

Noise & Vibration

Assessment report

Summary

This report assesses the noise and vibration impacts associated with the new Walsh Bay Arts Precinct where noise from operational activity, increases in traffic flow, construction and plant equipment are to meet the requirements set out in relevant New South Wales (NSW) policies.

Specifically, this report addresses the discipline-specific Director General's Requirements (DGR's) listed in the Department of Planning & Infrastructure letter dated 2/9/13; being predominantly DGR number 5;

'Identify the main noise sources during operation. Outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land.'

Relevant Policies and Guidelines: NSW Industrial Noise Policy (EPA)

Through community consultation undertaken by Elton Consulting, it is evident that noise associated with the development is one of the primary concerns of the local community, and this report has been provided to address these understandable concerns.

It is to be noted that this is the first, concept stage SSDA for the development, requesting "In Principal" approval for a series of flexible spaces to be utilised within the largely existing building envelopes. Should this request be granted, a further more detailed application and Noise & Vibration assessment will be included in a Phase 2 application. This Phase 2 application will respond to any more specific Conditions of Consent imposed on the development and address Construction Noise & Vibration if relevant.

Operational Activity Noise

Indoor Noise Generation

Noise produced by the operation of the future tenants housed within the precinct has been assessed against the NSW Industrial Noise Policy: 2000 (INP2000) – as requested in the DGR's for the development. All primary noise sources were modelled and assessed, including noise from all new indoor performance / rehearsal / commercial spaces; as well as noise from outdoor events in the proposed Waterfront Square..

With the implementation of the recommended noise mitigation measures contained within this report, which are co-ordinated within the current Concept Design for the scheme, noise from indoor sources is predicted to fall within the INP2000 requirements to nearby sensitive receptors within the day period (7am - 6pm), evening (6pm-10pm) and night (10pm-7am) periods.

Outdoor Noise Generation

Noise from outdoor events within the Waterfront Square has been assessed in order to assess the viability of the space as an Entertainment area and the noise emission criteria referenced in the DGR's be achieved. This assessment has shown that the required emission criteria can be achieved, subject to controlling the noise generated in the space to certain criteria (listed in Section 6.1.3). The report discusses a number of possible measures that may be used to limit the noise disturbance from this facility including the implementation of volume control devices on any permanently installed equipment, the implementation of permanent noise monitoring and noise limiting devices if required.

It should be noted that this first stage concept SSDA is not seeking permission to hold specific events within the Waterfront Square space.

It is recommended that noise emission requirements and hours-of-operation for any potential future major outdoor events in the Waterfront Square are written into Conditions of Consent for the project – and potential major events required seek permission and develop a Noise Management Plan to comply with the criteria imposed. These Noise Management Plans may include community consultation and noise monitoring as part of their requirements.

Traffic Noise

Noise associated with the increase in traffic flow due to the development has been assessed against the NSW Road Noise Policy: 2011 (RNP2011). As no additional car parking or loading dock facilities are included within the development, it is considered unlikely that the traffic flow within the Walsh Bay area will increase significantly (i.e. less than a 1 dBA increase) due to the proposed development.

Measures have been recommended to limit the impact of vehicular movements of the site to the surrounding noise sensitive receptors.

Construction Noise

As this is a Concept stage SSDA application, it is not seeking approval for any works to be commenced. As such, Construction Noise & Vibration will be assessed as part of a future, Stage 2 SSDA.

Plant Noise

Noise produced by plant equipment shall be designed against the INP2000.

Any existing external equipment located on the roof of Pier 4/5 altered as part of the scheme will be replaced with quieter and more efficient equipment.

New outdoor equipment to be located on the roof of Pier 2/3 is expected to be the most significant source of new mechanical plant noise from the site. The design of this equipment and associated enclosure shall be undertaken such that the INP2000 requirements are achieved at the noise sensitive receivers. This may include the use of careful equipment selection, noise barriers and acoustic louvers.

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1. Objectives of assessment

At a glance

The purpose of this assessment is to address the legislative Noise and Vibration issues associated with the proposed Walsh Bay Arts Precinct; and in particular address the relevant concerns included within the Director General Requirements.

1.1 Objectives of Noise & Vibration Assessment

The purpose of this Noise Impact Assessment is to address the Director General's requirements in relation to noise impacts on the surrounding residences and future occupants.

The following elements are assessed and addressed:

- Noise egress from the development
 - Mechanical and plant noise impact
 - Operational (Activity) noise impact
 - Operational outdoor noise impact
 - Impact on the external noise environment due to increased traffic movements

2. Site and Project Description

At a glance

This section outlines the Site and Project Description.

2.1 Background

Arts NSW is proposing to develop a new arts precinct at Walsh Bay which will expand and strengthen the existing cluster of cultural institutions and attractions along Sydney's "Arts and Cultural Ribbon". The arts precinct includes Wharf 4/5, Pier 2/3 and Sydney Theatre. The concept provides for an integrated performing arts and cultural precinct within an enhanced public domain at Walsh Bay. It is envisaged that the arts and cultural program within the Walsh Bay Arts Precinct (WBAP) will complement the other cultural initiatives in surrounding areas, including those proposed at nearby Barangaroo (currently under development).

In 2011/12 Arts NSW engaged the NSW Government Architect to prepare a master plan for the precinct. The master plan proposed:

- The transformation of Pier 2/3 to accommodate the Australian Chamber Orchestra, Bell Shakespeare and Australian Theatre for Young People
- The retention of a large "raw" space in Pier 2/3 for events, festivals and functions
- A major upgrade of ground floor facilities at Wharf 4/5, allowing Bangarra to confirm its place as the premier Indigenous performing arts company and maximise new tourist and engagement opportunities
- The expansion of creative and commercial activities along the shore sheds offering cafes, restaurants, retail and commercial activities to further enhance the visitor experience
- A new north facing waterfront square supported with new boardwalks which will significantly increase public open space and create a central platform for activity, collaborative outdoor performances, events, festivals and public art.

2.2 The Site and Surrounds

The WBAP site is part of the Walsh Bay area which is located adjacent to Sydney Harbour within the suburb of Dawes Point. Walsh Bay is strategically located to the north of Sydney's CBD in the vicinity of major tourist destinations including the Sydney Harbour Bridge, the historic areas of Millers Point and The Rocks, Circular Quay and the Sydney Opera House. The Barangaroo redevelopment precinct is located immediately to the south-west and McMahon's Point lies directly on the opposite side of the harbor to the north.

The location of the WBAP site is shown in Figures 1 and 2 overleaf.

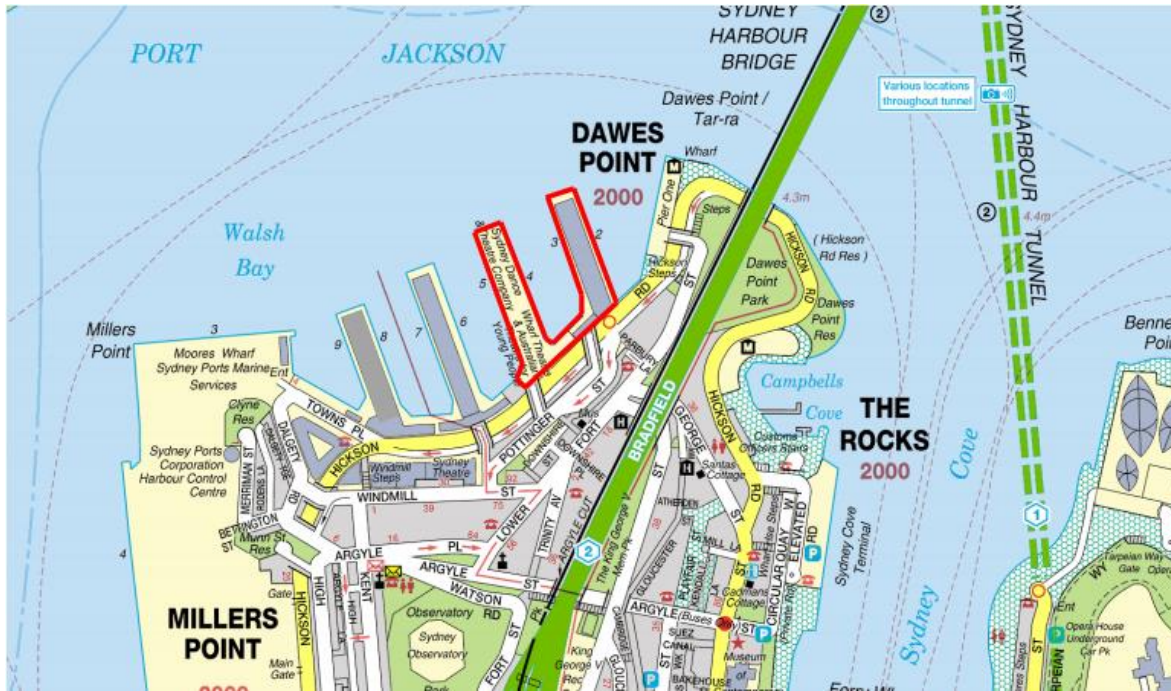


Figure 1 - Site Location (Source: UBD Digital Edition 2004)



Figure 2 - WBAP site (Source: Google Maps)

Walsh Bay comprises ten berths constructed between 1908 and 1922 for international and inter-state shipping. These are collectively known as the Walsh Bay Wharves. The Walsh Bay Wharves Precinct is listed as an item on the State Heritage Register. Much of Walsh Bay

(excluding Wharf 4/5 and Pier 2/3) was redeveloped between 1997 and 2004 by the NSW Government in partnership with the Walsh Bay Partnership (Mirvac and Transfield). The Walsh Bay Wharves comprise the following:

- Pier One which contains the Sebel Pier One Sydney Hotel
- Pier 2/3 is the last remaining undeveloped pier. It has approval for cultural uses, temporary arts events and some commercial events.
- Wharf 4/5 which is occupied by the Sydney Theatre Company, Australian Theatre for Young People, Bangarra Dance Theatre and other arts organisations.
- Pier 6/7 which has been redeveloped for residential apartments and associated boat marina
- Pier 8/9 which has been redeveloped for office uses
- Shore Sheds which contain a range of commercial activities, including restaurants, bars, shops and offices.

The Sydney Theatre is within the WBAP however it is not part of the proposed redevelopment. Given the significant difference in grade between Walsh Bay and Millers Point, there are a number of bridges over Hickson Road which provide pedestrian access between the site and Millers Point. The bridge linking Pottinger Street and Wharf 4/5 is also used for vehicular parking. To the south-west of the wharves is Hickson Road, which provides the major vehicular access to the site. Hickson Road links the site to Barangaroo to the south-west and Circular Quay and The Rocks to the north-east. Other roads providing access to the site include Pottinger Street which provides access to Millers Point, and Towns Place which also provides access to Millers Point via Dalgety Road and Argyle Street.

The Barangaroo redevelopment project to the south of Walsh Bay comprises three redevelopment areas – the Headland Park, Central Barangaroo and Barangaroo South. The Headland Park is to be located adjacent to the Walsh Bay Precinct and is currently under construction. The park is being built up to reflect a similar landform to other headlands around Sydney Harbour. It is proposed that a 300 space car park and an as yet undefined cultural facility will be located inside the headland. Master planning for Central Barangaroo is currently underway with the intention that it will be the cultural and civic focal point for recreation, events and entertainment. Barangaroo South is being developed as a major commercial and mixed use centre.

2.2.1 Pier 2/3

Pier 2/3 is a finger wharf comprising two storeys (and associated shore sheds) and was constructed between 1912 and 1921. It is Sydney's last wharf structure in its original state. Much of it is an empty shell however it does contain some commercial uses. There is a 99 year lease between the Maritime Authority of NSW (now Roads and Maritime Services) and Communities NSW (which now rests with Arts NSW, Department of Trade and Investment) for the finger wharf, the portion of open air wharf apron, the pedestrian link bridge and the wharf substructure. The granting of this lease, amongst other things, allows Pier 2/3 to be used for arts, cultural and creative purposes. The City of Sydney has granted consent for Pier 2/3 to be used as a cultural facility for a range of uses such as rehearsals, exhibitions, workshops, filming and events, including the Sydney Writers' Festival and the Biennale of Sydney. The consent was granted on 21 September 2011 and is for a period of 3 years.

2.2.2 Wharf 4/5

Wharf 4/5 is a four storey timber building which was built around 1917 and used as a steamship berthing and cargo storage facility until the mid-1970s. The Wharf has been progressively upgraded and adaptively reused since the early 1980s. Ten arts and cultural organisations use the facility which comprises a range of performance venues, rehearsal and workshop spaces, a recording studio, café/restaurants and office accommodation.

Wharf 4/5 is recognised as a highly successful adaptive reuse of an important heritage item. Its redevelopment 30 years ago was the subject of numerous architectural and design awards. However, many of its spaces are not fit for purpose and use of the space is not optimised.

2.3 Site Ownership

The land is legally described as follows:

- Pier 2/3 - Lot 11 DP 1138931
- Pier 2/3 Shore Sheds – Lot 24 DP 1071597
- Wharf 4/5 - Lot 65 in DP 1048377

The land owner of the WBAP site is the Roads and Maritime Services (RMS). Both Pier 2/3 and Wharf 4/5 are occupied under various lease arrangements with Arts NSW, Department of Trade and Investment, primarily for arts and cultural uses. The area of water that the project proposes to build over, with walkways and the bridge, is also owned by RMS. Its land title description is Lot 12 in DP 1138931.

2.4 The Project

The Concept Design more than doubles the arts and cultural offerings at Walsh Bay, with new and upgraded production, rehearsal, studio and performance venues. It remains a working arts precinct, with complimentary commercial opportunities

Following the Master Plan, the Concept Design has responded to stakeholder feedback and greater design investigation, resulting in a more resolved concept, with the following key differences from the Master Plan:

- Floating pontoons and connecting bridge have been removed;
- Heritage impacts have been interrogated and minimised;
- Internal planning has been further articulated to meet arts tenants requirements; and
- A stage area canopy has been introduced into the waterfront square.

The main features of the development of Pier 2/3 include:

- New homes for Bell Shakespeare, Australian Chamber Orchestra and the Australian Theatre for Young People, including office accommodation, rehearsal space and performance spaces; and
- Retention of raw heritage space for a range of events and functions, with some improved ancillary facilities.

The proposed refurbishment of Wharf 4/5 ground floor includes:

- Upgraded facilities for Bangarra Dance Theatre and Sydney Dance Company (Sydney Theatre Company facilities are not included in this proposed development)

- Several arts organisations - Accessible Arts, Regional Arts, and the choirs are to relocate from this building

The proposed modifications to Wharf 4/5 Shore Sheds include the provision of upgraded choirs office accommodation and rehearsal space, and new commercial spaces.

The Waterfront Square has been further developed from the public domain proposed in the Master Plan to include a central square for events, festivals, markets and public art. As noted above, the pontoons and bridges have been removed and a shade structure/canopy has been introduced over the notional stage area of the Waterfront Square.

3. Site analysis

At a glance

This section outlines the primary noise & vibration sources impacting the site, and establishes all surrounding noise and vibration sensitive receptors. This section also details the noise survey that has been undertaken and quantifies the existing ambient noise levels on site and at the noise sensitive receivers.

3.1 Key Noise & Vibration Site Analysis

3.1.1 Primary Noise & Vibration Sources

The site is subject to the following existing noise sources:

- Road and rail traffic from Sydney Harbour Bridge
- Marine activity on Sydney Harbour
- Low levels of air traffic noise from aircraft using Sydney Airport
- Occasional but regular light aircraft (Helicopter) noise.
- Existing restaurants & bars
- Existing noise generation from Pier 2/3 tenancies.

3.1.1 Surrounding Noise and Vibration Sensitive Receivers

The site has nearby residential and commercial areas. The closest residential properties are on Pier 6/7 and across Hickson Road sitting approximately 9m higher than the Piers. The closest commercial properties are local stores and cafés across Hickson Road, on street level. To the east, at Pier 1, a hotel with restaurants/cafes sits along the waterfront.

The following table and figure identify the most effected noise sensitive receivers for use throughout the assessments. These will be referenced throughout.

Table 1- Nearby noise sensitive receivers

Receiver	Building	Closest distance from site façade (horizontal)
R1	Residential Apartments	80m
R2	Residential Terrace houses	50m
R3	Residential Hotel – The Seibel Pier One	67m
R4	Residential Apartments – McMahons Point	540m
R5	Residential – McMahons Point	624m
C1	Commercial premises – Café Restaurants	67m
C2	Commercial Premises – Shops and cafes	25m



Figure 3 - Surrounding Noise Sensitive Receptors. Background image courtesy of Google Maps 2014

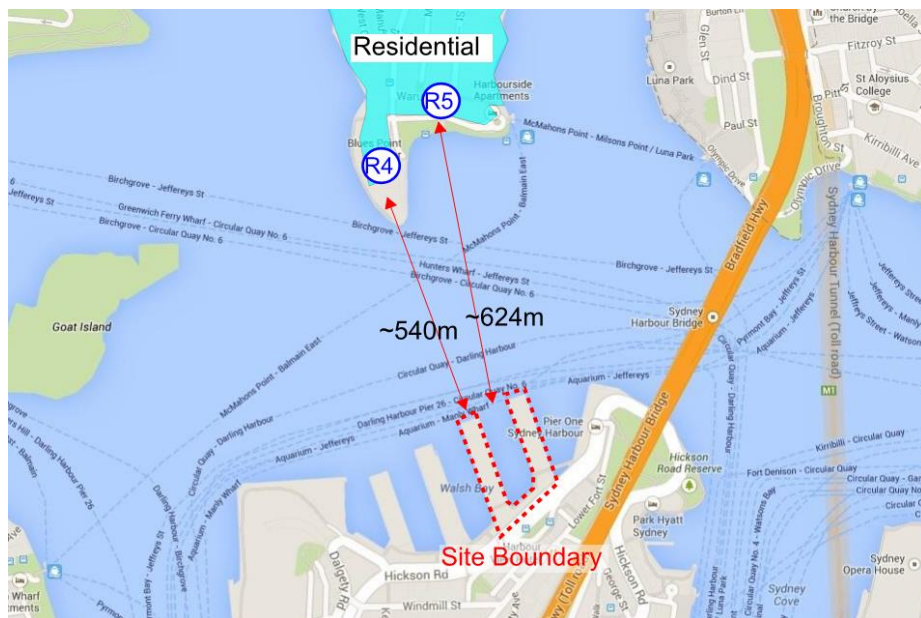


Figure 4 – Surrounding Noise Sensitive Receptors Mc Mahons Point. Background image courtesy of Google Maps 2014

3.3 Existing Prevailing Noise Environment

The existing noise environment has been to and from the site have been determined using site measurements and predictive methods. These methods and results are detailed within the following sections.

3.3.1 Ambient Noise Survey Methodology

Noise measurements have been undertaken around the site to benchmark the prevailing noise environment surrounding the site. Long term noise logging was undertaken taken over 7 days at Walsh Bay from 5/11/2013 - 11/11/2013 and at McMahons Point from 14/03/2014 – 19/03/2014. All logging time periods included typical weekday and weekend periods. Spot measurements were also taken at various locations around the site to inform and calibrate predictions and noise modelling.



Figure 5 - Noise measurement locations. Background image courtesy of Google Maps 2014

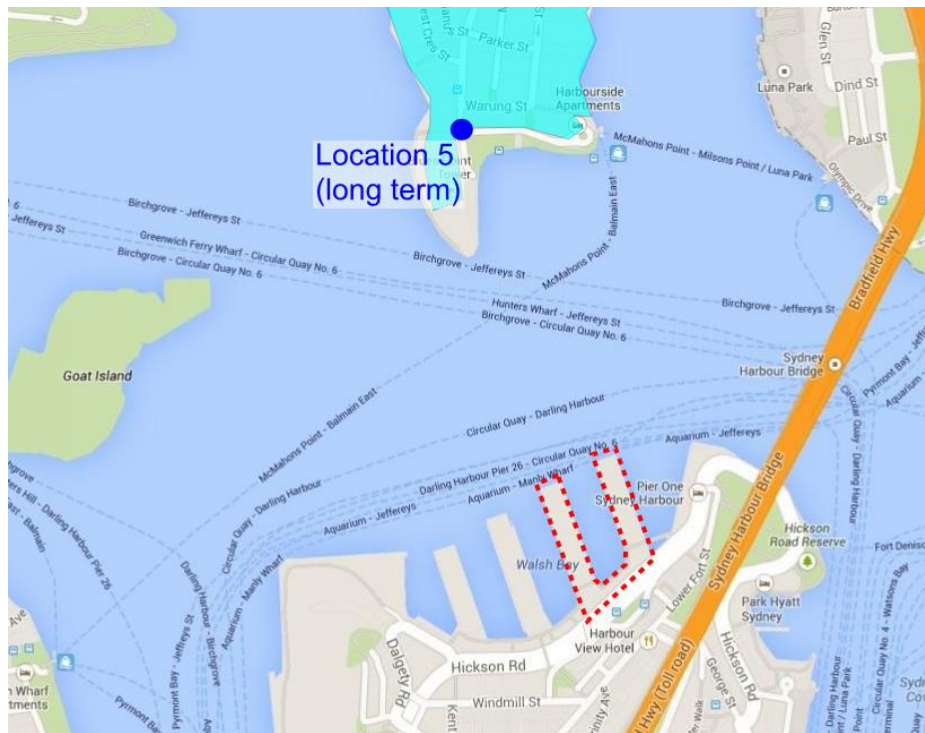


Figure 6 - Noise measurement locations McMahon's Point. Background image courtesy of Google Maps 2014

The measurements made during this visit were conducted in accordance with Australia Standard AS1055 “Acoustics-Description and Measurement of Environmental Noise”.

The equipment used during the survey is as follows:

Table 2 - Equipment used

Equipment Description	Manufacturer & Type No.	Serial No.	Calibration Due Date
Sound Level Meter*	Norsonic – Nor140	1404791	21/10/2014

Equipment Description	Manufacturer & Type No.	Serial No.	Calibration Due Date
Microphone	Norsonic - 1227	14105	21/10/2014
Preamplifier	Norsonic – 1209	14105	21/10/2014
Sound Level Meter*	NTI XL2	05718	01/10/2014
Microphone	M2210	2408	01/10/2014
Calibrator	Pulsar Model 105	55041	21/10/2014

* Class 1 sound level meter as described by IEC 61672-01:2002

Meteorological conditions for the duration of the noise survey were conducive to the measurement of environmental noise, being predominantly dry and with little wind.

The sound level meter was fitted with a windshield during the survey and was calibrated prior to, and on completion of the survey with the associated acoustic calibrator listed above. No significant calibration drift occurred (i.e. less than 0.5 dBA).

All measurements were taken at a height of 1.5m in the free field. Spot measurements were taken for 15 minute durations to mirror the assessment parameters discussed in the later section of this report.

All spot measurements (locations 2, 3 and 4) were undertaken multiple times throughout the daytime period on a 15-minute duration measurement in order to obtain an accurate measurement of the prevailing noise environment at the relevant locations. These measurements were time-synchronised to the long-term measurement at position 1; such that the prevailing noise levels all locations around the precinct could be accurately interpolated.

3.3.2 Noise survey results

The logging measurements over a seven day period are graphed below. All measurement levels are summarised in Table 3 below and broken into the relevant periods for the INP2000 assessment:

- Day time 0700hrs – 1800hrs
- Evening 1800hrs – 2200hrs
- Night time 2200hrs – 0700hrs

Table 3 – Long-Term Measurement results

	Measurement duration	Background noise dB $L_{A90,15,min}$			Ambient noise, dB $L_{Aeq,15min}$		
		Day	Eve	Night	Day	Eve	Night
Location 1	Long Term	59	54	52	63	58	57
Location 5	Long Term	49	50	42	57	56	51

Table 4 – Spot-Measurement results

	Measurement time period, T	Background noise dB	Ambient noise, dB
		$L_{A90,T}$	$L_{Aeq,T}$
Location 2	15 minutes	Day	Day
		60	67

	Measurement time period, T	Background noise dB	Ambient noise, dB
		$L_{A90,T}$	$L_{Aeq,T}$
		Day	Day
Location 3	15 minutes	52	55
Location 4	15 minutes	54	58

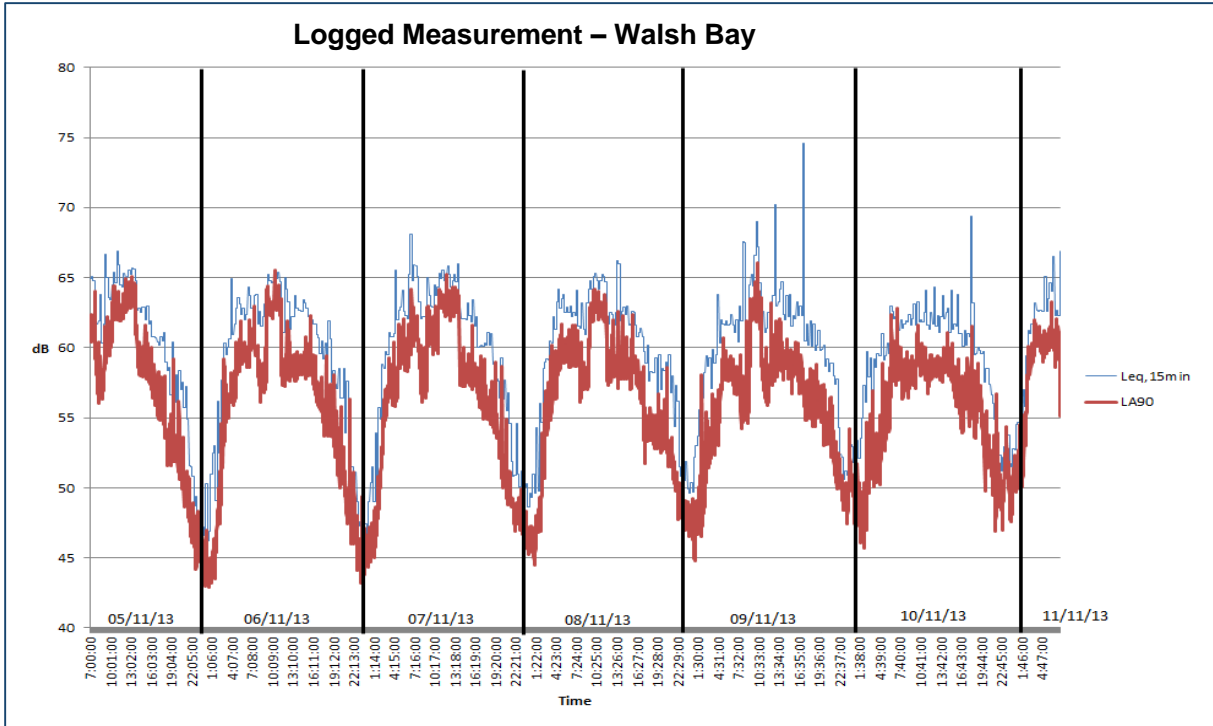


Figure 7 - Noise logging results (Location 1)

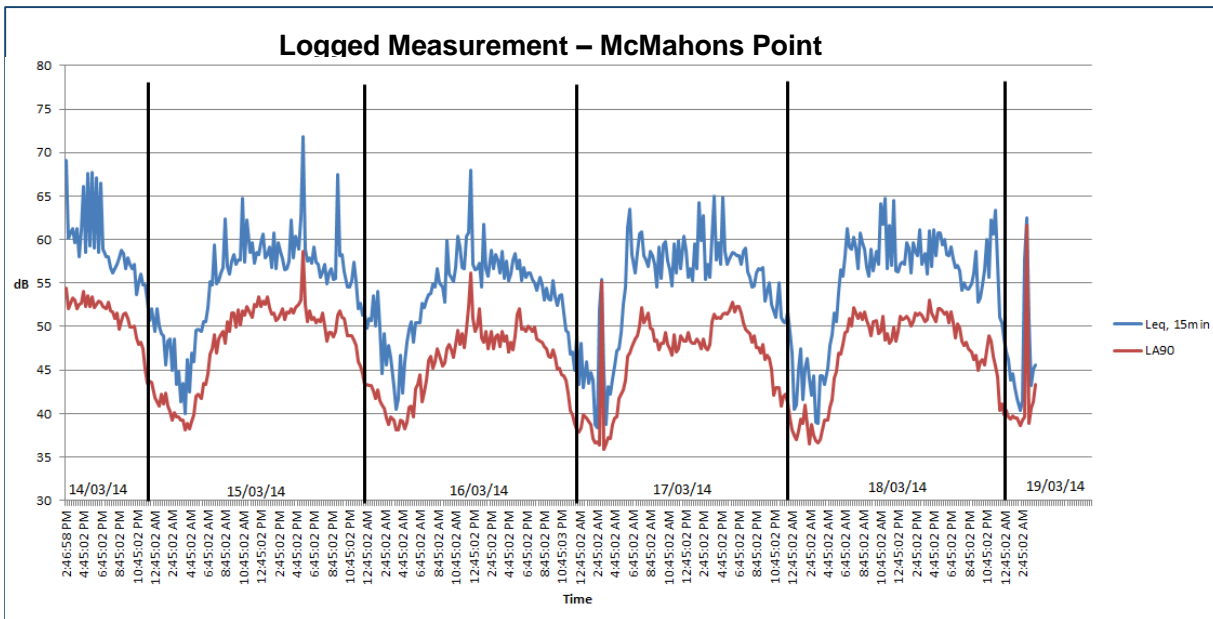


Figure 8 - Noise Logging Results (Location 5)

3.3.3 Establishing Existing Noise Levels at Noise Sensitive Receivers

Access was not available to undertake long-term noise measurements at the exact location of a number of the noise-sensitive locations identified. As such, the noise levels at these locations have been calculated based on the time-synchronised spot measurements and long-term logged noise data. This calculation was undertaken using an acoustic computer modelling program (see Section 6.1.1), which was calibrated to the measurement results obtained. As such, the noise levels presented at all noise sensitive receptors can be considered an accurate representation of the prevailing noise levels at these locations.

A predictive assessment has also been undertaken to determine the existing noise generated by Pier 2/3 activities, based on measured source noise levels for these activities. This has been completed through the use of a computer model using dedicated software (Cadna/A). This modelling process is fully detailed within Section 6.1.1.

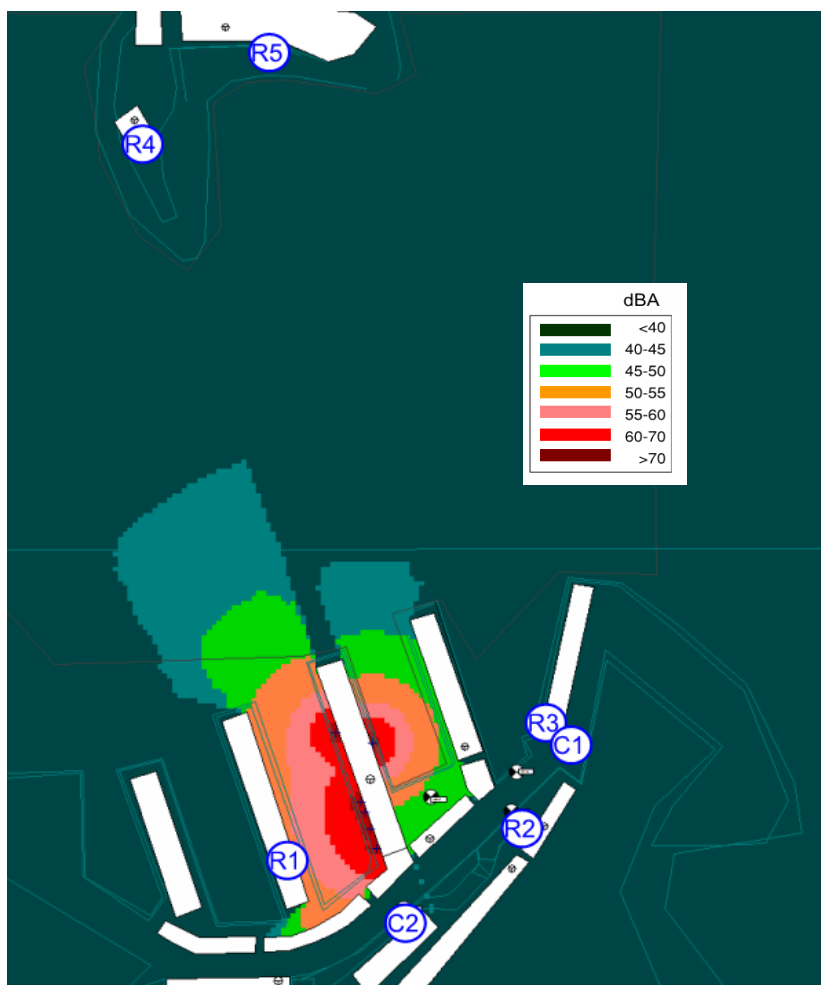


Figure 9 - Existing activity noise levels generated in Pier 2/3 on surrounding receptors

3.3.4 Existing Prevailing Noise Levels - Results

Table 5 below outlines the existing noise levels measured and predicted at each of the identified noise sensitive receivers.

Background noise and ambient noise levels are taken from the measurements of the existing environment.

Activity noise levels have been taken directly from the noise model described in Section 3.3.2 and represent only noise from activities within the existing cultural institutions.

Table 5 - Receiver noise levels based on measurements

Receiver	Background noise, dB LA90,15min			Ambient noise, dB LAeq,15min			Existing activity noise level*, dB LAeq
	Day	Eve	Night	Day	Eve	Night	
R1	52	47	45	55	50	49	56
R2	60	55	53	67	62	61	30
R3	60	55	53	67	62	61	29
R4	49	50	42	57	56	51	35
R5	49	50	42	57	56	51	28
C1	60	55	53	67	62	61	29
C2	60	55	53	67	62	61	33

* For time periods when Pier 2/3 is in use

4. The Project Analysis

At a glance

Existing and new Noise and Vibration sources on the site are identified within this section.

4.1 Existing Noise Sources

Sources of noise from the existing site and operations have been identified below:

- Studios and workshop spaces within the existing dance and theatre fitouts, within Pier 4/5. These spaces are ventilated using a mixed mode system, allowing the rooms to be acoustically sealed or open. Music egress from these studios is a key source of noise from the existing site.
- Existing plant equipment located on the roof of Pier 4/5 is a source of noise to the surrounding receivers. Equipment located here will be replaced with new (more efficient) units, which will likely reduce noise emissions.
- Occasional functions/event held within Pier 2/3. This use is intended to remain with the frequency of events likely to increase.

4.2 New sources of noise

Sources of noise associated with the proposed development have been identified below:

- New rehearsal spaces will be located on the west façade of Pier 2/3 and two on the east façade. These spaces have are proposed to have operable louvers that can be opened or closed when needed. Alternative ventilation will be provided to ensure the room may operate in a 'sealed' mode.
- Noise from the new performance spaces within Pier 2/3. These new performance spaces are not expected to be significant as these are fully sealed internal spaces with controlled acoustic environments. Building fabric will be designed to mitigate these noise sources
- New plant equipment will be located on the roof of Pier 2/3.
- Noise from new commercial spaces throughout the precinct.
- Occasional events may be held in the Waterfront Square.

Figure 10 to Figure 12 overleaf provide the location of the existing and proposed noise sources.

4.3 Vibration Sources

No sources of vibration affecting external receivers exist in the existing arrangement. No new sources are intended to be introduced as part of the proposed development.



Figure 10 - Existing and new noise generating areas - ground

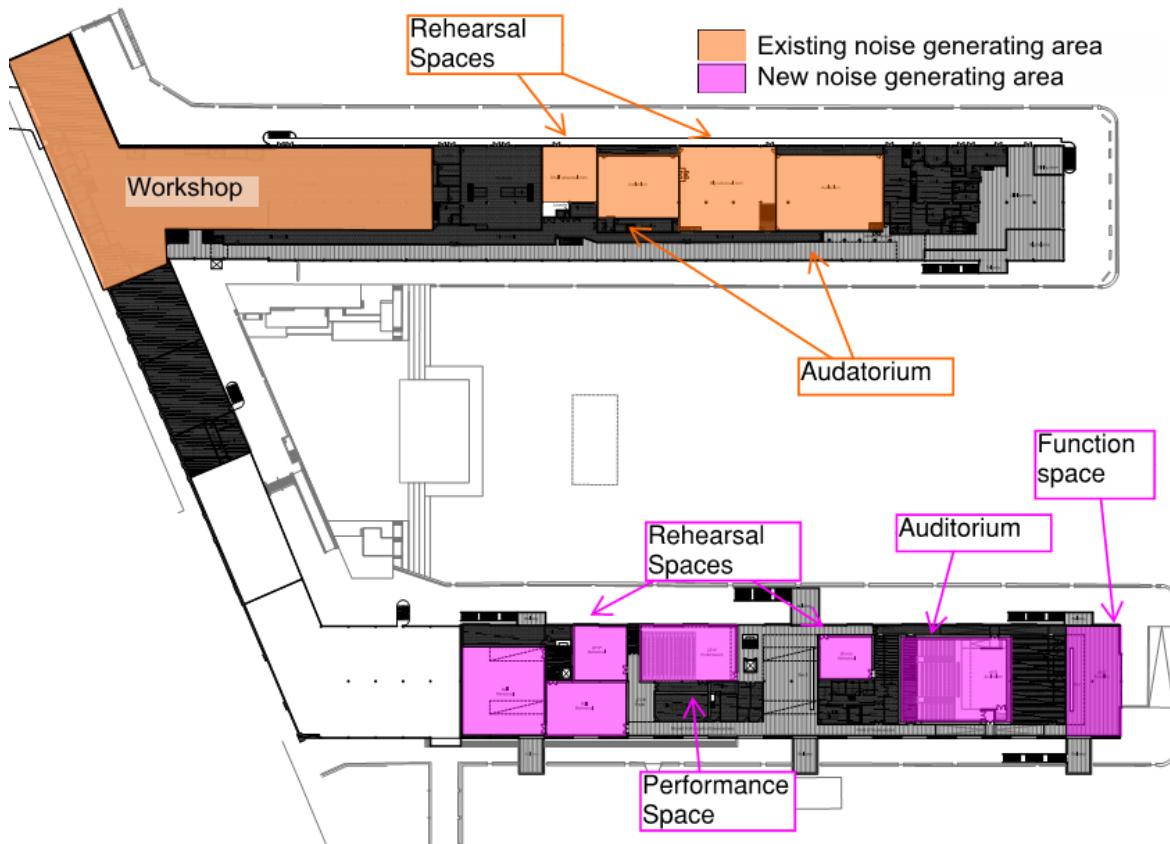


Figure 11 - Existing and new noise generating areas - level 2

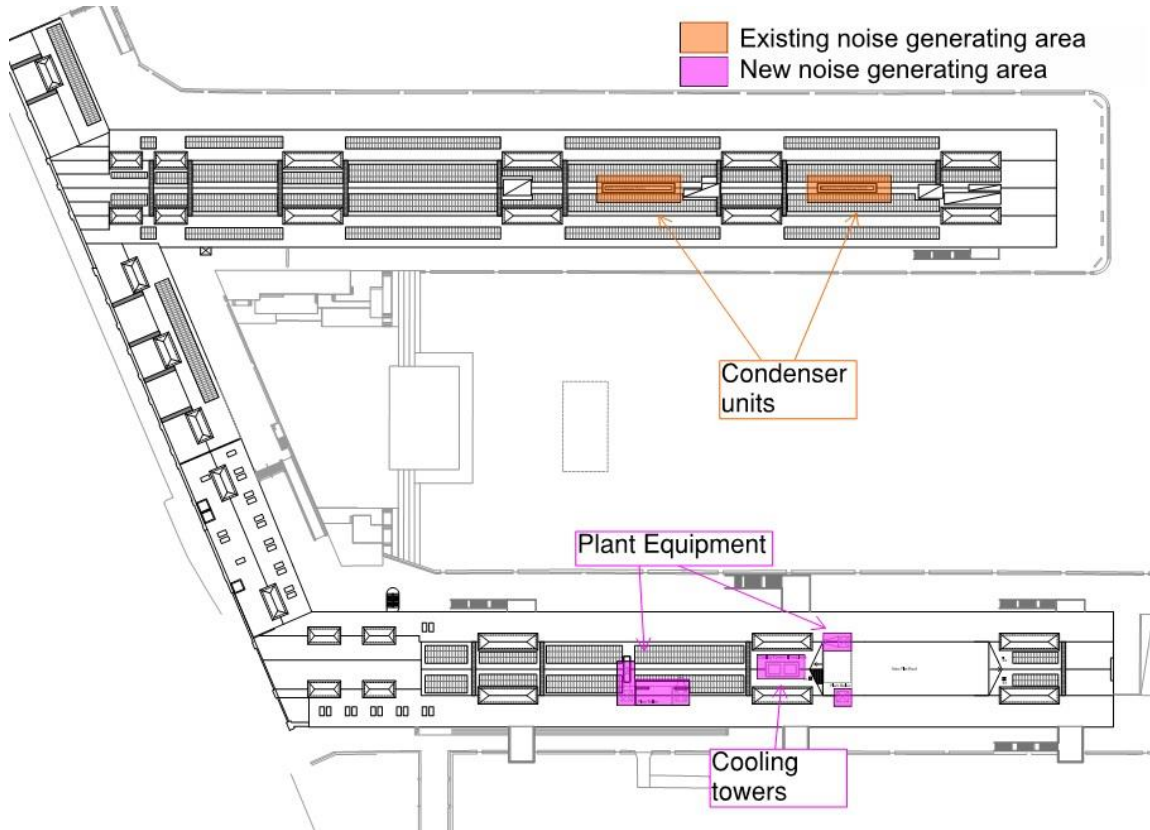


Figure 12 - Existing and new noise generating areas - roof

5. Regulatory context

At a glance

This section outlines the Director General's requirements relating to Noise and Vibration and quantifies these where applicable.

5.1 Director General's Requirements

The relevant Director General's Environmental Assessment Requirements (Schedule 2 of the Environmental Planning and Assessment Regulation 2000) are as follows:

Item 5:

'Address and demonstrate a high level of environmental amenity in respect of solar access, acoustic and visual privacy, servicing requirements (including waste management, loading zones, mechanical plant), access to views, and wind impacts, particularly regarding the impacts of the outdoor amphitheatre.'

Item 6:

'Identify the main noise sources during operation. Outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land.'

Relevant Policies and Guidelines: NSW Industrial Noise Policy (EPA)

5.2 NSW Industrial Noise Policy

The following targets have been derived from the New South Wales Industrial Noise Policy: 2000 (INP2000) and are designed to protect the amenity of the surrounding residences and community. The Policy has two components that must be considered and the more onerous of these becomes the controlling criteria;

1. Controlling the intrusive noise impact on residences in the short term: Such that, the equivalent continuous noise level (L_{Aeq}) of the noise source/sources under consideration should be no more than 5dB over the background noise level.
2. Maintaining noise level amenity for particular land uses for residences and other land uses.

The site is dominated by 'urban hum' (being mostly traffic noise sources) and has a commercial interface. As such, the indicative noise amenity area is classed as 'Urban' and the receiver type, 'Residence'. Shown below are the relevant acceptable and maximum noise levels taken from 'Table 2.1 Amenity criteria' of the INP2000

Table 6 - Extract from NSW INP 2000 'Table 2.1 Amenity criteria'

Type of receiver	Indicative Noise Amenity Area	Time of Day	Acceptable Noise Level (dB $L_{Aeq, 15min.}$)	Maximum Noise Level (dB $L_{Aeq, 15min.}$)
Residence	Urban	Day (0700-1800)	60	65
		Evening (1800-2200)	50	55
		Night (2200-0700)	45	50
Commercial	All	When in use (0800-1800)	65	70

5.2.1 Project Specific Criteria

Based on the results of the noise survey (Section 3.3.1) and in accordance with the INP2000 the intrusiveness criteria and the amenity criteria have been determined. The lower of these two criteria provides the project-specific criteria detailed below.

Time periods are as defined in Table 6 above.

Table 7 - Project specific noise emission criteria

Receiver	Building	Maximum noise level (dB LAeq (15 minute))		
		Day	Evening	Night
R1	Residential Apartments	57	52	44
R2	Residential Terrace houses	57	52	51
R3	Residential - The Seibel Hotel Pier One	57	52	51
R4	Residential Apartments – McMahons Point	54	47	42
R5	Residential - McMahons Point	54	47	42
C1	Commercial - Café Restaurants	65	60	58
C2	Commercial - Shops and cafes	65	60	58

5.2.2 Special Events

Special events within the Waterfront Square may be held on occasion. It should be noted that this first stage concept SSDA is seeking permission for this public space to be created and an entertainment zoned venue. It is not seeking permission to hold specific events within the space.

It is recommended that noise emission requirements and hours-of-operation for any potential future outdoor events in the Waterfront Square are written into Conditions of Consent for the project – and major events required seek permission and develop a Noise Management Plan to comply with the criteria imposed. These Noise Management Plans may include community consultation and noise monitoring as part of their requirements

5.3 Traffic Noise

The 2011 Department of Environment, Climate Change and Water (DECCW) document 'NSW Road Noise Policy' (RNP) shall be used in the assessment of the acoustic impact of any increase in traffic movement due to the development. This document aims to provide protection primarily inside and immediately around permanent residences and other sensitive land uses.

5.3.1 Noise assessment criteria

Noise generated by additional traffic on the road to be assessed against façade corrected noise levels when measured in front of a building façade.

Table 8 - Extract from RNP Section 2.3.1- Noise assessment criteria - residential land uses

Project type/land use	Assessment Criteria - dBA	
	Day (7am-10pm)	Night (10pm-7am)
Existing residences affected by additional traffic on existing local roads generated by land use developments	LAeq, (1 hour) 55 (external)	LAeq, (1 hour) 50 (external)

As seen in Table 5, measured existing levels at the noise sensitive receivers exceed these levels. Therefore it will not be possible to achieve these criteria through measurement as existing noise levels (pre-development) already exceed the nominated values. As such, the relative impact of the noise associated with any increase in traffic flow will be used to assess the impact of traffic associated with the development.

5.4 Construction Noise & Vibration

As this is a Concept stage SSDA application, it is not seeking approval for any works to be commenced. As such, Construction Noise & Vibration will be assessed as part of a future, Stage 2 SSDA.

6. Methods and results

At a glance

This section outlines the methodology and results of the assessments undertaken;

- Operational activity noise
 - Indoor and outdoor activity
- Traffic noise impact
- Plant noise emissions

6.1 Activity Noise Assessment

Within this assessment noise produced by activities on site have been predicted and compared against the existing conditions to determine any impacts and where mitigation measures should be put in place. This assessment has been undertaken for both the standard indoor noise sources and for the infrequent outdoor music event scenario.

6.1.1 Methodology

A noise model of the site and surrounding areas has been developed to predict the propagation of noise sources on site. These noise sources have been broken into two assessments:

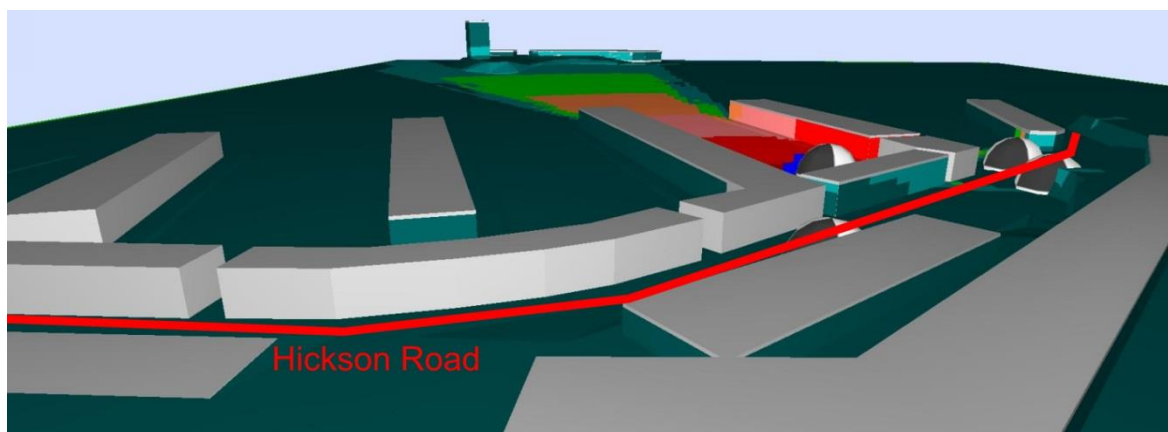
- Indoor sources such as performance, rehearsal, bars / commercial
 - With all doors and windows open (worst case)
 - All doors and windows closed
- Outdoor noise sources located in Waterfront square.

This has been undertaken using the dedicated computer software 'Cadna/A'. This is an advanced computer modelling software (similar to programs including SoundPlan and NoiseMap) which creates a 3D environment and accurately accounts for all acoustic characteristics between a noise source & receiver such as:

- Topography
- Noise barrier / screening effects
- Distance attenuation effects
- Meteorological conditions
- Reflections from multiple surfaces
- Ground absorption.

Computer modelling results are highly dependent on the manner in which the model is setup. As such, for transparency several key aspects of the calculation preferences have been provided below. These are believed to represent a 'worst-case' assessment in the majority of cases.

- Reflections enabled from all surfaces in model
- Absorption co-efficient (α_w) for all building & barrier surfaces = 0.0 (i.e. zero reflection loss)
- Ground absorption (G) over water = 0 (no absorption, fully noise reflective)
- Ground Absorption (G) over land = 0.6
- Prevailing wind as per Bureau of Meteorology data (www.bom.gov.au)
- Maximum order of reflections = 10
- Results grid resolution = 5.0m
- Receiver height taken at 1.4m


Figure 13 - 3D noise model

To model internal sources, an internal reverberant noise level of 90-95dBA, adjusted in accordance with the following spectrum to obtain a 1/1 octave spectrum was used to calculate an equivalent sound power level at the façade for the two scenarios (windows open or closed). The spectrum used was determined using published papers and WSP Acoustics library data and represents bass heavy music.

Table 9 - Music / activity noise spectrum used throughout assessment

	Octave band centre frequency (Hz)								
	32	63	125	250	500	1k	2k	4k	8k
Sound Pressure Level Correction	-10	-5	-5	-3	-3	-5	-8	-12	-12

6.1.2 Results - indoor sources

Two scenarios have been assessed for indoor noise sources within the proposed development; a worst case with all doors and windows open and a minimised emission scenario where all windows and doors in noise generating rooms are closed.

Noise maps and levels at key receiver locations have been output from the computer model below.

Table 10 - Predicted noise at noise sensitive receivers due to indoor activity noise sources

Receiver position	INP2000 Noise Emissions Criteria (dB L _{Aeq})			Results (dB L _{Aeq})	
	Day	Eve	Night	Windows open scenario	Windows closed scenario
R1	57	52	44	56	46
R2	57	52	51	51	41
R3	57	52	51	56	46
R4	54	47	42	40	28
R5	54	47	42	41	28
C1	65	60	58	56	46
C2	65	60	58	34	24

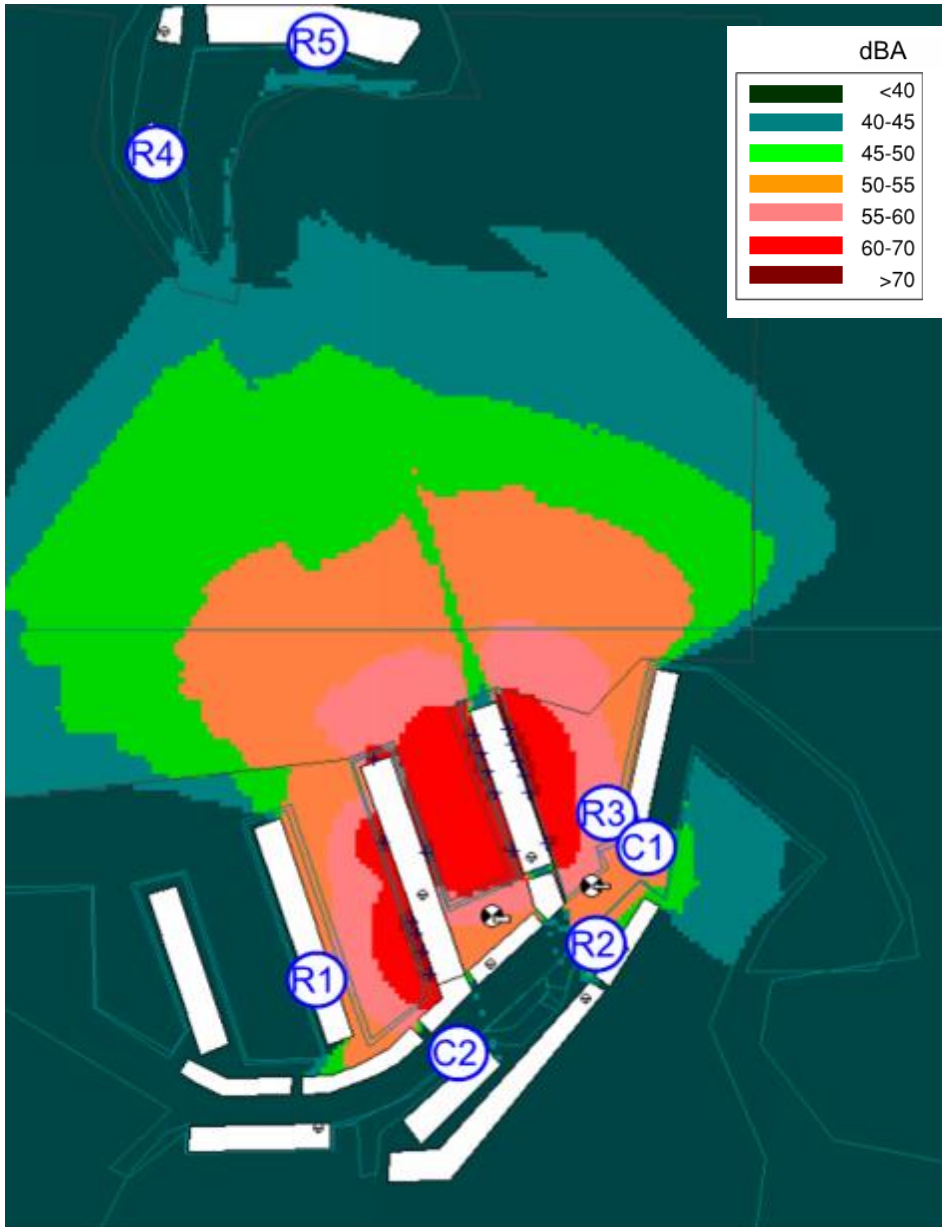


Figure 14 - Noise map output - Windows open scenario

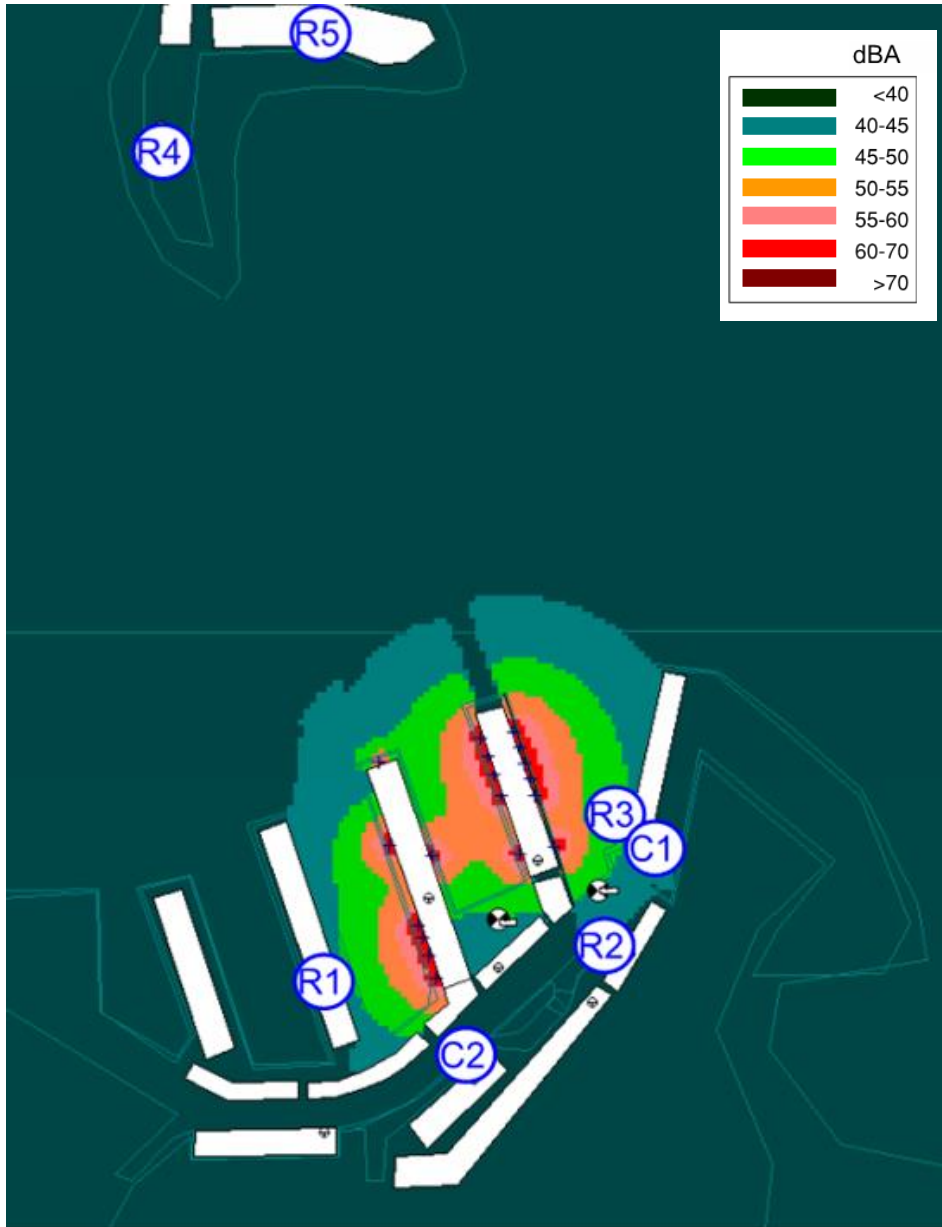


Figure 15 - Noise map output - Windows closed scenario

6.1.3 Results - outdoor sources

In order to assess the viability of the Waterfront Square as an entertainment venue and the noise levels referenced in the DGR's still be achieved, the following assessment has been undertaken.

The computer model has been calibrated to determine the maximum noise level from these to achieve the NSW INP2000 criteria as referenced in the DGR's and detailed in Section 5.2.1. It is envisaged that events may occur up until 11pm or midnight, limiting levels have been determined for all three periods; day, evening and night, as defined within Section 3.3.2.

This assessment assumes that the noise source is placed in the middle of the square.

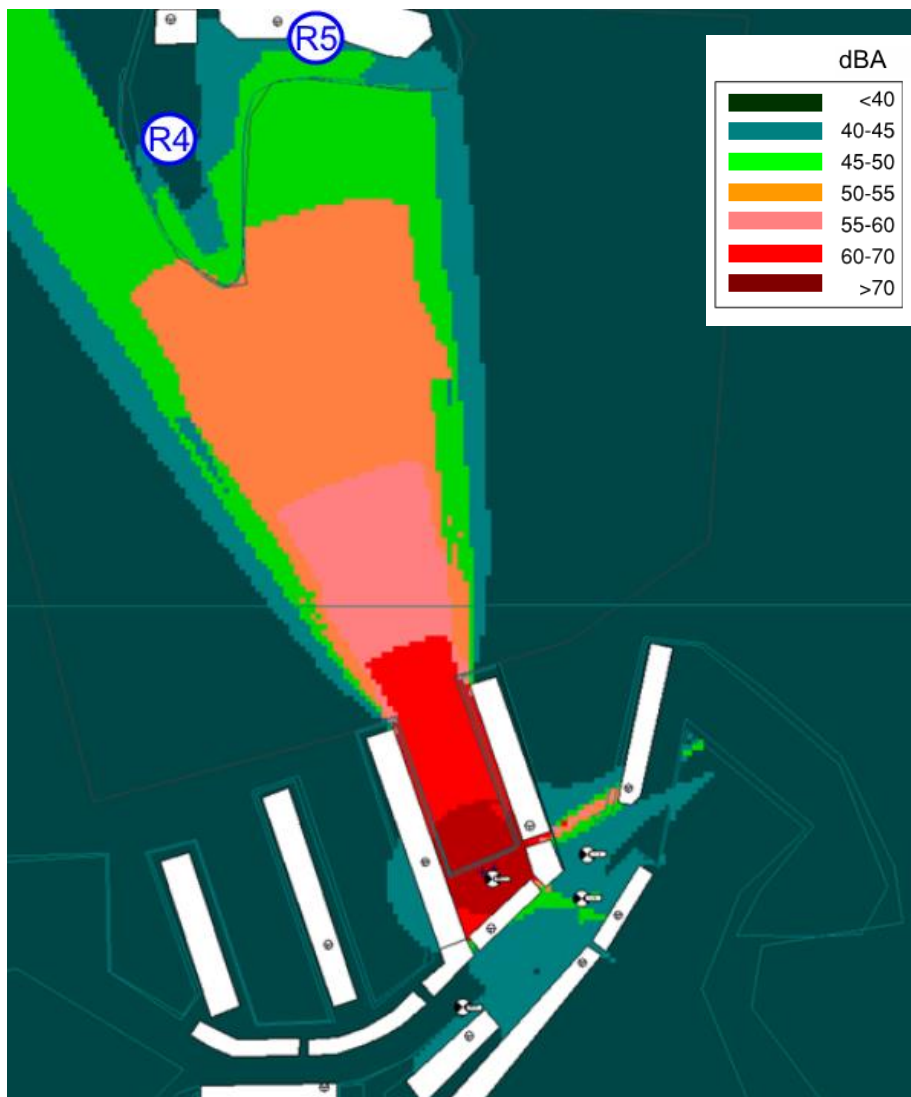


Figure 16 – Noise map of external music event - Day time

It has been determined that the following maximum noise levels should be applied to the events for the 3 time periods (day, evening and night) in order to achieve the noise criteria of the INP2000

- Day (0700-1800) - 81dBA at 10 meters
- Evening (1800-2200) - 78dBA at 10 meters

- Night (2200-0700) - 77dBA at 10 meters

The full analysis is provided in Table 11 below.

Table 11 - Resultant noise at noise sensitive receivers

Receiver position	INP2000 Noise Emissions Criteria (dB LAeq)			Resultant noise at receivers due to limited noise emissions		
	Day	Eve	Night	Daytime assessment to 81dB LAeq @10m	Evening assessment to 78dB LAeq @10m	Night assessment to 77dB LAeq @10m
R1	57	52	44	40	35	34
R2	57	52	51	42	37	36
R3	57	52	51	57	52	51
R4	54	47	42	47	42	42
R5	54	47	42	48	43	41
C1	65	60	58	57	52	51
C2	65	60	58	39	34	33

Noise levels experienced across the harbour at McMahons Point (R4 and R5) do not exceed INP2000 criteria and are lower than the measured background noise levels for day, evening and night time periods.

6.2 Traffic Noise Assessment

Additional road traffic is anticipated upon completion of the project which has been considered within this assessment. The road network surrounding the development is predominantly fronted by commercial; however residential dwellings on Pottinger Street face the site from an elevated and set back position.

To provide a noticeable increase in road traffic noise, the road traffic noise levels would need to change by more than 2 dBA. For the road traffic noise environment to increase by 2 dBA by an increase in traffic volume alone, the traffic volume needs to increase by nearly 60%.

The proposed loading dock for Pier 2/3 facilities is in the same location as the existing loading dock for events held in the space on the East side of Pier 2/3.

6.2.1 Results

Due to the fact that there is no dedicated parking associated with the development, the overall traffic flows on the surrounding roads will not be significantly increased over the existing condition. It is considered unlikely that traffic increases, if any, will increase the traffic noise to the nearby noise sensitive receivers by more than 2dBA.

It is recommended that noise from vehicular movements on the project site (associated with the loading dock) will be controlled via a management strategy including controlling the time of use of the loading dock, controlling the number of vehicles on the site simultaneously, as well as recommending the use of broadband (“quacker”) reversing alarms on all vehicles where possible from an OH&S perspective.

6.3 Plant Equipment Noise Assessment

As the design is at a concept level, no plant equipment selections have been made. Rather concept level information on expected equipment has been made available and a high level assessment based typical equipment noise levels has been completed. The expected equipment is as follows:

- Two existing condenser farms on the Pier 4/5 roof
- Internal plant equipment
- Cooling tower plant on the Pier 2/3 roof.

6.4.1 Results

Existing equipment on the roof of Pier 4/5 will be replaced as part of the new development. Due to advances in condenser and fan blade technologies the new units are expected to be more efficient and quieter than the existing equipment.

New cooling tower equipment will be the key new Cooling plant on the Pier 2/3 roof. This equipment will be designed such that the INP2000 noise levels at the noise sensitive receivers are not exceeded. This will be achieved with careful consideration in the selection, design and placement of all mechanical equipment that emit noise. Where equipment is in excess of these criteria, acoustic mitigation will be necessary. Typical measures are discussed in the conclusions section (8.4).

7. Assessment

At a glance

This section assesses the difference between the assessment results detailed in Section 6 and the site requirements provided in Section 5.

7.1 Activity Noise Assessment

7.1.1 Indoor sources

Table 11 in Section 6.1.3 shows a direct comparison of the NSW INP2000 criteria against the assessment results for activity noise emissions from internal rehearsal and performance spaces at the previously identified noise sensitive receivers. The external noise levels at the façade of sensitive receptors from these internal noise emissions have been compared to the existing conditions calculated by the same means within the site analysis section (3.3.3).

Comparing against the existing conditions predicted and detailed in Table 4 (Section 3.3.3) it can be seen that the noise levels due to internal activity noise are predicted to increase for most receivers. Nevertheless, the predicted noise levels do not exceed the daytime INP2000 requirements. For the evening and night periods windows should be closed to achieve the INP2000 requirements. A management strategy will be implemented to ensure that this is adhered and alternative ventilation provided to these spaces to allow them to operate in a 'sealed' manner. The new elements of building fabric (glazing, etc) will be specified in order to ensure the INP2000 noise targets are achieved.

7.1.2 Outdoor events

Noise from events within Waterfront Square should be controlled to within the INP2000 requirements for each of the identified noise sensitive receivers. To ensure this is achievable, the noise model of the site has been used to determine the noise limits for a noise source within Waterfront square when measured at a distance of 10 meters. These noise levels may be enforced through the implementation of permanent noise monitoring and noise limiting devices if required.

Additionally – creative measures may be employed by the operators of the space in consultation with the local community in order to limit the noise impact on the surrounding spaces. This may include the possibility of streaming audio for events to personal handheld devices (such as mobile phones, etc.) as oppose to using large speaker systems.

It should be noted that this concept SSDA is requesting permission for a public entertainment space as part of the future development, being the Waterfront Square. It is not seeking permission to hold specific events within the Waterfront Square. It is recommended that noise emission requirements and hours-of-operation for any potential future major outdoor events in the Waterfront Square are written into Conditions of Consent for the project – and major events required seek permission and develop a Noise Management Plan to comply with the criteria outlined in this report (or any requirements imposed in the Conditions of Consent). These Noise Management Plans may include community consultation and noise monitoring as part of their requirements.

7.2 Traffic Noise Assessment

Based on the assessment detailed within Section 6.2 it is considered unlikely that a noticeable increase in road traffic noise will occur to the nearby noise sensitive receivers. Therefore, no

mitigation measures are recommended to mitigate noise due to traffic increases to the sensitive buildings surrounding the project site.

It is recommended that noise from vehicular movements on the project site (associated with the loading dock) will be controlled via a management strategy including controlling the time of use of the loading dock, controlling the number of vehicles on the site simultaneously, as well as recommending the use of broadband (“*quacker*”) reversing alarms on all vehicles where possible from an OH&S perspective.

7.3 Plant Equipment Noise Assessment

As the design is at a concept level, no plant equipment selections have been made; however, a high level assessment has been undertaken.

Existing equipment on the roof of Pier 4/5 will be replaced as part of the new development. Due to advances in condenser and fan blade technologies the new units are expected to be more efficient and quieter than the existing equipment.

Internal plant equipment such as Fan Coil units or fans, may be controlled using in duct methods such as lined duct or Attenuators.

New cooling tower equipment on the Pier 2/3 roof will be the key new noise source on the site. This equipment will be designed such that the INP2000 noise levels at the receivers are not exceeded. This will be achieved with careful consideration in the selection, design and placement of all mechanical equipment that emit noise. Where equipment is in excess of these criteria, acoustic mitigation will be necessary. Typical measures to mitigate noise from this equipment may include, but are not limited to;

- Relocating equipment
- Careful selection of equipment
- Noise barriers
- Acoustic louvers
- Acoustic absorption.

8. Conclusions and Recommendations

At a glance

Within this section key conclusions from the assessments are drawn out and recommendations made.

8.1 Activity Noise

8.1.1 Indoor sources

Noise due to indoor activities associated with the operation of proposed development is expected to increase at some neighbouring receivers. However these increases can be fully mitigated (to within the criteria established in the DGR's) using the measures recommended in this report. These measures include:

- For evening and night periods; windows should be closed when noise generating activities are being undertaken.
- Alternative ventilation provided to these spaces to allow them to operate in a 'sealed' manner.
- The new elements of building fabric (glazing, etc.) will be specified in order to ensure the noise targets are achieved.

8.1.2 Outdoor events

Noise levels from outdoor events within Waterfront Square should be monitored to ensure it is controlled to within the INP2000 requirements at the neighbouring noise sensitive receivers.

It is recommended that monitoring throughout events is utilised in conjunction with limiters on equipment. To assist in this the following noise levels at 10m should be used as guidance;

- Day (0700-1800) - 81dBA at 10 meters
- Evening (1800-2200) - 78dBA at 10 meters
- Night (2200-0700) - 77dBA at 10 meters

Further to this, community consultation and complaint handling processes implemented by the event organisers to mitigate any adverse impacts on the surrounding environment are recommended. These may include;

- Engaging the local community during the organisation process
- Providing a complaints hotline to quickly manage complaints.

It should be noted that this concept SSDA is requesting permission for a public entertainment space as part of the future development, being the Waterfront Square. It is not seeking permission to hold specific events within the Waterfront Square. It is recommended that noise emission requirements and hours-of-operation for any potential future major outdoor events in the Waterfront Square are written into Conditions of Consent for the project – and potential major events required seek permission and develop a Noise Management Plan to comply with the criteria outlined in this report (or any requirements imposed in the Conditions of Consent). These Noise Management Plans may include community consultation and noise monitoring as part of their requirements

8.2 Traffic Noise

Based on the assessment detailed within Section 6.2 it is considered unlikely that traffic increases on surrounding public roads, if any, will increase the traffic noise to the nearby noise sensitive receivers. Therefore, no mitigation measures are recommended to mitigate noise due to traffic increases to the sensitive buildings surrounding the project site.

It is recommended that noise from vehicular movements on the project site will be controlled via a management strategy including controlling the time of use of the loading dock, controlling the number of vehicles on the site simultaneously, as well as recommending the use of broadband (“*quacker*”) reversing alarms on all vehicles where possible from an OH&S perspective.

8.3 Plant Equipment Noise

As the design is at a concept level, no plant equipment selections have been made; however, a high level assessment has been undertaken.

Existing equipment on the roof of Pier 4/5 will be replaced as part of the new development and is expected to produce less noise due to advances in condenser and fan blade technologies.

New equipment located internally and on the Pier 2/3 roof is expected to be controllable through the use of acoustic mitigation measures. These may include, but are not limited to:

- Relocating equipment
- Careful selection of equipment
- Noise barriers
- Acoustic louvres
- Acoustic absorption
- Lined duct
- Attenuators.

9. References

Legislative document

Environment Protection Authority - January 2000 - *New South Wales Industrial Noise Policy: 2000*

Legislative document

Department of Environment, Climate Change and Water NSW - March 2011 - *New South Wales Road Noise Policy: 2011*