Dwellings situated along the Southern boundary of the project site from 103 Botany Street to 15 Magill Street, Randwick.

Buildings surrounding the site are set back various distances from their property boundaries but the distances above are from the receiver property boundary to the construction site property boundary.


Project Site
Residential Receivers
UNSW Campus
Prince of Wales Hospital Complex
Unattended Vibration Monitor
Unattended Noise Monitor

8 BACKGROUND NOISE LEVELS

Acoustic Logic Consultancies background noise logging has been used in conjunction with Acoustic Studio's background logging data to determine the rating background noise level for the project site and surrounding receivers.

Background Noise levels which will be used as a basis for this assessment are detailed below.

8.1 NOISE ENVIRONMENT

The pre-existing noise environment was measured during the SSD application stage and is documented in Section 4 of the EIS / SSD [2]. This has been used to establish the relevant construction noise criteria for the project.

8.2 MEASUREMENT EQUIPMENT

Unattended noise monitoring was conducting using one Acoustic Research Laboratories Pty Ltd noise logger. The logger was programmed to store 15-minute statistical noise levels throughout the monitoring period. The equipment was calibrated at the beginning and the end of each measurement using a Rion NC-73 calibrator; no significant drift was detected. All measurements were taken on A-weighted fast response mode.

8.3 MEASUREMENT LOCATION

An unattended noise monitor was installed on ground level along the southern boundary of the proposed project site at 103 Botany Street, Randwick.

8.4 MEASUREMENT PERIOD

Acoustic Logic Consultancy conducted unattended noise monitoring from Friday the 22nd of November to Friday the 4th of December 2019.

8.5 MEASURED BACKGROUND NOISE LEVELS

The background noise levels established from the unattended noise monitoring are detailed in the Table below.

NSW EPA's RBL assessment procedure requires determination of background noise level for each day (the ABL) then the median of the individual days as set out for the entire monitoring period.

This report provides detailed results of the unattended noise monitoring. Weather affected data was excluded from the assessment. The processed Rating Background Noise Levels (lowest 10th percentile noise levels during operation time period) are presented in Table below.

Unattended and attended noise measurements have been undertaken as per the procedures outlined in Fact Sheet A and B of the NSW EPA Noise Policy for Industry.

Weather affected data (rain fall and wind speeds above 5m/s) have been excluded from the assessment as per Fact Sheet A and B. Where interval periods (day, evening and night) have 18%, 13% and 11% respectively, these periods have been excluded from the assessment.

Table 3 – Unattended Noise Monitor – Logger Location 1 – Rating Background Noise Level

Date	dB(A)$L_{90(Period)}$ [1]		
	6am – 7am	**7am – 6pm**	**6pm – 10pm**
22nd November 2019	44	45	43
23rd November 2019	43	43	45
24th November 2019	46	52	48
25th November 2019	46	45	44
26th November 2019	43	46	42
27th November 2019	43	45	43
28th November 2019	43	46	44
29th November 2019	44	44	43
30th November 2019	45	44	47
1st December 2019	44	47	43
2nd December2019	45	46	44
3rd December 2019	55	50	48
4th December 2019	53	46	43
Median	**44**	**45**	**44**

Table Notes:

1. Periods marked "-" above did not collect the enough data to be considered valid as the monitor as either installed before, during or after the interval.

The following table provides a summary of the background noise data applicable for the subject site:

Table 4 – Summarised Background Noise Levels

Project Site	Monitor Location	Time Period	Acoustic Logic Measured Noise Data	Monitor Location	Acoustic Studio Measured Noise Data
Randwick Campus Redevelopment	103 Botany Street, Randwick	6am - 7am	44	7 Magill Street, Randwick	Day – 46
		7am – 6pm	45		Evening – 44
		6pm – 10pm	44		Night - 43

The lowest background noise level for each time period has been adopted in this report to setup noise emission management level, detailed adopted RBL have been summarised below:

Table 5 – RBL adopted for this assessment

Receiver	Time Period	Adopted RBL
Residential Boundary	6am – 7am	44
	6pm – 10pm	44

9 NOISE MANAGEMENT TRIGGER LEVEL

Noise emissions from the bulk earthworks, excavation and construction of should satisfy the following:

- Requirements of the SSD 9113 from the minister of planning and public spaces;
- NSW EPA Interim Construction Noise Guideline (ICNG) 2009; and
- Australian Standard AS2436:2010.

9.1 REQUIRMENTS BY NSW INTERIM CONSTRUCTION NOISE GUIDELINE

The NSW EPA Interim Construction Noise Guideline (ICNG) 2009 details specific construction noise and vibration management levels applicable to construction sites within NSW.

Where feasible and practical measures may be applied to the construction site is to endeavour to comply with the noise management levels outlined in the guideline. A summary of the code is detailed below.

9.1.1 NSW EPA Interim Construction Noise Guideline (ICNG) 2009

NSW EPA INCG adopts different management levels depending on the applicable receiver type, each is discussed below.

9.1.2 Residential Receivers

EPA guidelines adopt differing strategies for noise control depending on the predicted noise level at the nearest residences:

- "Noise affected" level. Where construction noise is predicted to exceed the "noise effected" level at a nearby residence, the proponent should take reasonable/feasible work practices to ensure compliance with the "noise effected level". For residential properties, the "noise effected" level occurs when construction noise exceeds ambient levels by more than:
    - 10dB(A)Leq(15min) for work during standard construction; and
    - 5dB(A)Leq(15min) for work outside standard construction hours.
- "Highly noise affected level". Where noise emissions are such that nearby properties are "highly noise effected", noise controls such as respite periods should be considered. For residential properties, the "highly noise effected" level occurs when construction noise exceeds 75dB(A)Leq(15min) at nearby residences. Highly noise affected level only applies during standard construction hours.

Table 6 – Construction Noise Management Level

Time Period	"Noise Affected" Level dB(A)$L_{eq(15\ minutes)}$
6am to 7am	49
6pm to 10pm	49

9.1.3 Other Sensitive

Other sensitive land uses, such as schools and hospitals typically consider noise from construction to be disruptive when the properties are being used. The table below presents management levels for noise at other sensitive land uses based on the principle that the characteristic activities for each of these land uses should not be unduly disturbed.

External noise levels are to be assessed at the most affected point within 50m of the area boundary. Where internal noise levels cannot be measured, external noise levels may be used. A conservative estimate of the difference between internal and external noise levels is 10 dB for buildings other than residences. Some buildings may achieve greater performance, such as where windows are fixed (that is, cannot be opened)

Table 7 – Noise at Sensitive Land Uses

Land Uses	Management Trigger Level $L_{Aeq(15min)}$
Hospital Wards and Operating Theatres	Internal noise level 45dB(A)

9.2 AUSTRALIAN STANDARD AS 2436:2010 "GUIDE TO NOISE CONTROL ON CONSTRUCTION, MAINTENANCE AND DEMOLITION SITES"

Australian Standard AS 2436 provides guidance on noise and vibration control in respect to construction and demolition sites, the preparation of noise and vibration management plans, work method statements and impact studies.

The standard states that:

- "Some construction and demolition activities are by their very nature noisy. The authorities responsible for setting noise level criteria for essential works will take note of the constraints imposed by such activities, especially when they are of short duration."
- Construction, demolition and maintenance works pose different problems of noise and vibration control when compared with most other types of industrial activity, since (a) they are mainly carried on in the open; (b) they are often temporary in nature although they may cause considerable disturbance whilst they last; (c) the noise and vibration arise from many different activities and kinds of plant, and their intensity and character may vary greatly during different phases of the work; and (d) the sites cannot be separated by planning controls, from areas that are sensitive to noise and vibration.

The standard provides advice and guidelines for the prediction of impacts and the methods available to manage impacts. The guideline promulgates feasible and reasonable mitigation strategies and controls, and stakeholder liaison, in the effort to reach a realistic compromise between site activities and impacts on neighbouring properties.

9.3 CONSTRUCTION TRAFFIC NOISE

The RNP provides criteria for traffic noise from new roads or additional traffic generated on roads from land use development. The criteria apply to additional traffic generated on public roads from construction vehicles / traffic.

When considering land use redevelopment and the impact on sensitive land uses (residential / schools / hospitals / recreational) the RNP guideline states that ". In assessing feasible and reasonable mitigation measures, an increase of up to 2 dB" in relation to existing noise levels "represents a minor impact that is considered barely perceptible to the average person.

9.4 SUMMARISED CONSTRUCTION NOISE MANAGEMENT TRIGGER LEVELS

Construction noise management levels applicable to the development have been determined based on the minimum background noise level recorded and the construction noise guidelines detailed in 7of this report. Construction noise management levels of the site are detailed in Table 4 below.

Table 8 – External Construction Noise Management Levels

Receiver	Category	Time of Day	Background Noise Level dB(A) $L_{90(Period)}$	Construction Noise Management Trigger Levels dB(A) $L_{eq(15\ Minute)}$
Receiver 3 and 4 (Residential)	Monday to Friday	6am to 7am (BG + 5)	44	49
		6pm to 10pm (BG + 10)	44	54
	Saturday	6am to 5pm (BG + 10)	44	54
	Sunday	No works on Sunday	-	-
Receiver 1, 2 (Other Sensitive Land Uses)	Monday – Sunday	Applies when properties are being used (Internal)	-	45 (internal)

10 VIBRATION CRITERIA

10.1 CONSTRUCTION VIBRATION

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, British Standard BS 6472 – 'Guide to Evaluate Human Exposure to Vibration Buildings (1Hz to 80Hz).
- For sensitive equipment.

The criteria and the application of this standard are discussed in separate sections below.

10.2 STRUCTURE DAMAGE CRITERIA

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 2.

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.

Table 9 – DIN 4150-3 (1999-02) Safe Limits for Building Vibration

Type of Structure		Peak Particle Velocity (mms^{-1})			
		At Foundation at a Frequency of			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 a preservation order)	3	3 to 8	8 to 10	8

10.3 HUMAN EXPOSURE TO VIBRATION

The British Standard BS 6472 – 'Guide to Evaluate Human Exposure to Vibration Buildings (1Hz to 80Hz) will be used to assess construction vibration for human comfort.

This guideline provides procedures for assessing tactile vibration and regenerated noise within potentially affected buildings. The recommendations of this guideline should be adopted to assess and manage vibration from the site. Where vibration exceeds, or is likely to exceed, the recommended levels then an assessment of reasonable and feasible methods for the management of vibration should be undertaken.

Table 10 – BS 6472 Vibration Criteria

		RMS acceleration (m/s^2)		RMS velocity (mm/s)		Peak velocity (mm/s)	
Place	**Time**	**Preferred**	**Maximum**	**Preferred**	**Maximum**	**Preferred**	**Maximum**
Continuous Vibration							
Residences	Daytime	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							
Residences	Daytime	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

Note 1: Continuous vibration relates to vibration that continues uninterrupted for a defined period (usually throughout the daytime or night-time), e.g. continuous construction or maintenance activity. (DECC, 2006)

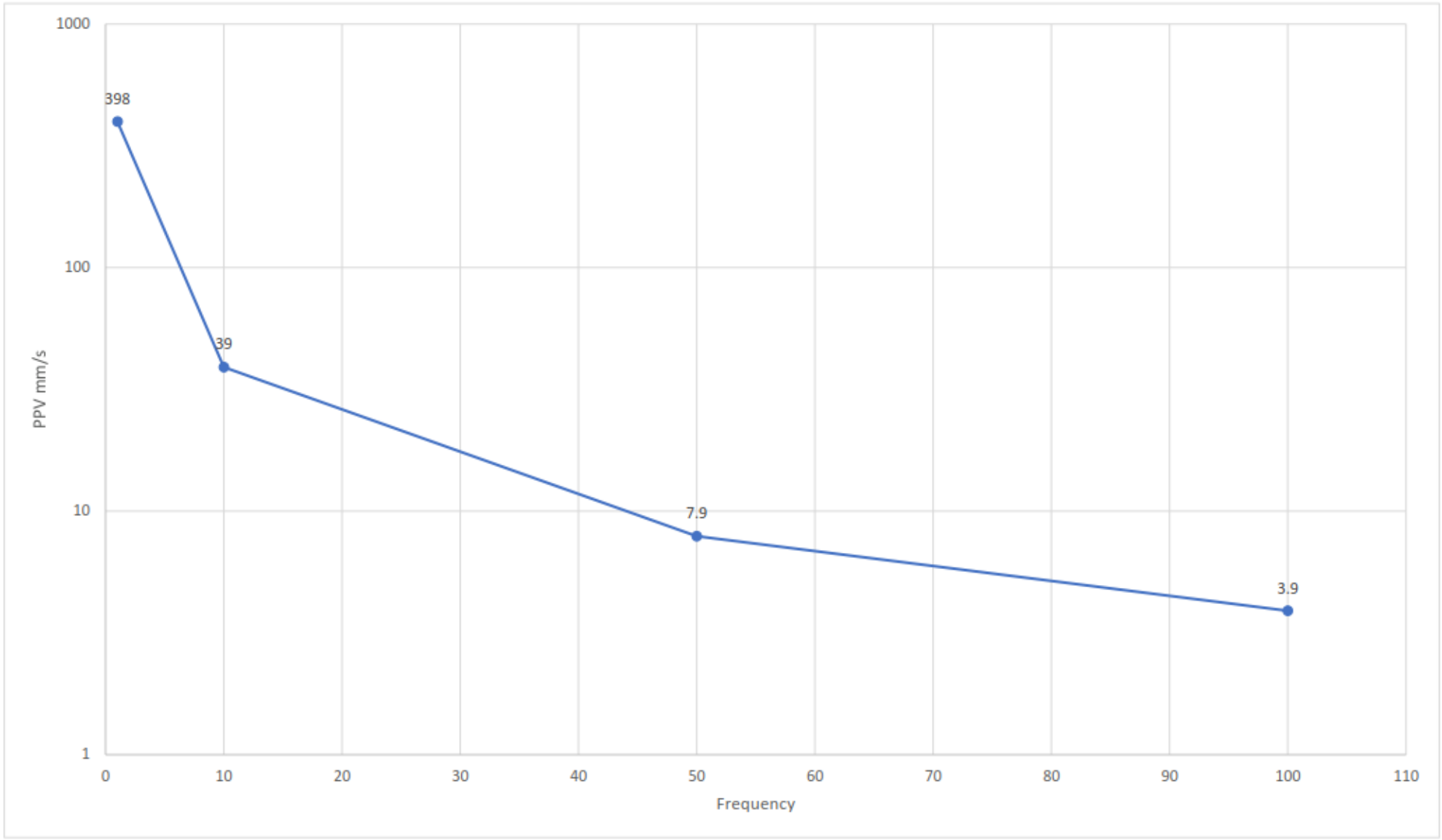
Note 2: Impulsive vibration relate to vibration that builds up rapidly to a peak followed by a damped decay and that may or may not involve several cycles of vibration (depending on frequency and damping), with up to three occurrences in an assessment period, e.g. occasional loading and unloading, or dropping of heavy equipment (DECC, 2006).

10.4 SENSITIVE EQUIPMENT VIBRATION CRITERIA

Acoustic Logic Consultancy have been advised that sensitive equipment is located within The Prince of Wales Hospital Foundation building with a nominated criterion of 2.5 m/s2. The corresponding Peak Particle Velocity has been calculated and is presented in the table and graph below.

Table 11 – Vibration Limit to Vibration Sensitive Machines

Sensitive Equipment	Peak Particle Velocity (mms-1)				
	At a Frequency of				Recommended Limit
	1Hz	10Hz	50Hz	100Hz	
	398	39	7.9	3.9	3.9


Sensitive Equipment Vibration Criteria PPV
1000
100
10
1
PPV mm/s
398
39
7.9
3.9
0
10
20
30
40
50
60
70
80
90
100
110
Frequency

11 MAIN WORKS NOISE AND VIBRATION ASSESSMENT

Potential sources of vibration and ground-borne noise during the Project works include:

- Construction and excavation plant including rock-breakers and jack hammers.
- Grinding, cutting and drilling of building structures.

Vibration and ground-borne noise impacts are likely to be highest during the excavation and piling work stages of the Project, when equipment such as rock breakers, jackhammers and piling rigs are used.

11.1 NOISE AND VIBRATION SOURCES

11.1.1 Construction Noise Assessment Methodology

A preliminary assessment of the likely noise impacts of the proposed works on the most-affected receivers surrounding the site was included in the project EIS <update for revised construction details>.

The assessment considered the following:

- Typical activities considered in the noise impact assessment are as detailed in Sections above.
- Noise management levels at sensitive receiver location as outlined in Section 11.
- Noise level predictions calculated using the noise data provided in section 11
- Noise level predictions considering distance attenuation only. This is appropriate because of the small distances between the site and surrounding receivers.
- The noise level predictions are based on assumptions that represent reasonable worst-case scenarios:
    - LAeq noise levels are predicted for the operations of the nearest works area on the site to each of the nearest sensitive receiver location.
    - The predictions consider a range from individual tasks and associated equipment up to the cumulative noise contribution from all key activities and corresponding equipment with plant running simultaneously for each phase and main task.
    - The predictions assume continuous operation of equipment / plant over the 15-minute assessment period, unless otherwise stated.

11.2 NOISE ASSESSMENT RESULTS

Noise from the worst-case construction works for each phase of the development have been predicted to the nearest most affected sensitive receivers. The predicted noise levels are presented in this section.

The following presents the predicted noise levels for each item of typically louder plant. Noise has been predicted to surrounding sensitive uses. The loudest typical appliances for each phase has been included and presented as a cumulative assessment.

The proposed construction works proposed for the site will include the following:

- Bulk Earthworks;
- Construction Phase.

The proposed works have been divided into a number of main work phase, along with the main noise producing equipment and activities likely to occur in each phase.

Table 12 – Excavation and Construction Activities

Construction Activity	Equipment	Sound Power Level dB(A)L_{max}
Bulk Excavation/Excavation Phase	Excavator Hydraulic Hammer	120
	Excavator Bucket	110
	Saw Rock Cutting	105
	CFA Piling	105
General Construction Works	Trucks	105
	Concrete Pumps	110
	Crane	105
	Concreting Helicopter	105
	Powered Hand Tools	94

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

1. Table D2 of Australian Standard 2436-1981;
2. Data held by this office from other similar studies.
3. Noise from the worst-case construction works for each phase of the development predicted to the nearest most affected sensitive receiver.

11.3 SOUND PLAN MODELLING

Noise monitoring has been undertaken for the proposed construction work to the buildings surrounding the site.

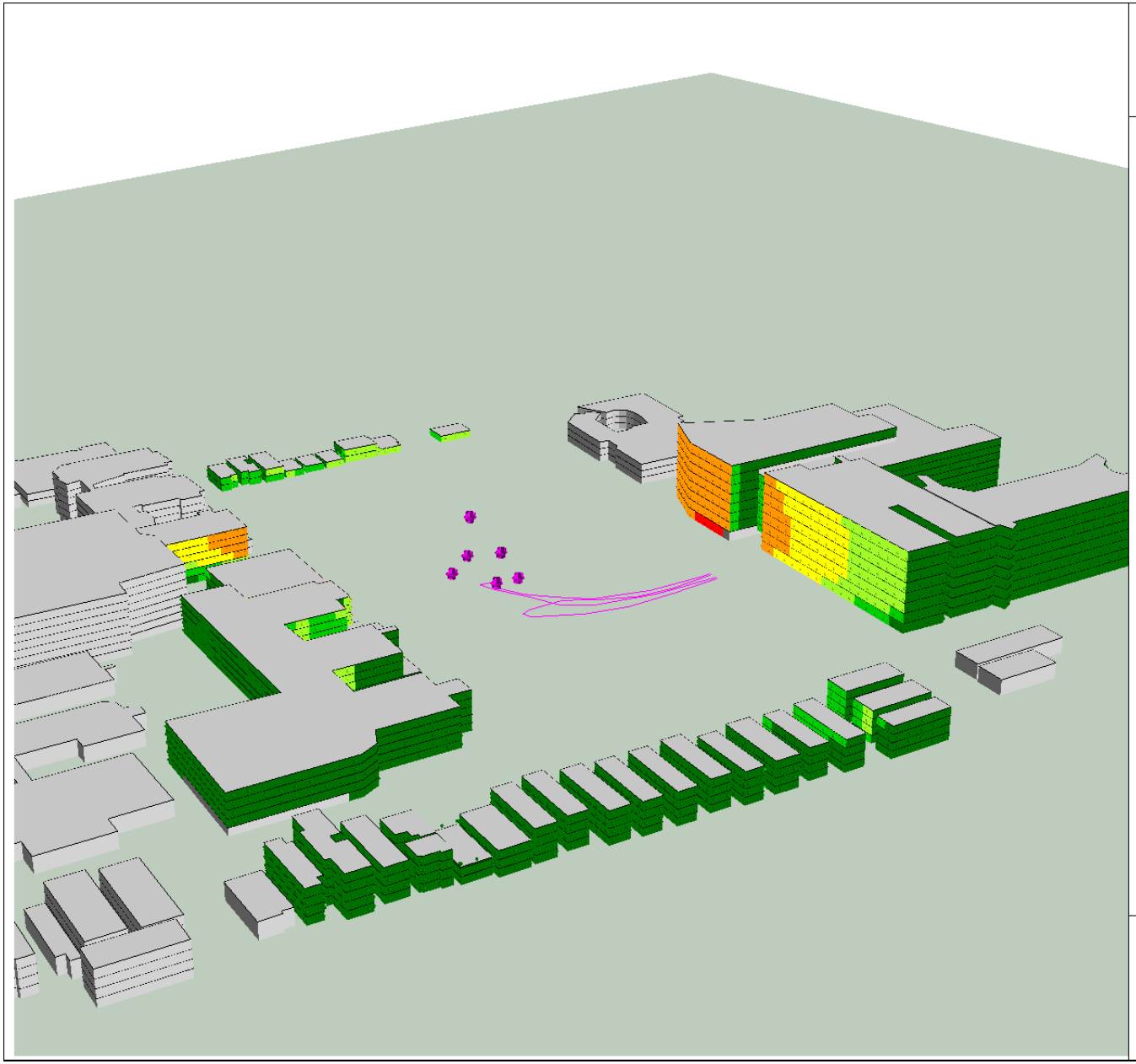
The noise sources are:

Table 13 – Noise Source Data

Time Period	Major Equipment	Sound Power Level dB(A)
6am to 7am	Concrete Pump	110
	North Crane	105
	2 Trucks	105 each
	4 Power Hand Tool	94 each
6pm to 10pm	1 Excavator with Hydraulic Hammer	120
	1 Excavator with Bucket	110
	1 Concrete pump	110
	2 Crane	105 each
	2 Concrete Helicopter	105 each
	1 Truck Engine	105
	1 Saw Rock Cutting	105
	1 CFA Piling	105
	4 Powered Hand Tools	94 each

A noise map has been prepared using SoundPlan™ modelling software implementing the ISO 9613-2:1996 *"Acoustics – Attenuation of Sound During Propagation Outdoors – Part 2: General Method of Calculation"* noise propagation standard.

Please see the figures below for further detail.



Randwick Campus Redevelopment

6am - 7am Construction Noise Prediction

1xConcrete Pump - 110dB(A) SWL
1xCrane (North Only) - 105dB(A) SWL
2xConcreting Helicopter - 105dB(A) SWL
2xTruck Engine @ 10km/h - 105dB(A) SWL
4xPowered Hand Tools - 94dB(A) SWL

Prepared by: S. Giannikopoulos
Date: 16/04/2020

Noise Level L_{eq}
in dB(A)

< 57
57 - 59
59 - 61
61 - 63
63 - 65
65 - 67
67 - 69
69 - 71
71 - 73
73 - 75
75 - 77
>= 77

Signs and symbols

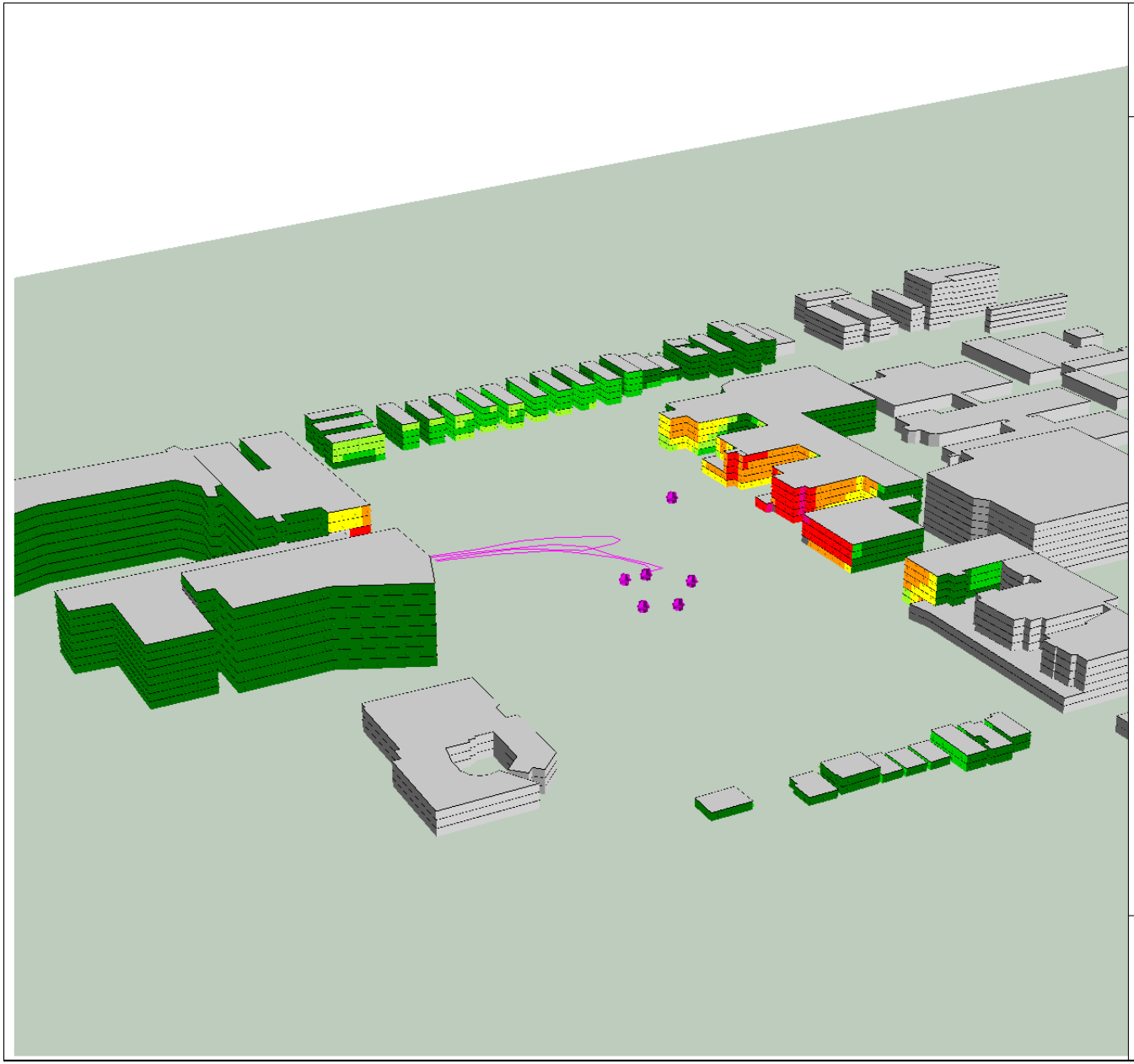
- Surface
- Receiver
- Point source

Facade Noise Map

- Facade point
- Line source

Length scale 1:5796
0 30 60 120 180 240 m

ACOUSTIC LOGIC



Randwick Campus Redevelopment

6am - 7am Construction Noise Prediction

1xConcrete Pump - 110dB(A) SWL
1xCrane (North Only) - 105dB(A) SWL
2xConcreting Helicopter - 105dB(A) SWL
2xTruck Engine @ 10km/h - 105dB(A) SWL
4xPowered Hand Tools - 94dB(A) SWL

Prepared by: S. Giannikopoulos
Date: 16/04/2020

Noise Level L_{eq}
in dB(A)

< 57
57 - 59
59 - 61
61 - 63
63 - 65
65 - 67
67 - 69
69 - 71
71 - 73
73 - 75
75 - 77
>= 77

Signs and symbols

- Surface
- Receiver
- Point source

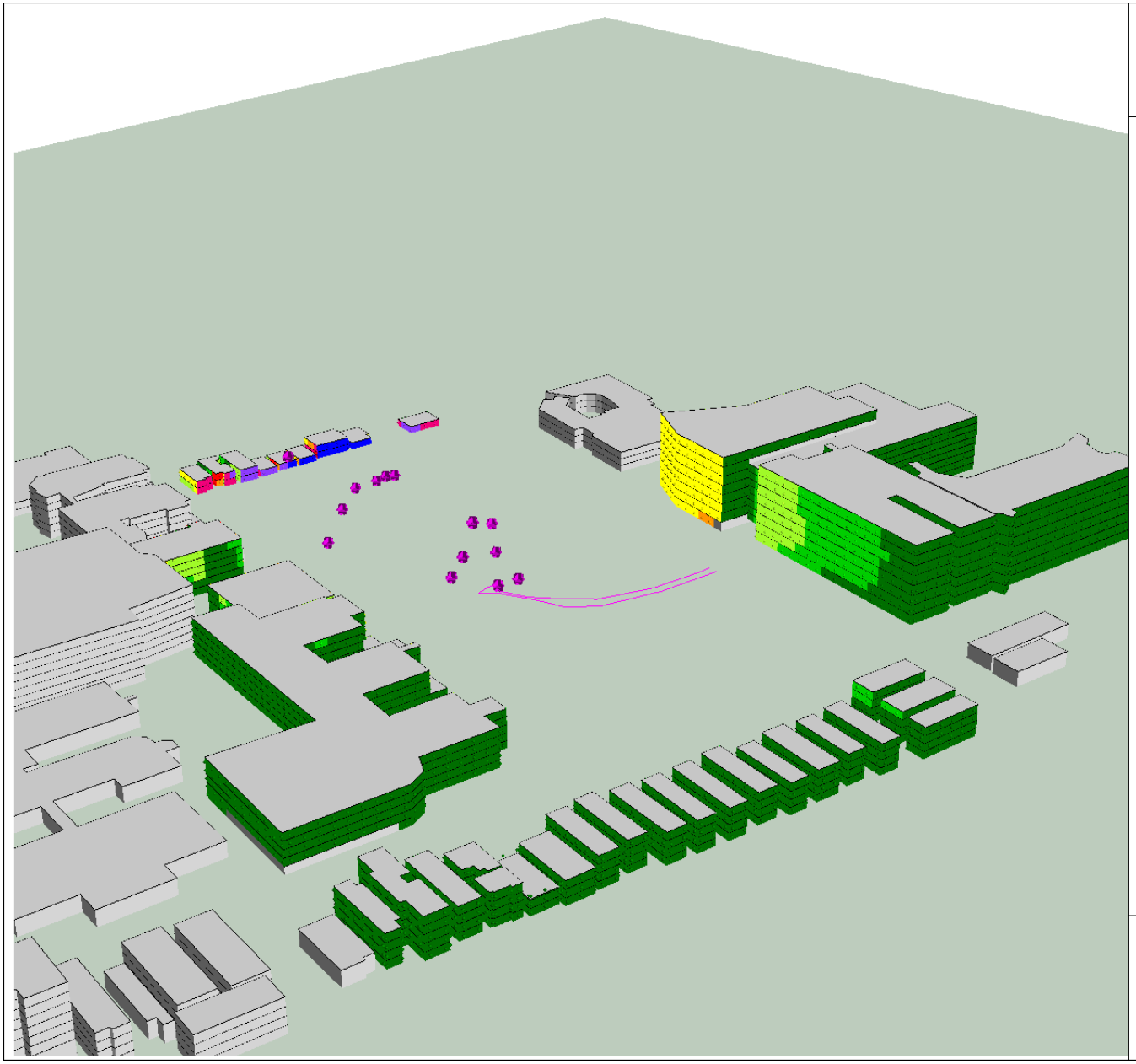
Facade Noise Map

- Facade point
- Line source

Length scale 1:5796

0 30 60 120 180 240 m

ACOUSTIC LOGIC



Randwick Campus Redevelopment

7am - 10pm Construction Noise Prediction

1xExcavator Hydraulic Hammer	- 120dB(A) SWL
1xExcavator Bucket	- 110dB(A) SWL
1xConcrete Pump	- 110dB(A) SWL
2xCrane (North & South)	- 105dB(A) SWL
2xConcreting Helicopter	- 105dB(A) SWL
1xTruck Engine @ 10km/h	- 105dB(A) SWL
1x Saw Rock Cutting	- 105dB(A) SWL
1xCFA Piling	- 105dB(A) SWL
4xPowered Hand Tools	- 94dB(A) SWL

Prepared by: S. Giannikopoulos
Date: 16/04/2020

Noise Level L_{eq}
in dB(A)

- < 65
- 65 - 67
- 67 - 69
- 69 - 71
- 71 - 73
- 73 - 75
- 75 - 77
- 77 - 79
- 79 - 81
- 81 - 83
- 83 - 85
- >= 85

Signs and symbols

- Surface
- Receiver
- Point source

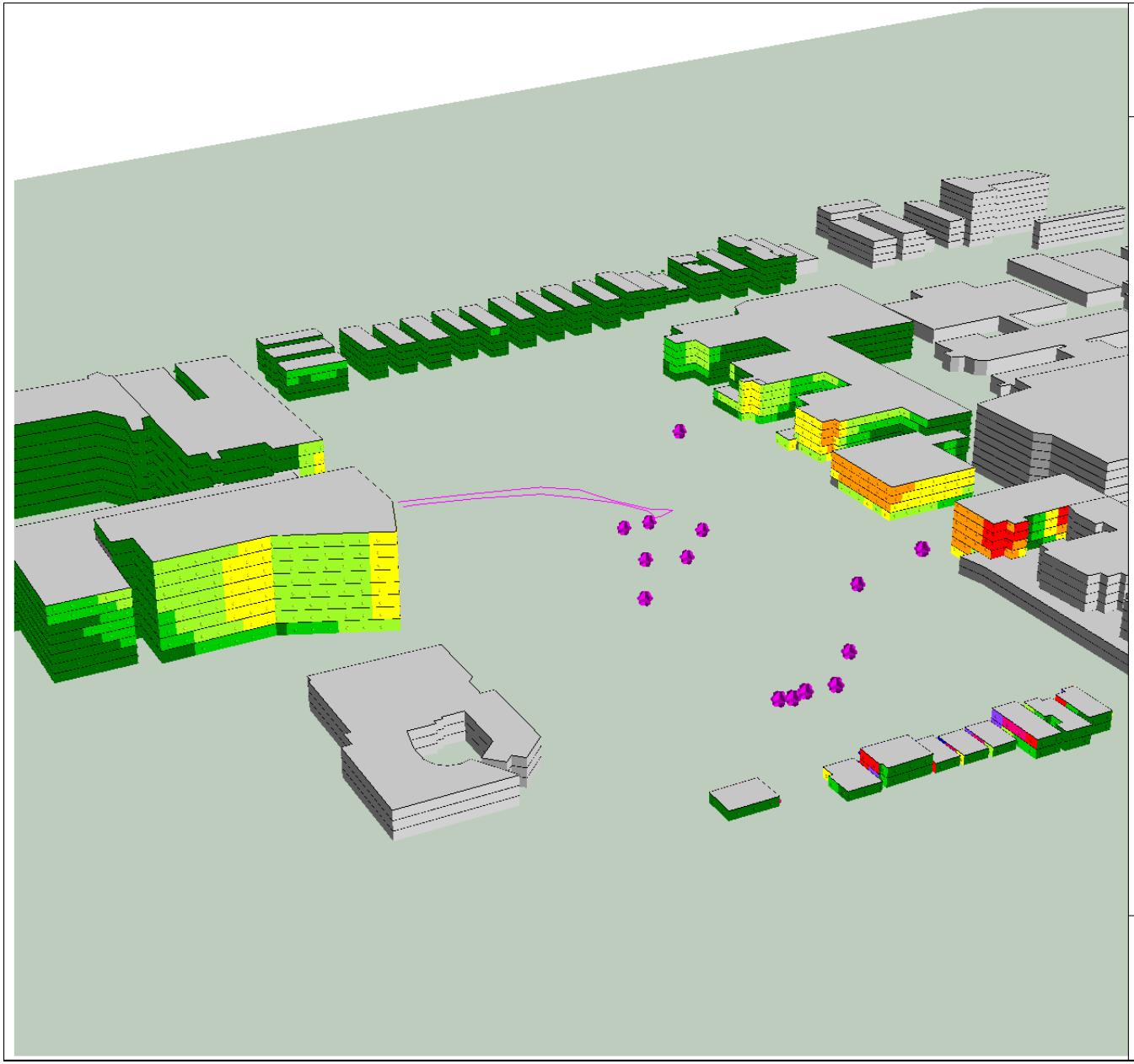
Facade Noise Map

- Facade point
- Line source

Length scale 1:5796

0 30 60 120 180 240 m

ACOUSTIC LOGIC



Randwick Campus Redevelopment

7am - 10pm Construction Noise Prediction

1xExcavator Hydraulic Hammer	- 120dB(A) SWL
1xExcavator Bucket	- 110dB(A) SWL
1xConcrete Pump	- 110dB(A) SWL
2xCrane (North & South)	- 105dB(A) SWL
2xConcreting Helicopter	- 105dB(A) SWL
1xTruck Engine @ 10km/h	- 105dB(A) SWL
1x Saw Rock Cutting	- 105dB(A) SWL
1xCFA Piling	- 105dB(A) SWL
4xPowered Hand Tools	- 94dB(A) SWL

Prepared by: S. Giannikopoulos
Date: 16/04/2020

Noise Level L_{eq} in dB(A)

- < 65
- 65 - 67
- 67 - 69
- 69 - 71
- 71 - 73
- 73 - 75
- 75 - 77
- 77 - 79
- 79 - 81
- 81 - 83
- 83 - 85
- >= 85

Signs and symbols

- Surface
- Receiver
- Point source

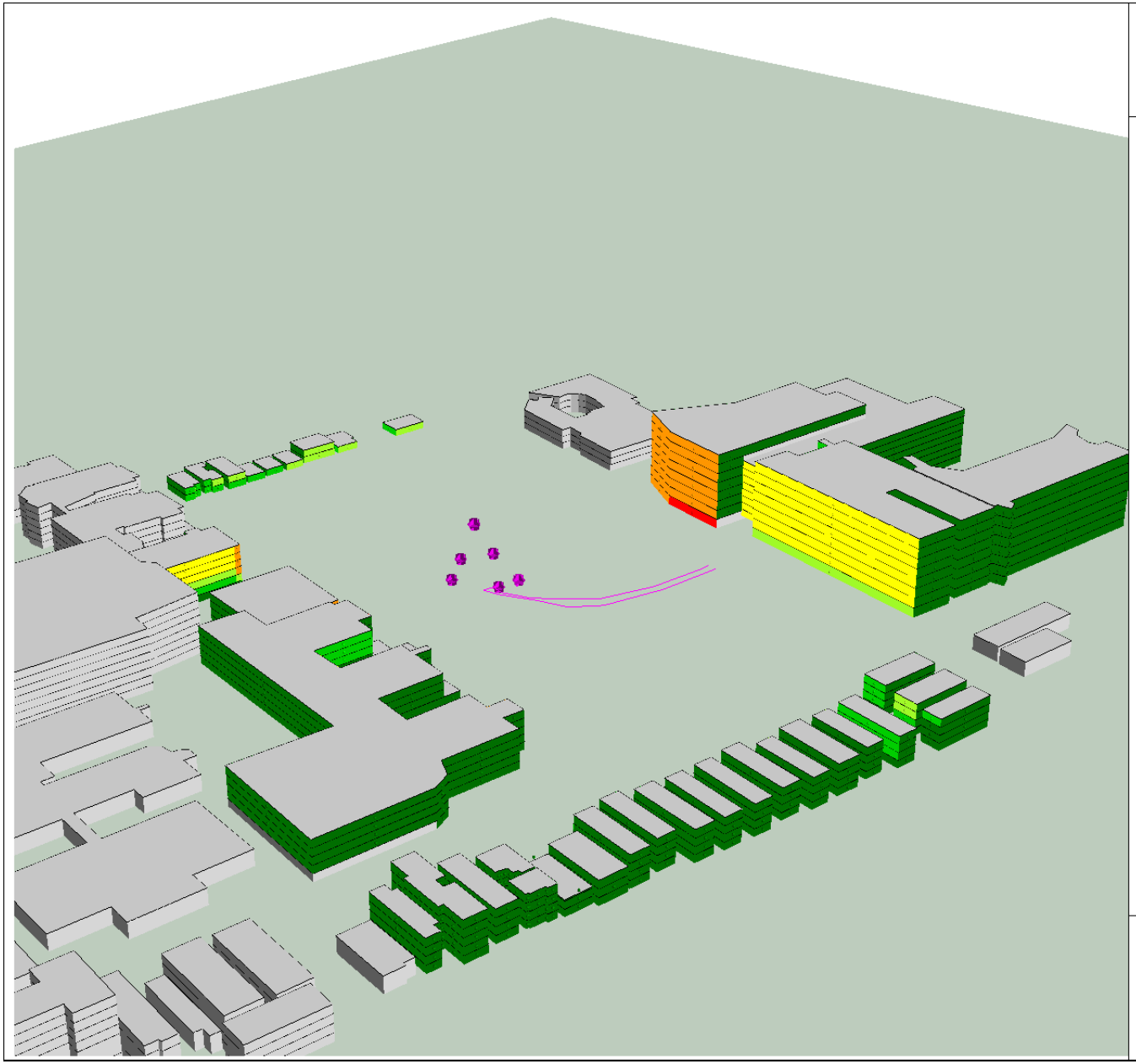
Facade Noise Map

- Facade point
- Line source

Length scale 1:5796

0 30 60 120 180 240 m

ACOUSTIC LOGIC



Randwick Campus Redevelopment

10pm - 1am Construction Noise Prediction

1xConcrete Pump - 110dB(A) SWL
1xCrane (North Only) - 105dB(A) SWL
2xConcreting Helicopter - 105dB(A) SWL
1xTruck Engine @ 10km/h - 105dB(A) SWL
4xPowered Hand Tools - 94dB(A) SWL

Prepared by: S. Giannikopoulos
Date: 16/04/2020

Noise Level L_{eq}
in dB(A)

< 57
57 - 59
59 - 61
61 - 63
63 - 65
65 - 67
67 - 69
69 - 71
71 - 73
73 - 75
75 - 77
>= 77

Signs and symbols

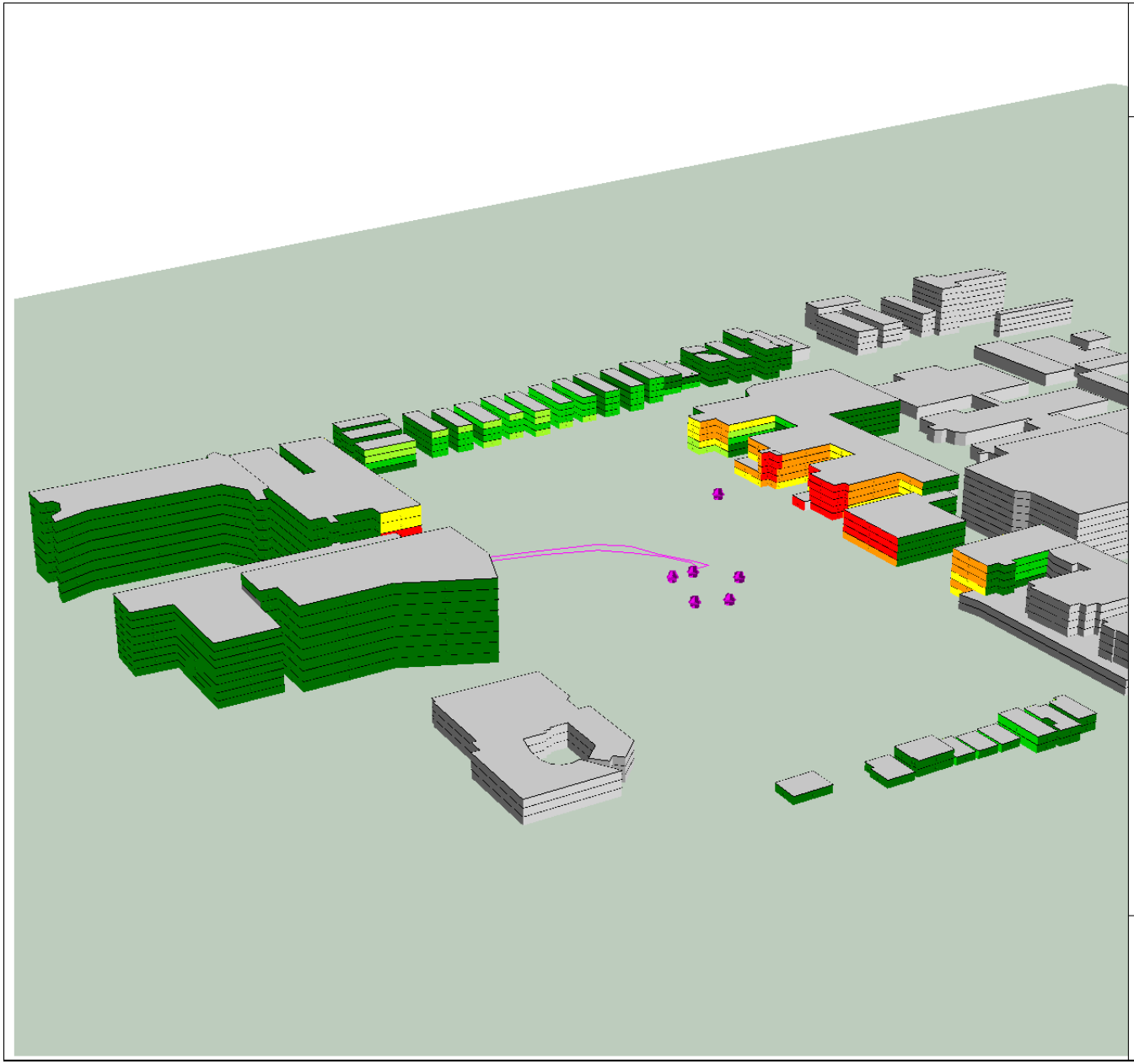
Surface
Receiver
Point source

Facade Noise Map

Facade point
Line source

Length scale 1:5796
0 30 60 120 180 240 m

ACOUSTIC LOGIC



Randwick Campus Redevelopment

10pm - 1am Construction Noise Prediction

1xConcrete Pump - 110dB(A) SWL
1xCrane (North Only) - 105dB(A) SWL
2xConcreting Helicopter - 105dB(A) SWL
1xTruck Engine @ 10km/h - 105dB(A) SWL
4xPowered Hand Tools - 94dB(A) SWL

Prepared by: S. Giannikopoulos
Date: 16/04/2020

Noise Level L_{eq}
in dB(A)

< 57
57 - 59
59 - 61
61 - 63
63 - 65
65 - 67
67 - 69
69 - 71
71 - 73
73 - 75
75 - 77
>= 77

Signs and symbols

- Surface
- Receiver
- Point source

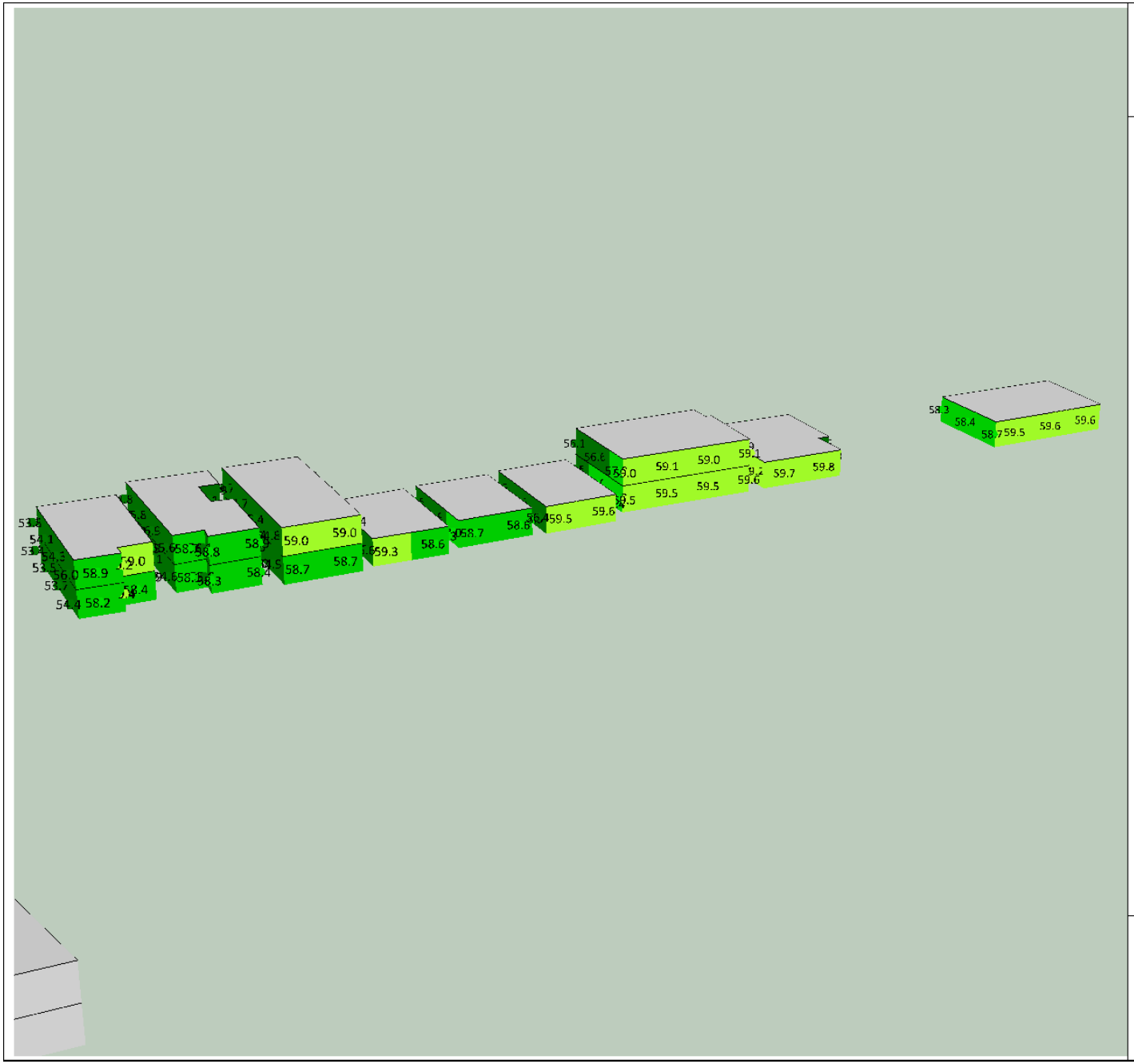
Facade Noise Map

- Facade point
- Line source

Length scale 1:5796

0 30 60 120 180 240 m

ACOUSTIC LOGIC



Randwick Campus Redevelopment

6am - 7am Construction Noise Prediction

1xConcrete Pump - 110dB(A) SWL
1xCrane (North Only) - 105dB(A) SWL
2xConcreting Helicopter - 105dB(A) SWL
2xTruck Engine @ 10km/h - 105dB(A) SWL
4xPowered Hand Tools - 94dB(A) SWL

Prepared by: S. Giannikopoulos
Date: 16/04/2020

Noise Level
L_{eq}
in dB(A)

< 57
57 - 59
59 - 61
61 - 63
63 - 65
65 - 67
67 - 69
69 - 71
71 - 73
73 - 75
75 - 77
>=77

Signs and symbols

- Surface
- Receiver
- Point source

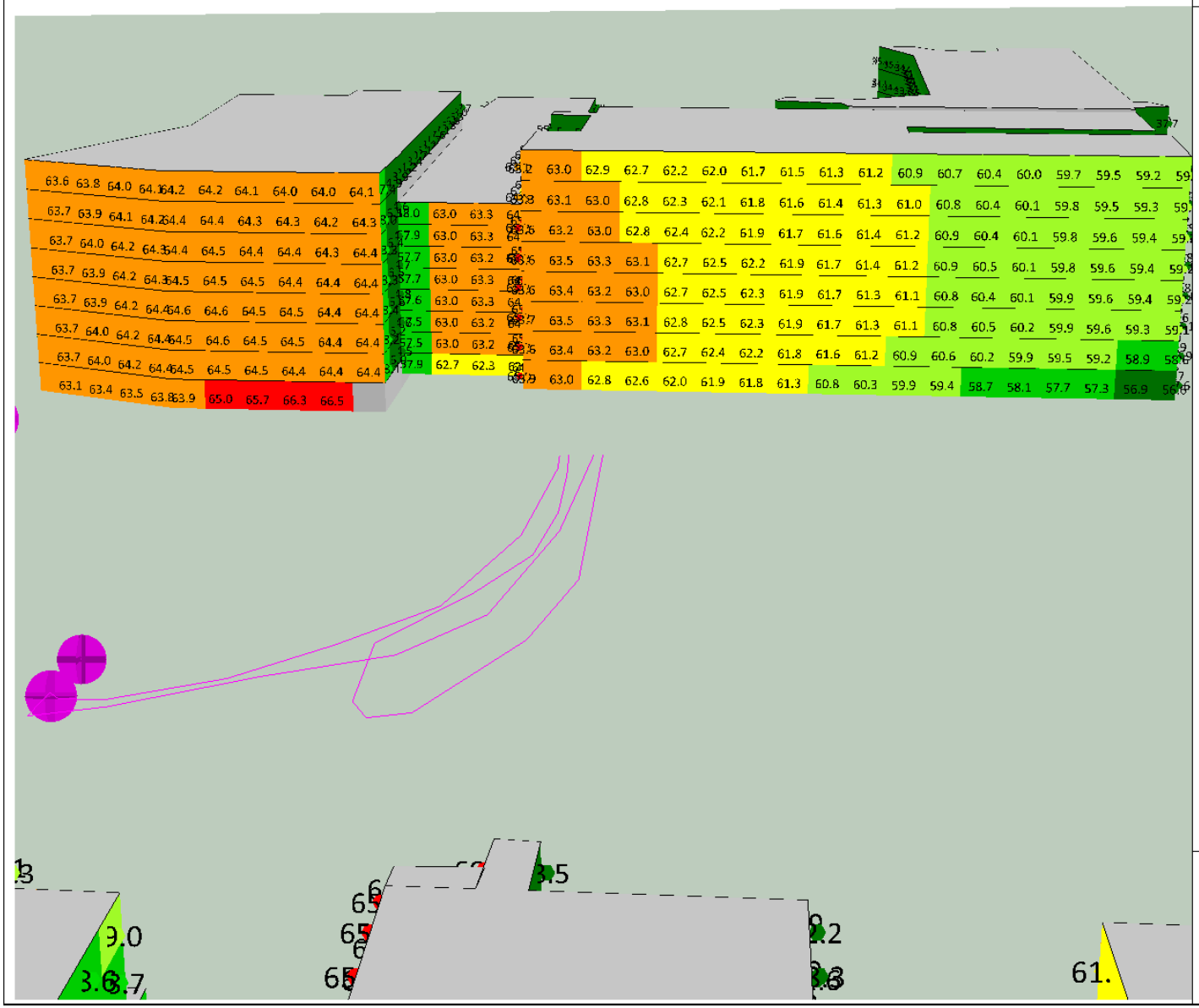
Facade Noise Map

- Facade point
- Line source

Length scale 1:5796
0 30 60 120 180 240 m

ACOUSTIC LOGIC

Randwick Campus Redevelopment



6am - 7am Construction Noise Prediction

1xConcrete Pump - 110dB(A) SWL
1xCrane (North Only) - 105dB(A) SWL
2xConcreting Helicopter - 105dB(A) SWL
2xTruck Engine @ 10km/h - 105dB(A) SWL
4xPowered Hand Tools - 94dB(A) SWL

Prepared by: S. Giannikopoulos
Date: 16/04/2020

Noise Level
L_{eq}
in dB(A)

< 57
57 - 59
59 - 61
61 - 63
63 - 65
65 - 67
67 - 69
69 - 71
71 - 73
73 - 75
75 - 77
>=77

Signs and symbols

- Surface
- Receiver
- Point source

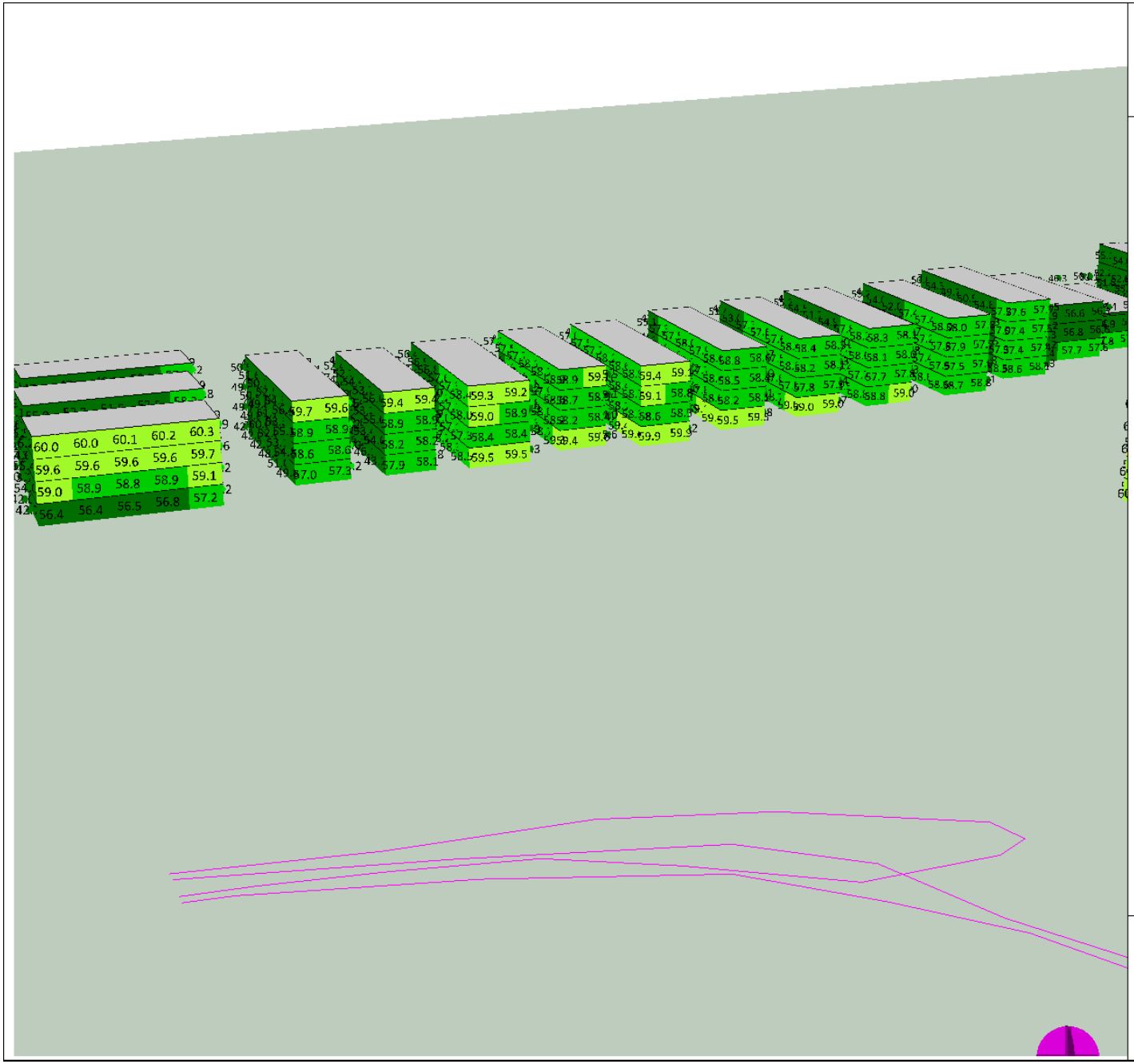
Facade Noise Map

- Facade point
- Line source

Length scale 1:5796

0 30 60 120 180 240 m

ACOUSTIC LOGIC



Randwick Campus Redevelopment

6am - 7am Construction Noise Prediction

1xConcrete Pump - 110dB(A) SWL
1xCrane (North Only) - 105dB(A) SWL
2xConcreting Helicopter - 105dB(A) SWL
2xTruck Engine @ 10km/h - 105dB(A) SWL
4xPowered Hand Tools - 94dB(A) SWL

Prepared by: S. Giannikopoulos
Date: 16/04/2020

Noise Level L_{eq}
in dB(A)

< 57
57 - 59
59 - 61
61 - 63
63 - 65
65 - 67
67 - 69
69 - 71
71 - 73
73 - 75
75 - 77
>=77

Signs and symbols

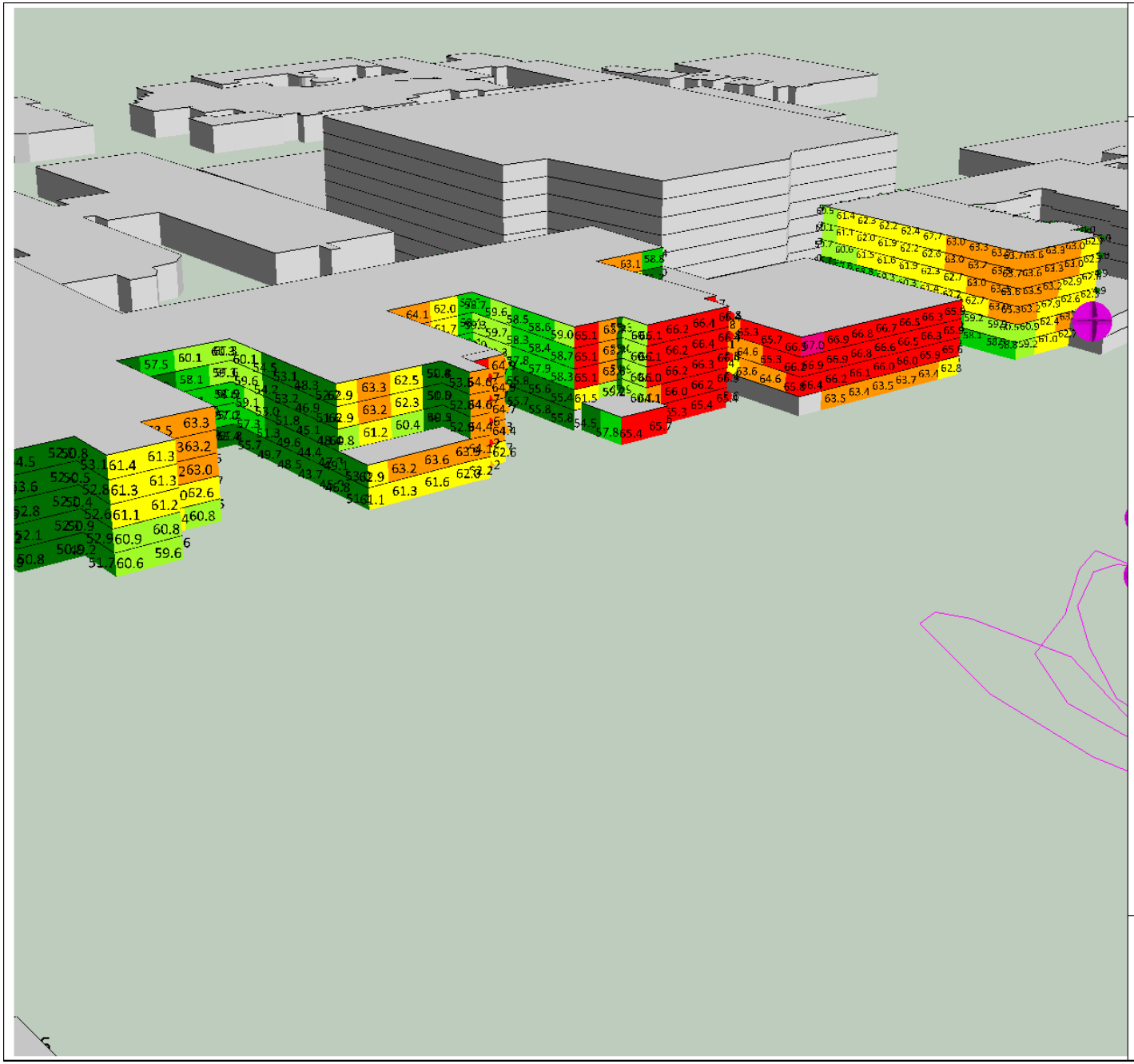
- Surface
- Receiver
- Point source

Facade Noise Map

- Facade point
- Line source

Length scale 1:5796
0 30 60 120 180 240 m

ACOUSTIC LOGIC



Randwick Campus Redevelopment

6am - 7am Construction Noise Prediction

1xConcrete Pump - 110dB(A) SWL
1xCrane (North Only) - 105dB(A) SWL
2xConcreting Helicopter - 105dB(A) SWL
2xTruck Engine @ 10km/h - 105dB(A) SWL
4xPowered Hand Tools - 94dB(A) SWL

Prepared by: S. Giannikopoulos
Date: 16/04/2020

Noise Level
L_{eq}
in dB(A)

< 57
57 - 59
59 - 61
61 - 63
63 - 65
65 - 67
67 - 69
69 - 71
71 - 73
73 - 75
75 - 77
>=77

Signs and symbols

- Surface
- Receiver
- Point source

Facade Noise Map

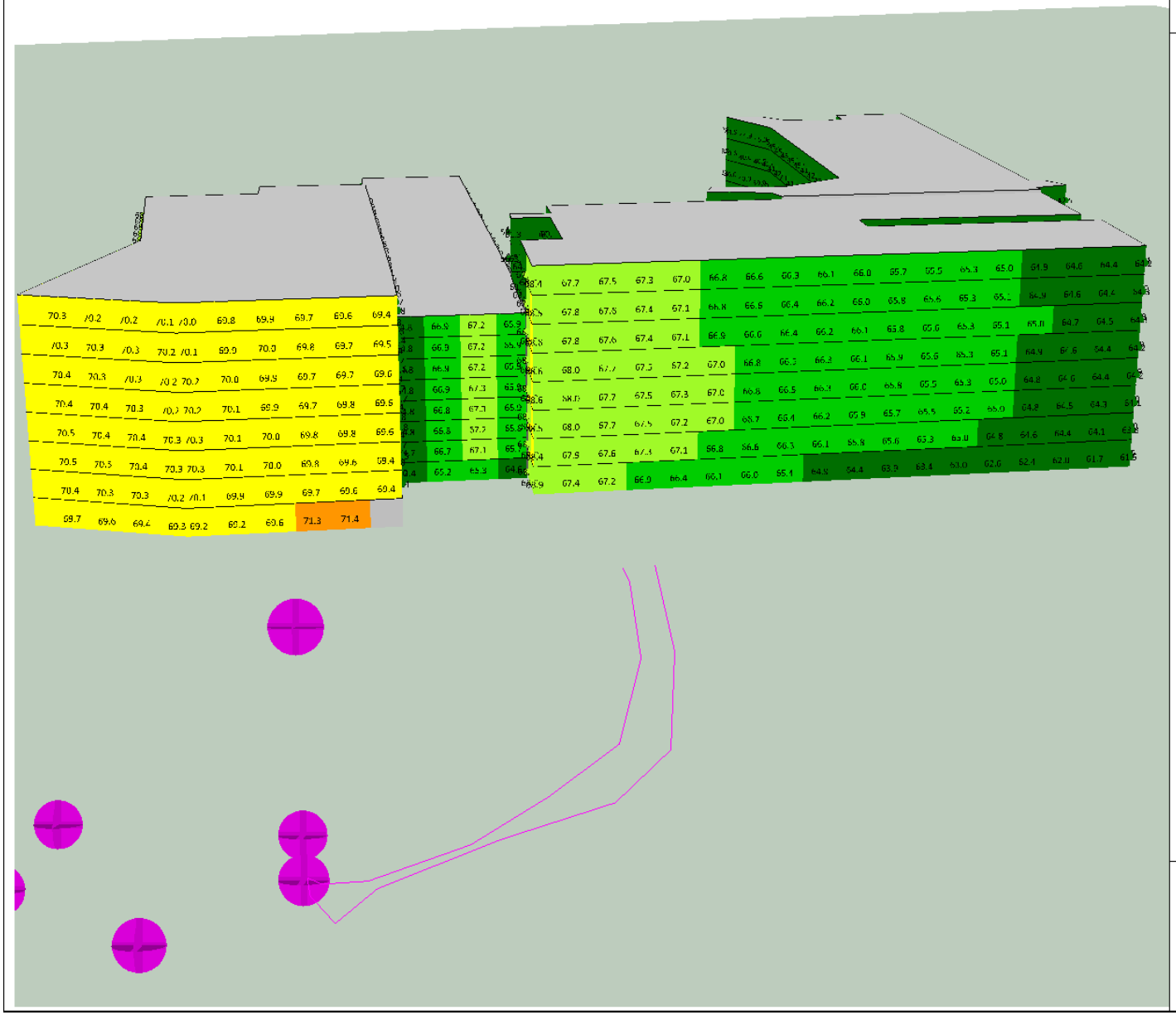
- Facade point
- Line source

Length scale 1:5796

0 30 60 120 180 240 m

ACOUSTIC LOGIC

Randwick Campus Redevelopment



7am - 10pm Construction Noise Prediction

1xExcavator Hydraulic Hammer	- 120dB(A) SWL
1xExcavator Bucket	- 110dB(A) SWL
1xConcrete Pump	- 110dB(A) SWL
2xCrane (North & South)	- 105dB(A) SWL
2xConcreting Helicopter	- 105dB(A) SWL
1xTruck Engine @ 10km/h	- 105dB(A) SWL
1x Saw Rock Cutting	- 105dB(A) SWL
1xCFA Piling	- 105dB(A) SWL
4xPowered Hand Tools	- 94dB(A) SWL

Prepared by: S. Giannikopoulos
Date: 16/04/2020

Noise Level
L_{eq}
in dB(A)

- < 65
- 65 - 67
- 67 - 69
- 69 - 71
- 71 - 73
- 73 - 75
- 75 - 77
- 77 - 79
- 79 - 81
- 81 - 83
- 83 - 85
- >= 85

Signs and symbols

- Surface
- Receiver
- Point source

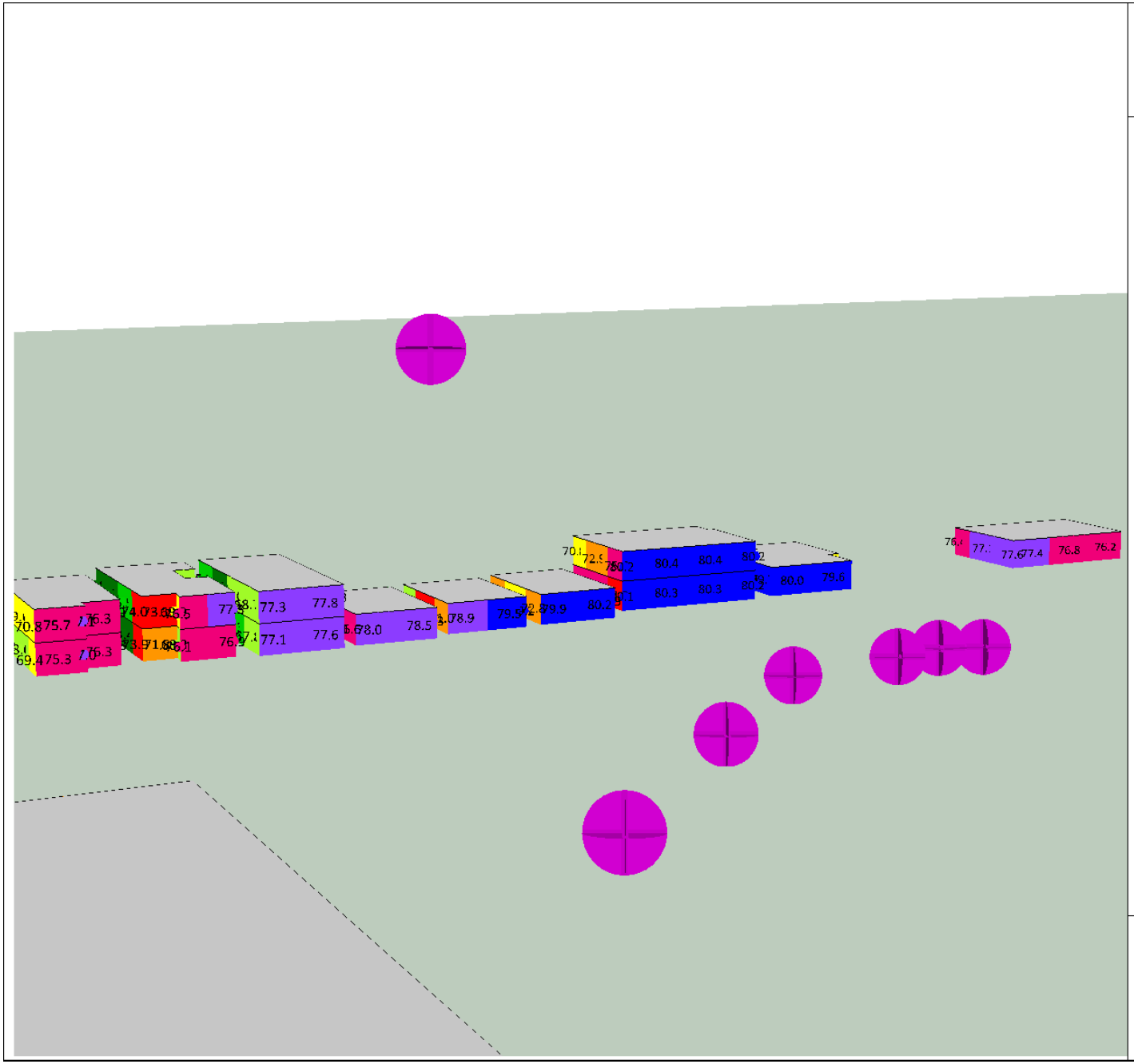
Facade Noise Map

- Facade point
- Line source

Length scale 1:5796

0 30 60 120 180 240 m

ACOUSTIC LOGIC



Randwick Campus Redevelopment

7am - 10pm Construction Noise Prediction

1xExcavator Hydraulic Hammer	- 120dB(A) SWL
1xExcavator Bucket	- 110dB(A) SWL
1xConcrete Pump	- 110dB(A) SWL
2xCrane (North & South)	- 105dB(A) SWL
2xConcreting Helicopter	- 105dB(A) SWL
1xTruck Engine @ 10km/h	- 105dB(A) SWL
1x Saw Rock Cutting	- 105dB(A) SWL
1xCFA Piling	- 105dB(A) SWL
4xPowered Hand Tools	- 94dB(A) SWL

Prepared by: S. Giannikopoulos
Date: 16/04/2020

Noise Level L_{eq} in dB(A)

- < 65
- 65 - 67
- 67 - 69
- 69 - 71
- 71 - 73
- 73 - 75
- 75 - 77
- 77 - 79
- 79 - 81
- 81 - 83
- 83 - 85
- >= 85

Signs and symbols

- Surface
- Receiver
- Point source

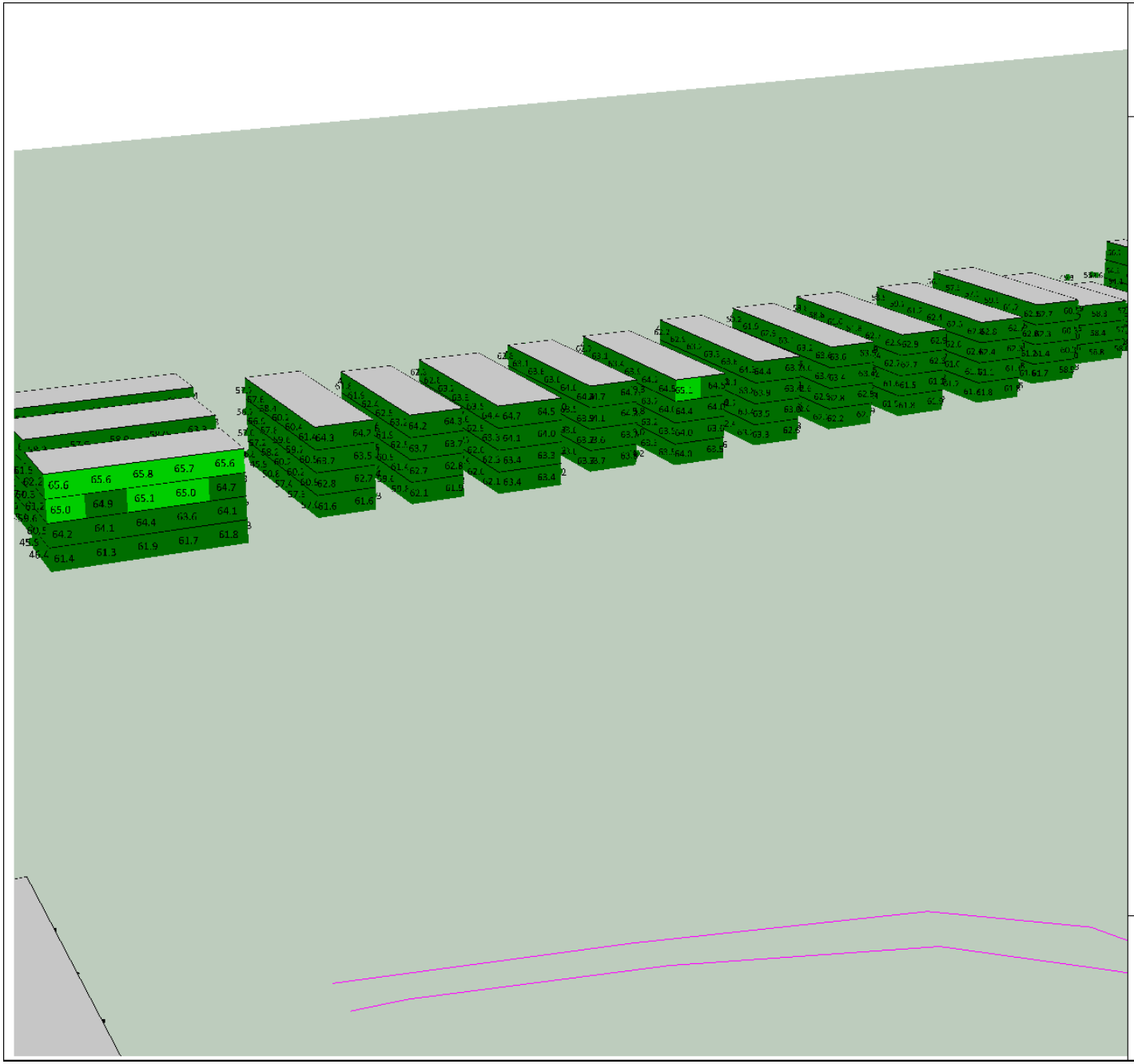
Facade Noise Map

- Facade point
- Line source

Length scale 1:5796

0 30 60 120 180 240 m

ACOUSTIC LOGIC



Randwick Campus Redevelopment

7am - 10pm Construction Noise Prediction

1xExcavator Hydraulic Hammer	- 120dB(A) SWL
1xExcavator Bucket	- 110dB(A) SWL
1xConcrete Pump	- 110dB(A) SWL
2xCrane (North & South)	- 105dB(A) SWL
2xConcreting Helicopter	- 105dB(A) SWL
1xTruck Engine @ 10km/h	- 105dB(A) SWL
1x Saw Rock Cutting	- 105dB(A) SWL
1xCFA Piling	- 105dB(A) SWL
4xPowered Hand Tools	- 94dB(A) SWL

Prepared by: S. Giannikopoulos
Date: 16/04/2020

Noise Level
L_{eq}
in dB(A)

- < 65
- 65 - 67
- 67 - 69
- 69 - 71
- 71 - 73
- 73 - 75
- 75 - 77
- 77 - 79
- 79 - 81
- 81 - 83
- 83 - 85
- >= 85

Signs and symbols

- Surface
- Receiver
- Point source

Facade Noise Map

- Facade point
- Line source

Length scale 1:5796

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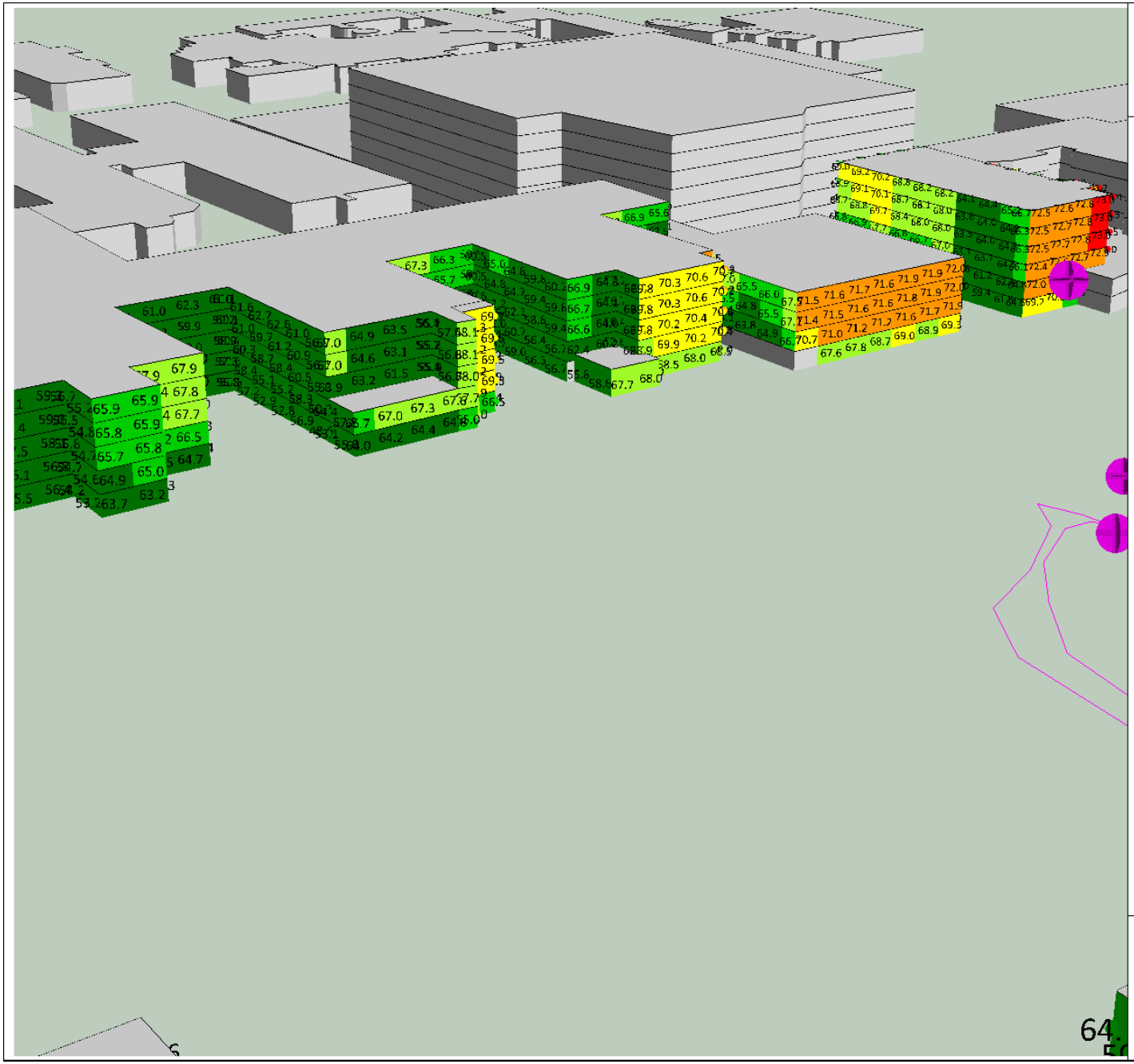
ACOUSTIC LOGIC



Randwick Campus Redevelopment

7am - 10pm Construction Noise Prediction

1xExcavator Hydraulic Hammer	- 120dB(A) SWL
1xExcavator Bucket	- 110dB(A) SWL
1xConcrete Pump	- 110dB(A) SWL
2xCrane (North & South)	- 105dB(A) SWL
2xConcreting Helicopter	- 105dB(A) SWL
1xTruck Engine @ 10km/h	- 105dB(A) SWL
1x Saw Rock Cutting	- 105dB(A) SWL
1xCFA Piling	- 105dB(A) SWL
4xPowered Hand Tools	- 94dB(A) SWL

Prepared by: S. Giannikopoulos
Date: 16/04/2020

Noise Level
L_{eq}
in dB(A)

- < 65
- 65 - 67
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- 75 - 77
- 77 - 79
- 79 - 81
- 81 - 83
- 83 - 85
- >=85

Signs and symbols

- Surface
- Receiver
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Facade Noise Map

- Facade point
- Line source

Length scale 1:5796

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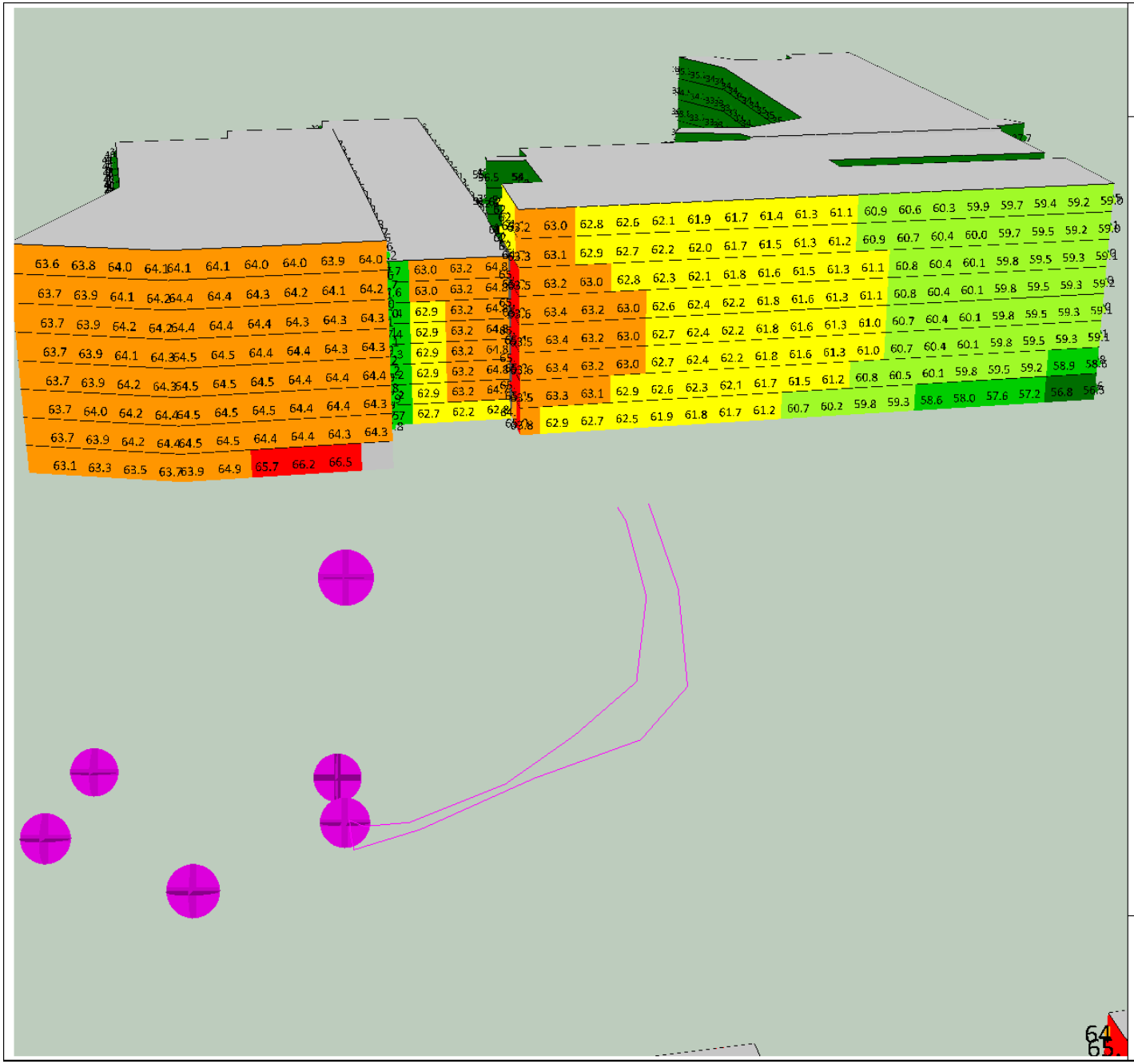
ACOUSTIC LOGIC



Randwick Campus Redevelopment

10pm - 1am Construction Noise Prediction

1xConcrete Pump - 110dB(A) SWL
1xCrane (North Only) - 105dB(A) SWL
2xConcreting Helicopter - 105dB(A) SWL
1xTruck Engine @ 10km/h - 105dB(A) SWL
4xPowered Hand Tools - 94dB(A) SWL

Prepared by: S. Giannikopoulos
Date: 16/04/2020

Noise Level L_{eq}
in dB(A)

- < 57
- 57 - 59
- 59 - 61
- 61 - 63
- 63 - 65
- 65 - 67
- 67 - 69
- 69 - 71
- 71 - 73
- 73 - 75
- 75 - 77
- >=77

Signs and symbols

- Surface
- Receiver
- Point source

Facade Noise Map

- Facade point
- Line source

Length scale 1:5796

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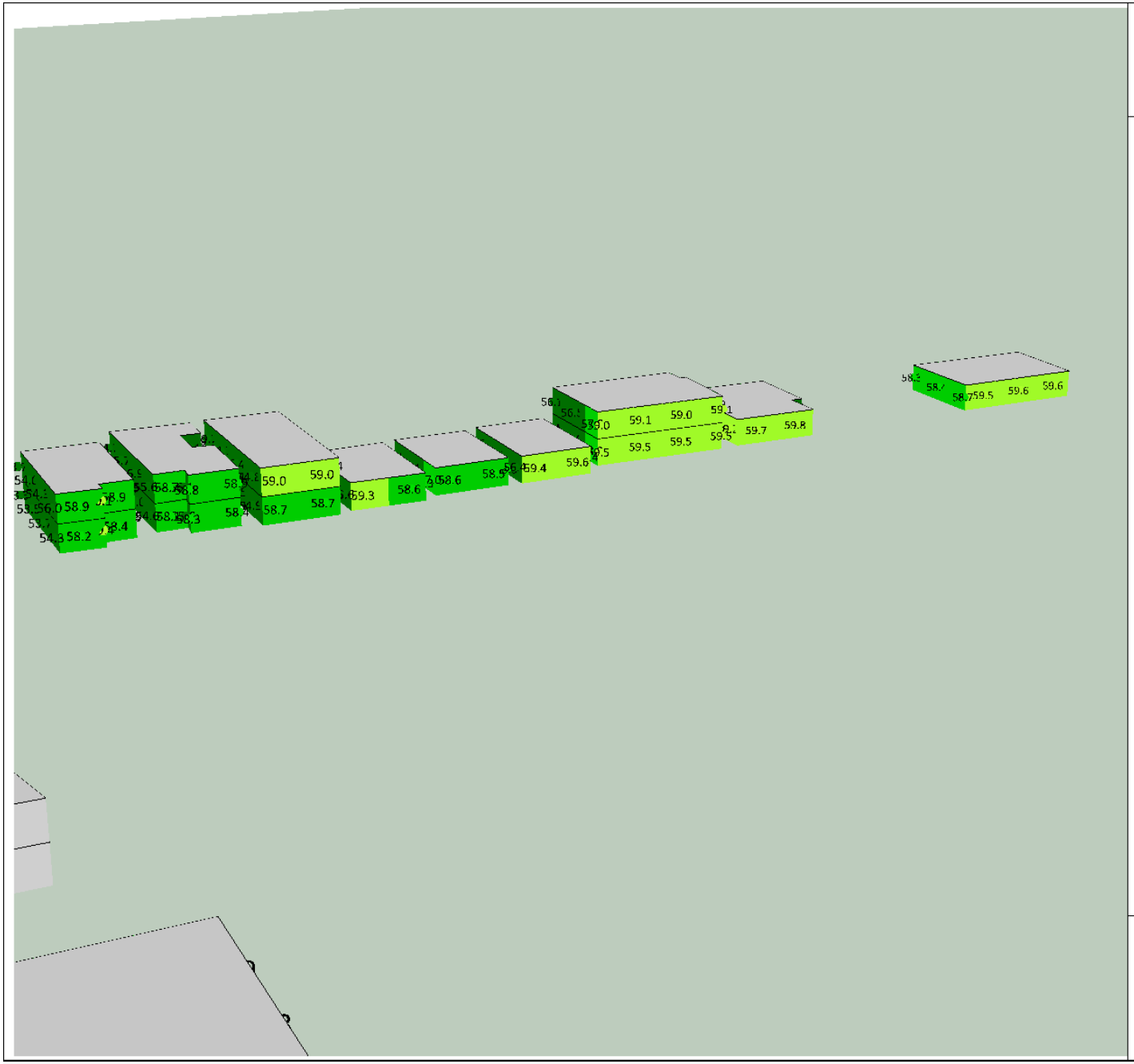
ACOUSTIC LOGIC



Randwick Campus Redevelopment

10pm - 1am Construction Noise Prediction

1xConcrete Pump - 110dB(A) SWL
1xCrane (North Only) - 105dB(A) SWL
2xConcreting Helicopter - 105dB(A) SWL
1xTruck Engine @ 10km/h - 105dB(A) SWL
4xPowered Hand Tools - 94dB(A) SWL

Prepared by: S. Giannikopoulos
Date: 16/04/2020

Noise Level
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Signs and symbols

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- Receiver
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Facade Noise Map

- Facade point
- Line source

Length scale 1:5796
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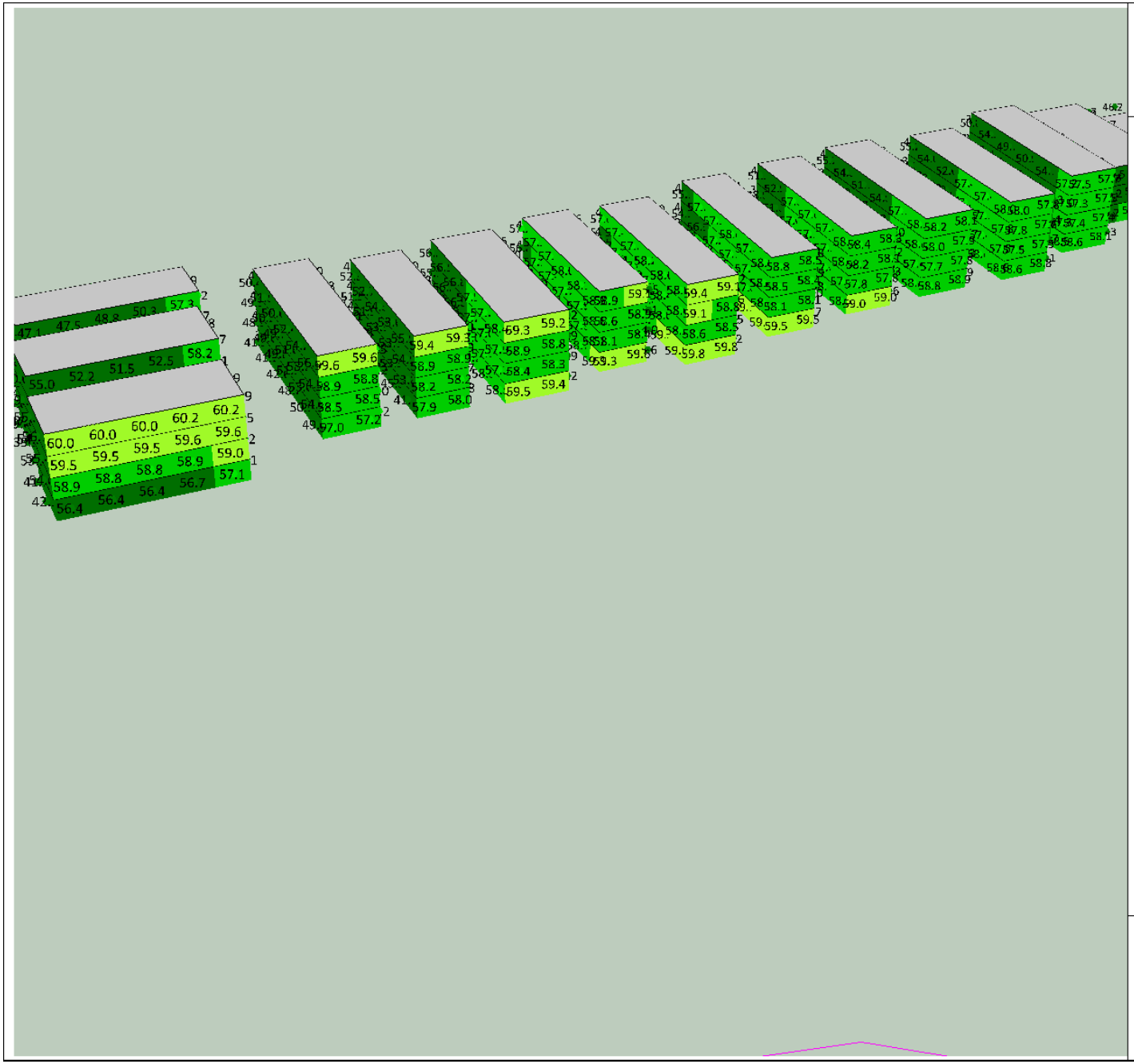
ACOUSTIC LOGIC



Randwick Campus Redevelopment

10pm - 1am Construction Noise Prediction

1xConcrete Pump - 110dB(A) SWL
1xCrane (North Only) - 105dB(A) SWL
2xConcreting Helicopter - 105dB(A) SWL
1xTruck Engine @ 10km/h - 105dB(A) SWL
4xPowered Hand Tools - 94dB(A) SWL

Prepared by: S. Giannikopoulos
Date: 16/04/2020

Noise Level L_{eq}
in dB(A)

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Signs and symbols

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- Receiver
- Point source

Facade Noise Map

- Facade point
- Line source

Length scale 1:5796

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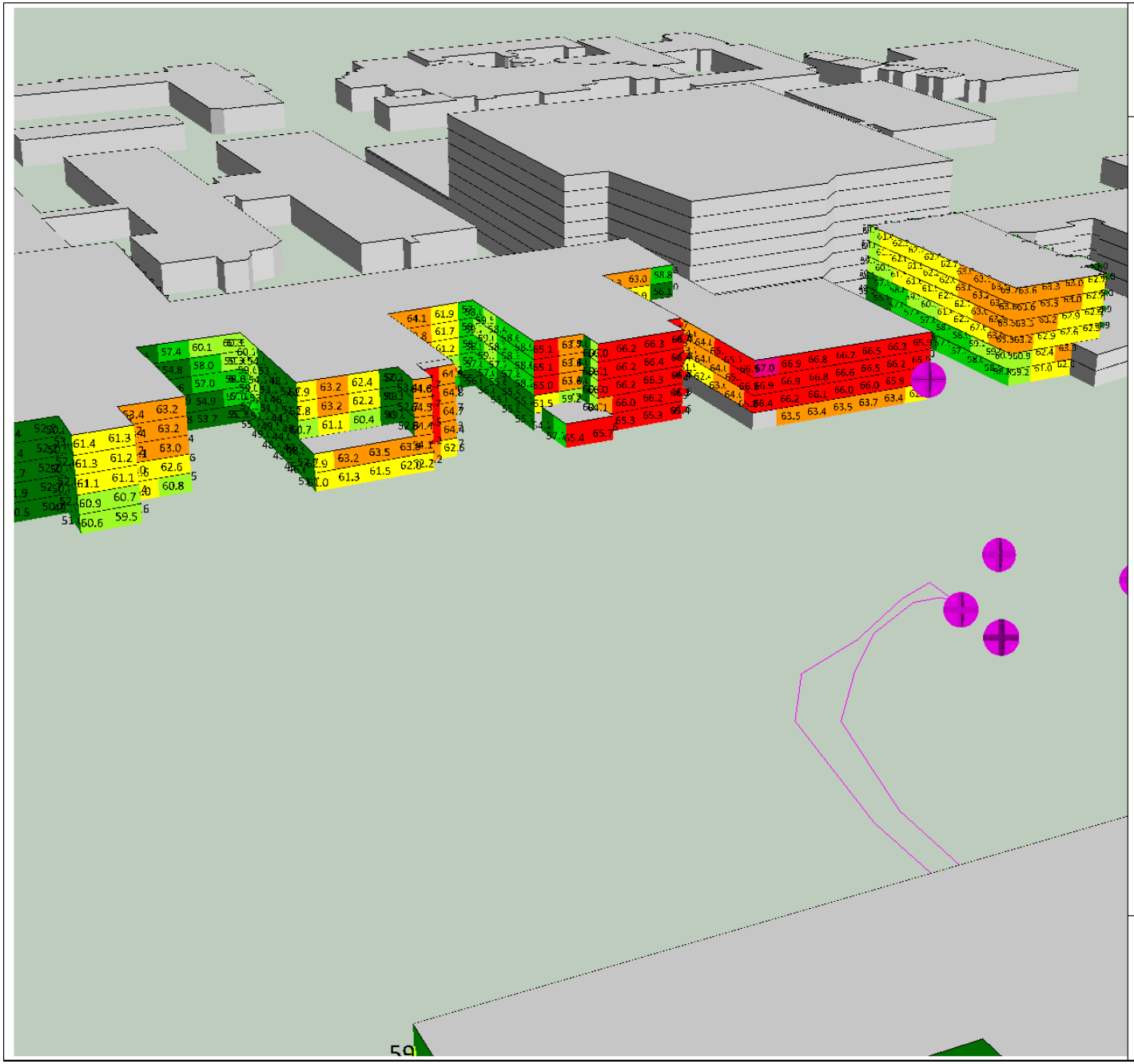
ACOUSTIC LOGIC



Randwick Campus Redevelopment

10pm - 1am Construction Noise Prediction

1xConcrete Pump - 110dB(A) SWL
1xCrane (North Only) - 105dB(A) SWL
2xConcreting Helicopter - 105dB(A) SWL
1xTruck Engine @ 10km/h - 105dB(A) SWL
4xPowered Hand Tools - 94dB(A) SWL

Prepared by: S. Giannikopoulos
Date: 16/04/2020

Noise Level
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Signs and symbols

- Surface
- Receiver
- Point source

Facade Noise Map

- Facade point
- Line source

Length scale 1:5796

0 30 60 120 180 240 m

ACOUSTIC LOGIC

11.3.1 Summarised Noise Prediction

The following table summarises the sound plan modelling above, making comparison to the noise management trigger levels. Please see table below for further detail.

11.3.1.1 To Receiver 1- Randwick prince of Wales Hospital Complex

Receiver 1 – Prince of Wales Hospital Complex		
Time of Day	6am – 7am	6pm – 10pm
Predicted Highest Noise Level	41	47
Noise Management Trigger Level	45 (Internal Criteria)	
Management Required	No	Yes

11.3.1.2 To Receiver 2- University of New South Wales Building

Receiver 2 – University of New South Wales Building		
Time of Day	6am – 7am	6pm – 10pm
Predicted Highest Noise Level	40	45
Noise Management Trigger Level	45 (Internal Criteria)	
Management Required	No	No

11.3.1.3 To Receiver 3

Receiver 3 – High Street Residential Receivers		
Time of Day	6am – 7am	6pm – 10pm
Predicted Highest Noise Level	67	65
Noise Management Trigger Level	49	54
Management Required	Yes	Yes

11.3.1.4 To Receiver 4

Receiver 4 – Magill Street Residential Receivers		
Time of Day	6am – 7am	6pm – 10pm
Predicted Highest Noise Level	60	80
Noise Management Trigger Level	49	54
Management Required	Yes	Yes

11.4 VIBRATION ASSESSMENT RESULTS

The levels of vibration generated by the construction activities will be site-specific and will depend upon the type of activity, the particular equipment used, and the proximity of the construction activity to the nearest occupied spaces within the affected properties and heritage structures.

A detailed vibration assessment has not been carried out at this stage, as actual vibration levels experienced will be dependent upon;

- Site characteristics, and
- Specific construction equipment used.

Vibration monitoring will be carried out at surrounding vibration sensitive receivers, at the nearest affected locations (where practical and accessible).

In addition attended monitoring will be carried out as required for heavy construction activities / equipment determine whether the vibration levels justify a more detailed investigation, confirm monitoring locations or provide transfer functions, and the exact requirements for ongoing vibration monitoring.

The Contractor will carry out an ongoing review of vibration generated by the construction activities, and assess these against the criteria for human comfort, building damage and vibration-sensitive equipment provided in Section above.

Vibration will be monitored against trigger levels for damage at two locations. If vibration exceeds the trigger levels works will cease, the building inspected and appropriate action taken, such as changing the work method.

These locations will be relocated as required. At the commencement of works the monitoring locations include:

- 103 Botany Street.
- Ainsworth Building, POW Hospital.

12 NOISE AND VIBRATION MANAGEMENT PROCEDURES

Control measures will be implemented for any noise sources or equipment that is found to exceed the construction noise limits.

Noise and vibration monitoring will be carried out at or near the most affected receiver locations during the main works activities as described in Section above.

If any work activities are found to exceed the noise and/or vibration criteria, then the noise and/or vibration control measures detailed in sections the above and the following sections will be implemented wherever reasonable and feasible.

12.1 GENERAL CONTROLS FOR NOISE AND VIBRATION

As a general rule, minimising noise and vibration will be applied as universal work practice at any time of day, but especially for noise sources or equipment that is found to exceed the construction noise limits plus any construction works to be undertaken at critical times outside normal daytime/weekday periods.

The reduction of noise and vibration at the source and the control of the transmission path between the construction site and the receiver(s) will be the preferred options for noise minimisation. Providing treatments at the affected receivers will only be considered as a last resort.

When any plant/activity exceeds the noise emission limits the following strategies will be implemented, where reasonable and feasible, to manage construction noise and vibration impacts:

- Plant and equipment. In terms of both cost and results, controlling noise and vibration at the sources is one of the most effective methods of minimising the impacts from any work site activities. The following work practices will be implemented to reduce noise and vibration at the source:
- Employ quieter techniques for all high noise activities such as rock-breaking, concrete sawing, and using power and pneumatic tools.
- Use quieter plant and equipment based on the optimal power and size to most efficiently perform the required tasks.
- Where possible, select alternative construction equipment that are quieter in order to avoid the generation of excessive noise, particularly considering the dominant noise sources for the activities identified.
- Select plant and equipment with low vibration generation characteristics.
- Operate plant in the quietest and most effective manner.

Where appropriate, limit the operating noise of equipment.

- Regularly inspect and maintain plant and equipment to minimise noise and vibration level increases, to ensure that all noise and vibration reduction devices are operating effectively. The allowable LA avmax (equivalent to LA10) noise levels for construction appliances provided in Page 3 of the City of Sydney "Construction Hours / Noise within the Central Business District – Code of Practice" (1992) will be used as a reference for indicative acceptable noise levels from various construction equipment.
- Where appropriate, obtain acoustic test certificates for equipment.

- On site noise management. Practices that will be implemented to reduce noise from the site include:
    - Maximising the distance between noise activities and noise sensitive receivers. Strategically locating equipment and plant.
    - Undertaking noisy fabrication work off-site where possible.
    - Avoiding the use of reversing beeping alarms or providing for alternative systems, such as broadband reversing alarms, particularly during night or out-of-hours works.
    - Maintaining any pre-existing barriers or walls on the site as long as possible to provide optimum sound propagation control.
    - Constructing barriers that are part of the project design early in the project to afford mitigation against site noise.
    - Using existing and temporary site buildings plus material stockpiles as noise barriers.
    - Installing purpose built noise barriers, acoustic sheds and enclosures wherever possible and where required to ensure construction noise limits are met.
- Work scheduling. Scheduling work during periods when people are least affected will be an important way of reducing adverse impacts. The following scheduling aspects will be implemented to reduce impacts wherever construction activities or equipment are found to exceed the construction noise limits:
    - Provide respite periods - including restricting very noisy activities to daytime, restricting the number of nights that after-hours work (if required) is conducted near residences, and by determining any specific requirements needed for noise sensitive receivers such as sleeping / rest, teaching, study, etc.
    - Schedule activities to minimise impacts by undertaking all possible work during hours that will least adversely affect sensitive receivers and by avoiding conflicts with any other scheduled noise-sensitive events. Works will be scheduled to only occur during the approved hours in accordance with Development Consent Conditions C4 and C7.
    - Where possible schedule noisy activities to coincide with high levels of neighbourhood noise (such peak traffic hours or in the middle of the day) so that noise from the activities is partially masked and not as intrusive.
    - Plan deliveries and access to the site to occur quietly and efficiently and organise parking only within designated areas located away from sensitive receivers.
    - Optimise the number of deliveries to the site by amalgamating loads where possible and scheduling arrivals within designated hours.
    - Designate, design and maintain access routes to the site to minimise impacts.
    - Include contract conditions that include penalties for non-compliance with reasonable instructions by the principal to minimise noise or arrange suitable scheduling.
- Consultation, notification and complaints handling
    - Information will be provided to neighbours before and during construction.
    - Good communication will be maintained between the community and project staff.
    - A documented complaints process will be maintained, along with a register of complaints.
    - Complaints will be given a fair hearing, and a quick response provided.
    - All feasible and reasonable measures to address the source of complaint will be implemented.

As a general approach, when noise goals cannot be met due to safety or space constraints, all reasonable and feasible mitigation measures will be implemented for all works to ensure that any adverse noise impacts to surrounding receivers are minimised.

12.2 SPECIFIC CONTROLS FOR AIRBORNE NOISE

Based on the findings from the noise and vibration assessment, and following discussions with Lendlease and HI, some specific airborne noise controls have already been agreed to be implemented and are included in the CMP:

- Only northern crane is allowed to be used before 7am and after 10pm of the proposed extended hours.
- No concrete helicopter is allowed before 7am.
- No high noise activities such as rock hammering or piling is allowed before 7am or after 10pm.
- Where practical and available for equipment and without compromising the safety of staff or members of the public, audible movement alarms of the type that minimise noise impacts at surrounding receivers will be used (such as broadband or "quacker" alarms instead of beepers).
- Hoarding is provided around the site to provide screening however due to topography of site, some areas will have a direct line of site with residential receivers. For the majority of the intensive works (excavation and piling) the hoarding will provide shielding to the noise-sensitive receivers.
- The following works will be carried out in locations such that the existing hoarding will provide shielding to the nearest receivers:
    - Parking and loading of tipper trucks / skip trucks
    - Works that can easily be strategically located (including, carpentry areas, temporary works, etc)
- Employees will receive training which will enable them to recognise areas where noise levels are likely to exceed 85dBA;
- A noise assessment of the site will be undertaken prior to or at the commencement of works on site with ongoing monitoring in strategic locations determined through consultation with HI during the construction period;
- As the work environment changes, additional assessments may be conducted, the timing of which will be determined in consultation between the site management, Site Safety Committee and the Principal;
- Use of acoustic barriers during concrete pours, demolition works, in particular at façade break ins required for installation of new link bridges at the Women's Hospital and Randwick Hospital.
- Implementing acoustic mufflers to impact driven equipment;
- Use of core holing rather than impact hammer drilling into concrete structures of existing buildings, in particular at façade break ins
- Introduce engineering controls within the methodology, such as acoustic panels to surround concrete pumps for attenuation;
- In conjunction with HI NSW, developing acceptable periods when specific "noisy works" can occur;
- Managing works within the approved site working hours;
- Planning and notification of noisy works via the Disruptive Works Notice procedure and in general consultation with HI;
- Warning signs shall be erected in areas where 85dBA is exceeded; and
- Where additional personnel protection equipment is required, the areas shall be identified by signage. The appropriate noise protection devices are to be issued to the effected personnel.
- Noise emissions will be managed in accordance with the regulatory requirements and Lendlease management procedures, complying with the following:
    - National Code of Practice for Noise
    - Management and Protection of Hearing at Work [NOHSC:2009];
    - AS/NZS 1269.0:2005: Occupational noise management – Series of several Standards;
    - AS 2012.2: Acoustics - Measurement of airborne noise emitted by earth-moving machinery and agricultural tractors - Stationary test condition - Operator's position;
    - AS 2436: Guide to noise control on construction, maintenance and demolition sites;
    - AS 2221.1: Methods for measurements of airborne sound emitted by compressor units including prime movers and by pneumatic tools and machines;
    - AS 3781: Acoustics – Noise labelling of machinery and equipment.

12.3 SPECIFIC CONTROLS FOR VIBRATION

We do not consider that controls will be required to control vibration to surrounding off-site buildings. The need to control vibration to the heritage buildings on site (plus the associated mitigation measures) is expected to ensure that vibration to surrounding off-site buildings will meet the relevant limits / criteria.

Notwithstanding the above, the Contractor will carry out a preliminary attended vibration assessments at the commencement / during use of intensive vibration generating plant to determine whether the existence of significant vibration levels justifies a more detailed investigation or vibration measurements / monitoring in areas other than those identified in this plan (refer to Section 7.5 for monitoring program).

If a more detailed investigation is required, this will involve methods of constraining activities generating high vibration levels. A method of monitoring vibration levels will then be put in place. Vibration mitigation measures and a review of vibration criteria may then be necessary.

Notwithstanding the above, all practical means will be used to minimise impacts on the affected buildings and occupants from activities generating significant levels of vibration on site.

Where vibration levels are found to exceed the relevant criteria, one or more of the following measures will be taken:

- Modifications to demolition equipment used.
- Modifications to methods of demolition.

If the measures given above cannot be implemented or have no effect on vibration levels or impact generated, a review of the vibration criteria will be undertaken and the vibration management strategy amended.

The following considerations will be taken into account:

- The layout of the site, including the location of static sources of vibration.
- Modifications to construction equipment used.
- Techniques used in construction to minimise generated vibration levels, including saw cutting and removal of structure wherever possible – as an alternative to hammers and hydraulic crushers.

- Hours of work with regard to the nature of operations in the affected buildings and the duration of the works.

As per the Consent Conditions, the following will be adhered to:

- B6. Before the commencement of construction, the Applicant must:
  (a) consult with the relevant owner and provider of services that are likely to be affected by the development to make suitable arrangements for access to, diversion, protection and support of the affected infrastructure;
  (b) prepare a dilapidation report identifying the condition of all public infrastructure in the vicinity of the site (including roads, gutters and footpaths);
  (c) prepare a dilapidation report identifying the condition of all adjoining and nearby premises including the residences on the south side of Magill Street and the heritage item located at 4 Hay Street, Randwick;
  (d) prepare a report by a professional engineer detailing the proposed methods of excavation, shoring or pile construction, including details of potential vibration emissions, and demonstrating the suitability of the proposed methods of construction to overcome any potential damage to nearby premises including the residences on the south side of Magill Street and the heritage item at no.4 Hay Street, Randwick.
  (e) submit a copy of the dilapidation report and engineers report to the Certifying Authority and Council. This Consent Condition was addressed prior to demolition works.
- Consent Condition C30, vibratory compactors (if used) will not be used closer than 30 m from residential buildings – unless vibration monitoring confirms compliance with the vibration criteria in Section 5.5.

If the measures given above cannot be implemented or have no effect on vibration levels or impact generated, a review of vibration criteria will be undertaken, and the vibration management strategy amended.

12.4 PLANT AND EQUIPMENT MAINTENANCE PROGRAM

The Contractor will prepare and implement a regular plant and equipment inspection and maintenance program to ensure that "noisy" equipment or tools are not used. "Noisy" equipment or tools are those with defective mufflers or other fitted noise attenuation features or devices that are not working as intended.

12.5 MONITORING PROGRAM

12.5.1 Noise monitoring

The builder will monitor environmental noise and vibration at or near the most affected noise receivers at locations to assess noise levels against those predicted in this document.

Noise is to be monitored continuously at 2 locations, with access to be obtained by Health Infrastructure, as follows:

- 103 Botany Street; and
- Sydney Children's Hospital, Hospital Road Playground.

As works progress and work locations change, the noise monitors will need to be relocated close to the most affected noise sensitive receiver as appropriate. If the noise monitoring indicates noise levels exceeding the levels predicted in this document, mitigation measures will be reviewed. Also, if noise monitoring indicates noise levels are less than the levels predicted in this document then opportunities will be considered to increase activity and reduce the overall duration of the works.

12.5.2 Vibration Monitoring

Vibration monitoring is critical to the success of this plan. Monitoring of vibration at the nearest affected receivers should be carried out at the commencement of heavy main works.

The purpose of this monitoring is to assess the risk of potential structural damage to the buildings of concern.

This monitoring will be used for specific activities generating significant levels of vibration, in situations where there are changes in equipment and activities or work procedures that might affect existing vibration control measures.

Vibration is to be monitored continuously at 2 locations, with access to be obtained by Health Infrastructure, as follows:

- 103 Botany Street
- Ainsworth Building, POW Hospital

As works progress and work locations change, the vibration monitors will need to be relocated close to the most affected vibration sensitive receiver as appropriate. These locations will be supplemented with attended monitoring required for heavy construction activities / equipment to determine whether the vibration levels justify a more detailed investigation, confirm monitoring locations or provide transfer functions, and the exact requirements for ongoing vibration monitoring (including relocation with progression of works). Ongoing vibration monitoring requirements to be reviewed following each stage of works.

Measured levels will be compared to the trigger levels nominated in this plan to assess whether additional respite or mitigation measures should be considered.

If vibration levels generated by the works approach the trigger values, then Lendlease shall monitor the situation and carry out the following:

- Liaise with plant operators and advise that criteria is being approached. Try to understand the cause of the vibration level and mitigate where practical.

Where the trigger value is exceeded the following process will be applied:

- Work shall stop as soon as practicable.
- Values reviewed to confirm frequency content against relevant targets and standards.
- Nearby properties will be inspected for cracks or other signs of damage against dilapidation reports.
- If no damage is identified, then the criteria may be increased to be agreed with Acoustic Logic, Lendlease and the engaged structural engineer.
- If there are signs of damage then:
    - the work method will be reviewed for an alternative method generating less vibration; or
    - the work method will continue, and the situation monitored to ensure damage remains at a level that is repairable (minor cracks and other cosmetic effects).

12.5.3 Reporting

Lendlease will maintain records on site of:

- Noise and vibration monitoring;
- Remedial actions taken to minimise, reduce or eliminate noise and vibration;
- Daily and weekly inspections of plant and equipment, hoarding and other noise management measures;
- A monthly Construction Noise and Vibration report will be prepared by Acoustic Logic.

12.6 COMMUNITY CONSULTATION

The project team is committed to an early, coordinated, proactive and transparent communications and consultation whilst developing strategies to manage noise and vibration (as required by Condition B37).

The project identified a broad range of stakeholders and community members who had varying degrees of involvement and interfaced with the project staging and associated construction activity.

With a strong commitment to stakeholder and community consultation, the project has benefited from stakeholder input into the design and planning of the ASB. The following activities have been undertaken to inform the community, build relationships and provide an opportunity for input and feedback into project delivery.

Prior to any construction activities the following strategies were put into place:

- Community information sessions held.
- Formal and informal briefings and feedback sessions held.
- Where required face-to-face engagement with neighbouring residents and businesses.
- Distribution of project community information resources
- Established communication channels for feedback including project community contact number and project email account

The following highlights stakeholder and community consultation outcomes for managing high noise generating works (Condition B37):

- Stop works procedures and lines of communication where works may affect sensitive receivers or continuity of Hospital Campus operations
- Programming of works to acknowledge periods of increased sensitivity for receivers i.e. exam periods for UNSW and local schools
- Identification of sensitive receivers within neighbouring buildings to inform mitigation planning i.e. sensitive medical or research equipment
- Consultation with Hospital Campus on appropriate location for noise and vibration monitoring devices
- Complaints management processes for noise and vibration
- Identification of preferred communication channels with key stakeholders and neighbouring residents for works notification

The noise sensitive receivers listed and described in the CNVMP: Section 4.1.1 – Nearest Noise & Vibration Sensitive Receivers and any other impacted stakeholders have been notified of the project. They will be kept informed of the project status and key activities throughout the project duration.

- Construction briefings – regular briefings and presentations to affected stakeholders to provide advance notice of noise generating works, work hours and construction impacts management strategies. Construction briefings are utilised to gain feedback and input into construction planning and minimise impacts to stakeholders.
- Community notification – notifications circulated via letter box drop, email and project website to communicate upcoming construction activity to the local community and affected stakeholders.

- Construction Interface Meetings – regular meetings with key project stakeholders to communicate upcoming works, impacts and mitigate strategies.
- Site hoarding or notices on the hoarding will also identify Health Infrastructure and Lendlease as the site operators.

These channels will be used to inform residents and business owners, describing the construction hours, potential high noise works/hours, the noise management measures being implemented and providing contact details for further information or complaints.

12.7 COMPLAINTS AND NON-COMPLAINTS

The development of the CNVMP has been consulted with the project stake holders in accordance with the projects Community Communication strategy. This strategy outlines the key consultation that has been and continues to be undertaken

Complaints will be logged and response actions documented.

Upon receipt of a complaint the Contractor will decide whether the complaint is in relation to offensive noise. Offensive noise is described in legislation and discussed in the Noise Guide for Local Government. In the context of this proposal, offensive noise is noise from this proposal that is as a result of:

- Works outside the work hours in Section 6.1. Offensive noise includes noise outside of the work hours as a result of arrival or departure of trucks and any site personnel or contractors parking on the surrounding streets and not entering or leaving the hotel parking, dedicated to project vehicles.
- Works generating noise above 75dBA that extends for longer than 3 hours without a minimum one hour respite break.
- Works generating noise above the levels predicted in this document;
- plant or equipment not maintained or operated in a proper and efficient manner, for example with defective mufflers or other fitted noise attenuation devices;
- loud radios, shouting (particularly swearing), and other unnecessary noise;
- site gates left open other than for entry or exit of a vehicle.

On receipt of a complaint of offensive noise, or of becoming aware of offensive noise, the contractor will take immediate action to stop the offensive noise.

For complaints about noise from this proposal other than offensive noise, the contractor will;

- Direct consultation with any affected stakeholders where noise and vibration is a planned part of construction activity. Timely communication provides stakeholder awareness, opportunity for forward community and implementation of mitigations prior to works occurring. The project team remains cognisant of nearby sensitive receivers and vigilant in providing advanced notification.
- Ongoing consultation with key stakeholders to understand and document the location of any sensitive receivers including medical and research equipment.
- Consultation with key project stakeholders to determine suitable locations for loggers that provide effective readings and limit disruption to Hospital Campus.
- Regular doorknocking of neighbouring residents to notify of planned construction activity and associated impacts.
- Construction Community Notices distributed to local businesses and residents to notify of planned construction activity and potential impacts. Noise and vibration generating activities are communicated in a timely fashion through Construction Community Notices.
- Maintenance of 24/7 Community Contact phone number and project email address for stakeholder contact and complaints.
- Maintenance of project Complaints Register detailing complaints related to noise and vibration and project response. The Complaints register is updated monthly and remains accessible via the project's website.
- Circulation and approval of Disruptive Works Notification detailing planned construction activity, associated impacts and mitigations.
- Try to ascertain from the complainant which activity is causing the problem (i.e. inside or outside the site and in what position).
- If required, establish from the monitoring equipment and or attended noise monitoring if the predicted noise levels have been exceeded. Attended noise monitoring may be required to determine this.
- Check that the activity and equipment are being operated in a proper and efficient manner.

- Immediately rectify any faulty equipment.

12.8 TRAINING AND AWARENESS

The Contractor shall provide all project personnel and subcontractors with training on the environmental obligations through project inductions, toolbox talks and through Safety Works Methods (SWMS).

Project personnel and subcontractors shall undergo a general project induction prior to commencing work. This will include a noise component reinforcing that works should be done in a manner that minimises noise and is respectful of neighbours and mindful of their amenity.

13 CONCLUSION

This report presents an assessment of noise and vibration impacts associated with the bulk earthworks and construction activities to be undertaken for the potential noise and vibration impacts associated with the proposed extended hours for Randwick Hospital Redevelopment to satisfy the requirements of NSW EPA Interim Construction Noise Guideline and Environmental Planning.

We trust this information is satisfactory. Please contact us should you have any further queries.

Yours faithfully,

Acoustic Logic Consultancy Pty Ltd
George Kinezos