ACOUSTICS AND AIR

BARANGAROO SOUTH

CONSTRUCTION OF COMMERCIAL BUILDING C3
PLANNING APPLICATION
CONSTRUCTION NOISE & VIBRATION ASSESSMENT

REPORT NO. 10232-C3
VERSION D

WILKINSON MURRAY

BARANGAROO SOUTH

CONSTRUCTION OF COMMERCIAL BUILDING C3
PLANNING APPLICATION
CONSTRUCTION NOISE & VIBRATION ASSESSMENT

REPORT NO. 10232-C3
VERSION D

NOVEMBER 2011

PREPARED FOR

LEND LEASE (MILLERS POINT) PTY LTD
THE BOND, 30 HICKSON ROAD
MILLERS POINT NSW 2000

Wilkinson Murray Pty Limited · ABN 39 139 833 060
Level 2, 123 Willoughby Road, Crows Nest NSW 2065, Australia • Offices in Orange, Qld & Hong Kong
t +61 2 9437 4611 • f +61 2 9437 4393 • e acoustics@wilkinsonmurray.com.au • w www.wilkinsonmurray.com.au

TABLE OF CONTENTS

1 INTRODUCTION

1.1 Scope of Commission

The report has been prepared to accompany the Project Application for the C3 Commercial Building and associated works at Barangaroo South. It addresses the relevant Director-General Requirements for the project. These Director-General Requirements are discussed in the Environmental Assessment Report that has been prepared to support the application.

A previous assessment of construction noise and vibration for Barangaroo South basement works has been conducted by Wilkinson Murray (Sydney) Pty Limited (WMSPL). That assessment is detailed in Report 10232 Version B. This report relies in part on the work contained in that previous report.

1.2 Background

The 22 hectare Barangaroo site has been divided into three distinct redevelopment areas (from north to south) – the Headland Park, Barangaroo Stage 2 and Barangaroo Stage 1 (herein after referred to as Barangaroo South).

Lend Lease was successfully appointed as the preferred proponent to develop Barangaroo Stage 1 (otherwise known as Barangaroo South) on 20 December 2009.

This report has been prepared to accompany the Project Application for the C3 Commercial Building and associated works at Barangaroo South. It addresses the relevant Director-General Requirements for the project. These Director-General Requirements are discussed in the Environmental Assessment Report (EAR) that has been prepared to support the application.

On 9 February 2007 the Minister approved a Concept Plan for the site and on 12 October 2007 the land was rezoned to facilitate its redevelopment. The Approved Concept Plan allowed for a mixed use development involving a maximum of 388,300m^2 of gross floor area (GFA) contained within 8 blocks on a total site area of 22 hectares.

Modification No. 1 was approved in September 2007 which corrected a number of minor typographical errors.

On 25 February 2009 the Minister approved Modification No. 2 to the Concept Plan. The Approved Concept Plan as modified allowed for a mixed use development involving a maximum of 508,300m^2 of gross floor area (GFA) contained within 8 blocks on a total site area of 22 hectares.

On 11 November 2009 the Minister approved Modification No. 3 to the Concept Plan to allow for a modified design for the Headland Park and Northern Cove. The Approved Concept Plan as modified allows for a mixed use development involving a maximum of 489,500m^2 of gross floor area (GFA) across Barangaroo as a whole.

On 16 December 2010 the Minister approved Modification No. 4 to the Barangaroo Concept Plan. The Approved Concept Plan as modified allows for approximately 563,965m^2 Gross Floor Area of mixed use development across the entire Barangaroo site.

This Project Application forms one of a series of individual Applications that Lend Lease will be submitting to deliver Barangaroo South. This Project Application is consistent with the established planning framework for the site, including the approved Concept Plan (as modified).

A Project Application (MP10_0023) has been approved for the bulk excavation and construction of a basement car park to accommodate up to 880 car parking spaces and associated services and infrastructure to support the initial phases of the future development of Barangaroo South. A Section 75W Modification Application was subsequently submitted seeking to modify MP10_0023 to extend the area of the approved basement to the south. This modification was approved by the Minister for Planning on 3 March 2011.

A further Section 75W application has been submitted to the Department of Planning and Infrastructure (the Department) and is currently being assessed, which seeks the Minister's approval to modify the depth of the excavation and change the reduced levels of the basement structure, using the same construction methodology as detailed and approved as part of the original project application. This includes:

- reduced excavation and bulk earthworks;
- reduced structural works – foundations, basement levels, perimeter retention system etc; and
- installation of associated services and infrastructure to support the initial phases of the future development of Barangaroo South.

A project application for the first commercial building, known as C4, was submitted to the Department of Planning on 29 October 2010. This application sought consent for construction and use of a new commercial Building C4 with accommodating commercial and retail uses, a child care centre, bicycle parking and associated use and operation of car parking and loading facilities in the basement. Consent was issued by the Minister on 3 March 2011.

A Section 75W application has been submitted to the Department and is currently being assessed which seeks the Minister's approval to modify certain elements of the approved C4 building, including:

- mix of the uses within the building;
- total GFA;
- shape of floor plates of the podium and the tower elements of the building;
- facade details;
- roof treatment; and
- basement layout.

1.3 Site Description

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 Stage 2 (also known as Barangaroo Central) and Barangaroo South.

The area of land within which development is proposed under this Project Application extends over land generally known and identified in the approved Concept Plan as Block 3 which comprises Lot 5 in DP 876514.

This Project Application seeks approval for the construction of a 49 storey building, comprising ground floor retail, a commercial lobby, childcare, podium and office tower, provision for associated cars and bicycle parking and the construction of the surrounding ancillary temporary public domain which includes access streets and landscaping.

1.4 Construction Hours

The proposed normal construction hours are between 7.00am and 6.00pm Monday – Friday and between 7.00am and 5.00pm on Saturdays. No work, with the exception of emergency work, will be undertaken on Sundays or Public Holidays.

It is noted that the proposed hours for Saturdays are outside OEH's standard hours of construction being 8.00am and 1.00pm. However, this extended period of construction hours will enable the major noise and vibration generating activities to be carried out in a more efficient manner, thereby shortening the period over which sensitive receptors will be exposed.

1.5 Hoardings / Site Fences

As part of the previous works for PA1, the construction site would be secured by a combination of hoardings and fencing that will remain as part of these works. The proposed location and construction of hoardings/site fences is described in Table 1-1.

Table 1-1 Proposed Construction Hoardings / Site Fences

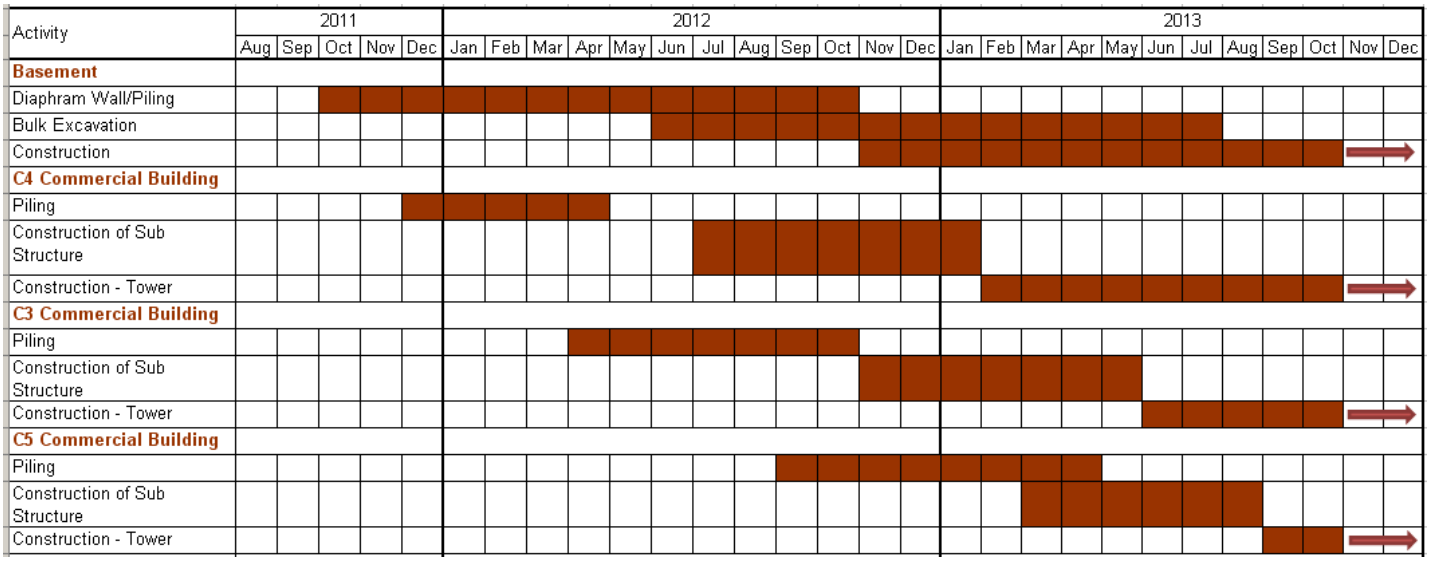
Frontage	Proposed Fencing
Hickson Road	A-Class B painted hoarding along Hickson Road extending north from the Margaret Street intersection. Vehicle gates will be located at the northern end of Stage 1 for access to and from site, to coincide with existing crossovers associated with the former Port use. This area will be secured by gatemen and stop/go personnel to control pedestrian and vehicle traffic.
Shelly Street	Shelley Street will be protected by Class A 3 m painted plywood hoarding.
Western Frontage	Class A 2.4m painted plywood hoarding or chain wire that bounds the site mesh / barbed fence will be erected along the Western Frontage to maintain the public thoroughfare through to King Street Wharf.
Northern Frontage	Class A painted hoarding of minimum 2.4m height.

1.6 Construction Activities

The expected works associated with the C3 development are shown in Figure 1-1, along with "Basement" and "C4 Commercial Building" works. The activities "Excavation" and "Construction Sub-structure" listed under "C3 Commercial Building" will be delivered as part of the Basement project, and are not specifically addressed in this report.

Piling will generally be done using bored piling. Vibratory impact piling may be used for limited work around the services core of C3.

Figure 1-1 Expected Construction Program



Note: Dates are estimates only and are subject to change.

It is important that the cumulative noise impacts from all site construction activities in the area are considered. Other construction activities that may occur concurrently include the Headland Park works, C4 construction and Basement works.

The Headland Park is likely to be carried out by a contractor separately commissioned by the Barangaroo Delivery Authority. This report also considers the cumulative effect of these works and C3 construction.

1.7 Construction Traffic

Construction traffic generated by the construction of C3 will combine with traffic from C4, 5 and basement works.

A review of construction traffic reports prepared by ARUP indicates that maximum truck movements will occur as follows;

- 230 truck movements per day during basement construction which includes works associated with buildings C3, C4 and C5.
- 152 truck movements per day during construction of C5 tower structure, facade, finishes and fit-out in parallel with C4 and C3 works.

2 AMBIENT NOISE LEVELS AND SURROUNDING RECEIVERS

WMSPL has conducted a noise study in 2010 at receivers surrounding the site for Lend Lease Millers Point Pty Ltd. That study was initially conducted for a construction noise and vibration assessment to accompany the Project Application for the Bulk Excavation and Basement Car Park.

In this noise study, representative residential and commercial receivers that may be affected by construction noise and vibration from the South Barangaroo site where identified and are detailed in Table 2-1.

Table 2-1 Surrounding Receivers

Receiver Address	Comments
Commercial Receivers	
Napoleon Street	Aon Australia Building Symantec Building
30 Hickson Road	Billabond Child Care Centre, Top Floor Café, Lend Lease offices,
Lime Street, (King Street Wharf)	Commercial Office Retail including indoor / outdoor cafes
37 High Street, Millers Point	KU Lance Preschool and Children's Centre
Barangaroo Site	Temporary Cruise Passenger Terminal
Shelley Street	Commercial on cnr Sussex & Shelley Streets
Residential Receivers	
38 Hickson Road	Multi Storey Residential Building
High Street, Millers Point	Terrace Residences
Kent Street	Hotel and Residential
Merriman Street, Dawes Point	Double Storey unit blocks and single storey houses
Dalgety Road, Dawes Point	Double Storey Community housing
Edward Street & Little Edward Street, Balmain East	Waterfront properties along Balmain peninsula
Northern end of Darling Island Rd and Wharf Crescent, Darling Island	Multi Storey High End Apartments
Northern end Sydney Wharf Pirrama Road Pyrmont	Multi Storey High End Apartments
Heritage Receivers	
Former Grafton Bond Store, Hickson Road, Millers Point	Former Grafton Bond Store Building
20-26 Sussex Street, Sydney	The Sussex Hotel – Former Moreton's Hotel
2-4 Jenkins Street	Former MWS stores

The existing noise environment of the surround area has been quantified by conducting long-term ambient noise monitoring at eight (8) locations surrounding the site.

The noise monitoring locations are described in Table 2-2 and shown in Figure 2-1.

Table 2-2 Long-Term Noise Monitoring Locations

Logger	Location	Monitoring Period in 2010	Company
1	Level 4, The Bond 30-38 Hickson Road	14 April to 29 April	ARUP
2	Middle of South Barangaroo Site – Representative of Temporary Passenger Terminal	14 April to 29 April	ARUP
3	South West of site adjacent to Sussex & Shelley Streets	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 Street, Millers Point	31 August – 9 September	WM
6	18 Merriman Street, Dawes Point	31 August – 6 September	WM
7	25 Edward Street, Balmain East	31 August – 9 September	WM
8	Adjacent to 3 Darling Island Road, Darling Island	31 August – 9 September	WM

The noise monitoring equipment used by Wilkinson Murray consisted of ARL Type EL-215 environmental noise loggers set to A-weighting, 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 that was conducted by ARUP, the data was reviewed by WM and is considered suitable to use for assessment purposes.

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. 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 2-1 Aerial showing Noise Monitoring Locations

*Source: Land and Property Management Authority

Table 2-3 summarises the noise results, for daytime, evening and night time periods as defined in the OEH's *Construction Noise Guideline* (*CNG*). Additionally, noise monitoring results for Saturday (7.00am-5.00pm) has been included as Lend Lease proposes to operate outside standard CNG hours.

Table 2-3 Summary of Measured Noise Levels

Noise Logging Site	RBL (dBA)				$L_{Aeq,period}$ (dBA)			
	Daytime 7-6pm	Evening 6-10pm	Night Time 10pm-7am	Saturday 7am-5pm	Daytime 7-6pm	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.
- L_{Aeq} (period) – the equivalent continuous L_{Aeq} noise level measured over the assessment period;
- RBL – Rating Background Level is a measure of typical background noise levels which is used in determining noise criteria.

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 OEH procedures.

3 CONSTRUCTION NOISE & VIBRATION CRITERIA

Site specific construction noise and vibration criteria are based on the following OEH guidelines, being:

- *Interim Construction Noise Guideline*; and,
- *Assessing Vibration: A Technical Guideline*.

3.1 Construction Noise Criteria

The OEH released the "*Interim Construction Noise Guideline*" *(ICNG)* in July 2009. The guideline provides construction management levels that assist in assessing the impact of construction noise on surrounding receivers. The guidelines are given in Table 3-1 and summarised below.

For residences, the standard daytime construction noise management level is that the $L_{Aeq,15min}$ construction noise level emanating from the site should not exceed the background noise by more than 10dBA at surrounding receivers. This is for standard hours as defined by the *ICNG* which are:

- Monday to Friday 7.00am to 6.00pm
- Saturday 8.00am to 1.00pm

Outside the standard hours, the management level is based on the background + 5dBA.

Table 3-1 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 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays	Noise affected RBL + 10dBA	The noise affected level represents the point above which there may be some community reaction to noise. 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. 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 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.
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. 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. For guidance on negotiating agreements see section 7.2.2.

In addition, the following $L_{Aeq,15\ min}$ construction noise management levels 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 3-2 presents the applicable site specific construction noise management levels at surrounding receivers.

Table 3-2 Site Specific Construction Noise Management Levels

Location	Construction Noise Management Level, L_{Aeq} – dBA				Maximum Construction 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 – Dawes Point 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 (at all times)				
Schools / Preschools	55* (at all times)				
Parks / Outdoor Play Areas	65 (at all times)				

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

3.2 Construction Vibration Criteria

Human Comfort and Building Damage construction vibration criteria that have been established for the entire South Barangaroo site are summarised in the following sections.

3.2.1 Human Comfort Vibration Criteria

Table 3-3 details guidance on preferred values for continuous vibration.

Table 3-3 Criteria for Exposure to Continuous Vibration

Place	Time	Peak Particle Velocity (mm/s)	
		Preferred	Maximum
Critical working areas (e.g. hospital operating theatres precision laboratories)	Day or night time	0.14	0.28
Residences	Daytime	0.28	0.56
	Night time	0.20	0.40
Offices	Day or night time	0.56	1.1
Workshops	Day or night time	1.1	2.2

In the case of intermittent vibration, which is caused by plant such as rockbreakers or sheet piling, the criteria are expressed as a Vibration Dose Value (VDV) which is presented in Table 3-4.

Table 3-4 Acceptable Vibration Dose Values for Intermittent Vibration ($m/s^{1.75}$)

Location	Daytime		Night Time	
	Preferred Value	Maximum Value	Preferred Value	Maximum Value
Critical areas	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

Calculation of VDV requires knowledge of the number of events in the relevant time period.

3.2.2 Building Damage

The recommended limits (guide values from BS7385) for transient vibration to ensure minimal risk of cosmetic damage to residential and industrial buildings are presented in Table 3-5.

Table 3-5 Transient Vibration Guide Values - Minimal Risk of Cosmetic Damage

Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures Industrial and heavy commercial buildings	50mm/s at 4 Hz and above	N/A
Unreinforced or light framed structures Residential or light commercial type buildings	15mm/s at 4 Hz increasing to 20mm/s at 15 Hz	20mm/s at 15 Hz increasing to 50mm/s at 40 Hz and above

In addition to the British Standard, for the case of nearby heritage buildings, guidance for structural damage is derived from the German Standard DIN 4150 – 3 *"Structural Vibration Part 3 – Effects of Vibration on Structures".* Table 3-6 details the recommendations for heritage buildings.

Table 3-6 DIN 4150 recommended vibration level for Heritage Buildings

Frequency Range of Predominant Pulse	1-10 Hz	10 to 15 Hz	40 to 50 Hz
Peak component particle velocity	3 mm/s	3 to 8 mm/s	8-10 mm/s

4 CONSTRUCTION METHODS, EQUIPMENT & NOISE SOURCE LEVELS

4.1 Sound Power Levels

Sound Power Levels (SWLs) for typical construction plant are identified in Table 4-1. These SWLs have recently 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 4-1 Typical Construction Plant Sound Levels – dBA

Plant	Sound Power Level	Sound Pressure Level at 7m
Bulldozer	114	89
Pug Mill – Remediation Plant	100	75
Excavator	108	83
Rotary Hoe	109	84
Mobile Crane	104	79
Concrete Truck	109	84
Angle Grinder	109	84
Concrete Pump – 120 mm diameter / 50 bar	112	87
Bentonite Plant	104	79
Sheet Metal Forming (Grinding, Hammer)	105	80
Concrete Crushing and Screening Plant	116	91
Concrete Saw	116	91
Crawler Cranes	98	73
Ground Water Pump	106	81
Mobile Crane	98	73
Rotary Boring Drill Rig	107	82
Site Cranes	104	79
Dump Truck	108	83
Front End Loader	112	87
Excavator	107	82
Hammer Hydraulic	122	97
Auger Vibro Pile	110	85
Bored Pile Rig	112	87
Sheet Piling - Vibrating	110	85
Concrete Saw	113	88
Compressor	100	75
Bobcat	103	78
Hand Tools	90	65
Jackhammer	105	80

5 CONSTRUCTION NOISE ASSESSMENT

Assessment of likely noise at surrounding commercial and residential receivers has been assessed for the site general construction of the C3 building.

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.

The model includes the effect of a 2.4 metre noise barrier around the site as recommended in the previous PA1 Basement construction noise assessment. In addition a 3 metre barrier on the southern site boundary has been included in the modelling. These measures have been included in the Lend Lease Project Management and Construction Noise and Vibration Management Sub-Plan.

Modelling has been conducted for a number of construction scenarios. The four scenarios considered are summarised in Table 5-1.

Table 5-1 Construction Scenarios for C3

Scenario	Description	Works
A1	C3 Piling	4 piling rigs and 2 truck movements are assumed to operate in 15-minutes.
A2	C3 Sheet Piling	In the event that vibratory impact sheet piling for C4 occurs in isolation. 1 piling rig operating for 4 weeks
B	C3 Building Construction	This scenario includes concreting and lifting. 2 concrete pumps, 2 forklifts, 4 compressors, 2 cranes, a boom truck and lift are assumed to operate in 15-minutes. Also concrete trucks and normal delivery trucks assumed to be 12 movements in 15-minutes.
C	C3 Facade	In the event that the construction of the façade occurs in isolation. Forklift and power tools assumed. 4 truck movements in 15-minutes assumed.
D	Scenarios B + C	Represents periods where both Scenarios B and C occur concurrently.

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

Area Noise Sources – General construction equipment that is distributed across the work site has been modelled as an area source based on proposed equipment numbers and total noise levels.

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.

5.1 Predicted Construction Noise Levels

Predicted construction noise levels at surrounding receivers are presented as follows:

- Table 5-3 Residential Receivers
- Table 5-4 Commercial Receivers
- Table 5-5 Schools and Pre-Schools

Cumulative noise levels at surrounding receivers from the basement works combined with C3, C4 and C5 construction have been modelled for scenario E as illustrated in Figure 5-1.

Figure 5-1 Expected Construction Program

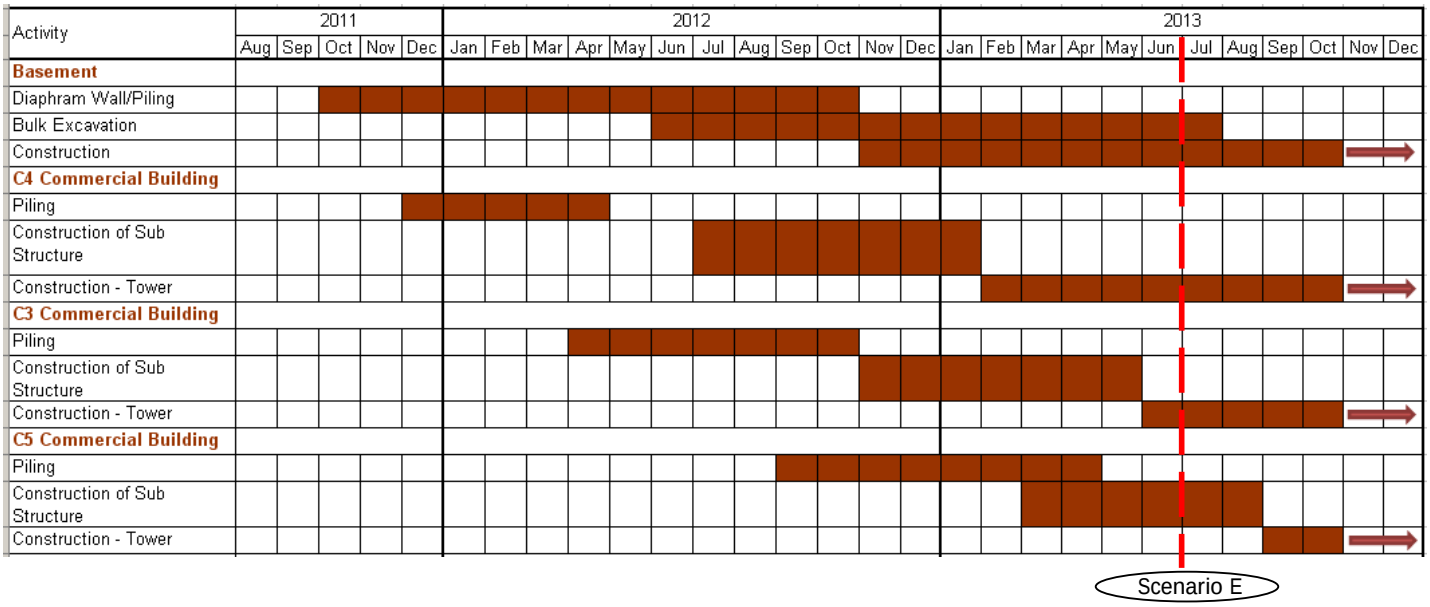


Table 5-2 details the equipment modelled in scenario E. Figure 5-7 show the noise contours of this scenario

Table 5-2 Cumulative Construction Scenarios for C5

Scenario	Description	Daytime Works	Night Time Works
E	Basement Bulk Excavation C3 and 4 tower (construction scenario type C) C5 substructure construction (scenario B)	Basement – Truck movements (6), Excavator Mounted w Hydraulic Hammer (2) (or rock breaker) Groundwater pumps , Excavator w Rock Saw, dewatering plant C3 / C4 – Forklift and power tools assumed. External Lift and Cranes 4 truck movements in 15-minutes assumed C5 – 2 concrete pumps, 2 forklifts, 4 compressors, 2 cranes, a boom truck and lift are assumed to operate in 15-minutes. Also concrete trucks and normal delivery trucks assumed to be 12 movements in 15-minutes	Basement – dewatering plant

In addition, daytime noise contour plots of the site and surrounds for Scenarios A-D are presented in Figures 5-2 to 5-5.

Table 5-3 Predicted Noise Levels at Residential Receivers – $L_{Aeq,(15\ min)}$

Location	Predicted Noise Day / Night dBA		Day			Evening			Night			Saturday (Extended)		
			Criteria dBA	Exceedance dBA	Compliance	Criteria dBA	Exceedance dBA	Compliance	Criteria dBA	Exceedance dBA	Compliance	Criteria dBA	Exceedance dBA	Compliance
Scenario A1 – C3 Piling														
1 – Hickson Road Residences	62	NA	63	-	Yes							55	**7**	**No**
5 – High Street Residences	53		57	-	Yes							50	-	Yes
6 – Dawes Point Residences	41		56	-	Yes				**NA**			51	-	Yes
7 – Balmain East Residences	40		59	-	Yes							51	-	Yes
8 – Darling Island Residences	46		57	-	Yes							55	-	Yes
9 – Sydney Wharf Residences	48		57	-	Yes							55	-	Yes
Scenario A2 – C3 Sheet Piling														
1 – Hickson Road Residences	58	NA	63	-	Yes							55	**8**	**No**
5 – High Street Residences	47		57	-	Yes							50	-	Yes
6 – Dawes Point Residences	34		56	-	Yes				**NA**			51	-	Yes
7 – Balmain East Residences	34		59	-	Yes							51	-	Yes
8 – Darling Island Residences	40		57	-	Yes							55	-	Yes
9 – Sydney Wharf Residences	41		57	-	Yes							55	-	Yes
Scenario B – C3 Building Construction														
1 – Hickson Road Residences	67	NA	63	**4**	Yes							55	**12**	**No**
5 – High Street Residences	57		57	-	Yes							50	**3**	**No**
6 – Dawes Point Residences	46		56	-	Yes				**NA**			51	-	Yes
7 – Balmain East Residences	45		59	-	Yes							51	-	Yes
8 – Darling Island Residences	51		57	-	Yes							55	-	Yes
9 – Sydney Wharf Residences	52		57	-	Yes							55	-	Yes

Location	Predicted Noise Day / Night dBA		Day Criteria dBA	Day Exceedance dBA	Day Compliance	Evening Criteria dBA	Evening Exceedance dBA	Evening Compliance	Night Criteria dBA	Night Exceedance dBA	Night Compliance	Saturday (Extended) Criteria dBA	Saturday (Extended) Exceedance dBA	Saturday (Extended) Compliance
Scenario C – C3 Facade														
1 – Hickson Road Residences	60	NA	63	-	Yes	**NA**						55	**5**	Yes
5 – High Street Residences	51		57	-	Yes							50	1	Yes
6 – Dawes Point Residences	39		56	-	Yes							51	-	Yes
7 – Balmain East Residences	38		59	-	Yes							51	-	Yes
8 – Darling Island Residences	44		57	-	Yes							55	-	Yes
9 – Sydney Wharf Residences	45		57	-	Yes							55	-	Yes
Scenario D – Scenarios B + C														
1 – Hickson Road Residences	67	NA	63	**4**	Yes	**NA**						55	**12**	**No**
5 – High Street Residences	58		57	1	Yes							50	-	Yes
6 – Dawes Point Residences	47		56	-	Yes							51	-	Yes
7 – Balmain East Residences	46		59	-	Yes							51	-	Yes
8 – Darling Island Residences	52		57	-	Yes							55	-	Yes
9 – Sydney Wharf Residences	53		57	-	Yes							55	-	Yes

Table 5-4 Predicted Noise Levels at Commercial Receivers – $L_{Aeq,(15\ min)}$

Location	Predicted Noise Day/Night dBA		Day			Evening			Night			Saturday (Extended)		
			Criteria dBA	Exceedance dBA	Compliance	Criteria dBA	Exceedance dBA	Compliance	Criteria dBA	Exceedance dBA	Compliance	Criteria dBA	Exceedance dBA	Compliance
Scenario A1 – C3 Piling														
Lime Street, (King Street Wharf)	53		70	-	Yes							70	-	Yes
30 Hickson Road	53		70	-	Yes							70	-	Yes
Shelly Street	55	NA	70	-	Yes				NA			70	-	Yes
Temporary Cruise Terminal	47		70	-	Yes							70	-	Yes
The Sussex Hotel	55		70	-	Yes							70	-	Yes
Scenario A2 – C3 Sheet Piling														
Lime Street, (King Street Wharf)	47		70	-	Yes							70	-	Yes
30 Hickson Road	48		70	-	Yes							70	-	Yes
Shelly Street	50		70	-	Yes				NA			70	-	Yes
Temporary Cruise Terminal	41		70	-	Yes							70	-	Yes
The Sussex Hotel	52		70	-	Yes							70	-	Yes
Scenario B – C3 Building Construction														
Lime Street, (King Street Wharf)	57		70	-	Yes							70	-	Yes
30 Hickson Road	58		70	-	Yes							70	-	Yes
Shelly Street	59	NA	70	-	Yes				NA			70	-	Yes
Temporary Cruise Terminal	51		70	-	Yes							70	-	Yes
The Sussex Hotel	59		70	-	Yes							70	-	Yes

Table 5-5 Predicted Noise Levels at Commercial Receivers – $L_{Aeq,(15\ min)}$

Location	Predicted Noise Day/Night dBA		Day			Evening			Night			Saturday (Extended)		
			Criteria dBA	Exceedance dBA	Compliance	Criteria dBA	Exceedance dBA	Compliance	Criteria dBA	Exceedance dBA	Compliance	Criteria dBA	Exceedance dBA	Compliance
Scenario C – C3 Facade														
Lime Street, (King Street Wharf)	50	NA	70	-	Yes							70	-	Yes
30 Hickson Road	51		70	-	Yes							70	-	Yes
Shelly Street	52		70	-	Yes				NA			70	-	Yes
Temporary Cruise Terminal	44		70	-	Yes							70	-	Yes
The Sussex Hotel	51		70	-	Yes							70	-	Yes
Scenario D – Scenarios B + C														
Lime Street, (King Street Wharf)	58	NA	70	-	Yes							70	-	Yes
30 Hickson Road	58		70	-	Yes							70	-	Yes
Shelly Street	60		70	-	Yes				NA			70	-	Yes
Temporary Cruise Terminal	52		70	-	Yes							70	-	Yes
The Sussex Hotel	60		70	-	Yes							70	-	Yes

Table 5-6 Predicted Noise Levels at School Receivers - $L_{Aeq,(15min)}$

Location	Predicted Noise Day / Night dBA		Day Playground			Day Internal Noise		
			Criteria dBA	Exceedance dBA	Compliance	Criteria dBA	Exceedance dBA	Compliance
Scenario A1 – C3 Piling								
Billabond Child Care Centre	53		65	-	Yes	55	-	Yes
KU Lance Preschool	53		65	-	Yes	55	-	Yes
Scenario A2 – C3 Sheet Piling								
Billabond Child Care Centre	48		65	-	Yes	55	-	Yes
KU Lance Preschool	47		65	-	Yes	55	-	Yes
Scenario B – C3 Building Construction								
Billabond Child Care	58		65	-	Yes	55	-	Yes
KU Lance Preschool	57		65	-	Yes	55	-	Yes
Scenario C – C3 Facade								
Billabond Child Care	51		65	-	Yes	55	-	Yes
KU Lance Preschool	51		65	-	Yes	55	-	Yes
Scenario D – Scenarios B + C								
Billabond Child Care Centre	58		65	-	Yes	55	-	Yes
KU Lance Preschool	58		65	-	Yes	55	-	Yes

Figure 5-2 Scenario A1 Daytime $L_{Aeq,(15\ min)}$ Construction Noise Contours

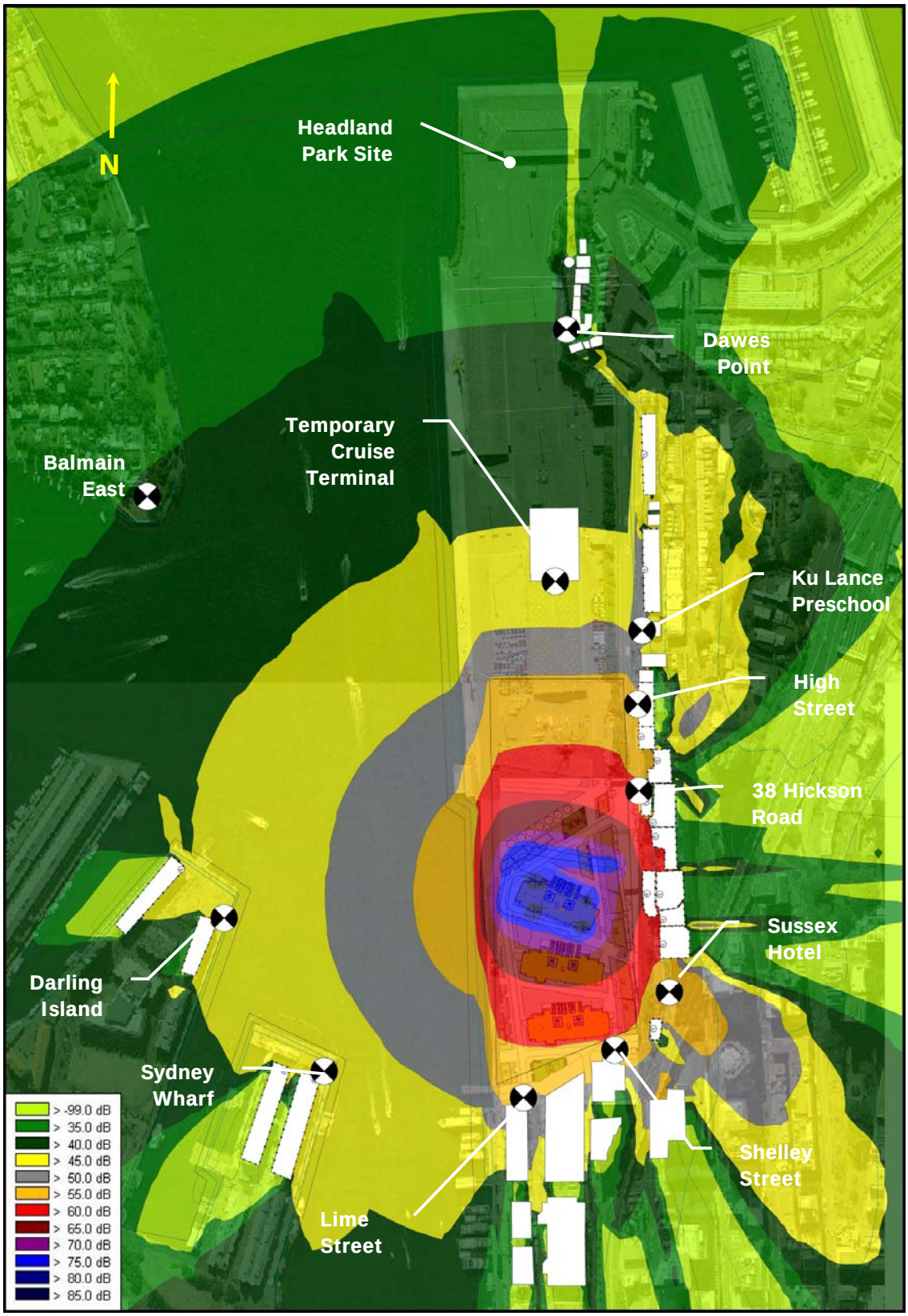


Figure 5-3 Scenario B Daytime $L_{Aeq,(15\ min)}$ Construction Noise Contours

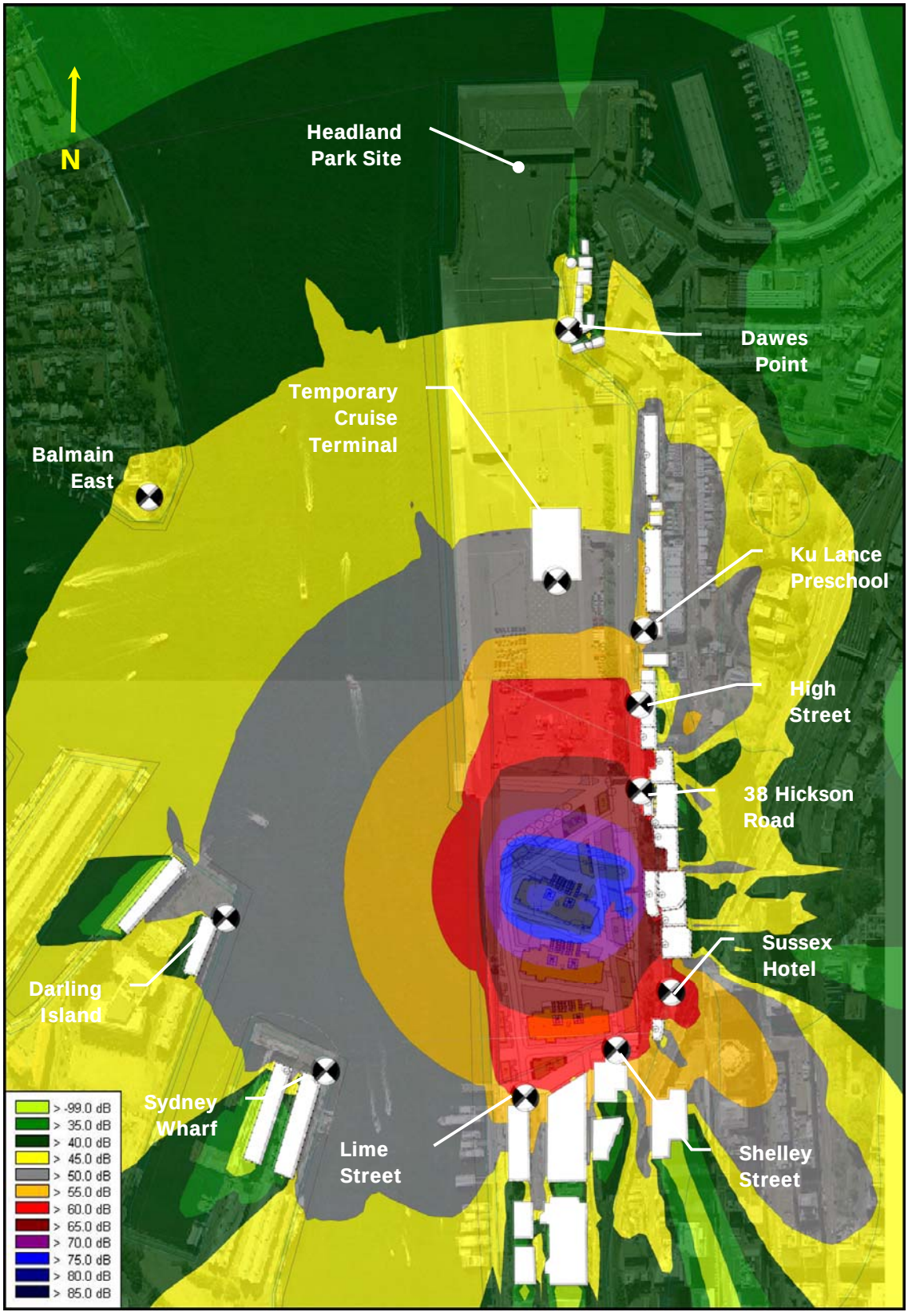


Figure 5-4 Scenario C Daytime $L_{Aeq,(15\ min)}$ Construction Noise Contours

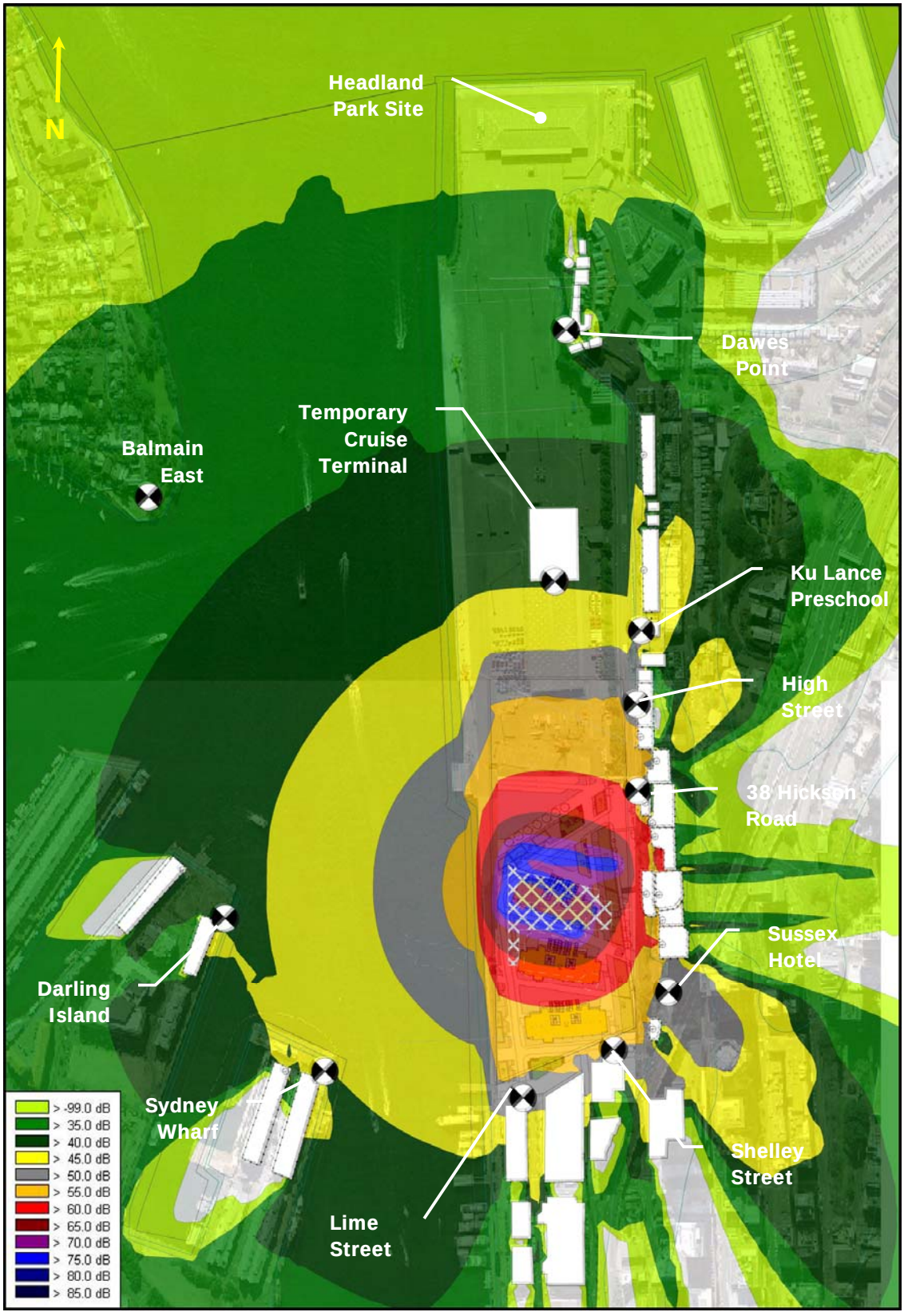
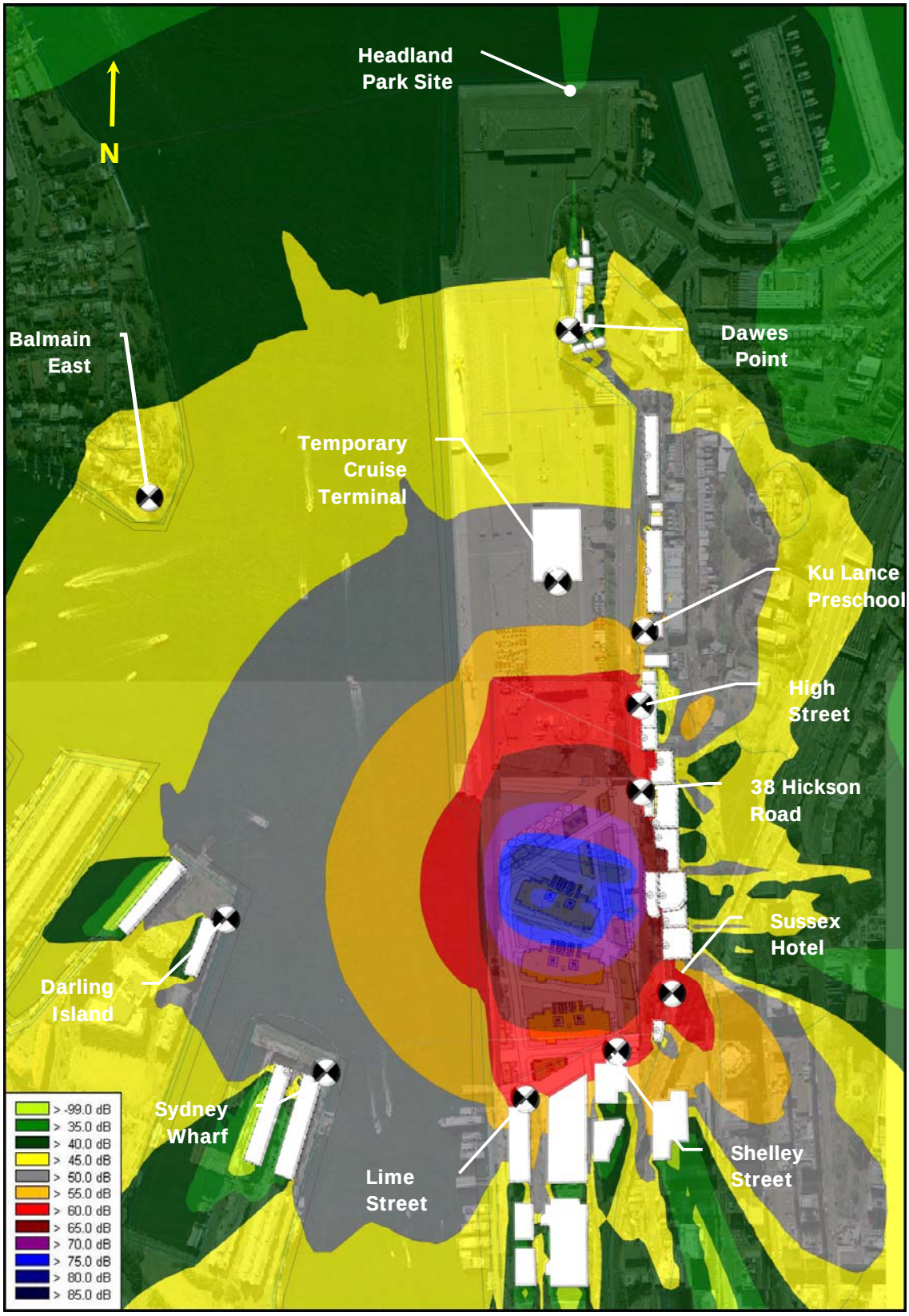


Figure 5-5 Scenario D Daytime $L_{Aeq,(15\ min)}$ Construction Noise Contours



The following Tables display the predicted cumulative noise evels (Scenario E) from Basement, C3, C4 and C5 construction.

Table 5-7 Scenario E – Predicted Cumulative Noise Levels at Residential Receivers – $L_{Aeq(15\ min)}$

Location	Predicted Noise Day/Night dBA		Day			Evening			Night			Saturday (Extended)		
			Criteria dBA	Exceedance dBA	Compliance	Criteria dBA	Exceedance dBA	Compliance	Criteria dBA	Exceedance dBA	Compliance	Criteria dBA	Exceedance dBA	Compliance
							Scenario E							
1 – Hickson Road Residences	73	52	63	**10**	**No**	58	-	Yes	54	**-**	Yes	55	**15**	**No**
5 - High Street Residences	56	42	57	-	Yes	49	-	Yes	46	**-**	Yes	50	**6**	**No**
6 - Dawes Point Residences	52	37	56	-	Yes	49	-	Yes	45	**-**	Yes	51	-	Yes
7 - Balmain East Residences	52	36	59	-	Yes	50	-	Yes	45	**-**	Yes	51	-	Yes
8 - Darling Island Residences	57	37	57	-	Yes	49	-	Yes	44	**-**	Yes	55	-	Yes
9- Sydney Wharf Residences	58	38	57	**1**	**Marginal**	49	-	Yes	44	**-**	Yes	55	-	Yes

Table 5-8 Scenario E - Predicted Cumulative Noise Levels Construction at Commercial Receivers – $L_{Aeq(15\ min)}$

Location	Predicted Noise Day/Night dBA		Day			Evening			Night			Saturday (Extended)		
			Criteria dBA	Exceedance dBA	Compliance	Criteria dBA	Exceedance dBA	Compliance	Criteria dBA	Exceedance dBA	Compliance	Criteria dBA	Exceedance dBA	Compliance
							Scenario E							
Lime Street, (King Street Wharf)	67	38	70	-	Yes	70	-	Yes	70	-	Yes	70	-	Yes
30 Hickson Road	64	49	70	-	Yes	70	-	Yes	70	-	Yes	70	-	Yes
Shelly Street	70	39	70	-	Yes	70	-	Yes	70	-	Yes	70	-	Yes
Temporary Cruise Terminal	59	48	70		Yes	70	-	Yes	70	-	Yes	70	-	Yes
Sussex Street	68	40	70				-	Yes	70	-	Yes	70	-	Yes

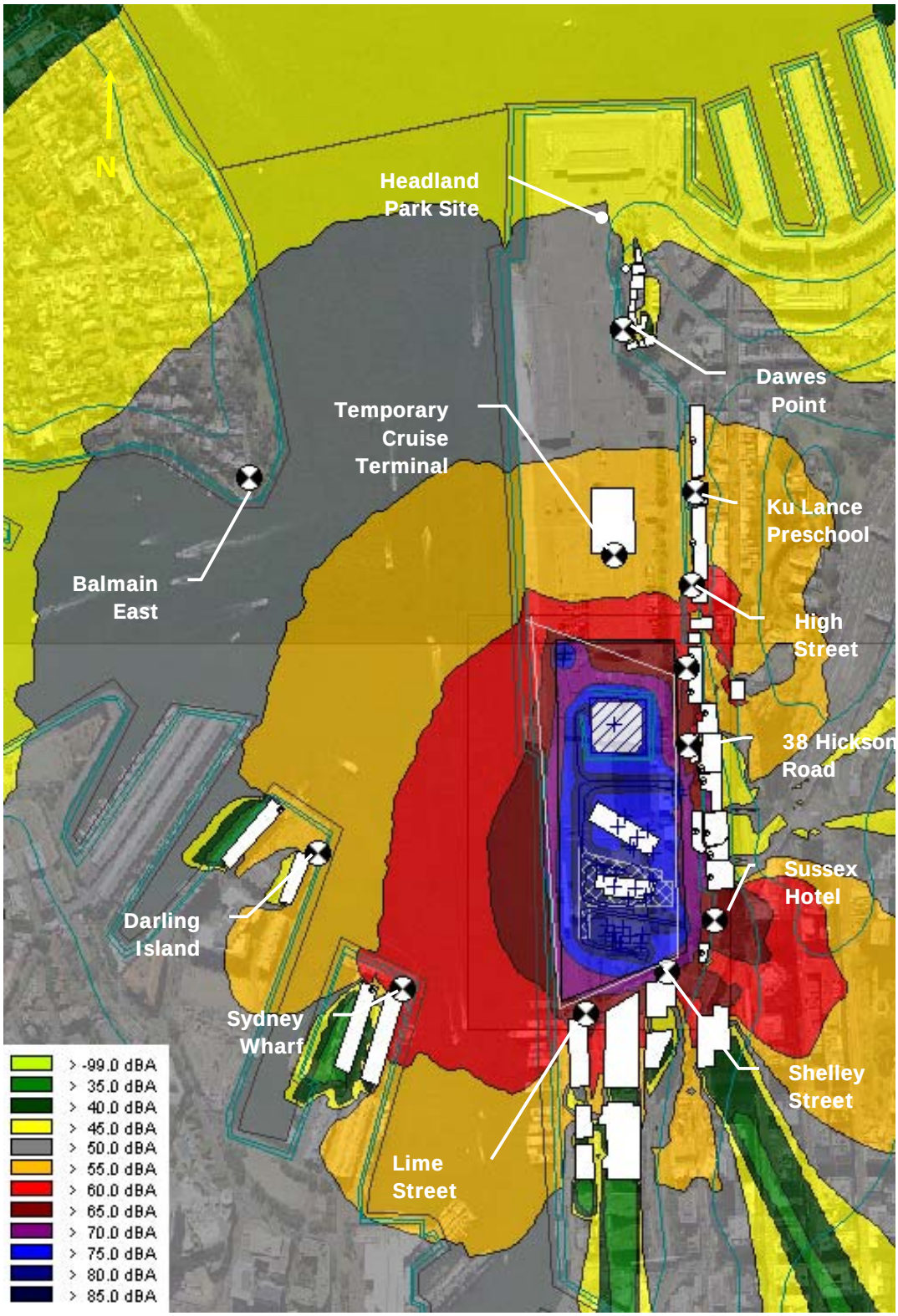
Note: Activities during the evening and night attributed to basement and carpark works only.

Table 5-9 Scenario E – Predicted Cumulative Noise Levels at School Receivers – $L_{Aeq(15\ min)}$

Location	Predicted Noise Day/ Night dBA	Day Playground			Day Internal Noise (Assuming 10dB façade reduction)		
		Criteria dBA	Exceedance dBA	Compliance	Criteria dBA	Exceedance dBA	Compliance
		Scenario E					
Billabong Child Care Centre	64	65	-	Yes	55	-	**Yes**
KU Lance Preschool	56	65	-	Yes	55	-	**Yes**

Note: Premises unlikely to be used during the evening, and not at night..

Figure 5-7 Cumulative (Scenario E) Daytime Noise Contours, L_{Aeq} dBA



5.2 Discussions of Results

5.2.1 Residential Receivers

C3 Construction Noise

A review of predicted noise levels indicates an exceedance of construction noise goals for Saturday at the nearest residences to the site, being those at 38 Hickson Road. Exceedances up to 12 dBA are indicated at these residences on Saturdays. Lower exceedances are expected on weekdays. In general no other exceedances are predicted for residential receivers surrounding the site.

It is worth noting that the maximum noise level of 75dBA is not predicted to be exceeded at any surrounding receivers.

Basement, C3, C4 and C5 Cumulative Noise

During normal weekday operating hours, there are exceedances of up to 10 dBA at nearby residences on Hickson Road.

Exceedances up to 15 dBA for Saturday works due to combined noise from basement, C3, C4 and C5 works are predicted at residences along Hickson Road. Lower magnitude exceedances are predicted at residences at High Street. The noise levels are consistent with the Basement construction noise assessment whereby noise from C3, C4 and C5 construction works are not significant contributors to predicted exceedances.

It is noted that all construction noise levels are well below the maximum construction noise level of 75dBA.

Selection of noise control kits for some louder plant would reduce these noise levels to some extent, and could potentially eliminate exceedances during normal working hours.

It is noted that should the construction of either C3 or C4 not proceed as projected in the program the cumulative noise levels associated with the construction of the basement and C5 will result in noise levels no higher that the levels detailed above.

5.2.2 Commercial Receivers

Compliance with the 70dBA noise objective is indicated at all surrounding commercial premises.

These premises are generally of modern construction and do not have operable windows, such that a facade reduction of at least 20dBA can be expected. As a result, maximum internal noise levels up to 40 dBA are predicted. This is consistent with the maximum noise levels recommended in Australian Standard 2107 for general office areas.

Commercial receivers which have operable windows would be subjected to construction noise levels at least 10dBA higher if windows were open. Therefore, where internal noise levels exceed 45 dBA, windows may need to be closed during intensive periods of construction.

In the case of restaurants and cafes at the northern end of Lime Street and the Shelley Street precinct, maximum internal construction noise levels up 48 dBA are predicted. The provision of plywood hoardings has been previously recommended on the southern site boundary to improve the acoustic amenity of outdoor eating areas. These barriers have been included in our predictions.

5.2.3 Preschools

At preschools, external noise levels are predicted to comply with the external 65 dBA noise objective for active recreation areas. There are no exceedances of internal noise objectives for the C3 construction, nor cumulative construction noise.

5.2.4 Temporary Cruise Ship Passenger Terminal

The temporary cruise ship passenger terminal has been approved by the Barangaroo Delivery Authority (under Part 5 of the Environmental Planning and Assessment Act 1979) to operate adjacent to Gate 5 on the site of Barangaroo until 2012. Based on information provided by Sydney Ports, there are approximately 130 ship days per year when a ship will be docked at Wharf 5.

Maximum noise levels of up to 52dBA are predicted for C3 construction. Cumulative noise levels at this location are predicted to be up 54dBA. These noise levels are not considered excessive.

5.3 Extended Hours of Operation

It is proposed to undertake activities outside OEH normal hours of construction. This will enable the activities to be carried out in a more efficient manner, thereby shortening the construction period during which receptors are exposed to construction-related noise and vibration impacts.

These works will be undertaken during hours that are consistent with the City of Sydney Council's preferred hours for construction. These hours include Saturday afternoon up to 5.00pm, which recognises the urban nature of the city environment. This differs from the OEH guideline which covers the entire range of environments in NSW.

Section 2.2 discusses proposed hours of operation in more detail.

Some activities are required to be undertaken outside normal construction hours, for example dewatering and treatment of groundwater, dust suppression, attendance to environmental protection structures, and other site and maintenance activities. These have been included in the noise assessment and where appropriate localised treatment will be implemented on site.

It is noted that the subject site is located within a commercial precinct where there is significant other local activity during the construction periods, and also bearing in mind the site's previous use permitted 24 hour per day operation of the port facilities. It is also noted that fewer impacts on commercial receivers are expected during these times, as some of these buildings would have reduced occupation during these periods.

It is recommended that for Saturday operations consideration be given to, where feasible, planning construction activities so that the loudest activities occur during standard construction hours. In addition, the use of equipment over defined periods with periods of respite is provided is recommended to be included in the Environmental Management Plan.

5.4 Cumulative Noise Impact with Headland Park Works

Noise from Basement works C4, C3 and C5 construction works when combined with Headland works has been assessed. The following has been determined:

Basement Construction Works findings are that – "*Based on the above findings the increase in construction noise levels at residences as a result of the South Barangaroo site in combination with Headland Park construction is small. Whereby the construction noise from the Headland Park site will be dominant at nearby residences"*

C4 Construction Works findings are that – "*The predicted construction noise levels due to the works associated with stage C4 are more than 10dB below those predicted construction noise from Headland Park Construction Works at Balmain East and Dawes Point Residences (based on predictions conducted by Acoustic Logic Consultancy Pty Ltd for the Barangaroo Delivery Authority BDA). As such the impact of C4 construction noise on theses receivers is considered negligible."*

The conclusion is the same for the C3 and C5 works. The worst case noise levels at those two receivers, compared with the predicted noise from the Headland Park works, are given in Table 5-10.

Table 5-10 Cumulative Noise Impact with Headland Park Construction

Location	Predicted Worst Case Noise from Basement C3, C4 and C5 Construction	Predicted Range of Noise from Headland Park Construction	Comment
6 – Dawes Point Residences	52	77 to 90	C3 ,C4 and C5 construction noise negligible
7 – Balmain East Residences	52	67 to 70	C3 ,C4 and C5 construction noise negligible

As such, the contribution from this site at these locations is considered acoustically negligible.

6 CONSTRUCTION VIBRATION ASSESSMENT

Construction, demolition and excavation activities have the potential to generate significant levels of vibration. However, as mentioned previously, the works associated with C3 will not involve plant that will generate significant vibration levels. The main plant that could generate vibration would be:

- vibratory piling (limited periods);
- bored piling; and
- general earthmoving plant such as excavators, truck etc (no rock breaker or rollers).

The nearest buildings to the site are across Hickson Road near the corner of Napoleon Street. Those buildings are approximately 50m from the nearest source of vibration.

As this is a commercial building the criterion for human comfort, assuming continuous vibration, is 0.4mm/s PPV.

The facade building is has an old brick and stone facade that has been refurbished. For a conservative assessment it should be assumed to be a heritage structure, hence the criterion for damage due to vibration is 3 mm/s PPV.

The vibratory level of all mentioned activities would be less than 0.1mm/s at 50m. Hence no vibration impact is predicted.

7 CONSTRUCTION NOISE & VIBRATION MANAGEMENT MEASURES

7.1 Construction Noise and Vibration Mitigation Measures

Noise levels from most C3 construction activities have been predicted to generally comply at most receivers with the noise management levels nominated in the guidelines at some surrounding receivers. Residences on Hickson Road and High Street will be subject to the highest construction levels.

In the case of cumulative noise associated with basement and C3 works exceedances of noise management gaols are predicted. These exceedances are of a similar magnitude to the noise levels of the basement and C4 assessments. This indicates the main contribution to the exceedances is a result of other construction projects at South Barangaroo.

Therefore, no specific noise control measures are considered necessary for C3 construction works that are beyond the measures that have not been previously identified in previous assessment.

The management and control of noise that have been included in the site Environmental Management Plan for the whole site are reproduced as follows:

A range of possible approaches to reducing the impact of construction noise is described below. It is proposed that these strategies be applied to the areas of potential exceedance identified in the preceding section.

- *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 OEH guidelines.
- *Site Noise Planning* – Where practical, 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 the street frontages with minimum 17mm thick structural plywood or similar. (The site would be surrounded by hoardings erected in accordance with the City of Sydney Guidelines.) This recommendation has been made for the PA1 basement application and has been included in modelling.

7.2 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 residences, 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 in Lend Leases' *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.

7.3 Noise and Vibration Management Plan

A Noise and Vibration Management Plan has been prepared for the PA1 Basement stage works. This plan will be incorporated into Lend Lease's Environmental Management Plan.

This plan details the mitigation, monitoring and community liaison measures. The plan will be updated to incorporate any additional measures that emerge as the project design evolves and work methodologies become better defined.

Areas that should be 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.

8 CONSTRUCTION TRAFFIC

8.1 Traffic Noise Criteria

Criteria for assessment of road traffic noise are set out in the NSW Government's *NSW Road Noise Policy (RNP)*. Table 8-1 sets out the assessment criteria for residences to be applied to particular types of project, road category and land use.

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

- $L_{Aeq,15hr}$ day 60 dBA.
- $L_{Aeq,9hr}$ night 55 dBA;

Table 8-1 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 3. Existing residences affected by **additional traffic** on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq,\ (15\ hour)}$ 60 (external)	$L_{Aeq,\ (9\ hour)}$ 55 (external)
Local roads	4. Existing residences affected by noise from **new** local road corridors 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	$L_{Aeq,\ (1\ hour)}$ 55 (external)	$L_{Aeq,\ (1\ hour)}$ 50 (external)

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'.

Accordingly all residences potentially affected by traffic noise will be assessed with respect to the above criteria.

The proposed haulage routes are located to the west of the site boundary, thereby avoiding the passby by haulage trucks of residences on Hickson Road. It has been determined that the residences subject to the highest levels of traffic noise associated with the site will be those on Hickson Road and Sussex Street. The main southern haulage truck route for would be along Sussex Street to the Western Distributor and / or Cross City Tunnel / Eastern Distributor.

Some trucks may also travel north via Napoleon Street, Kent Street and onto the Harbour Bridge.

The results of noise logging at Location 3 in Sussex Street have been processed to determine an existing daytime traffic noise level of $L_{Aeq,(15hrs)}$ 66.7dBA. It should be noted that existing traffic noise in relevant areas already exceeds the "base" noise criteria in the RNP. As any increase in traffic volumes associated with this project would be temporary in nature, the 2dBA allowance goal applies.

The results of noise logging at Location 3 at Sussex Street have been processed to determine a existing daytime traffic noise level of $L_{Aeq(15\ hrs)}$ 66.7 dBA. It should be noted that existing traffic noise in relevant areas already exceeds the "base" noise criteria in Table 8-1. As any increase in traffic volumes associated with this project would be temporary in nature, the 2dBA allowance goal applies.

A review of the basement and C3 traffic report indicates that a maximum of 115 Truck Loads per day (230 movements) is envisaged during "Basement Construction". Following a tapering down of basement truck movements the highest truck flow will occur during "C4, C3, C5, tower structure, facade, finishes and fit-out" stage when a maximum of 76 Truck Loads per day (152 movements) will occur.

Table 8-2 details predicted future noise levels due to the two truck movement scenarios.

Table 8-2 Predicted Daytime Traffic Noise Levels at Sussex Street - $L_{Aeq,15hr}$

Truck Movements per day along Sussex Street	Existing Traffic Noise Level – dBA	Truck Noise Contribution – dBA	Total Noise Level – dBA	Predicted Noise Increase – dBA
76	66.7	59.2	67.0	0.3
115	66.7	61.1	67.2	0.5

As the existing noise levels at residences along Sussex Street already exceed traffic objectives of the *RNP* the additional traffic should not increase traffic noise levels by more than 2 dBA. Review of the above prediction indicates that noise levels due to truck noise comply with the applicable noise criteria. Therefore the impact of construction traffic noise is considered acoustically acceptable.

9 SUMMARY OF RECOMMENDATIONS

Based on our investigations of the project the following findings have been determined.

9.1 Noise Criteria

Noise objectives for construction have been established based on OEH procedures. These criteria should be adopted as objectives to work towards in minimising any noise impact at surrounding residences.

Table 9-1 presents applicable noise criteria at residential receivers in the vicinity of the site.

Table 9-1 Site Specific Construction Noise Management Levels – dBA

Location	Construction Noise Management Level, L_{Aeq} – dBA				Maximum Construction Noise Level, L_{Aeq} - dBA
	Day	Evening	Night	Saturday (extended)	
1 – Hickson Road Residences	63	58	54	55	75
3 – The Sussex Hotel	70	64	54	62	75
5 – High Street Residences	57	49	46	50	75
6 – Dawes Point 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				

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

9.2 Construction Noise

It has been determined that noise from construction activities during the day period will potentially exceed established construction noise management goals, particularly during the proposed extended Saturday construction period. Therefore, the planning and management of construction activities must take into account the sensitivities of surrounding residents so as to minimise the impact of construction activities at these receivers.

The control of construction noise and vibration should form a part of the Construction Environmental Management Plan that would detail reasonable and feasible management measures and community consultation that would be employed.

The following measures are recommended:

- The noise barriers recommended in the PA1 basement stage should be maintained on site when C3 (and C4) construction works occur.
- Plant with noise control kits should be installed where practicable.
- An audit of plant should be conducted to select equipment that generates the lowest practical commercially available noise levels.
- Construction activities should be planned so that respite is provided to residences when noise activities occur. This is particular important during extended Saturday hours.
- An effective complaints and community consultation program should be implemented. This program should inform the project manager about appropriate mitigation measures to protect the acoustic amenity of surrounding residences.

10 CONCLUSION

A noise and vibration assessment has been conducted of the proposed construction activities associated with the construction of the Commercial Building C3 to determine the potential for noise and vibration impact at surrounding receivers.

The assessment allows the area of risk to be identified, and appropriately responsive measures to be adopted to mitigate or minimise any potential noise and vibration issues.

Management and mitigation measures to reduce noise impact at receivers have been identified which include:

- maintaining barriers between the site and the Temporary Passenger Terminal as well as the southern and western boundaries of the site;
- maintaining localised noise treatment of fixed plant and selection of quiet plant where practical;
- provision of respite from noise producing activities during extended hours operations where practicable; and
- effective community consultation and complaints management.

The impact from traffic along the road network is not considered to be acoustically significant.

A noise and vibration management plan has been prepared to assist Lend Lease in managing the environmental issues associated with this project.

Vibration associated with on-site construction activities is considered to be negligible.

Version	Status	Date	Prepared by	Checked by
A	Final	20 September2011	George Jenner	Brian Clarke
B	Final	29 September 2011	George Jenner	Ben Lawrence
C	Final	27 October 2011	George Jenner	Brian Clarke
D	Final	7 November 2011	Brian Clarke	John Wasserman