

Infrastructure NSW

Walsh Bay Arts Precinct

SSD 16_7689 SEARs - Noise Impact
Assessment

Issue 3 | 14 November 2016

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 248995

Arup
Arup Pty Ltd ABN 18 000 966 165



Arup
Level 17
1 Nicholson Street
East Melbourne VIC 3002
Australia
www.arup.com

ARUP

Contents

| | Page |
|---|-----------|
| Executive Summary | 1 |
| 1 Introduction | 2 |
| 1.1 The Site and surrounds | 2 |
| 1.2 The Project | 4 |
| 2 SEARs Issues Addressed | 8 |
| 3 Relevant Policies and Guidelines | 8 |
| 4 Existing Environment | 9 |
| 4.1 Description of Site | 9 |
| 4.2 Key receptors | 9 |
| 4.3 Measurement of existing noise levels | 10 |
| 5 Acoustic Criteria | 11 |
| 5.1 NSW Industrial Noise Policy (INP) | 11 |
| 5.2 Limits on noise local to the development | 13 |
| 5.3 Event noise | 13 |
| 6 Noise Impacts to the Community | 15 |
| 6.1 Modelling of noise | 15 |
| 6.2 Additive effects of other developments at Walsh Bay | 16 |
| 6.3 Mechanical plant noise | 17 |
| 6.4 Construction noise and vibration | 17 |
| 6.5 Assessment of outdoor event noise | 21 |
| 6.6 Breakout of internal event noise | 21 |
| 6.7 Other noise issues | 26 |
| 6.8 Operational Vibration Impacts | 27 |
| 6.9 Operational Traffic Noise | 27 |
| 7 Conclusion | 28 |

Appendices

Appendix A

Noise Survey Results - WSP

Executive Summary

This report has been produced in response to the Secretary's Environmental Assessment Requirements (SEARs) of the State Significant Development Application SSD 16_7689 relating to the Walsh Bay Arts Precinct – Stage 2.

This report addresses Key Issues required for a SSD and specifically responds to the SSD 7689 Key Issue 9 (noise and vibration). Reference is made to construction noise which is one of the topics in Key Issue 17 (Environmental and Construction Management Plan). In responding to these issues, reference has been made to the Conditions of Consent, particularly numbers A13 (relating to Operational Event Noise Management Plan) and B16 (outputs from previous studies into noise at the site).

This report sets out the criteria that relate to noise and vibration from the development affecting the environment both during construction and in operation.

A separate report (referenced herein) assesses the impact of noise from external events on the nearby residential properties.

Conclusion

This report has addressed the SEARs Key Issue 9 and demonstrates that the issues in the SEARs that relate to noise and vibration can be appropriately resolved. In particular:

- Criteria based on site measurements have been developed for noise from plant affecting the environment. These criteria comply with the *NSW Industrial Noise Policy (EPA 2000)*.
- Noise during construction will be assessed based on the requirements set out in the *Interim Construction Noise Guideline 2009 (EPA)*. The control of noise and vibration during construction will be a strict requirement for the future contractor. The requirements to achieve acceptable construction noise and vibration levels onto the existing development are likely to be more onerous than those to achieve acceptable conditions at the nearest noise sensitive receivers. Most of the construction work will take place within the existing building envelope although there is some necessary external works.
- Preliminary modelling demonstrates that noise from outside events can be effectively controlled. Included within the Event Noise Management Plan (separate document) are recommendations for protocols to manage noise as well as proposed noise limits for different types of activity.

1 Introduction

1.1 The Site and surrounds

The Walsh Bay Arts Precinct (WBAP) (the “site”) generally comprises Pier 2/3, Pier 4/5 and its shore sheds which make up Wharf 4/5, as well as the adjoining waterway. The site has a street frontage to Hickson Road. The site is shown in Figures 1 and 2. The site is part of the Walsh Bay area which is located adjacent to Sydney Harbour within the suburb of Dawes Point. The site is located within the City of Sydney Local Government Area.

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.

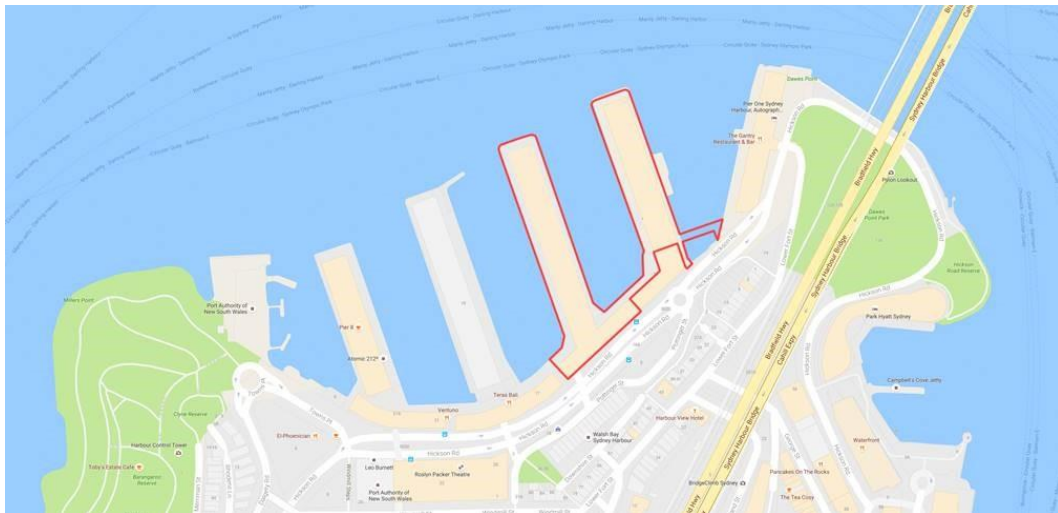


Figure 1: Site Location

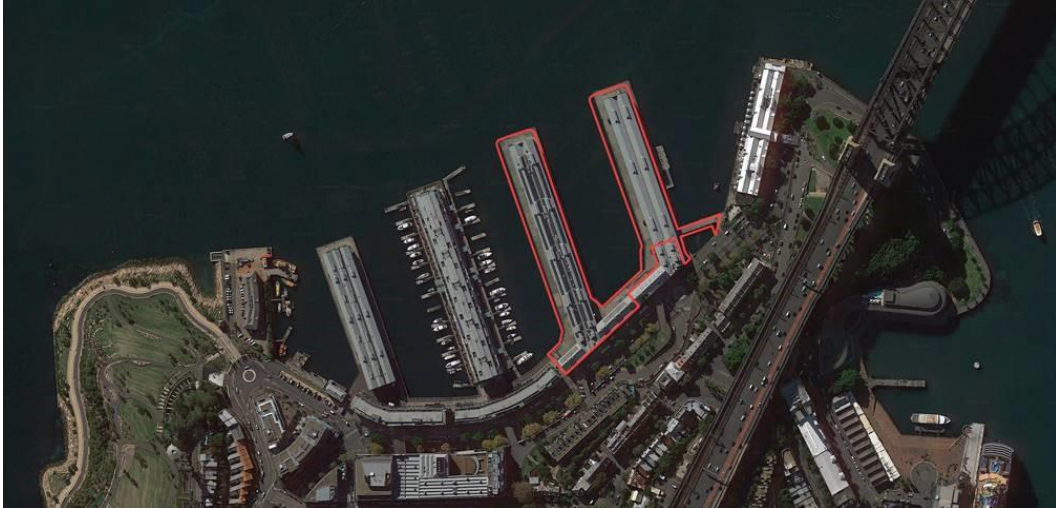


Figure 2: Aerial view

Pier 2/3 is legally described as Lot 11 in DP 1138931 and Wharf 4/5 is legally described as Lot 65 in DP 1048377. The total area for these lots is 18,090sqm.

The land owner of the 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 Justice, primarily for arts and cultural uses.

The area of water that the project proposes to build over is also owned by RMS. Its land title description is Lot 12 in DP 1138931.

Walsh Bay comprises ten berths constructed between 1908 and 1922 for international and interstate 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.

The Walsh Bay Wharves comprise the following:

- Pier One which contains the Sebel Pier One Sydney Hotel;
- Pier 2/3 the last remaining undeveloped pier (has previously received approval for cultural uses, temporary arts events and some commercial events);
- Wharf 4/5 which is occupied by the Sydney Theatre Company (STC), the Australian Theatre for Youth Program (ATYP), Sydney Dance Company (SDC), Bangarra Dance Theatre and the choirs comprising Gondwana, the Song Company and Sydney Philharmonia;
- Pier 6/7 which has been redeveloped for residential apartments and associated boat marina;
- Pier 8/9 which has been redeveloped for office uses; and,
- Shore sheds aligning Hickson Road which contain a range of commercial activities, including restaurants, bars, shops and offices.

1.2 The Project

The approved Stage 1 development application comprised:

- A new waterfront public square between Pier 2/3 and Wharf 4/5;
- A series of new stairs and balconies on Pier 2/3 and Wharf 4/5 and modification to the roof of Pier 2/3;
- The inclusion of new tenancy spaces in Pier 2/3 and Wharf 4/5 for arts and cultural activities; and,
- The use of the precinct for arts festivals, events and pop-ups and associated uses, including restaurants, cafes and bars.

The WBAP Stage 2 State Significant Development Application seeks consent for construction works for the above to realise the WBAP project, as well as the proposed external alterations and additions to all of Wharf 4/5. It also seeks consent for new commercial and event uses in the precinct. Key aspects of the proposed development are outlined below:

Early works

- Early construction works comprising infrastructure upgrades, demolition, hazmat removal and sub structure works.

Pier 2/3

- Internal alterations and reconfiguration to provide for the following:
 - Performance venues;
 - Rehearsal rooms, production workshops, back of house facilities and offices;
 - Function spaces, bars, cafes and foyer spaces extending onto external gantry platforms (balconies) providing breakout space for internal foyers and allowing views of outdoor performances;
 - Mezzanine spaces for offices and back of house facilities;
 - Upgrades to meet compliance with current BCA, DDA and fire codes;
 - New lifts and stairs;
 - Creation of new commercial tenancies and public toilets;
 - Removal of some storey posts and beams to facilitate internal reconfiguration and new uses; and
 - Retention of a large proportion of the ground floor in its existing 'raw' heritage state for events and festivals including Sydney Writers' Festival and Biennale including venue and commercial hire.
- External alterations and additions comprising:

- New balconies and external stairs for fire egress;
- New external lift for access;
- Installation of glazing in existing cargo sliding door openings and other solid panels on the eastern, western and northern elevations to allow for views into and out of the building;
- Roof penetrations within the central valley at the southern and northern end to accommodate new performance spaces and associated structural modifications including truss strengthening;
- Installation of ESD elements, such as photovoltaic panels and seawater heat exchange systems; and
- Raising of the external floor level on the eastern side by introducing a new raised deck and continuous set of stairs beyond the existing column line.

Wharf 4/5

- Internal alterations and reconfiguration to the Bangarra Dance Theatre (BDT) tenancy to provide for the following:
 - Upgrade of the main rehearsal and performance spaces;
 - Upgraded foyer and exhibition space along the eastern frontage;
 - Improved office space at mezzanine level including a new lift and stairs;
 - Provision of a function space at ground level of the northern end of wharf with associated kitchen facilities; and
 - New entrance and new glazing in bays of sliding cargo doors, opening up the foyer and main studio to the Pier 4 apron.
- Minor internal alterations and additions to the SDC tenancy comprising:
 - Reducing the existing workshop space to create a fifth dance studio; and
 - Upgrading office and reception areas.
- External alterations and additions to SDC tenancy comprising:
 - Raising of the timber wharf deck adjoining the SDC café and opening of the facade with new glazing to activate the waterfront square.
- Creation of new commercial tenancies and public toilets;
- External fabric alterations around the Sydney Theatre Company (STC) tenancy comprising:
 - Improved street entry at Hickson Road involving relocation of the stairs to allow for an improved landing and point of arrival to the STC;

- New ‘gantry’ balconies, stairs and lifts mid-wharf and at the end of the wharf to provide for improved accessibility and compliance with fire engineering solutions;
- Minor amendments to the existing façade to accommodate new entries and exits along the wharf;
- Roof penetrations within the central valley at two locations to accommodate theatre and workshop spaces and associated structural modifications including truss strengthening; and
- Reinstallation of existing photovoltaic panels where applicable.

Wharf 4/5 Shore Sheds

- Internal alterations to reconfigure the choir spaces, including provision of a mezzanine for choir administration;
- Creation of new commercial tenancies at ground and mezzanine levels; and
- Provision of office space at ground level.

Public Domain

- Construction of a new waterfront square comprising a deck on piled structure;
- Shaded informal performance space on piled structure; and
- Changes to existing levels and steps down to facilitate access between the existing apron and new waterfront square.

New Uses

- Use of the precinct for arts festivals, events and pop ups as well as a range of activating uses such as retail, restaurants, cafes and bars.
- Events as per table below extracted from SSDA 6096 conditions:

Table 1: Scope of Events

| Category | Scope of Events |
|-----------------------------|--|
| Major Events | <p>up to 10,000¹ people</p> <p>max 4 times per year</p> <p>must not occur over more than one day</p> <p>use must not occur before 7am or after midnight on any day, except New Year's Eve (when the use may occur until 2am the following day)</p> <p>music to be ceased by 11pm in all cases (with the exception of New Year's Eve)</p> <p>set-up/dismantle time for the use must not start earlier than 6am, or end later than 1am, on any day, except New Year's Eve when dismantle may occur until 2am the following day</p> <p>clean up time for the use must end no later than 2 hours after the use was to stop occurring or may be undertaken the following day</p> |
| Arts and Cultural Festivals | <p>up to 7,500 people moving through the site at any one time</p> <p>can occur over consecutive days</p> <p>max 6 times per year</p> <p>use must not occur before 7am or after 12 midnight on any day (including set up/dismantle and clean up time)</p> <p>music to be ceased by 11pm in all cases</p> |
| Community Events | <p>up to 5,000 people</p> <p>no limit on number of community events held in a year</p> <p>can occur over consecutive days</p> <p>use must not occur before 7am or after 12 midnight on any day, including set up/dismantle and clean up time</p> <p>music to be ceased by 11pm in all cases</p> <p>use of localised low output amplified sound system for announcements or for live intimate entertainment only</p> |
| Private Events | <p>up to 1,000 people</p> <p>no limit on number of private events</p> <p>can occur over consecutive days</p> <p>use must not occur before 7am or after 12 midnight on any day, including set up/dismantle and clean up time</p> <p>music to be ceased by 11pm in all cases</p> <p>private event should not restrict or impede public access to public outdoor areas</p> <p>use of localised low output amplified sound system for live intimate entertainment only</p> |

¹ Safety and pedestrian studies have shown that events with this number of attendees are not practicable. The external largest event is expected to be around 5000 visitors

2 SEARs Issues Addressed

This report addresses the following Key Issues:

- Assess construction noise and vibration impacts. The assessment must consider cumulative noise and vibration impacts from all concurrent construction activities;
- assess operational noise from the use of the buildings and the public domain, associated events and any food and drink premises;
- assess operational vibration from the use of the premises;
- outlines measures to minimise and mitigate potential noise and vibration impacts within the precinct and to surrounding occupiers of land

Noise from external events are discussed in detail in a separate document².

Reference has also been made to the Stage 1 DA conditions of consent for SSD 6069³, in particular:

- Condition A13 relating to the Operational Event Noise Management Plan (see reference ² below).
- Condition B16 relating to the demonstration of how the recommendations of the Noise Impact Assessment prepared by WSP (dated June 2014) have been implemented.

3 Relevant Policies and Guidelines

- NSW Industrial Noise Policy (EPA)
- Interim Construction Noise Guideline 2009 (EPA)
- Assessing Vibration: a technical guideline

Issues associated with air quality and odour are not considered in this report.

² Walsh Bay Arts Precinct – Operational Event Noise Management Plan, by Arup, dated 10 Nov 2016

³ Development Consent for Application SSD 6069 to Arts NSW dated 21 May 2015.

4 Existing Environment

The NSW Industrial Noise Policy (INP)⁴ sets out a methodology to derive appropriate criteria for noise from plant affecting the environment. This is based on the levels of existing noise around the site which in turn are derived from an extensive survey of existing noise levels, details of which are given below. The derivation of the noise criteria from this data is given in Section 5.1.

4.1 Description of Site

4.2 Key receptors

The key receptors are shown in Figure 3 and Figure 4 below.



Figure 3: Key Noise Receptors (Image taken from previous WSP report)

Residential receivers are highlighted in Blue and commercial and residential receivers shown in Green.

⁴ NSW Industrial Noise Policy. Environment Protection Authority. January 2000



Figure 4: Noise Receptors to the North of the Development (Image taken from WSP report)

4.3 Measurement of existing noise levels

The background noise levels have been determined previously by WSP⁵ and submitted as part of the Stage 1 SSDA. The results of the measurements are summarised below with the full report included as Appendix A of this report. Whilst the data is two years old, it has been shown to be representative of the existing noise climate through validation by Arup using attended and unattended noise measurements at various locations at site over recent months.

The noise measurement locations are shown in Figure 3 and Figure 4 above.

⁵ Noise and Vibration Impact Report, WSP, 24 June 2014

5 Acoustic Criteria

5.1 NSW Industrial Noise Policy (INP)

This section outlines applicable external noise limiting criteria. Noise criteria are provided to maintain on site acoustic amenity and avoid adverse acoustic impacts to the surrounding environment.

The INP covers noise emissions from the proposed operation of a facility and from other plant and equipment affecting the proposed facility. Noise from traffic movement on a site (i.e. not on public roads) is assessed as being operational noise under the INP.

The objective of the INP is to protect sensitive receivers, such as residences, from noise generated by commercial, industrial or trade premises. In this context, ‘industrial’ refers to the source of the noise (e.g. plant) rather than the nature of the premises.

Noise limits are set based on land use in the area and existing background noise levels. Compliance is achieved if the adjusted L_{Aeq} noise level at any sensitive receivers affected by noise from the facility is below the noise limit. The adjusted L_{Aeq} is determined by applying corrections for such noise characteristics as duration, intermittency, tonality, and impulsiveness.

The assessment of noise emission under the INP is based on the calculation of a noise limit at a receiver position, taking into account the land-use in the surrounding area and the existing background noise level.

The INP separates the 24 hour day into three different time periods – day, evening and night. These time periods are detailed below in Table 2.

Table 2: Standard INP time periods

| Period | Day of Week | Time period |
|---------|-------------------------|-------------------|
| Day | Monday-Saturday | 7:00 am-6:00 pm |
| | Sunday, Public Holidays | 8:00 am-6:00 pm |
| Evening | Monday-Sunday | 6:00 pm -10:00 pm |
| Night | Monday-Saturday | 10:00 pm -7:00 am |
| | Sunday, Public Holidays | 10:00 pm -8:00 am |

The INP states that background noise levels should be determined over the “days and times of operation of the project”. When setting criteria, only the measured data from the hours of operation of the project should be included.

The INP provides guidance on acceptable noise levels from the introduction of new industrial noise sources to an area. The assessment procedure for industrial noise sources has two components:

- Controlling intrusive noise impacts in the short term for residences; and
- Protecting noise level amenity for particular land uses such as residences, recreation areas and commercial offices etc.

Both of these components result in noise criteria that should not be exceeded in order to avoid any adverse noise impacts on the affected areas. Both criteria have been taken into account when assessing the noise impact of building services noise source(s) associated with the project. Where the intrusiveness and the amenity criterion differ, the most stringent of the noise criteria has been adopted as the ‘project-specific’ noise criterion.

The Project Specific Noise Emission Criteria derived from the noise measurements by WSP (see Appendix A), are given below in Table 3.

Table 3: Summary of Project Specific Noise Criteria (free-field noise criteria to be met at boundary of receiver)

| Location | Time Period | Project Specific Noise Criteria (L _{Aeq} 15min) |
|-------------------------------------|-------------------------|--|
| Receiver R1: Residential Apartments | Day (7:00 – 18:00) | 57 |
| | Evening (18:00 – 22:00) | 52 |
| | Night (22:00 – 7:00) | 44 |
| Receiver R2: Terraced houses | Day (7:00 – 18:00) | 57 |
| | Evening (18:00 – 22:00) | 52 |
| | Night (22:00 – 7:00) | 51 |
| Receiver R3: The Seibel Hotel | Day (7:00 – 18:00) | 57 |
| | Evening (18:00 – 22:00) | 52 |
| | Night (22:00 – 7:00) | 51 |
| Receiver R4: McMahons Point | Day (7:00 – 18:00) | 54 |
| | Evening (18:00 – 22:00) | 47 |
| | Night (22:00 – 7:00) | 42 |
| Receiver R5: McMahons Point | Day (7:00 – 18:00) | 54 |
| | Evening (18:00 – 22:00) | 47 |
| | Night (22:00 – 7:00) | 42 |
| Receiver C1: Café Restaurants | Day (7:00 – 18:00) | 65 |
| | Evening (18:00 – 22:00) | 60 |
| | Night (22:00 – 7:00) | 58 |
| Receiver C2: Shops and Cafes | Day (7:00 – 18:00) | 62 |
| | Evening (18:00 – 22:00) | 60 |
| | Night (22:00 – 7:00) | 58 |

Assessment of building services (mechanical plant) noise mitigation requirements to meet these criteria are discussed in Section 6.3 below.

5.2 Limits on noise local to the development

As well as controlling noise affecting nearby residences and the nearby recreation spaces, it is intended to control noise local to the development in order to protect amenity of the outdoor areas.

5.3 Event noise

Event noise is discussed in detail in the Event Noise Management Plan (ENMP – appended as a separate document). Criteria are proposed for the different types of events defined in Condition A7 of SSD 6069, reflecting their nature and frequency. For Major Events and Arts and Cultural Events, an absolute criterion is proposed based on common practice in Sydney. The more frequent events (i.e. Community and Private Events) have a more-onerous criterion that has been derived in relation to the existing background noise level.

The current proposals are for no overall site licensing for the public domain.

Liquor & Gaming NSW has a set of default noise clauses for licensed premises which they often apply to license approvals in the absence of other site specific noise criteria. For consistency in noise policy, it is recommended that the noise criteria proposed in this report (i.e. the final SSD consent conditions relating to noise) are used for all future liquor license approvals for precinct events, instead of the default Liquor & Gaming NSW noise clauses. There is a precedent for this approach being adopted by Liquor & Gaming NSW at other large precinct developments such as Barangaroo that have site-wide noise management policies.

The criteria are summarised below for reference. The types of events envisaged are described in Section 5.3 above.

5.3.1 Major events (up to 4 times per year)

The noise limits in Table 4 are proposed for Major Events. They cover noise from setup and take down as well as noise generated by the event itself.

Included in the table are suggested noise limits for 0000h to 0200h. This would only apply for New Years Eve.

Table 4: Noise Criteria for Major Events (free-field noise criteria to be met at any residential boundary)

| Activity | Early Morning (0700h to 1000h) | Daytime (1000 to 2200h) | Late Evening (2200h to 2400h ⁶) | Night – New Years Eve only (0000 to 0200h) |
|---------------------|-----------------------------------|--|--|--|
| Setup / takedown | $L_{Aeq,15m} < 55$ | $L_{Aeq,15m} < 65$ | $L_{Aeq,15m} < 55$ | $L_{Aeq,15m} < 50$ |
| Sound Check | None allowed | $L_{Aeq,15m} < 65$ $L_{Ceq,15m} < 80$ | $L_{Aeq,15m} < 55$ $L_{Ceq,15m} < 70$ | None allowed |

⁶ Events to finish at 2300h except on New Year's Eve

| Activity | Early Morning (0700h to 1000h) | Daytime (1000 to 2200h) | Late Evening (2200h to 2400h ⁶) | Night – New Years Eve only (0000 to 0200h) |
|----------|-----------------------------------|--|--|--|
| Event | None allowed | $L_{Aeq,15m} < 65$ $L_{Ceq,15m} < 80$ | $L_{Aeq,15m} < 55$ $L_{Ceq,15m} < 70$ | $L_{Aeq,15m} < 50$ $L_{Ceq,15m} < 65$ |

In addition to the above noise limits, the constraints set out in Table 1 would apply.

5.3.2 Arts and cultural events

As these events are more frequent than the Major Events, and last for longer, a lower noise criterion will need to be adopted. These are given below in Table 5.

Table 5: Noise Criteria for Arts and Culture Events (free-field noise criteria to be met at any residential boundary)

| Activity | Early Morning (0700h to 1000h) | Daytime (1000 to 2200h) | Late Evening (2200h to 2300h) |
|------------------|--------------------------------|--|--|
| Setup / takedown | $L_{Aeq,15m} < 50$ | $L_{Aeq,15m} < 60$ | $L_{Aeq,15m} < 50$ |
| Sound Check | None allowed | $L_{Aeq,15m} < 60$ $L_{Ceq,15m} < 75$ | $L_{Aeq,15m} < 50$ $L_{Ceq,15m} < 65$ |
| Event | None allowed | $L_{Aeq,15m} < 60$ $L_{Ceq,15m} < 75$ | $L_{Aeq,15m} < 50$ $L_{Ceq,15m} < 65$ |

In addition to the above noise limits, the constraints set out in Table 1 would apply.

5.3.3 Community and private events

Noise from these type of events would have to comply with the normal expectations for environmental noise emissions. The noise criteria in the INP have been applied to this source to be consistent with the previous DA submissions for this project.

The relevant INP requirements are given Table 3 above.

6 Noise Impacts to the Community

6.1 Modelling of noise

Noise from operation and construction has been modelled using SoundPlan 7.4. The model has included the terrain and taken into account the screening afforded by the existing buildings and the acoustical properties of water.

The modelling has been used to assess operational noise (from internal and external events) and noise from ventilation plant.

Screen shots of the acoustic model are shown below. The receiver locations can be seen as small yellow dots on the façade of the key buildings.

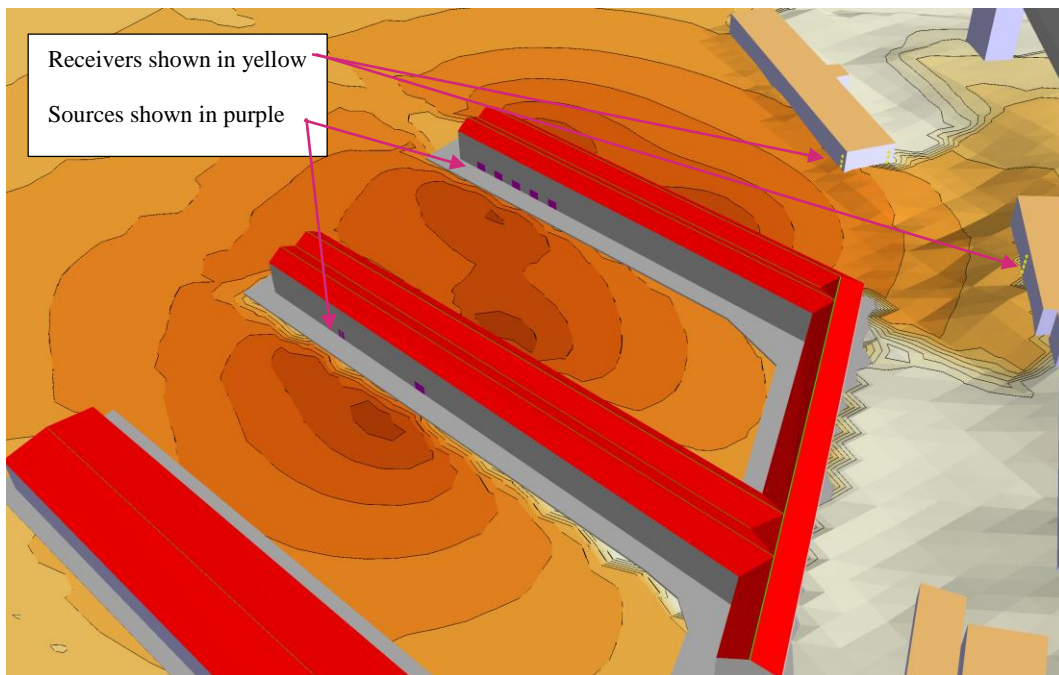


Figure 5: Screenshot of acoustic model showing nearby receivers

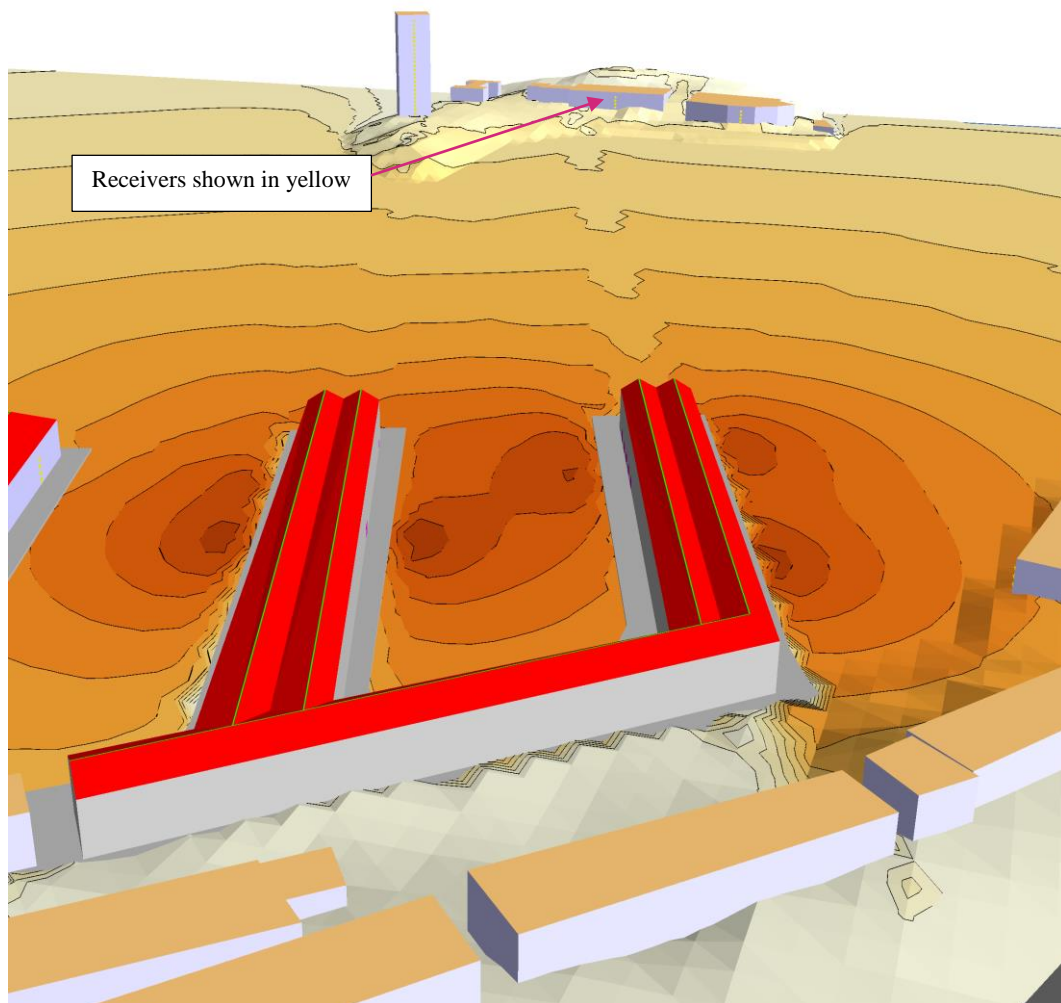


Figure 6: Screenshot of acoustic model showing distant receivers

6.2 Additive effects of other developments at Walsh Bay

Arup is involved in the DA application for the Sydney Theatre Company (STC) as well as the projects covered by this application. The projects are being conducted by separate teams but there has been a coordinated approach with regard to environmental noise issues. Allowance has therefore been made for the potential additive effects of noise from plant and from events.

In practice, the event noise from STC will be minimal because of the very high standards of sound insulation provided within the building envelope of the STC facilities. This is necessary to control both noise intrusion and noise breakout and for adherence to any existing noise management plan.

6.3 Mechanical plant noise

Plant noise will be limited to the criteria listed in Section 5.1, with an allowance for the additive effects for the STC plant (5 dB) and appropriate engineering margins.

At this stage in the project, details of the plant selections are not known. During the detailed design process, appropriate noise and vibration control treatments will be specified to ensure that the noise limits are maintained. These will be selected based on the actual duties of the selected plant as well as their location and orientation.

Calculations based on preliminary plant selections show that acceptable noise levels can be achieved. Most of the plant is serving low-noise internal areas and this requires the selection of inherently quiet plant.

The noise control treatments are likely to include:

- Specification of maximum sound power levels for all items of plant as part of the project documentation
- Rectangular and circular attenuators to control fan noise
- Acoustic louvres to control noise from plantroom ventilation openings
- Vibration isolators to reduce vibration input to the building structure
- Acoustic screens around any external plant
- Incorporation of sound absorptive treatments in plantroom spaces where needed
- Kitchen exhausts with discharge attenuators (treated against kitchen grease)

It is expected that the project will make use of seawater cooling. This is intrinsically quieter than many of the alternatives (i.e. cooling towers or air cooled condensers). The seawater cooling plant will be enclosed in a plantroom.

Current plant proposals do not include generator sets.

6.4 Construction noise and vibration

6.4.1 Effect on the community

The possible impact of the noise and vibration that will be generated by the project construction is recognised. As noted below, noise and vibration will be critical for the existing uses and in some cases, noise control treatments necessary to achieve appropriate noise levels at the existing facilities will help to reduce noise affecting the nearest residential and commercial properties.

The control of noise affecting the community will be given a high priority and form a critical part of the eventual Contractor's scope of work. There will be a specific requirement for the Contractor to prepare a detailed Construction Noise and Vibration Management Plan as part of their appointment.

The requirements given in the “**Interim Construction Noise Guideline**⁷” (ICNG) will apply (this is also in accordance with the relevant policies as listed in the SEARs). This defines noise management levels and work periods based on the Rating Background Level (RBL) as defined in the NSW Industrial Noise Policy.

Table 6: Management Levels at residences at different working hours

| Location | Time Period | RBL | Noise Management Level, L_{Aeq} 15minute | |
|-------------------------------------|--------------------|-----|--|-----------------------|
| | | | Noise affected | Highly noise affected |
| Receiver R1: Residential Apartments | Day (7:00 – 18:00) | 52 | 62 | 75 |
| Receiver R2: Terraced houses | Day (7:00 – 18:00) | 60 | 70 | 75 |
| Receiver R3: The Seibel Hotel | Day (7:00 – 18:00) | 60 | 70 | 75 |
| Receiver R4: McMahons Point | Day (7:00 – 18:00) | 49 | 59 | 75 |
| Receiver R5: McMahons Point | Day (7:00 – 18:00) | 49 | 59 | 75 |
| Receiver C1: Café Restaurants | Day (7:00 – 18:00) | 60 | 70 | - |
| Receiver C2: Shops and Cafes | Day (7:00 – 18:00) | 60 | 70 | - |

In cases where construction noise exceeds the Noise Management Levels during standard hours, all “feasible and reasonable” mitigation levels will be implemented in accordance with the requirements of the ICNG to reduce the noise levels.

6.4.2 Effect on the existing spaces

Much of the construction work will be done internally and some of the spaces will remain occupied during construction. There will be some decanting of tenants to during the works as well as the construction of hoardings around the works.

The eventual contractor will have a key role in managing the noise and vibration levels during the works and this will include:

- Appointing a named member of the site staff who will act as the Responsible Person with respect to noise and vibration.
- Ensuring that the Responsible Person keeps the precinct (and local community) advised on expected activities.

⁷ Interim Construction Noise Guideline, Department of Environment & Climate Change, NSW, July 2009

- Ensuring that the Responsible Person checks the conditions of the powered equipment used on site daily to ensure plant is properly maintained and that noise is kept as low as practicable.
- Managing and monitoring the noise and vibration logging equipment installed around the site.
- Ensuring that the Responsible Person controls the working hours on site to ensure that work is only done during the acceptable periods as defined in the ICNG (7am to 6pm on weekdays and 8am to 1pm on Saturdays. No work on Sundays).
- The impact of noise from construction activity on the precinct may be mitigated by working outside precinct opening hours, provided there are no significant adverse impacts on residential receivers nearby.
- Ensuring that noise levels are kept as low as is reasonably practicable and providing all “feasible and reasonable” noise mitigation methods following the procedures of the NSW ICNG, and reference to relevant standards including *AS2436-2010: Guide to noise control on construction, maintenance and demolition sites* and *BS5228-2009 Code of practice for noise and vibration control on construction and open sites*.
- Maintaining appropriate records of complaints.

6.4.3 Construction noise levels

The actual noise levels will depend on the equipment and processes finally selected for the works. This will be assessed in detail at a later stage as the construction methodology is developed and specific plant is identified.

As noted above, much of the work will be done internally and will therefore be screened by the existing building envelope. The heritage nature of the development means that many of the existing elements are being retained and the works will primarily involve the construction of new internal partitions and modifications to the roof.

6.4.4 Waterfront Square

There will be some piling work required to create the new waterfront square between the two piers. This will require the use of screw piling for the new wharf extensions in the harbour. The equipment used for this will be selected to be as quiet as is reasonably practicable. Noise levels for this type of equipment have been taken from BS 5228-1:2009⁸ as no specific information is given in AS 2436-2010⁹. The data for hydraulic jacking piles has been used which shows sound pressure levels of typically 63 dBL_{Aeq} at 10m.

⁸ British Standard BS5228-1: 2009 + A1 :2014 *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*

⁹ Australian Standard AS2436 (2010) *Guide to noise and vibration control on construction, demolition and maintenance sites*

Calculations show that noise from this activity would not impact the residential properties.

There would also be some pouring of concrete to create the new waterfront square. This would involve concrete trucks delivering concrete in Hickson Road and then a concrete pump (also in Hickson Road) and pipeline being used to transfer the concrete onto the formwork for the new wharf areas. A concrete pump would be typically 75 to 78 dBL_{Aeq} at 10m. The nearest residential property would be some 40m from the pump, resulting in noise levels of approximately 69 to 72 dBL_{Aeq} at the façade (freefield). The residential property could therefore be just 'noise affected'. However, the concreting work is not extensive and this would not take place for extended periods.

Concrete vibratory pokers have a typical noise level of 69 to 78 dBL_{Aeq} at 10m. Noise from this activity would be audible within the wharf area. The pokers would move around the wharf as the concrete is poured giving a typical level of 63 to 73 dBL_{Aeq} at the façade of the wharf buildings with two pokers at say 30 m distant. As noted above, the concrete pour is not extensive and timing will be carefully managed to ensure that the impact on the tenants of Walsh Bay is limited as far as is practicable.

6.4.5 Other External Construction Works

There will be some construction work externally for the erection of new lifts and new stairs. Neither of these activities are expected to involve the generation of high noise levels.

6.4.6 Internal works

There will be little, if any, breaking out of concrete, although some new concrete will be poured over the existing timber floors within the buildings. This is needed to improve sound insulation.

6.4.7 Deliveries and removal of materials

There will be a number of vehicles needed to deliver and remove equipment / debris from the site. It is estimated that there would be up to 40 vehicles per day during the demolition stage of the project and up to 80 vehicles per day during the construction process (ie 7 vehicles per hour).

This number of vehicles is unlikely to have any significant noise impact.

6.4.8 Respite

It is likely that noise levels during construction will be below the Management Levels in the ICNG. As such, no respite periods are expected to be necessary.

The potential for construction work to impact on the existing uses of the WBAP and surrounds is recognised. The ultimate Contractor (appointed at a later stage) will be required to liaise with the users so that noise from construction does not impact on any critical events taking place within the existing accommodation.

6.4.9 Construction vibration

No significant issues are expected with construction vibration affecting residential or commercial properties or the users of the existing venues at site. As noted above, no percussive piling is envisaged.

6.5 Assessment of outdoor event noise

Calculation models have shown that the criteria proposed for noise from events are achievable with event noise set at realistic levels. Notwithstanding this, care will need to be taken with events to ensure that local residents are not unduly disturbed.

Details of the protocols to manage noise from events and the supporting analysis is given in reference 2 (Operational Event Noise Management Plan).

6.6 Breakout of internal event noise

6.6.1 General

The project is cognisant of the potential for noise from internal activities to affect the nearby residences, particularly from events taking place in the spaces which are required to be naturally ventilated.

As the envelope of the facilities is largely being left 'as is' because of the heritage constraints, the noise breakout from activities will need to be managed by the operators of the various tenancies. Most of these are existing tenants and have developed appropriate protocols to manage noise to avoid complaints. These protocols have been working successfully for several years and it is considered reasonable to conclude that they will do in the future too.

6.6.2 Assumptions

It is worth noting that some of the spaces in the development, particularly those for the Australian Chamber Orchestra (ACO) and Australian Theatre for Young People (ATYP) are very well insulated acoustically to control noise intrusion and will therefore be effectively insulated against noise breakout. Noise breakout from these sealed and fully air conditioned spaces is not significant relative to that from the open spaces.

Similarly, although the STC facilities are not part of this assessment, it is known that the STC facilities will be acoustically insulated to control both noise intrusion and noise breakout. The designers of the STC facilities have been made aware of the acoustic requirements for noise to atmosphere, and a combined noise model will be developed jointly between the two projects to assess *cumulative* noise impacts in accordance with any approval requirements.

6.6.3 Calculations

Noise breakout has been assessed through acoustic modelling of the naturally ventilated spaces. This has made ‘worst case’ assumptions, in particular:

- All natural ventilation openings are in an open configuration
- All the noisy internal activities happen concurrently

The following noise spectra have been used in the assessment. These are based on measurements undertaken by Arup for similar uses and represent the most pessimistic (i.e. noisiest) of a range of events.

Table 7: Operational Noise Assumptions

| Source | dB(A) | Sound Pressure Level (dB re 10 ⁻⁶ Pa L _{eq}) Octave Band Centre Frequency (Hz) | | | | | | | |
|----------------------------|-------|--|-----|-----|-----|----|----|----|----|
| | | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k |
| Loud cocktail party | 85 | 86 | 86 | 87 | 83 | 80 | 74 | 67 | 60 |
| Loud applause | 85 | 57 | 65 | 72 | 76 | 82 | 81 | 72 | 62 |
| Amplified foreground music | 90 | 90 | 90 | 87 | 78 | 82 | 86 | 83 | 77 |

The calculations have used the above noise levels and applied them to the natural ventilation openings and, based on the areas of these openings, the sound power radiated to atmosphere then calculated and fed into the noise map.

The limited internal sound insulation *within* the piers means that it is not possible to have amplified music at a ‘concert’ level (i.e. ~105 dB(A)) as this would disturb adjoining tenants, as well as resulting in excessive noise leaving the development. The need to control noise will be part of the agreements with hirers of the function spaces.

These assumptions have been used as follows in the calculations:

Table 8: Assumed activities in naturally ventilated spaces

| Source | Location | Noise spectrum |
|---------------------------------------|--------------------------------|----------------------------|
| Bell Shakespeare Rehearsal | Ground floor Pier 2/3 | Loud applause |
| Function One (event space) | Ground floor Pier 2/3 | Loud cocktail party |
| SDC Studio 5 | Ground floor Pier 4/5 | Amplified foreground music |
| Bell Shakespeare small rehearsal room | 1 st floor Pier 2/3 | Loud applause |
| Bell Shakespeare large rehearsal room | 1 st floor Pier 2/3 | Loud applause |
| Commercial 6 (event space) | 1 st floor Pier 2/3 | Loud cocktail party |

The assumptions above are in line with (but not identical to) those used in the WSP Noise Impact Assessment.

The assessment has been based on the combined operation of the internal spaces. The noise breakout from *external* events in the waterfront plaza have been assessed separately in the Event Noise Management Plan. In practice, it is unlikely that there would be a cumulative noise impact on the community from both external *and* internal events concurrently. This is because such events would

interfere with each other and would therefore have to be programmed such that there is no mutual disruption.

6.6.4 Modelling results

The results of the modelling are shown below as noise contours in $dB_{L_{Aeq}}$ units for comparison with the INP criteria.

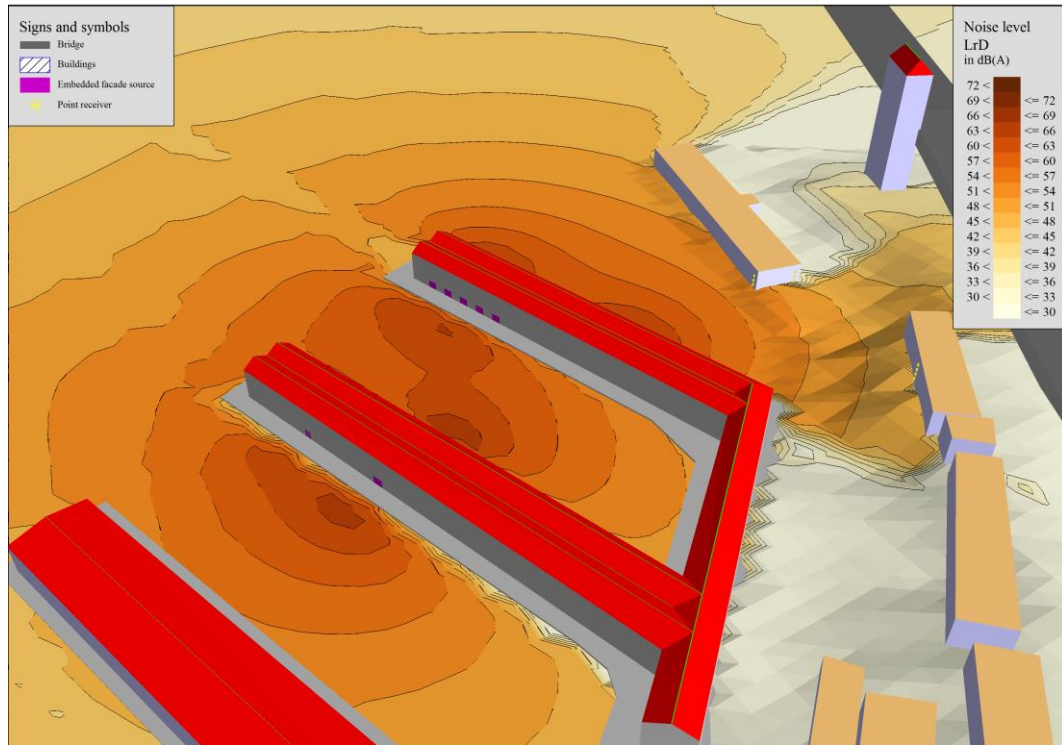


Figure 7: Noise Level Predictions from Internal Events (L_{Aeq}) showing local receivers

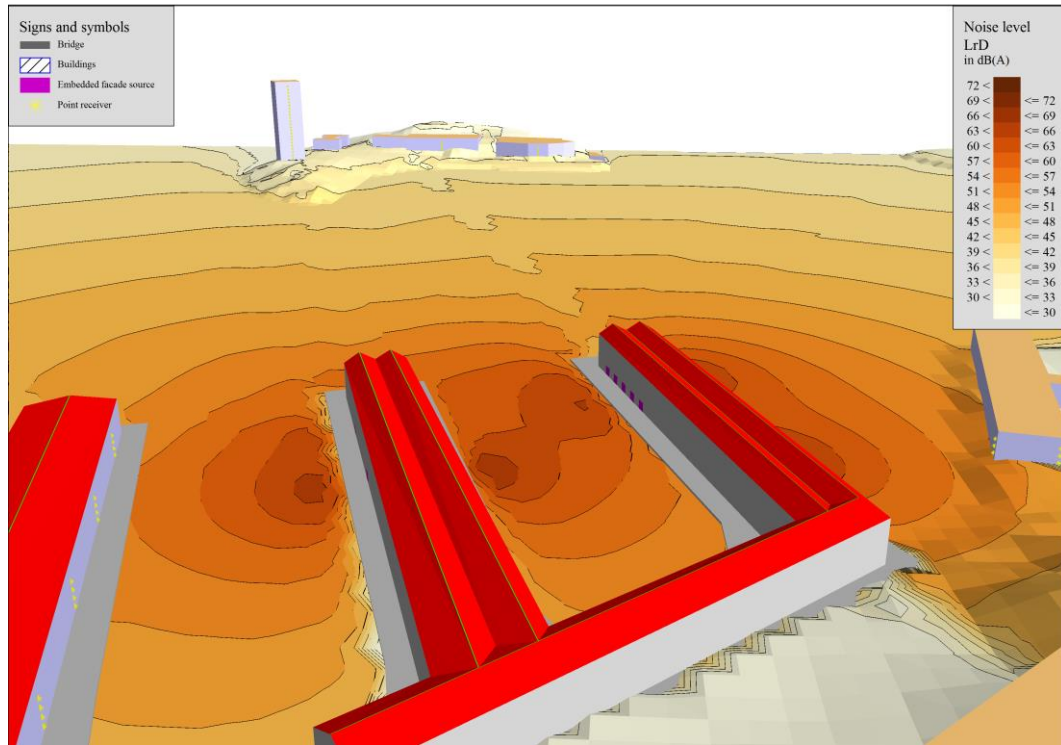


Figure 8: Noise Level Predictions from Internal Events (L_{Aeq}) showing northern receivers

The calculations show that noise levels are compliant with the proposed criteria during the daytime but with the possibility of a nominal 2 dB exceedance of the evening time noise criteria, based on the worst case assumptions noted above.

The worst affected residential units are in Pier 6/7 (location R1) and it is possible for the evening time noise criteria to be exceeded from loud events in Pier 4/5 and for the Pier 1 hotel (location R3) to be possibly affected by noise in Pier 2/3. Some control on noise levels within the spaces is therefore necessary.

Noise at the northern receivers from events within the units is not expected to exceed the proposed evening time criteria. The results are summarised below in Table 9.

The results are broadly consistent with the findings of the previous EIA study.

Table 9: Results of noise breakout calculations (refer to Figure 3 for details of the receivers)

| Location | Predicted Noise Level $dBL_{Aeq,15min}$ | Target (evening time period) $dBL_{Aeq,15min}$ | Assessment |
|----------|--|---|---|
| R1 | 54 | 52 | Slight exceedance with worst case assumptions |
| R2 | 48 | 52 | Acceptable with worst case assumptions |
| R3 | 53 | 52 | Acceptable with worst case assumptions |
| R4 | 37 | 47 | Acceptable with worst case assumptions |
| R5 | 37 | 47 | Acceptable with worst case assumptions |

6.6.5 Recommendations

Significant exceedances may occur during the night time period when the limits are more onerous than evening time, so it is recommended that the doors be closed after 2200 h for venues in use with significant noise generation. Closing the doors would be expected to reduce noise levels by around 10 dB and lead to compliance with the night time noise limits. The heritage nature of the doors means that it would not be practicable to seal the doors to obtain very high levels of sound insulation.

Noise in the Event Space will need to be controlled to avoid excessive noise disturbing the ACO venue which is directly over this space. It is likely that this constraint will be such that noise from the Event Space is unlikely to impact on the nearest residential units. Controls will be imposed on the hirers of the event space limiting the noise that they can produce. Noise monitoring devices, similar to those used by SDC will be installed if necessary.

SDC will also need to control noise from music in Studio 5 in Pier 4/5 after 2200 h, particularly if the doors are open through to the Production Workshop. It is understood that SDC have a rigorous noise management plan (including the use of noise limiting devices on the sound system). It is reasonable to assume that noise levels from SDC can be effectively managed, particularly given that the new Studio 5 is towards the centre of the building (i.e. away from the residential units).

6.7 Other noise issues

6.7.1 Loading and Unloading

The noise from unloading activities has been estimated from Arup data of noise from unloading and waste removal activity. The data is shown in Table 10.

Table 10: Data used for assessment of delivery noise

| Noise Source | Noise level measured at 10 m, L_{Aeq} dB(A) |
|---|---|
| Heavy Rigid Vehicle (HRV), 14.5 Tonne (TARE) waste removal truck driving forward at low speed | 64 |
| Heavy Rigid Vehicle (HRV), 14.5 Tonne (TARE) waste removal truck reversing at low speed with reversing beepers active | 67 |
| Heavy Rigid Vehicle (HRV), 14.5 Tonne (TARE) waste removal truck lifting and compacting operations | 67 |
| 8 Tonne (TARE) Truck (low speed) | 63 |
| 1 – 5 Tonne (TARE) Truck (low speed) | 57 |
| Loading dock activities – Use of pallet jack | 69 |

Calculations using these data show that noise from loading/unloading can be kept to within acceptable noise levels (as defined in the INP) to allow for daytime and evening loading and unloading activities (0700 h to 2200 h).

6.7.2 Set-building work

The Bell Shakespeare tenancy will include some set building facilities. Noise from this activity has been measured by Arup in a theatre set workshop. The measurements covered all the major noise-generating power tools although these items would not be expected to operate continually or concurrently.

A summary of the noise measurements is provided in Table 6 below.

Table 11: Summary of set workshop building activity noise levels

| Activity | Octave Band Centre Frequency, Hz | | | | | | | | | |
|-------------------------------------|----------------------------------|-----|-----|-----|-----|----|----|----|----|----|
| | dB(A) | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k | |
| Unknown saw type (dremel-like) @ 2m | L_{max} | 96 | 66 | 72 | 83 | 94 | 91 | 89 | 86 | 77 |
| Unknown saw type (dremel-like) @2m | L_{10} | 91 | 60 | 63 | 80 | 88 | 83 | 85 | 83 | 75 |
| Carba-Tec Thicknesser | L_{max} | 104 | 74 | 78 | 85 | 90 | 97 | 99 | 99 | 87 |
| Carba-Tec Thicknesser | L_{10} | 100 | 70 | 74 | 82 | 87 | 87 | 92 | 97 | 83 |
| Band saw @ 2m (sawing timber) | L_{max} | 101 | 77 | 80 | 86 | 90 | 91 | 92 | 95 | 96 |
| Band saw @ 2m (sawing timber) | L_{10} | 97 | 66 | 61 | 63 | 74 | 81 | 88 | 93 | 93 |
| Table saw @ 2m | L_{max} | 95 | 78 | 81 | 85 | 89 | 92 | 87 | 84 | 77 |

| Activity | Octave Band Centre Frequency, Hz | | | | | | | | | |
|----------------------------------|----------------------------------|-------|----|-----|-----|-----|----|----|-----|-----|
| | | dB(A) | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k |
| Table saw @ 2m | L ₁₀ | 89 | 75 | 77 | 76 | 82 | 84 | 83 | 80 | 76 |
| Table saw @ 2m | L _{max} | 91 | 74 | 77 | 70 | 77 | 82 | 86 | 84 | 81 |
| Table saw @ 2m | L ₁₀ | 88 | 73 | 76 | 67 | 72 | 79 | 82 | 83 | 80 |
| Nail gun @ 2m | L _{max} | 92 | 75 | 81 | 85 | 86 | 86 | 86 | 84 | 84 |
| Nail gun @ 2m | L ₁₀ | 84 | 72 | 76 | 77 | 78 | 77 | 78 | 77 | 76 |
| Angle grinder @ 2m | L _{max} | 91 | 70 | 72 | 70 | 76 | 80 | 84 | 87 | 86 |
| Angle grinder @ 2m | L ₁₀ | 86 | 67 | 68 | 66 | 71 | 77 | 80 | 81 | 80 |
| Band saw @ 2m (sawing aluminium) | L _{max} | 109 | 77 | 77 | 81 | 86 | 86 | 97 | 103 | 108 |
| Band saw @ 2m (sawing aluminium) | L ₁₀ | 100 | 66 | 68 | 75 | 83 | 84 | 91 | 96 | 95 |

The noise levels measured in Table 11 will assist in the building façade and internal wall/floor partition design to ensure noise break-out is controlled to meet noise limits at the nearest sensitive receiver locations. As there are regular set-building activities currently undertaken at the precinct, without noise issues, it is reasonable to assume that this can continue.

6.8 Operational Vibration Impacts

The intended use of the precinct is not expected to result in any significant vibration. All plant will need to be carefully vibration isolated to control structure-borne noise. The overall sensitivity of the development itself to noise and vibration (because of the arts uses) will mean that there will be tight control of any future vibration generating activities.

6.9 Operational Traffic Noise

The project is not expected to generate significant additional traffic to and from the venue. Traffic noise impacts are therefore expected to be minimal.

7 Conclusion

This report has addressed the SSD 16_7689 SEARs Key Issues relating to noise and vibration from construction and day to day operation. Noise from outdoor events are assessed in a separate document.

Reference has been made to relevant NSW and Australian guidance as well as international experience in arts facility design from within Arup.

Noise from construction is not expected to be a significant issue for the nearby residential and commercial properties. A majority of the construction work will take place internally and the Contractor will be required to manage noise. No percussive piling is proposed.

The analysis has shown that there is a possibility of excessive noise from the naturally ventilated performance and event venues when windows / shutters are open. These ventilation openings should be kept shut after 2200h for venues in use with significant noise generation to control this. The levels of noise in the large Function Space will need to be controlled to protect the nearby performance venues (particularly the ACO) and noise from the SDC Studio 5 facilities will also need to be controlled.

The development will be provided with seawater cooling which avoids the need for cooling towers or condenser plant. Space is being allowed for noise control to the internal plant to ensure that any noise radiation to the atmosphere from the plant does not exceed the criteria.

A combined noise model is being used to assess the cumulative total noise from the project, including the noise from the STC works. At this stage of the project, allowances are being made for the cumulative noise by including an overall 5 dB safety factor for each element. As more detail becomes available, the model will be updated to show the detailed requirements for noise control based on specific octave band noise data.

On the basis of the noise and vibration measurements made on site and the information currently available for the development, Arup see no impediment to approval.

Appendix A

Noise Survey Results - WSP

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.

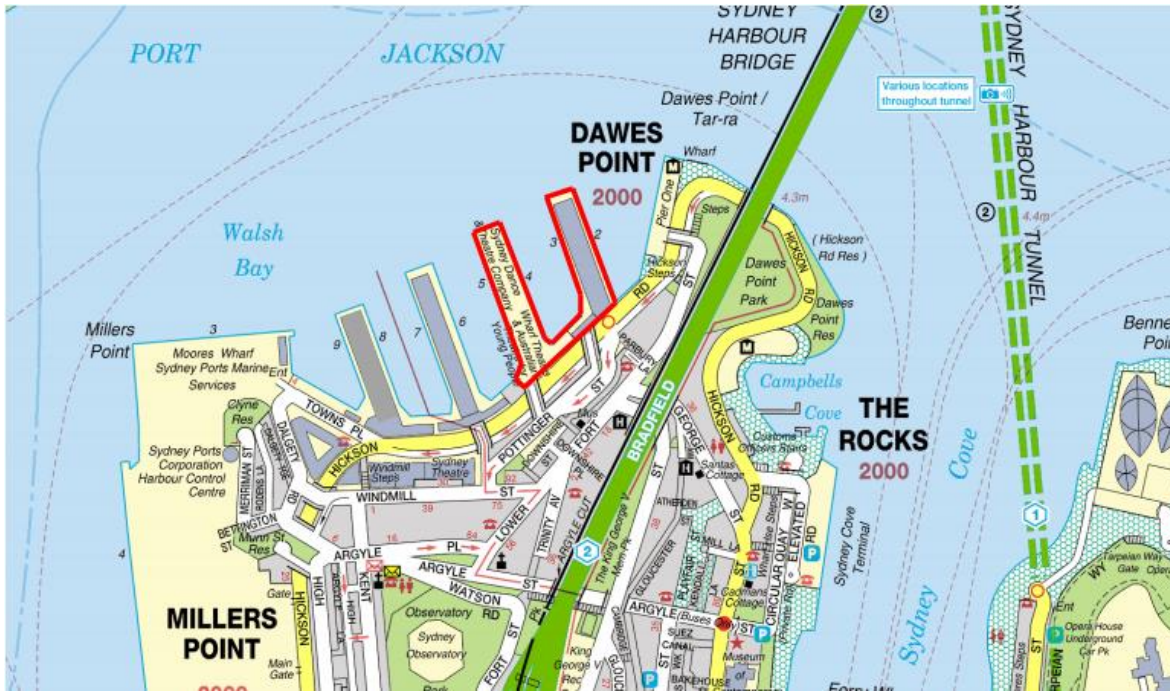


Figure 1 - Site Location (Source: UBD Digital Edition 2004)



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

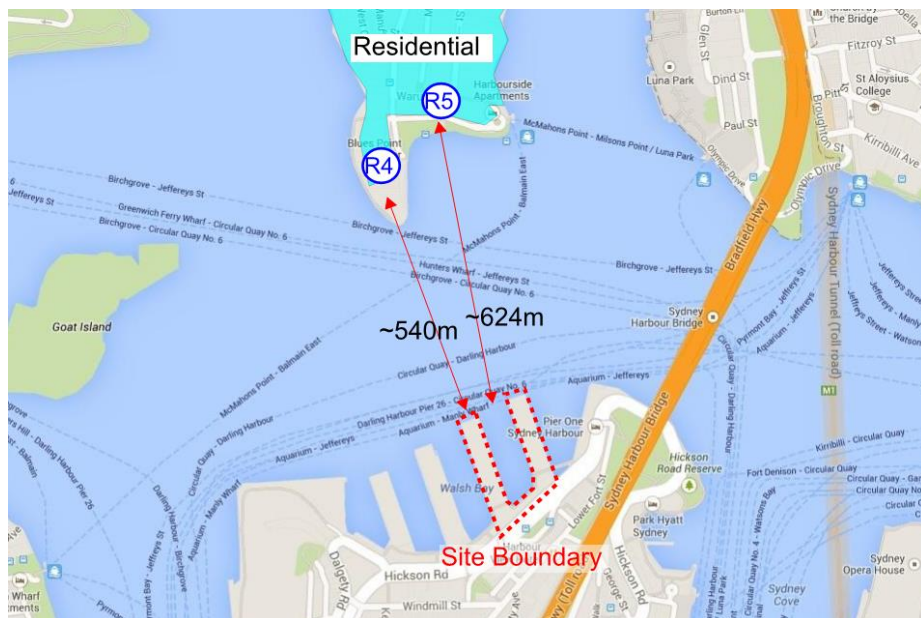


Figure 4 – Surrounding Noise Sensitive Receptors Mc Mahons Point. Background image courtesy of Google Maps 2014

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.

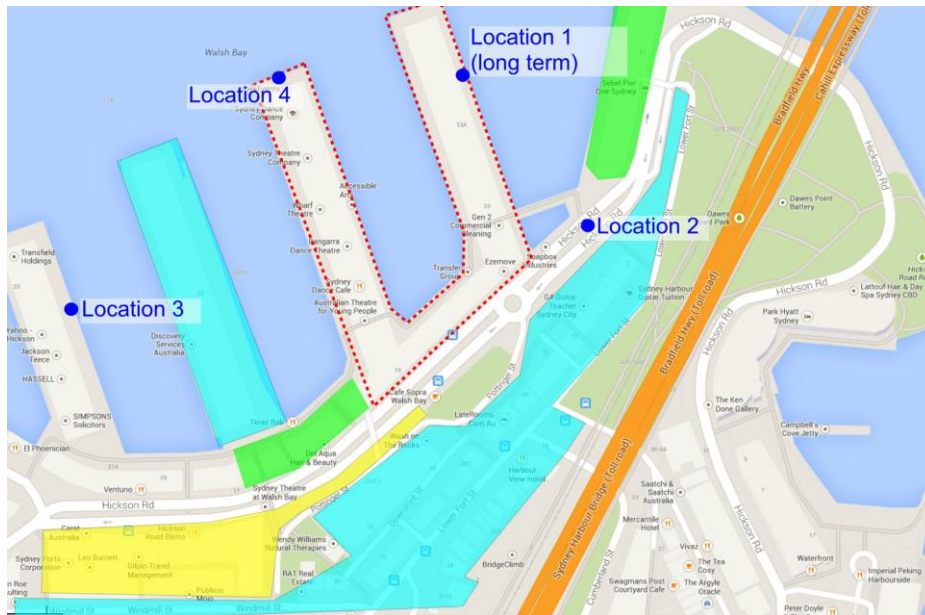


Figure 5 - Noise measurement locations. Background image courtesy of Google Maps 2014

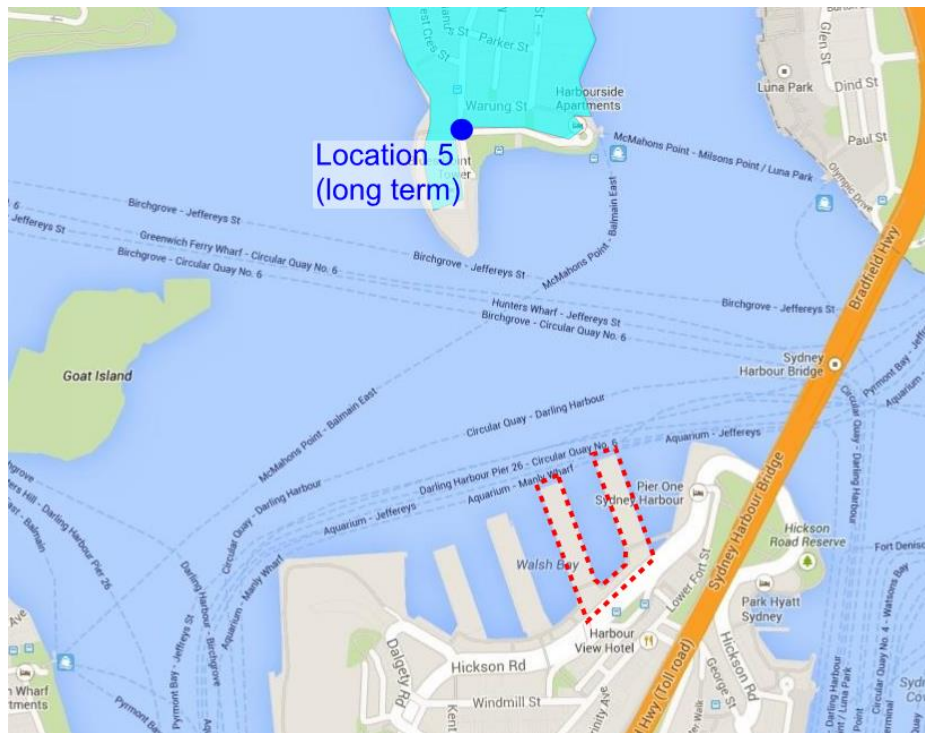


Figure 6 - Noise measurement locations McMahon's Point. Background image courtesy of Google Maps 2014

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 |

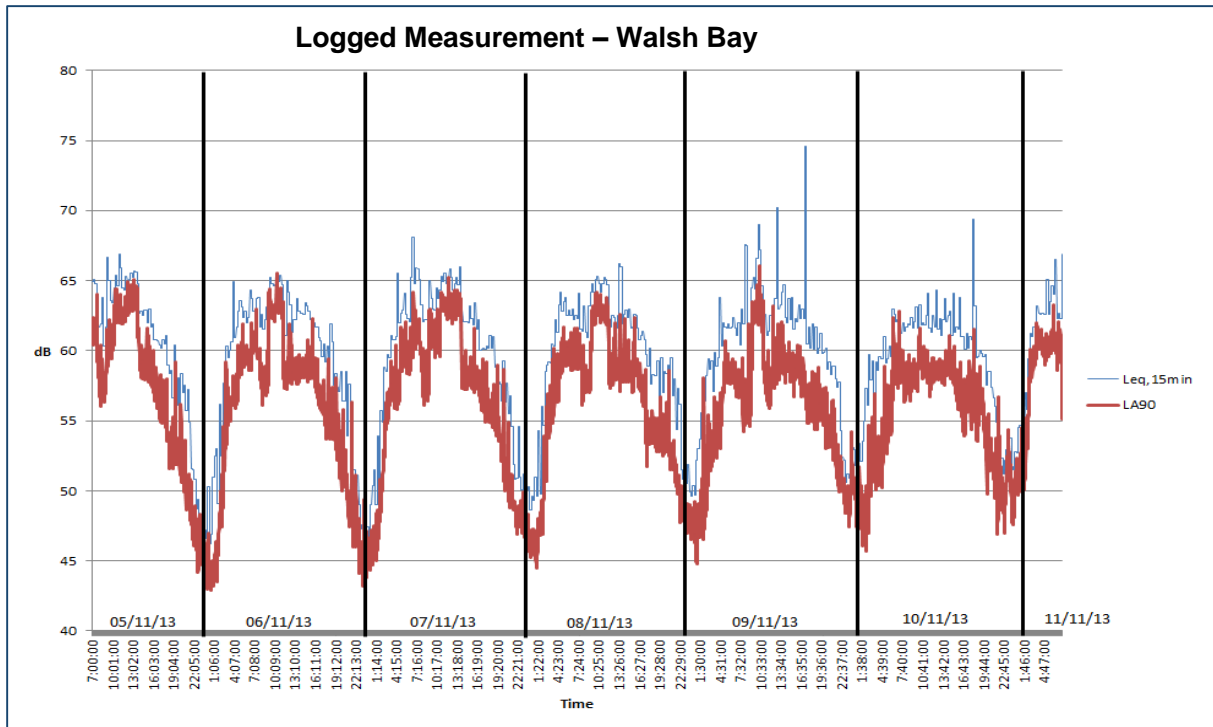


Figure 7 - Noise logging results (Location 1)

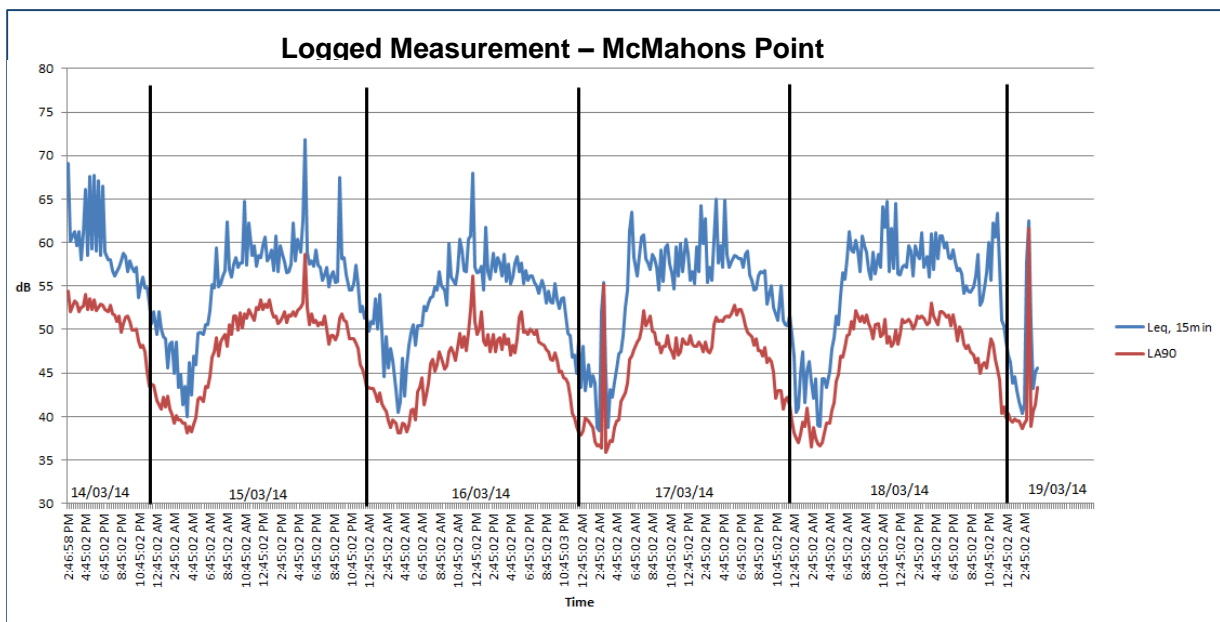


Figure 8 - Noise Logging Results (Location 5)

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.

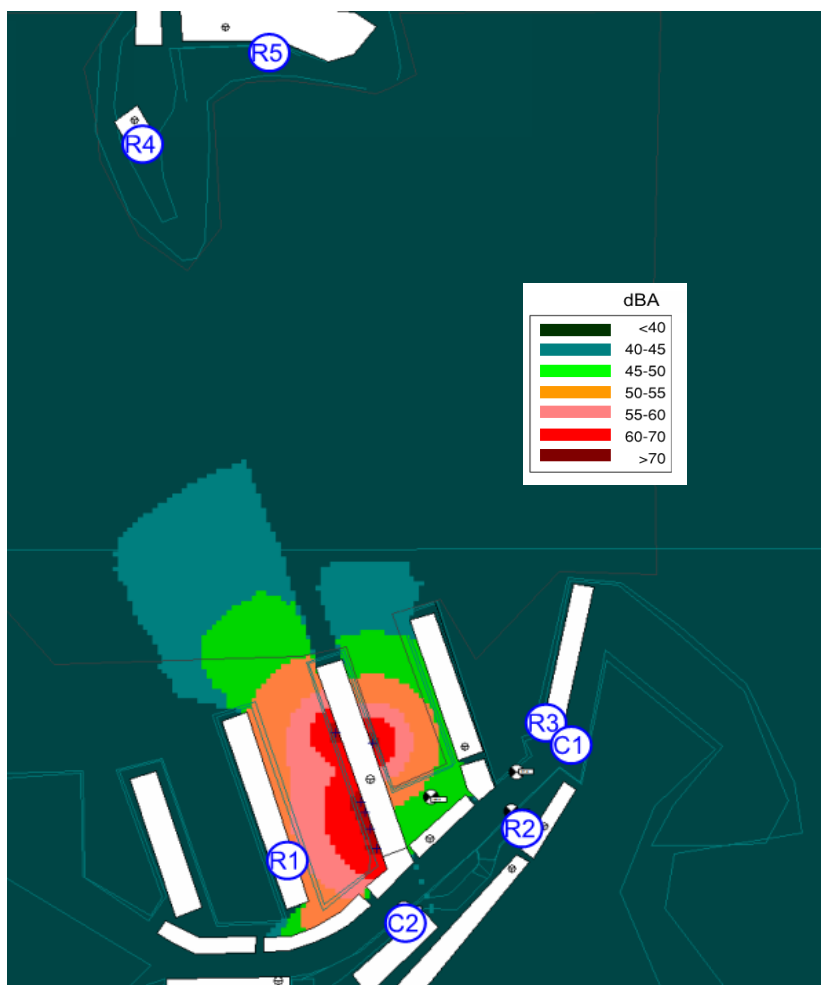


Figure 9 - Existing activity noise levels generated in Pier 2/3 on surrounding receptors

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