

Central Barangaroo

Noise Impact Assessment

SYDNEY

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EXECUTIVE SUMMARY

Acoustic Logic have been engaged to conduct an acoustic assessment to address the Planning Secretary's Environmental Assessment Requirements in relation to noise and vibration impacts associated with the proposed works, with consideration to the following guidelines:

- NSW Environment Protection Authority Interim Construction Noise Guideline (ICNG).
- Transport NSW guidelines in relation to protection of rail assets.
- General guidelines in respect of other nearby infrastructure

Sensitive receivers around the work site have been identified, and noise and vibration management levels appropriate to the receiver have been determined based on recommendations contained in the Interim Construction Noise Guideline.

Receiver noise levels have been predicted for the stages of the works 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.

The predictions indicate that at during stages of the work most receivers around the site will not be exposed to noise or vibration levels above the management levels established for them.

There are a limited number of receivers where minor exceedances of 1 dB(A) are predicted. For these receivers, normal good practice management to minimise noise emissions is recommended.

The High Street residences south of the child care centre will be exposed to noise levels up to 10 dB(A) above the applicable management levels, and the assessment of reasonable and feasible mitigation, as recommended in this report, is recommended. No residential receiver will be subject to noise exceeding the highly affected noise management levels. Strategies for the mitigation of the noise impacts identified have been recommended.

Minor impacts are predicted at Hickson Park when the piling plant is located close to the southern site boundary. However, given there is already an existing site hoarding, and the exceedances are minor and occur for a limited period additional, mitigation beyond the implementation of normal good practice management is not indicated.

It is not expected that vibration generated by the proposed activities will produce adversely impact any surrounding property.

It is recommended that a detailed noise and vibration management plan be conducted on behalf of the contractor prior to the commencement of construction that identifies all main noise producing plant proposed, predicts noise impacts and develops strategies for noise management in accordance with the recommendations of this assessment and the Interim Construction Noise Guideline and this report.

1 INTRODUCTION

Acoustic Logic have been engaged to conduct an acoustic assessment to address the Planning Secretary's Environmental Assessment Requirements in relation to noise and vibration impacts associated with the proposed works, with consideration to the following guidelines:

- NSW Environment Protection Authority Interim Construction Noise Guideline (ICNG).
- Transport NSW guidelines in relation to protection of rail assets.
- General guidelines in respect of other nearby infrastructure

Noise levels have been predicted for the scheme at the receiver locations 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.

Strategies for the mitigation of any impacts identified have been recommended.

2 ACKNOWLEDGMENT OF COUNTRY

We would like to acknowledge the Gadigal people who are the Traditional Custodians of this land. We would also like to pay respect to the Elders both past and present of the Eora Nation and extend that respect to all Aboriginal people.

3 SEARS

The SEARs for SSD-39587022 issued 14th April 2022 includes a general requirement to assess noise impacts. Requirement 5 is restated in the table below, along with the location in this report that addresses that requirement.

5. Noise and Vibration. The EIS must include a noise and vibration assessment prepared in accordance with the relevant NSW Environment Protection Authority (EPA) guidelines. The assessment must detail:	
Ambient Noise and Determination of Management Levels	6.2, 6.3
Construction noise and vibration impact assessment	6.4, 0, 0
Outline the proposed management and mitigation measures that would be implemented	7

4 PROPOSAL AND LOCATION

4.1 EXISTING USES

The site is located within the Barangaroo precinct area. Barangaroo is made up of three (3) distinct precincts, known as Barangaroo South, Central Barangaroo and Barangaroo Reserve. This assessment addresses the Central Barangaroo precinct. The site is presently unoccupied and is being used as construction staging areas for the Barangaroo redevelopment area.

Figures 1 and 2 show the Barangaroo Central site and surrounding receivers. Figure 3 shows the location of the proposed works.

4.2 EXISTING SENSITIVE RECEIVERS

The precinct is surrounded by the following uses:

- Metro Station site, public domain, and Barangaroo Reserve to the north, with a hotel and commercial and residential properties further to the north
- To the south-west, Crown Sydney Hotel Resort (including casino, hotel and residential receivers)
- To the west Darling Harbour and Balmain
- To the south:
 - Hickson Park, passive recreational public domain.
 - Lendlease residential developments
 - Commercial towers beyond
- To the east:
 - Residential dwellings on Hickson Road and High Street
 - Child Care Centre on the Corner of High Street and Argyle Lane.
 - Commercial and hotel development along Hickson Road and Kent Street beyond
 - Residential dwellings and serviced apartments on Kent Street

The Metro Barangaroo Station and railway line are currently under construction. There is a Sydney Water pumping station located to the south of the site on Hickson Road.

4.3 PROPOSED WORKS

The development being assessed involves construction activity, and there are no ongoing operational noise source as part of this application. Stage 1 primarily involves the construction of a secant pile wall near the eastern boundary of the site as indicated in Figure 3. The works would take approximately 8 months to complete. The general construction methodology is:

- Construct a surface guide beam by excavating a trench and partially infilling the trench with concrete to construct a guide beam. The proposed main noise producing plant is:
 - Excavator, and truck for off-site removal of spoil.
 - Concrete truck.
 - Concrete agitator.

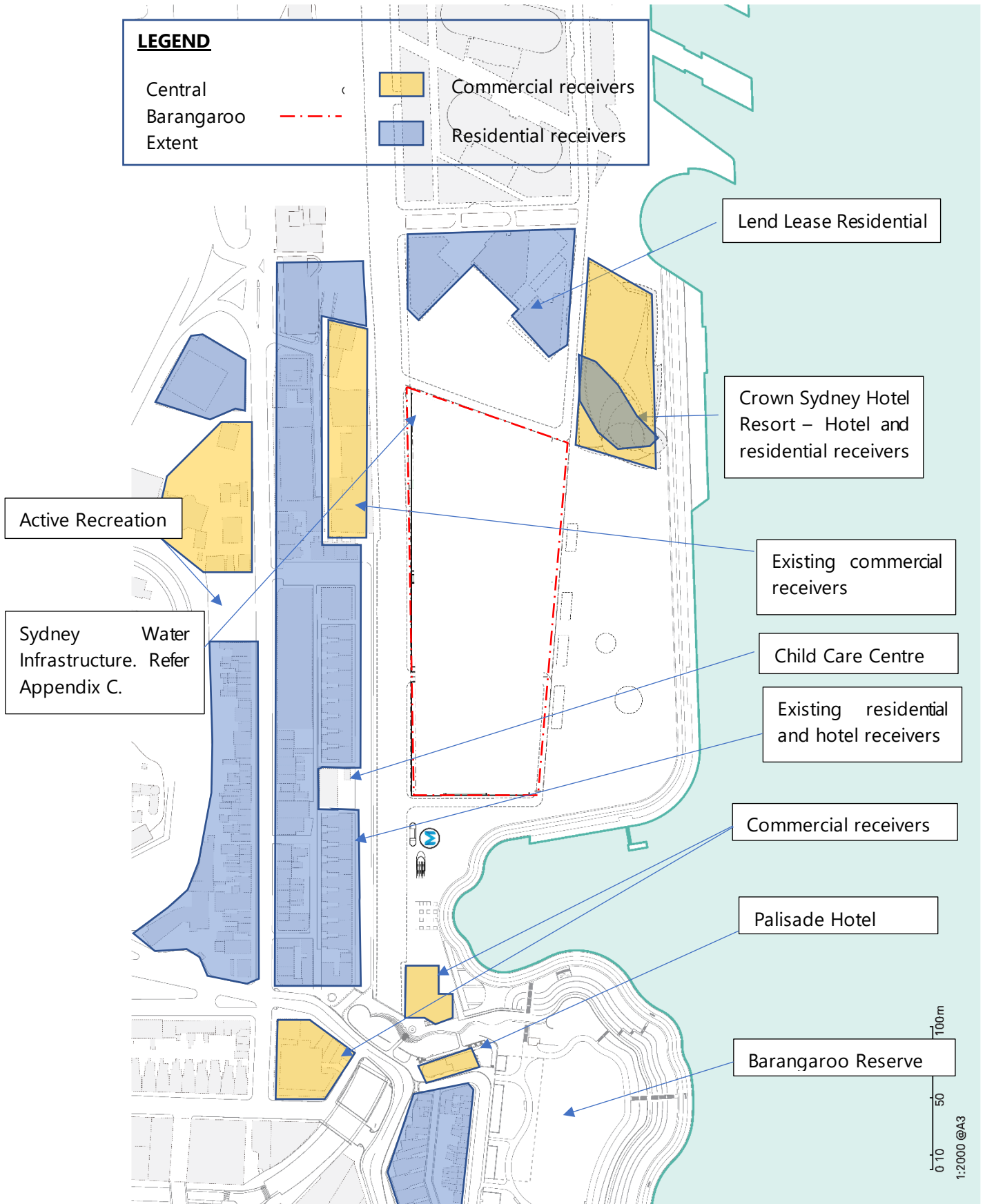


Figure 1: Site and Surrounds

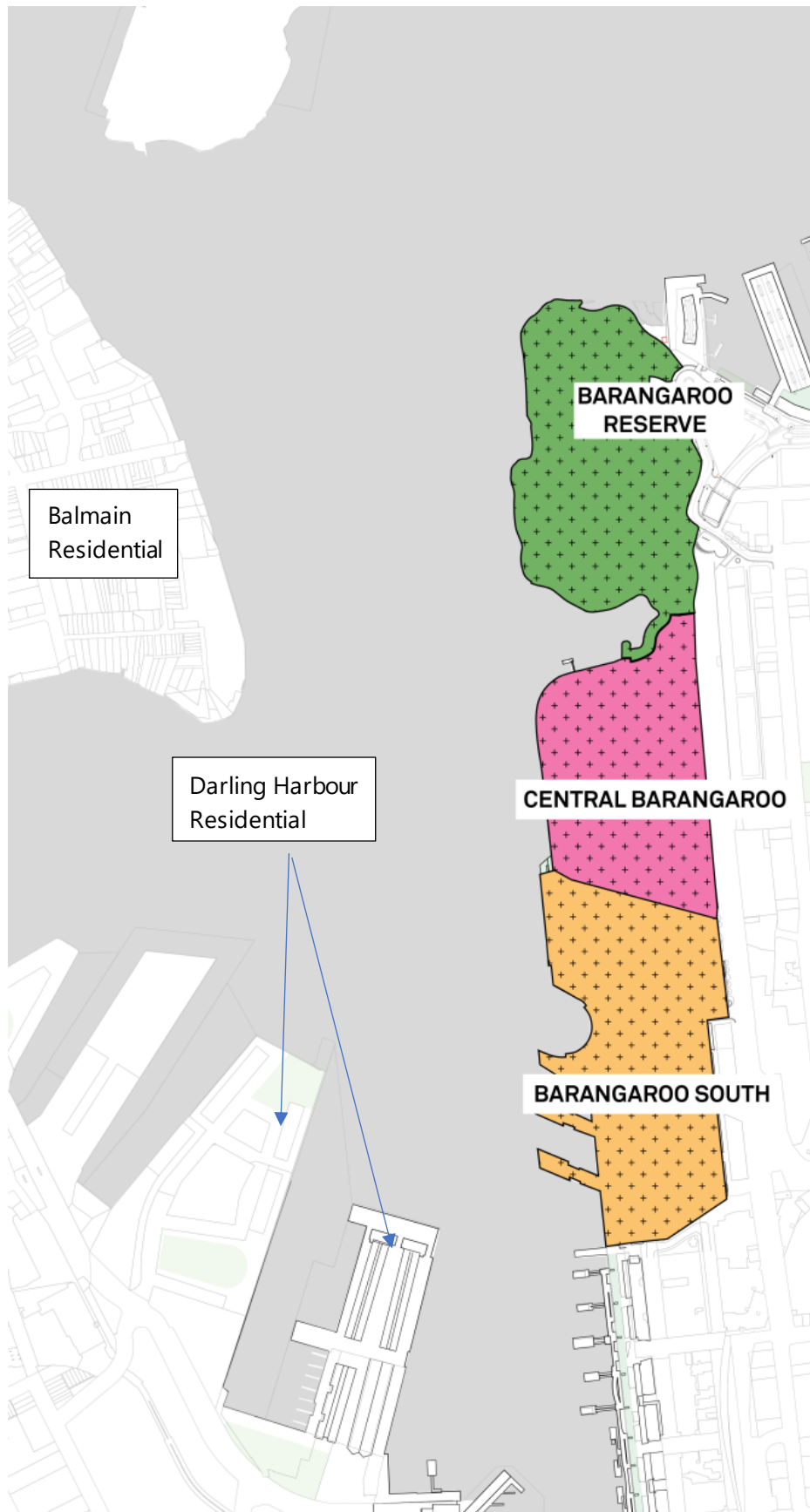


Figure 2: Site and Sensitive Receivers to West

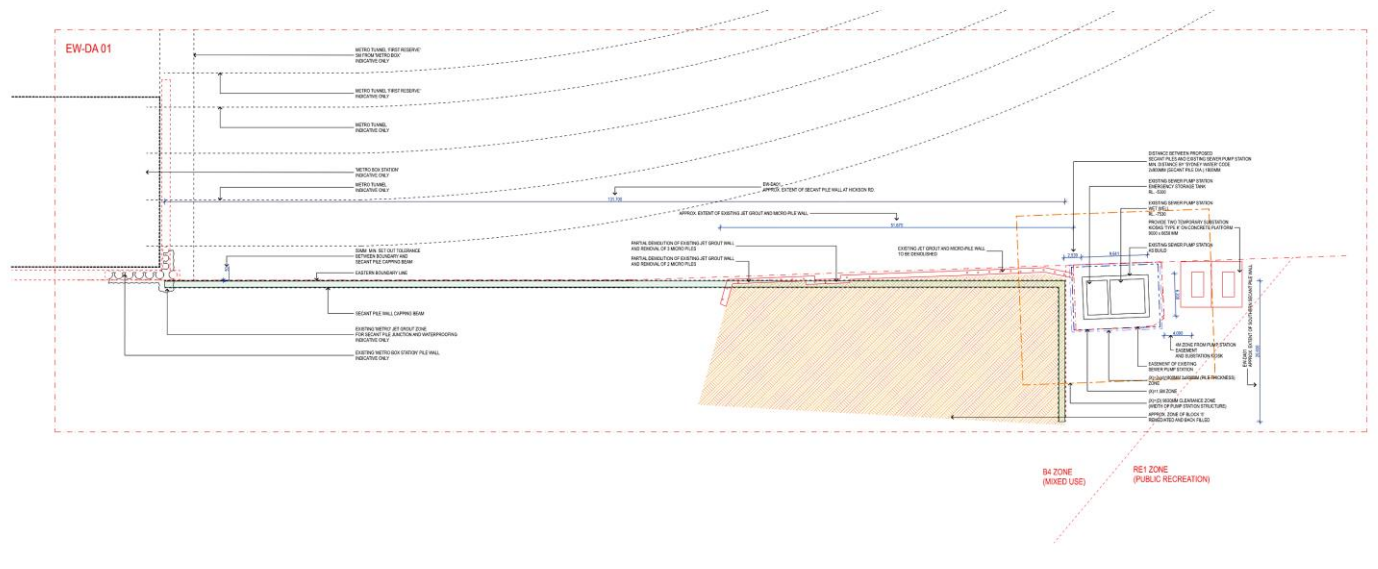
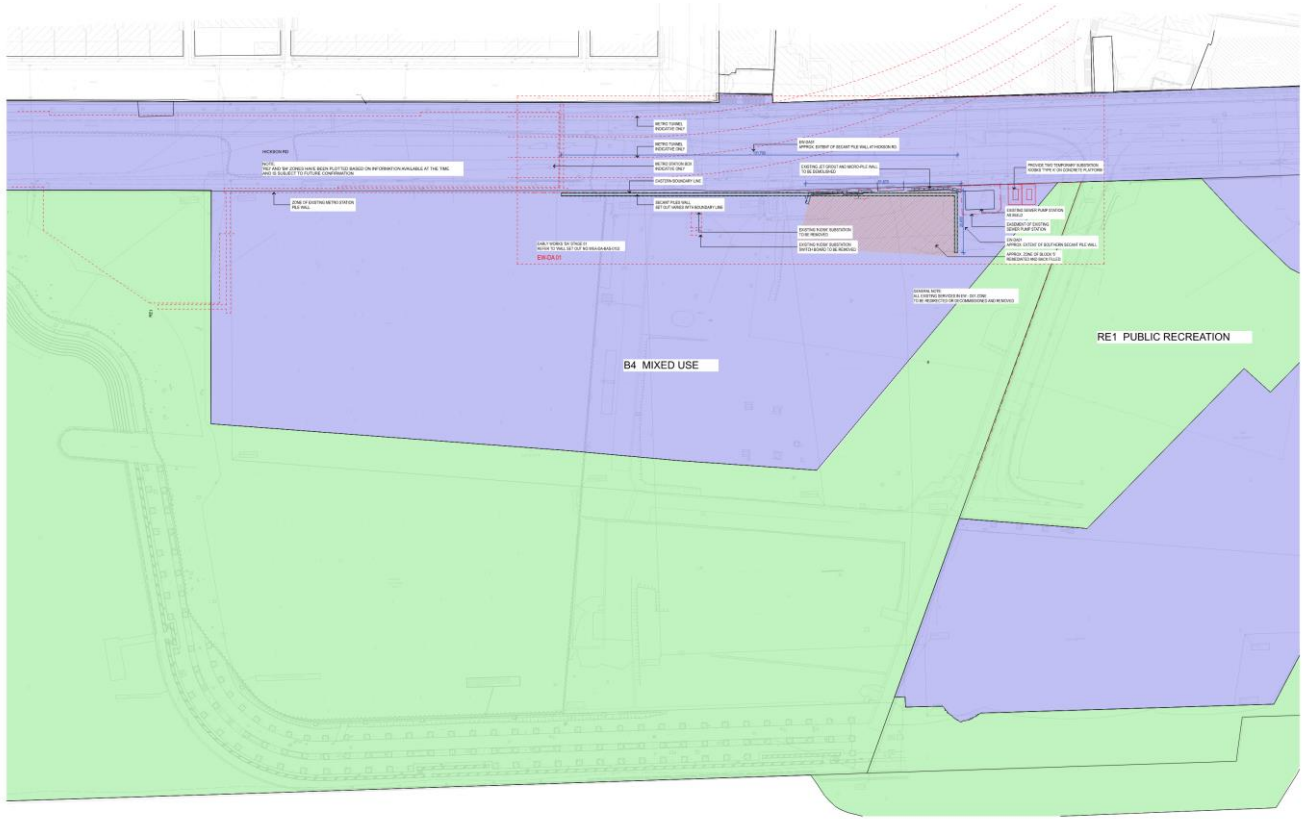


Figure 3: Proposed Site Works

- Construct primary piles by drilling using a continuous flight auger and infilling with concrete. The main noise producing plant is:
 - A machine mounted auger.
 - Excavator, and truck for off-site removal of spoil.
 - Concrete truck.
 - Concrete agitator.
 - Bentonite pump
 - Material delivery trucks.
- Construct secondary piles by drilling between the primary piles and inserting a reinforced steel pile and infilling with concrete. The main noise producing plant is:
 - A machine mounted auger.
 - Concrete truck.
 - Concrete agitator/vibrator.
 - Mobile Crane
 - Material delivery trucks.
- Construct a concrete capping beam at the top of the wall. The main noise producing plant is:
 - Concrete truck.
 - Concrete agitator.
 - Mobile Crane
 - Power tools (e.g. angle grinder)

It is proposed to construct the works during EPA "normal" work hours, being:

- Monday to Friday 7 am to 6 pm
- Saturday 8 am to 1 pm.
- No work on Sundays or public holidays will occur other than emergency operations.

Work on Saturdays between 7am to 8am and 1pm to 5pm may also occur with additional management restrictions for high noise impact activities (see below).

High noise impact activities would only be undertaken between the hours of:

- 8am and 6pm Monday to Friday
- 8am and 1pm Saturday
- In continuous blocks of no more than 3 hours, with at least one hour respite between each block of work generating high noise impact, where the location of the work is likely to impact the same receivers.

5 EXISTING ACOUSTIC ENVIRONMENT

Noise monitoring has been previously conducted as part of the Barangaroo Concept Plan and subsequent modifications. These noise levels have been used as a basis for this assessment given that the significant construction activity occurring in the vicinity prevents the establishment of rating background noise levels from monitoring at this time.

5.1 ENVIRONMENTAL NOISE DESCRIPTORS

Ambient noise constantly varies in level from moment to moment, so it is not possible to accurately determine prevailing noise conditions by measuring a single, instantaneous noise level.

To quantify ambient noise, a 15 minute measurement interval is typically utilised. Noise levels are monitored continuously during this period, and then statistical and integrating techniques are used to characterise the noise being measured.

For the assessment of construction noise, the principal measurement parameters obtained from the data are:

L_{eq} - represents the average noise energy during a measurement period. This parameter is derived by integrating the noise levels measured over the measurement period. L_{eq} is important in the assessment of noise impact as it closely corresponds with how humans perceive the loudness of time-varying noise sources (such as traffic noise).

L₉₀ – This is commonly used as a measure of the background noise level as it represents the noise level heard in the typical, quiet periods during the measurement interval. The L₉₀ parameter is used to set noise emission criteria for potentially intrusive noise sources since the disturbance caused by a noise source will depend on how audible it is above the pre-existing noise environment, particularly during quiet periods, as represented by the L₉₀ level.

5.2 HISTORICAL NOISE MONITORING

Noise monitoring has been conducted in and around the Barangaroo area as part of the approved Concept Plan and subsequent modifications.

Noise levels have been adopted from the Wilkinson Murray report titled 'One Sydney Harbour Residential Building R4A – Construction and Operational Noise Report' dated 28 July 2016.

Background noise levels were established prior to significant works being undertaken as part of the Barangaroo Site and as such would not be impacted by construction noise which currently exists. Monitored noise levels are presented in the following table.

Detailed noise monitoring is recommended to be conducted as part of future development applications (after construction activities in the area have abated) to ensure emission assessment criteria are based on representative background noise levels.

The activation of the Barangaroo precinct is expected to increase background noise levels, commensurate with the general increase in activity produced by the establishment of entertainment and community uses.

Appendix D provides the measurement location maps obtained from the referenced reports.

Table 1 – Historical Noise Monitoring

Logging Site	Monitoring Location	Rating Background Noise Level, dB(A) L ₉₀				Equivalent Continuous Sound Level dB(A) L _{eq}				Consultant
		Day	Evening	Night	Saturday	Day	Evening	Night	Saturday	
1	Level 4, The Bond 30-38 Hickson Road	53	53	49	51	62	61	57	60	Arup
2	Middle of Barangaroo South Site	52	50	45	50	56	54	50	56	Arup
3	Adjacent to Sussex Street and Shelley Street	60	59	49	57	67	66	62	66	Arup
4	Adjacent to King Street Wharf Boulevard	52	60	46	48	60	62	60	60	Arup
5	3 High Street, Millers Point	47	44	41	45	58	55	51	55	WM
6	18 Merriman Street, Millers Point	46	44	40	46	58	55	50	56	WM
7	25 Edward Street, Balmain East	49	45	40	46	67	51	47	56	WM
8	3 Darling Island Road, Darling Island	47	44	39	50	54	49	46	56	WM

6 CONSTRUCTION NOISE AND VIBRATION ASSESSMENT

6.1 GENERAL

The principal objective of this study is to undertake an evaluation of works to be performed during the operation of the various activities during construction and develop a management plan to ensure noise and vibration:

1. Does not excessively impact on the sensitive receivers.
2. Is monitored when potentially high noise and vibration generating activities are being used.

This assessment will formulate/present the relevant noise and vibration management levels which will be used to manage impacts from construction activities. Mitigation measures have been recommended that are used to control noise and vibration impacts.

The principal issues to be addressed in this section are:

- Identification of the noise and vibration guidelines which will be applicable to this project.
- Formulation of a strategy for construction activities to comply with the guidelines identified.
- Development of construction methods which will minimise the impact on surrounding uses in accordance with the guidelines.

The expected activities are described in Section 4.3.

6.2 CONSTRUCTION NOISE MANAGEMENT LEVELS

Noise emanating from the construction site has been assessed with reference to the recommendations of the EPA ICNG.

The guideline reflects on feasible and reasonable mitigation strategies, management controls and public liaising in the effort to reach realistic compromises between construction sites and potential noise affected receivers.

Table 2 - Construction Noise Management Levels

Management Level L_{Aeq,(15min)}	How to Apply
Noise affected RBL + 10dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured L _{Aeq (15 min)} is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur

Where construction works may be required to be undertaken outside of normal construction hours, following is typically adopted.

Table 3 – Construction Noise Management Levels- Out of Normal Hours

Management Level L_{Aeq,(15min)}	How to Apply
Noise affected RBL + 5dB	<p>A strong justification would typically be required for works outside the recommended standard hours.</p> <p>The proponent should apply all feasible and reasonable work practices to meet the noise affected level.</p> <p>Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community</p>

The ICNG provides guidance on construction noise management levels for sensitive uses other than residential dwellings. These uses as detailed in the following table.

Table 4 – Construction Noise Management Levels – Non Residential Uses

Land Use	Management Level, L_{Aeq (15min)} (applies when properties are being used)
Commercial and Retail Outlets	70dB(A)

A summary of noise emission management levels for both standard hours of construction and outside standard hours are presented.

Table 5 – Construction Noise Emission Objectives

Location	Time of Day	“Noise Affected” Level dB(A) L_{eq (15min)}	“Highly Noise Affected” Level dB(A)L_{eq(15min)}
Residences	Standard construction hours	RBL + 10	75
	Outside recommended standard hours	RBL + 5	-
Active Recreation	Day	65	
Passive Recreation	Day	60	
Classrooms at Schools (Child Care Centre)	Day	45 (internal)	
Commercial Development	When in use	70	N/A

The NML's for the most impacted receivers are summarised in the following table using the objectives tabled above and the adopted background noise levels.

Table 6 – Noise Management Levels for Most Impacted Receivers

Location/Receiver	Adopted Background dB(A) L₉₀	NML dB(A) L_{eq}	HANML dB(A) L_{eq}
Balmain	49	59	75
Darling Point	47	57	75
Casino Podium/Hotel	-	70	-
Casino Residential	52	62	75
Lend Lease Residential	52	62	75
Barangaroo Commercial	-	70	-
Hickson Road Commercial	-	70	-
High Street Residences	47	57	75
Hickson Road Residences	53	63	75
High Street Child Care Centre	-	45 internal* 65 external in play area	-
Kent Street Residences	52	62	75
Barangaroo Reserve	-	60	-
Commercial Receivers to North	-	70	-
Residential Receivers to North	46	56	75

* An external noise level of 65 dB(A) would result in an internal noise level of 45 dB(A) assuming a typical 20 dB(A) reduction for a standard façade. Therefore, compliance with the external NML will also result in compliance with the internal NML.

6.3 CONSTRUCTION VIBRATION MANAGEMENT LEVELS

6.3.1 Amenity Management Generally

Vibration goals for the amenity of nearby land users are those recommended by the EPA document *Assessing Vibration: A technical guideline*. These levels (extracted from the guideline) are presented below for various types of vibration:

Table 2.2 Preferred and maximum weighted rms values for continuous and impulsive vibration acceleration (m/s²) 1–80 Hz

Location	Assessment period ¹	Preferred values		Maximum values	
		z-axis	x- and y-axes	z-axis	x- and y-axes
Continuous vibration					
Critical areas ²	Day- or night-time	0.0050	0.0036	0.010	0.0072
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day- or night-time	0.020	0.014	0.040	0.028
Workshops	Day- or night-time	0.04	0.029	0.080	0.058
Impulsive vibration					
Critical areas ²	Day- or night-time	0.0050	0.0036	0.010	0.0072
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day- or night-time	0.64	0.46	1.28	0.92
Workshops	Day- or night-time	0.64	0.46	1.28	0.92

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

² Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. There may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria specified above. Stipulation of such criteria is outside the scope of this policy, and other guidance documents (e.g. relevant standards) should be referred to. Source: BS 6472–1992

Table 2.4 Acceptable vibration dose values for intermittent vibration (m/s^{1.75})

Location	Daytime ¹		Night-time ¹	
	Preferred value	Maximum value	Preferred value	Maximum value
Critical areas ²	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

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

² Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous or impulsive criteria for critical areas. Source: BS 6472–1992

6.3.2 Infrastructure Assets

Nearby infrastructure includes Sydney Water and Sydney Metro assets.

6.3.2.1 Metro

Construction activities will occur near Metro assets, and management of activities may be required in order to protect these assets.

Transport for NSW, Sydney Metro – Technical Services – *Sydney Metro Underground Corridor Protection Technical Guidelines* (dated 16th October 2017, Reference: NWRLSRT-PBA-SRT-TU-REP-000008, Revision 1) provides noise and vibration criteria. The relevant sections from this document are provided below.

All construction activities should have regard for the requirements of the guideline and monitoring requirements imposed by Clause 9.3.

9.3 Noise and vibration

The noise from construction and rail operation must be considered against statutory and project noise vibration limit requirements. TfNSW does not accept liability for the generation of noise and vibration from normal railway operations (including track maintenance), or for its transmission into developments above or adjacent to rail tunnels.

When designing developments above or adjacent to rail tunnels (existing or planned), consideration must be given to operational and construction vibration; as well as ground or structure borne noise emissions in accordance with *Developments Near Rail Corridor and Busy Roads – Interim Guideline*, Department of Planning, NSW Government 2008.

In planning development construction the following requirements apply.

Any development that occurs within a screening distance of 25 m horizontally from first reserve must consider the vibration on the metro infrastructure with the following assessment criteria of maximum peak particle velocity (PPV):

- 15 mm/s for tunnel and cavern cast insitu concrete linings that are in good condition.
- 20 mm/s at the running tunnels supported using a precast concrete segment lining.

It is important to note that more stringent limits may apply if rail equipment, that is sensitive to vibration, has the potential to be affected by the development and its construction.

During development construction vibration monitoring may be required of the underground metro support, such as concrete linings. This monitoring must be conducted based on the selection of appropriate trigger levels.

If the vibration levels exceed tolerable limits, then the developer must modify the construction methodology in such a way that the vibration limits are satisfied.

Figure 4: Extract of Section 9.3 Noise and Vibration

6.3.2.2 Sydney Water

There is an existing sewer pump station located immediately to the south of the site. The location is indicated in Appendix C. Aqualand are consulting regularly with SW and INSW regarding the Pump Station. Vibration considerations will be made during the detailed design of the piling wall and selection of equipment. In the absence of any vibration level criteria from Sydney Water, a limit of 20 mm/s peak particle velocity will be used, corresponding to the lower end of the range for commercial and industrial buildings (refer below).

6.3.3 Other Structures

In addition to amenity management levels, higher vibration limits are imposed to generally protect nearby structures. 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 the following table. The peak velocity is the value of the maximum of any of the three orthogonal component particle velocities as measured at the foundation, and the maximum levels measured in the x- and y-horizontal directions in the plane of the floor of the uppermost storey.

Table 7 – DIN 4150-3 (1999-02) Safe Limits for Building Vibration

TYPE OF STRUCTURE		PEAK PARTICLE VELOCITY (mms ⁻¹)			
		At Foundation – 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

It is noted that these vibration levels are significantly higher than the corresponding amenity management levels. Therefore, compliance with the amenity levels will result in vibration that is significantly below structure damage risk levels.

6.4 ASSESSMENT OF CONSTRUCTION NOISE

With respect to general construction noise, the impacts on nearby development will be dependent on the activity in question and where on the site the activity is undertaken.

6.4.1 Construction Noise Predictions

Noise from construction activities at the surrounding receivers has been predicted using the Soundplan computer model based on the following inputs.

- ISO 9613-2:1996 “Acoustics – Attenuation of Sound During Propagation Outdoors – Part 2: General Method of Calculation” noise propagation standard.
- Meteorological Conditions – 20°C , 70% RH, neutral weather conditions.
- The following plant sound power levels (dB(A) (sourced from AS 2436 and AL database):
 - Truck – 106 at 15 km/hr driving around site, 95 idling (continuous). (2 truck movements per 15 minutes assumed worst case)
 - CFA Rig – 107 (continuous)
 - Concrete truck discharging – 103 (continuous)
 - Concrete Vibrator – 102 (continuous)
 - Tracked Excavator 103 (continuous)
 - Angle Grinder Cutting Steel 108 (5 dB added for tonality, -5 dB for time correction (operated for 5 mins in 15 minutes)
 - Crane – 104 operating, idling – 94. Assumed 50% of time lifting and 50% of time idling.
 - Bentonite pump (diesel) – 108 (continuous)
- Elevation data for the site and surrounding areas was obtained from NSW Spatial Services via the ELVIS – Elevation and Depth – Foundation Spatial Data website.
- Source heights – 2m above ground level.

6.4.2 Scenarios Modelled

A worst case assumption was made for the modelling: all operations may occur on the site simultaneously. Movable plant was modelled at two locations along length of the wall to indicate the highest and range of noise levels expected. The modelled noise sources are described below.

6.4.2.1 Secant Pile Wall Construction Generally

The plant was modelled at 2 locations (refer Figure 5) (Scenario 1 and Scenario 2) to represent noise levels from operation at both ends of the wall, with the following plant included at each location:

- Truck idling
- CFA Rig
- Tracked Excavator
- Angle Grinder Cutting Steel
- Crane

It was also assumed that the bentonite pump is operating, and one truck movement into and out of the site occurs. The modelled scenario would provide a worst case estimate given that all processes are unlikely to occur together.

6.4.2.2 Secant Pile Wall Concrete Pour

The plant was modelled at 3 locations (refer Figure 5) (Scenario 3 and 4) to represent noise levels from operation at both ends of the wall, with the following plant included at each location:

- Concrete truck discharging
- Concrete Vibrator
- One concrete truck entering and leaving site

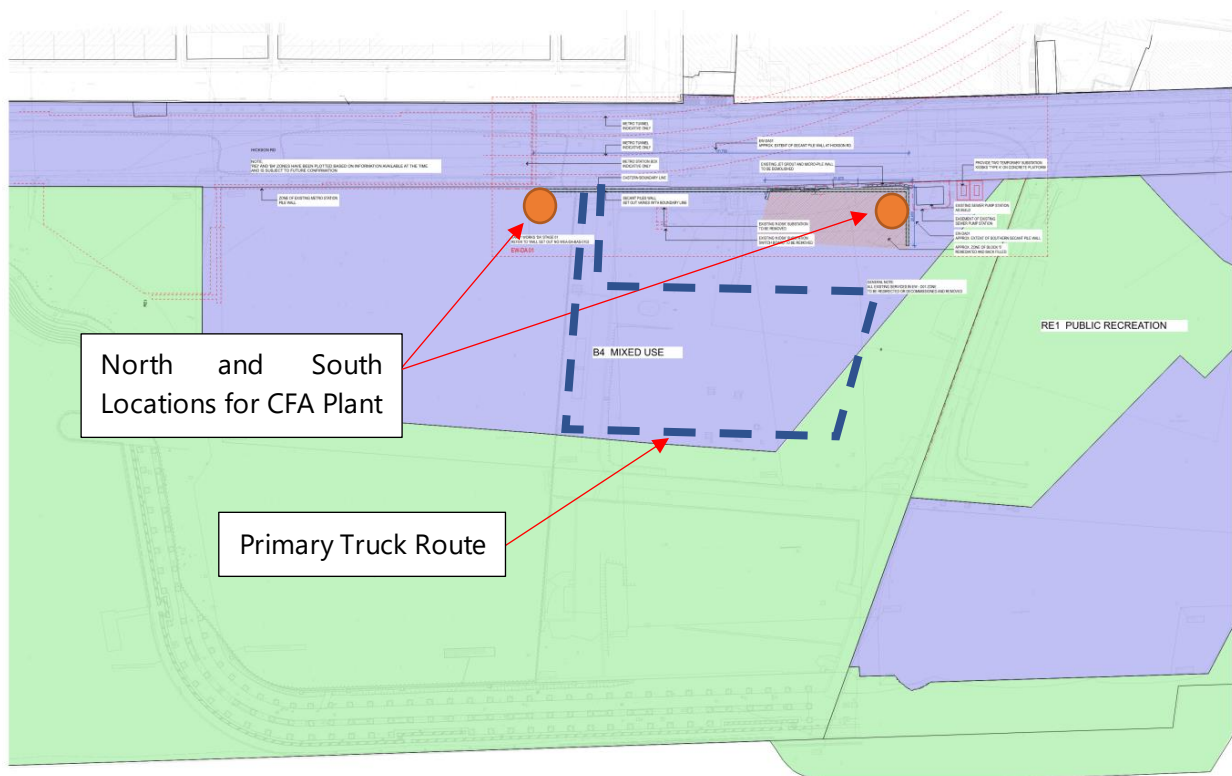


Figure 5 – Secant Wall Construction Equipment Locations

6.4.3 Predicted Noise Levels

The output of the Soundplan modelling is provided in Appendix B. The predicted noise levels are summarised in the following tables.

Table 8 – Predicted Noise Impacts - Wall Construction Generally – Scenarios 1 and 2

Location/Receiver	Highest Predicted Level dB(A) L_{eq}	NML dB(A) L_{eq}	HANML dB(A) L_{eq}	Requires Assessment of Additional Management
Balmain	48	59	75	No
Darling Point	46	57	75	No
Casino Podium/Hotel	65	70	-	No
Casino Residential	62	62	75	No
Lend Lease Residential	63	62	75	Yes
Barangaroo Commercial	55	70	-	No
Hickson Road Commercial	71	70	-	Yes
High Street Residences	67	57	75	Yes
Hickson Road Residences	62	63	75	No
High Street Child Care*	57	65	-	No
Kent Street Residences	60	62	75	No
Barangaroo Reserve*	<55	60	-	No
Hickson Park*	63	60	-	Yes
Commercial Receivers to North	53	70	-	No
Residential Receivers to North	45	56	75	No

* Assessed at 1.5m above ground level.

Table 9 – Predicted Noise Impacts - Secant Pile Wall Concrete Pour– Scenarios 3 and 4

Location/Receiver	Highest Predicted Level dB(A) L_{eq}	NML dB(A) L_{eq}	HANML dB(A) L_{eq}	Requires Assessment of Additional Management
Balmain	41	59	75	No
Darling Point	37	57	75	No
Casino Podium/Hotel	57	70	-	No
Casino Residential	54	62	75	No
Lend Lease Residential	57	62	75	No
Barangaroo Commercial	52	70	-	No
Hickson Road Commercial	65	70	-	No
Hickson Road Residences	55	63	75	No
High Street Residences	62	57	75	Yes
High Street Child Care*	53	65	-	No
Kent Street Residences	55	62	75	No
Barangaroo Reserve	<50	60	-	No
Hickson Park	58	60	-	No
Commercial Receivers to North	45	70	-	No
Residential Receivers to North	40	56	75	No

* Assessed at 1.5m above ground level

The analysis indicates that:

- No receiver will be subject to noise exceeding the HANML.
- With the exception of the nearest receivers on Hickson Road, no commercial receiver will be subject to noise exceeding the NML. The exceedance of the NML at the Hickson Road commercial receivers opposite the site is 1 dB(A).
- There are 2 residential receivers that will be subject to noise exceeding the NML. These being:
 - the closest residents in the Lend Lease Tower for which a marginal exceedance of 1 dB(A) is predicted during construction.
 - Approximately 25 residences in High Street south of Argyle Lane where an NML exceedance of up to 10 dB(A) is predicted during piling depending on the location of the plant along the wall being constructed.
- Noise to the Barangaroo Reserve would not exceed the NMLs. Noise levels in Hickson Park will exceed the NML's by up to 3 dB(A) when piling close to the southern boundary.

The predicted exceedances at the Hickson Road commercial and Lend Lease Towers are 2 dB(A) or less. To assess whether mitigation of these exceedances is feasible or reasonable" the IGNG indicates the following should be considered:

- The levels of impact including noise levels and the number of people affected.
- The benefits of noise mitigation and the number of people protected.
- Cost effectiveness of mitigation.
- Community views.

As a noise level difference of 2 dB(A) is not readily perceptible, the number of impacted receivers is small in each case, and the exceedances will only occur when plant is operating on the part of the site closest to the receiver, any significant mitigation for these receivers is not indicated beyond "good practice" management of the works.

For the High Street residences south of the child care centre, this preliminary assessment indicates that feasible and reasonable noise mitigation would need to be investigated to by the contractor to minimise noise impacts, based on the procedures and methods in Section 7 and the ICNG.

The most effective mitigation investigation strategy is likely to be:

- Select the quietest plant/activity available (or retrofit acoustic treatment to the plant such as residential class mufflers) to minimise any NML exceedances.
- If any residual exceedances, investigate the use of additional barriers to screen the affected receivers. It is noted that there is an existing approximately 2m high hoarding on the boundary of the site.
- If any remaining residual significant exceedances, investigate time restrictions (e.g. avoiding loud early morning works at the residences and Saturday afternoon works to limit construction noise to "background + 5 dB(A)) and notification of affected receivers when works likely to exceed the NML's is likely to occur.

Regarding impacts are Hickson Park it is noted that:

- There is already a hoarding that separates the subject site from the park that provides a noise barrier.
- The exceedances only occur when the piling rig is being used close to the southern boundary, and even these exceedances are minor. For other operations and times, noise levels are predicted to be compliant.

For the reasons outlined above, additional mitigation for this receiver is not indicated.

6.5 CONSTRUCTION VIBRATION

The available literature indicates that vibration produced by the proposed CFA piling is negligible, and is the preferred method when working near vibration sensitive structures. The proposed activities would not generate significant ground vibration and it expected that ground vibration from the proposed activities will be well below the recommended vibration limits and management levels at all receivers.

6.6 TRAFFIC GENERATION ON EXISTING ROADS

The proposed works will generate 6 movements per hour typically, and an additional 8 movements per hour during concrete pours. Compared to existing traffic volumes on Hickson Road, this is a relatively small volume of traffic that would not cause a noticeable change in traffic noise experienced at properties along Hickson Road.

6.7 CONSTRUCTION OUTSIDE OF EPA NORMAL HOURS

The predictions indicate that the main noise producing activities (CFA piling and concrete pours) will generate noise levels exceeding the after hours NML's for Saturday afternoon (and other after hours periods). The IGNG guidelines would not normally permit these activities to occur after normal hours without justification.

The City of Sydney Construction Noise Code regards Saturday morning between 7am and 8am and Saturday afternoon as a "normal" construction period, with a criterion of "background + 5 dB(A)". Construction on sites outside of Barangaroo surrounding the residences would be governed by this code. On this basis, consideration should be given to including Saturday afternoon as part of "normal construction" for the subject site, given the predicted impacts are moderate, Saturday afternoons represents a more benign period for the nearby commercial buildings, and will and there is a corresponding benefit to all surrounding properties of a reduction in the overall construction period.

Time of use restrictions for high noise impact activities apply to Saturday works outside the normal EPA construction hours, and other activities not producing significant noise (e.g. maintenance) could occur on Saturday afternoons until 6pm without impacting the surrounding properties. (Refer Section 7.1.7).

7 NOISE AND VIBRATION MANAGEMENT AND CONTROL

The flow chart that follows illustrate the process followed to assess construction activities prior to the start of work on site and well as the ongoing investigation into noise during the construction period.

7.1 NOISE CONTROL METHODS

The determination of appropriate additional noise control measures will be dependent on the particular activities and the construction equipment and plant identified as requiring future acoustic treatments to those already identified in this report. This section provides an outline of available methods which have previously been used on similar construction sites and may be possible on this site.

7.1.1 Selection of Alternate Appliance or Process

Where a particular activity or plant and equipment is found to generate noise levels that exceed the management levels, it may be possible to select an alternative approach or plant and equipment. For example; the use of excavator mounted hydraulic hammers of the site may potentially generate high levels of noise. By carrying this activity by using concrete saws or smaller plant here practical, construction noise levels and/or length of exposure to construction noise levels may be reduced.

7.1.2 Acoustic Barriers

The placement of barriers at the source is generally only effective for static plant. Placing barriers at the source cannot effectively attenuate equipment which is on the move or working in rough or undulating terrain.

The degree of noise reduction provided by barriers is dependent on the amount by which the line of sight can be blocked by the barrier. If the receiver is totally shielded from the noise source reductions of up to 15 dB(A) can be effected. Where only partial obstruction of line of sight occurs, noise reductions of 5 to 8 dB(A) may be achieved. Where the barrier does not obstruct line of sight, generally no noise reduction will occur.

Barriers are used to provide shielding and do not act as an enclosure. The material they are constructed from should have a noise reduction performance which is approximately 10dB(A) greater than the maximum reduction provided by the barrier screening. In this case, the use of a material such as 15mm plywood (or equivalent material) would be acceptable for the barriers.

7.1.3 Silencing Devices

Where construction methodologies or plant and equipment permit, investigate the use of silencing devices. These may take the form of engine shrouding, or special industrial silencers fitted to exhausts, for example.

7.1.4 Treatment of Specific Equipment

In certain cases it may be possible to specially treat a piece of equipment to dramatically reduce the sound levels emitted.

7.1.5 Establishment of Site Practices

This involves the formulation of work practices to reduce noise generation. This includes investigating the possibility of locating fixed plant items as far as possible from residents as well as rotating plant and activities to provide respite to receivers.

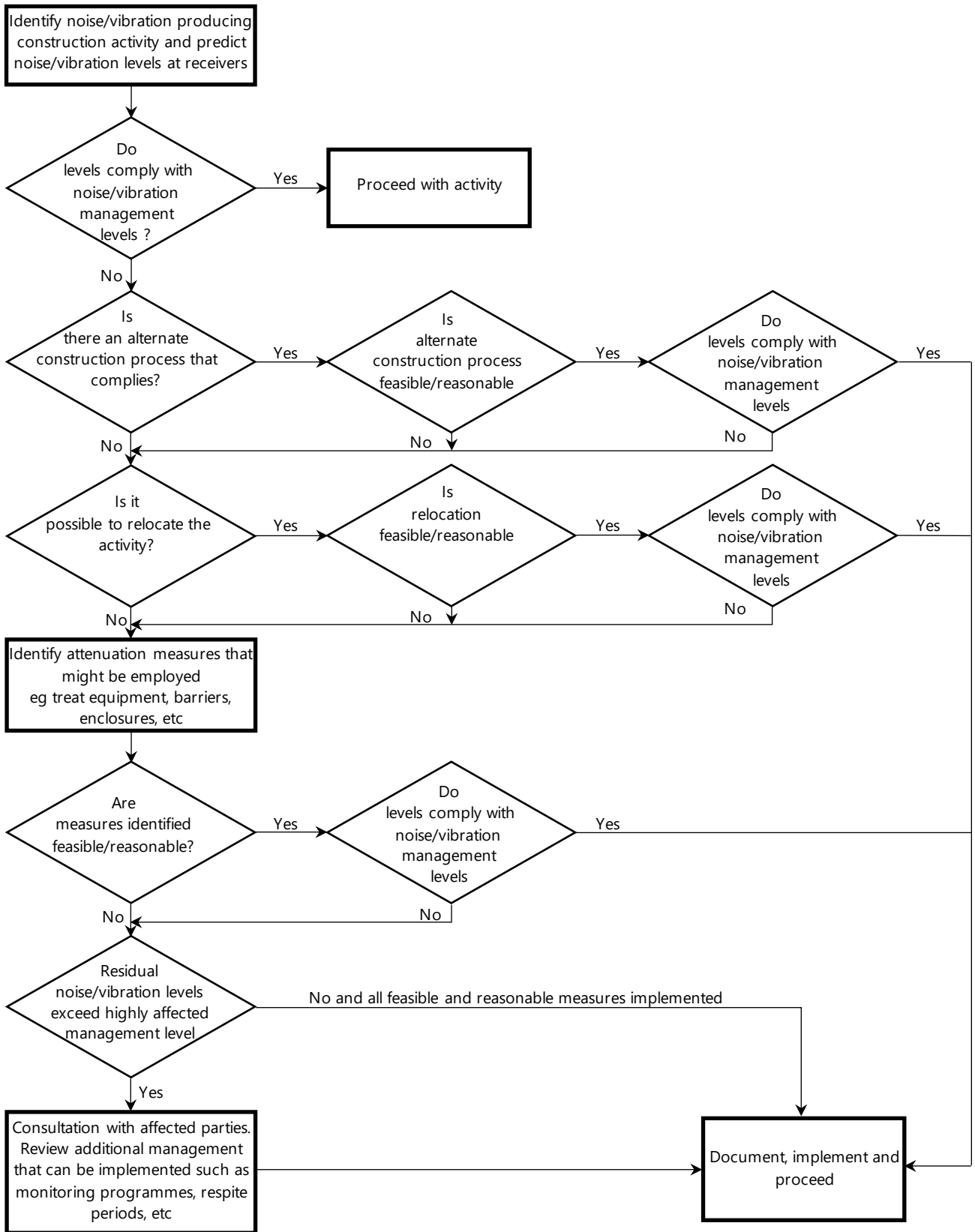


Figure 6: Process Flowchart

7.1.6 Notification

Notification of affected receivers of the progress of works, particularly when short-term activities likely to create higher noise levels occur, can in many cases minimise community reaction.

7.1.7 Time of Use

High noise level generating activities would be subject to additional time of use restrictions to:

- Restrict activities prior to 8am and after 1pm Saturdays to those generating noise levels complying with "background + 5 dB(A)"
- Provide respite for high noise impact activities. These activities will be limited to continuous blocks of no more than 3 hours, with at least one hour respite between each block of work generating high noise impact, where the location of the work is likely to impact the same receivers.

7.2 NOISE AND VIBRATION MANAGEMENT PLAN

It is recommended that a project specific noise and vibration management plan be undertaken on behalf of the contractor prior to commencing works to manage noise and vibration impacts. The plan should be revised as the works proceed in response to changing or latent conditions and to incorporate the results of additional analysis, monitoring or modified work practices implemented to minimise impacts.

The management plan should be prepared in accordance with IGNG and AS 2436 guidelines and include:

- Identification of sensitive receivers and applicable noise and vibration management levels.
- A description of the main noise or vibration producing activities, processes and equipment that will be employed and an indicative construction programme.
- Proposed construction hours.
- A prediction of likely noise/vibration levels at the most impacted receivers.
- The assessment and recommendation of mitigation methods to be applied where the predicted levels exceed the management levels.
- A monitoring plan including the type and extent of monitoring, reporting procedures.
- Recommended management procedures including complaints handling, response to monitoring exceedances, reporting, site training, etc.
- Community liaison.

7.3 NOISE AND VIBRATION MONITORING, REPORTING AND RESPONSE PROCEDURES

Noise and vibration monitoring may either consist of manned and/or unmanned measurements. Active monitoring may be undertaken during the construction work phase of the project if required in the event complaints are received from neighbours.

In the event that complaints are received from neighbours the following process should be considered:

1. Assessing impacts and determining the offending plant/equipment/process and.
2. Locating the plant/equipment/process further away from the affected receiver(s) if possible.
3. Implementing additional acoustic treatment in the form of localised barriers, silencers etc.
4. Selecting alternative equipment/processes

Where monitoring is required and indicates exceedances of the predicted noise impacts immediate action should be taken to identify any further controls as required to reduce noise emissions so that the noise limits are complied with. Monitoring of the activities following the implementation of these additional controls will be undertaken to confirm compliance.

7.3.1 Reporting Requirements

The following is an example of reporting which may be kept on site;

1. A register of complaints received/communication with the local community shall be maintained and kept on site with information as detailed below.
2. Where noise/vibration complaints require noise/vibration monitoring, results from monitoring shall be retained on site at all times.
3. Any noise exceedances occurring including, the actions taken and results of follow up monitoring.
4. A report detailing complaints received and actions taken shall be presented.
5. All monitoring and reporting shall be conducted in conjunction with the conditions of consent.

7.3.2 Response Procedures

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

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

- The name and address of the complainant (if provided).
- The time and date the complaint was received.
- The nature of the complaint and the time and date the noise was heard.
- The name of the employee who received the complaint.
- Actions taken to investigate the complaint, and a summary of the results of the investigation.
- Indicate what operations were occurring on site at the time of the complaint.
- Required remedial action, if required
- Validation of the remedial action.
- Summary of feedback to the complainant.

7.4 BACKGROUND AND NOISE MANAGEMENT LEVELS

Prior to works commencing, should the proposed works associated with this development application be carried out following the completion of the other works in the vicinity, background noise levels at the nearby residential receivers in High Street, Casino and the Lend Lease residential development (as a minimum) should be reconfirmed using long term measurements of background noise levels in accordance with Fact Sheet B of the EPA Noise Policy for industry (2117) and the management levels adjusted accordingly. Otherwise, additional short term monitoring of background noise levels during designated builder's rostered days off (if available) should be undertaken to supplement the existing data.

The results of the noise monitoring should be incorporated into the noise and vibration management plan recommended in Section 7.2 and the management of noise emissions modified accordingly.

8 CONCLUSION

An assessment of noise and vibration impacts from the proposed works has been undertaken based on recommendations contained in the NSW Interim Construction Noise Guideline.

Sensitive receivers around the work site have been identified and noise and vibration management levels appropriate to the receiver have been determined based on recommendations contained in the Construction Noise Guideline.

Predictions of noise and vibration levels from the works at the sensitive receivers have been made for the proposed activities. The predictions indicate that most of the receivers around the site will not be exposed to noise or vibration levels above the management levels established for them.

There are a limited number of receivers where minor exceedances are predicted. For these receivers, normal good practice management to minimise noise emissions is recommended.

The High Street residences south of the child care centre will be exposed to noise levels up to 10 dB(A) above the applicable management levels, and the assessment of reasonable and feasible mitigation, as recommended in this report, is recommended. No residential receiver will be subject to noise exceeding the highly affected noise management level. Noise mitigation strategies have been identified and recommended for assessment prior to commencement.

Minor impacts are predicted at Hickson Park when the piling plant is located close to the southern site boundary. However, given there is already an existing site hoarding, and the exceedances are minor and occur for a limited period additional mitigation beyond the implementation of normal good practice management is not indicated.

It is not expected that vibration generated by the proposed activities will produce adverse impact at any surrounding property.

It is recommended that a detailed noise and vibration management plan be conducted on behalf of the contractor prior to the commencement of construction that identifies all main noise producing plant proposed, predicts noise impacts and develops strategies for noise management in accordance with the recommendations of this assessment, AS 2436, the Interim Construction Noise Guideline and this report.

Yours faithfully,

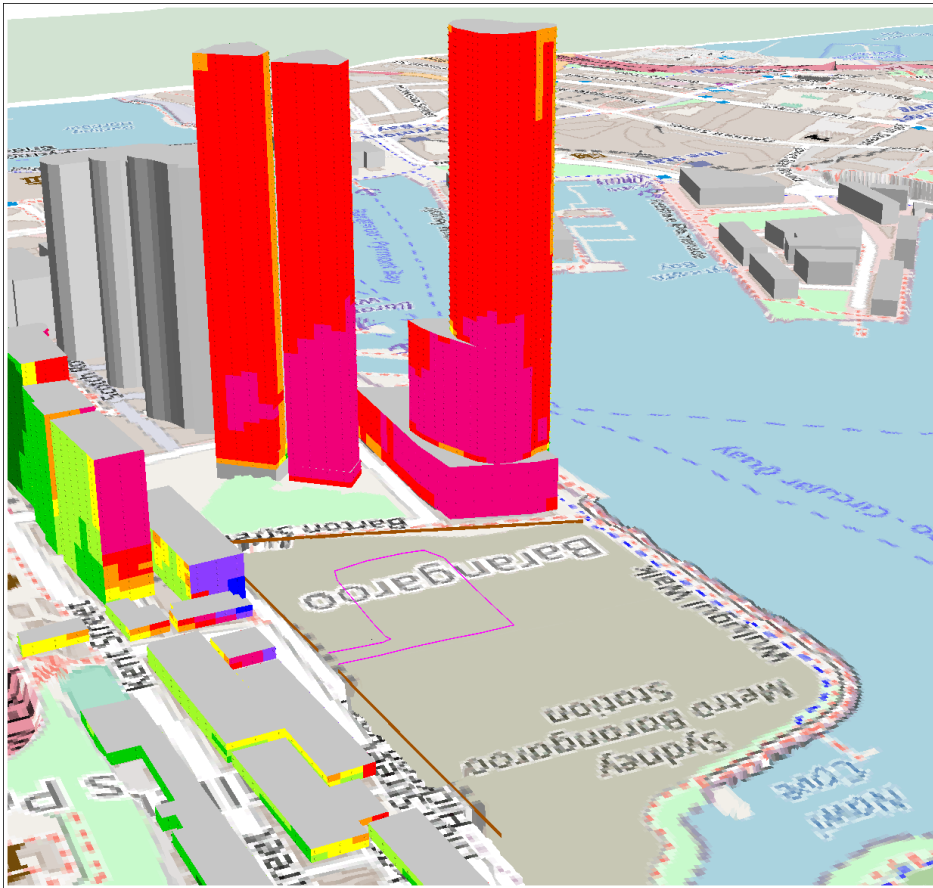


Acoustic Logic Pty Ltd
Victor Fattoretto
MAAS

APPENDIX A - PLANT SOUND POWER LEVEL SPECTRA

Plant	63	125	250	500	1000	2000	4000	8000	A-wt
CFA Rig	109	109	106	104	102	100	96	91	107
Concrete Vibrator	95	103	104	97	95	94	92	89	102
Tracked Excavator	102	108	103	101	97	94	88	79	103
Angle Grinder Cutting Steel	84	78	79	87	97	104	100	100	108
Crane	110	98	92	96	97	94	88	81	101
Crane Idling	96	87	82	84	88	85	79	71	91
Bentonite Pump	107	100	101	106	103	101	96	93	108
Truck Idle	94	91	90	89	90	89	85	72	95
Truck at 15 km/h									106

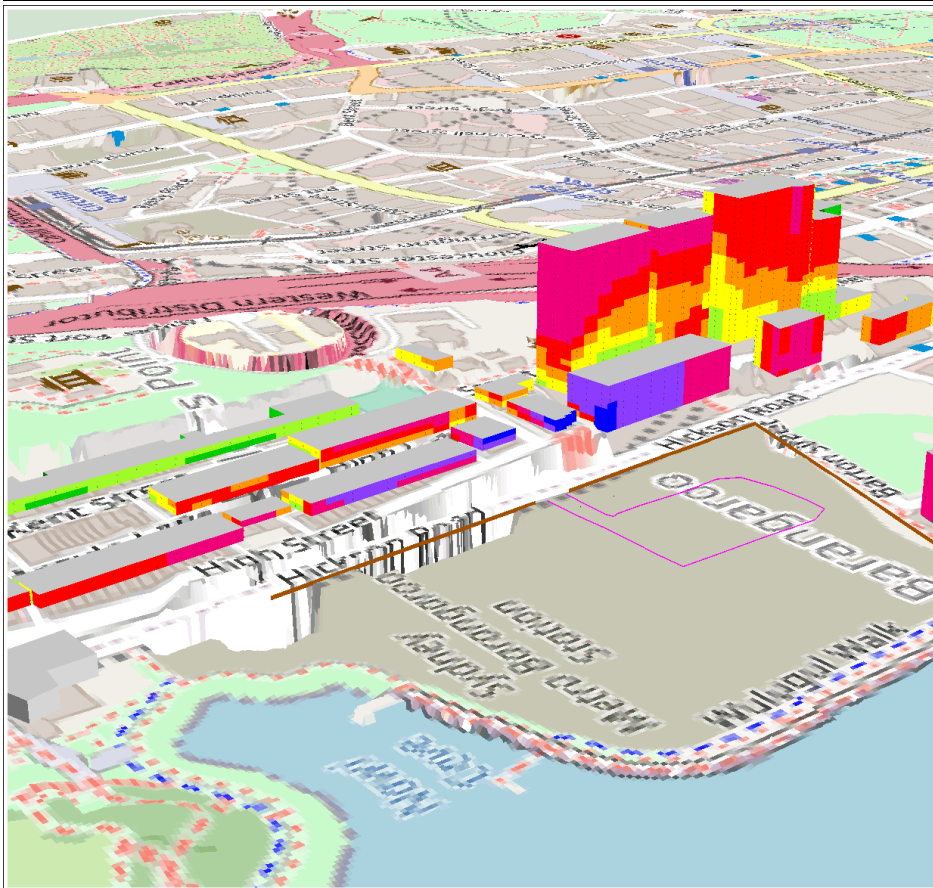
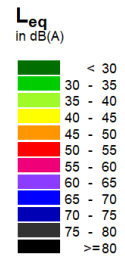
APPENDIX B – SOUNDPLAN MODELLING OUTPUTS



Central Barangaroo

Scenario 1
Facade Noise Map

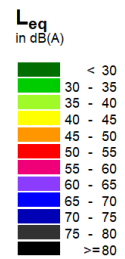
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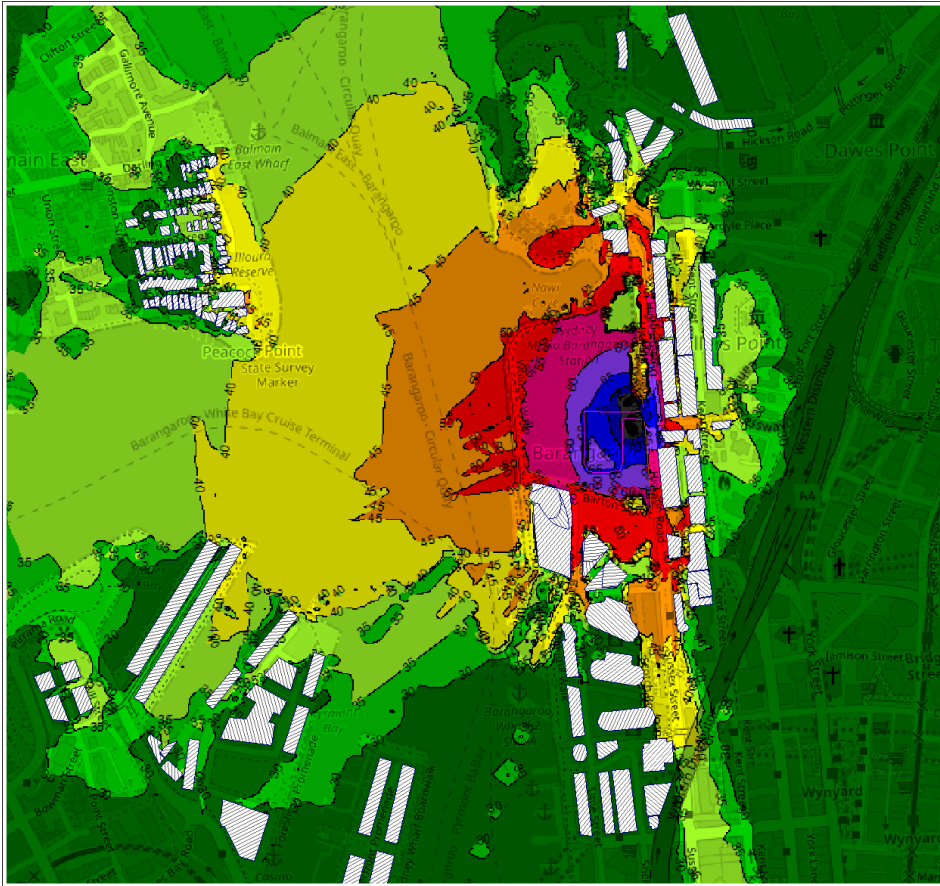


Central Barangaroo

Scenario 1
Facade Noise Map

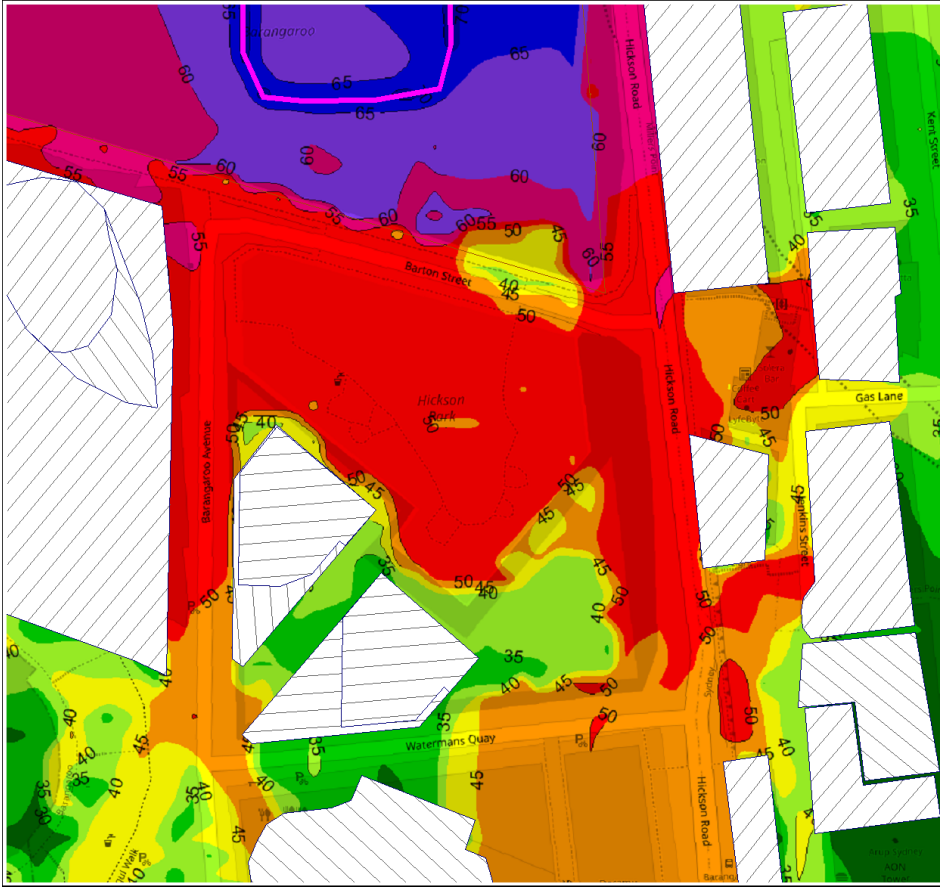
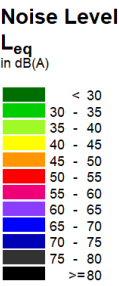
Noise Level





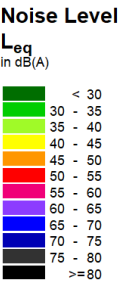
Central Barangaroo

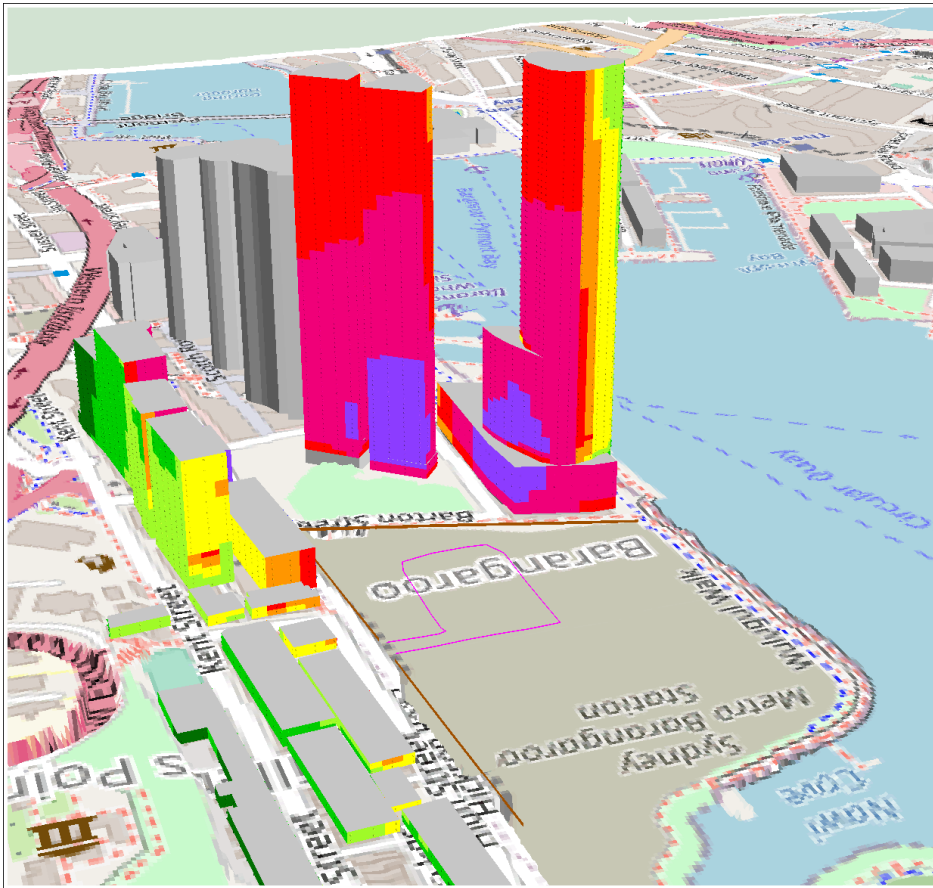
Scenario 1
 Noise Contours
 Height above ground: 1500mm



Central Barangaroo

Scenario 1
 Noise Contours
 Height above ground: 1500mm



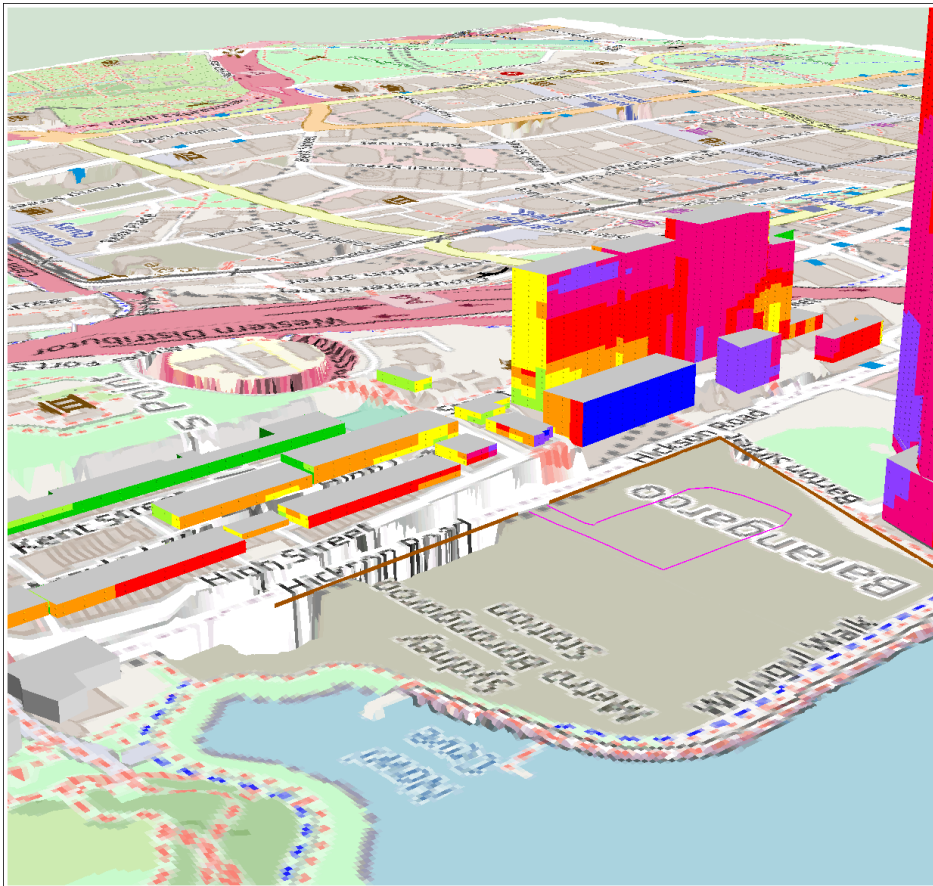
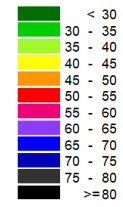


Central Barangaroo

Scenario 2
Facade Noise Map

Noise Level

L_{eq}
in dB(A)

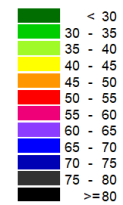


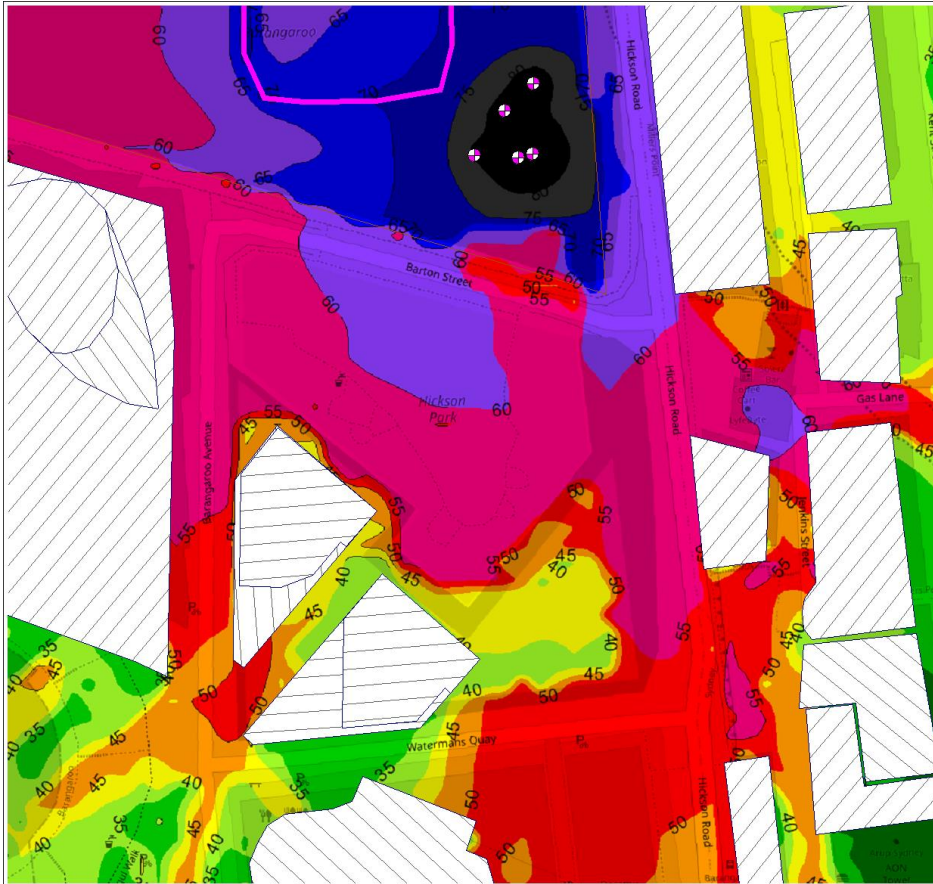
Central Barangaroo

Scenario 2
Facade Noise Map

Noise Level

L_{eq}
in dB(A)

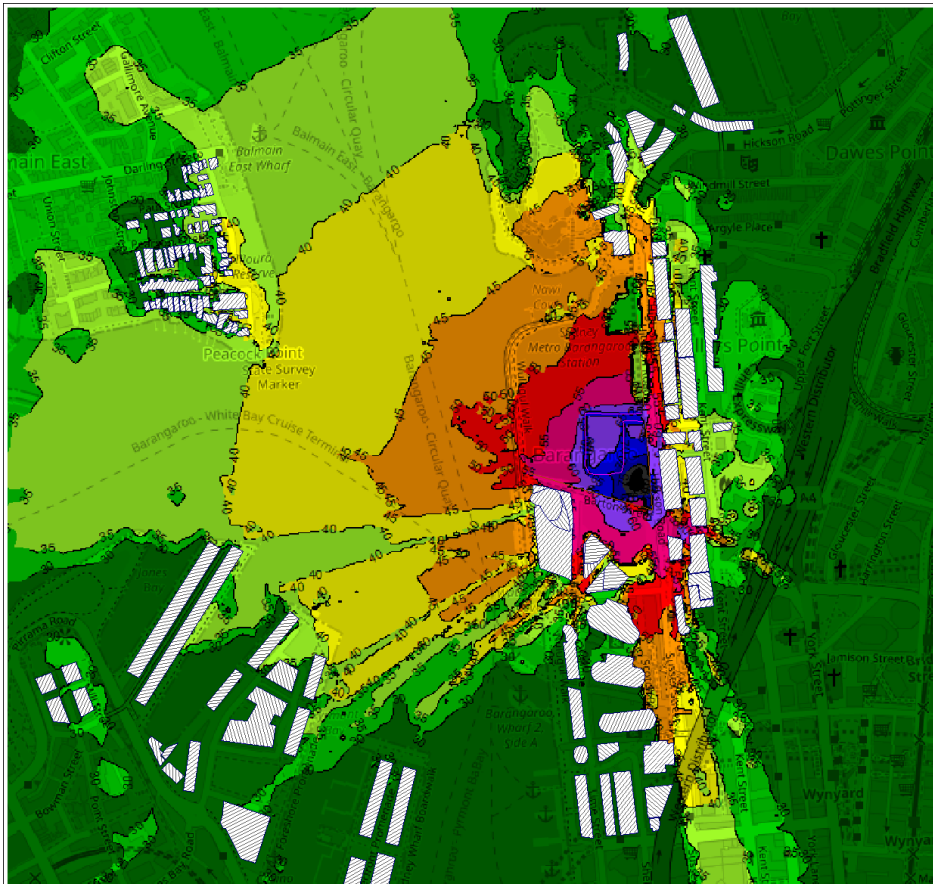
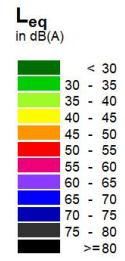




Central Barangaroo

Scenario 2
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 Height above ground: 1500mm

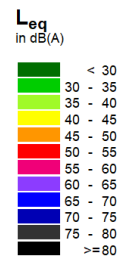
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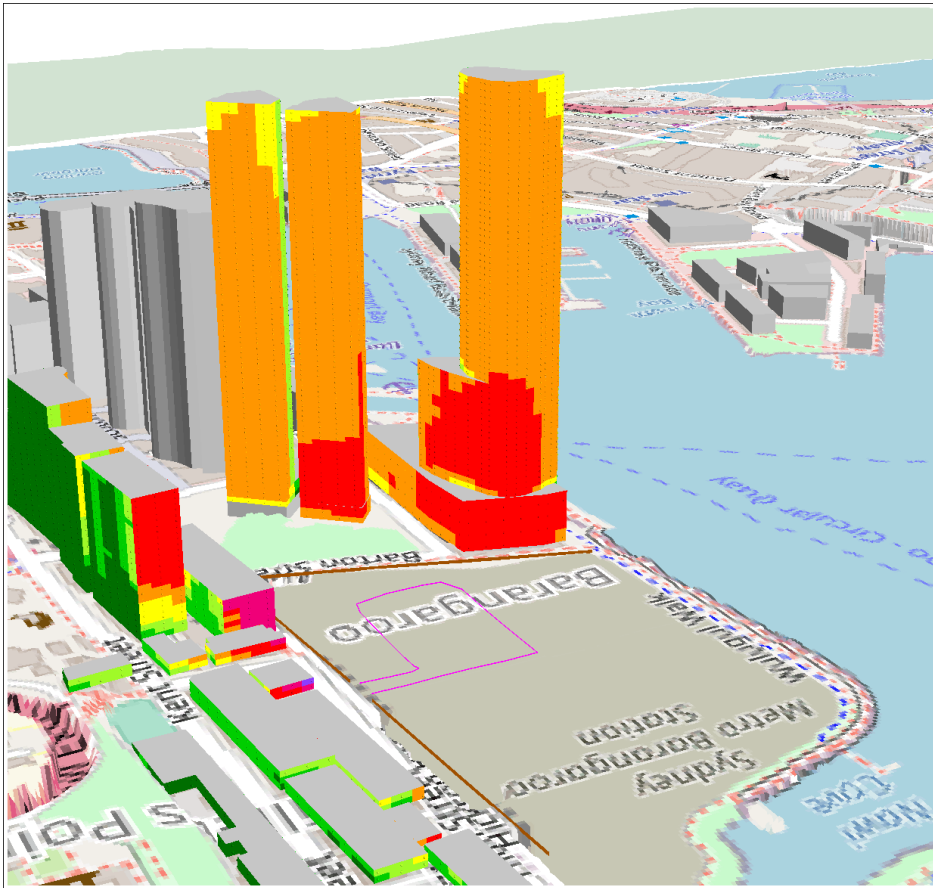


Central Barangaroo

Scenario 2
 Noise Contours
 Height above ground: 1500mm

Noise Level

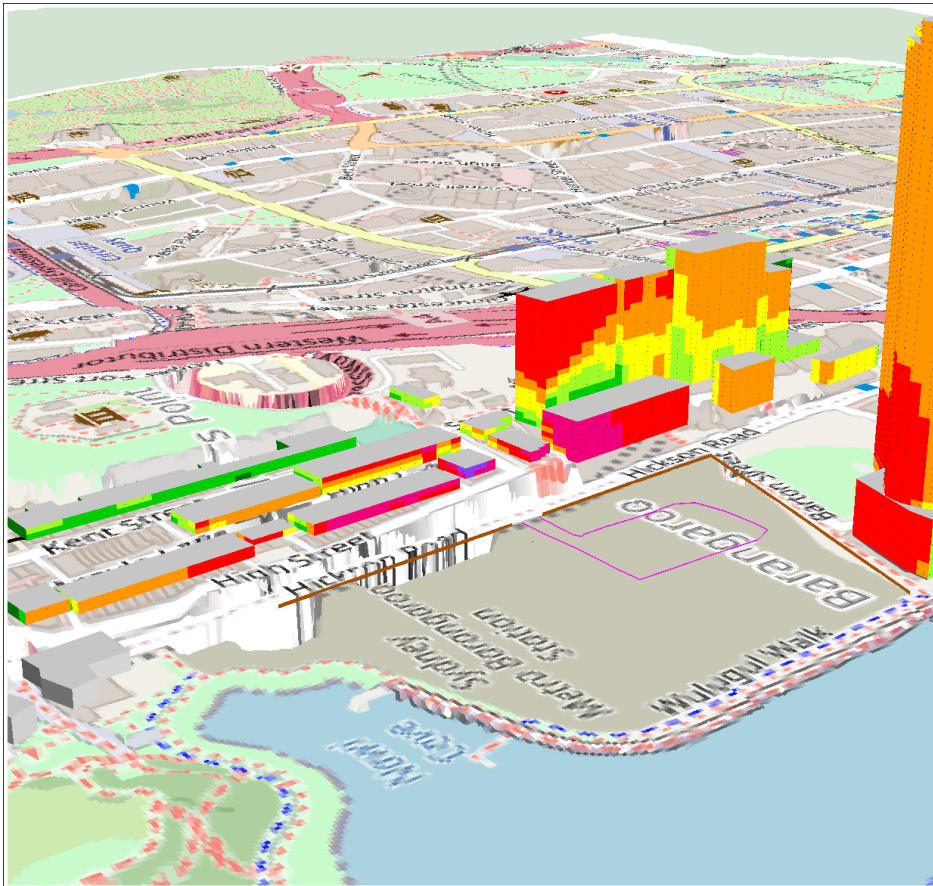
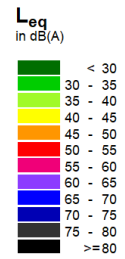




Central Barangaroo

Scenario 3
Facade Noise Map

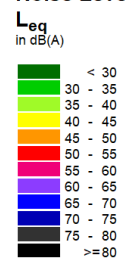
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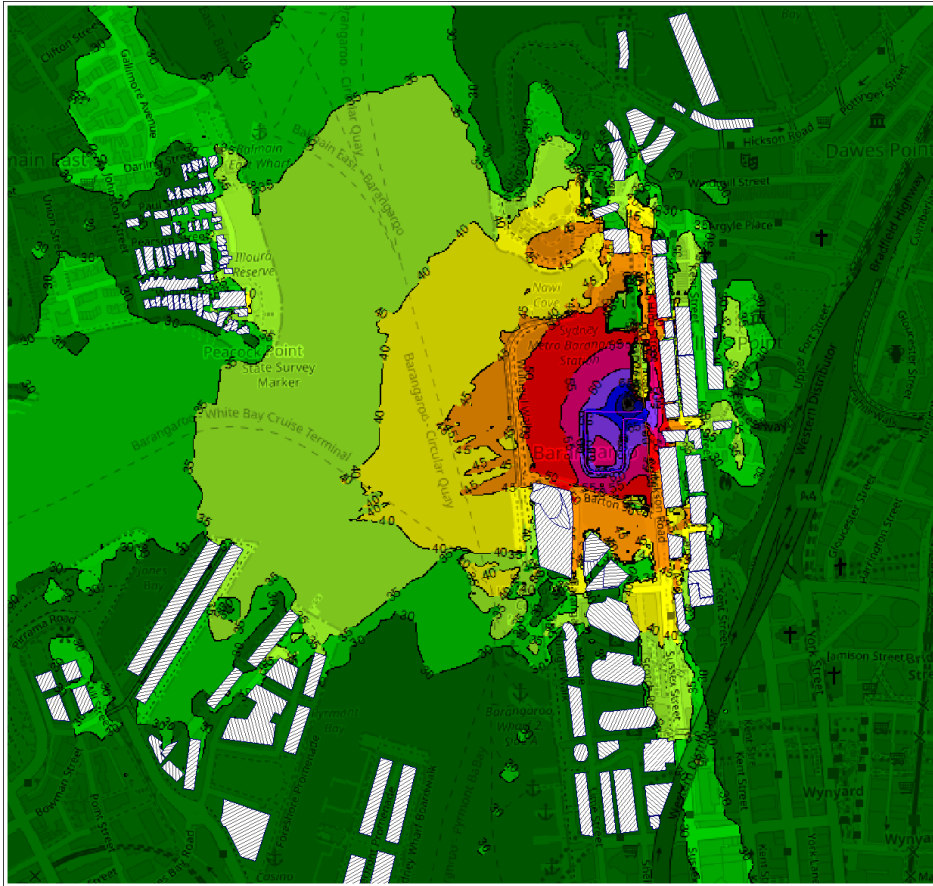


Central Barangaroo

Scenario 3
Facade Noise Map

Noise Level

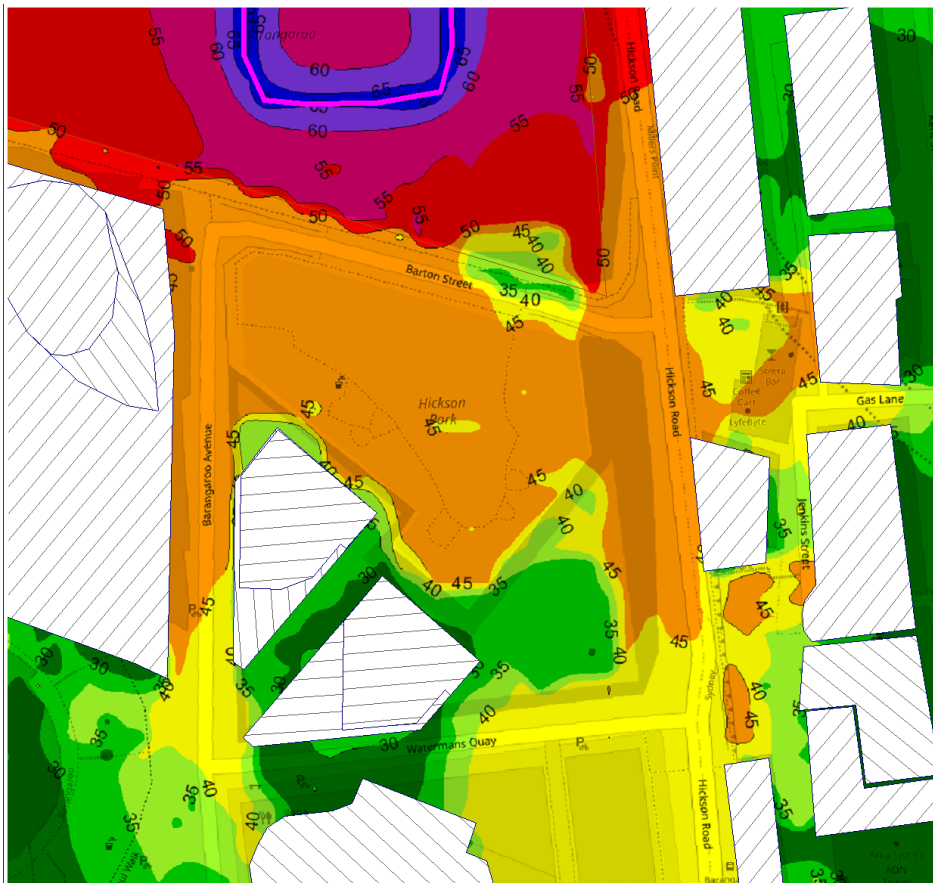
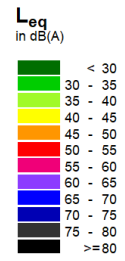




Central Barangaroo

Scenario 3
 Noise Contours
 Height above ground: 1500mm

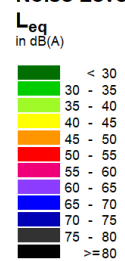
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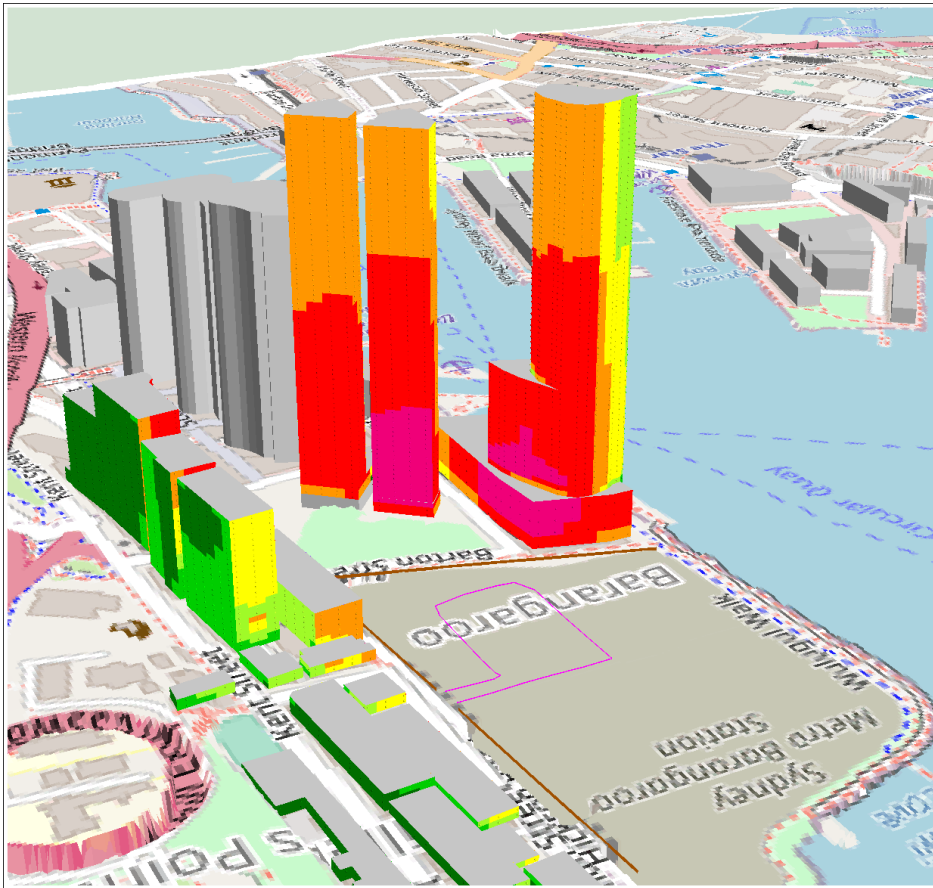


Central Barangaroo

Scenario 3
 Noise Contours
 Height above ground: 1500mm

Noise Level

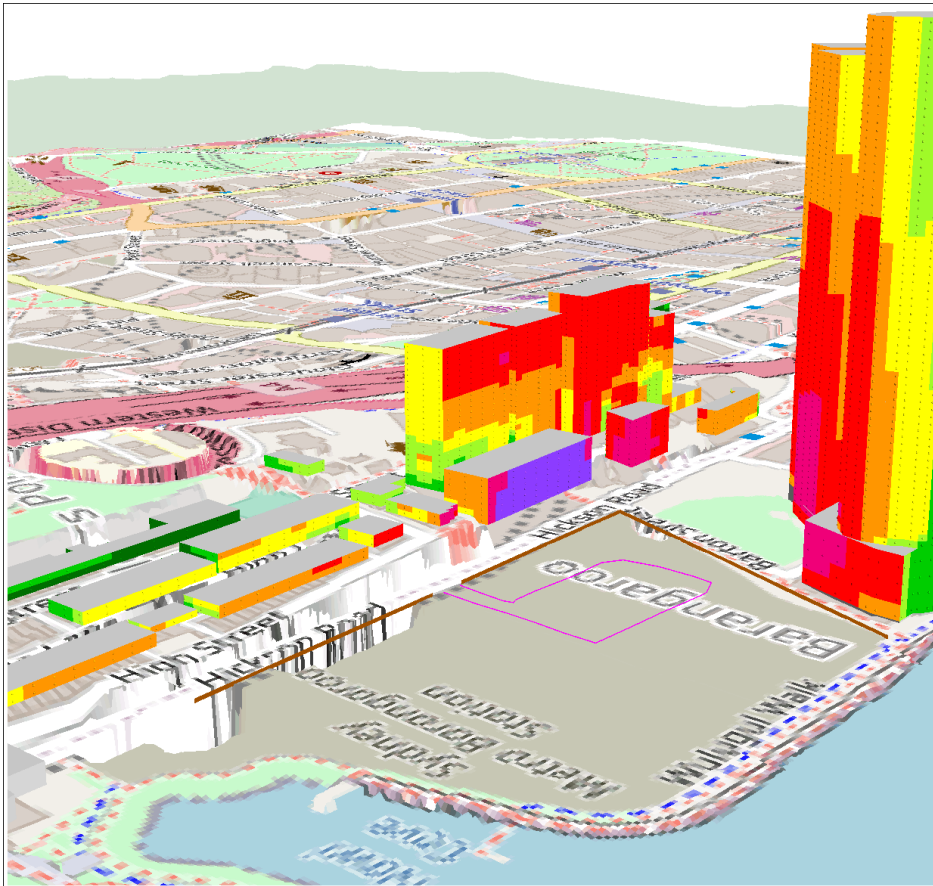
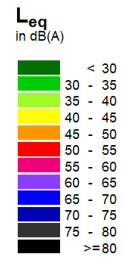




Central Barangaroo

Scenario 4
Facade Noise Map

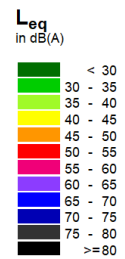
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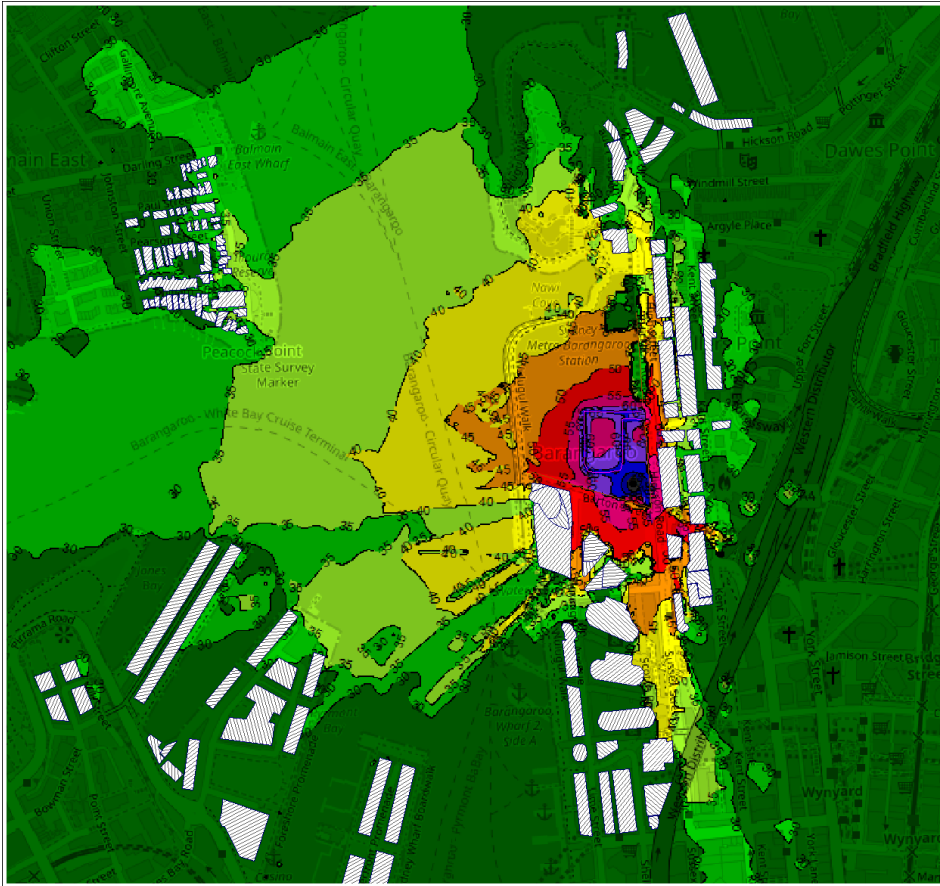


Central Barangaroo

Scenario 4
Facade Noise Map

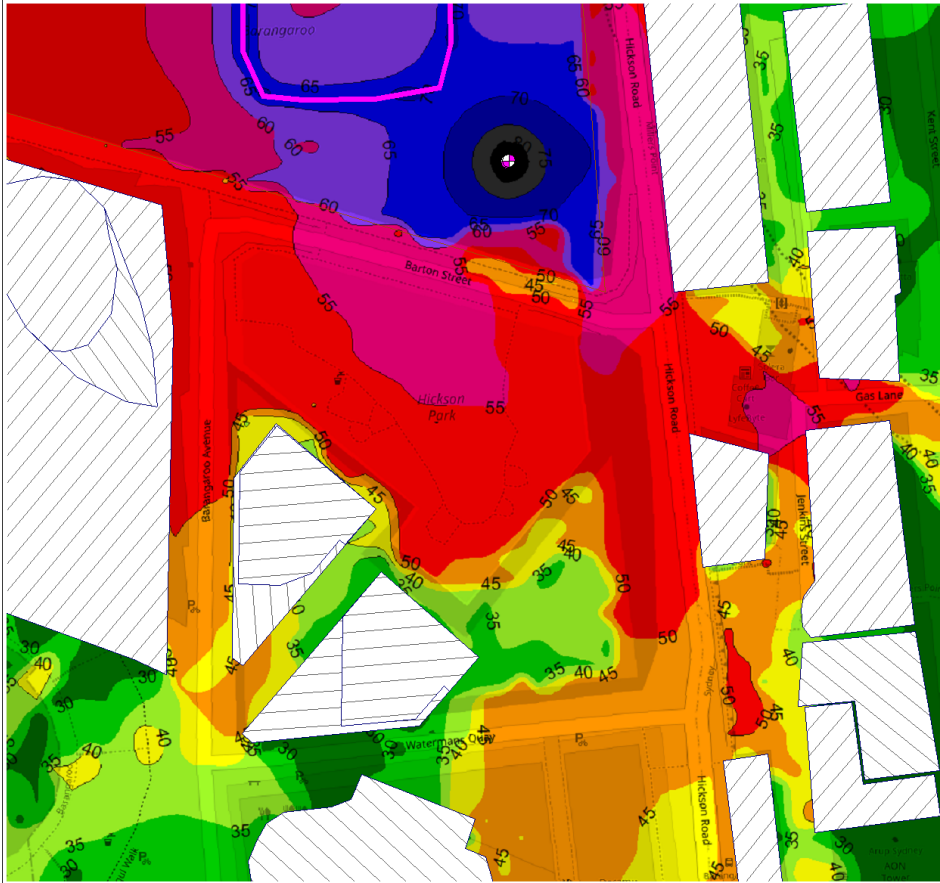
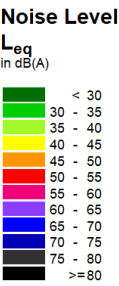
Noise Level





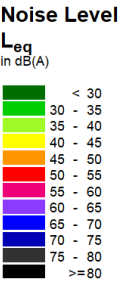
Central Barangaroo

Scenario 4
 Noise Contours
 Height above ground: 1500mm



Central Barangaroo

Scenario 4
 Noise Contours
 Height above ground: 1500mm



APPENDIX C – PROPOSED DEVELOPMENT

APPENDIX D – MONITORING LOCATIONS IN REFERENCED PREVIOUS ASSESSMENTS

Table 3-2 Long-Term Noise Monitoring Locations

Logger	Location	Monitoring Period in 2010	Company*
1	Level 4, The Bond 30-38 Hickson Rd	14 April to 29 April	Arup
2	Middle of South Barangaroo Site	14 April to 29 April	Arup
3	South West of site adjacent to Sussex St and Shelley St	14 April to 29 April	Arup
4	South of site adjacent to King Street Wharf Boulevard	14 April to 29 April	Arup
5	3 High St, Miller Point	31 August – 9 September	WM
6	18 Merriman St, Millers Point	31 August – 6 September	WM
7	25 Edward St, Balmain East	31 August – 9 September	WM
8	Adjacent to 3 Darling Island Rd, Darling Island	31 August – 9 September	WM

* Monitoring conducted by Arup and Wilkinson Murray.

Figure 3-1 Aerial showing Noise Monitoring Locations



*Source Land and Property Management Authority