ACOUSTICS AND AIR

ONE SYDNEY HARBOUR RESIDENTIAL BUILDING R4B

CONSTRUCTION & OPERATIONAL NOISE REPORT

REPORT NO. 10232-R4B
VERSION G

NOVEMBER 2020

PREPARED FOR

LENDLEASE
LEVEL 14, TOWER THREE INTERNATIONAL TOWERS SYDNEY
EXCHANGE PLACE, 300 BARANGAROO AVENUE
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TABLE OF CONTENTS

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.

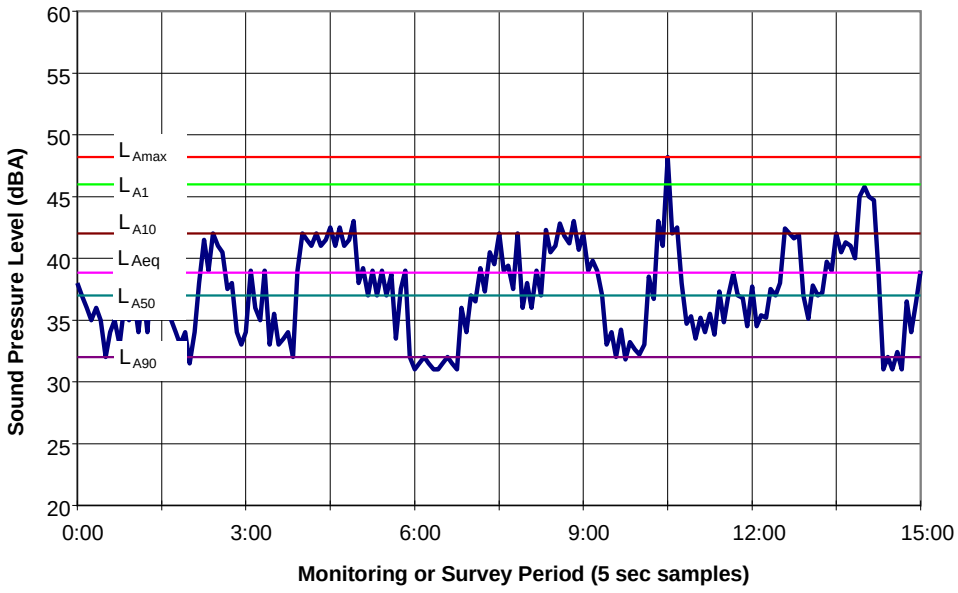
L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

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 (SSD) Development Application (DA) submitted to the Department of Planning, Infrastructure and Environment (DPIE) pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act). The 'amending' SSD DA seeks approval for eight additional storeys and 5,650sqm of gross floor area (GFA), amongst other items, to Residential Building R4B approved under SSD 6965. This SSD DA proposes to amend the 60-storey Residential Building R4B development approved under SSD 6965, which in turn necessitates the inclusion of condition(s) of consent to this SSD DA that require the modification of SSD 6965.

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 report relies on previous project applications for the site, particularly our assessment Report 10232-R4B Version C "*One Sydney Harbour Residential Building R4B Construction and Operational Noise Report*" dated September 2019 and the assessment has taken into account the following requirements in item 14 of SSD 6965:

Noise

The applicant must include a Noise and Vibration Assessment of construction, operation, traffic and cumulative noise impacts prepared in accordance with the relevant EPA guidelines. This assessment must consider any potential noise impacts on nearby noise sensitive receivers and outline proposed noise mitigation and monitoring issues.

Relevant Policies and Guidelines:

- *NSW Industrial Noise Policy 2000 (EPA)*
- *NSW Industrial Noise Policy – application notes 2013 (EPA)*
- *Interim Construction Noise Guideline 2009 (DECC)*
- *Assessing Vibration: A Technical Guideline 2006 (DECC)*
- *NSW Road Noise Policy (DECCW 2001)*
- *NSW Road Noise Policy – application notes 2013 (EPA).*

2 PROPOSED WORKS

2.1 Background

2.1.1 Barangaroo South Concept Plan (as modified)

- The approved Barangaroo South Concept Plan (MP06_0162) (as modified), includes approval for the following:
    - A mixed use development involving a maximum of 602,354 sqm gross floor area (GFA), comprised of:
    - a maximum of 191,031 sqm of residential GFA of which a maximum of 162,031 sqm will be in Barangaroo South;
    - a maximum of 76,000 sqm of GFA for tourist uses of which a maximum of 59,000 sqm will be in Barangaroo South;
    - a maximum of 34,000sqm of GFA for retail uses of which a maximum of 30,000 sqm will be in Barangaroo South;
    - a maximum of 5,000 sqm of GFA for active uses in the Public Recreation zone of which 3,500 will be in Barangaroo South; and
    - a minimum of 12,000sqm GFA for community uses.
- Approximately 11 hectares of new public open space/public domain, with a range of formal and informal open spaces serving separate recreational functions and including an approximate 2.2km public foreshore promenade.
- Built form design principles, maximum building heights and GFA for each development block within the mixed use zone.
- Public domain landscape concept, including parks, streets and pedestrian connections.
- Alteration of the existing seawalls and creation of a partial new shoreline to the harbour.
- Construction, operation and maintenance of a concrete batching plant to supply concrete for construction of future development under this Concept Plan at Barangaroo South.
- No approval is granted or implied for the future use of a heliport and/or a helipad.

This 'amending' SSD DA seeks to achieve the maximum permissible GFA and height for Residential Building R4B that was approved as part of the latest modification to the Concept Plan (modification 10). Any consent that is granted to this SSD DA will be generally consistent with the terms of approval of the Concept Plan (as modified).

2.1.2 Residential Building R4B - Development consent SSD 6965

Development consent SSD 6965 was granted by the NSW Minister for Planning on 7 September 2017 for Residential Building R4B, comprising of a 60-storey mixed use building, with 297 residential units and retail floor space at ground level. This included a total gross floor area (GFA) of 38,896sqm, 38,602sqm of which was approved for residential floor space, and the remaining 294sqm was approved for retail floorspace.

Consent was also provided for associated building public domain works, fit-out and use of the basement, a link bridge connecting to Building R4A and associated building identification signage.

On 7 February, 2020, development consent SSD 6965 was amended to account for a range of design changes, including an increase in total GFA from 38,896sqm to 38,911sqm, comprised of an increase in retail GFA from 294sqm to 309sqm, and a reduction in the number of apartments to 283.

A second application to modify development consent SSD 6965 has been submitted to the DPIE. The amendments contained within the modification application broadly relate to the following changes:

- increase the number of apartments from 283 to 290;
- revised dwelling mix and internal layout changes;
- changes to the landscaped podium layout; and
- changes to the number of car spaces from 320 to 324.

It is anticipated that this modification application to development consent SSD 6965 will be determined prior to the determination of this SSD DA. As such, this SSD DA is made with the above changes in mind.

2.2 Overview of Proposed Development

This 'amending' SSD DA seeks consent for eight additional storeys with 5,650sqm of GFA and containing 32 additional apartments, and an allocation of 7 additional car parking spaces to Residential Building R4B. More specifically, this SSD DA proposes to amend Residential Building R4B, through:

- an increase to the overall building height from RL208.23 up to RL235 (an additional 8 levels);
- increase the overall number of apartments from to 290 to 322;
- revise the dwelling mix and apartment relocations within the building envelope; and
- change to the number of car spaces from 324 to 331.

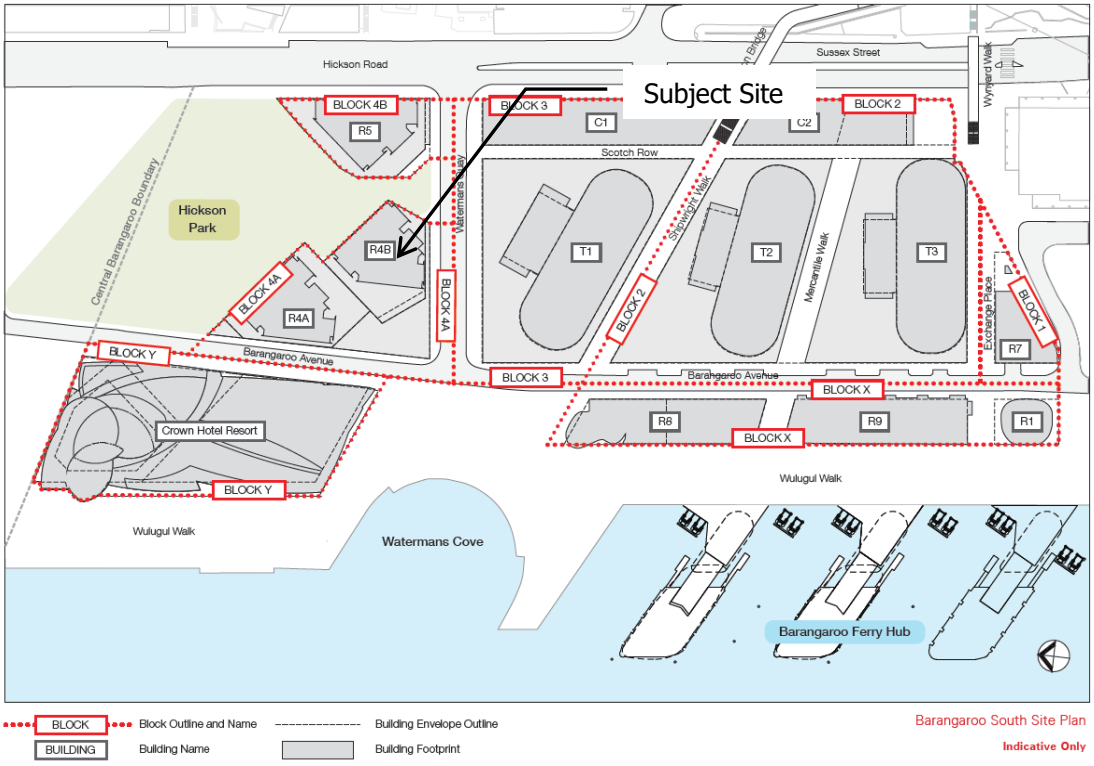
The operation of the building will consist of normal residential operations where noise from mechanical plant presents the main source of any potential noise emissions from the site.

2.3 Site Description

Barangaroo is located on the north western edge of the Sydney Central Business District (CBD), 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 containing 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 Residential Building R4B site is located within Barangaroo South. The site of this proposed DA is located on land generally known and identified in the approved Concept Plan (as modified) as Block 4A, as shown in Figure 2-1 below.

Figure 2-1 Block 4A in relation to Barangaroo South (source: Lendlease)



2.4 Construction Hours

The proposed construction hours for the works are between 7.00am and 6.00pm Monday – Friday and between 7.00am and 5.00pm on Saturdays.

This extended period of construction hours is consistent with the City of Sydney's approach to hours of works within the CBD, which recognises the urban nature of the city environment. It is also consistent with the approach already approved under other consents at Barangaroo South.

It is noted that the Saturday hours are longer than the standard EPA hours of 8.00am to 1.00pm

as mobilisation of works on a site of this size requires a full day's work to be effective. If standard EPA Saturday hours were adopted, it would not be practical to work on Saturdays. This would extend the project duration by 6-7 months, resulting in a longer duration of exposure of residents to construction noise.

No construction work is proposed to be undertaken outside the proposed construction hours, including on Sundays or Public Holidays, with the exception of emergency work.

2.5 Exceptions to Proposed Hours of Operation – Out of Hours Works

Anticipated out of hours works to be undertaken during construction include:

- Concrete pours that need to be completed to prevent waste and re-working.
- Service installation works and cut overs during temporary utility shutdowns or off-peak periods.
- Works behind a façade (such as plastering, internal fit out, painting and finishes).
- Delivery to site, and removal from site, of over-sized plant and equipment to conform to RMS requirements.
- Use of internal lifts and internal electric hoists.
- Crane and hoist installation, maintenance, climbing and dismantling 9am - 5pm Sundays, for worker and public safety.
- Environmental controls required (such as operation of a water treatment plant, monitoring equipment and dust suppression).
- Other critical works that are generally inaudible at nearby sensitive receivers (such as concrete curing, post tensioning and membrane placement).

Some other out of hours activities may be required throughout construction. These activities may be required to be undertaken out of hours to:

- undertake works for safety reasons for the protection of workers and members of the public.
- reduce disruption to traffic and the community.
- satisfy operational requirements of government agencies or authorities.
- due to unforeseen circumstances.

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 from the site 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 (with childcare) Symantec Building
B – 30 Hickson Rd	Top Floor Cafe Commercial 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
E – Shelley St	Commercial on Cnr of Sussex & Shelley St Commercial on Cnr of Lime & Shelley St
F – Building T1	Commercial Includes a childcare centre
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 & Little Edward St, Balmain East	Waterfront properties along Balmain peninsula
L – Northern end of Darling Island Rd & Wharf Cr, Darling Island	Multi storey high end apartments
M – Northern end Sydney Wharf Pirrama Rd, Pyrmont	Multi storey high end apartments

Background noise levels at residential receiver's external to the Barangaroo development have been measured at various locations and times over the past few years (2010-2016) by Wilkinson Murray.

The locations are presented in Table 3-2 and Figure 3-1.

Table 3-2 Long-Term Noise Monitoring Locations

Logger	Location	Monitoring Period	Company*
1	Level 4, The Bond 30-38 Hickson Rd	18 – 26 Aug 2016	Wilkinson Murray
2	Eastern Side of Building R8	27 May – 2 Jun 2015	Arup
3	3 High St, Millers Point	31 Aug – 9 Sep 2010	WM
4	18 Merriman St, Millers Point	31 Aug – 6 Sep 2010	WM
5	25 Edward St, Balmain East	31 Aug – 9 Sep 2010	WM
6	Adjacent to 3 Darling Island Rd, Darling Island	31 Aug – 9 Sep 2010	WM

Figure 3-1 Noise Measurement Locations

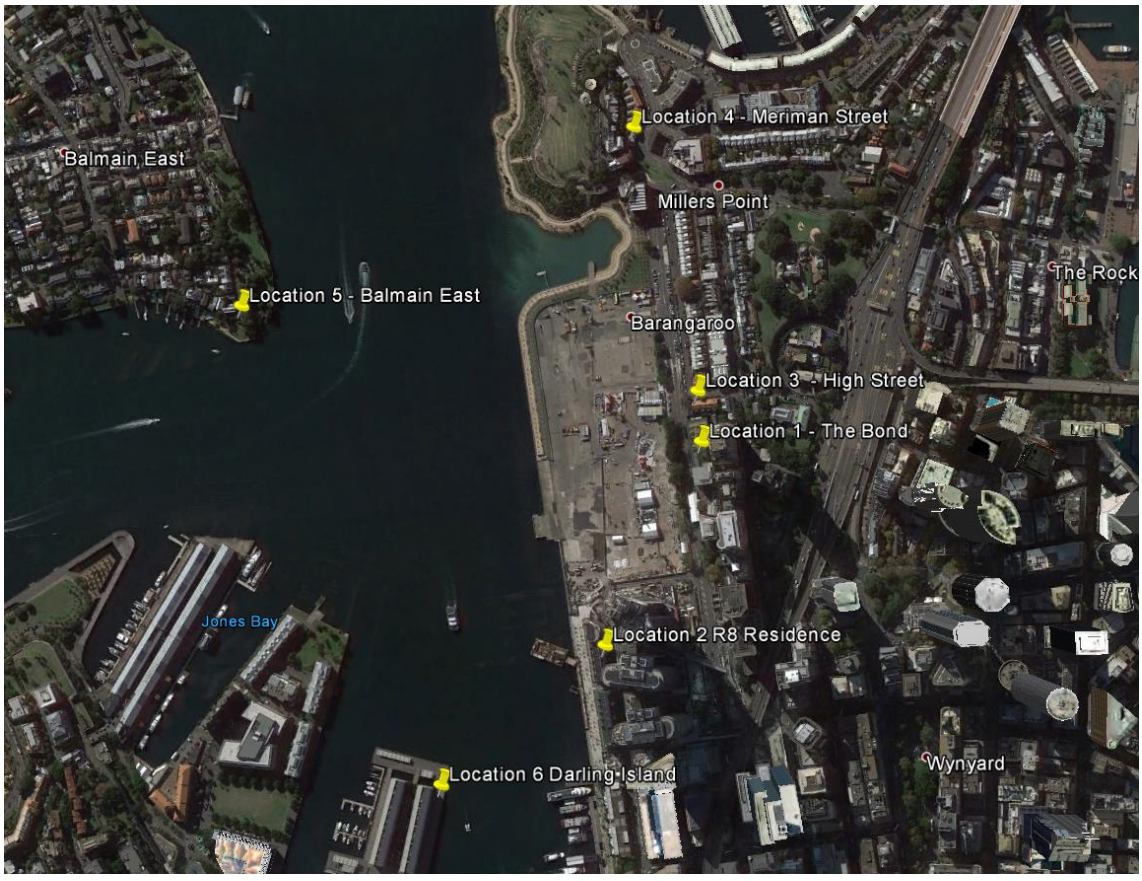


Table 3-3 summarises the noise results, for daytime, evening and night time periods as defined in the EPA's *Construction Noise Guidelines (CNG)* and the NSW *Industrial Noise Policy (INP)*. Additionally, noise monitoring results for Saturday (7.00am-5.00pm) has been included as Lend Lease proposes to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

Table 3-3 Summary of Measured Noise Levels

Noise Logging Site	RBL (dBA)			
	Daytime 7am-6pm	Evening 6-10pm	Night Time 10pm-7am	Saturday 7am-5pm
1 – The Bond	54	51	45	52
2 – R8 Residences	55	51	44	48
3 – High St, Millers Point	47	44	41	45
4 – Merriman St, Millers Point	46	44	40	46
5 – Balmain East	49	45	40	46
6 – Darling Island	47	44	39	50

* 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
- NSW *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 (RBL) 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.

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 4-1 presents the applicable noise management levels for construction activities at surrounding receivers that have been adopted for all applications.

Table 4-1 Site-Specific Construction Noise Management Levels

Location	Construction Noise Management Level, L_{Aeq} – dBA			
	Day	Evening	Night	Saturday (extended)
1 – Hickson Road Residences	64	56	50	57
2 – R8 Residences / Crown Development	65	56	49	53
3 – High St, Miller Point	57	49	46	50
4 – Merriman St, Millers Point	56	49	45	51
5 – Balmain East	59	50	45	51
6 – Darling Island	57	49	44	55
All Commercial Properties	70			
Schools / Preschools	55*			
Parks / Outdoor Play Areas	65			

* The external NML of 65 / 55dBA is based on a 20 / 10dBA reduction through a closed and open window respectively to meet an internal level of 45dBA.

Noise Criteria for assessment of road traffic noise are set out in the NSW Government's *Road Noise Policy (RNP)*. Table 4-2 sets out the assessment criteria for residences to be applied to particular types of project, road category and land use.

Table 4-2 Traffic Noise Criteria extracted from the NSW *RNP*

Road Category	Type of Project / Land Use	Assessment Criteria – dBA	
		Day (7am-10pm)	Night (10pm-7am)
Freeway / arterial / sub-arterial roads	1) Existing residences affected by noise from new freeway / arterial / sub-arterial road corridors	$L_{Aeq,15hr}$ 55 (external)	$L_{Aeq,9hr}$ 50 (external)
	2) Existing residences affected by noise from redevelopment of existing freeway / arterial / sub-arterial roads	$L_{Aeq,15hr}$ 60 (external)	$L_{Aeq,9hr}$ 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	$L_{Aeq,1hr}$ 55 (external)	$L_{Aeq,1hr}$ 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 on Hickson Road, 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 construction plant are identified in Table 4-3. These SWLs have been measured at other similar construction sites. The table gives both Sound Power Level and Sound Pressure Levels (SPL) at 7m from the equipment. Sound Power Level is independent of measurement position.

Table 4-3 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	112	87
Concrete Saw	116	91
Mobile Crane	98	73
Dump Truck	108	83
Compressor	100	75
Bobcat	103	78
Hand Tools	90	65
External Hoist	94	69
Tower Crane	104	79

4.3 Construction Noise Predictions

Assessment of likely construction noise at surrounding commercial and residential receivers has been assessed for Building R4B construction works. These works will be conducted when much of the Barangaroo South 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 specifically for Building R4B are summarised in Table 4-4.

Table 4-4 Construction Scenarios for the Residential Building R4B Construction Works

Scenario	Description	Works
A	Building Construction	This scenario includes concreting and structural works. 2 concrete pumps, 2 forklifts, 2 compressors, 2 cranes, 2 hoists and compressors are assumed to operate in 15 minutes. Also, concrete trucks and normal delivery trucks assumed to be 8 movements in 15 minutes.
B	Facade	This scenario assumes that the construction of the facade occurs in isolation. Forklift, truck, cranes and power tools assumed. 4 truck movements in 15 minutes assumed.
C	Fitout	Internal fitout works assume internal works with power tools and internal lift access.

In addition a cumulative noise scenario (Scenario D) of adjacent tower R4A and water treatment plant have been modelled based on a period in early 2021. These developments are subject to separate application; however, they are to be delivered concurrently.

The cumulative scenario has been assessed as follows:

- Building R4A Façade Works
- Building R4B Structure
- Water Treatment Plant Operation

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 4-5 Predicted Construction Noise Levels at Residence – $L_{Aeq(15\ min)}$ – dBA

Residential Receiver	Predicted Noise Level	Weekday	Exceedance	Sat	Exceedance
		NML	Level	NML	Level
Scenario A – Structure Construction					
1 – Hickson Road Residences	61	64	0	57	4
2 – R8 Residences / Crown	53	65	0	53	0
3 – High St, Miller Point	53	57	0	50	3
4 – Merriman St, Millers Point	29	56	0	51	0
5 – Balmain East	38	59	0	51	0
6 – Darling Island	45	57	0	55	0
Scenario B – Facade					
1 – Hickson Road Residences	53	64	0	57	0
2 – R8 Residences / Crown	56	65	0	53	3
3 – High St, Miller Point	50	57	0	50	0
4 – Merriman St, Millers Point	29	56	0	51	0
5 – Balmain East	37	59	0	51	0
6 – Darling Island	43	57	0	55	0
Scenario C – Fitout					
1 – Hickson Road Residences	44	64	0	57	0
2 – R8 Residences / Crown	42	65	0	53	0
3 – High St, Miller Point	48	57	0	50	0
4 – Merriman St, Millers Point	21	56	0	51	0
5 – Balmain East	30	59	0	51	0
6 – Darling Island	30	57	0	55	0
Scenario D – Cumulative R4A, R4B & Water Treatment					
1 – Hickson Road Residences	61	64	0	57	4
2 – R8 Residences / Crown	54	65	0	53	1
3 – High St, Miller Point	53	57	0	50	3
4 – Merriman St, Millers Point	31	56	0	51	0
5 – Balmain East	40	59	0	51	0
6 – Darling Island	45	57	0	55	0

Predicted noise levels at commercial receivers are presented in Table 4-6.

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

Residential Receiver	Predicted Noise Level	Weekday NML	Exceedance Level	Sat NML	Exceedance Level
Scenario A – Structure Construction					
Lime Street, (King Street Wharf)	33	70	0	70	0
Crown	53	70	0	70	0
30 Hickson Road	54	70	0	70	0
Shelly Street	30	70	0	70	0
The Sussex Hotel	34	70	0	70	0
Scenario B – Facade					
Lime Street, (King Street Wharf)	30	70	0	70	0
Crown	56	70	0	70	0
30 Hickson Road	54	70	0	70	0
Shelly Street	30	70	0	70	0
The Sussex Hotel	38	70	0	70	0
Scenario C – Fitout					
Lime Street, (King Street Wharf)	< 30	70	0	70	0
Crown	42	70	0	70	0
30 Hickson Road	44	70	0	70	0
Shelly Street	< 30	70	0	70	0
The Sussex Hotel	< 30	70	0	70	0
Scenario D – Cumulative R4A, R4B & Water Plant)					
Lime Street, (King Street Wharf)	35	70	0	70	0
Crown	54	70	0	70	0
30 Hickson Road	54	70	0	70	0
Shelly Street	31	70	0	70	0
The Sussex Hotel	35	70	0	70	0

Predicted noise levels at the preschools are presented in Table 4-7.

Table 4-7 Predicted Noise Levels at Pre Schools – $L_{Aeq,15min}$

Pre School	Predicted Noise Level*	Playground NML	Exceedance Level	Internal NML	Exceedance Level
Scenario A – Structure Construction					
Ku Lance	53	65	0	55	0
AON	53	65	0	55	0
T1	56	65	0	55	0
Scenario B – Facade					
Ku Lance	50	65	0	55	0
AON	49	65	0	55	0
T1	50	65	0	55	0
Scenario C – Fitout					
Ku Lance	48	65	0	55	0
AON	39	65	0	55	0
T1	29	65	0	55	0
Scenario D – Cumulative R4A, R4B & Water Plant)					
Ku Lance	53	65	0	55	0
AON	56	65	0	55	0
T1	56	65	0	55	0

*Internal levels will be 10dBA lower through an open window.

A review of the results indicated that noise from the proposed construction works associated with the residential Building R4B at preschools will comply with all noise management levels.

4.4 Discussion of Results (Scenarios A, B & C)

It is noted that construction noise from the proposed Residential Building R4B works will not generate excessive levels of construction noise at surrounding receivers during normal weekday works. Exceedances of up to 5 dBA may occur at surrounding residences on Saturdays however these levels are not considered excessive by construction standards and can be managed by existing construction management procedures.

A review of the results indicated that noise from the proposed construction works associated with the residential Building R4B will comply with all commercial noise management levels.

4.5 Noise & Vibration Mitigation Measures

The construction equipment associated with the structure and facade construction are not significant generators of vibration there are no specific noise and vibration measures that have been identified that need to be adopted for building R4B works.

It is noted that a Construction Noise and Vibration Management Sub Plan titled "*Noise & Vibration Management Sub-Plan Barangaroo South Document No: H010106LLC004* "has been prepared by Lendlease for the Barangaroo South Site in its entirety. It is intended that this plan be a "live document" whereby project-specific noise and vibration control measures are incorporated into the noise and vibration sub plan. The following project specific mitigation measures are recommended:

4.5.1 General Measures

- Plant Noise Audit – Noise emission levels of all critical items of mobile plant and equipment should be checked for compliance with noise limits appropriate to those items prior to the equipment going into regular service. To this end, testing should be established with the contractor.
- Operator Instruction – Operators should be trained in order to raise their awareness of potential noise problems and to increase their use of techniques to minimise noise emission.
- Equipment Selection – All fixed plant at the work sites should be appropriately selected, and where necessary, fitted with silencers, acoustical enclosures and other noise attenuation measures in order to ensure that the total noise emission from each work site complies with EPA guidelines.
- Site Noise Planning – Where practicable, the layout and positioning of noise-producing plant and activities on each work site should be optimised to minimise noise emission levels.
- Install a noise barrier between the site and street frontages. This should be a minimum 17mm thick structural plywood or equivalent panel. (Included in noise modelling)

The adoption of the above measures and application of the procedures in the Project Noise and Vibration Management Sub Plan are aimed at working towards achieving the noise management levels established at surrounding receivers.

4.5.2 Community Liaison & General Approaches to Mitigation

An effective community relations programme should be put in place to keep the community that has been identified as being potentially affected appraised of progress of the works, and to forewarn potentially affected groups (e.g. by letterbox drop, meetings with surrounding tenants, etc.) of any anticipated changes in noise and vibration emissions prior to critical stages of the works, and to explain complaint procedures and response mechanisms. This programme will be included throughout Lend Lease's *Community and Stakeholder Engagement Strategy* that has been specifically developed for the Barangaroo Project.

Close liaison should be maintained between the communities overlooking work sites and the parties associated with the construction works to provide effective feedback in regard to perceived emissions. In this manner, equipment selections and work activities can be coordinated where necessary to minimise disturbance to neighbouring communities, and to ensure prompt response to complaints, should they occur.

4.5.3 Noise & Vibration Management Plan

Lendlease have prepared a construction Noise and Vibration Management Sub-Plan for the Barangaroo South Stage 1B site. The sub-plan is revised as needed for additional assessments and planning approvals. Measures required by this assessment and any subsequent planning approval requirements, will be incorporated into a revised version of the sub-plan. Areas that have been addressed in plan include:

- noise and vibration monitoring;
- response to complaints**;**
- responsibilities;
- monitoring of noise emissions from plant items;
- reporting and record keeping;
- non-compliance and corrective action; and
- Community consultation and complaint handling.

Details of monitoring procedures are shown in Table 4-8 extracted from the Sub Plan:

Table 4-8 Sub- Plan Monitoring Procedures

Detail	Frequency	Standards	Reporting	Action if non-complying	Responsibility
Continuous unattended noise monitoring at locations shown in Appendix D, both L_{Aeq} and $L_{Aeq(>1000Hz)}$ (using web-based monitoring).	Real-time monitoring using a web-based system.	NMLs in Appendix D, Table 4.	Monthly	Follow noise response table below. Seek professional acoustic input if required.	EHS Manager (Environment) Noise Specialist
Construction equipment monitoring (noise audit) to assess compliance with expected noise levels, and to allow any increase in noise levels to be detected and addressed.	If equipment is perceived as being noisy or noisier than other similar equipment, or in response to complaints.	Levels in Appendix D, Table 2 – Typical Plant & Equipment Noise Levels. AS 2012	N/A	Assess equipment and undertake remedial action such as repair, noise-proofing, redeployment or removal.	Subcontractors Noise Specialist
Attended noise monitoring: • in response to complaints, as per noise response table below, • to refine construction methods to minimise noise, • to differentiate between construction noise sources and other sources (eg. road traffic or Crown works), • to assess internal construction noise levels at commercial premises, if needed, or • as needed during site establishment.	As required.	NMLs in Appendix D, Table 4. AS 1055	As required as part of monthly reports	Follow noise response table below. Seek professional acoustic input if required.	EHS Manager (Environment) Noise Specialist
Attended vibration monitoring: Trial testing at locations in Appendix D where equipment identified as having potential to exceed human comfort criteria is proposed.	As required for changes in works or complaints. As required to determine least impact work distances and equipment.	EPA guidelines BS6472 DIN4150 Part 3	As required as part of monthly reports	Cease relevant activities, and/ or implement additional measures. Seek professional vibration input if required.	EHS Manager (Environment) Vibration Specialist
Integrity of site hoarding.	Weekly.	Hoarding intact.	Weekly Site Checklist	Construction Manager to repair or replace	Foreman

Table 4-9 Additional Noise Mitigation Procedures

Scenario	Mitigation measures LAeq(15 minute) noise level above NML	
	0 to 10 dBA Noticeable	> 10 dBA Clearly audible – potentially intrusive
Approved hours, no complaints received		• Review noise data and current work practices.
Approved hours, complaint(s) received	• Respond to complainant • CRM entry indicating additional reasonable and feasible measures (see Appendix G)	• Respond to complainant • CRM entry indicating additional reasonable and feasible measures (see Appendix G)
Planned out of approved hours, no complaints received	• Letter box drops prior to works • Inform relevant authorities prior to works	• Letter box drops prior to works • Inform relevant authorities prior to works • Briefing of residents via CCLG • CRM entry indicating close out actions
Planned out of approved hours, complaint(s) received	• Letter box drops prior to works • Inform relevant authorities prior to works • Respond to complainant • CRM entry indicating additional reasonable and feasible measures for next planned out of approved hours work.	• Letter box drops prior to works • Inform relevant authorities prior to works • Respond to complainant • CRM entry indicating additional reasonable and feasible measures for next planned out of approved hours work.

4.6 Cumulative Noise Impact (Scenario D)

Apart from R4A, R4B and R5 works there are no other approved projects that will be under any stage of construction when all three residential buildings and the 1B basement structure is nearing completion (due for completion first half of 2021).

Table 4-10 presents cumulative noise impact.

Table 4-10 Cumulative Construction Noise Increases – dBA

Receiver	Construction Noise Level		Increase
	Building R4B Works Only (Structure)	Cumulative Scenario	
1 – Hickson Road Residences	61	61	0
5 – High Street Residences	53	53	0
10 – R8 / Crown Residences	53	54	1

Based on a review of the above noise levels, the noise from the R4B building will be very similar to overall cumulative noise levels at the surrounding most affected receivers. At receiver R8 a small increase in noise levels of 1 dB can be expected as these receivers are closer to building R4A.

It is noted that these predicted noise levels can be considered ***typical worst-case*** noise levels whereby noise levels can be expected to reduce as works progress on the site.

Accordingly, no specific additional noise mitigation is required to address cumulative noise impacts at this stage of the development of South Barangaroo.

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 construction works.

4.7 Construction Traffic Noise

A review of the Traffic report prepared by JMT Consulting states:

> *"The amending DA will not result in any increased level of construction vehicle activity for Building R4B when compared to that considered as part of the originally approved project.*
>
> *The key change with respect to construction traffic management is in relation to vehicle access and circulation around the construction site. This is a result of the introduction of Barton Street as a temporary construction road."*

The previous assessment has determined that traffic noise associated with constriction will be acceptable therefore this finding remains unchanged noting that the use of Barton Street will not impact on surrounding residences.

5 OPERATIONAL NOISE & VIBRATION

Operational noise from the proposed R4B building will be from mechanical plant located predominantly on the rooftop of the development and plant in dedicated plant areas.

5.1 Operational Noise Criteria

Noise impact from the general operation of the proposed residential 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, as detailed in Table 3-3, applicable site-specific noise criteria 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	59	56	50
2 – R8 / Crown Residences	Residential	60	56	49
3 – High St, Miller Point	Residential	52	49	46
4 – Merriman St, Millers Point	Residential	51	49	45
5 – Balmain East	Residential	54	50	45
6 – Darling Island	Residential	52	49	44
Commercial Receivers	Commercial	65	65	65

It is noted that the *Industrial Noise Policy (INP)* has been replaced by the *Noise Policy for Industry (NPfI)*; however, the SEAR's refence the *INP* therefore the criteria in Table 5-1 have been retained.

5.2 Operational Noise Assessment & 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.

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.

It is noted that all three residential towers at the One Sydney Site are the closest in proximity to Hickson Road and High Street residences therefore at assessment stage the combined noise emissions from the three towers will be assessed and future noise mitigation of services will be determined. Where necessary standard engineering noise controls will be adopted on site.

5.3 Road Traffic Noise Assessment

JMT consulting notes:

> *The traffic assessment undertaken to support the original development approval for Building R4B considered an overall level of traffic generation of approximately 43 vehicles in the AM peak hour and 28 vehicles in the PM peak hour. Traffic modelling undertaken at the time for the Barangaroo precinct was based on this level of traffic generation.*

An increase of 3 and 2 cars is predicted for the AM and PM peak hours respectively. Such an increase in traffic flows will be acoustically insignificant, therefore the finding that traffic noise will be acceptable remains.

6 CONCLUSION

This report supports a State Significant Development (SSD) Development Application (DA) submitted to the Department of Planning, Infrastructure and Environment (DPIE) pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act).

The amending SSD DA for Building R4B seeks to modify the approved 60-storey Residential Building R4B (SSD 6965) by increasing the overall building height to 68 storeys and increasing the gross floor area (GFA) of the building by 5,650 sqm. Accordingly, an updated noise review of the R4B residential building has been conducted for Barangaroo South reflecting an increased building height. Site-specific noise criteria based on most recent measurements that are applicable to this project have been presented. These criteria 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 R4B and adjacent development within Stage 1B that will occur concurrently to determine the potential for noise and vibration impact at surrounding receivers. No exceedance of noise management levels is expected at surrounding receivers is predicted during normal weekday construction. On Saturday's exceedances of up to 4 dBA are predicted during intensive periods of construction.

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 LendLease in managing the environmental issues associated with this project.

Site-specific operational noise criteria have been determined for the project based on ambient noise monitoring. It is envisaged that compliance will readily be achieved at surrounding noise sensitive receptors and will be addressed during the detailed design phase.

The contribution of the project to operational traffic noise levels at residences on Hickson Road will be negligible when compared to existing or future traffic noise levels.

It is noted that the proposed increase in height to 68 stories will not changes the predictions of findings of the initial noise and vibration assessment that was prepared for the development.