

BARANGAROO SOUTH COMMERCIAL BUILDING C2 AND C6 KIOSK CONSTRUCTION AND OPERATIONAL NOISE REPORT

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TABLE OF CONTENTS

	Page
GLOSSARY OF ACOUSTIC TERMS	
1 INTRODUCTION	1
2 OVERVIEW OF PROPOSED WORKS	2
2.1 Site Location	2
3 AMBIENT NOISE MONITORING	4
3.1 Ambient Noise Levels at South Barangaroo	4
4 CONSTRUCTION NOISE ASSESSMENT	8
4.1 Construction Noise Criteria	8
4.1.1 Construction Noise Management Levels	8
4.1.2 Traffic Noise Criteria	10
4.2 Construction Equipment & Noise Source Levels	11
4.3 Construction Noise Predictions	11
4.4 Discussion of Results	14
4.5 Noise and Vibration Mitigation Measures	14
4.6 Cumulative Noise Impact	14
4.7 Construction Traffic Noise	17
5 OPERATIONAL NOISE AND VIBRATION	19
5.1 Operational Noise Criteria	19
5.2 Operational Noise Assessment and Recommendations	19
5.3 Road Traffic Noise Assessment	20
6 CONCLUSION	21

GLOSSARY OF ACOUSTIC TERMS

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph below, are here defined.

Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

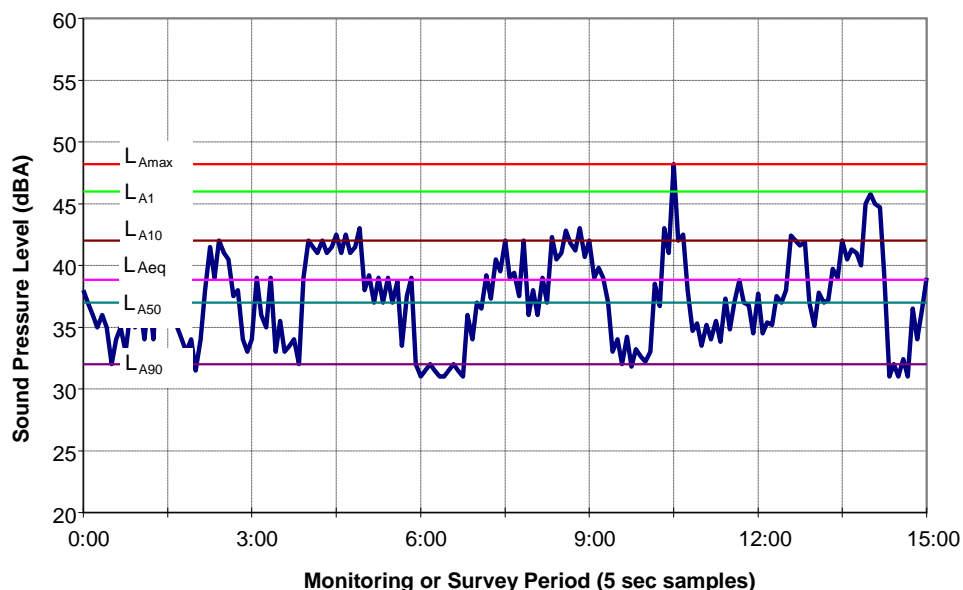
L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

ABL – The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10th percentile (lowest 10th percent) background level (L_{A90}) for each period.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period – daytime, evening and night time.

Typical Graph of Sound Pressure Level vs Time



1 INTRODUCTION

This report supports a State Significant Development Application (SSDA) (SSD 6425) submitted to the Minister for Planning and Infrastructure pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act). The SSDA seeks approval for construction of a commercial building (known as the Commercial Building C2 and C6 Kiosk) and associated works at Barangaroo South as described in the Overview of Proposed Development section of this report.

Wilkinson Murray Pty Limited has reviewed and assessed the drawings and relevant documentation prepared in respect of the Significant Development Application (SSDA) submission. Wilkinson Murray has prepared the noise and vibration assessments to support the Development Applications for all major components of the South Barangaroo project.

The assessment has taken into account the following requirements:

Identify and provide a qualitative assessment of the main noise generating sources and activities at all stages of construction (including cumulative noise), and any noise sources during operation. Outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land.

Relevant Policies and Guidelines:

- NSW industrial Noise Policy (EPA)
- Interim Construction Noise Guideline (EPA)
- Assessing Vibration: A Technical Guideline 2006 (EPA)
- NSW Road Noise Policy (EPA)
- Development Near Rail Corridors and Busy Roads (DoPI)

It is noted that the last policy is not relevant to this site.

2 OVERVIEW OF PROPOSED WORKS

The Commercial Building C2 and C6 Kiosk SSDA seeks approval for the construction works and operation within 'Stage 1A' of the Barangaroo South Site. These works include construction of the building structure, façade installation and fitout works. Including a single level retail tenancy "Kiosk" situated in Hickson Place, constructed on a raft slab on grade, with no piling works expected.

No excavation or piling works are associated with the development.

It is noted that the proposed construction activities will not generate significant levels of vibration. Therefore, the issue of construction vibration is not considered further in this report.

The operation of the building consists of normal commercial operations where noise from mechanical plant presents the main source of any potential noise emissions from the site.

2.1 Site Location

Barangaroo is located on the north western edge of the Sydney Central Business District, bounded by Sydney Harbour to the west and north, the historic precinct of Millers Point (for the northern half), The Rocks and the Sydney Harbour Bridge approach to the east; and bounded to the south by a range of new development dominated by large CBD commercial tenants.

The Barangaroo site has been divided into three distinct redevelopment areas (from north to south) – the Headland Park, Barangaroo Central and Barangaroo South.

The Commercial C2 and C6 Kiosk site area is located within Barangaroo South as shown in Figure 2-1. The SSDA Site extends over land generally known and identified in the approved Concept Plan as buildings C2 and C6.

The buildings is proposed to be a commercial A-grade building which is to consist of ground plus 6 storey building with ground floor retail and commercial office upper floors. Level 2 and above is to bridge across Union Walk and extend through to the boundary of the southern elevation.

[illegible]

3 AMBIENT NOISE MONITORING

3.1 Ambient Noise Levels at South Barangaroo

Residential and commercial receivers surrounding the site that may be affected by construction and operational noise have been identified in previous relevant applications for the Barangaroo South site. These receivers are also relevant in assessing noise impacts from the broader site. They are detailed in Table 3-1.

Table 3-1 Surrounding Receivers

Receivers	Comments
Commercial Receivers	
A – Napoleon St	Aon Australia Building Symantec Building
B – 30 Hickson Rd	Top Floor Cafe, Lend Lease offices,
C – Lime St, (King Street Wharf)	Commercial office Retail including indoor / outdoor cafes
D – 37 High St, Millers Point	KU Lance Preschool and Children’s Centre
F – Shelley St	Commercial on Cnr of Sussex and Shelley St Commercial on Cnr of Lime and Shelley St
Residential Receivers	
G – 38 Hickson Rd	Multi storey residential building
H – High St, Millers Point	Terrace residences
I – Merriman St, Millers Point	Double storey unit blocks and single storey houses
J – Dalgety Rd, Millers Point	Double storey Community housing
K – Edward St and Little Edward St, Balmain East	Waterfront properties along Balmain peninsula
L – Northern end of Darling Island Rd and Wharf Cr, Darling Island	Multi storey high end apartments
M – Northern end Sydney Wharf Pirrama Rd, Pyrmont	Multi storey high end apartments
Heritage Receivers	
N – Former Grafton Bond Store, Hickson Rd, Millers Point	Former Grafton Bond Store Building
O – 20-26 Sussex St , Sydney	The Sussex Hotel – Former Moreton's Hotel
P – 2-4 Jenkins St	Former MWS stores

In order to quantify the existing noise environment, long-term ambient noise levels were monitored at eight (8) locations surrounding the site, selected to cover the range of environments in the potentially affected areas.

The locations are presented in Table 3-2. The noise logger locations are shown in Figure 3-1.

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

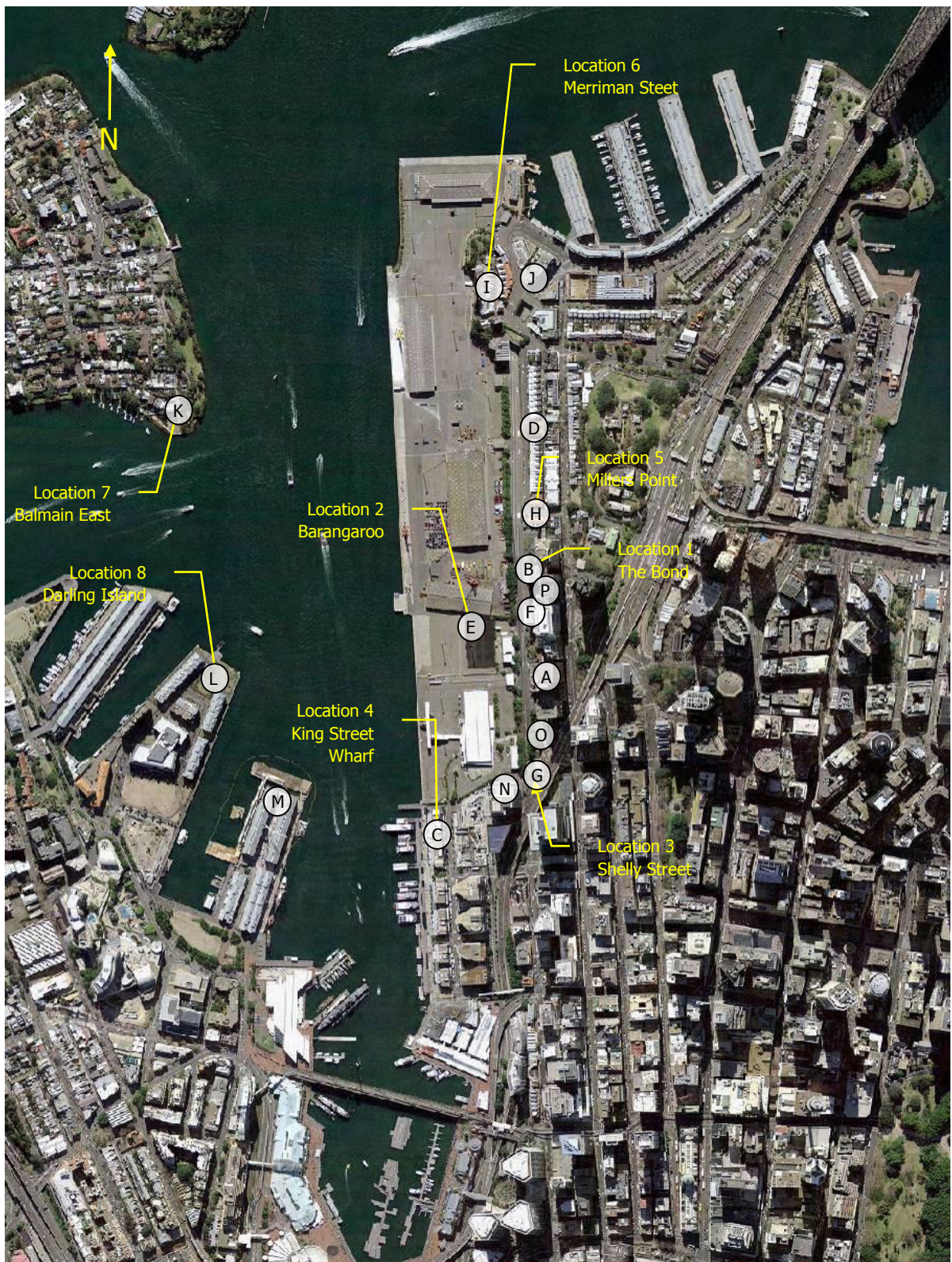
* Monitoring conducted by Arup and Wilkinson Murray.

The noise monitoring equipment used for the Wilkinson Murray noise measurements consisted of ARL Type EL-215 environmental noise loggers set to A-weighted, fast response, continuously monitoring over 15-minute sampling periods. This equipment is capable of remotely monitoring and storing noise level descriptors for later detailed analysis. The equipment calibration was checked before and after the survey and no significant drift was noted.

In the case of noise logging conducted by Arup, the data was reviewed and is considered suitable to use for assessment purposes. The details of the noise measurement equipment and calibration can be referred to within the report.

The logger determines L_{A1} , L_{A10} , L_{A90} and L_{Aeq} levels of the ambient noise. L_{A1} , L_{A10} and L_{A90} are the levels exceeded for 1%, 10% and 90% of the sample time respectively (see Glossary for definitions). The L_{A1} is indicative of maximum noise levels due to individual noise events such as the occasional pass-by of a heavy vehicle. The L_{A90} level is normally taken as the background noise level during the relevant period.

Figure 3-1 Aerial showing Noise Monitoring Locations



*Source Land and Property Management Authority

Table 3-3 summarises the noise results, for daytime, evening and night time periods as defined in the EPA's Construction Noise Guidelines (CNG) and the NSW Industrial Noise Policy (INP). Additionally, noise monitoring results for Saturday (7.00am-5.00pm) has been included as Lend Lease proposes to operate outside standard CNG hours during that time.

Table 3-3 Summary of Measured Noise Levels

Noise Logging Site	RBL (dBA)				L _{Aeq,period} (dBA)			
	Daytime 7am-6pm	Evening 6-10pm	Night Time 10pm-7am	Saturday 7am-5pm	Daytime 7am- 6pm	Evening 6-10pm	Night Time 10pm-7am	Saturday 7am-5pm
1	53	53	49	51	62	61	57	60
2	52	50	45	50	56	54	50	56
3	60	59	49	57	67	66	62	66
4	52	60	46	48	60	62	60	60
5	47	44	41	45*	58	55	51	55
6	46	44	40	46*	58	55	50	56
7	49	45	40	46*	67	51	47	56
8	47	44	39	50*	54	49	46	56

* Determined from the afternoon on Saturday 4 September as the morning was affected by rain.

Background noise levels at all locations were free of the influence of extraneous noise sources, such as plant or construction activities. Noise data measured during inclement weather was excluded in accordance with EPA procedures.

4 CONSTRUCTION NOISE ASSESSMENT

4.1 Construction Noise Criteria

The following sections detail the applicable site-specific noise and vibration criteria based on the guidelines from EPA, being:

- Interim Construction Noise Guideline; and
- Road Noise Policy (RNP).

4.1.1 Construction Noise Management Levels

The EPA released the "Interim Construction Noise Guideline" (CNG) in July 2009. The guideline provides noise goals that assist in assessing the impact of construction noise.

For residences, the basic daytime construction noise goal is that the $L_{Aeq, 15min}$ noise level should not exceed the background noise by more than 10dBA. This is for standard hours: Monday to Friday 7.00am to 6.00pm, and Saturday 8.00am to 1.00pm. Outside the standard hours, the criterion would be background + 5dBA. Table 4-1 details the CNG noise goals.

Table 4-1 Construction Noise Goals at Residences using Quantitative Assessment

Time of Day	Management Level $L_{Aeq, (15min)}$	How to Apply
Recommended		
Standard Hours:		
Monday to Friday		The noise affected level represents the point above which there may be some community reaction to noise.
7am to 6pm	Noise affected	Where the predicted or measured $L_{Aeq, (15min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to minimise noise.
Saturday	RBL + 10dBA	
8am to 1pm		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.
No work on Sundays or		
Public Holidays		
	Highly noise affected 75dBA	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 proponent should consider very carefully if there is any other feasible and reasonable way to reduce noise to below this level. If no quieter work method is feasible and reasonable, and the works proceed, the proponent should communicate with the impacted residents by clearly explaining the duration and noise level of the works, and by describing any respite periods that will be provided.

Time of Day	Management Level $L_{Aeq,(15min)}$	How to Apply
Outside recommended standard hours	Noise affected RBL + 5 dB	<p>A strong justification would typically be required for works outside the recommended standard hours.</p> <p>The proponent should apply all feasible and reasonable work practices to meet the noise affected level.</p> <p>Where all feasible and reasonable practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community.</p> <p>For guidance on negotiating agreements see section 7.2.2.</p>

In addition, the following construction noise management levels $L_{Aeq,15 min}$ are recommended for other receivers and areas.

- Active recreation areas (such as parks): external $L_{Aeq,15 min}$ 65dBA
- Industrial premises: external $L_{Aeq,15 min}$ 75dBA
- Offices, retail outlets: external $L_{Aeq,15 min}$ 70dBA
- Classrooms at schools and other educational institutions: internal $L_{Aeq,15 min}$ 45dBA

Based on the above, Table 4-2 presents the applicable noise management levels for construction activities at surrounding receivers that have been adopted for all applications.

Table 4-2 Site-Specific Construction Noise Management Levels

Location	Construction Noise Management Level, $L_{Aeq} - dBA$				Highly noise affected Noise Level, $L_{Aeq} - dBA$
	Day	Evening	Night	Saturday (extended)	
1 – Hickson Road Residences	63	58	54	55	75
5 – High Street Residences	57	49	46	50	75
6 – Merriman St Residences	56	49	45	51	75
7 – Balmain East Residences	59	50	45	51	75
8 – Darling Island Residences	57	49	44	55	75
All Commercial Properties			70		
Schools / Preschools			55*		
Parks / Outdoor Play Areas			65		

* The external noise goal of 55dBA is based on a 10dB reduction through an open window.

4.1.2 Traffic Noise Criteria

Noise Criteria for assessment of road traffic noise are set out in the NSW Government's *NSW Road Noise Policy (RNP)*. Table 4-3 sets out the assessment criteria for residences to be applied to particular types of project, road category and land use.

Table 4-3 Traffic Noise Criteria extracted from the NSW RNP

Road category	Type of project/land use	Assessment criteria – dB(A)	
		Day (7 a.m.–10 p.m.)	Night (10 p.m.–7 a.m.)
Freeway/ arterial/ sub-arterial roads	1. Existing residences affected by noise from new freeway/arterial/sub-arterial road corridors	L _{Aeq} , (15 hour) 55 (external)	L _{Aeq} , (9 hour) 50 (external)
	2. Existing residences affected by noise from redevelopment of existing freeway/arterial/sub-arterial roads	L _{Aeq} , (15 hour) 60 (external)	L _{Aeq} , (9 hour) 55 (external)
	3. Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments		
Local roads	4. Existing residences affected by noise from new local road corridors	L _{Aeq} , (1 hour) 55 (external)	L _{Aeq} , (1 hour) 50 (external)
	5. Existing residences affected by noise from redevelopment of existing local roads		
	6. Existing residences affected by additional traffic on existing local roads generated by land use developments		

In summary, the noise level goals at the residential receivers, for this project, based on the *RNP* are:

- L_{Aeq,1hr} day 55dBA; and
- L_{Aeq,1hr} night 50dBA

In addition, where the above criteria are already exceeded as a result of existing traffic the policy notes:

“For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding ‘no build option’.

4.2 Construction Equipment & Noise Source Levels

Sound Power Levels (SWLs) for typical C2 and C6 Kiosk construction plant are identified in Table 4-4. These SWLs have been measured at other similar construction sites. The table gives both Sound Power Level and Sound Pressure Levels (SPL) at 7m for the equipment. Sound Power Level is independent of measurement position.

Table 4-4 Typical Construction Plant Sound Levels – dBA

Plant	Sound Power Level	Sound Pressure Level at 7m
Mobile Crane	104	79
Concrete Truck	109	84
Angle Grinder	109	84
Concrete Pump – 120 mm diameter / 50 bar	112	87
Concrete Saw	116	91
Mobile Crane	98	73
Dump Truck	108	83
Compressor	100	75
Bobcat	103	78
Hand Tools	90	65

4.3 Construction Noise Predictions

Assessment of likely construction noise at surrounding commercial and residential receivers has been assessed for the Commercial Building C2 and C6 Kiosk construction works. These works will be conducted when much of the South Barrangaroo development is complete or the structure of the buildings is well progressed. Therefore, noise modelling has been conducted with many of the buildings included.

Site-related noise emissions were modeled with the “CadnaA” noise prediction program, using the ISO 9613 noise prediction algorithms. Factors that are addressed in the noise modeling are:

- equipment sound level emissions and location;
- screening effects from buildings;
- receiver locations;
- ground topography;
- noise attenuation due to geometric spreading;
- ground absorption; and
- atmospheric absorption.

Modelling has been conducted for a number of construction scenarios. The three works scenarios considered are summarised in Table 4-5

Table 4-5 Construction Scenarios for the Commercial Building C2 and C6 Kiosk Construction Works

Scenario	Description	Works
A	Commercial Building C2 and C6 Kiosk Construction	This scenario includes concreting and lifting. 2 concrete pumps, 2 forklifts, 2 compressors, 1 crane, a boom truck and lift are assumed to operate in 15minutes. Also concrete trucks and normal delivery trucks assumed to be 8 movements in 15minutes.
B	Commercial Building C2 and C6 Kiosk Facade	In the event that the construction of the façade occurs in isolation. Forklift, cranes and power tools assumed. 4 truck movements in 15minutes assumed.

Noise modelling has been conducted for each of the above scenarios, with plant located across the construction site as follows.

Line Noise Source – Truck routes are modelled as line noise sources with the number of trucks on the haulage route in a 15 minute period applied to these sources.

Point Noise Sources – Fixed plant and equipment are modelled as point sources.

The modelling assumes a “typical worst case” scenario whereby all plant, is running continuously. As such the modelling represents likely noise levels that would occur during intensive periods of construction. Therefore the presented noise levels can be considered in the upper range of noise levels that can be expected at surrounding receivers when the various construction scenarios occur.

Once noise sources have been applied to the model, the resultant noise levels at identified surrounding receivers are predicted. These results are then compared with established site-specific noise criteria.

The following tables detail results of noise modelling for each scenario.

Table 4-6 Predicted Construction Noise Levels at Residence – $L_{Aeq}(15 \text{ min})$ – dBA

Residential Receiver	Predicted Noise Level	Weekday NML*	Exceedance Level	Sat NML	Exceedance Level
Scenario A – Structure Construction					
1 – Hickson Road Residences	50	63	0	55	0
5 – High Street Residences	39	57	0	50	0
6 – Merriman Street Residences	38	56	0	51	0
7 – Balmain East Residences	33	59	0	51	0
8 – Darling Island Residences	40	57	0	55	0
9 – Sydney Wharf Residences	43	57	0	55	0
Scenario B – Facade					
1 – Hickson Road Residences	50	63	0	55	0
5 – High Street Residences	37	57	0	50	0
6 – Merriman Street Residences	37	56	0	51	0
7 – Balmain East Residences	31	59	0	51	0
8 – Darling Island Residences	41	57	0	55	0
9 – Sydney Wharf Residences	41	57	0	55	0

A review of results indicates that compliance with noise management levels will be achieved at all surrounding residences during week day and Saturday construction.

Predicted noise levels at commercial receivers are presented in Table 4-7.

Table 4-7 Predicted Construction Noise Levels at Commercial – $L_{Aeq}(15 \text{ min})$ – dBA

Residential Receiver	Predicted Noise Level	Weekday NML*	Exceedance Level	Sat NML	Exceedance Level
Scenario A – Structure Construction					
Lime Street, (King Street Wharf)	52	70	0	70	0
30 Hickson Road	48	70	0	70	0
Shelly Street	67	70	0	70	0
The Sussex Hotel	65	70	0	70	0
Scenario B – Facade					
Lime Street, (King Street Wharf)	49	70	0	70	0
30 Hickson Road	45	70	0	70	0
Shelly Street	66	70	0	70	0
The Sussex Hotel	62	70	0	70	0

A review of the results indicated that noise from the proposed construction works associated with the Commercial Building C2 and C6 Kiosk will comply with all commercial noise management levels.

4.4 Discussion of Results

It is noted that construction noise from the proposed Commercial Building C2 and C6 Kiosk works will not generate excessive levels of construction noise at surrounding receivers. The Commercial Building C2 and C6 Kiosk development is not a large building by city standards and given the fact that the works do not include the noise intensive stage of excavation these findings are not unexpected.

4.5 Noise and Vibration Mitigation Measures

The construction equipment associated with the structure and facade construction are not significant generators of vibration. As the site is across Hickson Road from commercial properties no perceptible vibration is predicted at these receivers.

Based on the investigations and findings of this assessment, there are no specific noise and vibration measures that have been identified that need to be adopted for Commercial Building C2 and C6 Kiosk works.

It is considered that the procedures and management measures that are included in the existing site Environmental Management Plan are more than adequate to address any noise or vibration generated by the Commercial Building C2 and C6 Kiosk construction works.

4.6 Cumulative Noise Impact

There are other projects that will be under various stages of construction when the Commercial Building C2 and C6 Kiosk works occur. These include elements of the South Barangaroo project site along with the other major projects at Barangaroo, being:

South Barangaroo Projects

- Stage 1A Basement;
- T1/C3;
- T2/C4;
- T3/C5;
- R8 & R9;
- Stage 1A Public Domain;
- Basement Risers (additional to basement);
- Stage 1B Remediation of Block 4 and construction of Stage 1B Basement D-Wall;
- Temporary Concrete Batching Plant;
- Waste water plant; and
- Wynyard Walk Bridge.

OTHER Barangaroo Projects

- Barangaroo Central Waterfront Promenade and Interim Public Domain;
- Wynyard Walk; and
- Headland Park and Northern Cove – Main Works.

Construction noise levels associated with the South Barangaroo projects have predicted based on noise modelling conducted for these projects associated with the project applications prepared for these projects. In addition, we have reviewed the potential cumulative noise increase based on previous noise assessment prepared by Wilkinson Murray, namely;

- Headland Park – “Barangaroo Headland Park – Construction Noise and Vibration Assessment” conducted by Wilkinson Murray Report 12213 Version C dated August 2012”; and
- Barangaroo Central - “Barangaroo Central - Construction and operational Noise & Vibration Management Assessment” conducted by Wilkinson Murray Report 12228 – Version B dated September 2012.

In the case of Wynyard Walk, this period correlates to the construction of the Sussex Street Bridge and associated earthworks. Wilkinson Murray has been engaged by Thiess (the company constructing Wynyard Walk) to assess noise associated with construction. Based on a review of the current assessment it has been determined that a construction sound power level of 112 dBA is appropriate for this stage of the works. This information has been used in the WM noise model to predict the resultant noise levels associated with Wynyard Walk at residential receivers consistent with this assessment.

Based on these assessments, noise levels at residences potentially affected by these sites have been assessed based on noise levels predicted in 2014. Table 4-8 presents cumulative noise impact from Wilkinson Murray’s predictions of this assessment, Headland Park, Barangaroo Central and Wynyard Walk Assessments.

Table 4-8 Cumulative Construction Noise Levels with South Barangaroo Headland Park, Barangaroo Central and Wynyard Walk Operations – LAeq(15 minutes) – dBA

Residences	Block 4 Remediation Works / C3/ C4 / C5 / R8 / R9 Building Basement Works & Batch Plant and Water Treatment Construction	Headland Park Construction Noise 2014	Barangaroo Central Construction Noise 2014	Wynyard Walk Bridge Construction	Wynyard Walk Bridge Construction	Cumulative (without Commercial Building C2 and C6 Kiosk Works)	Cumulative (with Commercial Building C2 and C6 Kiosk Works)
Dawes Point	55	63	66*	35	43	68	68
Balmain East	54	51	51	37	44	57	57
37 High Street	68	57	72*	27	47	74	74
38 Hickson Road	76	50	63*	49	57	76	76

*Includes a 5 dBA penalty for impulsive noise from Rockbreakers

A review of the above noise levels in the table reveals that construction noise from the Commercial Building C2 and C6 Kiosk site in 2014 will be more than 10dBA below the cumulative noise levels of other construction works thereby not resulting in any increase in construction noise levels at surrounding residences.

Given this fact, the predicted Commercial Building C2 and C6 Kiosk construction noise levels at residences will be relatively low by construction standards. Therefore it is concluded that the Commercial Building C2 and C6 Kiosk works will not result in cumulative construction noise increase at surrounding noise sensitive receivers.

The above consideration does not preclude the application of the management procedures contained in the site environmental management plan which of course should be consistently applied to the Commercial Building C2 and C6 Kiosk construction works.

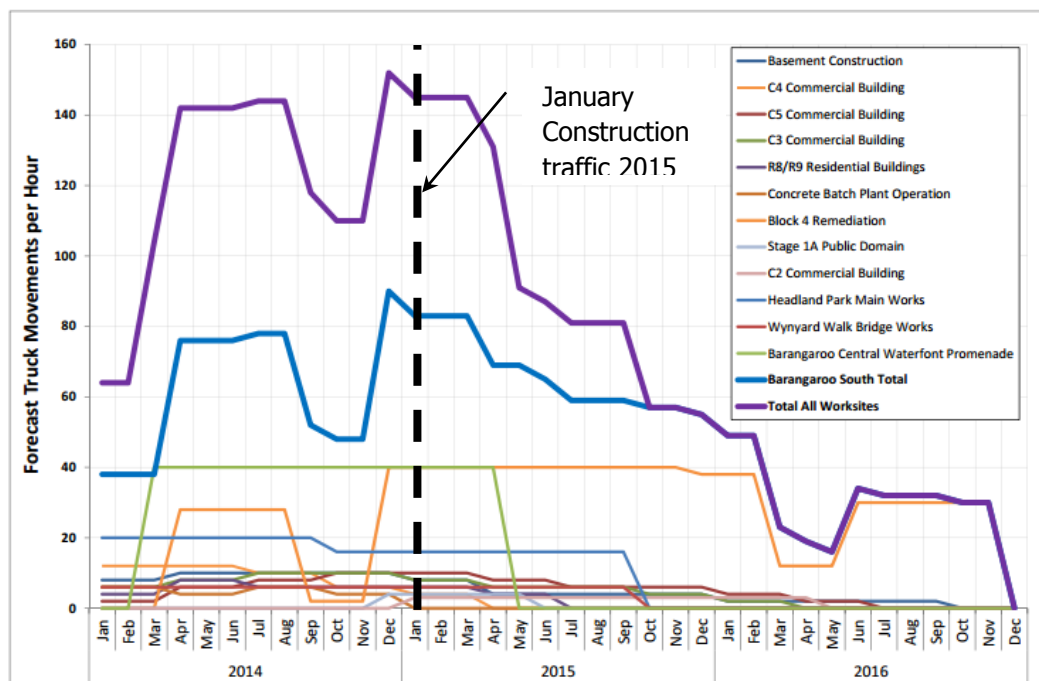
4.7 Construction Traffic Noise

Arup, the traffic consultants, in their report titled "Barangaroo South; C2 Commercial Building Construction Management dated 5 March 2014" advises the following with respect to the Commercial Building C2 and C6 Kiosk works:

"The works associated with construction of the C2 building will occur over a 16 month period, between January 2015 and April 2016. On average 30 truck movements per day are anticipated to be directly attributable to the building, equating to 3 vehicle movements per hour. This activity will be occurring at the anticipated peak period of January 2015 and represents a negligible 2% increase in overall construction activity."

Based on the traffic report, the 3 additional trucks will occur when all other projected construction heavy vehicles will result in 145 truck movements per hour. This is illustrated in Figure 4-1.

Figure 4-1 Forecast Peak Hour Cumulative Construction Vehicle Movements



The proposed haulage routes are generally located to the west of the site boundary, thereby avoiding the passby by haulage trucks of residences on Hickson Road. The main southern haulage truck route for off-site disposal would be along Sussex Street to the Western Distributor and / or Cross City Tunnel / Eastern Distributor. Of the roads with adjacent residences, the one with the highest predicted additional traffic volumes is Sussex Street.

The results of previous pre-construction noise logging at Sussex Street have been processed to determine an existing daytime peak hour traffic noise level of $L_{Aeq(1 \text{ hrs})}$ 68.1dBA (8.00am to 9.00 am). It should be noted that existing traffic noise in relevant areas already exceeds the "base" noise criteria detailed in Table 4-3. As any increase in traffic volumes associated with this project would be temporary in nature, the 2dBA allowance goal applies.

The noise contribution of half of these truck movements along Sussex Street has been assessed with respect to the total $L_{Aeq,1hr}$ peak hour traffic noise level at Sussex Street residences, using the Calculation of Road Traffic Noise (CORTN) traffic noise prediction technique. (Note it has been assumed that half of trucks will use the south route on Sussex Street.)

Table 4-9 details predicted future traffic noise levels due peak traffic movements January 2015 with and without Commercial Building C2 and C6 Kiosk construction traffic.

Table 4-9 Predicted January 2015 Daytime Traffic Noise Levels at Sussex Street
– $L_{Aeq,1hr}$ – dBA

Construction Traffic	Existing Traffic Noise Level	Construction Noise Contribution	Total Noise Level
Commercial Building C2 and C6 Kiosk Traffic Only		52.5	68.2
Construction Traffic All Other Works	68.1	66.5	70.4
Total Construction Traffic with Commercial Building C2 and C6 Kiosk Traffic		66.7	70.5

A review of predictions indicates the following;

- Peak Commercial Building C2 and C6 Kiosk construction traffic will increase traffic noise levels at Sussex Street residences by a very small amount (0.1 dBA),
- In January 2015, traffic noise levels are predicted to exceed the 2dBA objective by a marginal levels of 0.4 dBA,
- When Commercial Building C2 and C6 Kiosk construction traffic is added the exceedance is increased by a further 0.1dBA.

An increase of 0.1 dBA will be imperceptible to any receivers and is not considered acoustically significant. Therefore, it is concluded that the construction traffic associated with the Commercial Building C2 and C6 Kiosk construction will not adversely impact on residents. Furthermore, it is noted that these noise levels will reduce after 2015 when construction traffic reduces.

5 OPERATIONAL NOISE AND VIBRATION

Operational noise from the proposed C2 and Kiosk building will be from mechanical plant located predominantly on the rooftop of the development and plant in dedicated plant areas.

It is noted that retail uses are proposed on the ground floor; however these will be subject to separate applications for their specific uses.

5.1 Operational Noise Criteria

Noise impact from the general operation of the proposed Commercial Building C2 and C6 Kiosk buildings is to be assessed with respect to the site specific noise criteria based on site monitoring and the NSW Industrial Noise Policy (INP). The assessment procedure in terms of the INP has two components:

- Controlling intrusive noise impacts in the short term for residences; and
- Maintaining noise level amenity for particular land uses for residences and other land uses.

In accordance with the INP, noise impact is assessed in terms of both intrusiveness and amenity. Based on the background and ambient noise monitoring carried out at the nearest affected residential locations, applicable noise criteria for the site are detailed in Table 5.1.

Table 5-1 Site Specific Operational Noise Criteria for South Barangaroo*

Site	Type of Receiver	L _{Aeq,15min} (dBA)		
		Daytime 7-6pm	Evening 6-10pm	Night Time 10pm-7am
1 – Hickson Road Residences	Residential	58	50	45
5 – High Street Residences	Residential	52	49	45
6 – Merriman Street Residences	Residential	51	49	45
7 – Balmain East Residences	Residential	54	45	40
8 – Darling Island Residences	Residential	52	49	44
9 – Sydney Wharf Residences	Residential	52	49	44
Commercial Receivers	Commercial	65	65	65

*Criteria has been derived from previous project applications at South Barrangaroo.

5.2 Operational Noise Assessment and Recommendations

Detailed specifications of mechanical services equipment that would otherwise allow an acoustic assessment of noise emission from the site are not available at this stage of the project as selection and design is conducted after project approval. In line with the approvals for other development within Barangaroo, and not unlike other similar development within the City of Sydney area, detailed assessment of operational noise emission should form a conditional requirement of the development, to be satisfied prior to the issue of the construction certificate.

It is noted that the acoustic objectives within the Barangaroo site are such that the nearest most sensitive receptors to operational noise from the development will be the surrounding South Barrangaroo buildings, and will be the determining locations for the acoustic design.

By satisfying the relevant criteria at the subject site, compliance will readily be achieved at surrounding noise sensitive receptors. Noise emission from the Barangaroo site will be addressed during the detailed design phase.

Mechanical plant such as rooftop exhausts, air-conditioning and refrigeration associated with the development should be assessed at the time of detailed design and selection, having regard to nearby residential and commercial properties surrounding the development, and to future development within Barangaroo South.

5.3 Road Traffic Noise Assessment

Arup, the traffic consultants, traffic report "Barangaroo South;C2 Commercial Building Transport Management and Accessibility 3 January 2014" advises the following with respect to the C2 operations:

"The C2 commercial building is forecast to generate four vehicle trips in both the AM and PM peak hours. This is minimal in the context of future traffic volumes in the CBD precinct and would not result in any additional impacts on surrounding intersections."

Consistent the above findings the minimal traffic movements of the projected magnitude will not result in any noticeable change in traffic noise levels at surrounding receivers given overall traffic flows in the area.

6 CONCLUSION

A noise review of the Commercial Building C2 and C6 Kiosk has been conducted for Barangaroo South. Site-specific noise criteria that are applicable to this project have been presented. These have been determined for surrounding receivers to be applied on all state significant development applications.

A noise assessment has been conducted of the proposed construction activities associated with the construction of the Commercial Building C2 and C6 Kiosk to determine the potential for noise and vibration impact at surrounding receivers. No exceedance of noise management levels is expected at surrounding receivers.

Vibration associated with on-site construction activities is considered to be negligible. No specific management and mitigation measures to reduce noise impact at receivers have been identified beyond the normal measures.

Construction traffic noise has been assessed and the increase in noise has determined to be marginal. A Noise and Vibration Management Plan has been prepared to assist Lend Lease in managing the environmental issues associated with this project.

Site specific operational noise criteria has been determined for the project based on ambient noise monitoring. The acoustic objectives within the Barangaroo site are such that the nearest most sensitive receptors to operational noise from the development will be the surrounding South Barrangaroo buildings, and will be the determining locations for the acoustic design.

By satisfying the relevant criteria at the subject site, compliance will readily be achieved at surrounding noise sensitive receptors. Noise emission from the Barangaroo site will be addressed during the detailed design phase.