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NSW | **Sydney Harbour
Foreshore Authority**

STATE SIGNIFICANT DEVELOPMENT SSD6611
ENVIRONMENTAL IMPACT STATEMENT

COCKLE BAY MARINE STRUCTURES RENEWAL

May 2015

STATEMENT OF VALIDITY

Environmental Impact Statement prepared by:

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Project Cockle Bay Marine Structures Redevelopment

Applicant & Land Details

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Applicant address Level 6, 66 Harrington Street, The Rocks NSW 2000
Lot No, DP Refer site description in Section 2.3 of the EIS

Environmental Impact Statement

An Environmental Impact Statement (EIS) is attached.

Statement of Validity

I certify that I have prepared the contents of the Environmental Impact Statement and to the best of my knowledge:

- It is in accordance with Part 4 of the *Environmental Planning and Assessment Act 1979* and Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*
- The information contained in the Environmental Impact Statement is neither false nor misleading.

Signature



Name Sarah McNeilly
Date 26 May 2015

Reviewed by

Signature



Name Ruth Frettingham
Date 26 May 2015

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Abbreviations

ANMM	Australian National Maritime Museum
EIS	Environmental Impact Statements
ICC Sydney	International Convention Centre Sydney
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy

Executive Summary

This Environmental Impact Statement (EIS) is submitted to the Minister for Planning and Environment in support of a State Significant Development Application for the renewal of marine structures at Cockle Bay, Darling Harbour. The proposed development is submitted pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 and Schedule 2 of State Environmental Planning Policy (State and Regional Development) 2011.

The owner and applicant is Sydney Harbour Foreshore Association (the Authority). The Authority is a crown applicant.

Context

Cockle Bay is central to the function and appeal of Darling Harbour and supports the future success of the new International Convention Centre (ICC Sydney), due to open in late 2016. Darling Harbour is one of the most popular visitor destinations in Sydney, attracting over 26 million people a year. It is a place of gathering and celebration. The proposed renewal of marine structures within Cockle Bay aims to retain the international standard of this precinct, improve public access and safety and deliver improved event and recreational opportunities.

The Authority is committed to creating extraordinary places the world talks about and the new facilities at Cockle Bay will be unique within Sydney Harbour. A number of alternatives were considered including doing nothing and undertaking a basic safety upgrade. These alternatives come with high maintenance costs or upgrade costs and will not resolve underlying conflicts between users of the bay. The proposed renewal represents a total reconfiguration of existing facilities to better meet user requirements and contribute to Sydney's premier place of celebration.

Consultation

The Authority has undertaken extensive consultation in developing the proposal in accordance with the NSW Government's Major Project Consultation Guidelines 2005 and all planned pre-DA consultation is complete. The consultation process was commenced at the earliest point in the process and has informed the design. The proposal as documented appropriately responds to all stakeholder input and feedback, with only minor exception.

The Proposed Development (the proposal)

The proposal is permissible within the bay under the provisions of Darling Harbour Development Plan No.1.

The proposal seeks demolition of existing marine structures in Cockle Bay and their replacement with new floating facilities; one on each side of the Bay. Both facilities will be accessible to all people at all tides. Each contains a drop-off and pick-up zone which complies with the safety requirements of a public wharf.

The proposal will enhance functionality of the bay for public events, replace existing maritime structures which are at the end of their useful life and create a contemporary forecourt to ICC Sydney. The renewed public facilities will reaffirm Cockle Bay as a place for people.

The western scheme will replace a clutter of ageing structures and replace them with a single streamlined facility comprising a floating public wharf and associated access systems. It will provide access for charter and tourism vessels, private water transport vessels and water taxis to pick up and drop off passengers. The facility will enhance the area for public entertainment and events in and around ICC Sydney and Darling Harbour.

The eastern scheme replaces the existing marina with a smaller recreational boating facility which will provide short stay visiting opportunities for up to 40 recreational vessels between 10 and 15 metres in length. Up to six of the berths may be used for permanent storage of event service vessels or charter vessels. The facility will also include a water taxi rank, an events staging area and storage for event barges. This facility will enliven and activate the waterway ensuring a vibrant bay that can be enjoyed by 97 per cent of recreational boat owners.

The proposal provides for shared use of Cockle Bay, safe navigation, access for people with a disability, retention of major view corridors and visual de-cluttering. The proposal will reduce the amount of water occupied by structures by 17 per cent.

Impact Assessment

Non-construction Impacts

The environmental impacts of the proposal have been assessed considering all matters raised in the SEARs. The assessment found the proposal would result in an improvement on current conditions in relation to:

- Social impacts, including community facilities and services, employment opportunities, transport infrastructure, public safety and accessibility
- Navigation Safety
- Public Access
- Transport and accessibility
- Visual amenity
- Event management and recreational capacity

No adverse impact was identified in relation to sustainability and operational impacts, including sea level rise, infrastructure servicing and waste management.

The proposal has no direct or indirect heritage impacts on Pymont Bridge, the Darling Harbour Woodward Water Feature or the South Steyne. There is an acceptable impact on possible archaeological remains associated with former wharves and works will be done with an Exception under Section 139(4) of the Heritage Impact Act 1977.

Construction Impacts

Construction will be staged with consideration to the precinct's busy events programme and is expected to take place during February-May 2016 and August-December 2016.

Even though construction is planned concurrent with other major developments in the precinct, the proposal is not expected to result in cumulative construction impacts.

The impact of construction on the events programme is expected to be minimal. Vehicular, pedestrian and maritime access impacts during construction are also expected to be minimal.

Construction will not generate any material vibration impacts on identified receivers.

Despite the specification of screwed piles, there will be minor exceedances of the noise management level at some receivers during the works. However, these are considered acceptable in light of the surrounding uses. The proposal has identified appropriate noise mitigation measures and will implement best practice management strategies during construction.

Minor air quality impacts are anticipated; appropriate mitigation measures and best practice management strategies will be implemented during construction.

Water quality and sediment and flora and fauna impacts have been assessed variously as minor, negligible and ALARP (as low as reasonably possible). All recommendations in the impact assessments will be incorporated in construction of the proposal.

Cockle Bay Marine Structures Renewal Environmental Impact Statement

1 Introduction

This Environmental Impact Statement (EIS) is submitted to the Department of Planning and Environment as a State Significant Development for the renewal of the marine structures for public transport and recreation purposes within Cockle Bay, Darling Harbour. The proposal will ensure the longevity, usability and public safety of these public facilities while contributing to a high quality urban environment and reducing occupation of the waterway.

The EIS has been prepared by Sydney Harbour Foreshore Authority (the Authority) and Environet Consultancy Pty Ltd.

The EIS describes the proposal, the subject site and its locality, and addresses relevant considerations and impacts associated with the proposal.

1.1 Value and Permissibility of Development

The value of the proposal is in the order of \$20 million. The Minister for Planning is the relevant consent authority with reference to SEPP (State and regional development) 2011 as the development is located within Darling Harbour and exceeds \$10 million.

The proposal is permissible with consent with reference to the Darling Harbour Development Control Plan No 1 under which development for the purposes of transport facilities and recreation are permitted.



Figure 1: Aerial Photo showing Location of Cockle Bay relative to Sydney's CBD

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1.2 Secretary's Environmental Assessment Requirements

The Department of Planning and Environment provided the Secretary's Environmental Assessment Requirements (SEARs) for the proposal to the Authority on 13 August 2014. A copy of the SEARs is included in Appendix 1. Matters raised in the SEARs are addressed in the sections and appendices of the EIS as referenced in Tables 1 and 2 below.

Table 1: Location of Responses to SEARs in EIS

Issue identified in SEARs	EIS Section Reference	Appendix Reference
1.Environmental Planning Instruments, Policies and Guidelines	6 Consideration of Policies and Plans	N/A
2. Design and Justification		N/A
a) Details on the proposed design of all structures including construction plans and drawings and methods of construction;	a) Appendix 3 Drawings and 4.4 Design Requirements	
b) The adequacy of marina design in accordance with the relevant Australian Standards	b) 4.8 Footprint	
c) Design quality with specific consideration to the foot print proposed materials and colours, waterfront interface, setbacks and visual impacts of all proposed structures and berthed vessels.	c) 4.12 Form & Materiality and 8.5 Visual Impacts	
d) Justification for development as a whole, in particular the number of berths and the size of occupation of the waterway; and	d) 4.2 Imperatives for Renewal and 4.11 Capacity & Sizing Considerations	
e) An assessment of the need for on-water boat storage (including boat length, height and type) in the locality and region, including justification or any proposed changes to existing berthing facilities	e) 5.8.2 Permanent Berthing/Boat Storage in Cockle Bay	
3. Public Access		N/A
a) Consideration of existing and future opportunities/benefits for public access to and along the foreshore and waterfront including pedestrian linkage improvements;	a) 8.4.2 Existing & Future Public Access Impact Assessment	
b) Identification of proposed open space, public domain and linkages with and between other public domain spaces, including the waterfront;	b) 8.4.3 Proposed Open Space and Linkages Impact Assessment	
c) Details on the interface between the proposed uses, public domain	c) 7.4.4 Proposed Uses/Existing Public Domain Interface Impact Assessment	
4. Navigation and Safety		Appendix 7
a) A review of existing boating activities in the area and an assessment of the impact of the development on water based traffic, waterway access (including equity), waterway sharing and existing users of Cockle Bay and Darling Harbour in the vicinity of the marina;	a) 8.12.2 Review of Existing Boating Activities & Impact of Proposal	
b) Consideration of the potential impacts of increased vessel movements likely to be generated by the proposal (if any) on the existing users of Cockle Bay and Darling Harbour and ferry operations at the King Street, Sydney Aquarium and Pyrmont Bay Wharves; and	b) 8.12.3 Assessment of Vessel Movements during Operational Phase	
c) Consideration of measures to ensure the safety of any recreational users of Cockle Bay and Darling Harbour.	c) 8.12.4 Consideration of Measures to Ensure Public Safety of Recreational Users	
5. Visual Impacts		N/A
Including an assessment of the visual impact of the proposal, particularly on:		
a) Land uses along the foreshore areas of Cockle Bay and Darling Harbour;	a) 8.5.2 Visual Impact on Land Uses Along the Foreshore	
b) Water uses of Cockle Bay and Darling Harbour	b) 8.5.3 Visual Impact on Water Uses of Cockle Bay & Darling Harbour	
c) Private properties and significant vantage points in the public domain; and	c) 8.5.4 Visual Impact on Private Properties and Significant Vantage Points	
d) The scenic quality of Cockle Bay	d) 8.5.5 Visual Impact on the Scenic Quality of Cockle Bay	

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<p>6. Heritage</p> <p>a) The EIS is to include a Heritage Impact Statement (HIS) which must assess the likely impacts of the proposal on the significance of heritage items in the vicinity of the site including the Pymont Bridge, Woodward Water Feature and the former Sydney ferry and floating restaurant SS South Steyne;</p> <p>b) The HIS is also to include an assessment of any potential marine archaeological items or relics (both above and below water and under historical relation areas) that may be impacted by the proposal including strategies and procedures to be followed in the case of an unexpected discovery of items or relics of significance to indigenous and non-indigenous community.</p>	<p>a) 8.11.4 Assessment of Impact on Pymont Bridge and 8.11.5 Assessment of Impact on Darling Harbour Woodward Water Feature and 8.11.6 Assessment of Impact Associated with the Removal of Harbourside Jetty</p> <p>b) 8.11.3 Assessment of Impact on Maritime Archaeological Remains</p>	<p>Appendix 6</p>
<p>7. Transport and Accessibility Impacts</p> <p>a) Demonstrate the provision of sufficient car parking in accordance with the relevant Australian Standards (AS 3962-2001) and secure bicycle storage and amenities for the amended proposal having regard to accessibility of the site to public transport, local planning controls and Roads and Maritime Services (RMS) guidelines; and</p> <p>b) A Traffic Impact Assessment (TIA) is to be prepared in accordance with the RMS Guide to Traffic Generating Developments, considering traffic generation, any required road/ intersection upgrades, access measures to promote public transport usage and pedestrian and bicycle linkages resulting from the development. The TIA is to assess the cumulative impact of the proposal associated with other construction and operational activities on the site and the surrounding area.</p>	<p>a) 8.13 Transport, Traffic and Parking Impacts</p> <p>b) 8.13 Transport, Traffic and Parking Impacts</p>	<p>Appendix 8</p>
<p>8. Flora and Fauna</p> <p>a) Assessment of potential impacts on any flora and fauna, including threatened species, populations or communities (e.g. Psodonia seagrass) or their habitats); and</p> <p>b) Recommendation of appropriate mitigation measures during construction and operation, including potential impacts of shading form fixed facilities and berthed vessels.</p>	<p>a) 8.15.4 Construction Effects Assessment & 8.15.5 Operational Phase Considerations</p> <p>b) 8.15.6 Conclusion and Proposed Additional Mitigation Measures</p>	<p>Appendix 10</p>
<p>9. Water Quality and Contamination</p> <p>a) Undertake an assessment of the potential impacts on water quality of Cockle Bay and Darling Harbour. Relevant consideration should be given to the National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ), the ANZECC Guideline and Water Quality Objectives in NSW (OEH) and Approved Methods for Sampling and Analysis of Water Pollutants in NSW (OEH);</p> <p>b) Assess the impacts of the proposal on surface and groundwater quality and hydrology.</p> <p>c) The assessment must include details of proposed erosion and sediment controls (during construction), the proposed stormwater management system (during operations) and management and mitigation measures for the containment of pollutants (e.g. fuel and sewage) and prevention of potential water quality impacts during operation;</p> <p>d) Assess the potential for the development to intercept groundwater, including predicted groundwater dewatering volumes and disposal methods;</p> <p>e) Assess the potential impact of the development on the groundwater flow paths and discharge flows;</p>	<p>a) 8.14.4 Construction Effects Assessment</p> <p>b) 8.14.4.1 Screening & Scoping Results</p> <p>c) 8.14.4 Construction Effects Assessment & 8.14.8 Operational Phase Impacts</p> <p>d) 8.14.4.1 Screening & Scoping Results</p> <p>e) 8.14.4.1 Screening & Scoping Results</p>	<p>Appendix 9</p>

Cockle Bay Marine Structures Renewal Environmental Impact Statement

<p>f) Identification of any water licensing requirements or other approvals required under the Water Act 1912 or Water Management Act 2000;</p> <p>g) Assess the geotechnical and contamination issues (including Acid Sulphate soils) associated with the construction of the development including the contamination status of the sediments to be disturbed, the impacts associated with disturbance of sediment, and the management and mitigation measures to be employed during marine works; and</p> <p>h) Include a suitable water quality monitoring system</p>	<p>f) 8.14.5 Water Licensing Requirements & Other Approvals</p> <p>g) 8.14.6 Geotechnical Considerations and Acid Sulphate Soils & 8.10.3 Waste Management & 8.16.6 Air Quality</p> <p>h) 8.14.7 Water Quality Monitoring Program</p>	
<p>10. Air Quality and Odour</p> <p>a) An Air Quality Impact Assessment including odour during construction and operation prepared in accordance with relevant Environment Protection Authority guidelines shall be submitted. This assessment must consider any potential impacts on nearby private receptors.</p>	<p>a) 8.16 Air Quality & Odour Impacts, including all subsections</p>	Appendix 11
<p>11. Noise and Vibration</p> <p>a) A Noise and Vibration Assessment during construction, operation and traffic prepared in accordance with relevant Environment Protection Authority guidelines shall be submitted. This assessment must consider any potential impacts on nearby private receptors.</p>	<p>a) 8.17 Noise & Vibration Impacts, including all subsections</p>	Appendix 12
<p>12. Waste Management</p> <p>a) Identify all potential sources of liquid waste and non-liquid wastes as defined in the EPA's Waste Classification Guidelines 2008. The EIS should identify any waste that will be stored, separated or processed on the site and identify the procedures to be adopted to minimise, manage, dispose of this waste in accordance with the relevant standards and guidelines.</p>	<p>a) 8.10 Waste Management Impacts, including all subsections</p>	N/A
<p>13. Sea Level Rise</p> <p>a) The EIS must assess the risk associated with sea level rise on the proposal.</p>	<p>a) 8.8 Sea Level Rise Impacts</p>	N/A
<p>14. Infrastructure Servicing</p> <p>a) Detail the existing infrastructure on site and identify possible impacts on any such infrastructure from the proposal;</p> <p>b) Detail measures to mitigate the impacts on any infrastructure items, including proposed relocation; and</p> <p>c) Detail of water supply, consideration of water sensitive urban design and water conservation measures</p>	<p>a) 8.9 Infrastructure Servicing</p> <p>b) 8.9 Infrastructure Servicing</p> <p>c) 8.9 Infrastructure Servicing</p>	N/A
<p>15. Social Impacts</p> <p>a) Consideration of social impacts including but not limited to potential impacts on existing community facilities and services, employment opportunities, transport infrastructure and public safety.</p>	<p>a) 8.3 Social Impacts, including all subsections</p>	N/A
<p>16. Construction Impacts</p> <p>a) Identify measures to ameliorate construction impacts including to vehicular, pedestrian and maritime access, noise and vibration, air quality, erosion and sediment control, water quality and waste management</p>	<p>a) 8.1 Construction Impacts, including Table 8: Construction Impact Section References</p>	Appendices 8-12
<p>17. Event Management</p> <p>a) As assessment of event management and recreational capacity, including passive and active recreational opportunities; and</p> <p>b) If events are proposed within the public domain, an event plan of management must be provided. This plan will also inform traffic and maritime management</p>	<p>a) 8.6.2 Existing Situation and Capacity & 8.6.3 Proposed Events and Recreational Capacity & 8.6.4 Construction Impacts on Events</p> <p>b) 8.6.5 Event Plan of Management</p>	N/A

Cockle Bay Marine Structures Renewal Environmental Impact Statement

18. Staging		
a) Detail regarding the staging of the proposed development	a) 7 Construction Methodology and Staging	N/A
19. Ecologically Sustainable Development (ESD)		
a) Identify how the development will incorporate ESD principles in the design, construction and ongoing operation phases of the development	a) 8.7 Sustainability	N/A
20. Consultation		
a) Undertake an appropriate and justified level of consultation in accordance with Department's Major Project Community Consultation Guidelines October 2007.	a) 5 Consultation	N/A
21. Contributions		
a) The EIS shall address applicable developer contributions and/or details of any Voluntary Planning Agreement.	a) 6.2.7 Contributions	N/A
Drawings	N/A	Appendix 3
Site Survey	N/A	Appendix 2
Locality Plan	Figure 2	N/A

Table 2: Location of Responses to Matters Raised in Attachment 1 to SEARS

Government Authority	EIS Section Reference	EIS Appendix Reference
Port Authority of NSW	8.12 Navigation Safety 8.14 Water Quality & Contamination	Appendix 7 Appendix 9
Sydney Water	8.9 Infrastructure Servicing	N/A
Heritage Council	8.11 Heritage Impacts	Appendix 6
Transport for NSW	8.12 Navigation Safety 8.13 Transport, Traffic & Parking Impacts	Appendix 7 Appendix 8
City of Sydney	Issue (a) 8.5 Visual Impacts Issue (b) 8.5 Visual Impacts Issue (c) 8.2 Cumulative Impacts Issue (d) 8.2 Cumulative Impacts Issue (e): 4.11: Capacity and Sizing Considerations and 8.6 Event Management & Recreational Capacity	N/A N/A N/A N/A N/A
Department of Primary Industries	8.14 Water Quality & Contamination & 8.15 Flora and Fauna	Appendices 9 & 10

1.3 Structure of the EIS

The remainder of the EIS is structured as follows:

2. The Site and its Locality
3. Proposed Development
4. Design and Justification
5. Consultation
6. Consideration of Policies and Plans
7. Construction Methodology and Staging
8. Impact Assessment
9. Summary of Additional Environmental Mitigation Measures to be Implemented
10. Approvals Required
11. Conclusion and Justification of the Proposal

1.4 Contributions

The subject site is not within a development contributions area.

Cockle Bay Marine Structures Renewal Environmental Impact Statement

2 The Site and its Locality

2.1 Site Location

The subject site is known as Cockle Bay and is within the Darling Harbour precinct which is a focal entertainment, celebration, shopping and meeting place within central Sydney. The Pyrmont Bridge defines the northern boundary of Cockle Bay. Public promenades define its other boundaries. Cockle Bay and surrounding foreshore land is owned and managed by the Authority.

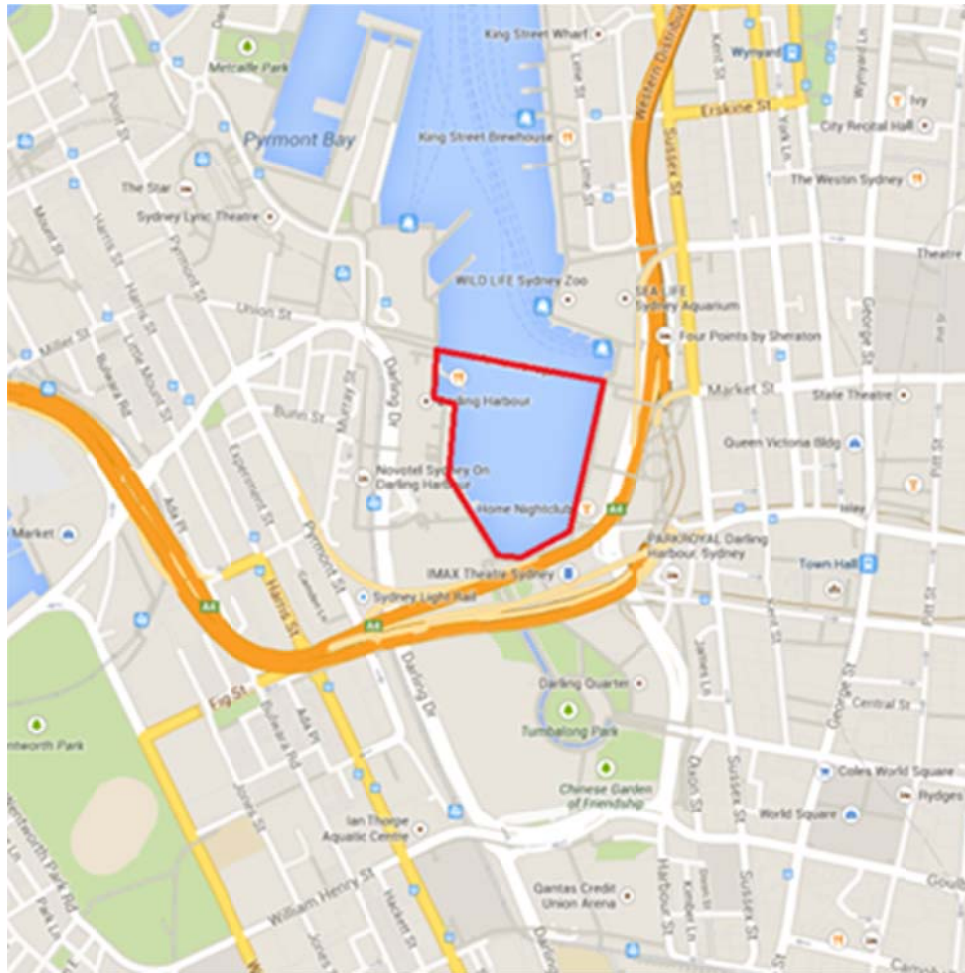


Figure 2: Locality Plan

Cockle Bay Marine Structures Renewal Environmental Impact Statement

2.2 Site Context

The Darling Harbour precinct, within which Cockle Bay sits, is located between Pyrmont and Sydney's central business district.

Immediately to the north of the Darling Harbour precinct is the Barangaroo urban renewal precinct. The Rocks and Circular Quay are to the north-east.

To the east is the CBD including Hyde Park and the Botanic Gardens.

To the west of the site is Pyrmont, Rozelle, Glebe, the Anzac Bridge and the Bays urban renewal precinct.



Figure 3: Context Plan

2.3 Site Description

The real property description of the subject site is Lot 1010 DP1147364 which includes the entire waterway of Cockle Bay as well as much of the foreshore of Darling Harbour surrounding it. The proposal has an interface to adjoining lots as shown in Figure 4.

Cockle Bay and Darling Harbour were redeveloped in the late 1980's and various minor additions and alterations have occurred in the intervening time. Darling Harbour is a major gathering place within Sydney for celebration and attracts 26.7 million visitors annually.

Cockle Bay has an area of approximately 6.4 hectares and a perimeter of just over 1 kilometre. The harbour depth varies from 2.5 metres to 8 metres.

Cockle Bay is a low speed environment with a 4 knot speed limit applying. The geographic location of Cockle Bay means there is no through traffic and vessels entering the Bay do so to use facilities within the Bay.

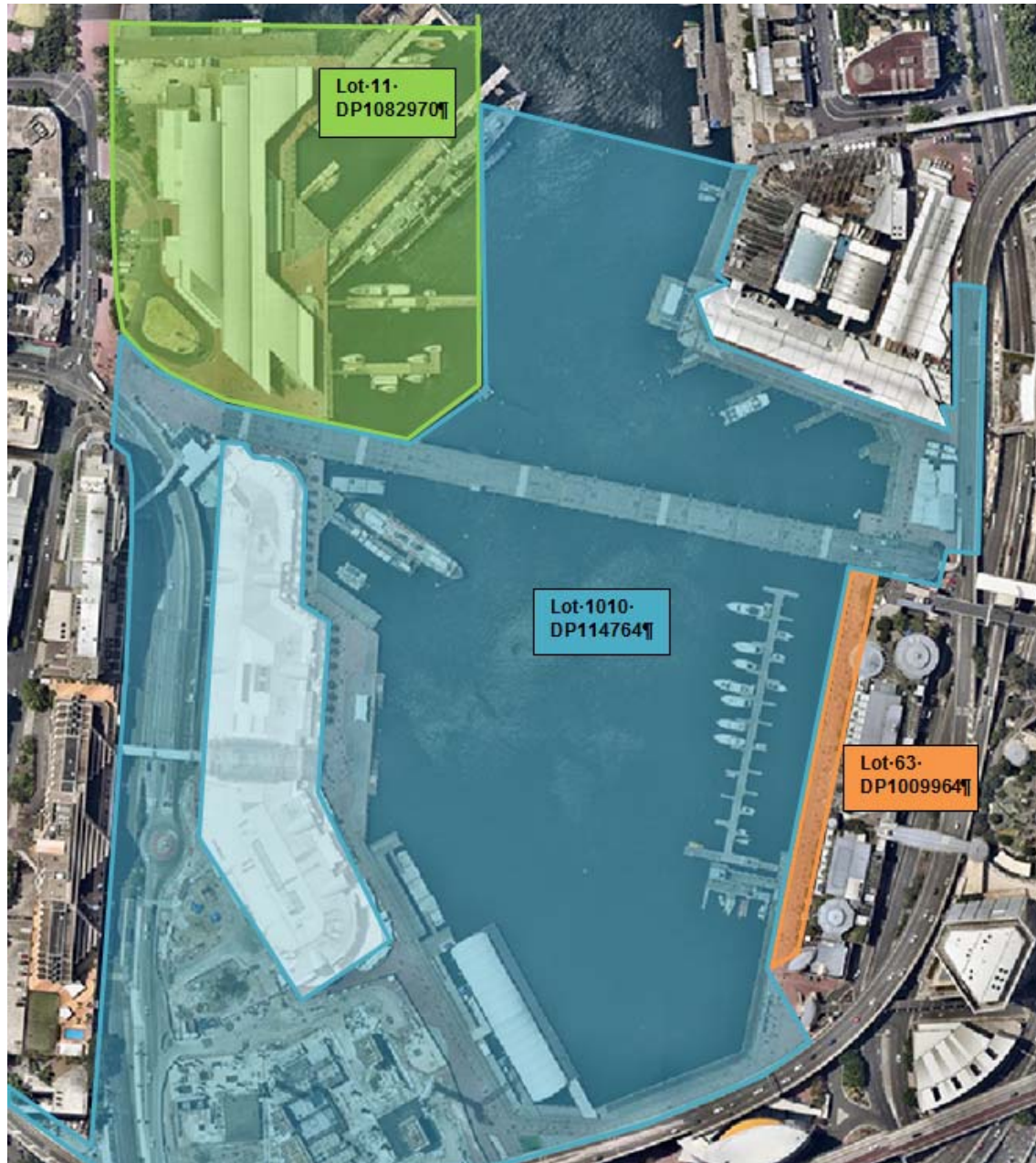


Figure 4: Lots and DP's Relevant to the Proposed Development

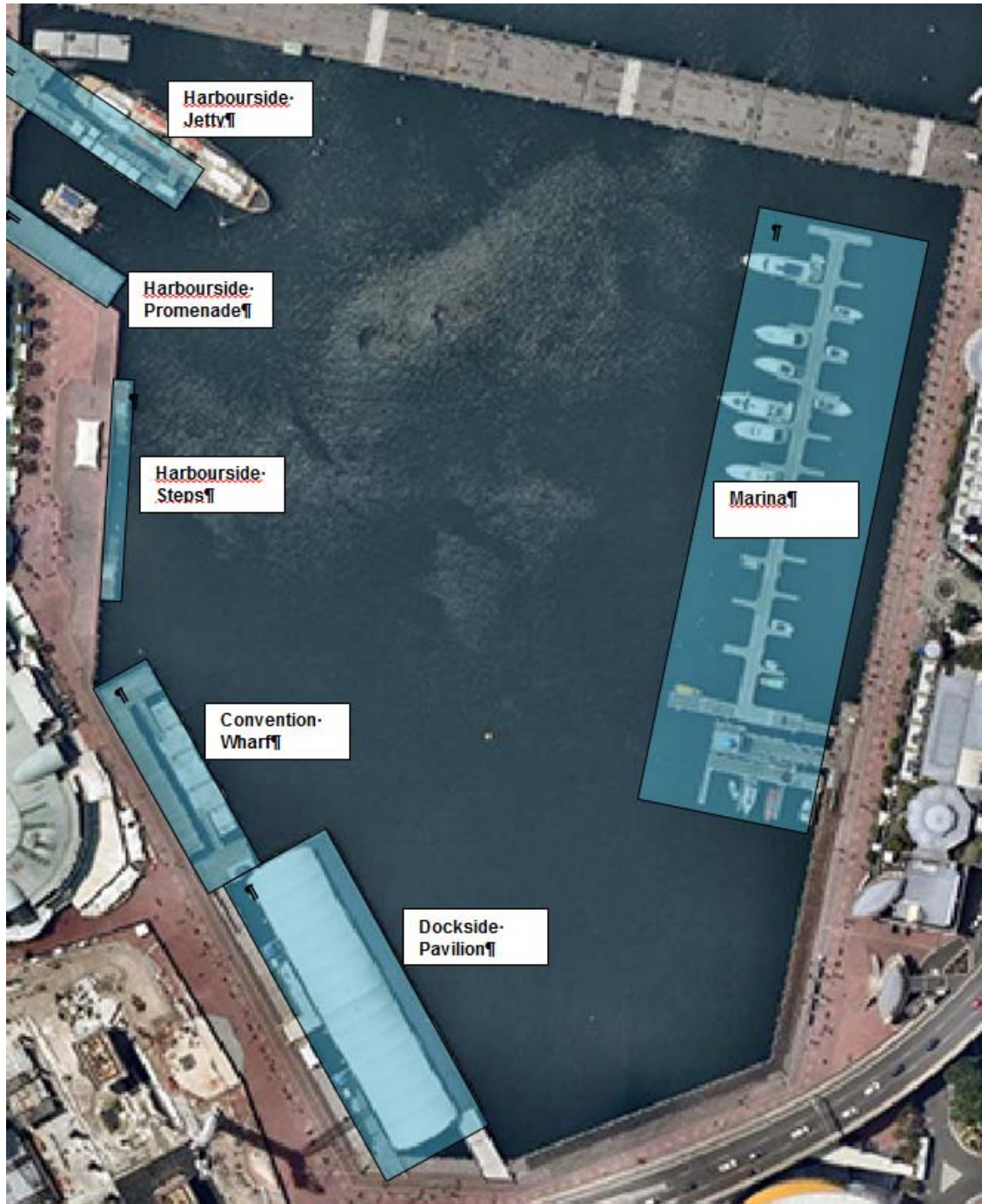


Figure 5: Existing Structures within Cockle Bay Waterway

2.4 Existing Marine Structure Development

Cockle Bay is currently developed with various marine structures. The existing marine structures are shown on Figure 5 and described in more detail in the following pages.

Cockle Bay Marine Structures Renewal Environmental Impact Statement

2.4.1 Harbourside Jetty

Constructed in 1988 as a public wharf. Comprises a fixed timber deck with substantial timber substructure, timber fender piles and timber landing platforms to north and south. Currently used for outdoor dining in association with the historic “South Steyne”, a former Manly ferry. Landing platforms are disused and the entire structure is at end of life.

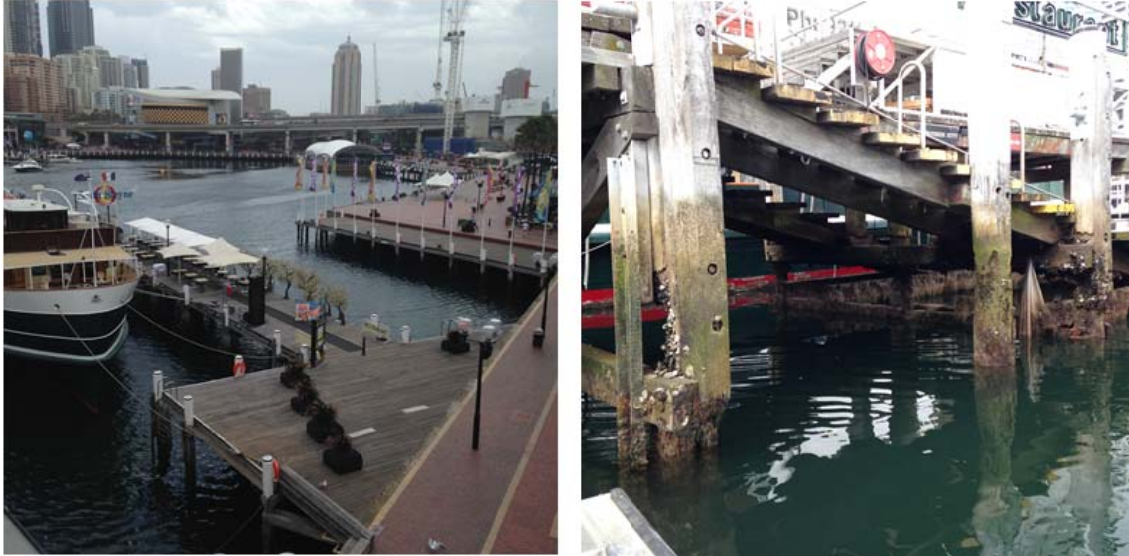


Figure 6: Existing Structures – Harbourside Jetty

2.4.2 Harbourside Promenade

Constructed in 1992 as a promenade widening scheme to relieve circulation pinch-point. Comprises a fixed timber deck with timber substructure and timber interpretation piles. The structure is used as circulation space and for the occasional berthing of large vessels in display mode. The structure is in poor condition.

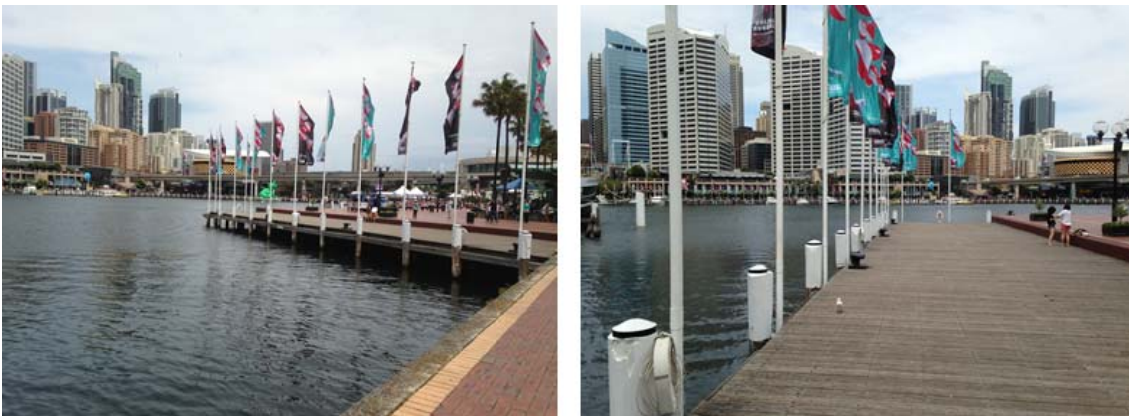


Figure 7: Existing Structures – Harbourside Promenade

2.4.3 Harbourside Steps

The Harbourside Steps were constructed in 1988 as a public wharf. They comprise two sets of concrete landings/steps with steel substructure and timber fender piles. Currently it is disused due to condition and associated compliance risk. Fender piles are at end of their life and the steps do not comply with safety standards.

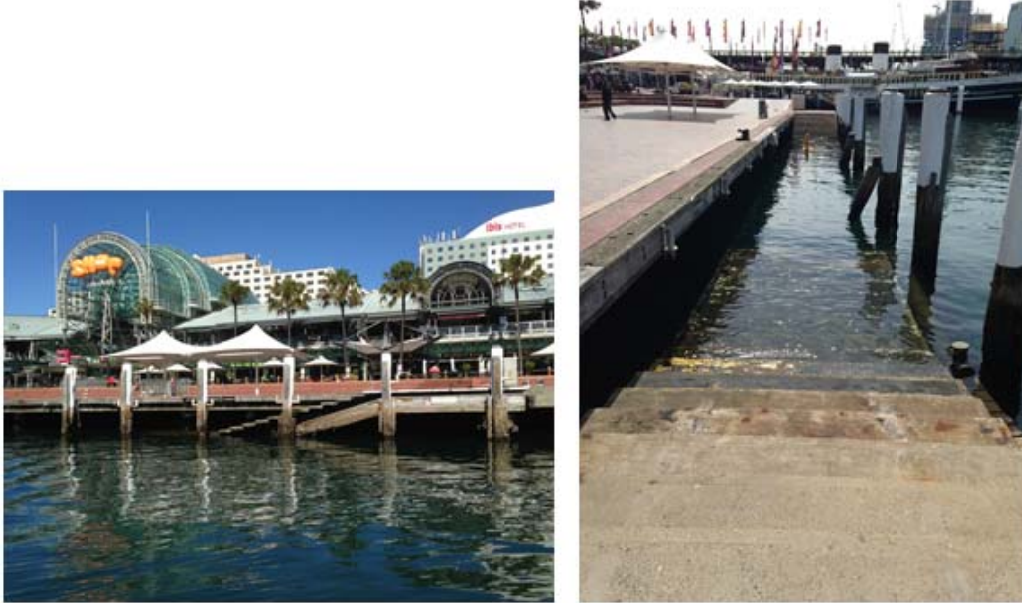


Figure 8: Existing Structures – Harbourside Steps

2.4.4 Convention Wharf

Convention Wharf was constructed in 1988 as a public wharf. It comprises:

- a promenade extension being a fixed timber deck with steel sub-structure and timber fender piles
- 2 fixed deck timber jetties with steel substructure
- Pontoon wharf with steel fender piles and 2 access ramps

It is currently used as a public wharf although it does not fully comply with the requirements of the Disability Discrimination Act 1992. The existing timber decking requires replacement and the steel substructures require major remediation and partial replacement. The pontoon system is near end of life.



Figure 9: Existing Structures – Convention Wharf

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2.4.5 Cockle Bay Marina

Cockle Bay Marina was constructed in 1997 and extended in 2006. It comprises a 50 berth polystyrene pontoon system with steel piles and 2 access ramps, and a fixed deck timber jetty with office accommodation. The facility is required to be publicly accessible from the shore at all times that it is in operation. The current approved uses are:

1. 44 berths for casual (daytime and occasional overnight) berthing. Permanent berthing is expressly prohibited in these berths. The berth sizes are as follows:
 - 9 x 10m
 - 15 x 12m
 - 4 x 15m
 - 14 x 18m
 - 2 x 24m
2. 6 berths, at the southern end of the marina, are approved for commercial purposes and allow for the permanent berthing of vessels up to 12 metres in length. They are used by charter vessels and event service vessels. Conditions of consent control signage and ticketing associated with the use of the commercial berths.

The current facility does not comply with the requirements of the Disability Discrimination Act 1992. 10 vessels berthed on the south-eastern side of the facility (bays 35-44) must be moved during 65mm shell fireworks displays. All vessels are required to vacate Cockle Bay when it is closed during >65mm shell fireworks and major on-water events.

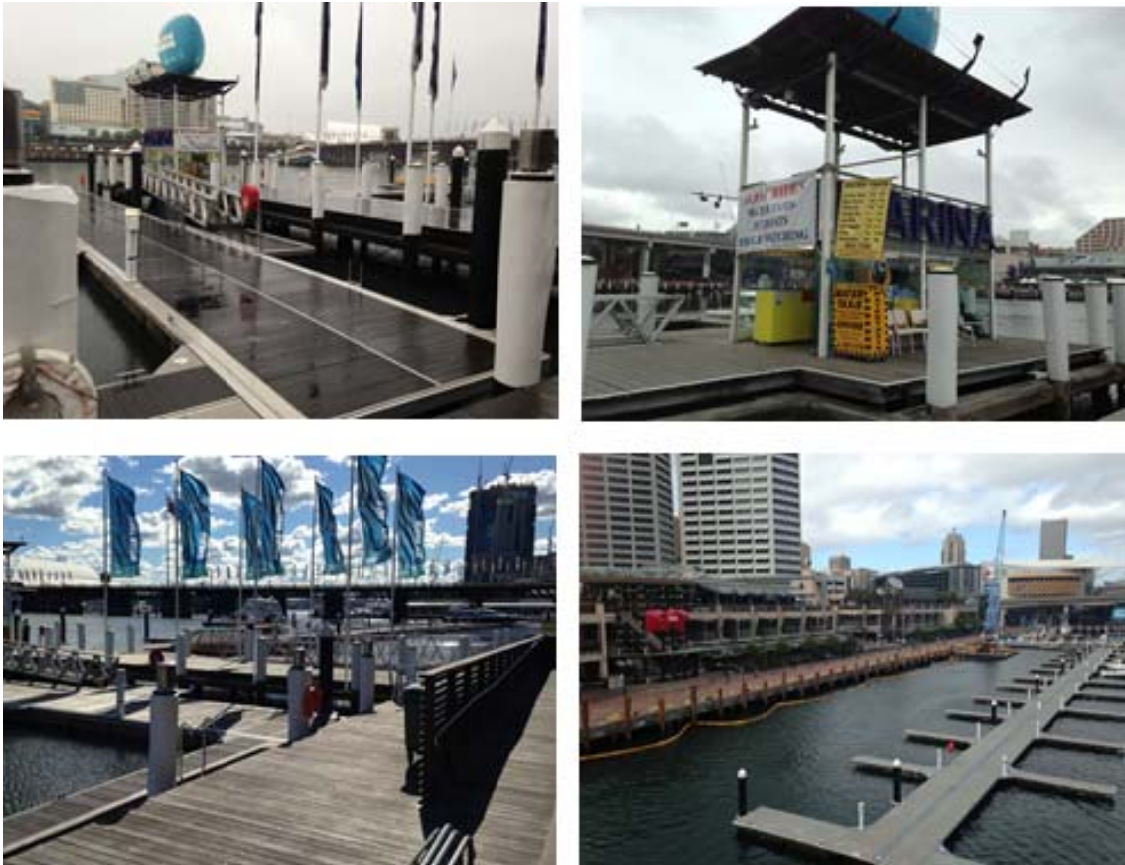


Figure 10: Existing Structures – Cockle Bay Marina

2.4.6 Dockside Pavilion

Dockside Pavilion is a temporary structure which was installed 2013. It is expected to be decommissioned in 2016. It is approved for use as floating venue/conference space.



Figure 11: Existing Structures – Dockside Pavilion

2.5 Land Based Development

The key land based features surrounding Cockle Bay can be characterised as a busy retail and entertainment precinct. To the east and west of the Bay are the retail centres of Cockle Bay Wharf and Harbourside which are popular for dining. To the south, Darling Harbour is being renewed with the new International Convention Centre Sydney under construction and renewal of the IMAX complex approved. The location of each of these major land-based developments are shown in Figure 12 below and described in further detail in the following pages.



Figure 12: Land Based Development surrounding Cockle Bay

Cockle Bay Marine Structures Renewal Environmental Impact Statement

2.5.1 Australian National Maritime Museum (ANMM)

Located to the north-west of Cockle Bay, the Australian National Maritime Museum sits north of Harbourside and the Pyrmont Bridge.

2.5.2 Harbourside Shopping Centre

This three storey retail complex sits on the western side of Cockle Bay and houses numerous retail, entertainment and restaurant premises. It was constructed in the 1980s and is one of the original buildings opened for the bicentenary celebrations.

2.5.3 International Convention Centre Sydney (ICC Sydney)

The original exhibition centre construction for the 1988 Bicentennial and has recently been demolished. Construction is underway for the new Convention, Exhibition and Entertainment hub which is planned to be completed in late 2016.



Figure 13: Artist's Impression of the ICC Redevelopment on the Western Shore

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2.5.4 IMAX Building

The IMAX Building was built in the 1980s and sits at the southernmost point of the Bay. Its demolition and redevelopment has recently been approved. Figure 14 below shows an artist's impression of the approved redevelopment known as The Ribbon.



Figure 14: Artist's Impression of the Ribbon Redevelopment on the Southern Shore

2.5.5 Cockle Bay Wharf Complex

On the eastern side of Cockle Bay, opposite Harbourside Shopping Centre, is the Cockle Bay Wharf complex. This is a three storey development comprising restaurants overlooking Cockle Bay.

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2.6 Existing Access

Public access to Cockle Bay is available by water and land.

2.6.1 Boat Access

Cockle Bay is a public waterway and access is available under the Pyrmont Bridge for all vessels under 7 metres in height. Vessels over 7 metres require a bridge opening in order to proceed into Cockle Bay. The Bridge is opened on Saturdays, Sundays and most public holidays (weather permitting) at 10:30am, 12 noon, 1 pm, 2pm and 3pm and as required to permit vessel access.

Cruise and charter vessels can book use of Convention Wharf, Harbourside Steps, Harbourside Promenade and Harbourside Jetty through an on-line system managed by the Authority. A small number of charter and tourism vessel owners operate from the Cockle Bay Marina.

Recreational vessel owners can book use of one of the 44 short stay berths at the Cockle Bay Marina which is privately operated on behalf of the Authority. The cost to berth at the marina varies depending on the size of vessel and duration of stay (from \$25 for up to three hours for vessels under 7m to \$245 for up to 24 hours for vessels over 14m). The marina is closed on New Years' Eve December 31st & Australia Day, January 26th.

Cockle Bay is open much of the year. There are certain event periods when the bay is required to be closed to accommodate the events program.

2.6.2 Pedestrian Access

The entire foreshore of Cockle Bay and the Pyrmont Bridge is open to the public and has been developed as pedestrian zone. People have unimpeded access to the existing marine structures which are public facilities. However not all are fully accessible to people with a disability due to steps or ramps which do not allow access at all tides, including the Cockle Bay Marina. The key access points into Darling Harbour for pedestrians are shown in Figure 15.

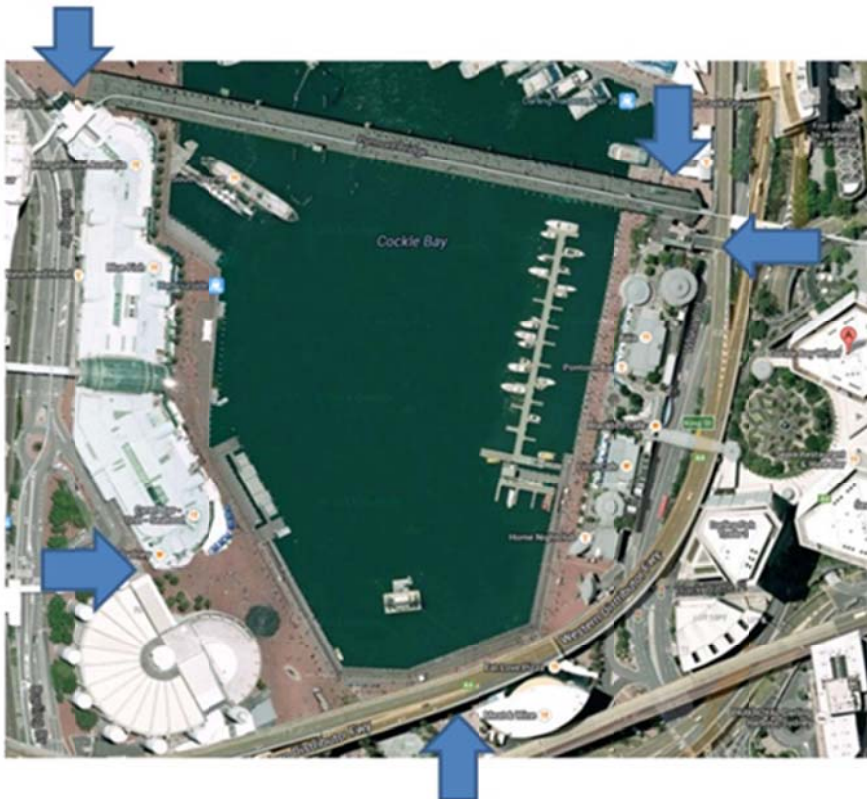


Figure 15: Pedestrian Access Points

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2.6.3 Vehicle Access

Vehicular access is not provided to the foreshore, other than for service /maintenance vehicles. Many visitors to Darling Harbour arrive by car and park within the numerous existing car parks in the immediate vicinity as shown in Figure 16.

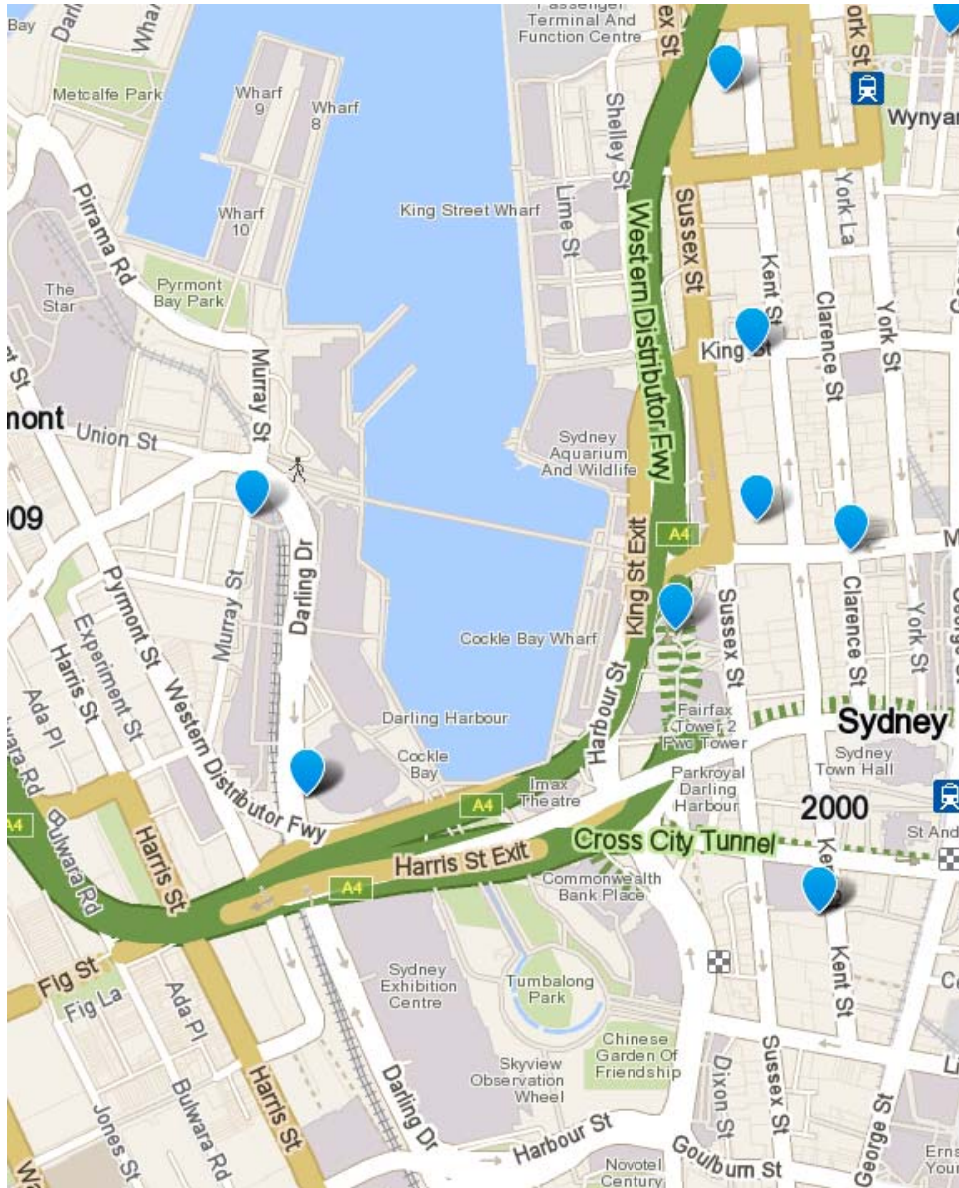


Figure 16: Existing Car Parking Locations

2.6.4 Public Transport

The site is highly accessible by public transport including buses, trains from Town Hall station, light rail (near the Qantas Credit Union Arena, former Entertainment Centre) and public ferry services which operate to King Street Wharf and Pyrmont Bay Wharf.

3 Proposed Development (the proposal)

3.1 Objectives of the Proposal

The Authority is seeking to renew the marine structures in Cockle Bay as part of the transformation of Darling Harbour.

This proposal supports the Government's vision of Darling Harbour as Sydney's premier gathering place and leading urban entertainment precinct. The design quality of the proposal will be keeping with the vision for Cockle Bay as the water forecourt of the new International Convention Centre Sydney.

The proposal will optimise Cockle Bay as a unique events and activation space, whilst providing water-based transport and leisure options to International Convention Centre Sydney patrons, other precinct visitors and the people of Sydney.

The specific objectives of the proposal can be summarised as follows:

- Improve public safety and waterway access
- Enable improved events delivery capability
- Improve urban design and heritage outcomes
- Enhance the visitor experience
- Reduce visual impacts
- Reduce ongoing maintenance burden

3.2 Overview of the Proposal

The proposal involves the demolition and removal of the following structures:

- Harbourside Jetty
- Harbourside Promenade
- Harbourside Steps
- Convention Wharf, including all piles, pontoon systems and fixed deck jetties
- Marina, including all piles, pontoon systems and the fixed deck jetty with office accommodation

It proposes to replace the existing marine structures with two new public facilities as follows:

- On the western side of the bay – a floating pontoon system accessible by a number of ramps incorporating a 45 metre drop-off and pick-up zone for passengers of charter and tourism vessels, private water transport services and water taxis. The facility will service ICC Sydney and the broader Darling Harbour precinct.
- On the eastern side of the bay - a floating pontoon system accessible by two ramps configured to provide 40 short stay berths for visiting recreational vessels up to 15 metres in length, a water taxi drop off and pick up zone, and an event staging and event barge storage area. Flexibility is sought to use up to 6 of the short stay berths for permanent storage of charter and service vessels.

The new facilities will cover an area of approximately 3400m² and result in a reduction of area of water occupied by structures by 17 per cent and a reduction in alienated water of 30 per cent.

Both facilities will be accessible to all people under all tidal conditions.

The layout of the proposed scheme is shown in Figure 17. An overlay of the existing arrangement is shown in Figure 18 in blue.

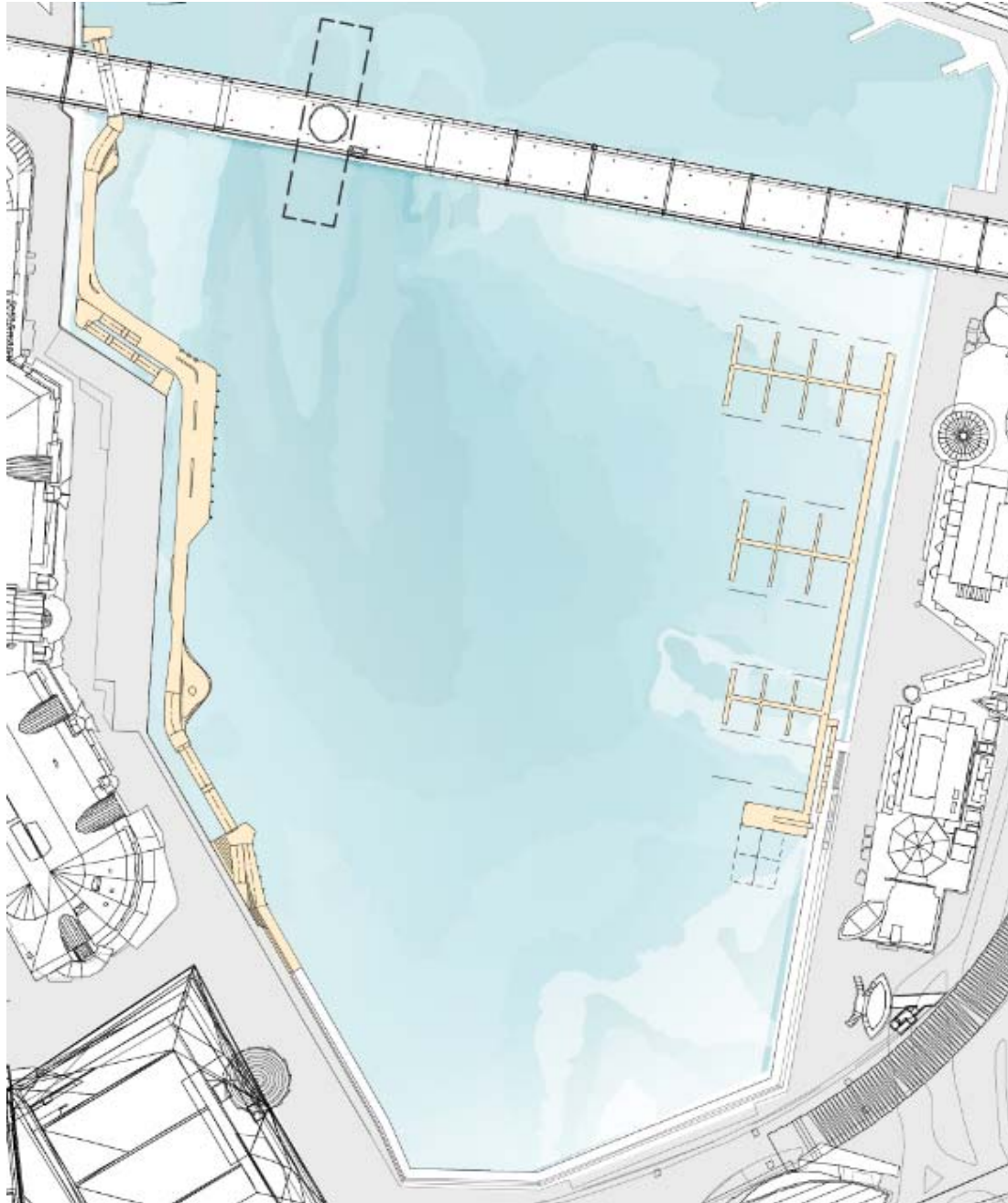


Figure 17: Layout of Proposed Scheme

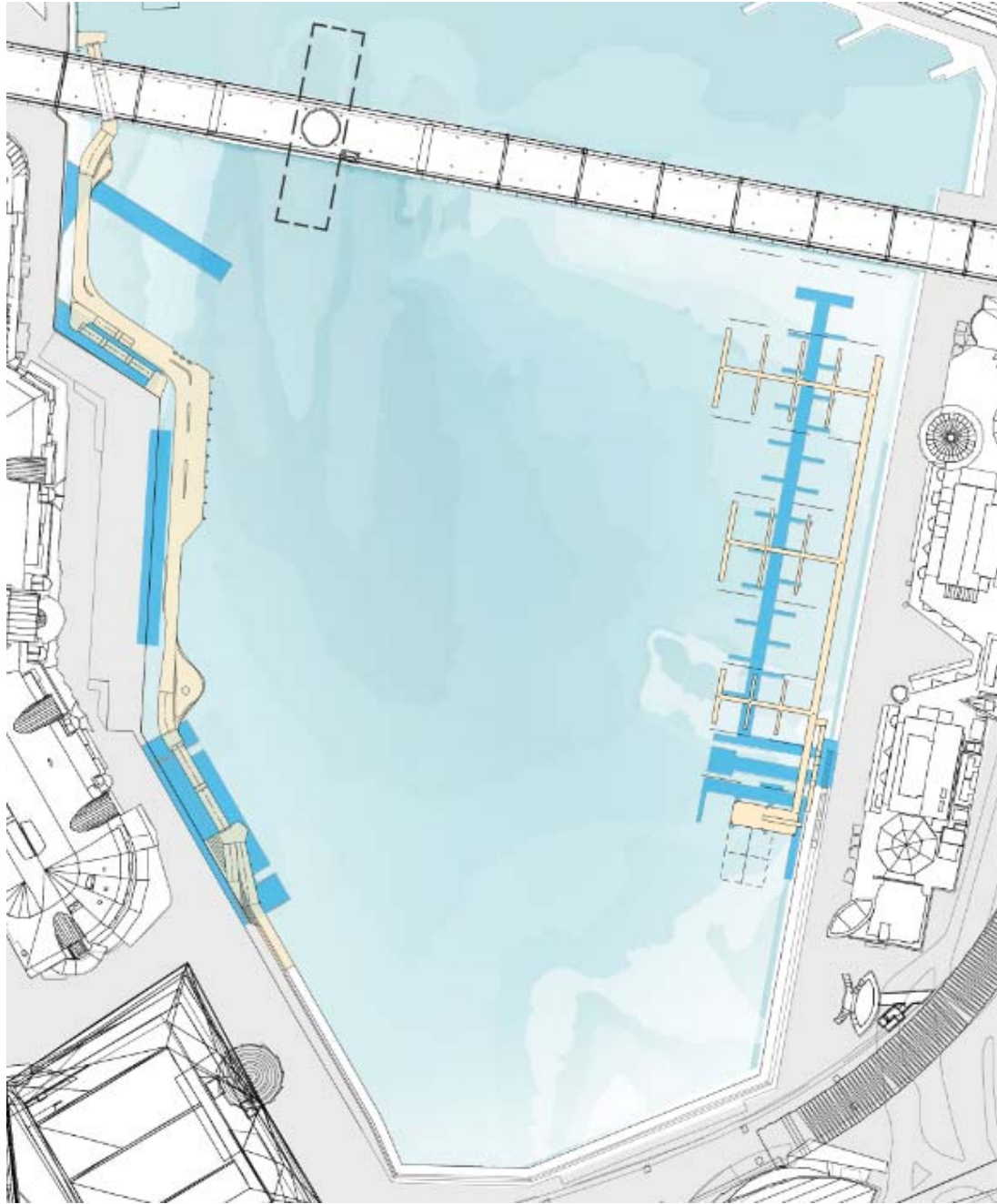


Figure 18: Overlay of Proposed Scheme over Existing

3.2.1 Western Scheme Overview

Scope and Siting

The proposed western scheme is a floating public wharf and associated access systems providing for the drop-off and pick-up of passengers of charter and tourism vessels, water transport services and water taxis.



Figure 19: Model Perspective of Western Scheme

The facility consolidates all existing wharf structures into a single floating system with capacity to simultaneously berth two 35m commercial vessels and two water taxis at the central drop-off and pick-up area.

The facility will be accessible from the Australian National Maritime Museum in the north, the Harbourside Shopping Centre in the west and ICC Sydney in the south, under all tidal conditions, providing access for all users, including people with a disability.

There will be no on-water accommodation for ancillary operations such as ticket sales, office or sale of refreshments. These will be provided from land-based outlets, expected to be in the Harbourside Shopping Centre.

Proposed Use

Berths will be available via an on-line booking system to commercial operators of vessels up to 35m in length for passenger pick up and drop off only. It is expected that berths will be allocated for 10 or 15 minutes. Loading of goods and provisions from the facility will not be permitted.

Larger vessels may utilise Cockle Bay from time to time associated with events and following risk assessment.

The smaller north and south faces of the drop-off and pick-up area will be designated water taxi ranks. It is envisaged that water taxi operators will be able to use the ranks without booking and will be permitted to wait at the ranks for passengers as long they remain with the vessel.

Recreational vessels will not be permitted to use the facility.

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The design offers the operational flexibility to close off areas as required for crowd control while allowing the passenger drop-off and pick-up to continue to operate.

The facility will be closed during bay closures, as deemed necessary by the Authority's Operations Team and including the one hour exclusion zone enforcement period during fireworks displays.

Compliance with approved terms of use of the facility will be managed by the Authority's Operations Team via its existing Ranger and Coxswain services.

The facility will provide a superior level of access to Darling Harbour from the water than the existing structures.

3.2.2 Eastern Scheme Overview

Scope and Siting

The proposed eastern scheme is a public recreational boating facility comprising pontoons and two ramps, one of which will be accessible under all tidal conditions, providing up to 40 short stay berths for visiting recreational vessels, a water taxi rank, and a pontoon for events staging and the storage for 4 event barges. Flexibility is sought to use up to 6 of the short stay berths for permanent storage of charter and service vessels.



Figure 20: Model Perspective of Eastern Scheme

Access to the facility comprises a main 2.4m wide ramp and floating walkway parallel to the shoreline. The main ramp provides access for all people under all tidal conditions. From the main spine, there will be three perpendicular 1.5 metres wide floating pontoon arms. The two arms to the north provide 28 berths to accommodate vessels up to 15m length and the third arm to the south provides 12 berths to accommodate vessels up to 10m length.

At the southern end of the facility are the drop-off and pick-up pontoon and events staging area which comprise an 8m x 20m floating pontoon with a second access ramp. The northern side of the pontoon will be a dedicated taxi rank for up to 2 vessels. The southern side will be used for events staging and the storage of up to four event barges, each 9m x 7m, when they are not in use. These barges are currently stored under the Pymont Bridge near the Pymont abutment. From time to time, the barges in their new storage location may be used for ancillary purposes associated with the staging of events.

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Proposed Use

The short stay berths will be available to the general public via an on-line booking system. A fee may be charged for use which will vary depending on the duration of stay and size of vessel. The maximum length of stay will be 24 hours.

The facility will be open to the public at all times that it is in operation.

Based on the proposed short term use, the facility will not provide on-water waste services, including pump-out. Users will be required to keep waste on-board for disposal at the vessel's permanent mooring location or approved waste facility. Power and water will be available.

The proposed amenity for short term berths is consistent with those applying to the current Cockle Bay Marina which it will replace.

The proposal seeks flexibility for permanent vessel storage as follows:

- use 2 berths in the facility for 2 service vessels up to 5m, owned and operated by the Authority (a launch used in the staging of events and the Coxswain's vessel)
- optional use of 4 berths for commercial vessels up to 15m

The four berths for permanent berthing of commercial vessels would be limited to storage only. Passengers would not be permitted to board vessels at the berths and operators would not be permitted to load goods. The operators would be required to pick-up and drop-off from the new purpose designed facility on the western side of Cockle Bay as their vessels are licensed to carry 8 or more passengers and are therefore required to berth at a public wharf in accordance with the Marine Safety Act 1988.

There will be no on-water accommodation for ancillary operations such as ticket sales, office or other back of house functions.

Any berths nominated for permanent commercial use would be subject to licensees containing provisions to provide their own waste management services, as per existing licence agreements. Maintenance of vessels will not be permitted at the berths and any commercial vessels will be required to visit approved facilities for maintenance and pump-out.

Vessels at the facility, including any commercial vessels approved, but excluding the Authority's service vessels (which are required for operational reasons), will not be permitted to leave their berths during bay closures, as deemed necessary by the Authority's Operations Team and including the one hour exclusion zone enforcement period during fireworks displays.

Compliance with approved terms of use of the facility will be managed by the Authority's Operations Team via its existing Ranger and Coxswain services.

3.2.3 Proposed Hours of Construction and Operation

Proposed hours of construction are in accordance with the Authority's standard precinct wide construction hours:

- Monday to Friday 07:00 – 18:00
- Saturday 07:00 – 15:00

It is noted that the standard construction hours in the Interim Construction Noise Guideline (ICNG) for Saturday work are 08:00 – 13:00. Extended construction hours on Saturday are considered appropriate in this case because the work site is in a non-residential precinct and the proposal may be classified as public infrastructure. The ICNG contemplates construction outside the recommended standard hours for public infrastructure works.

Proposed hour of operation will be the same as existing facilities. Public access and vessel access will generally be permitted at all times. Public access will be restricted during event crowd scenarios, as deemed necessary by the Authority's Operations Team. Vessel access and exit will not be permitted during bay closures, as assessed by the Authority's Operations and Events teams, to enable the staging of major events.

4 Design and Justification

4.1 Design Documentation

Design documentation for the proposal has been prepared by Mott MacDonald, Maritime Engineering Division and Woods Bagot Architects. Drawings are included at Appendix 3.

4.2 Imperatives for Renewal

The key reasons for renewal of the marine structures in Cockle Bay at this time are:

Asset risk management. The existing marine structures in Cockle Bay present compliance risk and are at or near the end of their useful life. Significant investment is required in the short term to maintain existing functionality. Rather than maintaining the existing assets or replacing like-for-like, an opportunity exists to achieve significant functional, heritage and urban design outcomes by re-designing the existing infrastructure. This provides a cost effective alternative with benefits not achievable without completely redeveloping the infrastructure.

Authority's corporate objectives. The Authority aims to create extraordinary places the world talks about and recognises Cockle Bay as the water forecourt of the new ICC Sydney. As owner of Cockle Bay and its surrounds, it aims to modernise facilities in the bay to support Darling Harbour's strategic economic value as NSW's leading precinct for meetings, conferences, exhibitions and entertainment. The Government's \$3 billion investment in the new ICC Sydney demands a level of design quality and aesthetic consistent with that investment.

The NSW Government's Sydney Harbour and maritime agenda. The NSW Government, through its recently released Plan for Growing Sydney, has reaffirmed its commitment to improving public access to the harbour and its foreshores, and maintaining its ongoing role as a focus for major civic events and celebrations. Cockle Bay is central to delivering on that commitment as it is the most highly visited harbourside destination in Sydney, providing rare access for recreational vessels to the CBD. The Sydney Harbour Boating Destinations Plan, part of the Government's Maritime Policy Agenda, is designed to increase the number of services and amenities available to the general boating public on Sydney Harbour.



Figure 21: Artist's Impression of ICC Sydney with Cockle Bay as the Water Forecourt

4.3 Analysis of Alternatives

The existing marine structures in Cockle Bay were largely constructed in 1988 as part of the original Darling Harbour precinct development. They have been added to and altered in a piecemeal manner since that time in an attempt to meet requirements as they have arisen. At nearly 30 years old, many of these structures are at or nearing the end of their useful life and their design does not meet current compliance and functional requirements. The forthcoming opening of the ICC makes renewal of these facilities a priority for the NSW Government and provides an opportunity to enhance their functionality.

In realising the issues presented by the existing marine structures, several options were considered as follows:

- Option 1 – **retain** structures in their existing form and continue to maintain
- Option 2 – **upgrade** and alter the existing structures to suit current compliance requirements
- Option 3 – **replace** with new facilities designed to comply with current standards and meet current and future functional requirements

4.3.1 Option 1 - Retain

Option 1 is not considered a viable option due to the existing compliance risk associated with the design and condition of the assets, with all assets being at or near the end of their useful life. Retention would also preclude the functional benefits associated with the proposal.

The existing arrangement has been developed in a hap-hazard way over nearly 30 years and the result is a group of structures that are not aligned with current needs nor of a quality befitting the setting to the new ICC Sydney.

4.3.2 Option 2 - Upgrade

Continued use of the existing structures would result in a high degree of cost to restore condition and meet current compliance requirements.

Furthermore, as the assets are at or near the end of their design life, in many cases it would not be possible to restore condition without significant component replacement.

The option of upgrading would also not achieve the functional benefits required by key stakeholders and currently negated by the siting and design of the existing structures.

4.3.3 Option 3 - Replace

Demolition and replacement of existing assets enables the stated objectives of the project, whilst avoiding ongoing maintenance cost burden.

Replacement is the preferred option and this proposal responds to it.

4.4 Design Requirements

The design is based on the project Functional Brief, developed in consultation with the Authority's Project Working Group, TfNSW Maritime Management Centre and the NSW Commercial Vessels Association, representing maritime users of the proposed facilities. The design has been developed in consultation with the operator of the new facilities (Sydney Harbour Foreshore Authority), the Authority's in-house strategic planning, heritage and event management experts, external project stakeholders including neighbouring ground lease tenants and relevant Government authorities. Details of external consultation can be found in Section 5: Consultation. The design will comply with all applicable legislation, design codes and guidance material including the following:

- AS1428 – 2009 Design for Access & Mobility (Parts 1-4)
- AS 2159: 'Piling - Design and Installation'
- AS 3962 – 2001: 'Guidelines for Design Of Marinas'
- AS 1170.2 – 2002: 'Structural Design Actions – Part 2: Wind Actions'
- AS 4997 – 2005: 'Guidelines for the Design of Maritime Structures'
- AS 5100.2 – 2004: 'Bridge Design – Part 2: Design Loads'
- AS/NZS 3000 – 2007: 'Electrical Installations'
- AS 2419.1 – 2005: 'Fire Hydrant Installations - System Design, Installation and Commissioning'
- The Building Code of Australia (BCA)
- Disability Discrimination Act 1992
- Disability Standards for Accessible Public Transport 2002
- Maritime Safety Act 1998
- 'Engineering Standards and Guidelines for Maritime Structures', NSW Waterways Authority, 2005
- 'Procedure for the Assessment of Public Ferry Wharf Safety', NSW Maritime, August 2007
- 'Guidelines for the Design of Fender Systems', PIANC, 2002
- 'Report of Working Group 41: Guidelines for Managing Wake Wash from High Speed Vessels', PIANC, 2003
- 'Approach Channels A Guide for Design', PIANC, June 1997
- "Inventory of Inspection and Repair Techniques of Navigational Structures", PIANC Report No. 119 – 2013
- 'Coastal Engineering Manual', US Army Corp of Engineers, 2002
- 'Western Harbour Design Guidelines', Sydney Harbour Foreshore Authority, 2014
- 'Boating Destinations Plan', NSW Maritime
- 'Cockle Bay Marine Structures Strategic Plan', Arup, 2012
- 'New Wharf in Cockle Bay Feasibility Study and Options Analysis', Arup, 2013
- 'Cockle Bay Marine Structures Redevelopment Project Design RFT Document - 101100435, Sydney Harbour Foreshore Authority, 2014

4.5 Design Philosophy

The design philosophy has been informed by the objectives of the proposal described in Section 3.1 and is based on creating:

People-friendly Facilities: The design seeks to respects the original design intent for conversion of Darling Harbour from an obsolete railway goods yard to a place for the people in 1988. The focus was on prioritising pedestrian access, opening the harbour to visiting vessels and establishing a foreshore promenade linked into the valley floor open space system.

A Unified Aesthetic: The design provides for a unified experience with surrounding developments. The design team has coordinated with developments currently in planning or construction across the Darling Harbour precinct, including ICC Sydney and the Ribbon (IMAX redevelopment), and responds to the Authority's Draft Public Realm Manual that seek to establish an integrated design approach to these developments and ensure an appropriate interface with the City of Sydney's public domain space that connect to the precinct.

A less cluttered Cockle Bay: Further to consolidating structures, the aim of de-cluttering the built form on the edge of the bay is developed through integration of elements into single design forms – doing more with fewer elements, and integrating functions rather than applying additional overlays. For example, piles, signage and lighting are integrated in the main structures rather than applied as separate objects into the scheme. Seating and rest points are seamlessly integrated and grow out of the form of the structure rather than land on it as individual elements.

A Unique Identity and Experience: Being at the same level as the water is a rare experience in the inner city. The need for a floating pontoon on the western edge provides an opportunity to make a series of new public spaces, space for embarking/disembarking passengers that creates a more intimate setting on the water, contrasting to the scale of the surrounding landside development. In addition there is an opportunity to:

- Bring the sense of the water closer to the edge by minimising 'fixed' attachment points of elements to land based structure
- Clearly differentiating elements on the water from 'fixed' concourse and land based structure through form and material

Opening up Views: A number of opportunities were identified to open up views from surrounding areas to the waterway and to historic elements. Realigning the short stay berthing arms of the facility on the eastern side of the bay and enlarging fairways enables new view corridors to be established over the waterway. The berthing of smaller vessels and grading of their size and the length of berthing arms provide an opportunity to improve visibility of the Pyrmont Bridge from the south. More significant opportunities for expanding views were identified under the western scheme with removal of fixed structures which currently block views to the Pyrmont Bridge and the rare 1850s-1870s remnant original Darling Harbour seawall.

Seamless Waterfront Interface: The waterfront interface has been carefully considered and the proposal seeks to:

- Provide safe and accessible access at all interfaces
- Considers the siting of landside connection points to minimise circulation impacts at landside confluences
- Minimise view impacts

4.6 Functional Considerations

Cockle Bay is Sydney's premier foreshore celebration space and is one of the most unique water spaces in the world.

A key criterion for the proposal is to separate the conflict between events and maritime uses. In doing so, there will be more clarity around operations and usage, concentrating commercial vessel movements to the west, near the entry channel and visiting recreational vessels to the east and freeing up the south of the bay for events.

This clears the stage for enhanced visitor experiences, facilitating safer and more efficient maritime activity alongside on-water events. De-cluttering the bay is an enabler for state agency collaborations to stage unique on-water events and activations, reinforcing Sydney as an international destination.

The design seeks to consolidate existing structures and reduce the existing conflict of use between maritime use and the staging of on-water events and activations. The scope of the design also removes existing uses that are currently not supported by planning policy such as office accommodation, ticketing and back of house operations and berthing for a floating restaurant and function centre.

The existing structures have been built over a period of time in response to changing needs and the result is a collection of structures that, although useful in isolation, present conflict of use that does not collectively meet the needs of stakeholders. There are currently three wharf structures in the bay. The siting of the existing Convention Wharf presents a conflict of use because the south of the bay is used to stage on-water events and activations.

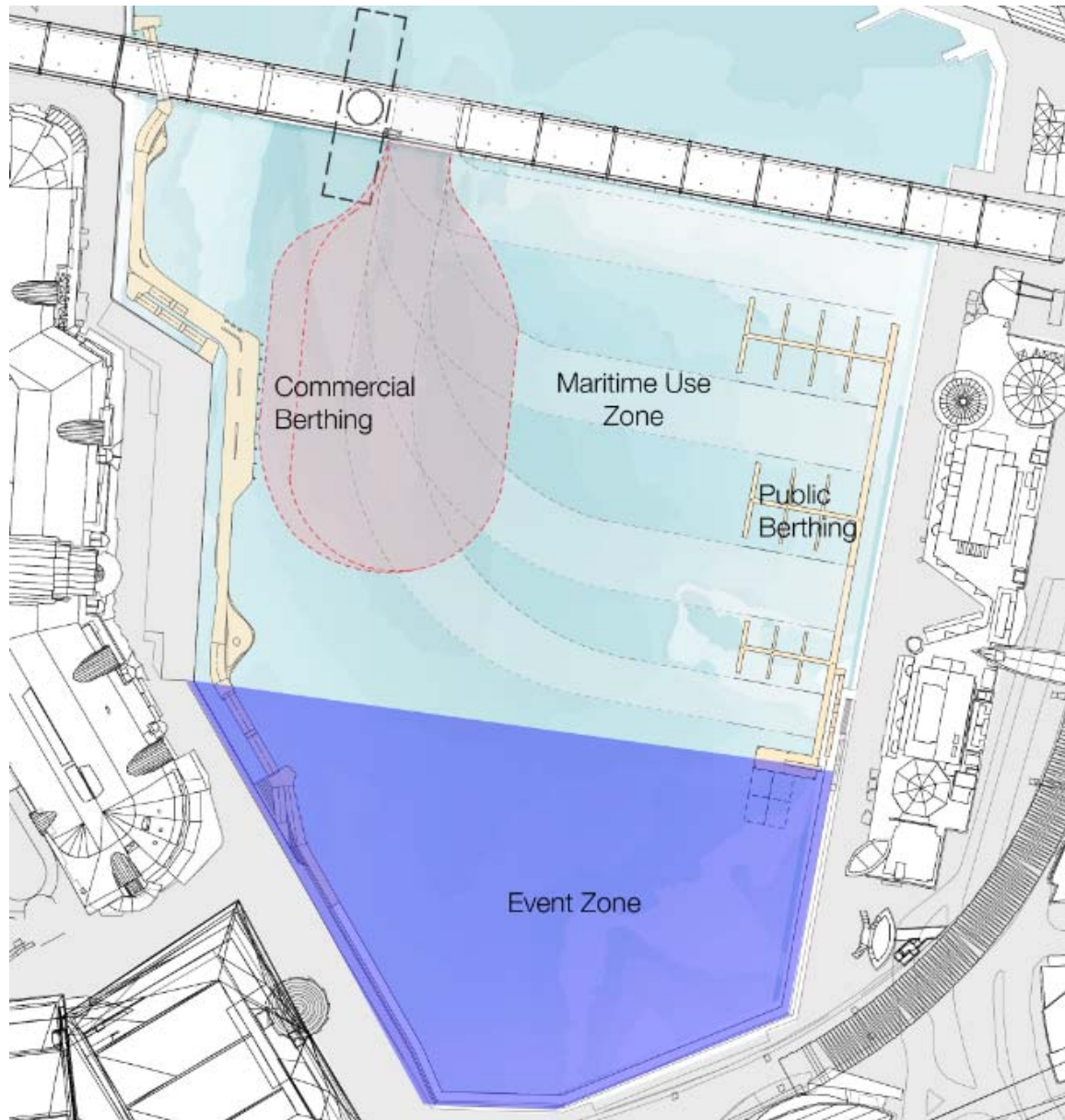


Figure 22: Proposed Scheme showing Functional Overlays

The western scheme consolidates the existing three wharf structures in to a single fit for purpose facility, sized and designed to safely accommodate all anticipated commercial vessels. The layout of the scheme has been established to ensure all non-events uses can operate without risk or hindrance during the staging of most events, including fireworks. Both facilities are outside the 65mm shell fireworks displays typical in the bay. Notwithstanding this capacity, it will be necessary to close the bay to all maritime use during major events such as the Boat Show and New Year's Eve celebrations.



Figure 23: Cockle Bay Event

4.7 Peer Review by the Authority's Design and Development Advisory Panel

The Authority established the Design and Development Advisory Panel to provide prompt, objective and expert advice to the Authority on a range of significant Authority projects as they move from planning and design to delivery. The Panel's informal critique and comment on work in progress is intended to enable designs to be refined and projects effectively delivered in accordance with best practice.

The terms of reference for the Design and Development Advisory Panel are:

- Encourage excellence in design and development;
- Provide an external perspective that enriches and contributes to the decision-making capabilities of the Authority to ensure successful urban renewal of its sites;
- Enable design refinement to projects involving property development, economic development, architecture, urban planning and heritage conservation.

Current members of the Panel have expertise in architecture, planning, heritage and urban design.

The Panel was supportive of the proposal and provided the following feedback:

- Expressed an opinion that the recreational boating facility on the eastern shore should be made as widely available to the general boating public as possible
- Provided the following suggestions for optimising the amenity of the western scheme:
 - Minimise the separation of the western scheme from the landside promenade whilst ensuring public safety
 - Maximise viewing space in shade of bridge
 - Consider views from western scheme into the substructure of the promenade
 - Avoid the use of railings and barriers where possible

Matters raised by the Advisory Panel requiring further investigation are analysed in Section 5.8.

4.8 Footprint

A key consideration in the design was to reduce the extent of on-water structures to enable more effective use of the waterway.

The following is a summary of the structures on water and alienated water and demonstrates a 30% reduction in alienated water and a 17% reduction in structure on water.

Table 3: Footprint Analysis

	Existing		Proposed	
	Structure, m2	Alienated Water, m2	Structure, m2	Alienated Water, m2
Western Scheme	2509	346	2336	1515
Eastern Scheme	1586	7100	1078	3721
Totals	4095	7446	3414	5236

Note that the western scheme alienated water figure includes the 5m separation of the public wharf access from the promenade and that this is provided for public safety reasons. Refer Section 4.11 for capacity and sizing considerations.

4.9 Future Proofing

Whilst the capacity of the facilities has been given careful consideration, future demand for the facilities is subject to a number of variables outside the control of the project. The design responds to this by providing layouts for the facilities that can be expanded, subject to the relevant public and navigation safety considerations and planning approval. Berthing capacity at the floating public wharf can be duplicated to the south and the recreational boating facility can be extended to the west. The use of modular proprietary pontoon systems also enables flexibility. Whilst not anticipated, the design is future proofed for increased demand beyond current forecasts.

4.10 Urban Structure and Siting

The design respects the original Darling Harbour design principles of:

- Valley floor pedestrian precinct
- Harbour edge public promenade
- Convenient pedestrian entries

Three points of confluence in the public realm on the western shore make natural connection points to the new wharf and access arrangement. Refer Figure 24 below.

Connection to these nodes reinforces clarity of wayfinding decision points, and eases pedestrian flows by connection at these more generous spaces.

As well as providing access to vessels loading and unloading passengers, the western scheme provides a new public realm experience for the inner harbour – being directly on the water and acting as an extension of the public realm.

The siting of the public wharf is based on feasibility studies undertaken by ARUP and is based on 3 key factors:

- Proximity to ICC Sydney
- Separation of events and maritime uses in the bay
- Compliance with the Darling Harbour design principles and connectivity to the landside precinct

Given the primary importance of ICC Sydney to the Darling Harbour precinct, a location in convenient proximity to the ICC Sydney facilities was a primary consideration. This consideration has been accommodated in the design, whilst ensuring the required separation of the wharf to enable the effective and efficient delivery of events in the bay. The wharf is located far enough south to be within easy walking distance to the ICC forecourt and far enough north to be out of the designated events zone. This enables maximum utilisation efficiency of the wharf and the bay.

The final siting of the public wharf is a short walk from ICC Sydney's forecourt. The design of the ramp connection to the ICC Sydney forecourt provides for a unique on water experience and sense of arrival.

The northern connection provides access to the Australian National Maritime Museum / Pyrmont confluence and the mid-way connection provides short and convenient access to the promenade. The mid-way access is also provided as a dedicated access to the drop-off and pick-up zone when the north and south connections are closed during crowd conditions, as experienced during major events. The access arrangements will include appropriate segregation mechanisms for crowd control.

The layout of the northern connection near the Australian National Maritime Museum allows for appropriate separation from the bridge pier to the east and from shallow water to the west. The routing of the access under the bridge is deliberate from an access point of view and also provides the unique opportunity for viewing the substructure of the heritage listed Pyrmont Bridge and the only section of original seawall in Darling Harbour, dating from 1850-1870. A large part of this rare seawall is currently obscured by structures. A discrete heritage interpretation breakout area will be provided at this location with a small amount of seating for visitors to enjoy the heritage experience this location offers.

The separation of the western scheme from the edge of the landside promenade is 5m. This separation has been determined by safety considerations and minimises the risk of persons jumping or falling from the promenade onto the new structures. From an aesthetic perspective, this separation provides for a sense of being on water, rather than the new structures appearing as an extension of the land.

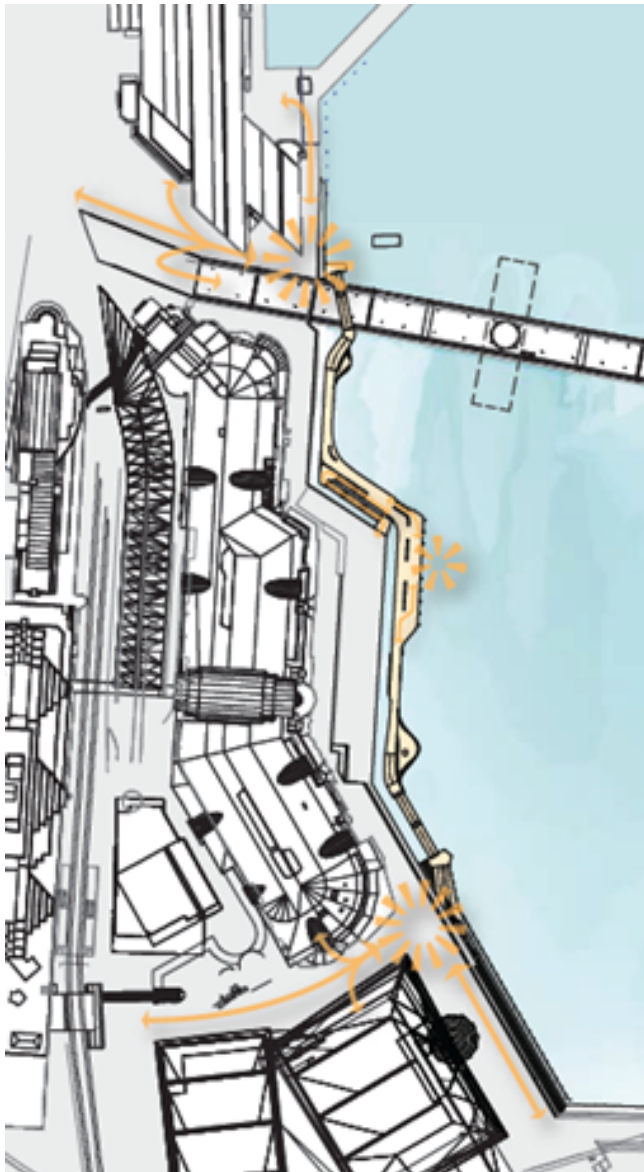


Figure 24: Western Scheme showing Connection with Landside Circulation Confluences

4.11 Capacity and Sizing Considerations

4.11.1 Western Scheme

The sizing of the facility has been established on the basis of four considerations:

- safe navigation
- berthing demand projection
- public safety
- industry advice

Safe navigation is ultimately informed by the size of the entry channel at Pymont Bridge and the limited extent of the Cockle Bay waterway. The Authority's navigation safety consultant has recommended that commercial vessels servicing the bay are limited to 35m in length and 10m in beam.

The number of commercial vessel berthings at Cockle Bay wharves in the twelve months prior to closure of the former convention centre was 348 and the pattern of usage is summarised in Figure 25.

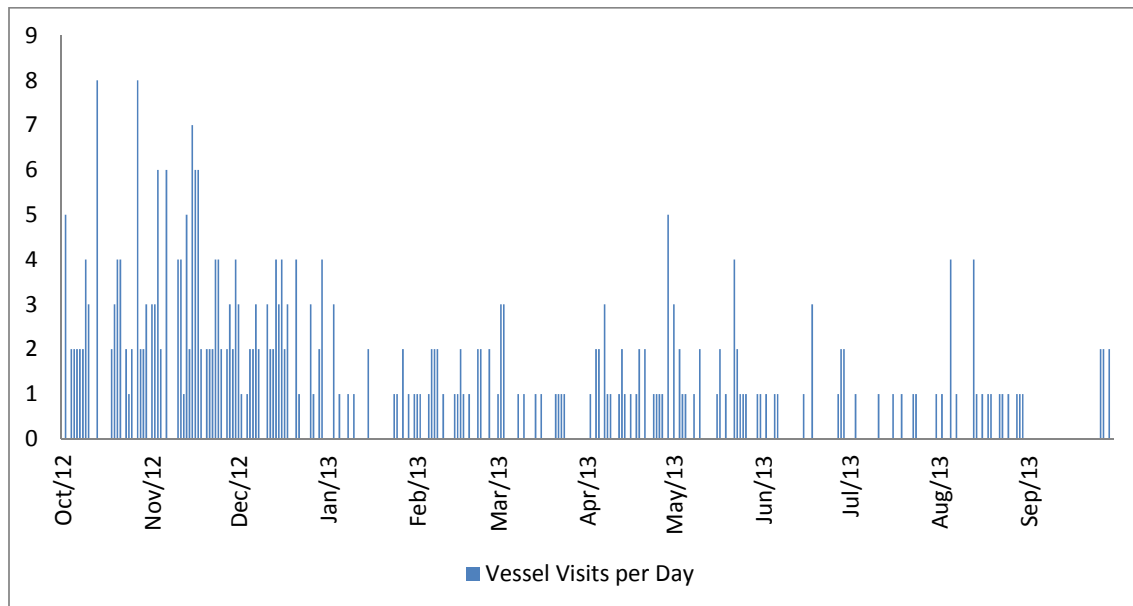


Figure 25: Commercial Vessel Casual Berthing Statistics in Cockle Bay Oct 2012-Sept 2013

The data results in a berthing demand of between 0 and 8 berthings per day, with a maximum peak utilisation of 3 berthings per hour.

In addition to these berthings, permanent berthing licensees at the marina are currently permitted to board passengers at their berths. This demand relates to a typical demand of 2 berthings per hour and a maximum peak utilisation of 6 berthings per hour.

The anticipated private ferry service is expected to result in a maximum peak utilisation of 3 berthings per hour.

On the basis of past usage and a modest increase in demand, consistent with the need to future proof the design, a peak demand of 10 berthings per hour has been assumed. Based on a design vessel of 35m in length, this demand can be adequately serviced by the provision of a single 45m long berthing face allowing for simultaneous berthing of 2 vessels.

Of the 25 vessels that berthed in Cockle Bay during the 12 months prior to closure of the former Convention Centre, only three berthings (2 per cent of total berthings) were for vessels exceeding 35 metres.

The capacity of the access ramps has been determined by the need to safely and effectively manage peak pedestrian demands during conference, exhibition and event modes in the precinct. The access

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ramps and floating pontoons are 6m wide and provide pleasant space for waiting passengers and have sufficient capacity to manage the volume of passengers anticipated.

The extent of the separation (5m) between the fixed promenade and the western edge of the ramps and pontoons has been determined through consideration of two factors:

- Safety – the access arrangements must be sufficiently separated from the promenade to prevent members of the public falling or jumping onto the structure
- Place making – the separation provides for a sense of being on the water, rather than being on an extension of the landside structures

Various stakeholders, including the NSW Commercial Vessels Association, were consulted in with respect to future demand forecast for commercial berthing in Cockle Bay. The Association advised that a 10-20 per cent increase in berthings over the 12 months immediately prior to the closure of the Convention Centre (Oct 2012 to Sept 2013) would adequately future proof the new facilities and allow for a modest private ferry service to operate directly into Cockle Bay.

4.11.2 Eastern Scheme

The sizing of the facility has been established on the basis of five considerations:

- safe navigation
- recreational vessel sizes in Sydney Harbour
- footprint on water, considering fairway width
- view and event constraints
- adequate separation from heritage listed Pyrmont Bridge

The Authority's navigation safety consultant has recommended that recreational vessels using public berthing facilities are limited to 15m in length and 5m in beam. This ensures the full fairway width for such vessels is achieved at Pyrmont Bridge channel and reduces risk of property damage to private vessels and the heritage structure. More experienced commercial vessel operators are assumed to have the skills to allow them to navigate safely under the bridge with reduced clearances.

Most vessels on Sydney Harbour are less than 15 metres in length and the current marina operator has advised that the majority of recreational vessels visiting the marina are between and 7m and 14m in length.

Table 4 shows the sizes of registered vessels on Sydney Harbour and indicates that 97 per cent of registered recreational vessels on Sydney Harbour are of a size that could be accommodated at the facility.

The NSW Government's growth forecasts to 2026 suggests a modest annual growth rate of 1% in the size of the fleet in Sydney Harbour.

Table 4: Vessels by Size in Sydney Harbour (source: NSW Maritime, June 2010, [NSW Boat Ownership and Storage: Growth Forecasts to 2026](#))

Vessel Type	<10m	10-14m	>14m
Recreational	15,461	2,010	540
	85.8%	11.2%	3%
Commercial	691	161	232
	63.7%	14.9%	21.4%

Size of vessels and the footprint of the facility has also been informed by the need to comply with the mandated fairway widths in AS3962, which are wider than the existing fairway. An analysis of various vessel size and facility configurations was undertaken. It found that a facility placed parallel to the foreshore would push it further into the bay and adversely impact events and commercial vessel access to the western side of the bay. The facility was therefore realigned as a series of arms perpendicular to the foreshore. Larger vessels require larger fairways, resulting in the provision of fewer berths or a greater footprint (if the capacity is to be retained).

The proposed number of berths is 40, representing a 20% reduction in existing capacity and the maximum that can be accommodated considering all factors.

4.12 Form & Materiality

The majority of the existing structures are robust in scale, with a number of fixed deck components at promenade level, office accommodation above promenade level and a large number of visible steel piles. The design of the proposal seeks to reduce built form bulk and is of a much more discrete scale and nature. Access ramps will gradually fall to water level and on-water components will be floating. This results in improved views from the promenade and a sense of de-cluttering. There will be no visible piles other than at the main berthing face of the drop-off and pick-up zone on the western side of the Bay. Telescopic piles will be integrated with the pontoon systems. Way-finding and informational signage, seating and lighting will be integrated with structural forms.

The proposal will result in increased visibility throughout the precinct by:

- Ensuring views from ground level entry points to the precinct terminate in water and not permanent structures
- Reducing the height, footprint and bulk of structures
- Removal of office accommodation and other non-maritime uses from the waterway
- Increasing visibility to the bridge by layout changes and limitation to vessel sizes
- Increasing visibility to the heritage seawall
- Minimising the extent to which the public visiting berths push into the sight line across the bay

Refer Section 8.5 for consideration of visual impacts.

The entire scheme will be manufactured from proprietary pontoon systems with timber decking throughout. The single material of a consistent timber surface creates an identifiable singular structure on the edge of the bay. The use of timber respects the maritime heritage of the site, whilst providing a contemporary and minimalist feel.

The western scheme will be seamlessly integrated in to the existing fixed deck timber boardwalk around the southern shore of Cockle Bay. New ramps will connect to both the existing boardwalk at the lower level and to the promenade level above.

4.13 Signage and Interpretation Points

Signage will be integrated into the design, rather than placed as a separate overlay. Three levels of signage are required:

- Primary wayfinding– main directional signage indicating name, route to wharf and public berths, plus informational notifications (no swimming, no cycling, no fishing etc)
- Informational reminder – signage at main activity points, with reminders for no swimming, fishing or berthing
- Interpretive signage – information outlining legacy and history of Cockle Bay. This signage will be integrated directly into the material and finishes of the structures where possible.

Signage will be in accordance with the Authority's Draft Public Realm Manual, Heritage Interpretation Strategy and Signage Policy.



Figure 26: Precedent Images Informing Materiality

5 Consultation

5.1 Consultation Report

The Authority has undertaken extensive consultation in developing the proposal and all pre DA consultation is now complete.

Consultation has been undertaken in accordance with the Department's Major Project Community Consultation Guidelines October 2005 and a detailed Consultation Log has been maintained.

5.2 Summary of Findings from Consultation Process

The consultation process was commenced at the earliest point in the process and has informed the design of the proposal. In general, stakeholders' input was sought proactively and resulted in requirements being accommodated in the project as it developed. It is considered that the proposal as documented appropriately responds to all stakeholder inputs and feedback, with minor exception as analysed at Section 5.8: Analysis of Outstanding Consultation Issues.

The Authority has consulted with each of the authorities nominated in the SEARs and a summary of this consultation is provided at Section 5.9.

5.3 Consultation Objectives

The Authority's consultation objectives for this proposal include:

- Ensuring that factual information about the proposal is available to people with an interest
- Allowing the community and relevant stakeholders to have their say in the assessment process
- Bringing new information and ideas to the project
- Avoiding unnecessary delays by addressing stakeholder concerns prior to lodgement
- Providing an opportunity for the negotiation of outcomes acceptable to both the proponent and community
- Enhancing the Authority's reputation in the community

The Authority has organised, resourced and documented the consultation process and aimed to:

- Consult early
- Commit adequate resources to consultation
- Clearly describe who has been consulted and what issues were raised
- Demonstrate how the issues raised during the consultation process have been addressed in the environmental assessment

The Authority has given consideration to the nature of the proposal and the extent of its likely environmental, social and economic impacts and the level of consultation required in the SEARs and has sought to:

- provide adequate opportunity for those individuals and organisations likely to have an interest in to express their views
- accurately and widely distribute information regarding the nature of the proposal (letters to key stakeholders, newsletters, project webpage)
- encourage, consider and keep records of community and stakeholder feedback

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5.4 Consultation Programme

The Authority has identified the following phases of consultation which it will lead.

5.4.1 Phase 1: Pre-DA

Pre-DA consultation took place between September 2014 and May 2015 and is now complete. DA consultations are to be led by the SSD process.

5.4.2 Phase 2: Pre-Construction

Subject to determination of this proposal, pre-construction consultation is expected to take place between October 2015 and January 2016.

5.4.3 Phase 3: Construction

Consultation is expected to take place throughout the construction period between February and December 2016.

5.5 Stakeholder Analysis

The Authority established a Project Working Group as part of its governance structure at the commencement of the project, with representatives from the Authority's specialist departments. The Project Working Group has undertaken a detailed stakeholder analysis and the following categories of stakeholder have been identified:

- Government agencies identified in the SEARs
- Other Government agencies involved in briefing the project
- Other Government agencies with an interest in the project
- Industry bodies with an interest in the project
- Media
- General public
- Ground lease tenants surrounding the site
- On-water tenants with licences over the existing structures

Stakeholder consultation will be targeted in each phase of the consultation process as indicated in Table 5 below.

Table 5: Stakeholder Consultation Phases

Stakeholder Group	Phase 1 Pre-DA	Phase 2 Pre- Construction	Phase 3 During Construction
Government agencies identified in SEARs	Yes	Yes	Yes
Other Government agencies and industry bodies involved in briefing the project	Yes		
Other Government agencies with an interest in the project	Yes	Yes	Yes
Industry bodies with an interest in the project	Yes	Yes	Yes
Media		Yes	Yes
General public		Yes	Yes
Ground lease tenants surrounding the site	Yes	Yes	Yes
On-water tenants with licences over the existing structures	Yes	Yes	

The general public was not consulted prior to DA lodgement as there are no residents living in the immediate vicinity and no negative impacts to the service offering to the public will result from the proposal.

5.6 Communication Channels

A Communications Management Plan has been prepared and is being progressively implemented. The plan has identified the following communication channels applicable to this project:

- Media releases
- Project Website
- Project Information Sheet
- What to Expect during Construction Sheet
- Darling Harbour Newsletter
- Project presentations
- Existing and Project specific meetings
- Email
- Direct mail
- Hoarding signage
- 1300 customer relationship management number
- Contact/complaints register

5.7 Consultation Completed to Date

All phase 1 consultation has been completed and is recorded in the Project's consultation log as required by the Major Project Consultation Guidelines.

5.7.1 Authority Internal Consultation

The Authority's internal consultation process commenced with a series of User Group workshops to identify user requirements for the proposal, prepare a functional brief and inform the concept design. The following User Groups were established:

- Marine Leisure and Tourism Future for Cockle Bay
- Designing for Events and Activation
- Asset Management, Maintenance, Sustainability and Lifecycle Considerations
- Safety, DDA and Security
- Urban Design and Heritage

User Groups were represented by functional expertise from the Authority, including heritage, strategic planning and event management. Government and industry bodies were also consulted during the briefing process.

The design has subsequently been reviewed by the Authority's Project Working Group, Project Control Group and Executive team, the Authority's Design and Development Advisory Panel and Board and a number of government authorities.

5.7.2 Government Authorities & Industry Bodies – Briefing the Project

In addition to functional experts within the Authority, the following Government authorities and industry bodies were involved in briefing and reviewing the design between September 2014 and May 2015:

- Maritime Management Centre
- RMS Wharf Safety
- RMS Navigation
- Port Authority
- NSW Commercial Vessels Association

The Maritime Management Centre and NSW Commercial Vessels Association were invited to brief the project via project user groups. The schematic design has been reviewed by RMS Operations (Navigation and Public Wharf Safety) and the Port Authority and comments incorporated into the final proposal.

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5.7.3 Government Authorities – SEARS Comments

Government agencies nominated in the SEARs (as follows) were considered a high priority and were briefed during the concept and their comments have been considered in finalising the design.

- City of Sydney Council
- Transport for NSW
- Roads and Maritime Service
- Port Authority of NSW
- Environmental Protection Agency
- Office of Environment & Heritage
- Sydney Water Corp
- Department of Primary Industries

5.7.4 Other Government Authorities and Industry Bodies

The following Government authorities are aware of the proposal and have been advised of the availability of the Authority's staff to provide more detailed briefings on request:

- NSW Treasury
- Department of Premier and Cabinet
- NSW Event Operations Group
- Heritage Council
- Infrastructure NSW
- Destination NSW
- Committee for Sydney
- Tourism and Transport Forum
- Boating Industry of Australia

5.7.5 Tenant Briefings

The following Authority tenants have ground leases surrounding the subject site and were briefed between December 2014 and May 2015:

- Owners and operators of Harbourside Shopping Centre
- Australian National Maritime Museum
- Owners and operators of IMAX Building
- Owners and operators of Cockle Bay Wharf complex
- ICC Sydney and Darling Harbour Live consortium
- Owners and operators of Darling Quarter
- Owners and operators of Aquarium complex

5.7.6 On-water Licensee Briefings

The Authority's on-water licensees were briefed in May 2015. Licensees have been provided with reasonable notice of the construction programme.

- Owner and operator of South Steyne Floating Restaurant and Function Centre
- Operator of Darling Harbour Marina
- Owner and operator of Darling Harbour Water Taxis
- Owner and operator of Bass & Flinders Cruises
- Operator of Sydney Jet Boat

5.8 Analysis of Outstanding Consultation Issues

Most stakeholders have strongly supported the proposal, considering it to be a positive contribution to Darling Harbour and of great benefit to the public. Feedback has been welcomed and incorporated into the proposal where possible.

The following provides a brief analysis of matters raised which are either not addressed in the proposal or are inconsistent with the proposal's objectives.

5.8.1 Potential Impacts on Barangaroo Ferry Hub

The proposed ferry hub at Barangaroo will be a major new element in the public water transport system for Sydney. Concern was raised about the potential impact the proposal might have on the operation of the new hub if there were to be an increase in vessel movements entering and leaving Cockle Bay. The proposal is not expected to result in increased vessel movements past the Barangaroo ferry wharves as the anticipated modest increase in commercial vessel activity is balanced by a reduction in recreational vessel berthing capacity. However, the service demand of ICC Sydney and other precinct stakeholders is not guaranteed and therefore there may be a modest increase in vessel traffic over time.

5.8.2 Permanent Berthing/Boat Storage in Cockle Bay

A number of stakeholders sought clarification regarding whether it is proposed to allow permanent berthing within the bay with a number opposing any commercial permanent berthing. Concerns relating to permanent berthing include water quality, visual and operational impacts.

The existing consent for the marina includes approval to permanently berth six vessels. The proposal seeks to provide flexibility to allow up to six short stay berths to be used for the permanent storage of event service vessels and charter vessels. This provides for no intensification of use. Use of the permanent berths will be restricted to vessel storage only and no other uses will be permitted including maintenance, waste disposal including vessel pump out, loading of goods and materials, ticketing, advertising or other ancillary functions. No recreational vessels will be permitted to permanently berth in Cockle Bay.

The permanent storage of 2 Authority owned service vessels is an imperative to enable the staging of events and the Coxswain's service controlling navigation safety in Cockle Bay. Vessel details are as follows:

Events vessel

- Aluminium punt with petrol outboard
- 5m length, 600mm total height, no cabin

Coxswain vessel

- Arvor with inboard diesel engine
- 5m length, 1.8m cabin height from waterline

Details of proposed commercial vessels are not available at this time but they must not exceed 15m.

5.8.3 Location of Wharf

The NSW Commercial Vessels Association expressed a preference for the siting of the wharf on the eastern shore because of perceived ease of access for commuters to the CBD and to compensate for the anticipated loss of King Street Wharf on the eastern shore of Darling Harbour to the north.

The siting of the wharf on the western shore is based on feasibility studies undertaken by ARUP and is based on 3 key factors:

- Proximity to ICC Sydney
- Separation of events and maritime uses in the bay
- Compliance with the Darling Harbour design principles and connectivity to the landside precinct

Given the primary importance of ICC Sydney to the Darling Harbour precinct, a location in convenient proximity to the ICC Sydney facilities was a primary consideration. This consideration has been accommodated in the design, whilst ensuring the required separation of the wharf to enable the effective and efficient delivery of events in the bay. The wharf is located far enough south to be within

easy walking distance to the ICC forecourt and far enough north to be out of the designated events zone. This enables maximum utilisation of the wharf.

5.8.4 Views of Promenade Substructure from Western Scheme

The Authority's Design and Development Advisory Panel queried the visual impact of the promenade substructure as viewed from the western scheme.

There will be limited views of substructure at low tide. The team is currently undertaking a photo view analysis to identify whether any screening of the substructure is required for aesthetic reasons.

Any screening required will have an interpretive value or possibly involve an art form to add to the experience of the user.

5.8.5 Opportunities to Optimise Seating and Shade

The Authority's Design and Development Advisory Panel identified an opportunity to maximise public amenity by providing more space for public viewing and seating adjacent to Pymont Bridge.

The footprint available under the bridge is limited because there is shallow water to the west and the heritage fabric of Pymont Bridge piers to the east. It is therefore not feasible to widen the scheme at this location for safety and heritage protection reasons. However, a heritage interpretation station is provided immediately south of the bridge and will be in shadow of the bridge for part of the day. Improvements to this location to meet the stated objective will be investigated further during detailed design of the proposal.

5.8.6 Passenger Shelter

A number of stakeholders have proposed all weather protection and particularly shade, for waiting passengers. Shade structures impacts visual amenity and are not proposed. Some shade is provided at the heritage interpretation station as addressed above.

5.8.7 Height of Wharf Freeboard

The charter vessel industry has proposed freeboard heights between 500mm and 1m for the western facility considering the varying heights of vessel decks. The final freeboard height will be resolved during detailed design.

5.8.8 Ancillary Facilities for Permanent Berthing of Commercial Vessels

The Industry has requested ancillary facilities adjacent to permanent commercial berths on the recreational boating facility including point of sale, equipment storage and advertising. The design philosophy has been based on maximising available space for public use and de-cluttering the bay including removal of ancillary structures on top of marine structures. Third party advertising over water is prohibited development.

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5.9 Summary of Public Authority Consultation as Required by SEARs

The Authority has consulted with each of the authorities nominated in the SEARs. Initial concept plans were issued and authorities were briefed in November 2014. Table 6 below summarises feedback provided by the authorities at the briefing and in subsequent meetings and conversations, and the proposal's response.

Table 6: Summary of Public Authority Consultation

Issue	Response
City of Sydney Council	
What will be done with the existing barges used for events? Where will these vessels be stored?	In response to these comments, the design was modified to provide dedicated storage for event barges as part of the eastern scheme
Are any shade structures proposed on the new facilities?	No shade structures are proposed on the facilities because of the visual impact they present. Some shade will be available at the interpretation area immediately to the south and in the partial shadow of the bridge. Refer Section 5.8 for further details
Transport for NSW	
Generally interested in a reduction in number of marina berths and limit on sizes of vessels. Confirmed Sydney Ferries would in future only stop at Pyrmont Bay south of Barangaroo but that private ferry operators could utilise Barangaroo for transfer purposes into Cockle Bay	The recreational boating facility will have 10 fewer berths than the existing marina. Further recreational vessels using the facility will be limited to 15 metres in length to improve navigation safety and minimise risk of damage to heritage listed Pyrmont Bridge (the existing marina includes 14 x 18m berths and 2 x 24m berths)
Concerns about increased water traffic in the Darling Harbour waterway and possible impacts on Barangaroo ferry operations	No net increase in vessel traffic in Darling Harbour is anticipated as a result of the proposal. Refer Sections 4.11 for capacity & sizing considerations Refer Section 8.12 for navigation safety considerations
If vessels are limited in size, where do the other vessels go which have been displaced?	The Authority's navigation safety consultant has recommended that commercial vessels servicing the bay are limited to 35m and recreational vessels are limited to 15m in length Only 3 of the 25 commercial vessels berthing in Cockle Bay during the twelve months prior to the closure of the former convention centre were longer than 35m. This is equivalent to only 2% of the total berthings during the period. These vessels have access to nearby berths at King Street Wharf, Casino Wharf, Pyrmont Bay Wharf and Aquarium Wharf. Most of the vessels currently using the marina are between 7m and 14m. 97% of vessels using Sydney Harbour are under 14 m in length Displacement impacts are therefore expected to be minimal. Refer 5.7.6 for further details
Anticipate no significant traffic or parking issues with intensity of development not increasing. Key issue will be a traffic management plan for construction Attention to the pedestrian maritime interface will be required	A traffic management plan will be prepared for the construction phase of the proposal Refer 8.13 for transport, traffic and parking impacts The proposal improves the pedestrian maritime interface by providing access to and from vessels for all people at all tides. The proposal complies with relevant Australian Standards and provides greater safety and a more logical and complementary flow and connection. Refer Sections 4.10 for urban structure and siting considerations Refer Section 8.4.4 for proposed uses/existing public domain interface considerations

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Table 6: Summary of Public Authority Consultation (continued)

Issue	Response
Roads and Maritime Services	
Consider travel distance to landside connection points	The travel distance from the wharf to the landside is informed by extent of the structure connecting the wharf to the landside, which in turn is determined by the need to safely handle the anticipated peak number of passengers, whilst not impacting on the circulation of the landside promenade. Refer Section 4.12 for further detail
Consider how boats will be prevented from dropping off at non-public wharf locations	Suitable signage will be provided; mooring cleats/bollards will not be provided at non-wharf locations; the Authority's ranger and coxswain services will manage non-compliance
Ensure adequate segregation of public wharf from non-public wharf zones	The public wharf will be adequately segregated. RMS will reviewed the detailed design to assess compliance with public wharf safety requirements
Consider passenger management and allow adequate space for waiting/embarking/disembarking passengers (up to 600 passengers)	The wharf and access arrangements have been sized to safely and efficiently handle anticipated passenger volumes Refer Section 4.11.1 for western scheme sizing considerations Refer Section 7.1.4 for public safety & accessibility considerations
Consider use of railings, ladders and lifebuoys	Railings, ladders and lifebuoys will be provided as required by Australian Standards, RMS Public Wharf safety requirements and the findings of relevant risk analyses
Consider management during fireworks	The proposed scheme removes all structures from the exclusion zone of 65mm shell fireworks. As the bay is closed during fireworks displays and no vessel movements are permitted, the wharf will be closed. The Authority will manage public access during fireworks displays in accordance with its standard protocols
Consider wave action and impact damage on structure	This will be considered during detailed design and RMS will be consulted accordingly
Port Authority of NSW	
Navigation channels and vessel priorities at Pyrmont Bridge to be resolved	The Authority will consult with the Port Authority during detailed design to meet requirements
Navigation safety including vessel circulation to be resolved	The Authority will consult with the Port Authority during detailed design to meet requirements
Consider operational phase protocols and how these will be enforced	The Authority will consult with the Port Authority during detailed design to meet requirements
Construction zone to be appropriately segregated through use of buoyage/pollution booms/lighting	The Authority will consult with the Port Authority during detailed design to meet requirements
Rangers to be on 24 hour call in case of incidents	The Authority will consult with the Port Authority during detailed design to meet requirements
Access to stormwater drains to be maintained during construction in case of pollution incident	The Authority will consult with the Port Authority during detailed design to meet requirements
Traffic management plan required	The Authority will consult with the Port Authority during detailed design to meet requirements
Approval required for disturbance of seabed	The Authority will consult with the Port Authority during detailed design to meet requirements

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Table 6: Summary of Public Authority Consultation (continued)

Issue	Response
Environment Protection Authority	
Identification of proposed demolition and construction hours – see recommended standard hours (p.8) per Table 1 to the EPA's Interim Construction Noise Guideline at http://www.epa.nsw.gov.au/noise/constructnoise.htm	Propose change to ICNG Saturday working hours Refer Section 3.2.3 for proposed construction hours and justification
Full justification of any demolition and construction work that may be proposed to be undertaken outside the recommended standard hours	Propose change to ICNG Saturday working hours Refer Section 3.2.3 for proposed construction hours and justification
Intra-day respite periods (i.e. 3 hours on, 1 hour off) for highly intrusive demolition and construction activities such as saw cutting, jack hammering, rock breaking, piling and vibratory rolling;	It is not considered that this will be required Refer Section 8.17.6 for construction noise assessment
A comprehensive demolition and construction noise and vibration impact assessment, including the predicted noise impact footprint using the LAeq (15 minute) noise descriptor and additionally the LA1 (1minute) noise descriptor for any night works (Note: a 5 dB adjustment factor applies to highly intrusive and annoying demolition and construction activities),	Refer Section 8.17.4 for noise criteria Refer Section 8.17.6 for construction noise assessment
Assessment of contamination of shore-side areas of the site and marine sediments (including ASS and PASS) – see the 1998 Acid Sulfate Soils Manual published by the NSW Acid Sulfate Soil Management Advisory Committee (ASSMAC)	Refer Section 8.14.3 Baseline Conditions and 8.14.6 Geotechnical Considerations and Acid Sulphate Soils
Demolition and construction related waste classification, handling and management – see EPA's Waste Classification Guidelines including – http://www.epa.nsw.gov.au/resources/waste/091216classifywaste.pdf http://www.epa.nsw.gov.au/resources/waste/08446acidsulfsoils.pdf	Refer Section 8.10.2 Waste Management Impacts during Construction
Site preparation, demolition and construction phase dust control and management, including controls for works over harbour waters	Refer Section 8.16 for air quality & odour impacts
Site preparation, demolition and construction phase runoff and sediment control and management;	No landside works are proposed
Construction-related waste handling and management, particularly concrete waste and rinse water	Refer Section 8.10.2 for waste management impacts during construction
Determination of background noise levels in accordance with the principles and guidance material provided in the NSW Industrial Noise Policy	Refer Section 8.17.3 for existing acoustic environment
Operational noise and vibration impacts on noise sensitive receivers (especially surrounding residences both sides of the bay) arising from operational activities such as outdoor entertainment events, including sound checks in preparation for those events	Refer Section 8.17.8 for noise impacts during operational phase
Identification of the capacity (i.e. number of vessels of all types) that the new marina would be capable of handling at any time – the marina operator may need an environment protection licence	The recreational boating facility will provide 40 berths. This is less than the minimum 80 listed in the Protection of the Environment Operations Act in Schedule 1 and accordingly an environment protection licence is not required
Details and justification of any proposed refuelling, maintenance or effluent pump out facilities	No refuelling, maintenance or pump out facilities are proposed. These are not required due to the short stay nature of the berthing

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Table 6: Summary of Public Authority Consultation (continued)

Issue	Response
Environment Protection Authority (continued)	
<p>The EPA has also identified the noise from 'beeper' type plant movement alarms to be particularly intrusive and is aware of feasible and reasonable alternatives. Transport for NSW (nee Transport Construction Authority), Barangaroo Delivery Authority/Lend Lease and Leighton Contractors (M2 Upgrade project) have undertaken safety risk assessments of alternatives to the traditional 'beeper' alarms. Each determined that adoption of 'quacker' type movement/reversing alarms instead of traditional beepers on all plant and vehicles would not only maintain a safe workplace but also deliver improved outcomes of reduced noise impacts on surrounding residents.</p>	Noted
<p>Interim Construction Noise Guideline Appendix C provides additional background material on this issue.</p>	Noted
<p>The proponent should commit to undertaking a safety risk assessment of construction activities to determine whether it is practicable to use audible movement alarms of a type that would minimise the noise impact on surrounding noise sensitive receivers, without compromising safety.</p>	<p>This is not considered applicable to the proposed development which is a water based construction process, with materials brought in primarily by barge</p>
<p>Will there be any dredging?</p>	No dredging is proposed
<p>Seeking confirmation that no long term layover of vessels proposed/ just drop off and pick up and no permanent berthing</p>	<p>The recreational boating facility is proposed for short stay of recreational vessels for up to 24 hours with flexibility for six of those berths to be used for permanent berthing of event service vessels and charter vessels.</p> <p>It is noted the existing Cockle Bay marina allows permanent berthing of six commercial vessels. The proposal does not increase the number of permanent commercial berths in the bay</p> <p>Water taxis will be permitted to wait at dedicated water taxi stops as long as they stay with their vessels</p>
Office of Environment and Heritage	
<p>Is a Heritage impact assessment being undertaken?</p>	Yes – provided at Appendix 6
<p>Cockle Bay precinct has potential for submerged maritime sites</p>	Submerged sites have been considered. Refer Section 8.11.3 and Appendix 6
<p>Will there be any heritage impact on existing heritage items?</p>	Yes – Refer Section 8.11.3 and Appendix 6

6 Consideration of Policies and Plans

The site and proposal are subject to a number of Government policies, strategic plans and environmental planning instruments which have been considered throughout the proposal development process.

6.1 Government Policies and Guidelines

Because of its prime location within Sydney, the proposal has sought to contribute to broad government objectives to support growth in the visitor economy and enhance public access to and along the foreshore of Sydney Harbour.

6.1.1 NSW 2021 (2011)

The State Government's 10 year business plan aims to improve the NSW economy, rebuild infrastructure, improve quality of services and government accountability and strengthen local communities. The proposal contributes to the following goals and targets:

- **Goal 1 Improve the performance of the NSW Economy:** target "increase tourism in NSW with double the visitor expenditure by 2020"
- **Goal 19 Invest in critical infrastructure:** target "major strategic infrastructure delivered as a priority as promised". An identified priority action is "construct a world-class conference and exhibition facility at Darling Harbour to enable NSW to compete for international business events"
- **Goal 27 Enhance cultural, creative, sporting and recreational opportunities:** target "increase the number of major international sports, artistic, creative and cultural events in NSW from 2010 to 2016 by 10%"

The proposal renews public infrastructure in Cockle Bay, Darling Harbour and in so doing supports it as a world class destination and Sydney's premier gathering place. In particular, the southern part of the bay will become more usable for events. Public access and safety will be enhanced. The proposal is located within the visual forecourt of the new International Convention Centre and will complement its functions.

6.1.2 A Plan for Growing Sydney 2031 (2014)

This Government's vision for Sydney is: a strong global city, a great place to live. To grow a more internationally competitive Sydney CBD, the Plan proposes to deliver a vision for Sydney Harbour which will:

- Improve public access to the harbour and its foreshores, and maintain its ongoing role as a focus for major civic events and celebrations
- Enable opportunities to improve ferry services throughout Sydney Harbour and its tributaries

The proposal contributes to these objectives by improving the amenity and functionality of Sydney's most popular foreshore place for events and by providing safe and modern facilities for leisure and water transport services. The facilities will be accessible to all people at all tides enhancing established foreshore public access.

6.1.3 Draft Sydney Sub-regional Strategy NSW (2008)

The proposal supports a number of objectives under the draft subregional strategy including:

- Improve access to waterways and links between bushland, parks and centres
- Continue to plan for the improvement of tourism precincts in Sydney

Cockle Bay is central to Darling Harbour, one of the City of Sydney's key tourist precincts. The proposal is a major renewal initiative which will lead to an overall upgrade in the public domain at Darling Harbour, and its visitor appeal and accessibility especially by water.

6.2 Statutory Considerations

The *Environmental Planning and Assessment Act 1979* establishes the framework for State Significant Development. An Environmental Impact Statement is required to be submitted with an application in the form prescribed by the Regulations.

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6.2.1 State Environmental Planning Policy (State and Regional Development) 2011

Development on the subject site is declared to be State Significant Development subject to Schedule 2, Clause 2b of SEPP (State and Regional Development) 2011, as the development is located in Darling Harbour and has a value exceeding \$10 million. As such the Minister for Planning is the consent authority for the proposal.

6.2.2 Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005

Sydney Regional Environmental Plan (Sydney Harbour Catchment) includes the waterway of Cockle Bay in its provisions. Cockle Bay is not zoned under the SREP but is within the Foreshores and Waterways Area and therefore a range of matters must be considered (clauses 21 to 27). These matters are addressed in Table 7. Figure 27 below shows that Cockle Bay is not zoned under the plan (shown pale blue) but is within the Foreshores and Waterways Area (shown by a heavy black line).

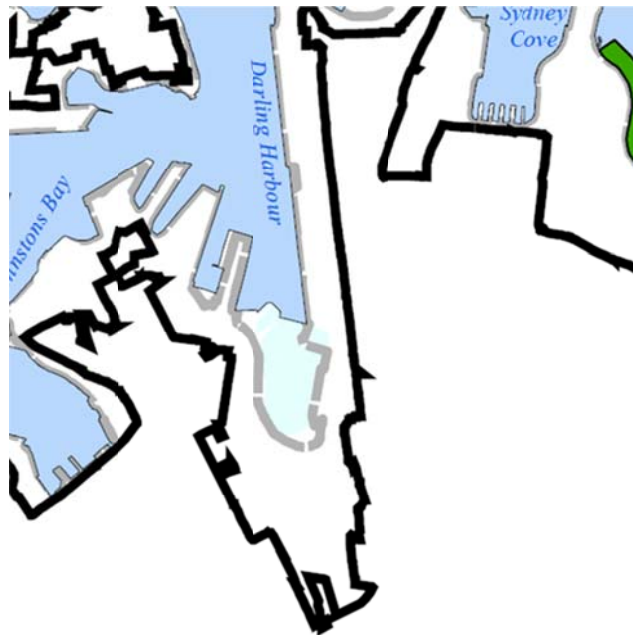


Figure 27: Extract from SREP showing Cockle Bay Zoning

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Table 7: Response to SREP Considerations

Matters for Consideration	Response
Biodiversity, ecology and environment protection	Cockle Bay was the state's major rail-sea goods interchange for over 100 years and its marine environment reflects this prior heavy use. There is a general lack of aquatic biodiversity and the primary environmental issues relate to minimising disturbance of sediments during construction. Refer Section 8.14 Water Quality and Contamination Impacts
Public access to and use of foreshores and waterways	The proposal will improve public access to the foreshore and interface between the waterway and the land. Both facilities will be accessible to the public at all times except during major fireworks and major events for safety reasons
Maintenance of a working harbour	The proposal will support working harbour operations by providing safe facilities for public and private marine operators to access and use the bay. The commercial users of Cockle Bay, the Port Authority and RMS were consulted in the planning of the project and their input has helped inform the functional design of the facilities
Interrelationship of waterway and foreshore uses	The proposal is for a public facility adjoining a public foreshore area and is therefore compatible with existing and future use of the area. The proposal will improve the relationship between the waterway and foreshore by providing access at all tides for all people to vessels using the facilities
Foreshore and waterways scenic quality	The proposal comprises floating structures and ramps with a low visual profile. It will be less visually intrusive within the bay than existing structures. The foreshore is highly urbanized and the new structures are compatible with this setting. Views to the waterway are retained and optimized from surrounding locations and the overall result is a more favourable visual aesthetic of the bay
Maintenance, protection and enhancement of views	Views will be maintained and enhanced with the proposed development having a smaller water footprint and visibility of Pymont bridge and historic seawall on the western side of the Bay improved
Boat storage facilities	The proposed development contributes to supply of public boat storage facilities by providing rare access for recreational vessels to visit the city on a short term basis. The public visiting vessel facility will provide up to 40 berths for such vessels for up to 24 hour stays. Cockle Bay is relatively sheltered and is not adversely affected by the wave environment for mooring purposes

6.2.3 Darling Harbour Development Plan No.1

Darling Harbour Development Plan No. 1 is the principal environmental planning instrument applying to the site. Under Schedule 6 Part 7 Clause 23(1) of the Environmental Planning and Assessment Act 1979, the Darling Harbour Development Plan No. 1 is taken to be a Regional Plan. Subsequently, by operation of Schedule 6 Part 21 and Clause 15 of the Environmental Planning and Assessment Regulation 2000, Regional Environmental Plans are now deemed to be State Environmental Planning Policies (SEPPs).

Uses which are permissible are outlined in the deemed SEPP and are fairly broad including public transport, recreation, entertainment and cultural facilities. It is noted that there are no development controls such as heights, setbacks or floor space ratios within the instrument. The proposal is permissible with development consent.

The objectives of Darling Harbour Plan No. 1 are:

- *to promote the development of the Darling Harbour area as part of the State's Bicentennial Program;*
- *to encourage the development of a variety of tourist, educational, recreational, entertainment, cultural and commercial facilities within that area; and*
- *to make provision with respect to controlling development within that area.*

The proposal contributes to these objectives by renewing facilities built to celebrate the Bicentennial nearly 30 years ago and therefore extending the longevity of this legacy. It brings the facilities up to date with contemporary standards to improve public safety and meet current user requirements. The proposal will allow continued use of the waterway and Darling Harbour as an area focused on tourist, educational, recreational, entertainment, cultural and commercial facilities.

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6.2.4 State Environmental Planning Policy No. 64 – Advertising and Signage

The provisions of the SEPP do not apply as the proposal does not include any advertising signage.

6.2.5 Sydney Environmental Planning Policy No.55 – Remediation of Land

A water quality assessment has been provided which determines that the site is suitable for development. There is not known to be any requirement for remediation works and the proposed development is appropriate and does not require further assessment under the provision of SEPP 55.

6.2.6 Sydney Harbour Foreshores and Waterways Development Control Plan

The provisions of the Sydney Harbour Foreshores and Waterways Development Control Plan do not apply to the Cockle Bay site which is excluded from the area of this plan. The DCP states:

Where and When the Plan Applies

The Plan applies to all development proposals within the Foreshores and Waterways Area identified in SREP (Sydney Harbour Catchment) 2005 (refer to the Foreshores and Waterways Area map). It principally relates to the waterway and adjoining land identified on the maps accompanying this plan. It should be noted that this DCP does not apply to those parts of the Harbour not covered by SREP (Sydney Harbour Catchment) 2005, that is, Walsh Bay and Cockle Bay but does now apply to the Lane Cove River and the Bays precinct (Blackwattle, Johnstons, White and Rozelle Bays).

6.2.7 Contributions

No contribution plan applies to the subject site and the proponent is a public authority.

7 Construction Methodology and Staging

In order to evaluate the potential construction impacts for the proposal, the following process has been assumed:

1. Site Establishment: Includes installation of hoardings on the land; all amenities and equipment will be on barges delivered via the waterway;
2. Dismantling and removal of the existing structures: The existing timber structures and pontoons will be dismantled and removed; all piles will be removed, where possible; piles will be cut off at seabed level but if they cannot be removed or if removal may disturb a heritage relic (heritage will take precedence);
3. Removal of the existing Harbourside Steps: The existing concrete steps will be sawn and removed using water based crane;
4. Installation of piles: The timber and steel piles supporting the new structures will be installed using water based crane and piling rig;
5. Installation of the structures: All pontoon systems will be proprietary timber-decked concrete floats manufactured off-site; these fixed structures will be delivered to the site by a service barge. The pontoons will be lifted onto the piles by water based crane; and
6. Fit out of the wharf: Installation of services and signage will occur progressively following pontoon positioning.

All demolition and construction will be undertaken using best practice environmental controls and using modern communications methods. Works will be conducted from the waterway and all demolished material either recycled or disposed of at a licensed facility. Screwed piles will be used to minimize noise impacts.

The project will be constructed in stages to accommodate the precinct events and activation schedule. The following construction windows have been established through consultation with the Authority's Events Team. This team collaborates with the Department of Premier & Cabinet and the City of Sydney through EOG (Events Operations Group) in relation to interagency event coordination. The following stages have been identified for construction (refer Figure 28 below):

Stage 1 (NW Scheme)

- February – May 2016
- Demolish Harbourside Jetty, Harbourside Promenade and Harbourside Steps
- Build new wharf and connection to ANMM

Stage 2 (SW Scheme & Eastern Scheme)

- August – November 2016
- Demolish existing marina
- Build new recreational boating facility and events pontoon
- Demolish Convention Wharf and build connection to ICC Sydney



Figure 28: Construction Staging

8 Impact Assessment

8.1 Construction Impacts

This section addresses SEARs Key Issue 16 as stated below:

- Identify measures to ameliorate potential construction impacts including vehicular, pedestrian and maritime access, noise and vibration, air quality, erosion and sediment control, water quality and waste management

Construction impacts are included along with operational impacts in the following sections:

Table 8: Construction Impact Section References

Construction Impact	Section Reference
Vehicular Access	8.13.4 Construction Impacts (Transport, Traffic and Parking)
Pedestrian Access	8.4.5: Public Access Impacts during Construction (Public Access)
Maritime Access	8.12.5 Assessment of Maritime Access Impacts during Construction Phase (Navigation Safety)
Noise & Vibration	8.17.6 Construction Noise Assessment
Air Quality	8.16.5 Assessment of Construction Impacts (Air Quality)
Flora and Fauna	8.15.4 Construction Effects Assessment (Flora & Fauna)
Water Quality, Erosion and Sediment Control	8.14.4 Construction Effects Assessment (Water Quality)
Waste Management	8.10.2 Waste Management Impacts during Construction
Event Management	8.6.4 Construction Impacts on Events

8.2 Cumulative Impacts

The Authority has given consideration to the cumulative impacts of construction activity considering other developments underway in the precinct.

There are no other waterfront public domain works planned by the Authority during the proposed construction stages.

ICC Sydney and Four Points Hotel redevelopment will be in progress during construction of the proposal and the Ribbon redevelopment is also expected to be in construction during 2016. Construction of the proposal is not expected to conflict with these works or result in unacceptable cumulative impacts because:

- Works will be undertaken from the water and will not interfere with landside construction access arrangements for other projects
- The proposal has been staged to avoid major events and construction activities will be closely monitored for unanticipated impacts and compliance with approved mitigation measures
- Noise and air quality impacts will be small and localised, occurring at some distance from concurrent developments

8.3 Social Impacts

8.3.1 Potential Issues

This section addresses SEARs Key Issue 15 as stated below:

- Consideration of social impacts including but not limited to potential impacts on existing community facilities and services, employment opportunities, transport infrastructure and public safety

As a proposal for public use, the main social issues relate to whether the facilities meets the needs of the public for water transport and recreational purposes and can be used by all people. In this respect safety and accessibility are primary issues. Secondary issues are employment benefits and disruption to the public during construction.

8.3.2 Existing Community Facilities and Services Impact Assessment

There will be minor impacts to community facilities and services during construction. For further detail and mitigation measures, refer Section 8.4.5 for Public Access Impacts during Construction.

There is a positive impact on existing community facilities and services during the operational phase. The functions of public wharf and recreational berthing will be retained with improved safety and amenity provisions. New facilities will comply with all current standards and guidelines and be fully accessible under all tidal conditions. The proposal will deliver facilities purpose designed for their intended use and aesthetically pleasing.

There will be a minor impact on the use of the new facilities with the introduction of a size limit for recreational and commercial vessels. The majority of existing users are within the proposed size restrictions and the measure will result in improvements to navigational safety in the bay. For further detail and additional mitigation measures, refer Section 8.12.6: Proposed Additional Mitigation Measures (Navigation Safety).

8.3.3 Employment Opportunities

The proposal will result in employment opportunities during the construction and operational phases as follows:

- 45 construction jobs will be created
- 2 new jobs will be created during the operational phase of the proposal; these jobs relate to the safe and efficient operation of the public wharf and recreational berthing facilities and associated navigation safety and environment protection enforcement

8.3.4 Transport Infrastructure Impact Assessment

The proposal will provide transport infrastructure via the provision of a new fully compliant and accessible public wharf which is sited and configured to:

- minimize impacts from the staging of on-water events
- provide improved connectivity to the precinct

The siting and sizing of the wharf enables a modest ferry service to operate into Cockle Bay, whilst maintaining leisure services. ICC Sydney, NSW Commercial Vessels Association and other stakeholders have indicated that a regular ferry service into Cockle Bay would be of benefit to ICC patrons, commuters and the visiting public.

Refer Sections 4.10 and 4.11 for further details relating to siting, capacity and sizing considerations.

8.3.5 Public Safety Impact Assessment

The design complies with all applicable legislation and design standards and the proposal will improve public safety outcomes for users of the Darling harbour precinct.

The following section summarises the assessment of public safety impacts. On-water safety impacts are considered in Section 8.12 Navigation Safety Impacts.

Layout and sizing of the proposed facilities has been informed in the first instance by public safety considerations.

The proposal has been subject to a Safety in Design risk assessment and all applicable recommendations from the assessment will be included in the proposal during the detailed design stage.

One of the key outcomes of this risk assessment on the design is the separation of the western scheme from the western promenade. This has been established at 5m to mitigate the risk of public domain users falling or jumping from the promenade to the pontoons below.

A crowd management analysis has been undertaken and informed the sizing of the access arrangements associated with the public wharf. The design of the access systems provides safe circulation and mustering space and allows for the segregation of moving and seated passengers through passive means such as the location of seating.

The western scheme maintains manageable one-way crowd flowrate of 502 pedestrians/minute under Level of Service D ($\geq 1.4\text{m}^2/\text{pedestrian}$) and 838 pedestrians/minute under Level of Service E ($\geq 0.6\text{m}^2/\text{pedestrian}$). Consideration has been given to the desired pedestrian level of service of the facility and the pedestrian environment in this case allows for sufficient space for the pedestrian to:

- Walk at a relaxed walking speed
- Bypass slower pedestrians
- Avoid conflicts with oncoming or crossing pedestrians and
- Interact visually with the surrounding

The proposal addresses principles for minimising crime risk under the guidelines for crime prevention and the assessment of development applications. The proposal poses a relatively low risk of creating or exacerbating crime. The attractiveness and popularity of the Darling Harbour area generally discourages vandalism and other petty crime. The proposal is located in an open environment with surveillance available from the public promenade and adjacent shopping and dining areas. The area is managed by the Authority with rangers on regular patrols.

The design of the public wharf will comply with RMS requirements for public wharf safety. RMS will be further consulted during detailed design of the wharf structure.

8.3.6 Conclusion and Proposed Additional Mitigation Measures

The proposal will result in positive social impacts for users of the Darling Harbour precinct. Additional mitigation measures proposed to minimise identified impacts are summarised below.

1. Consult with RMS Wharf Safety during detailed design to ensure the public wharf design meets all applicable WHS and DDA requirements

8.4 Public Access Impacts

8.4.1 Potential Issues

This section addresses SEARs Key Issue 3 as stated below:

1. Consideration of existing and future opportunities/benefits for public access to and along the foreshore and waterfront including pedestrian linkage improvements;
2. Identification of proposed open space, public domain and linkages with and between other public domain spaces, including the waterfront;
3. Details on the interface between the proposed uses, public domain, and the relationship to and impact upon the existing public domain

The facilities are for public use and therefore the main public access issues relate to connections with adjoining open space (both on land and water) and potential disrupted access during construction.

8.4.2 Existing and Future Public Access Impact Assessment

The facilities will be open to the public and have been designed to improve public access to and from the waterway for recreation and for water transport services. Access for people with a disability is provided to both facilities and is available at all tides.

The existing marine structures do not meet current design standards for public safety and access. The proposed design meets all current applicable legislative and guidance requirements.

Passenger drop-off and pick-up zones on both facilities comply with navigation and safety requirements for public wharves.

The proposal results in an overall improvement in public access to and from the waterway, and better connections with the surrounding public domain. It will enable less mobile people to access water transport services and will enable 97 per cent of recreational boat owners to visit the bay to watch events or enjoy the attractions of Darling Harbour.

The proposal further enhances public access to the waterway through better designed and safer facilities. In this way the proposal strengthens links between the public promenade and the public waterway.

8.4.3 Proposed Open Space and Linkages Impact Assessment

From its earliest inception as a new city precinct in the late 1980s, Darling Harbour has been intended as “a place for people” with a pedestrianised valley floor. A foreshore promenade has been successfully established around Cockle Bay in accord with the design objectives for Darling Harbour. The proposal complements and supplements the existing foreshore promenade by providing seamless public pedestrian access from the foreshore to all parts of the new facilities.

The western facility acts as an extension to The Boulevard, the main north-south pedestrian street in Darling Harbour, providing a strong link to the open space system of Darling Harbour. The entry/exit ramps are within convenient walking distance to the Australian National Maritime Museum, ICC Sydney and Harbourside Shopping Centre.

8.4.4 Proposed Uses/Existing Public Domain Interface Impact Assessment

The proposal will not interfere or impede established foreshore public access along the promenade. The interface between the promenade and facilities is minimal and flush at the point each of the ramps connect. Special care has been taken with the design of the western scheme to ensure access ramps do not result in congestion on the promenade. Further information is provided in Section 4.10 Urban Structure and Siting.

8.4.5 Access Impacts during Construction

All access and works, including demolition, will be from the water except for the erection of hoardings during site establishment. No landside parking or site compound will be required. All materials, including waste shall be transported to and from the site by vessels provided by the Contractor. Any materials required to be stored on site and all tools will be stored on these vessels.

There will be no on-site vehicular movements associated with the project except for those required for the erection and removal of hoardings. Hoardings will be erected in accordance with the Authority's public domain permit system, requiring access for pedestrians and deliveries at all times. The Contractor will be responsible for the management of vehicles and pedestrian traffic around the site in accordance with the Authority's Vehicle Operations Procedures – Darling Harbour. Vehicle access for hoarding erection and removal will only be from Wheat Road.

The only impact on pedestrians as a result of the project will be the loss of approx. 1200mm width of circulation space on the promenade, as required for hoardings. Where safe to do so, ply hoardings will be replaced with cyclone fencing to maintain views across the water.

8.4.6 Conclusion and Proposed Additional Mitigation Measures

The proposal will result in positive public access impacts for users of the Darling Harbour precinct. Vehicular and pedestrian impacts during construction have been assessed as negligible.

No further mitigation measures are proposed.

8.5 Visual Impacts

8.5.1 Potential Issues

The potential issues are understood to be as stated in Key Issue 5 in the SEARs and matters raised in correspondence attached to the SEARs:

- An assessment of the visual impact of the proposal, particularly on:
 - Land uses along the foreshore areas of Cockle Bay and Darling Harbour;
 - Water uses of Cockle Bay and Darling Harbour;
 - Private properties and significant vantage points in the public domain; and
 - The scenic quality of Cockle Bay.
- Issue identified by the City of Sydney in relation to the visual impact of SHFA vessels and barges

The proposal will have an overall positive impact on the scenic setting of Cockle Bay and open up views to water and Pyrmont Bridge. It will be less visually intrusive than existing marine structures. The following sections assess the visual impacts.

8.5.2 Visual Impact on Land Uses Along the Foreshore

Cockle Bay is surrounded by a public promenade which is edged by:

- Commercial uses - retail and dining at Harbourside Shopping Centre and the Cockle Bay Wharf complex on the western and eastern side respectively
- Business and entertainment uses – new conference facilities (ICC Sydney under construction), new hotel (ICC Hotel), and future office, retail and recreation (at the approved Ribbon development to replace the existing IMAX building) on the southern side of the Bay.

These building and Pyrmont Bridge form the immediate visual catchment to the proposal.

The facilities are anticipated to have a reduced visual impact on their immediate surrounds when compared with the existing situation. This is because the facilities comprise ramps and pontoons and are therefore low-lying structures that float with the tide. In addition they are smaller than the structures they replace opening up more water space to public view by pedestrians and diners in the vicinity.

Both facilities will have consistent deck finishes providing for a more integrated and uniform look and will not include office accommodation, ticketing facilities and advertising signage, thereby reducing visual clutter;. Any directional, information or interpretative signs will be fully integrated into the design of the facilities.

The floating wharf is a simpler and more elegant design solution to the four existing mismatched facilities it replaces. The recreational boating facility has been designed to minimise impact on views from the central plaza of the Cockle Bay Wharf complex by aligning the fairway with this axis.

On the scale of indicative potential visual impact of various developments, the proposed development is rated on the lower end as it is a replacement of an existing facility within an existing largely commercial environment.

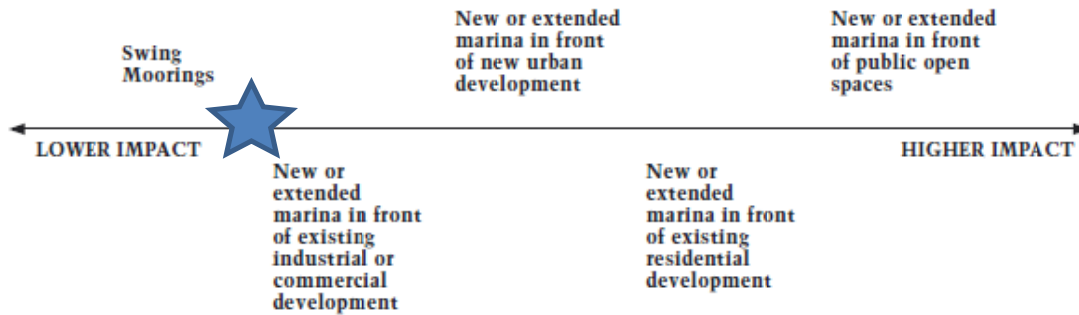


Figure 29: Indicative Potential Visual Impact of Various Development Scenarios (Sydney Harbour Foreshore and Waterways Areas DCP)

8.5.3 Visual Impact on Water Uses of Cockle Bay and Darling Harbour

The main water uses of the Cockle Bay are boating activities and event activities. Boating activities relate to the proposed facilities and there is no passing vessel traffic due to the geographic location of the Bay. The proposal will be both more attractive and less visually intrusive than the existing marine facilities when viewed from the waterway. Boat owners can expect that the bay will appear more open and less cluttered. In particular:

- the floating wharf will appear as a single streamlined and low-lying element replacing four different structures of a more bulky nature;
- the recreational boating facility will also be low-lying with no exposed piles.
- both will have similar finishes and will not have any shelters or advertising signs.

The proposal does not block views to the events area in the south of Cockle Bay.

8.5.4 Visual Impact on Private Properties and Significant Vantage Points

There are no private properties in the immediate visual catchment of the proposal. Beyond this, Cockle Bay is overlooked by a number of residential towers within Pyrmont and the CBD, with more planned in the Haymarket area. The closest residential development is more than 200 metres away and views of Cockle Bay can only be obtained from upper levels. From these elevated locations, the facilities are seen within a broader city and harbour context, rather than in isolation. They do not stand out or detract from the overall visual appeal of the city and harbour, at day or night. From the south, the new Ribbon development (redevelopment of the Imax Building) will obscure views of the recreational boating facility from the new Darling Square residential apartments. Refer to Figure 30 below.

The proposal was designed to maintain primary viewing corridors from the public domain around Cockle Bay, with a particular focus on clearing the waterway in the vicinity of on-water events as identified in Figure 31. The removal of Harbourside Jetty opens up views to the Pyrmont Bridge from the public promenade and main event viewing area at the south of Cockle Bay. Views of the water from this main gathering place have been improved by grading the size of vessels and length of berthing arms on the recreational boating facility with the larger vessels and longer arms further away.

Views from the Pyrmont Bridge are usually associated with pedestrians and cyclists crossing the bridge and are therefore short-term. In addition, viewers are elevated above the waterway and look over the top of the proposal. The proposal does not obscure views to surrounding foreshore areas because they are floating structures.



Figure 30: Artists Impression of View from Stage 1 of the Darling Square Development

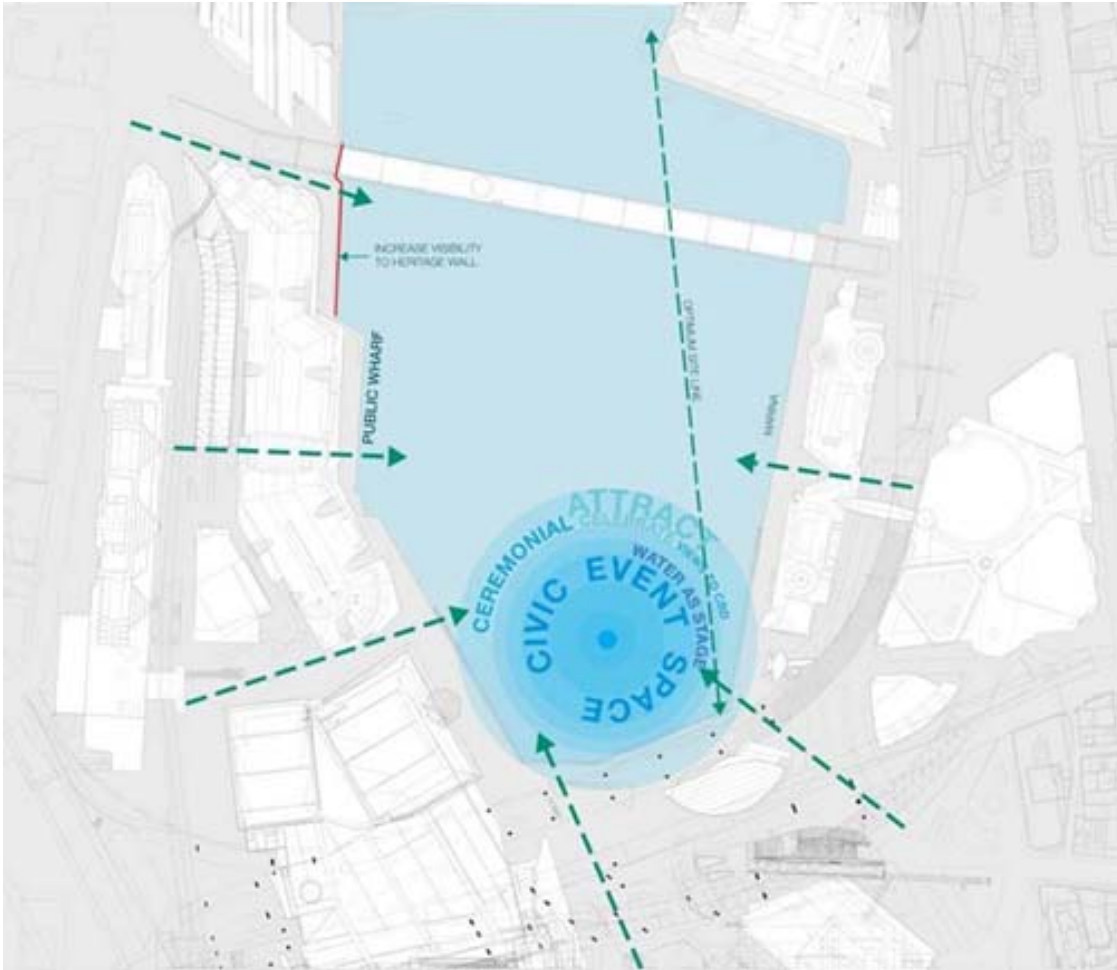


Figure 31: Primary View Corridors



Figure 32: Photo Montage of Proposed Scheme (View North)

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8.5.5 Visual Impact on the Scenic Quality of Cockle Bay

The proposal is located within a highly urbanised setting comprising a number of large and bold buildings and will replace a number of existing marine structures. Cockle Bay and its public promenade surrounds may be characterised as dynamic, reflecting the high level of activity, colour and movement which peaks during events.

This rich and varied city setting has a high capacity to absorb visual change. In general, as a major city location for dining and celebrating, the scale and form of the proposal is visually compatible with its built surrounds.



Figure 33: Urban Landscape showing the ICC Sydney and Ribbon Developments (View South)

8.5.6 Visual Impact of Storage of SHFA Vessels and Barges, including on Pymont Bridge

SHFA vessels and event barges are currently stored underneath Pymont Bridge. They will continue to be stored in the open but at the new recreational boating facility. Existing event barges will be replaced with new pontoon barges which will be stored by connecting them together and to the southern arm of the recreational boating facility. This is a neater solution which will enable them to appear as an extension of the floating pontoon system rather than as separate items.

By removing the Harbourside Jetty, positioning the recreational boating facility further south and relocating events barges, greater physical and visual separation is provided between Pymont Bridge and marine structures.

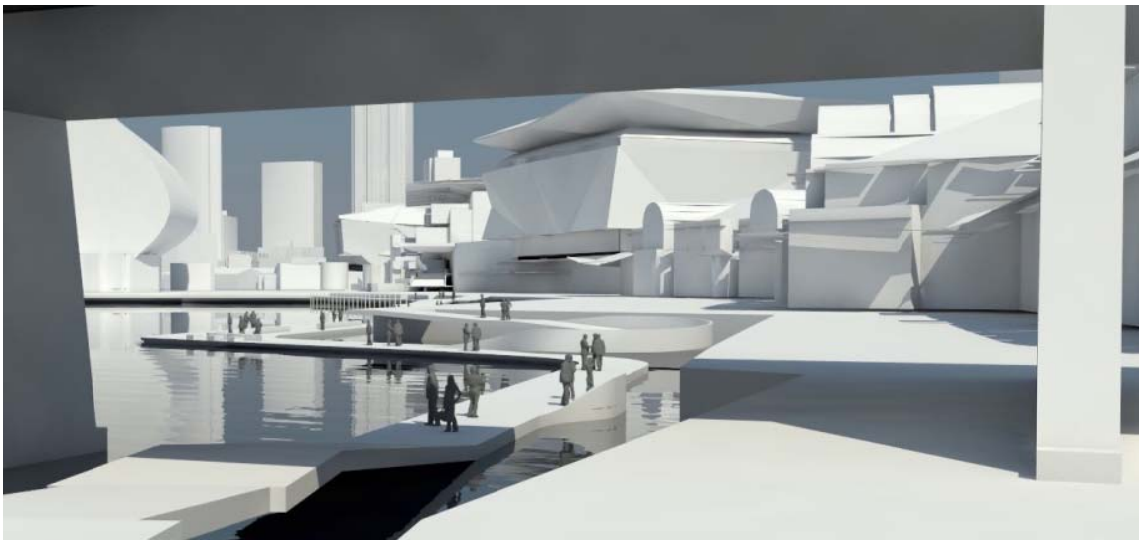


Figure 34: Model Perspective showing View under Pymont Bridge

8.5.7 Visual Impact Assessment of Recreational Boating Facility

A detailed visual impact assessment has been undertaken of the recreational boating facility with reference to the requirements set out in the Sydney Harbour Foreshores and Waterways Development Control Plan. The facility is not a traditional marina as it is a public facility and intended primarily for short stay purposes.

The visual assessment has taken into account:

- Visibility of the proposal
- Magnitude of proposed change
- The level of visual harmony

1. Visibility of the Proposal

Major view situations were identified and analysed against the indicative contribution to visual impact contained in the Table 9. In relation to “spatial relationships”, the recreational boating facility was deemed to fall into the medium category, with reference to Table 10, as most vessels will be using the facility on a short term basis. The overall average visibility is considered to be medium reflecting the fact that people close to the facility are either moving through the area or visiting the area for recreation or entertainment. People likely to be viewing the facility for longer durations are located further afield and from a more elevated position.

Table 9: Indicative Contribution to Potential Visual Impact (source: DCP for Sydney Harbour)

Factor	Low Impact	Medium Impact	High Impact
Location of viewer	Elevated position (ridge top) with clear view over marina.	Slightly elevated (lower slopes) with partial view over marina.	Adjoining shorelines or waterway with view blocked by marina and boats.
Distance of view	Land areas or waterway. (> 1000 m)	Land areas or water. (100–1,000 m)	Adjoining shoreline or waterway (< 100 m)
Period of view	Glimpse (eg moving car, bus or bike).	Few minutes up to half day (eg walking along foreshore, recreation in adjoining open space, boating on adjoining waterway).	Majority of day (e.g. adjoining residence or workplace).
Scale or relative size	Powerboat or yacht. (< 10 m long)	Powerboat or yacht (10–30 m long)	Powerboat or yacht. (30–50 m long)
Spatial relationships	Swing moorings adjoining relatively straight shoreline.	Marina adjoining relatively straight shoreline or swing moorings in narrow enclosed bay.	Marina in narrow enclosed bay.
Motion of objects	Motionless flags, wind generators and other objects.	Gently fluttering flags and slowly moving wind generators and other objects.	Flags fully extended and regularly changing direction, wind generators at full speed etc.

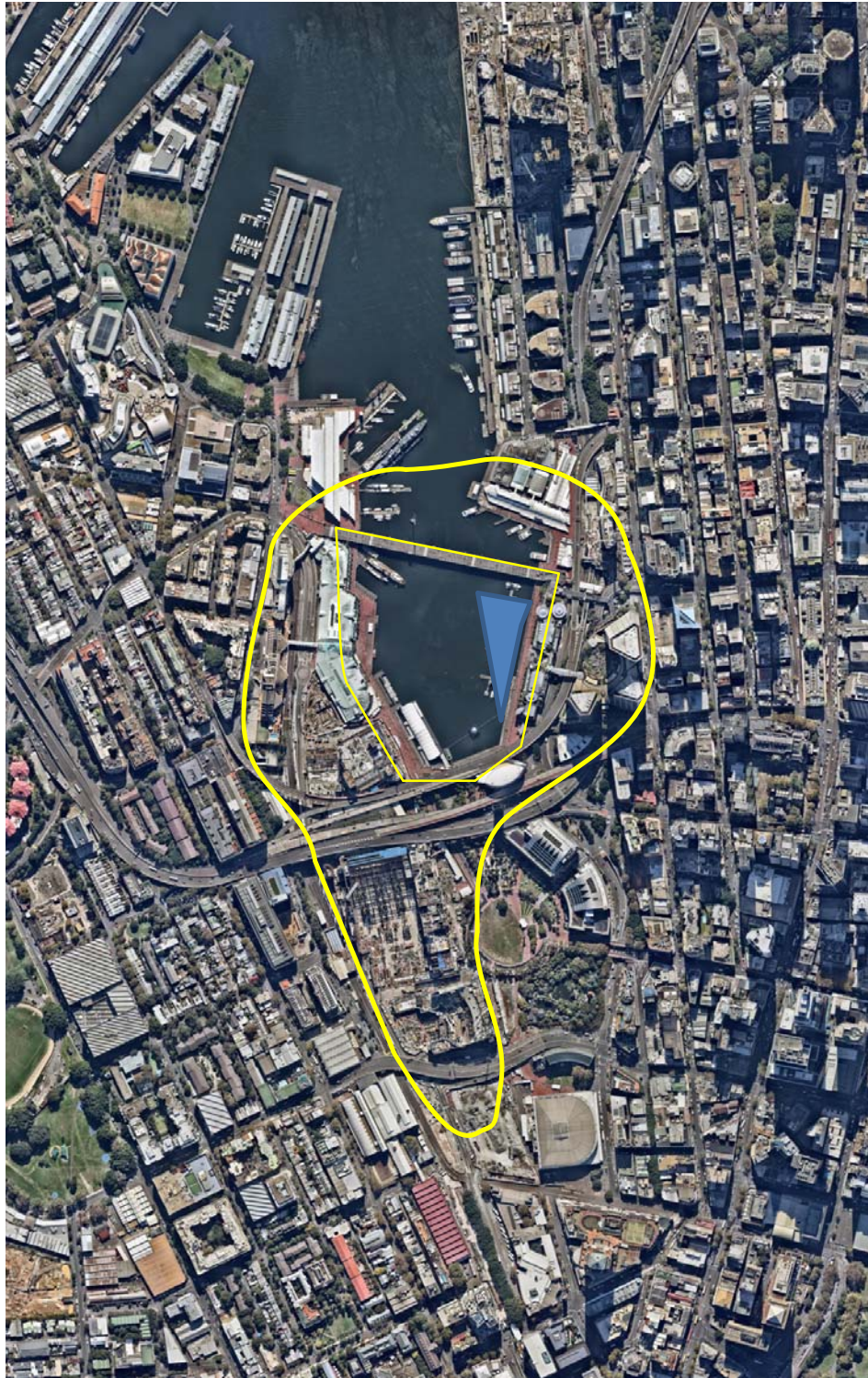


Figure 35: Immediate and Intermediate View Catchments

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Table 10: View Analysis for the Recreational Boating Facility

Factor	View Situation				
	View 1 Promenade	View 2 Pymont Bridge	View 3 Western Distributor	View 4 Commercial office	View 5 Residential
Location to viewer	3	3	2	1	1
Distance of view	3	3	2	2	1
Period of view	2	2	1	3	3
Scale or relative size	2	2	2	2	2
Boat storage type	2	2	2	2	2
Overall potential visual impact	2.4	2.4	1.8	2.0	1.8

Note: High impact= 3, Medium impact = 2, Low impact = 1

2. Magnitude of Proposed Change

The recreational boating facility replaces an existing similar facility with one which is smaller both in overall footprint, capacity and size of vessels that can use it. In general the magnitude of change will be positive resulting in reduced scale and visibility of the facility compared to the current situation, with reference to Table 11.

Table 11: Comparison of Magnitude of Change

	Existing Cockle Bay Marina	Proposed Recreational Boating Facility	Magnitude of Change
Footprint of structure	1586 m2	1078 m2	32 % reduction
Number of vessels	50	40	20% reduction
Maximum vessel size length	24 m	15 m	37% reduction



Figure 36: Before Renewal: Photo View East (Note structures in lower left corner are temporary event structures)



Figure 37: After Renewal: Photo Montage of Proposal (View East)

3. Level of Visual Harmony

The DCP for Sydney Harbour identifies the foreshore around Cockle Bay as “urban development”. Cockle Bay does not fall within any Landscape Character Type in the DCP. The urban setting is rich and varied with strong building silhouettes and a diverse range of materials, finishes and colours. The recreational boating facility is considered to be compatible with its urban surroundings.

4. Overall Visual Impact of the Recreational Boating Facility

The recreational boating facility has been assessed as having a medium impact on viewers within the catchment but will result in an improvement on the current appearance of Cockle Bay and is compatible with its urban setting. The visual impact of the recreational boating facility is assessed as making a positive contribution to Cockle Bay and the visual amenity of people around the Bay.

8.5.8 Conclusion & Proposed Mitigation Measures

The assessment of visual impacts of the proposal found:

- The proposal will have a reduced visual impact on its immediate surrounds compared with the existing situation
- The proposal will also appear less visually intrusive for boat owners and result in more open water being visible
- The proposal will not detract from elevated views of the city and harbour from commercial and residential buildings in the intermediate catchment
- The proposal will improve the visibility of Pyrmont Bridge from public domain surrounds to Cockle Bay
- The proposal is compatible with its urban setting

These findings were confirmed in a detailed visual assessment for the recreational boating facility. In conclusion, the visual impacts arising from the proposal are considered acceptable and no additional mitigation measures are proposed.

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8.6 Event Management & Recreational Capacity

8.6.1 Potential Issues

This section addresses SEARs Key Issue 17 as stated below:

1. An assessment of event management and recreational capacity, including passive and active recreational opportunities and
2. If events are proposed within the public domain, an event plan of management must be provided. This plan will also inform traffic and maritime management

Potential issues relate primarily to potential reduction in event management capability and recreational capacity in the future and temporary disruption to events during the construction period.

The following sections describe current and proposed capacity for events and recreation and assess likely impacts of the proposal.

8.6.2 Existing Situation and Capacity

Cockle Bay is Sydney's premier aquatic amphitheatre and hosts an array of events on and around the bay. The events viewing capacity around Cockle Bay (Refer Figure 38) is 22,843m² of which 803m² or approximately 3.5% is from on-water structures that will be demolished as part of the project (Convention Wharf and Harbourside Promenade).

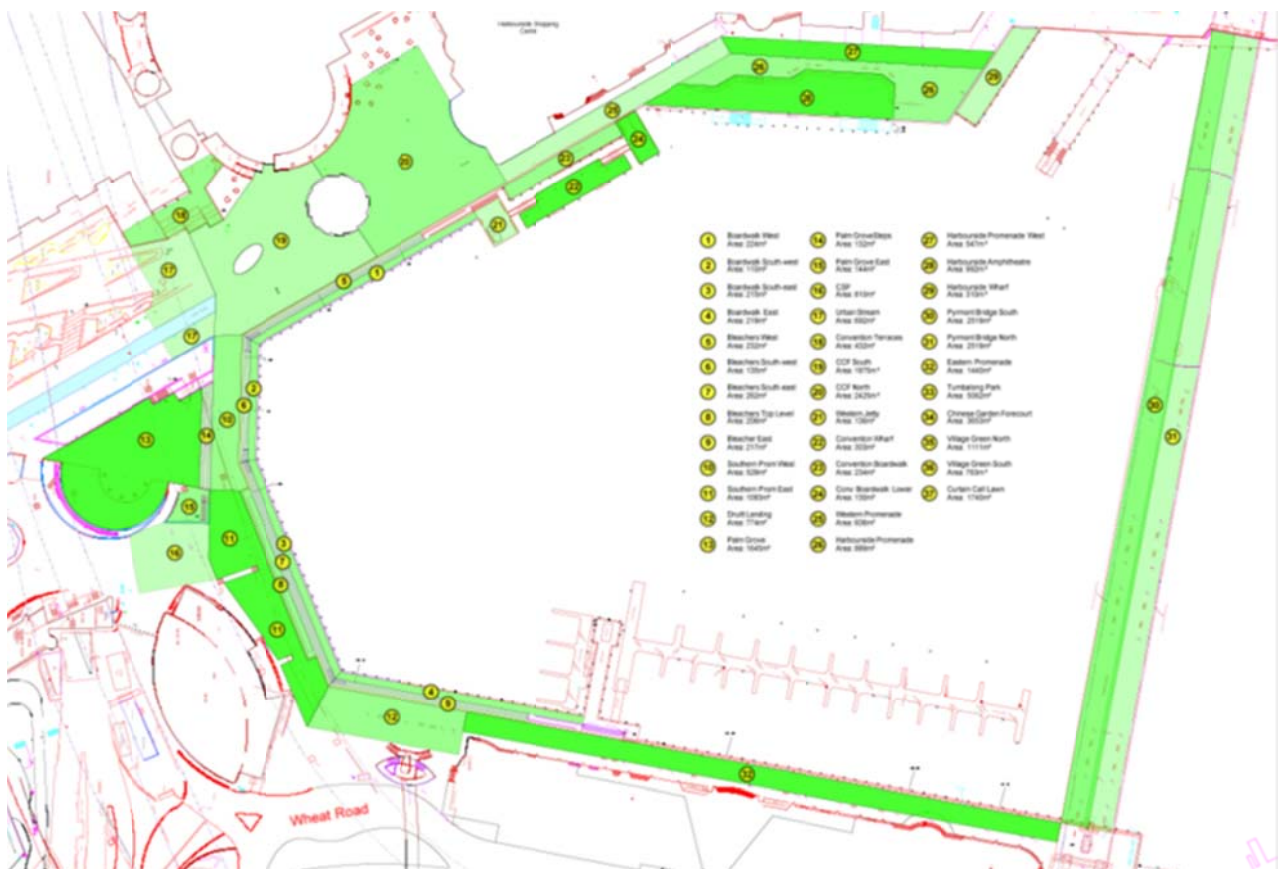


Figure 38: Cockle Bay Events Viewing Capacity

The following annual events are currently programmed on-water in Cockle Bay:

- Chinese New Year
- Month of Love
- Vivid
- Cool Yule

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- Sydney International Boat Show
- Dragons Abreast
- Santa Fest
- Christmas Eve and New Year's Eve

In addition to these regular annual events, there are a number of one-off events and activations.

Darling Harbour is a primary destination for recreation with major attractions including the Australian National Maritime Museum, the IMAX Building, Chinese Garden and Sydney Aquarium (Merlin Entertainment), along with numerous retail and food and beverage outlets surrounding Cockle Bay. The bay itself offers marine leisure activities, including cruises, sailing, jet boat rides and overnight berthing for the visiting public.

The world class views looking north over the bay provide significant passive recreational opportunity and the foreshore is a popular place for locals and visitors to meet, picnic and enjoy being close to the water. Kayaking and swimming is prohibited under the Sydney Harbour Foreshore Authority Regulation 2006.

8.6.3 Proposed Events and Recreational Capacity

The proposal is part of the Government's vision to deliver world-class facilities and recognition of Darling Harbour as Sydney's premier gathering place and a leading urban entertainment precinct.

The proposal seeks to maximise Cockle Bay as a unique events and activation space by:

- Reducing the existing conflict between maritime operations and water-based events uses
- Enabling improved events delivery capability by providing new spaces and infrastructure for the staging of on-water events and activations

The proposed arrangement provides dedicated events space to the west and south of the maritime operations area. Whilst the bay is currently closed to all vessel traffic during very large events (New Year's Eve, Boat Show and Vivid), the proposal aims to enable routine maritime operations during smaller events and activations. There will be no change to bay closures in large event mode.

The existing configuration presents a conflict between boat movements and the staging of on-water events due to the current location of the wharf in the south of the bay and this conflict will be resolved by the proposal. By moving it to the north, closer to the navigation channel, the need for vessel movements in the south of the bay is removed and clear water is available for events and activation. Refer Figure 39 below.

Whilst the proposal does not specifically cater for an increase in the number or scale of on-water events, it provides space and infrastructure to improve the effectiveness and efficiency of event delivery. The proposal will not significantly impact on existing on-water event viewing capacity. Approximately 3.5% of the total current events viewing area will be removed as part of the proposal due to the demolition of Convention Wharf and Harbourside Promenade, however this impact will be compensated for by improvements in viewing capacity resulting from the ICC Sydney (in construction) and Ribbon (DA approved) developments at the southern shore of the bay.

The proposal will provide the following specific infrastructure to optimise event delivery in the bay:

- An events pontoon on the eastern shore
- New moveable events barges

The events pontoon will provide event crew and patron access to on-water events and activations, including temporary mooring of small vessels forming part of an event. The events pontoon will comply with RMS public wharf safety requirements to ensure the safety of the public boarding small vessels during events. No commercial vessels will use this facility.

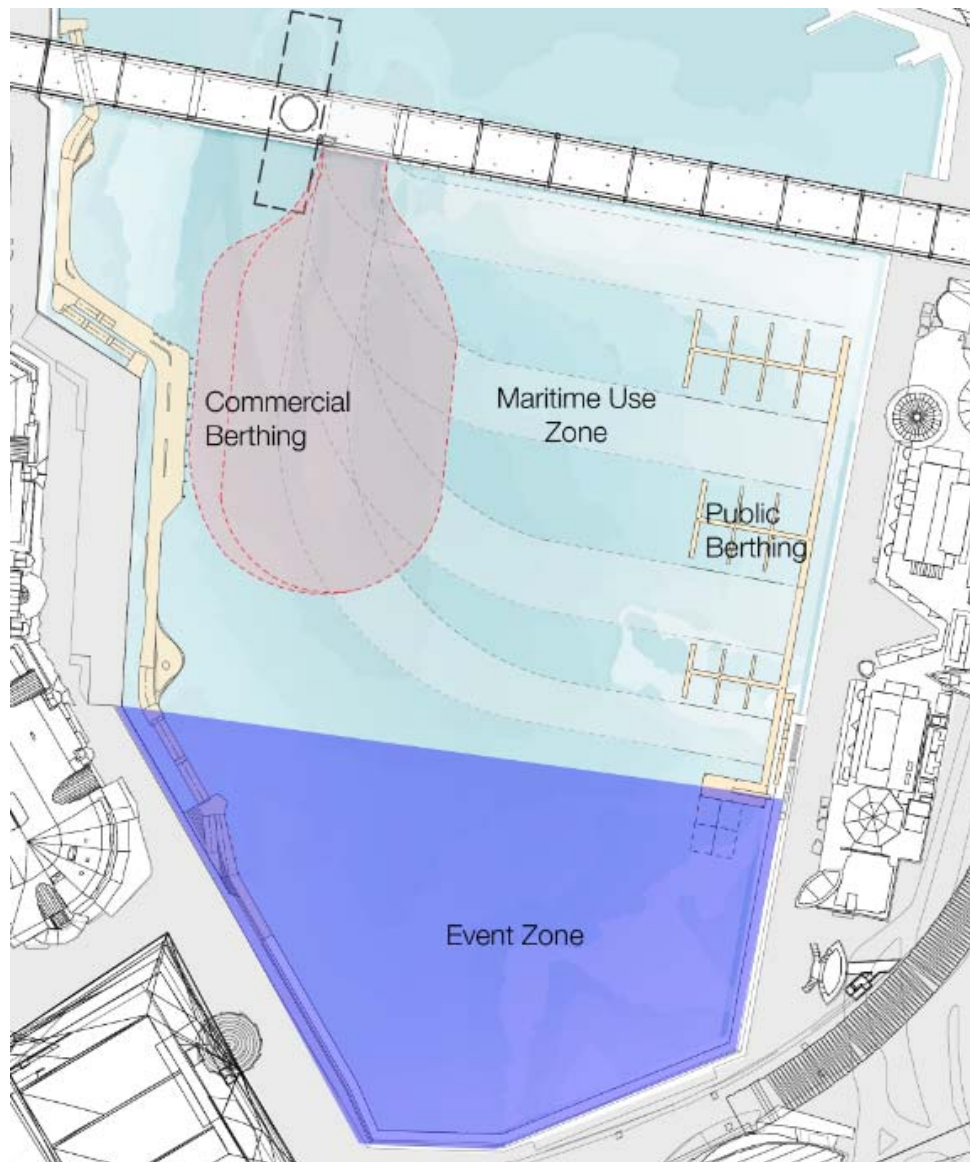


Figure 39: Spatial Arrangement showing Dedicated Maritime and Events Spaces

The existing events barges (refer Figure 40 below) are currently moored at Pymont Bridge outside Harbourside, and are unsightly. This storage location is not in keeping with the heritage status of the bridge.

The proposal will provide the same number and size of events barges; they will be made from the same proprietary pontoon system as the rest of the eastern and western schemes and will be able to be attached to the events staging area when not in use for events. The barges will be furnished with temporary seating for public use between events (refer Figure 41).

In addition to enabling optimised event and activation delivery, the proposal seeks to provide more opportunities for people to enjoy being on and around the water through the following active and passive recreation opportunities:

- more efficient water-based transport and charter vessel servicing to the bay
- safer and more accessible facility for public boating activities
- improved visibility of and better access to heritage
- a better built environment for the public

The proposal will provide new contemporary facilities whilst de-cluttering the bay by consolidating use and reducing on-water footprint. The use of floating structures with telescopic piles and low

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freeboards will also improve sight lines across the bay from all vantage points and provide an opportunity for people to get closer to the water and enjoy on-water pause points.



Figure 40: Existing Events Barges stored adjacent to Pymont Bridge



Figure 41: Precedent Images for Proposed Events Barges

8.6.4 Construction Impacts on Events

As construction staging has been determined based on the precinct events and activation calendar, the impact of construction on events is expected to be minimal. Some single day events and activations, including Dragon Boat Festival and Saturday fireworks will continue concurrent with construction. No construction work will take place during these events and construction barges will be relocated so as not to impact on the required event footprint. In the case of the Dragon Boat Festival, temporary access will be provided to the start line of the race as Harbourside Jetty will no longer be available for this purpose.

8.6.5 Event Plan of Management

The Authority arranges for an annual aquatic licence from Roads and Maritime Services to enable it to host aquatic events in Cockle Bay. It also prepares an Event Plan of Management (EPM) for each event in the public domain. Example EPMs are available for viewing if required.

The proposal will not result in any changes to the way in which events are managed in Darling Harbour.

8.6.6 Conclusion and Proposed Additional Mitigation Measures

The proposal will result in positive event management and recreational capacity impacts and no additional mitigation measures are proposed.

8.7 Sustainability

8.7.1 Potential Issues

This section addresses SEARs Key Issue 19 as stated below:

1. Identify how the development will incorporate ESD principles in the design, construction and ongoing operation of the development

Concern may relate to provision of public facilities that may not be sustainable.

8.7.2 Impact Assessment

The design and development of the proposal has been undertaken with an understanding of the need for ecologically sustainable development. In particular it has played a role in all relevant decisions made on materials and construction.

Ecologically sustainable development requires the effective integration of economic and environmental considerations in decision-making processes through the implementation of the following principles:

The Precautionary Principle

The subject site is a highly modified environment and the proposal seeks to replace existing facilities. The proposal does not pose a serious threat to the environment.

Intergenerational Equity

The proposal has been designed following a lengthy consultation process which has looked at current and future needs of key stakeholder groups. The Authority has also been guided by long term public interest objectives which seek to maintain and enhance public access to the waterway and along the foreshore. The proposal has been designed to ensure longevity of the facilities with a design that has flexibility to allow for changes and expansion in the future. Refer Section 4.9 for future proofing strategy for the proposal.

Conservation of Biological Diversity and Ecological Integrity

The proposal has been designed with the advice and guidance of environmental specialists with reports prepared with regard to impacts on water quality, flora and fauna and air quality. The result is a design and construction program which will have minimal impacts on the environment. Operation of the facilities is expected to have a neutral impact on the aquatic environment as no net increase in vessel activity is anticipated and vessel maintenance and pump-out will not be undertaken at the subject site. Further information on measures to minimise construction impacts can be found in Sections 8.15 Flora and Fauna Impacts and Section 8.14 Water Quality and Contamination.

Improved Valuation, Pricing and Incentive Mechanisms

A number of decisions have been made to reduce waste and life-cycle costs. The use of timber for decking of the facilities is an appropriate ecological choice for the use and the location. The materials will also be able to be reused and recycled at the end of their safe life.

8.7.3 Conclusion and Proposed Additional Mitigation Measures

The proposal will incorporate appropriate ESD measures. No additional mitigation measures are identified.

8.8 Sea Level Rise

This section addresses SEARs Key Issue 13 as stated below:

1. The EIS must assess the risks associated with sea level rise on the proposal

The Australian Standard AS 4997 “Guidelines for the Design of Maritime Structures” requires maritime facilities to be designed to cater for increase in water level due to promulgated sea level rises caused by global warming. The allowance for future sea level rise for a structure with a design life of 25 years is recommended to be 0.1m. The new structures designed for Cockle Bay are floating structures (pontoon system) and therefore the rise in sea level will not impact the operation of the structures. The design of the guide piles and the access ramps takes into account the recommended sea level rise.

8.9 Infrastructure Servicing

This section addresses SEARs Key Issue 14 as stated below:

1. Detail the existing infrastructure on site and identify possible impacts on any such infrastructure from the proposal;
2. Detail measures to mitigate the impacts of the proposal on any infrastructure items, including proposed relocation; and
3. Detail of water supply, consideration of water sensitive urban design and water conservation measures

Power and water are available to the subject site and amplification or relocation of service mains on the foreshore will not be required. The facilities will be reticulated with power and water.

Construction will not impact infrastructure to any other building or facility.

The provision of potable water supply is for recreational vessels visiting the short stay facility. Proposed use will not intensify existing consumption levels.

8.10 Waste Management

This section addresses SEARs Key Issue 12 as stated below:

1. Identify all potential sources of liquid waste and non-liquid wastes as defined in the EPA's *Waste Classification Guidelines 2008*. The EIS should identify any waste that will be stored, separated or processed on the site and identify the procedures to be adopted to minimise, manage, dispose of this waste in accordance with the relevant standards and guidelines.

Other potential issues relating to waste management are concerns regarding air and water pollution from waste materials. These matters are considered further under Section 8.16 Air Quality and Odour Impacts and Section 8.14 Water Quality and Contamination Impacts.

8.10.1 Operational Waste Strategy

No waste will be stored, separated or processed on the site during the operational phase.

The strategy for managing waste is based on the first aim of the National Waste Policy – avoid the generation of waste. The project philosophy is one of waste minimisation. There are currently no on-water waste disposal facilities in Cockle Bay other than the provision of sewer to the South Steyne Floating Restaurant and Function Centre berthed at Harbourside Jetty, which will be decommissioned as part of the project.

Vessel operators are responsible for making appropriate commercial arrangements for waste, including pump-out. The proposal will not result in the removal of public waste bins on the foreshore promenade, and have a neutral impact on existing public and commercial waste facilities in the area.

Passengers using the public wharf facilities will continue to use existing public bins on the foreshore promenade. These bins are managed by the Authority's Operations Team under a third party contract.

The recreational boating facility is for short stay purposes and for fewer vessels than at the existing marina which it will replace. There will be no on-water waste services, including pump-out, available at the facility. Users will be required to keep waste on board for disposal at the vessel's permanent mooring location or approved waste facility.

Any berths approved for permanent berthing of commercial vessels will be subject to licences. Licensees will be required to make their own waste management arrangements as per existing licence agreements. Maintenance of vessels will not be permitted at the berths and any commercial vessels will be required to visit approved facilities for maintenance and pump-out.

8.10.2 Waste Management Impacts during Construction

Construction waste will comprise:

- Timber piles, decking and substructure elements
- Steel piles and substructure elements
- Concrete pontoons
- Polystyrene pontoons
- Possible contamination from acid sulphate soils on removed piles

All construction waste is classified as General Solid Waste (Non-putrescible)/Building & Demolition Waste under the EPA's Waste Classification Guidelines – Part 1: Classifying Waste, Nov 2014.

Removed piles may contain residues of potential acid sulphate soils and handling prior to disposal will take consideration of the EPA's Waste Classification Guidelines – Part 4: Acid Sulphate Soils, Nov 2014, as applicable.

No liquid or hazardous construction waste will be generated by the project and no waste will be processed on the site.

Waste will be temporarily separated and stored on prescribed materials work barges and transported to the contractor's yard for recycling or disposal at a licenced waste facility as soon as the barge is at capacity. Waste will be covered as required to minimise air quality impacts, including dust and odour, as required.

The project will comply with the NSW Government Sustainability Policy – WRAPP Reporting Guidelines 2011.

8.10.3 Conclusion and Proposed Additional Mitigation Measures

Waste management impacts during the construction phase are expected to be minimal. Operational phase waste management strategy will not result in any change to existing arrangements.

Additional mitigation measures proposed to minimise identified impacts are summarised below:

1. The Contractor will be prohibited from depositing waste in the public domain, either Cockle Bay or its surrounds.
2. All demolished material which cannot be reused or recycled must be taken to a licensed waste facility
3. All demolished material transported from the site will be adequately contained to prevent any material entering the water
4. The project will be required to comply with NSW Government Sustainability Policy – WRAPP Reporting Guidelines 2011
5. Waste management procedures compliant with EPA guidelines will be documented in the Contractor's Environmental Management Plan, which will include:
 - a. all applicable laws and regulations and the requirement to ensure site personnel have been appropriately inducted as to the requirements of the site
 - b. methodologies to ensure the site is kept clean and tidy, including the appropriate management of demolished materials
 - c. methodologies for sorting waste streams
 - d. methodologies for handling and disposal of removed piles contaminated with acid sulphate soils, as required
 - e. methodologies for ensuring records of pump-outs and all waste disposal facility dockets are retained for reporting purposes

8.11 Heritage Impacts

8.11.1 Potential Issues

This section addresses SEARs Key Issue 6 as stated below:

1. The EIS is to include a Heritage Impact Statement (HIS) which must assess the likely impacts of the proposal on the significance of heritage items in the vicinity of the site including the Pyrmont Bridge, Woodward Water Feature and the former Sydney ferry and floating restaurant *SS South Steyne*;
2. The HIS is also to include an assessment of any potential marine archaeological items or relics (both above and below water and under historical reclamation areas) that may be impacted by the proposal, including strategies and procedures to be followed in the case of an unexpected discovery of items or relics of significance to indigenous and non-indigenous community

The main heritage issue relates to the need to protect heritage items from construction impacts. The proposal also seeks to provide opportunities for improved access and interpretation of remaining heritage items in Cockle Bay.

A Maritime Archaeological Survey and Heritage Impact Assessment has been undertaken for the proposal by Cosmos Archaeology and is included as Appendix 6. A summary of the survey and impact assessment is included below. The full report must be read to gain a thorough understanding of the heritage impact assessment methodology and conclusions. The historic seawall at the north west of the bay has not been heritage listed but is considered valuable maritime heritage and it is considered at Section 8.11.7 below.

8.11.2 Archaeological Potential

The maritime archaeological survey identified a large number of modern finds littering the seabed, including chairs, wheelbarrows, a bicycle and advertising signs. A number of buried items were also identified and the survey concludes that there is a high potential for remains associated with previous wharves, jetties and activities in Cockle Bay buried below a considerable amount of sediment that has accumulated since the last dredging occurrence in the 1980s. Given the number and scale of the wharves constructed in Cockle Bay and the 150 years of continuous maritime activity, the archaeological potential, including the physical remains of wharf structures, and also relics associated with the operation of these wharves (including shipwrecks), located within the seabed within this area is considered to be high.

8.11.3 Assessment of Impact on Maritime Archaeological Remains Associated with Former Wharves

The archaeological resource present is representative of the earliest maritime infrastructure in Sydney Harbour and is considered to be state significant.

The impact from seabed disturbance through piling is expected to be to an area of 25m², or less than 1%, of the archaeological site and the proposed works are not expected to have a detrimental impact to the heritage significance of the potential maritime archaeological remains present in Cockle Bay.

The works are considered an **acceptable impact** but will need to be undertaken with an Exception under Section 139(4) of the Heritage Impact Act 1977.

8.11.4 Assessment of Impact on Pyrmont Bridge

Pyrmont Bridge is an item of State heritage significance for its aesthetic, historical and scientific cultural values and is a National Engineering Landmark. The Bridge is closely associated with the economic and social development of Sydney at the end of the 19th century and is one of the world's oldest surviving electrically operated swingspan bridges. The timber spans demonstrate a rare example of deck type Allan trusses, there being no other known example.

There is not likely to be any direct or indirect impact from the proposal on Pyrmont Bridge. No permit or further archaeological or heritage works are required.

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8.11.5 Assessment of Impact on Darling Harbour Woodward Water Feature

The Darling Harbour Woodward Water Feature is of state significance.

There is not likely to be any direct or indirect impact from the proposal on the Darling Harbour Woodward Water Feature. No permit or further archaeological or heritage works are required.

8.11.6 Assessment of Impacts Associated with Removal of Harbourside Jetty

The 'South Steyne' is a moveable heritage item under the State Heritage Register. It was the best known of the Manly ferries and served for 36 years from 1938. It has been moored at various places in Cockle Bay since 1999 and is currently moored alongside the Harbourside Jetty where it is used as a floating restaurant and function centre.

The removal of Harbourside Jetty will require the South Steyne to be relocated to another berth. The licence to berth the vessel at this location has expired and the owner will be relocating the vessel within the next six months. The heritage significance of the South Steyne is not associated with Cockle Bay and the proposal will not diminish the vessel's significance.

8.11.7 Historic Seawall & Heritage Access Opportunities

The sandstone seawall currently extending south from Pymont Bridge on the western shore is the only surviving original seawall in Darling Harbour, dating from the 1850s – 1870s. The proposal will remove the fixed deck structures currently obscuring a large part of its extent (refer Figure 42). While not heritage listed, the seawall is identified as an important part of Cockle Bay's history that many people will be interested in, given the scarcity of remaining original marine heritage in the Darling Harbour precinct. The proposal seeks to provide opportunities for improved access to and interpretation of remaining heritage items in Cockle Bay, by removing concealing structures and providing viewing space and interpretation signage to the historic seawall and Pymont Bridge.

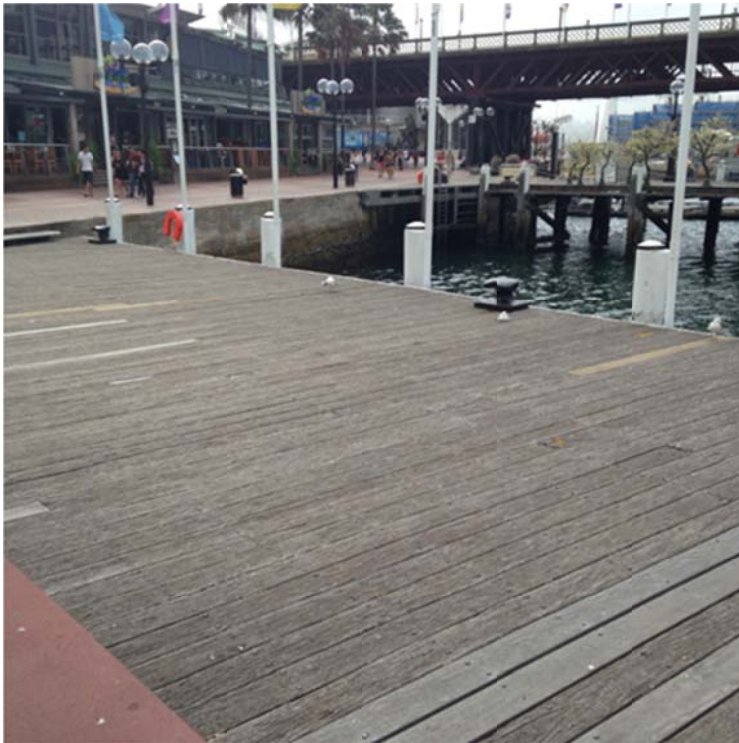


Figure 42: View Showing Existing Extent of Heritage Seawall Concealment

8.11.8 Conclusion and Proposed Additional Mitigation Measures

The proposal will not have a direct or indirect impact on Pymont Bridge or the Woodward Water Feature.

Minor impacts to state significant maritime archaeological remains on the seabed are considered an acceptable impact.

The proposal will not diminish the heritage significance of the South Steyne.

Additional mitigation measures proposed to minimise identified impacts are summarised below:

1. Piling works are to be carried on with an Exception under Section 139(4) of the Heritage Impact Act 1977.

8.12 Navigation Safety

8.12.1 Potential Issues

This section addresses SEARs Key Issue 4 as stated below:

1. A review of existing boating activities in the area and an assessment of the impacts of the development on water based traffic, waterway access (including equity), waterway sharing and existing users of Cockle Bay and Darling Harbour in the vicinity of the marina.
2. Consideration of the potential impact of increased vessel movements likely to be generated by the proposal (if any) on the existing users of Cockle Bay and Darling Harbour and ferry operations at the King Street, Sydney Aquarium and Pyrmont Bay wharves; and
3. Considerations of measures to ensure the safety of any recreational users of Cockle Bay and Darling Harbour.

In the construction phase potential issues relate to the use of construction vessel and disruption to existing water based traffic. During operation, potential issues relate to changed patterns and levels of use as well as safety for recreational users.

A Navigation Safety Assessment has been undertaken for the proposal by Thompson Clarke and their full report is included as Appendix 7. The following sections include extracts from the assessment for ease of reference.

The assessment notes that maritime opinions are based on what is considered to be the common average capabilities of vessel operators, the need to balance maritime activities with the public space, views and utility, and to provide a cost effective wharf infrastructure based on vessel traffic volumes and size.

8.12.2 Review of Existing Boating Activities & Impact of Proposal

The current users of the existing marine structures include a mix of commercial and private uses ranging from the berthing of power assisted vessels to the marina, drop off and pick up by marine leisure vessels such as cruises, jet boats and private boats, and water taxi services.

Historically commercial vessel calls to Cockle Bay reached 348 vessel calls over a 12 month period (October 2012 to September 2013), prior to the closure of the exhibition centre. The maximum number of vessel calls on any given day was 8 which occurred twice within the year.

There are no records of annual marina utilisation and water taxis and private drop off boats are not required to make a booking to berth so the figures of calls for this category of use are also unavailable. The marina offers temporary moorings for 50 berths and based on anecdotal reports is only ever full on the occasion of a major event.

With regard to waterway access and equity, it is important to note that existing facilities, some of which and in poor condition, are being replaced by newer, safer structures and no additional marine structures are being introduced within the bay.

These replacement facilities will offer boat/vessel users a safer and more functional outcome because:

- The marina will be constructed based on guidance provided by AS 3962-2001. Therefore boat size, berth dimensions and fairways within the marina will, unlike the present situation, conform to this standard. The design recreational vessel for the marina is to be a power driven mono-hull boat of 15m length and a 5m beam.
- Marine berth alignments are an improvement as they are orientated in line with the main prevailing winds and tidal current (Windtech: "Wind Environment Statement, Darling Harbour", April 2008).
- The width of the designed commercial vessel is based on the methodology shown in PIANC (Permanent International Association of Navigation Congresses) which is subject to channel width and other environmental and operational criteria, for a one way channel. Based on the PIANC guidelines it was determined that a mono-hull or twin hull, twin screw vessel of 35m in length and a 10m beam would be an appropriate design vessel size.
- Water taxis and other small private boats will have a safer and dedicated location for embarking/disembarking passengers.

In terms of waterway sharing, it is understood that vessels proceeding to the marina will be power-driven mono-hulls, and the operators of these recreational vessels will mostly, not possess the boat skills of commercial operators who will have some form of State/Commonwealth certification and who will be experienced in manoeuvring their vessels many times throughout the year. The aim of recreational users berthing at the north-east side of the bay and commercial operators berthing at the north-west side of the bay is to separate these two classes of operators and so reduce any potential conflict.

8.12.3 Assessment of Vessel Movements during Operational Phase

The proposal will unlikely result in an increase in vessel movements. In fact, vessel traffic based on current information will decrease once the Exhibition Centre shuttle service ceases to operate (estimated to be by the end of 2016) and vessel numbers are expected to revert back to levels from before the Convention and Exhibition Centre closure. No increase in traffic is anticipated primarily because:

- There will be less available berths at the new marina;
- Vessels will be restricted in size and so new berths to cater for this design size will not provide a mooring opportunity to larger vessels;
- There is no through traffic due to the geographical location of Cockle Bay;
- It is highly unlikely that the new facilities will result in any commuter ferry traffic to and/or from the bay, however private hop-on hop-off service providers might offer services to and from Cockle Bay.

The existing users of Cockle Bay will have much safer and more functional facilities, with their operations carried out with much the same traffic numbers that they are used to now. Therefore the effect on areas adjacent to Cockle Bay, such as Darling Harbour, is anticipated to remain largely unchanged as a result of the development. That is, through traffic will be much the same.

Transport for New South Wales (TfNSW) has already indicated that commuter ferry operations within Cockle Bay are not worthwhile and operationally feasible, because of the 4 knot speed restriction within Darling Harbour south of Barangaroo. Calling at Cockle Bay would add approximately 20 minutes to their timetable.

As vessel movements are anticipated not to increase within Cockle Bay, as outlined, the development is likely to have no impact on ferry operations at the other ferry locations mentioned.

8.12.4 Consideration of Measures to Ensure Safety of Recreational Users

The following measures will be taken which will improve safety and reduce potential conflict for recreational boat owners:

- The bay has been divided into two specific and dedicated areas as follows and permanent navigation routes have been provided around and outside the Events space:
 - An Events zone in the southern half; and
 - A Maritime zone in the northern half.
- The northern Maritime area has been further divided into two zones to separate users with:
 - The eastern side dedicated to the sole use of recreational boats to the marina; and
 - The western side dedicated predominately to commercial operators.
- The vessel size for recreational boats has been reduced and this together with more manoeuvring room and fewer berths within the marina will result in safer boating operations.
- The location of berthing operations on both the east and west side is close to the channel entrance which minimises vessel movements in the bay.
- Vessel speed within the bay has been mandated at 4 knots.

8.12.5 Assessment of Maritime Access Impacts during Construction Phase

Vessel movements resulting from construction are expected to be limited and are not expected to have any adverse impact on the operation of the Darling Harbour waterway.

All vessels servicing the project will be moored in the Cockle Bay waterway during the construction period. The Contractor will be responsible for all protocols and approvals for vessel and barge movement and mooring.

The existing marina and Convention Wharf will remain in operation during construction of the western scheme to minimise impacts on transport and recreation. Impacts to existing operations during construction are expected to be minimal due to the current low utilisation rates of the wharves and marina, particularly over the winter and shoulder periods.

Construction vessels and barges will not impede channels or navigation space in Cockle Bay. Lighting and buoyage will be provided in accordance with the Harbour Master's and Roads and Maritime Services requirements to segregate the on-water construction zone. In accordance with existing arrangements, the Authority's rangers will be on 24/7 call in the event of any maritime incident.

The Harbour Master and Roads and Maritime Services will be consulted further with respect to requirements for the construction phase of the proposal prior to construction commencement to ensure that all maritime access considerations have been addressed.

An operational wharf will be maintained at all times during construction. The following minor impacts to maritime users of bay will result from the proposal:

- Convention Wharf will be closed in August 2016 - vessels utilising Convention Wharf will be directed to the new wharf from August 2016
- The existing marina will be replaced with a new facility and there will be no public berthing in the bay between August and November 2016
- All commercial services currently operating from the marina will cease from August 2016.

8.12.6 Conclusion and Proposed Additional Mitigation Measures

The impact assessment undertaken by Thompson Clarke found that the proposal will improve on-water safety and provide a functional outcome to the benefit of both commercial and recreational water users. Impacts during construction are expected to be minimal.

Additional mitigation measures proposed to minimise identified impacts are summarised below.

Construction Phase

1. Lighting and buoyage will be provided in accordance with the Harbour Master's and Roads and Maritime Services requirements to segregate the on-water construction zone.
2. The Harbour Master and Roads and Maritime Services will be consulted further with respect to requirements for the construction phase of the proposal prior to construction
3. Appropriate communication of service changes will be made in advance of construction impacts

Operational Phase

4. Vessel sizes will be limited to 15m for recreational users and 35m for commercial users during routine operation; larger vessels may only access the bay on an as needed basis following risk assessment
5. Detailed operational protocols will be implemented prior to putting the new facilities into service to ensure safe and equitable maritime access. Considerations will include:
 - Inbound/outbound priority at the Pyrmont Bridge channel
 - Removal of vessel movements other than through designated channel
 - Guidance on commercial and recreational vessel navigation paths within the bay
 - Implementation and enforcement protocols, including use of consultation, education and CCTV
 - Segregation of maritime use and events use with appropriate management and enforcement during the operational phase

- Segregation of recreational and commercial vessels with appropriate management and enforcement during the operational phase
6. The Harbour Master and Roads and Maritime Services will be consulted further with respect to their requirements for the operational phase of the proposal.

8.13 Transport, Traffic and Parking Impacts

8.13.1 Potential Issues

This section addresses SEARs Key Issue 7 as stated below:

1. Demonstrate the provision of sufficient car parking in accordance with the relevant Australian Standards (AS3962-2001) and secure bicycle storage and amenities for the amended proposal having regard to accessibility of the site to public transport, local planning controls and Roads and Maritime Services (RMS) guidelines; and
2. A Traffic Impact Assessment (TIA) is to be prepared in accordance with the RMS's '*Guide to Traffic Generating Development*' considering traffic generation, any required road/intersection upgrades, access, measures to promote public transport usage and pedestrian and bicycle linkages resulting from the development. The TIA is to assess the cumulative impact of the proposal associated with other construction and operational activities on the site and the surrounding area.

Potential issues relate to traffic impacts during construction, the provision of car parking/bicycle storage, traffic generation during the operational phase and impacts on public transport usage.

A Traffic and Parking Impact Statement has been prepared for the proposal by Mott MacDonald and is included as Appendix 8 to this report. Extracts from this assessment are reproduced in the following sections for ease of reference.

8.13.2 Existing Situation

Cockle Bay is highly accessible by public transport, which presents visitors and users of the area with a range of transport options to access the site. The range of public transport options include Town Hall or Wynyard station which are a 10 minute walk from the site, Pyrmont Bay Sydney Light Rail stop and bus stop locations along Market, Park, Druitt or Bathurst Street. The precinct can also be accessed via water transport, with public timetabled ferries alighting at the King Street and Pyrmont Bay wharves, water taxi services alighting from multiple locations within Cockle Bay and deregulated ferry services at Pier 26 and King St wharves.

The Darling Harbour precinct and western edge of the Sydney CBD also offers a wide range of parking facilities which are situated within a short walk of the site. Pedestrian access to the various marine structures is achieved by walking along the promenade walkway that forms the landside perimeter of Cockle Bay.

The existing wharves in Cockle Bay that make up the project are used for a range of commercial and public purposes and as such attract a range of user groups.

8.13.3 Proposed Change to Development

Proposed Facility Changes

The Project and its proposed changes incorporate the consolidation of existing facilities to support future operations and more clearly define public and private vessel use and events space. On this basis, the project team have developed a design which is driven by the future functional requirements and vision for Cockle Bay. The design comprises a new visiting vessel facility to the eastern side of Cockle Bay and more coherent, legible and integrated public wharf on the western side.

Traffic Impact

From the comparison of existing and proposed developments, it is evident that the proposed development of Cockle Bay will lead to the consolidation of existing facilities which will service similar user groups and demand levels. In terms of transport accessibility, all user groups will continue to travel to the site using the existing range of transport modes and services.

Given that the development is a replacement of existing assets, albeit under a more space efficient arrangement, the development is not expected to generate an increase in vehicle trips to those currently experienced and will therefore have minimal impact on the surrounding road network.

Parking Impact

The existing parking facilities that are currently available will continue to be available to current user groups when the facilities are upgraded. During the delivery phase of the project, construction staff that wish to drive to work will be able to use a wide range of paid parking stations available within a short distance of the site. On this basis, no additional parking is required to be provided as a result of the proposed development.

8.13.4 Construction Impacts

Construction Staging

Construction will be staged as follows:

- Stage 1 – February - May 2016
- Stage 2 – August – November 2016

The staging of the project has given appropriate consideration to the busy events and activation programme and no construction will take place during on-water events.

Construction Methodology

The proposed construction works will incorporate the demolition of existing waterside assets and the construction of new waterside assets. A construction methodology has been developed and aims to address some of the various planning assessment requirements with a focus on:

- Utilising waterborne demolition and management of waste materials where possible
- Minimising the construction footprint on the perimeter walkway around Cockle Bay wharf
- Minimising the generation of vehicular construction traffic to the site.

Construction techniques include off site manufacture of structural items and installing on site via plant and machinery located on a barge or working platform. The only landside site occupation will be a hoarding 900mm from the water's edge. The Authority has extensive experience with managing public domain impacts arising from on-water projects within Cockle Bay.

Construction Traffic and Parking

It is anticipated that the construction works will require only a relatively small team of construction workers to be situated on site. The estimated workforce size is not expected to be greater than 30, with most construction staff arriving via work vessels. Given the location of the development site, it is anticipated that the peak construction traffic generated by the development would be less than 10 construction vehicles per day. Construction workers who wish to drive to the site by private vehicle can utilise a wide range of paid parking stations situated in the Darling Harbour precinct or on the western edge of the CBD. Based on this, the impact of construction staff on parking availability within these parking stations will be minimal.

Cumulative Impact of Developments

It is acknowledged that a high level of development is underway within the Darling Harbour precinct and adjacent areas. Some of the developments currently underway that will coincide with the construction of Cockle Bay include Sydney ICC and Barangaroo South. These two major developments generate significant construction traffic in the area. It is understood that construction management plans are in place to manage the traffic and parking impacts for these developments and neither of the access routes to these developments conflict with access to the project.

With all of the project construction work to be undertaken waterside, the landside construction traffic associated with the Cockle Bay marine structures will be negligible. The contractor will need to manage waterborne construction works and vessel movements associated with delivery of goods and removal of waste from the site. This will be coordinated to avoid conflict with timetabled ferry services and other associated construction at the Barangaroo site.

Construction Management Strategy

The approved contractor for the construction works will be required to develop a construction management plan that would identify measures to ameliorate potential construction impacts.

8.13.5 Conclusion and Proposed Additional Mitigation Measures

The Traffic and Parking Impact Statement prepared by Mott MacDonald concludes:

- The proposed upgrade of the Cockle Bay marine structures is primarily a replacement of existing facilities;
- The project aims to consolidate facilities and is unlikely to result in any additional traffic generation or change in trip patterns;
- The proposed development will retain the same level of transport access;
- There will be minimal impacts on the surrounding road network resulting from the project;
- There will be minimal impacts on parking during construction and post-delivery of the project.

Additional mitigation measures proposed to minimise identified impacts are summarised below:

1. The Construction Management Plan will include measures to minimise impacts on transport, traffic, parking and pedestrian movement along the waterfront.

8.14 Water Quality and Contamination

8.14.1 Potential Issues

This section addresses SEARs Key Issue 9 as stated below:

1. Undertake an assessment of the potential impacts on water quality of Cockle Bay and Darling Harbour. Relevant consideration should be given to the *National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality* (ANZECC/ARMCANZ), the *ANZECC Guideline and Water Quality Objectives in NSW* (OEH) and *Approved Methods for the Sampling and Analysis of Water Pollutants in NSW* (OEH);
2. Assess the impacts of the proposal on surface and groundwater quality and hydrology;
3. The assessment must include details of proposed erosion and sediment controls (during construction), the proposed stormwater management system (during operations) and management and mitigation measures for the containment of pollutants (e.g. fuel and sewage) and prevention of potential water quality impacts during construction and operation;
4. Assess the potential for the development to intercept groundwater, including predicted groundwater dewatering volumes and disposal methods;
5. Assess the potential impact of the development on groundwater flow paths and discharge flows;
6. Identification of any water licensing requirements or other approvals required under the *Water Act 1912* or *Water Management Act 2000*;
7. Assess the geotechnical and contamination issues (including Acid Sulphate Soils) associated with the construction of the development including the contamination status of the sediments to be disturbed, the impacts associated with disturbance of sediment, and the management and mitigation measures to be employed during marine works; and
8. Include a suitable water quality monitoring program.

Potential issues during construction relate to the disturbance of sediments and impacted water quality during demolition and piling and potential contamination resulting from construction vessels and impacts on stormwater drains. Concerns during the operational phase of the proposal largely relate to water contamination by vessels using the facilities. The removal and replacement of structures also has the potential to impact aquatic habitat.

A Water Quality and Sediment Impact Assessment has been undertaken for the proposal by Environmental Resource Management Australia and their full report is included as Appendix 9. Extracts of the full report are included in Sections 8.15.1 to 8.15.4 for ease of reference. The assessment has been prepared in accordance with the following standards and guidance:

- Environmental Planning & Assessment Act 1979
- Fisheries Management Act
- Protection of the Environment Act 1997
- Contaminated Land Management Act 1997
- Water Management Act 2000

Table 12 below identifies the section reference addressing each component of SEARs Key Issue 9.

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Table 12: Water Quality & Contamination – Section References addressing SEARs Key Issue 9

Assessment Requirement	EIS Section Reference
Impacts on Surface and Groundwater Quality and Hydrology	8.14.4.1
Proposed Erosion and Sediment Controls during Construction	8.14.9
Proposed Stormwater Management System during Operations	8.14.9
Management and Mitigation Measures for the Containment of Pollutants (e.g. fuel and sewage)	8.14.9
Prevention of Potential Water Quality Impacts during Construction	8.14.9
Prevention of Potential Water Quality Impacts during Operation	8.14.9
Potential to Intercept Groundwater	8.14.4.1
Water Licensing Requirements & other Approvals	8.14.5
Assessment of Geotechnical & contamination issues, including acid sulphate soils	8.14.6
Water Quality Monitoring	8.14.7

8.14.2 Construction Impact Assessment Methodology

8.14.2.1 Impact Assessment Scoping

Scoping was undertaken by ERM in accordance with ERM's standard methodology. This scoping exercise documented the resources and receptors potentially present within the Area of Interest (AOI), and assessed which of these the Project activities may interact with and potentially effect.

1. Identifying the Project Activities

To initiate the scoping process, the activities were described based on information provided by SHFA. This stage of the Study entailed gathering information to define the Project design as far as possible. This Project design was then broken down into a series of discrete activities which could more readily be assessed for impact against the receiving environment.

2. Establishing the Area of Interest

Throughout the assessment process, the extent of the AOI took into account the specific aspect and the types of effects considered.

The AOI for the Project has been defined to include all that area within which it is likely that significant impacts could result. This takes into account:

- Primary Project site: the site of the Project, being the physical extent of the Project activities (in this case Cockle Bay);
- Potential areas affected by impacts from unplanned events resulting from the Project; and
- The nature of the affected resource or receptor, the source of impact and the manner in which the resultant effect is likely to be propagated beyond the Project footprint.

3. Assessing Project: Resource/Receptor Interactions

The nature and availability of baseline environmental and Project information is such that the identification of the potential interactions between the Project and resources/receptors within the AOI could be undertaken to a high level of confidence. Professional judgement was used to assess whether interactions have the potential to result in impacts that could lead to negative or positive

effects greater than negligible. In addition the current regulatory requirements and industry best practices were considered.

Once potential interactions were identified, they were charted using a colour-coded matrix (see Table 23: Potential Interaction Matrix). The different colours within the matrix indicate the level of potential impact based on the following criteria:

Potential interactions between the activities and existing environment and uses were each classified into one of the following four categories:

- **No interaction:** where the Project is unlikely to interact with the existing environment or interests (coded white);
- **Interaction possible, but not likely to be significant:** where there is likely to be an interaction, but the resultant effect is unlikely to change baseline conditions in an appreciable or detectable way (coded light grey); and
- **Significant interaction:** where there is likely to be an interaction, and the resultant effect has a reasonable potential to cause a significant effect on the existing environment or interests (coded dark grey).
- **Positive interaction:** where there is likely to be an interaction that results in a beneficial effect on the existing environment or interests (coded with diagonal hatching).

4. Environmental Baseline Definition

To assess and define the Project components and the environmental baseline, two steps were undertaken:

- Collection of relevant Project (and Project alternative) information; and
- Collection of baseline data for the AOI or considered to be adequately representative of the area.

A range of information was reviewed by ERM and incorporated into the Study including data from the following sources:

- Project technical specifications and project details provided by SHFA;
- Primary literature;
- Published environmental studies of the AOI and surrounding areas;
- Internet websites; and
- A review of diver survey footage of the Project site collected in February 2015.

Each data set was assessed for completeness, sufficiency and applicability for use in the Study.

5. Assessing Condition and Sensitivity

For the purposes of this Study, the existing ecosystem condition was also taken into account. ANZECC (2000) defines three categories of ecosystem condition and the required levels of protection. These include;

- *High conservation/ecological value systems — effectively unmodified or other highly-valued ecosystems, typically (but not always) occurring in national parks, conservation reserves or in remote and/or inaccessible locations. While there are no aquatic ecosystems in Australia and New Zealand that are entirely without some human influence, the ecological integrity of high conservation/ecological value systems is regarded as intact.*
- *Slightly to moderately disturbed systems — ecosystems in which aquatic biological diversity may have been adversely affected to a relatively small but measurable degree by human activity. The biological communities remain in a healthy condition and ecosystem integrity is largely retained. Typically, freshwater systems would have slightly to moderately cleared catchments and/or reasonably intact riparian vegetation; marine systems would have largely intact habitats and associated biological communities. Slightly– moderately disturbed systems could include rural streams receiving runoff from land disturbed to varying degrees by grazing or pastoralism, or marine ecosystems lying immediately adjacent to metropolitan areas.*
- *Highly disturbed systems - These are measurably degraded ecosystems of lower ecological value. Examples of highly disturbed systems would be some shipping ports and sections of harbours serving coastal cities, urban streams receiving road and stormwater runoff, or rural streams receiving runoff from intensive horticulture.*

Due to the current quality of both water and sediment within Darling Harbour, Cockle Bay and the greater Port Jackson estuary, the Project Area has been defined as a 'Highly Disturbed System'.

8.15.2.2 Effects Assessment Methodology

This section describes the Study methodology adopted for identifying and assessing impacts from the Project on the environment. This methodology includes consideration of the activities, the physical and social conservation values affected by the activities, potential effects, and measures to avoid, remedy or mitigate adverse effects.

There are four phases to the assessment process, which are outlined below.

1. Identification of effects
2. Evaluation of Impacts
3. Identification of Mitigation Measures
4. Evaluation of Residual Effects

1. Phase One - Identification of Effects

Environmental effects arise as a result of project activities interacting either directly or indirectly with the local environment. Specific interactions can affect a number of environmental aspects or contribute to a wider cumulative effect. The types of effect that may arise from the proposed works are outlined in Table 13.

Certain effects may be scoped out due to their minor or negligible effect on the surrounding environment. Any issue with the potential to have a significant effect is assessed in greater detail during the following phases.

2. Phase Two – Evaluating Impacts

Following the identification of potential environmental effects (Phase One), the significance of these effects was assessed, taking into account mitigation measures fundamental to the design of the Project.

For the purposes of this Study, the following definition of significance has been adopted:

An impact is significant if, in isolation or in combination with other impacts, it should, in the judgment of the Study team, be taken into account in the decision-making process, including the identification of mitigation measures and consenting conditions.

Assessing the level of significance requires consideration of the likelihood and magnitude of the environmental effect, taking account of the geographical scale and duration of the impact in relation to the sensitivity of the key receptors and resources. Criteria for assessing the significance of impacts stem from the following key elements:

- The magnitude (including nature, scale and duration), of the change to the natural environment (for example, loss or damage to habitats or an increase in noise), which is expressed in quantitative terms wherever practicable.
- The nature of the impact receptor, which may be physical, biological, or human, and its sensitivity. Where the receptor is physical (e.g. a water body) its quality, sensitivity to change and importance are considered.
- The likelihood (probability) that the identified impact will occur is estimated based upon experience and/or evidence that such an outcome has previously occurred. .

Effects predictions have been made using available data, but where significant uncertainty remains, this is acknowledged and an indication of its scale was provided.

The significance of impacts is then defined, based on the sensitivity of the receptor as shown in Tables 14 and 15.

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Table 13: Water Quality & Contamination – Types of Effects as Categorised in the Study

Type of Effect	Definition
Nature of Effect	
Negative	An effect that is considered to represent an adverse change from the baseline, or to introduce a new undesirable factor.
Positive	An effect that is considered to represent an improvement to the baseline or to introduce a new desirable factor.
Type of Effect	
Direct (or Primary)	Effects that result from a direct interaction between a planned Project activity and the receiving environment.
Secondary	Effects that follow on from the primary interactions between the Project and its environment as a result of subsequent interactions within the environment
Indirect	Effects that result from other activities that are encouraged to happen as a consequence of the Project.
Cumulative	Effects that act together with other effects (including those from concurrent or planned future third party activities) to affect the same resources and/or receptors as the Project.
Duration of Effect	
Temporary	Effects are predicted to be of short duration and intermittent/occasional in nature.
Short-term	Effects that are predicted to last only for a limited period but will cease on completion of the activity, or as a result of mitigation/reinstatement measures and natural recovery.
Long-term	Effects that will continue over an extended period, but cease when the Project stops operating. These will include effects that may be intermittent or repeated rather than continuous if they occur over an extended time period.
Permanent	Effects that occur during the development of the Project and cause a permanent change in the affected receptor or resource that endures substantially beyond the Project lifetime.
Scale of Effect	
Local	Effects on locally important environmental resources or restricted to a single habitat or biotope, a single (local) administrative area, a single community.
Regional	Effects on regionally important environmental resources or that are experienced at a regional scale as determined by administrative boundaries, habitat type or ecosystem.
National	Effects on nationally important environmental resources, affect an area that is nationally important, protected or have macro-economic consequences.
International	Effects on internationally important resources such as areas protected by International Conventions.
Trans-boundary	Effects that are experienced in one country as a result of activities in another.

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Table 14: Water Quality & Contamination – Criteria for Assessing the Magnitude of Effects for Sediment Disturbance and Water Quality

Sediment Disturbance/Quality		Water Quality
Negligible	Immeasurable, undetectable or within the range of normal natural variation	Immeasurable, undetectable or within the range of normal natural variation
Small	Minimal seabed disturbance/ change in sediment quality	Slight change in water quality expected over a limited area with water quality returning to background levels within a few metres
Medium	Localised and/or short term disturbance of seabed/ change in sediment quality	Temporary or localized change in water quality with water quality returning to background levels thereafter
Large	Widespread and/or long term disturbance or permanent change to the seabed/ sediment quality	Change in water quality over a large area that lasts over the course of several months with quality likely to cause secondary effects on marine ecology
Positive	In the case of positive effects, it is generally recommended that no magnitude be assigned, unless there is ample data to support a more robust characterization. It is usually sufficient to indicate that the Project will result in a positive effect, without characterizing the exact degree of positive change likely to occur.	

Table 15: Water Quality & Contamination – Criteria for Assessing Sensitivity

Seawater and Air Quality	
Low	Existing quality is good and the ecological resources and human receptors that it supports are not sensitive to a change in quality.
Medium	Existing quality already shows some signs of stress and/ or supports ecological resources and human receptors that could be sensitive to change in quality.
High	Existing quality is already under stress and/ or the ecological resources and human receptors it supports are very sensitive to change (secondary ecological or health impacts are likely).

For this assessment, four effects significance categories have been applied being: *Negligible*, *Small*, *Medium*, *Large* and *Positive*. These categories of significance for environmental receptors are defined in Table 17 Impact Significance Definitions.

Table 16: Water Quality & Contamination – Assessment Matrix

		Sensitivity of Receptor		
		Low	Medium	High
Magnitude of Effect	Negligible	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major
	Positive	Minor	Moderate	Major

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Table 17: Water Quality & Contamination – Impact Significance Definitions

Impact Significance	Definition
Negligible	A resource/receptor (including people) will essentially not be affected in any way by a particular activity or the predicted effect is deemed to be 'imperceptible' or is indistinguishable from natural background variations.
Minor	A resource/receptor will experience a noticeable effect, but the effect magnitude is sufficiently small (with or without mitigation) and/or the resource/receptor is of low sensitivity/ vulnerability/ importance. In either case, the magnitude should be well within applicable standards.
Moderate	Within applicable standards, but falls somewhere in the range from a threshold below which the impact is minor, up to a level that might be just short of breaching a legal limit. The emphasis for moderate impacts is on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that impacts of moderate significance have to be reduced to minor, but that moderate impacts are being managed effectively and efficiently.
Major	An accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. An aim of this Study is to get to a position where the Project does not have any major residual impacts, certainly not ones that would endure into the long-term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (i.e ALARP has been applied). In such circumstances it is the function of regulators and stakeholders to weigh such negative factors against the positive ones, such as employment, in coming to a decision on the Project.

Likelihood has been considered for the assessment of all unplanned events (e.g. spill), but only after the impact of the event is determined.

Impacts from Unplanned Activities

For impacts from unplanned activities, the approach adopted in this assessment considered the likelihood of an unplanned event occurring and if it does, the likely consequence on the environment and public health and safety. A qualitative approach to impact prediction was adopted. Criteria to assess the likelihood and severity of impacts from unplanned events are presented in Tables 18 and 19 below

Table 18: Water Quality & Contamination – Likelihood Categories

Likelihood	Definition
Extremely Unlikely	The unplanned event is extremely unlikely to occur under normal operating conditions but may occur in exceptional circumstances.
Unlikely	The unplanned event is unlikely but may occur at some time during normal operating conditions.
Possible	The unplanned event is likely to occur at some time during normal operating conditions.
Likely	There is a high probability that the unplanned event could occur during normal operating conditions.

Table 19: Water Quality & Contamination – Severity Criteria for Unplanned Events

Severity	Definition
Low	<ul style="list-style-type: none"> Some damage to the environment/very localised No sensitive resources impacted Rapid degradation of spilled materials and rapid recovery of affected resources
Medium	<ul style="list-style-type: none"> Localised environmental damage No sensitive resources impacted Degradation of spilled materials and full recovery of affected resources
High	<ul style="list-style-type: none"> Severe environmental damage Sensitive resources impacted Recovery of affected resources is very slow

The overall significance was then determined through a matrix of severity vs. likelihood as shown in Table 20 below.

Table 20: Water Quality & Contamination – Unplanned Event Impact Significance Matrix

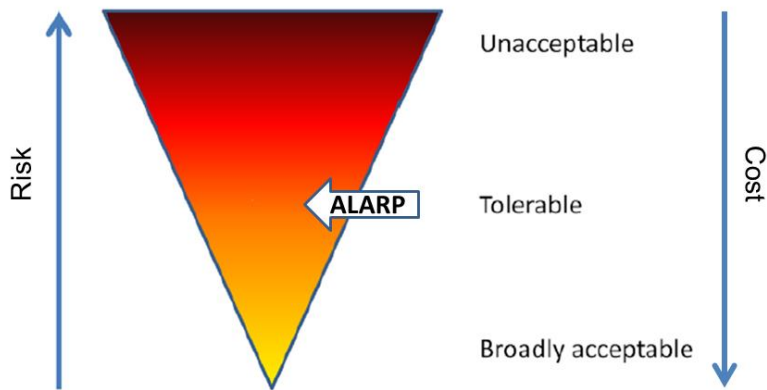
		Severity of Impact		
		Low	Medium	High
Likelihood	Extremely Unlikely	ALARP	ALARP	ALARP
	Unlikely	ALARP	Minor	Moderate
	Possible	Minor	Moderate	Major
	Likely	Moderate	Major	Major

3. Phase Three – Mitigation Measures

A key component of the process is to explore practical ways of avoiding or reducing potentially significant effects of the proposed project activity. These practical actions are termed mitigation measures and are aimed at preventing, minimising or managing significant negative effects to as low as reasonable practical (ALARP) as well as optimising and maximising any potential benefits of the Project.

ALARP is defined as the point where the cost (in time, money and effort) of further risk reduction is grossly disproportionate to the risk reduction achieved. For example, where an event is already extremely unlikely to occur, the implementation of any control measures other than not undertaking the activity would not further reduce the risk associated with the event.

In addition, risks must be tolerable in that they are within the bounds that society as a whole is willing to live with, based on confidence that the risk is worth taking and is properly controlled, in order to secure the benefits associated with the activity. This does not necessarily mean that everyone will find the risk acceptable. The concept of ALARP is illustrated below.



The approach taken to identifying and incorporating mitigation measures into the Project is based on a hierarchy of decisions and measures as described below. This is aimed at ensuring that wherever possible potential effects are mitigated at source rather than mitigated through restoration after the effect has occurred.

<p><i>Avoid at Source; Reduce at Source</i></p> <p>Avoiding or reducing at source is essentially 'designing' the Project so that a feature causing an effect is designed out (e.g. a waste stream is eliminated) or altered— often called minimisation</p>
<p><i>Abate on Site</i></p> <p>This involves adding something to the basic design or procedures to abate the effect – often called 'end-of-pipe'. Pollution control (e.g. on board waste water treatment) falls within this category.</p>
<p><i>Abate Offsite/at Receptor</i></p> <p>If an effect cannot be abated on-site then measures can be implemented off-site. Measures may also be taken to protect a receptor.</p>
<p><i>Repair or Remedy</i></p> <p>Some effects involve unavoidable damage to a resource e.g. pollution from a spill. Repair essentially involves restoration and reinstatement type measures, such as the clean-up of a coast line where an oil spill has beached.</p>
<p><i>Compensate in Kind</i></p> <p>Where other mitigation approaches are not possible or fully effective, then compensation, in some measure, for loss, damage and general intrusion might be appropriate.</p>

4. Phase Four – Evaluating Residual Effects

Following the assessment of effects and their significance and the application of mitigation measures, effects may not be eliminated entirely. These remaining effects are termed residual effects and their significance is further defined.

5. Limitations in Assessing Effects

Any impact assessment involves a process that interprets activities that are yet to unfold. Thus there is an inevitable uncertainty that arises between the predictions made and what will actually happen during the course of the Project. However, the proposed activity categories are not uncommon even within the local area, therefore the sources of effects are generally well-understood. Effect predictions have been made using available data, however, where the sensitivity of a resource to any particular activity is unknown and the magnitude of effects cannot be predicted, the Study team has used its professional experience to judge whether a significant effect is likely to occur or not.

8.14.3 Baseline Conditions

Sydney Harbour is a drowned river estuary with narrow winding channels and irregular bathymetry (Birch & Taylor, 1999). Estuaries generally act as a transition zone, in which mainland material is trapped and through which some of this material is then transported to the open sea. The chemical composition of estuarine sediments and the variability of suspended particulate matter is controlled by complex physical and biogeochemical processes (Hatje *et al.* 2001), including the mixing of terrigenous and marine sediments.

Embayments on the southern shores of the upper and central harbour (such as Darling Harbour and Cockle Bay) are shallow (<8 m in depth) and contain fine sediments with a high potential for trapping contaminants (Birch & Taylor, 1999). Waterways of the Port Jackson estuary have been identified as the most contaminated on the eastern seaboard of Australia (Birch & Taylor, 2001) after more than two hundred years of industrial activities in the area. In more recent times, with the implementation of improved pollution controls on industry, urban stormwater is thought to be the major source of contaminants in the estuary (Rochford 2008).

The Port Jackson estuary experiences a maximum 2.1m tidal range (Lee *et al.* 2011) with Darling Harbour having a naturally low flushing rate. As a result contaminants that enter Darling Harbour are not diluted or dissipated as readily as other parts of the estuary (OEH 2011).

Water Quality

Areas within the Port Jackson estuary, including Cockle Bay and Darling Harbour are reported to be some of the most contaminated of any harbour in the world. The sources of this contamination are believed to be past and present industrial activities, and the ever-increasing use of the harbour.

Water quality in Darling Harbour and Cockle Bay is known to have been significantly degraded by industrial and urban activities within the catchment area (ERM 2007). Urban stormwater has been identified as the largest contemporary source of heavy metals within the estuary (Birch *et al.*, 1996; Birch & Taylor, 1999; Barry *et al.*, 2000). Birch *et al.*, (2010) estimates that, on average, stormwater contributes to 475 tonnes of total nitrogen, 63 tonnes of total phosphorous and 343,000 tonnes of total suspended solids to Sydney Harbour each year.

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Water samples collected from Pier 26 (less than 200 metres north of the Project Area) in April and May 2014 indicate exceedances of the ANZECC values for marine waters for copper and zinc (see Table 21, SMC Marine 2014). These metals are also known to be found in high concentrations in sediments within the wider area. Values that exceed the ANZECC 2000 trigger values for a moderately disturbed system are shown in bold.

Table 21: Water Quality & Contamination - Water Quality Results at Pier 26, Darling Harbour – April and May 2014

Date	Units	Trigger Value ⁽¹⁾	22/04/2014	28/04/2014	13/05/2014	30/05/2014
			Total Suspended Solids	mg/L	-	<5
Turbidity	NTU	-	0.5	0.9	8	<0.1
Arsenic-Total	µg/L	-	2	2	2	2
Cadmium-Total	µg/L	0.7	<0.1	<0.1	<0.1	0.3
Chromium-Total	µg/L	4.4 ⁽²⁾	<1	<1	<1	<1
Copper-Total	µg/L	1.3	8	7	10	23
Lead-Total	µg/L	4.4	<1	1	4	1
Mercury-Total	µg/L	0.4	<0.05	<0.05	<0.05	<0.05
Nickel-Total	µg/L	7	<1	2	<1	3
Zinc-Total	µg/L	15	22	46	63	47

1. ANZECC (2000) 'slight-moderately disturbed systems' trigger values
2. Trigger values for Chromium VI adopted here

Harbour waters at Barangaroo (just over 1,000 metres north of the project area) are regularly monitored, revealing stable and consistent results for conductivity, turbidity, pH and temperature from a number of areas between Barangaroo and Johnston's Bay. Table 22 provides a summary of water quality data collected for Barangaroo.

Table 22: Water Quality & Contamination - Water Quality Results at Barangaroo Headland Park – 2013 and 2014

Sampling date	Parameter	Conductivity	pH	Turbidity	Temperature
	Units	mS/cm	pH	NTU	°C
December 2013 ⁽¹⁾	min	34.5	6.7	1.4	21.2
	max	53.7	7.41	6.4	24.5
	mean	52.85	7.06	1.96	23.32
April 2014 ⁽²⁾	min	33	7.67	0	17.8
	max	53.7	8.06	14.3	23.46
	mean	52.27	7.94	1.2	21.66
July 2014 ⁽³⁾	min	49.7	7.78	1.2	12.3
	max	54.2	8.07	12.1	15.88
	mean	52.9	7.97	1.6	14.47
September 2014 ⁽⁴⁾	min	28.5	7.7	1.2	14.09
	max	52.7	8.25	15	19.65
	mean	50.2	7.98	1.7	17.24

1. Lend Lease (2013)
2. Boulderstone (2014)
3. Lend Lease (2014a)
4. Lend Lease (2014b)

Sediment Quality

The Port Jackson estuary is known to be heavily effected after years of contamination. Studies over the past 20 years have shown extensive contamination within the estuary by a range of toxicants (Rochford, 2008). Sediments are known to have elevated heavy metal concentrations and a recent

study indicated very high concentrations of copper, lead and zinc within surficial sediments across the entire Port Jackson estuary, including Cockle Bay and Darling Harbour (Birch & Taylor, 1999).

Sediments within industrialised and urbanised harbours and lakes worldwide have been found to frequently contain high concentrations of organic pollutants (NRC, 1989; Bryan and Langston, 1992; Burton, 1992; Simpson *et al.*, 1996; Long, 2000 *cited in* McCreedy *et al.*, 2006). Typical contaminants include organochlorine pesticides (OCs), polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs), and the Port Jackson estuary is no exception. Studies within Cockle Bay indicated high concentrations of copper (200 to 300 µg/g), zinc (500 to >800 µg/g) and lead (>400 µg/g) (Birch & Taylor, 1999). Nutrient analysis of sediment samples collected within the Port Jackson estuary were analysed by Birch *et al.* (1999) and indicated high levels of organic phosphorous, total phosphorous and total Kjeldahl nitrogen in Darling Harbour, and the greater region. McCreedy *et al.* (2000) collected 124 sediment samples from the Port Jackson estuary for analysis of Polycyclic Aromatic Hydrocarbons (PAHs). Levels within Cockle Bay were found to be approximately 20,000 µg/kg⁻¹. These levels were lower than a number of other sites, with PAH levels at Neutral Bay (approximately six kilometres northeast of the Project Area) reaching 380,000 µg/kg⁻¹.

The original source of these substances can be broadly grouped as being sourced from industrial activities, historic and current stormwater discharges, and leachates from reclaimed land (Birch 2007). Stormwater continues to deliver large quantities of contaminants (particularly heavy metals and PAHs) to the estuary (Birch 2007).

8.14.4 Construction Effects Assessment

8.14.4.1 Screening and Scoping Results

A scoping exercise was undertaken in January 2015 to characterise the discrete processes and activities involved with the works to inform the potential for effects and guide the further development and assessment of the potential impacts. Each of the individual activities that would be undertaken as part of the Project were identified and were then further considered with respect to their potential environmental aspects (e.g. generation of underwater noise, disturbance of seabed sediments). A further distinction was made between planned activities and unplanned events (e.g. accidental spills).

The planned activities and unplanned events are summarised in Table 23.

Effects from planned activities have been quantified by assessing the sensitivity of the resources and receptors being affected, coupled with the magnitude of the effects, to determine the overall effect significance. Effects from unplanned events have been assessed by considering the severity of potential effects against the likelihood of the effects occurring to assess the overall effect significance. In all instances, mitigation and control measures are considered after the initial effect assessment, and residual effect significance is then provided.

The Project components which may result in effects include:

1. Removal of structures;
2. Installation of structures;
3. Construction logistics, including vessel movements and discharges from vessels;
4. The long-term presence of structures; and
5. Unplanned activities resulting from the operation of vessels and equipment.

Consideration was also given also to the potential for interactions between the Project activities and groundwater or drainage patterns. In both cases it was determined that there was no potential for interactions, with all works being conducted at water depths well above that of any subsurface aquifers, and no land-based activities being conducted that would alter drainage patterns.

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Table 23: Water Quality & Contamination - Potential Interactions Matrix

Project Phases and Activities		Water Quality	Sediment Quality	
Planned Activities	Removal of Existing Structures			
	Removal of marine structures	Temporary increase in light		
		Generation of surface noise		
	Removal of piles	Marine growth removal		
		Removal of vertical habitat		
		Sediment plumes/smothering		
		Mobilisation of contaminants		
		Generation of underwater noise and vibration		
	Installation of New Structures			
	Installation of piles	Generation of underwater noise and vibration		
		Sediment plumes/smothering		
		Mobilisation of contaminants		
		Increased benthic area unoccupied		
		Addition of vertical habitat		
	Installation of marine structures	Permanent changes to light regime		
		Generation of surface noise		
		Increased benthic area unoccupied		
	Construction Logistics			
	Vessels anchoring	Destruction of habitat		
		Sediment plumes/smothering		
Mobilisation of contaminants				
Vessel and equipment noise	Generation of noise and vibration			
Discharge from vessels	Minor releases of contaminants			
Long-Term Presence of Structures				
Presence of marine structures	Addition of new habitat			
Presence of piles	Addition of new habitat			
Unplanned Events	Marine hydrocarbon spill	Habitat degradation/direct toxicity		
	Marine vessel incident	Minor release of contaminants		
		Debris		
	Dropped objects	Sediment plumes/smothering		
Debris				

LEGEND:

- **No interaction:** where the Project is unlikely to interact with the existing environment or interests (coded white);
- **Interaction possible, but not likely to be significant:** where there is likely to be an interaction, but the resultant effect is unlikely to change baseline conditions in an appreciable or detectable way (coded light grey); and
- **Significant interaction:** where there is likely to be an interaction, and the resultant effect has a reasonable potential to cause a significant effect on the existing environment or interests (coded dark grey).
- **Positive interaction (coded with diagonal hatching):** where there is likely to be an interaction that results in a beneficial effect on the existing environment or interests.

18.14.4.2 Sensitivity of Receptors

Water Quality

Water quality within Cockle Bay and Darling Harbour is known to be contaminated, with the source most commonly found to be effected stormwater run-off. These waters are therefore not considered pristine and background levels of heavy metals, PAHs etc. are high and is therefore defined as a highly disturbed ecosystem in accordance with the ANZECC (2000) criteria.

In the absence of definitive information on the sensitivity of the water quality in the area to further degradation for the purposes of this assessment ERM has conservatively determined the sensitivity of the marine water quality in the AOI as **Medium** as follows:-

Medium	Existing water quality already shows some signs of stress and/or supports ecological resources and human receptors that could be sensitive to change in quality.
--------	--

Sediment Quality

Sediments within the Port Jackson estuary, including Cockle Bay and Darling Harbour are the most contaminated along the eastern seaboard of Australia (Birch & Taylor 2001). Sediments within and surrounding the Project Area have high concentrations of a wide range of contaminants over extensive areas, including heavy metals, organochlorine pesticides, PAHs, polychlorinated biphenyls (PCBs), polychlorinated dibenzo-p-dioxins and dibenzofurans (Birch & Taylor, 1999, 2000; Birch *et al* 2006; Irvine & Birch, 1998; McCreedy *et al* 2000). Background levels therefore, (not unlike water quality) are not considered pristine and the ecosystem is defined as highly disturbed in accordance with ANZECC (2000) criteria.

In the absence of definitive information on the sensitivity of the marine sediments in the area to further degradation for the purposes of this assessment ERM has conservatively determined the sensitivity of the water quality in the AOI as **Medium** as follows:-

Medium	Existing sediment quality already shows some signs of stress and/or supports ecological resources and human receptors that could be sensitive to change in quality.
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8.14.4.3 Planned Activities Impact Assessment

Removal of Structures

Sources of Effect and Sensitivity of Receptors

The key source of disturbance during this activity is the removal of 185 existing piles, which is expected to result in the disturbance of seabed sediments. The sediment, as mentioned previously, is heavily contaminated and disturbance of sediments has the potential to result in localised increases in turbidity, and may also elevate the concentration of contaminants in the water column. The bioavailability of these contaminants may also increase as a result of this disturbance.

The current status of the water and sediment quality within the Project Area is defined as highly disturbed and their sensitivity has been assessed as **medium**. Additionally, sediments in Cockle Bay are routinely resuspended by propeller wash during vessel movements and the placement and removal of temporary moorings.

The activity of removing the existing piles is anticipated to be of a short duration. It is considered unlikely that the temporary increase in sedimentation and turbidity during this time will significantly alter the water or sediment quality of the surrounding area. Increases in total suspended solids (TSS) are expected to be localised due to the low flushing rate within Darling Harbour.

Magnitude of Effects – Removal of Piles	Negligible	Small	Medium	Large
Applicable Criteria	Temporary or localised change in water / sediment quality, with water / sediment quality returning to background levels thereafter.			

Mitigation Measures

Silt curtains will be installed prior to any construction works. Silt curtains are a floating barrier, designed to temporarily contain, deflect or slow down the movement of suspended particles. The use of these curtains during construction will help to contain any suspended sediment and therefore limit the spread of turbidity and contaminated sediments through the Bay.

Residual Effect

While the sensitivity of water and sediment quality was found to be **medium**, the effect magnitude from the removal of structures was found to be **small**. Accordingly, the effect significance from the removal of existing structures is considered to be **minor**.

Category	Effect before Mitigation	Residual Effect
Magnitude of Removal of Structures	Medium	Small
Sensitivity of Water and Sediment Quality to Removal of Structures	Medium	Medium
Significance of Removal of Structures on Water and Sediment Quality	Moderate	Minor

Installation of Structures

Sources of Effect

The key source of disturbance from the installation of structures is the installation of piles. Approximately 80 piles will be installed with the majority of these of a smooth steel construction, with some timber piles also to be used. Piles will be screwed into the seabed utilising a purpose built 18 m crane mounted barge.

Effect Description

The installation of piles is expected to have a temporary effect on water quality. Screwing or boring of piles is known to increase turbidity, and may also introduce toxicants into the water column and increase overall bioavailability of contaminants through disturbance of contaminated sediments. However, the extent of sediment disturbance is expected to be less than that generated during removal of the old piles, and the increase in suspended sediment is expected to be localised due to the low flushing rate within Darling Harbour.

Magnitude of Effects – Installation of Piles	Negligible	Small	Medium	Large
Applicable Criteria	Temporary or localized change in water / sediment quality with water / sediment quality returning to background levels thereafter.			

Mitigation Measures

Silt curtains will be installed prior to any construction works. These curtains will help to contain any suspended sediment and therefore limit the spread of turbidity and contaminated sediments.

Residual Effect

While the sensitivity of water and sediment quality was found to be **medium**, the effect magnitude from the removal of structures was found to be **small**. Accordingly, the effect significance of the installation of structures is considered to be **minor**.

Category	Effect before Mitigation	Residual Effect
Magnitude of Installation of Structures	Medium	Small
Sensitivity of Water and Sediment Quality to Installation of Structures	Medium	Medium
Significance of Installation of Structures on Water and Sediment Quality	Moderate	Minor

Long-Term Presence of Structures

Sources of Effect

The key sources of disturbance from the long-term presence of installed structures include the presence of the new piles, and the potential for changes to the existing current regime within Cockle Bay. However, despite reduction in the number of piles within the water, it is expected that the installation of new piles would have an immeasurable effect on current regimes within Cockle Bay and Darling Harbour due to the limited water movement and current speeds experienced in the area and the semi-enclosed nature of the site.

Magnitude of Effects – Long term Presence of Structures	Negligible	Small	Medium	Large
Applicable Criteria	Immeasurable, undetectable or within the range of normal natural variation.			

Mitigation Measures

No mitigation measures are required for this action.

Residual Effect

While the sensitivity of water and sediment quality was found to be *medium*, the effect magnitude from the long term presence of structures was found to be *negligible*. Accordingly, the effect significance of the long term presence of structures is considered to be *negligible*.

Category	Effect before Mitigation	Residual Effect
Magnitude of Long-Term Presence of Structures	Negligible	Negligible
Sensitivity of Water and Sediment Quality to Long-Term Presence of Structures	Medium	Medium
Significance of Long-Term Presence of Structures on Water and Sediment Quality	Negligible	Negligible

Construction Logistics

Sources of Effect

The key sources of disturbance from the overall construction logistics include:

1. project vessels anchoring; and
2. operational discharges from vessels

Vessels and their movements can have an effect on the water quality of the within the vicinity of works. The Project Area is shallow (<8 m) and therefore, the use of propellers or dynamic positioning systems can cause sediment plumes and increase local turbidity, as well as introduce contaminated sediment to the water column. Anchoring can also cause sediment disturbance and also cause plumes. Discharges from vessels, including sewage, garbage and oils can impact on water quality and increase contamination of sediments.

Magnitude of Effects – Construction Logistics	Negligible	Small	Medium	Large
Applicable Criteria	Temporary or localized change in water / sediment quality with water / sediment quality returning to background levels thereafter.			

Mitigation Measures

As discussed previously, silt curtains will be used during the entirety of the Project. These curtains will help to contain any suspended sediment and therefore limit the spread of turbidity and contaminated sediments.

Vessels used during the Project are legally required to comply with Annexes of the International Convention for the Prevention of Pollution (MARPOL 93/98) including Annexes relating to the discharge of oil, noxious liquid substances, sewage, garbage and air, under the

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Ports and Maritime Administration Act 1995, the Marine Safety Act 1998 and the Marine Pollution Act 1987.

Residual Effect

While the sensitivity of water and sediment quality was found to be **medium**, the effect magnitude from use of anchoring and discharges was found to be **small**. Accordingly, the effect significance of the construction logistics is considered to be **minor**.

Category	Effect before Mitigation	Residual Effect
Magnitude of Effects from Construction Logistics	Medium	Small
Sensitivity of Water and Sediment Quality to Removal of Structures	Medium	Medium
Significance of Construction Logistics on Water Quality	Moderate	Minor
Significance of Construction Logistics on Sediment Quality	Moderate	Minor

8.15.4.4 Unplanned Events Impact Assessment

There is the potential for adverse consequences on both water and sediment quality in the event of an accidental event. The unplanned events that could potentially occur during the proposed works and are considered to have potential for significant environmental effects are discussed below.

Marine Hydrocarbon Spill

Effect Description

The most likely unplanned spill or release of fuels is the accidental spill during refuelling or due to a vessel collision. Fuels, hydraulic fluids and lubricating oils have the potential to cause further effects to the local water and sediment quality. The construction vessels are expected to use marine diesel, which is a middle petroleum distillate that typically undergoes rapid dispersion and evaporation in the marine environment when subjected to weathering. Due to the size of the vessels and the availability of resources (being within the confines of the harbour), spills are expected to be small in size and immediately responded to.

Given the localised nature of the accidental spills outlined above, due to the small quantities considered, the severity of effects from the accidental spill of hydrocarbons or chemicals is considered to be **medium**.

Severity of Effect	Low	Medium	High
Applicable Criteria	Localised environmental damage, no sensitive resources effected and degradation of spilled materials and full recovery of affected resources.		

Due to the range of operations that could result in an accidental spill and the access to emergency responses, it is considered unlikely that a small accidental spill may occur at some stage during the Project.

Likelihood of Occurrence	Extremely Unlikely	Unlikely	Possible	Likely
Applicable Criteria	The event is unlikely but may occur at some time during normal operating conditions.			

Mitigation and Control Measures

Vessels used during the Project are legally required to comply with Annex 1- Oil of the International Convention for the Prevention of Pollution (MARPOL), under the *Ports and Maritime Administration Act 1995, the Marine Safety Act 1998 and the Marine Pollution Act 1987*. Vessels are required to store fuels, oils and chemicals in banded areas on board and refuelling will only occur in calm conditions. Emergency Response Plans are also required on board in addition to spill kits on each vessel for the immediate containment of any spill.

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With the implementation of the above mitigation measures, including the immediate response to any discharge or oil from the Project vessels, the severity effects from the accidental spill of fuel, oil or chemicals, is considered to be **Low**.

Severity of Effect	Low	Medium	High
Applicable Criteria	Some damage to the environment/ very localised, no sensitive resources effected and rapid degradation of spilled materials and rapid recovery of affected resources.		

With these mitigation and control measures in place, the likelihood of an accidental spill of fuels, oils and chemicals, is considered to be **unlikely**.

Likelihood of Occurrence	Extremely Unlikely	Unlikely	Possible	Likely
Applicable Criteria	The event is unlikely but may occur at some time during normal operating conditions.			

Residual Effect

With the implementation of mitigation measures the severity of a marine hydrocarbon spill is considered to be reduced due to the reduced volumes that may be spilled and the response to remove hydrocarbons quickly from the water surface. Accordingly, the effect significance is considered to be **ALARP**.

Category	Effect before Mitigation	Residual Effect
Magnitude of Effects from a Marine Spill	Medium	Low
Likelihood	Unlikely	Unlikely
Significance of Effects	Minor	ALARP

Marine Vessel Incident

Effect Description

Vessel collisions could cause debris and chemicals to enter the harbour. Sunken debris or the sinking of a vessel would cause sediment disturbance, and therefore a potential effect on water quality. Additionally, a vessel collision would potentially result in the spill of fuels, oils or chemicals. An incident due to a vessel collision is considered unlikely due to the low speed of vessel traffic and the sheltered conditions of the harbour. Additionally, the work barges will be stationary for the majority of the time they are working in the bay.

Given the already contaminated nature of the water and sediment within the Project Area, and the use of silt curtains during operation, the severity of effects from vessel collisions is considered to be **medium**.

Severity of Effect	Low	Medium	High
Applicable Criteria	Localised environmental damage, no sensitive resources effected and degradation of spilled materials and full recovery of affected resources.		

Due to the low speed of vessel traffic and the sheltered conditions of the harbour range of operations, it is considered **unlikely** that vessel collisions will occur at some stage during the Project.

Likelihood of Occurrence	Extremely Unlikely	Unlikely	Possible	Likely
Applicable Criteria	The event is unlikely but may occur at some time during normal operating conditions.			

Mitigation and Control Measures

Vessels used during the Project are legally required to comply with Annexes of the International Convention for the Prevention of Pollution (MARPOL), under the *Ports and Maritime Administration Act 1995*, the *Marine Safety Act 1998* and the *Marine Pollution Act 1987*. Vessels are required to store fuels, oils and chemicals in bunded areas on board and refuelling will only occur in calm conditions. Emergency Response Plans are also required on

board in addition to spill kits on each vessel for the immediate containment of any spill. In addition to pollution controls, these regulations provide for standards of crew training, watchkeeping and navigational safety to minimise the risk of a collision occurring.

With these mitigation and control measures in place, the likelihood of an accidental spill of fuels, oils and chemicals, is considered to be **unlikely**.

Likelihood of Occurrence	Extremely Unlikely	Unlikely	Possible	Likely
Applicable Criteria	The unplanned event is extremely unlikely to occur under normal operating conditions but may occur in exceptional circumstances.			

With the implementation of the above mitigation measures, the severity of an effects from the accidental spill of fuel, oil or chemicals, is considered to be **Low**.

Severity of Effect	Low	Medium	High
Applicable Criteria	Some damage to the environment/ very localised, no sensitive resources effected and rapid degradation of spilled materials and rapid recovery of affected resources.		

Residual Effect

With the implementation of mitigation measures both the likelihood and severity of a marine vessel incident are considered to be reduced. Accordingly, the effect significance is considered to be **ALARP**.

Category	Effect before Mitigation	Residual Effect
Magnitude of Effects from a Vessel Collision	Medium	Low
Likelihood	Unlikely	Extremely Unlikely
Significance of Effects	Minor	ALARP

Dropped Objects

Effect Description

The Project Area is relatively shallow (<8 m in depth) and therefore any dropped objects should be easily retrieved. These objects though, depending on their size, may create localised sediment disturbance and plumes.

Given the already contaminated nature of the water and sediment within the Project Area, and the use of silt curtains during operation, the severity of effects from dropped objects is considered to be **low**.

Severity of Effect	Low	Medium	High
Applicable Criteria	Some damage to the environment/ very localised, no sensitive resources effected and quick recovery of dropped objects.		

Mitigation and Control Measures

Vessels used during the Project are legally required to comply with annexes of the International Convention for the Prevention of Pollution (MARPOL), under the *Ports and Maritime Administration Act 1995*, the *Marine Safety Act 1998* and the *Marine Pollution Act 1987*. Vessels are required to hazardous materials in banded areas or secure areas on board.

Due to the range of operations that could result in an accidental spill and the access to emergency responses, it is considered **unlikely** that objects may be dropped overboard at some stage during the Project.

Likelihood of Occurrence	Extremely Unlikely	Unlikely	Possible	Likely
Applicable Criteria	The event is unlikely but may occur at some time during normal operating conditions			

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With the implementation of the above mitigation measures, the severity of an effects from dropped object is considered to be **Low**.

Severity of Effect	Low	Medium	High
Applicable Criteria	Some damage to the environment/ very localised, no sensitive resources effected and quick recovery of dropped objects.		

Residual Effect

With the implementation of mitigation measures, the likelihood and effect of a dropped object remain unlikely and low respectively and the effect significance is considered to be **ALARP**.

Category	Effect before Mitigation	Residual Effect
Magnitude of Effects from a Dropped Object	Low	Low
Likelihood	Unlikely	Unlikely
Significance of Effects	ALARP	ALARP

8.14.5 Water Licensing Requirements and other Approvals

No water licensing requirements have been identified in relation to the proposal. Harbour Master approval will be required prior to disturbance of the seabed.

8.14.6 Geotechnical Considerations and Acid Sulphate Soils

The Geotechnical Report for the proposal is included as Appendix 4.

When sediment or rock containing metal sulphides is exposed to oxygen and water, sulphuric acid can be generated, resulting in acidification of soil, sediment, rock, surface or ground water. This has the potential to reduce soil fertility, kill vegetation and reduce fish populations. Metals may be released from sediments and become bioavailable in the environment, oxygen may be removed from the water column and gases such as hydrogen sulphide, sulphur dioxide and methane may be released.

The potential environmental impact of acid sulphate soils depends on a number of factors including exposure to oxidising conditions. Acid sulphate soils cannot commence generating acidic discharges unless exposed to oxygen and water.

Acid sulphate soils occur throughout Sydney Harbour and may be present at locations where piles will be removed as part of the proposal. Acid sulphate soils present on extracted piles will only begin to oxidise on removal from the water and therefore will not result in contamination of the waterway.

Any extracted piles containing acid sulphates soils will require appropriate treatment to avoid air quality contamination (odours) and may require appropriate disposal at a licensed waste management facility. Mitigating actions are covered in Sections 8.10.3 Waste Management Impacts and 8.16.7 Air Quality - Acid Sulphate Soils.

8.14.7 Water Quality Monitoring Program

Given the baseline water quality conditions and existing knowledge of water and sediment contaminants from recent projects, water quality monitoring is not proposed.

8.14.8 Operational Phase Impacts

Operational phase impacts relate to the use of the facilities, including waste management, accidental spills of fuel, oil or chemicals and dropped objects. Waste management is addressed in Section 8.10. The impact of operational phase activities is considered to be neutral when compared to existing operations, as no intensification of use is proposed and management and enforcement of the bay operations will be optimised as a result of the proposal. The Harbour Master and Environmental Protection Authority will be consulted further with respect to protocols required for the operational phase.

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8.14.9 Conclusion and Proposed Additional Mitigation Measures

The Water and Sediment Impact Assessment has identified that the residual effects from project activities on water and sediment quality are as follows:

Table24: Summary of Water & Sediment Impact Residual Effects

Activity	Residual Effect
Removal of existing structures	Minor
Piling	Minor
Presence of new structures	Negligible
Construction logistics (vessels anchoring and operational discharges from vessels)	Minor
Unplanned event – accidental spill of fuel, oil or chemicals	ALARP
Unplanned event – vessel collision	ALARP
Unplanned event – dropped objects	ALARP

The following additional mitigation measures have been identified to minimise effects on water and sediment quality:

Construction Phase

1. The Harbour Master will be consulted further with respect to pollution prevention measures for the construction phase of the proposal to ensure that all pollution prevention measures have been addressed, including access to stormwater drains within the site boundary.
2. Any disturbance of the seabed will be subject to the approval of the Harbour Master in accordance with clauses 67 and 69 of the Management of Water and Waterside Lands Regulations - NSW
3. Piles will be completely withdrawn from the seabed. In the event a pile cannot be fully removed, it will be cut off at the seabed using an appropriate cutting sleeve to reduce seabed disturbance
4. Silt curtains and booms will be installed prior to any works and suitably maintained during demolition and construction works to contain suspended sediment and limit spread of turbidity and contaminated sediments
5. Vessels used during the construction will be legally required to comply with:
 - Annexes of the International Convention for the Prevention of Pollution (MARPOL 93/98) including Annexes relating to the discharge of oil, noxious liquid substances, sewage, garbage and air
 - *Ports and Maritime Administration Act 1995*, the *Marine Safety Act 1998* and the *Marine Pollution Act 1987*; this legislation requires vessels to store fuels, oils and chemicals in banded areas on board and refuelling to only occur in calm conditions; Emergency Response Plans are also required on board in addition to spill kits on each vessel for the immediate containment of any spill.
6. Preparation and implementation of an Environmental Management Plan including procedures minimising risk of unplanned events relating to spills, collisions and avoiding material entering the waterway, including:
 - Only suitable and appropriately certified vessels are used on the project
 - Only qualified and experienced vessel operators may work on the project
 - Minimum volumes on site and spill kits to be carried on all vessels
 - Oil spill contingency plans to be understood and actioned if necessary by vessel operators including immediate response to any discharge
 - Appropriate measures to prevent material entering the waterway during concrete cutting
 - Notification, reporting and corrective action procedures in the event of a pollution incident are in place
7. The Harbour Master and the Environmental Protection Authority will be consulted further with respect to pollution prevention measures for the construction phase of the proposal to ensure that all pollution prevention measures have been addressed, including access to stormwater drains within the site boundary.

Operational Phase

8. The Authority will utilise its operational ranger services to ensure the potential for contamination is minimised during the operational phase
9. The Authority will consult with the Harbour Master and the Environmental Protection Authority in relation to best practice management requirements prior to the new facilities being put into operation.

8.15 Flora and Fauna

8.15.1 Potential Issues

This section addresses SEARs Key Issue 8 as stated below:

1. Assessment of potential impacts on any flora and fauna, including threatened species, populations or communities (eg. Psodonia seagrass) or their habitats; and
2. Recommendation of appropriate mitigation measures during construction and operation, including potential impacts of shading from fixed facilities and permanently berthed vessels.

Potential issues relate to destruction or change of habitat (changes to light regime, removal of vertical habitat, removal marine growth, increased benthic area not occupied), generation of underwater noise and vibration and impacts on fish and species housed in the Aquarium, sediment plumes resulting in mobilisation of sediment contaminants, and release of contaminants from vessels. Positive impacts can include the creation of new habitat.

A Flora and Fauna Impact Assessment has been undertaken for the proposal by Environmental Resource Management Australia and their full report is included as Appendix 10. Extracts of the full report are included in the following sections for ease of reference. The assessment has been prepared in accordance with the following standards and guidance:

- Environmental Planning & Assessment Act 1979
- Fisheries Management Act
- Threatened Species Conservation Act 1995
- Protection of the Environment Act 1997

8.15.2 Construction Impact Assessment Methodology

8.15.2.1 Impact Assessment Scoping

Scoping was undertaken by ERM in accordance with ERM's standard methodology. This scoping exercise documented the resources and receptors potentially present within the Area of Interest (AOI), and assessed which of these the Project activities may interact with and potentially effect.

Identifying the Project Activities

To initiate the scoping process, the activities were described based on information provided by SHFA. This stage of the Study entailed gathering information to define the Project design as far as possible. This Project design was then broken down into a series of discrete activities which could more readily be assessed for impact against the receiving environment.

Establishing the Area of Interest

Throughout the assessment process, the extent of the AOI took into account the specific aspect and the types of effects considered.

The AOI for the Project has been defined to include all that area within which it is likely that significant impacts could result. This takes into account:

- Primary Project site: the site of the Project, being the physical extent of the Project activities (in this case Cockle Bay);
- Potential areas affected by impacts from unplanned events resulting from the Project; and
- The nature of the affected resource or receptor, the source of impact and the manner in which the resultant effect is likely to be propagated beyond the Project footprint.

Assessing Project: Resource/Receptor Interactions

The nature and availability of baseline environmental and Project information is such that the identification of the potential interactions between the Project and resources/receptors within the AOI could be undertaken to a high level of confidence. Professional judgement was used to assess whether interactions have the potential to result in impacts that could lead to negative or positive effects greater than negligible. In addition the current regulatory requirements and industry best practices were considered.

Once potential interactions were identified, they were charted using a colour-coded matrix (see Table 26: Potential Interaction Matrix). The different colours within the matrix indicate the level of potential impact based on the following criteria:

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Potential interactions between the activities and existing environment and uses were each classified into one of the following four categories:

- **No interaction:** where the Project is unlikely to interact with the existing environment or interests (coded white);
- **Interaction possible, but not likely to be significant:** where there is likely to be an interaction, but the resultant effect is unlikely to change baseline conditions in an appreciable or detectable way (coded light grey); and
- **Significant interaction:** where there is likely to be an interaction, and the resultant effect has a reasonable potential to cause a significant effect on the existing environment or interests (coded dark grey).
- **Positive interaction:** where there is likely to be an interaction that results in a beneficial effect on the existing environment or interests (coded with diagonal hatching).

Environmental Baseline Definition

To assess and define the Project components and the environmental baseline, two steps were undertaken:

- Collection of relevant Project information; and
- Collection of baseline data for the AOI or considered to be adequately representative of the area.

A range of information was reviewed by ERM and incorporated into the Study including data from the following sources:

- Project technical specifications and project details provided by SHFA;
- Primary literature;
- Published environmental studies of the AOI and surrounding areas;
- A review of diver survey footage of Project Area collected in February 2015; and
- Internet websites including the following database searches:
 - The EPBC Act Protected Matters Search Tool returned a total of 29 species listed as Vulnerable and Endangered under the EPBC Act and FM act that are known to occur or may potentially occur within a 1 km buffer around the coordinates 33.87179 151.20075 or otherwise defined as the Project Area (Data retrieved 28th January 2015). Of these species, 21 were marine, freshwater and/or terrestrial birds, 1 fish, 5 turtle and 2 species of shark. These species are described further in Section 8.14.3.
 - The NSW Wildlife Atlas database search returned a total of 210 species that are known to occur or may potentially occur within a 10 km buffer of the Project Site (Data retrieved 28th January 2015). Of these, 19 species were considered Vulnerable, Endangered or as an Endangered Populations under the TSC Act and they included 16 marine, freshwater and/or terrestrial birds and 3 marine mammals as described in Section 8.15.3.

Each data set was assessed for completeness, sufficiency and applicability for use in the Study.

8.15.2.2 Effects Assessment Methodology

The effects assessment methodology adopted is the same as that adopted for Water Quality and Contamination – refer Section 8.14.4.

8.15.3 Baseline Conditions

Sydney Harbour is a drowned river valley, formed many years ago during a rise in sea level (Hutchings et al., 2013). It is approximately 30 km long, 3 km wide and spans an area of 50 km² (Birch & Taylor, 1999). The Harbour, also referred to as Port Jackson, has experienced relentless stress due to a rapidly increasing population density and extensive residential, commercial and industrial expansion (Birch, 2007).

Port Jackson has been extensively modified by reclamation over the last 200 years, especially in the upper and central estuary (including Darling Harbour and Cockle Bay). Approximately 50% of natural foreshores have been modified by artificial structures such as seawalls, breakwaters, pier pilings and floating pontoons (Chapman & Bulleri, 2003). Reclamation of this land has resulted in a loss of almost 9 million cubic metres of water on each tidal cycle, causing large changes in water movements, water quality, sedimentation and ecology of the upper estuary (Liu, 1989).

Darling Harbour and Cockle Bay are shallow (< 7 m), contain fine sediments known to trap contaminants (Birch & Taylor, 1999) and have naturally low flushing rates (OEH, 2011). As a result

pollution that enters these embayments is not readily diluted or dissipated as in other areas of the estuary (OEH, 2011). Therefore, it is not surprising that Port Jackson estuary has been identified as containing the most contaminated sediments on the eastern seaboard of Australia (Birch & Taylor, 2001).

Inherently, development and reclamation within Port Jackson and Cockle Bay has significantly affected the distribution and abundance of marine organisms and resulted in major alteration to ecological function, biological productivity, hydrology and physico-chemical attributes of the area (URS, 2011).

Marine Ecology

This assessment comprises of a desktop review of available primary literature, published ecological assessments of the AOI and surrounding areas, internet database searches and diver survey footage within the AOI to determine the baseline conditions of marine ecological values within Cockle Bay, Darling Harbour and the greater Port Jackson estuary. It is noted that limited information is available that directly refers to Darling Harbour itself, and the information presented in this assessment refers to more general assessments of the wider area that have been the subject of historic studies and are considered applicable.

Benthic Communities

Benthic communities are strong indicators of ecosystem health as they are linked to the physical and chemical properties of sediments (Stewart *et al.*, 2000).

Information relating to the taxonomy, distribution and abundance of benthic assemblages within Sydney Harbour is limited due to the lack of comprehensive surveys conducted in the area; however some indication of the diversity is given by Australian Museum collection records (Hutchings *et al.* 2013).

To date the total number of polychaete, crustacean and molluscan species recorded from Sydney Harbour stands at 2,355. Interestingly, neighboring estuaries have recorded significantly less, with 1,636, 1,335 and 981 species recorded in Botany Bay, Port Hacking (Fraser *et al.* 2006) and Hawkesbury River (Hutchings & Murray, 1984) respectively. This high species richness within Sydney Harbour is attributable to many factors including significant tidal flushing and high diversity of habitat types (Australian Museum, 2015a) (for records of benthic invertebrate species refer to <http://australianmuseum.net.au/blogpost/science/sydney-harbour-species>).

A more recent study carried out by Worley Parsons (2010) at Barangaroo Ferry hub (located approximately 1,000 m from the Project Area) indicated that sediments contained elevated levels of heavy metals and polycyclic aromatic hydrocarbons (PAHs) and supported a simple benthic assemblage including 120 individuals from 23 taxa comprising 15 polychaete worm taxa (72% of total abundance), 4 decapod crustaceans taxa (18% of total abundance) and 4 other taxa (10% of total abundance) (see Table 25). Molluscs and echinoderms, which are commonly abundant species in marine and estuarine sediments, were noticeably absent from the area (as cited in Marine Pollution Research Pty Ltd (MPR Pty Ltd), 2014).

Table25: Bethnic Assemblages in Seabed Sediments at Barangaroo (as cited in MPR Pty Ltd, 2014)

		Occurrence and Abundance of Biota in Replicate Sediment Samples	
Class or Order	Family or Species	Occur	Abundance
Polychaeta	Cirratulidae	2	2
Polychaeta	Lumbrineridae	2	3
Polychaeta	Nephtyidae	1	1
Polychaeta	Pilargidae	2	2
Polychaeta	Syllidae	1	1
Polychaeta	Oweniidae	2	2
Polychaeta	Sigalionidae	1	1
Polychaeta	Spionidae	5	5
Polychaeta	Terebellidae	5	11
Polychaeta	Hesionidae	1	1
Polychaeta	Chaetopteridae	5	8
Polychaeta	Capitellidae	8	42
Polychaeta	Maldanidae	3	4
Polychaeta	Opheliidae	1	1
Polychaeta	Orbiniidae	2	2
Decapoda	Callianassidae	8	19

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Decapoda	Alpheidae	1	1
Decapoda	Xanthidae	1	1
Decapoda	<i>Brachyura sp.a</i>	1	1
Bryozoa	<i>Cheilostomata spp.</i>	1	1
Gastropoda	Philinidae	1	1
Nemertea	<i>Hoplonemertea spp.</i>	5	8
Platyhelminthes	<i>Digenia sp</i>	1	2
	No Taxa		23
	Abundance	120	

While it is well known that Port Jackson estuary, including Darling Harbour and Cockle Bay are heavily impacted upon after years of contamination it is not understood what benthic assemblages are present within the Project Area.

A recent archaeological dive survey carried out in the Project Area showed there to be some evidence of burrowing from crustaceans (see Figure 43), however baseline conditions have been inferred largely from more comprehensive assessments undertaken in the wider area. On this basis the Project Area, like that of Barangaroo, is expected to support a restricted assemblage of benthic invertebrate fauna due to the presence of heavily contaminated sediments.



Figure 43: Dive Survey Image showing Benthic Habitat & Evidence of Burrowing within the Project area (Source: Cosmos Archaeology Pty Ltd, 2015)

Sub-tidal and Intertidal Invertebrate Communities

More than 50% of intertidal habitats within Sydney Harbour have been replaced with artificial structures (Chapman & Bulleri, 2003).

The physical characteristics of these structures differ significantly compared to that of natural rocky reefs; however both have been found to support a similar suite of species differing only in relative abundances and frequencies of occurrence (Chapman & Bulleri, 2003).

Although there is little information available in relation to sub-tidal and intertidal invertebrate communities in the Project Area, inference can be drawn from ecological surveys carried out nearby at Barangaroo Ferry Hub and King Street Wharf 10 Jetty (located approximately 400 m from the Project Area).

Prior to the development of Barangaroo Ferry Hub, existing structures consisted of a vertical concrete seawall, set onto basement sandstone rock which transitioned into rock rubble overlying a silty sand slope (MPR Pty Ltd, 2014). These concrete structures supported a restricted assemblage of intertidal invertebrates, including barnacles, Sydney rock oysters, limpets, littorinid snails and periwinkles in the intertidal zone; and bryozoan, sponges and colonial ascidians in sub-tidal areas (from 4 m to depths of 10.5 m). The adjacent seabed was devoid of most biota except for some encrusting sponges occurring within a thick layer of fine silt (MPR Pty Ltd, 2014).

In contrast, King Street Wharf 10 Jetty prior to its refurbishment, consisted of various structures including a fixed timber and steel wharf, built out from a concrete retaining wall and supported by steel and timber piles. In addition, steel wave baffles had fallen away from their wharf fixtures and settled on the seabed. Typical of a natural shallow marine community, distinct depth zonation of all biota on all vertical surfaces was evident, including barnacles in high intertidal surge zones; various gastropod molluscs in lower intertidal areas; oysters, black mussels, sponge, bryozoa and tunicate species

occupying sub-tidal habitats. The discarded wave baffles and areas shaded by the wharf also supported encrusting species (MPR Pty Ltd, 2013).

The Project Area is similar to King Street Wharf 10 Jetty in that it consists of various marine structures including natural and artificial seawalls; and timber and steel wharf structures that shade the seabed. Therefore it is likely that the Project Area and its array of structures support a variety of invertebrate species at each tidal zone.

Marine Plants

Intertidal and sub-tidal plant communities play an important role in contributing to estuarine food chains and offering shelter for juvenile and adult species of fishes, crustaceans and molluscs (West *et al.*, 2004).

The NSW DPI has mapped the distribution aquatic vegetation within Sydney Harbour, focusing on seagrasses, mangroves and saltmarsh, all of which provide productive and sheltered habitats for other organisms. Results showed that species of seagrass are distributed in soft sediment habitats downstream of the Harbour Bridge, areas of mangrove reside in the upper reaches of the Parramatta River and saltmarsh reside on the foreshore of Sydney Olympic Park (West *et al.*, 2004). Seagrasses are of particular conservation significance, they provide shelter for pipefish (*Solenostomidae*) and seamoths (*Pegasidae*) which are listed as protected under the FM Act and in addition, seagrass *Posidonia australis* is listed as an Endangered Ecological Community also under the FM Act.

While these plant species have a higher conservation profile than kelp, it is important to note that much of the rocky foreshore of Sydney Harbour is covered in kelp habitat mainly *Ecklonia* and small amounts of *Sargassum spp* (West *et al.*, 2004). Seahorses (*Syngnathids*) which are protected under the EPBC Act and the FM Act are commonly observed in kelp forests.

No mapping has been undertaken in the Project Area. A recent archaeological dive survey undertaken in the Area showed piles supported some microalgae species (see Figure 44), however baseline conditions of aquatic vegetation is largely inferred from more comprehensive surveys carried out in surrounding localities. Barangaroo Ferry Hub supported few species of microalgae in the intertidal and sub-tidal portions of the seawall (MPR Pty Ltd, 2014). In contrast, the sub-tidal areas of King Street Wharf 10 Jetty supported a variety of algae including three large kelp species (*Ecklonia radiate*, *Padina sp.*, and *Sargassum spp.*) which were confined to piles and parts of wave baffles exposed to light (MPR Pty Ltd, 2013). No species of seagrass, mangroves or saltmarsh were observed at either location. It is therefore considered that the Project Area, which is structurally very similar to King Street Wharf 10 Jetty, is likely to support a similar suite of algae species attached to support piles.



Figure 44: Dive Survey Footage of Aquatic Vegetation on Piles within the Project Area (Source: Cosmos Archaeology Pty Ltd, 2015)

Fish

Sydney Harbour has a diverse fish fauna with over 588 species, 20 of those species belong to the Families of seahorses, ghost pipefish and seamoths (*Syngnathidae*, *Solenostomidae* and *Pegasidae*) which are listed as protected under the FM Act (Australian Museum, 2015b) (for a list of species refer to <http://australianmuseum.net.au/Fishes-of-Sydney-Harbour>).

Past commercial and recent recreational fishing efforts also provide an indication of fish species in the Harbour. Commercial fisheries, banned in 2006 due to unacceptably high levels of dioxins in the tissue of fin fish (Birch, 2007), traditionally targeted dusky flathead (*Platycephalus fuscus*), blue swimmer crab (*Portunus pelagicus*), sand whiting (*Sillago ciliata*), silver biddy (*Gerres subfasciatus*), river (longfinned) eels (*Anguilla reinhardti*, pipis (*Plebidonax deltoids*), mullet (*Mugil cephalus*), luderick (*Girella tricuspidata*) and yellowfin bream (*Acanthopagrus australis*) (NSW DPI, 2015a). Commercial prawn trawlers, also forbidden, targeted eastern king prawn (*Penaeus plebejus*) (URS, 2011). Recreational fishing efforts remain high in the area, despite known accumulations of toxins in fish. Results show recreational fishers were estimated to have caught approximately 74 tonnes of fin fish, crabs and cephalopods over a 3 month period in 2008 (NSW DPI, 2015a).

No direct studies of fish species have been conducted within the Project Area and therefore baseline conditions of fish fauna have been inferred from surveys carried out in surrounding localities. The vertical concrete seawalls of nearby Barangaroo Ferry Hub provided suitable shelter and feeding habitat for small reef fish, including cardinal fish, eastern hulafish, pygmy leather jackets, fan bellied leatherjackets; and predatory fish which included luderick and bream (MPR Pty Ltd, 2014). In contrast, timber and steel wharf structures of King Street Wharf 10 Jetty provided significant areas of shading and kelp-covered support piles suitable for larger fish species including senator wrasse, bat fish, bream and luderick. Smaller substratum fish such as eastern hula fish were not observed (MPR Pty Ltd, 2013). Specific searches were carried out at both localities and also in the recent dive survey to investigate the presence of seahorses, however no individuals were observed. No other threatened or protected species as listed under the FM Act or EPBC Act were observed at either site (MPR Pty Ltd, 2014; MPR Pty Ltd, 2013).

A database search carried out using the EPBC Act Protected Matters Search Tool recorded three protected fish species listed as vulnerable under the FM Act and EPBC Act, including black rock cod, grey nurse shark and great white shark. Black rock cod inhabit coastal and estuarine rocky reefs and could potentially occur in Darling Harbour, however the lack of suitable cave and crevice habitats within the Project Area conclude that it is unlikely to occur. Both species of shark are near-shore coastal species that could enter Sydney Harbour, however such visits would be infrequent and generally only in the outer harbour and therefore they are unlikely to occur in the Project Area. No seahorses were recorded in the database search.

Based on the above information, it is considered that the Project Area, like that of King Street Wharf 10 Jetty, is likely to support an assemblage of large fish species occupying shaded habitats beneath wharf structures and is unlikely to support seahorse or any other protected fish species will be present within the Project Area. This is consistent with a recent dive survey carried out within the Project Area which showed the presence of large fish (species unknown) occupying habitat around the piles (see Figure 45) and no observations of seahorse.



Figure 45: Dive Survey Footage of Fish Occupying Habitat around Piles within the Project Area (Source: Cosmos Archaeology Pty Ltd, 2015)

Seabirds

Seabirds that may occur in the area, such as gulls and cormorants are common and widely distributed however marine structures, such as the conical shaped piles, are designed specifically to minimise birds resting and therefore the Project Area is not important habitat even for these species.

The EPBC Act Protected Matters Search Tool recorded 21 species of bird that are known to occur or may potentially occur within the Project Area. Of these, a total of 12 seabird species were listed as Vulnerable including 10 species of albatross, northern giant-petrel and Australian fairy tern; and 9 bird species considered as Endangered including 7 marine and freshwater species (3 albatross species, Australian bittern, eastern bristle bird, southern giant-petrel, Australian painted snipe) and 2 terrestrial species (regent honeyeater and swift parrot).

The NSW Wildlife Atlas tool recorded 19 bird species listed as Vulnerable, Endangered or as an Endangered Population under the TSC Act that are known to occur or may potentially occur within the Project Area. Of these, 9 species are considered as Vulnerable, including 4 terrestrial species (little eagle, glossy black cockatoo, sooty owl, diamond firetail) and 5 species transient across all habitats (black bittern, little lorikeet, barking owl, powerful owl, white-fronted chat); 6 species considered as Endangered including 2 species of seabird (wandering albatross, pied oystercatcher), 2 terrestrial species (bush stone-curlew, swift parrot) and 2 species transient across all habitats (curlew sandpiper, little tern); and white-fronted chat also considered as an Endangered Population.

The recorded bird species are either open water or open coastal in the distribution or inhabit freshwater and terrestrial habitat that are not represented within the Project Area and therefore these species are unlikely to occur. In addition, there is no literature supporting the presence of these protected bird species.

It should be noted that little penguin, which are listed as an Endangered Population under the TSC Act, reside in a colony located at Manly (approximately 7 km from the Project Area). Little penguin are known to swim a considerable distance from nesting sites during foraging trips, however there are no records of them utilising the Project Area and although it may be possible that they enter the area during the planned works it is considered unlikely.

Invasive Marine Pests

Port Jackson's trading ports, Botany Bay, Port Kembla and Eden are known to contain at least 30 introduced marine taxa, including aquarium caulerpa (*Caulerpa taxifolia*), and the dinoflagellates (*Alexandrium catenella*, *Alexandrium tamarense* and *Gymnodinium catenatum*) found as inactive cysts (URS, 2011). NSW DPI continually monitors *Caulerpa taxifolia*, the European fanworm and the green crab and is involved in the development of the National System for the Prevention and Management of Marine Pest Incursions, which is aimed at preventing the introduction and translocation of exotic marine species (NSW DPI, 2011b).

It is not known whether the Project Area contains any invasive marine pests. Surveys carried out at nearby Barangaroo Ferry Hub and King Street Wharf 10 Jetty, did not observe listed pest algae *Caulerpa taxifolia* nor are the habitats suitable due to the depth of the seabed at these sites and the degree of sediment disturbance and turbidity (MPR Pty Ltd, 2014; MPR Pty Ltd, 2013). Based on this, the Project Area is unlikely to support the invasive algae *Caulerpa taxifolia*.

Other Marine Protected Species (Reptiles, Marine Mammals)

The EPBC Act Protected Matters Search Too, recorded 5 species of turtle that are known to occur or may potentially occur within the Project Area including 3 species listed as Vulnerable (green turtle, hawksbill turtle, flatback turtle) and 2 species considered as Endangered (loggerhead turtle, leatherback turtle).

The NSW Wildlife Atlas database search returned a total of 3 protected species of marine mammal that are known to occur or may potentially occur within the Project Area. Of these, the southern right whale is considered as Endangered and Australian fur seal and New Zealand fur seal are considered as Vulnerable under the Threatened Species Conservation Act 1995.

The recorded species are open water or open coastal in their distribution and therefore are unlikely to occur within the Project Area.

It should be noted that nearby, Sydney Sea Life Aquarium holds a number of marine species listed as protected under the FM Act and EPBC Act, including marine turtles, dugongs, grey nurse sharks (*Carcharias taurus*) and seabirds such as the little penguin (*Eudyptula minor*) (URS, 2011). Additionally, a large number of captive fish are held by the aquarium. The Aquarium, which is located

north east of the Project Area and separated by approximately 120 m of water, houses two steel oceanariums that are in direct contact with harbour water. The Aquarium also accesses seawater from the harbour through an intake located under the adjacent wharf (approximately 80 m from the Project Area).

The facility's proximity to the Project Area means that it has been considered as a sensitive receptor to the planned works.

8.15.4 Construction Effects Assessment

8.15.4.1 Screening and Scoping Results

A scoping exercise was undertaken in January 2015 to characterise the discrete processes and activities involved with the works to inform the potential for effects and guide the further development and assessment of the potential impacts. Each of the individual activities that would be undertaken as part of the Project were identified and were then further considered with respect to their potential environmental aspects (e.g. generation of underwater noise, disturbance of seabed sediments). A further distinction was made between planned activities and unplanned events (e.g. accidental spills).

The planned activities and unplanned events are summarised in Table 26 below:

Effects from planned activities have been quantified by assessing the sensitivity of the resources and receptors being affected, coupled with the magnitude of the effects, to determine the overall effect significance. Effects from unplanned events have been assessed by considering the severity of potential effects against the likelihood of the effects occurring to assess the overall effect significance. In all instances, mitigation and control measures are considered after the initial effect assessment, and residual effect significance is then provided.

The Project components which may result in effects include:

6. Removal of structures;
7. Installation of structures;
8. Construction logistics, including vessel movements and discharges from vessels;
9. The long-term presence of structures; and
10. Unplanned activities resulting from the operation of vessels and equipment.

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Table26: Flora & Fauna - Potential Interactions Matrix

Project Phases and Activities		Environmental Aspects and Existing Uses					
		Benthic Communities (Sediment Quality)	Invertebrates (Attached)	Fish	Marine Mammals	Seabirds	Sydney Aquarium
Planned Activities	Removal of Existing Structures						
	Removal of marine structure	Temporary increase in light					
		Generation of underwater noise and vibration					
	Removal of piles	Marine growth removal					
		Removal of vertical habitat					
		Sediment plumes/smothering (ISS)					
		Mobilisation of contaminants					
		Generation of underwater noise and vibration					
	Installation of New Structures						
	Installation of piles	Generation of underwater noise and vibration					
		Sediment plumes/smothering (ISS)					
		Mobilisation of contaminants					
		Increased benthic area unoccupied					
	Installation of marine structure	Addition of vertical habitat					
		Permanent changes to light regime					
		Generation of underwater noise and vibration					
		Increased benthic area unoccupied					
	Construction Logistics						
	Vessels anchoring	Destruction of habitat					
		Sediment plumes/smothering (ISS)					
Mobilisation of contaminants							
Vessel and equipment noise	Generation of noise and vibration						
Discharge from vessels	Minor releases of contaminants						
Long-Term Presence of Structures							
Presence of marine structure	Addition of new habitat						
Presence of piles	Addition of new habitat						
Unplanned Events	Marine hydrocarbon spill	Habitat degradation/direct toxicity					
	Marine vessel incident	Minor release of contaminants					
		Debris					
Dropped objects	Sediment plumes/smothering (ISS)						
	Debris						

LEGEND:

- **No interaction:** where the Project is unlikely to interact with the existing environment or interests (coded white);
- **Interaction possible, but not likely to be significant:** where there is likely to be an interaction, but the resultant effect is unlikely to change baseline conditions in an appreciable or detectable way (coded light grey); and
- **Significant interaction:** where there is likely to be an interaction, and the resultant effect has a reasonable potential to cause a significant effect on the existing environment or interests (coded dark grey).

8.15.4.2 Sensitivity of Receptors

Benthic Communities

Studies indicated that sediments within the AOI contain elevated levels of heavy metals and PAHs and therefore the area is likely to support a simple benthic assemblage of polychaete and crustacea. No threatened or endangered benthic communities were recorded within the AOI.

In the absence of definitive information on the sensitivity of benthic communities in the area to further degradation for the purposes of this assessment ERM has determined the sensitivity of benthic communities in the AOI as **low**.

Low	Benthic communities are abundant, common or widely distributed and are generally adaptable to changing environments. Species are not endangered or protected.
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Attached Invertebrates

Studies indicated that various artificial marine structures within the AOI, including natural and artificial seawalls, and timber and steel wharves which shade the seabed, provide habitats likely to support a

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variety of invertebrate species in each tidal zone. No threatened or endangered invertebrate species were recorded within the AOI.

For the purposes of this assessment ERM has determined the sensitivity of invertebrate species in the AOI as **low** based on the homogenous nature of the sedimentary habitats and the current high levels of contamination in the area.

Low	Attached invertebrates are abundant, common or widely distributed and are generally adaptable to changing environments. Species are not endangered or protected.
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Fish

Studies indicate that timber and steel wharf structures and associated shaded areas within the AOI are likely to support an assemblage of fish using these structures as shelter, and feeding and foraging habitat. No threatened or endangered fish species were recorded within the AOI. In the absence of definitive information on the sensitivity of fish species in the area to further degradation for the purposes of this assessment ERM has determined the sensitivity of fish species in the AOI as **low**.

Low	Fish species are abundant, common or widely distributed and are generally adaptable to changing environments. Species are not endangered or protected.
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Seabirds

Records from database searches indicated the presence of protected seabird species within the AOI. However, the identified species are either open water or open coastal in their distribution or inhabit freshwater and terrestrial habitat that are not represented within the AOI and therefore these species are unlikely to occur. Marine structures specifically designed to limited resting habitat, restrict the occurrence of even those widely distributed species such as gulls and cormorants. No other threatened or endangered seabirds, including little penguin, were recorded within the AOI.

For the purposes of this assessment ERM has determined the sensitivity of seabird species that are likely to occur in the AOI as **low**.

Low	Seabirds are abundant, common or widely distributed and are generally adaptable to changing environments. Species are not endangered or protected.
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Sydney Aquarium

This facility is located approximately 120 m north-east of the AOI and holds species protected under the FM Act and the EPDC Act, including marine turtles, dugongs, grey nurse sharks and little penguin. In addition, the facility accesses seawater from the harbour through an intake located under the adjacent wharf approximately 80 m from the AOI.

The sensitivity of Sydney Aquarium's species to impacts from the Project activities has been determined to be **high**.

High	Sydney Aquarium's protected species are rare or endemic, under significant pressure and/ or highly sensitive to changing environments. Species are valued nationally / globally and are listed as endangered or protected.
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8.15.4.3 Planned Activities

Removal of the Marine Structure

1. Sources of Effects

The key source of disturbance during this activity is the demolition and removal of the existing 4,365 m² marine structure, which is expected to result in a temporary reduction in shaded areas of seabed and an associated increase in light and potential generation of underwater noise and vibration. These effects and their sensitive receptors are discussed below.

2. Temporary Increases in Light on Fish

Wharf structures provide shelter from light, temperature and wave action. Studies have shown that organisms favouring these habitats have experienced greater recruitment and survival where there is shade (Blockley, 2007). Therefore the removal of the marine structure and temporary increases in light have the potential to temporarily affect species of fish within the immediate area. Studies indicate that the wharf structure supports an assemblage of fish, their sensitivity has been assessed as **low**. Additionally, given their mobility most fish species are expected to avoid unfavourable lighting

conditions and abundant alternative shaded habitats are present in nearby areas as well as shading provided by buildings surrounding the bay.

Evaluation of Effects

Magnitude of Effects – Temporary Increase in Light	Negligible	Small	Medium	Large
Applicable Criteria	Affects a specific group of localised individuals within a population over a short time period (one generation or less), but does not affect other trophic levels or the population itself.			

Mitigation Measures

No mitigation measures are required for this action although it is noted that some of the removed marine structures will be replaced, with a permanent reduction in shaded area of approximately 973 m². Fish temporarily displaced by the increase in light may return to the newly shaded areas as these are completed.

Residual Impacts

The sensitivity of fish is considered to be **low**, the magnitude effect of increased light on these species was found to be **small**. Accordingly, the overall significance of removal of the marine structure and subsequent temporary increases in light on fish is considered **negligible**.

Category	Effect before Mitigation	Residual Effect
Magnitude of Temporary Increase in Light	Small	Small
Sensitivity of Fish	Low	Low
Significance of Temporary Increase in Light on Fish	Negligible	Negligible

3. Generation of Underwater Noise and Vibration on Fish

Most marine animals, particularly marine mammals and fish, are sensitive to underwater noise, using sound for all important aspects of their life including feeding, reproduction, navigation and avoiding hazards like predators (Tyack and Miller 2002; Popper 2003).

Studies have observed fish mortality at 229 dB to 231 dB, injury at 220 dB re 1 µPa and changes to behaviour at 171 dB re 1 µPa rms (SLR, 2014). In this instance, general construction noise has been identified as 10 to 100 Hz (NRC, 2003). Therefore short-term generation of low level noise is unlikely to alter the behaviour of fish species within the. This noise will not contribute much in excess of the ambient noise levels generated from existing boat traffic and adjacent road traffic. Fish sensitivity has been assessed as **low**.

Evaluation of Effects

Magnitude of Effects – Generation of Underwater Noise and Vibration	Negligible	Small	Medium	Large
Applicable Criteria	Affects a specific group of localised individuals within a population over a short time period (one generation or less), but does not affect other trophic levels or the population itself.			

Mitigation Measures

No mitigation measures are required for this action although it is noted that all works will be completed within a total of 29 weeks, and only some of the activities are expected to generate significant underwater noise levels.

Noise generating equipment used at the site will be maintained in accordance with manufacturer’s recommendations, and any malfunction that results in elevated noise levels above those normally expected for the equipment will be immediately investigated and remedied.

Residual Impacts

While the sensitivity of fish is considered to be **low**, the magnitude effect of underwater noise and vibration on these species was found to be **small**. Accordingly, the overall significance of removal of the marine structure and subsequent generation of noise and vibration on fish is considered **negligible**.

Category	Effect Mitigation before	Residual Effect
Magnitude of Generation of Underwater Noise and Vibration	Small	Small
Sensitivity of Fish	Low	Low
Significance of Generation of Underwater Noise and Vibration on Fish	Negligible	Negligible

4. Generation of Underwater Noise and Vibration on Sydney Aquarium

As discussed, most marine animals are sensitive to sound and this has been taken into consideration for species housed within Sydney Aquarium. Of these species, dugongs are considered the most sensitive to noise and have similar thresholds to that of cetaceans, which may experience injury at 226 dB re 1 µPa, injury at 225 to 218 dB re 1 µPa and changes in behaviour at 157 to 164 dB re 1 µPa if the underwater noise is within their sensitive hearing range (SLR, 2014). However, considering the distance to the facility from the Project Area and the level of noise anticipated to be generated by the project activities it is understood that short-term generation of construction and barge noise is unlikely to alter the behaviour of these species. In addition, this type of noise is unlikely to contribute notably in excess of the existing noise levels generated from vessel movements in waters surrounding the facility from adjacent road traffic. Sensitivity of species within the Aquarium has been assessed as **high**.

Evaluation of Effects

Magnitude of Effects – Generation of Underwater Noise and Vibration	Negligible	Small	Medium	Large
Applicable Criteria	Immeasurable, undetectable or within the range of normal natural variation.			

Mitigation Measures

Noise generating equipment used at the site will be maintained in accordance with manufacturer's recommendations, and any malfunction that results in elevated noise levels above those normally expected for the equipment will be immediately investigated and remedied.

The presence of suitably experienced personnel at the aquarium facility means that behavioural changes of important marine fauna within Sydney Aquarium during noise-intensive activities would likely be observed rapidly. Any reports of adverse effects by the Aquarium would be investigated by SHFA.

Residual Impacts

While the sensitivity of species housed in Sydney Aquarium is considered to be **high**, the magnitude of impact of underwater noise and vibration on these species was found to be **negligible**. Accordingly, the overall significance of removal of the marine structure and subsequent generation of underwater noise and vibration on Sydney Aquarium's protected species is considered **negligible**.

Category	Effect before Mitigation	Residual Effect
Magnitude of Generation of Underwater Noise and Vibration	Negligible	Negligible
Sensitivity of Sydney Aquarium	High	High
Significance of Generation of Underwater Noise and Vibration on Sydney Aquarium	Negligible	Negligible

Removal of Piles

1. Sources of Effects

The key sources of disturbance during this activity are the removal of 185 existing timber piles, which are expected to result in marine growth removal; removal of vertical habitat; sediment disturbance; and generation of underwater noise and vibration. These effects and their sensitive receptors are discussed below.

2. Marine Growth Removal of Attached Invertebrates

Marine growth removal from piles will result in direct destruction of those invertebrates that have become attached to the structures. Piles within the AOI and more widely in the area are expected to support a diverse assemblage of encrusting biota at each tidal zone. Their sensitivity has been assessed as **low**.

Evaluation of Effects

Magnitude of Effects – Marine Growth Removal	Negligible	Small	Medium	Large
Applicable Criteria	Affects a specific group of localised individuals within a population over a short time period (one generation or less), but does not affect other trophic levels or the population itself.			

Mitigation Measures

The loss of attached invertebrate species during pile removal is unavoidable and as such no mitigation measures are offered.

Residual Effects

While the sensitivity of attached invertebrates is considered to be **low**, the magnitude of impact on these species was found to be **small**. Accordingly, the overall significance of removal of the marine structure and subsequent removal of attached invertebrates is considered **negligible**.

Category	Effect before Mitigation	Residual Effect
Magnitude of Marine Growth Removal	Small	Small
Sensitivity of Attached Invertebrates	Low	Low
Significance of Marine Growth Removal on Attached Invertebrates	Negligible	Negligible

3. Removal of Vertical Habitat on Attached Invertebrates

Temporary reduction of vertical habitat within the AOI will limit the area available for colonisation by encrusting invertebrates; their sensitivity has been assessed as **low**. Accordingly the loss of these habitats is not considered significant due to the eventual installation of approximately 80 new vertical structures for recolonization in Cockle Bay and the large amount of alternative habitat in nearby areas that will support the local populations of these species.

Evaluation of Effects

Magnitude of Effects – Removal of Vertical Habitat	Negligible	Small	Medium	Large
Applicable Criteria	Affects a specific group of localised individuals within a population over a short time period (one generation or less), but does not affect other trophic levels or the population itself.			

Mitigation Measures

No mitigation measures are required for this action.

Residual Effects

While the sensitivity of attached invertebrates is considered to be **low**, the magnitude of impact on these species was found to be **small**. Accordingly, the overall significance of removal of vertical habitat is considered **Negligible**.

Category	Effect before Mitigation	Residual Effect
Magnitude of Removal of Vertical Habitat	Small	Small
Sensitivity of Attached Invertebrates	Low	Low
Significance of Removal of Vertical Habitat on Attached Invertebrates	Negligible	Negligible

4. Removal of Vertical Habitat on Fish

Temporary reduction of vertical habitat within Cockle Bay will limit the availability of foraging and feeding structures for fish species; their sensitivity has been assessed as **low**. Accordingly the loss of these habitats is not considered significant due to the eventual installation of approximately 80 new structures and the presence of large areas of alternative foraging habitat within the wider AOI and harbour areas.

Evaluation of Effects

Magnitude of Effects – Removal of Vertical Habitat	Negligible	Small	Medium	Large
Applicable Criteria	Affects a specific group of localised individuals within a population over a short time period (one generation or less), but does not affect other trophic levels or the population itself.			

Mitigation Measures

No mitigation measures are required for this action.

Residual Effects

While the sensitivity of fish is considered to be **low**, the magnitude of impact on these species was found to be **small**. Accordingly, the overall significance of removal of vertical habitat on fish species is considered **Negligible**.

Category	Effect before Mitigation	Residual Effect
Magnitude of Removal of Vertical Habitat	Small	Small
Sensitivity of Fish	Low	Low
Significance of Removal of Vertical Habitat on Fish	Negligible	Negligible

5. Localised Sediment Disturbance on Benthic Communities, Invertebrates and Fish

The sediment, as mentioned previously, is believed to be substantially contaminated and disturbance of sediments has the potential to result in localised increases in turbidity. Sediment disturbance may also elevate the concentration of contaminants in the water column and their bioavailability to benthic communities, invertebrates and fish species in the AOI. However, considering the current and ongoing extent of vessel movements and anchoring within the AOI, this activity is unlikely to contribute much in excess of the existing sediment disturbance levels. As can be seen from the images taken during the archaeological surveys, the water clarity in Cockle Bay is low indicating the presence of suspended solids in the water column. Benthic communities, invertebrates and fish sensitivities have been assessed as **low**.

Evaluation of Effects

Magnitude of Effects – Sediment Disturbance	Negligible	Small	Medium	Large
Applicable Criteria	Affects a specific group of localised individuals within a population over a short time period (one generation or less), but does not affect other trophic levels or the population itself.			

Mitigation Measures

Silt curtains will be installed prior to any construction works. Silt curtains are a floating barrier, designed to temporarily contain, deflect or slow down the movement of suspended particles. In addition, a cutting sleeve will be utilised to cut piles off below the surface of the seabed and minimise sediment disturbance. The use of these structures during this activity will help to contain any suspended sediment and therefore limit the spread of turbidity and contaminated sediments through the Bay.

Residual Effects

While the sensitivity of benthic communities, invertebrates and fish species is considered to be **low**, the magnitude of impact on these species was found to be **small**. Accordingly, the overall significance of sediment disturbance on benthic communities, invertebrates and fish species is considered **negligible**.

Category	Effect before Mitigation	Residual Effect
Magnitude of Localised Sediment Disturbance	Small	Small
Sensitivity of Benthic Communities, Invertebrates and Fish	Low	Low
Significance of Localised Sediment Disturbance on Benthic Communities, Invertebrates and Fish	Negligible	Negligible

6. Localised Sediment Disturbance on Sydney Aquarium

Sediment is highly contaminated and its disturbance may affect species housed within Sydney Aquarium via a seawater intake located approximately 80m from the AOI. However, based on the current and ongoing extent of vessel movements and anchoring within the AOI, this activity is unlikely to contribute much in excess of the existing sediment disturbance levels. Species housed within Sydney Aquarium have been assessed as **high**.

Evaluation of Effects

Magnitude of Effects – Sediment Disturbance	Negligible	Small	Medium	Large
Applicable Criteria	Affects a specific group of localised individuals within a population over a short time period (one generation or less), but does not affect other trophic levels or the population itself			

Mitigation Measures

Silt curtains will be installed and a cutting sleeve utilised during this activity.

Residual Effects

While the sensitivity of species within Sydney Aquarium is considered to be **high**, the magnitude of impact on these species was found to be **small**. Accordingly, the overall significance of sediment disturbance on species housed within Sydney Aquarium is considered **minor**.

Category	Effect before Mitigation	Residual Effect
Magnitude of Sediment Disturbance	Small	Small
Sensitivity of Sydney Aquarium	High	High
Significance of Sediment Disturbance on Sydney Aquarium	Moderate	Minor

7. Generation of Underwater Noise and Vibration on Fish

As discussed, fish may be sensitive to underwater noise generated by the project resulting in temporary alterations of normal behavioural patterns. The extent of noise and vibration is expected to be less than that generated during screw piling and therefore is unlikely to result in behavioural responses in fish (SLR, 2014). Their sensitivity has been assessed as **low**.

Evaluation of Effects

Magnitude of Effects – Generation of Underwater Noise and Vibration	Negligible	Small	Medium	Large
Applicable Criteria	Affects a specific group of localised individuals within a population over a short time period (one generation or less), but does not affect other trophic levels or the population itself.			

Mitigation Measures

No mitigation measures are required for this action.

Residual Impacts

While the sensitivity of fish is considered to be **low**, the magnitude of effect on these species was found to be **small**. Accordingly, the overall significance of underwater noise and vibration on fish is considered **negligible**.

Category	Effect before Mitigation	Residual Effect
Magnitude of Underwater Noise and Vibration	Small	Small
Sensitivity of Fish	Low	Low
Significance of Underwater Noise and Vibration on Fish	Negligible	Negligible

8. Generation of Underwater Noise and Vibration on Sydney Aquarium

As discussed, species within Sydney Aquarium are potentially sensitive to noise. The extent of noise and vibration is less than that generated during screw piling, which was found during a similar activity conducted at Pier 26 to have negligible impacts on species within Sydney Aquarium (SLR, 2014). Therefore noise and vibration is unlikely to alter behaviour of these species. Their sensitivity has been assessed as **high**.

Evaluation of Effects

Magnitude of Effects – Generation of Underwater Noise and Vibration	Negligible	Small	Medium	Large
Applicable Criteria	Affects a specific group of localised individuals within a population over a short time period (one generation or less), but does not affect other trophic levels or the population itself			

Mitigation Measures

Noise generating equipment used at the site will be maintained in accordance with manufacturer's recommendations, and any malfunction that results in elevated noise levels above those normally expected for the equipment will be immediately investigated and remedied.

The presence of suitably experienced personnel at the aquarium facility means that behavioural changes of important marine fauna within Sydney Aquarium during noise-intensive activities would likely be observed rapidly. Any reports of adverse effects by the Aquarium would be investigated by SHFA.

Residual Impacts

While the sensitivity of species housed in Sydney Aquarium is considered to be **high**, the magnitude of impact of underwater noise and vibration on these species was found to be **small**. Accordingly, the overall significance of underwater noise and vibration on Sydney Aquarium's protected species is considered **Minor**.

Category	Effect before Mitigation	Residual Effect
Magnitude of Underwater Noise and Vibration	Small	Small
Sensitivity of Sydney Aquarium	High	High
Significance of Underwater Noise and Vibration on Sydney Aquarium	Moderate	Minor

Installation of Piles

1. Sources of Effects

The key source of disturbance from the installation of structures is the installation of piles. Approximately 80 piles will be installed with the majority of these made of smooth steel, although some timber piles also to be used. Piles will be screwed into the seabed using a purpose built 18 m barge. The installation of piles is expected to result in generation of underwater noise and vibration; and sediment disturbance. These effects and their sensitive receptors are discussed below.

2. Generation of Underwater Noise and Vibration on Fish

Fish are sensitive to noise and vibration. The extent of noise and vibration is expected to be more than that generated during removal of the existing marine structure and support piles. Studies have indicated screw piling has an expected sound exposure level of 117 to 122 dB re 1 µPa at 100 m range, and 130 dB re 1 µPa at 10 m range and this is unlikely to result in behavioural responses in fish (SLR, 2014). Fish sensitivity has been assessed as **low**.

Evaluation of Effects

Magnitude of Effects – Generation of Underwater Noise and Vibration	Negligible	Small	Medium	Large
Applicable Criteria	Affects a specific group of localised individuals within a population over a short time period (one generation or less), but does not affect other trophic levels or the population itself.			

Mitigation Measures

Noise generating equipment used at the site will be maintained in accordance with manufacturer's recommendations, and any malfunction that results in elevated noise levels above those normally expected for the equipment will be immediately investigated and remedied.

Residual Effects

While the sensitivity of fish is considered to be **low**, the magnitude effect of underwater noise and vibration on these species was found to be **small**. Accordingly, the overall significance of the installation of piles and subsequent generation of underwater noise and vibration on fish is considered **negligible**.

Category	Effect before Mitigation	Residual Effect
Magnitude of Underwater Noise and Vibration	Small	Small
Sensitivity of Fish	Low	Low
Significance of Underwater Noise and Vibration on Fish	Negligible	Negligible

3. Generation of Underwater Noise and Vibration on Sydney Aquarium

The expected noise levels for this activity at 100 m range are below the noise threshold for dugong. In addition a similar activity undertaken at Pier 26 (located directly adjacent to the Aquarium) resulted in negligible impacts from screw piling (SLR, 2014) and therefore it is expected that there is unlikely to be any changes in the behaviour of Aquarium species from pile installation within the AOI. Sensitivity of Sydney Aquarium's species has been assessed as **high**.

Evaluation of Effects

Magnitude of Effects – Underwater Noise and Vibration	Negligible	Small	Medium	Large
Applicable Criteria	Affects a specific group of localised individuals within a population over a short time period (one generation or less), but does not affect other trophic levels or the population itself.			

Mitigation Measures

In addition to the maintenance of equipment as described above, the presence of suitably experienced personnel should continuously monitor behaviour of important marine fauna within Sydney Aquarium during noise-intensive activities. Any reports of adverse effects by the Aquarium should be investigated by SHFA.

Residual Effect

While the sensitivity Sydney Aquarium is considered to be **high**, the magnitude of effect of underwater noise and vibration on these species was found to be **small**. Accordingly, the overall significance of the installation of piles and subsequent generation of underwater noise and vibration on Sydney Aquarium's species is considered **moderate**.

Category	Effect before Mitigation	Residual Effect
Magnitude of Underwater Noise and Vibration	Small	Small
Sensitivity of Sydney Aquarium	High	High
Significance of Underwater Noise and Vibration on Sydney Aquarium	Moderate	Minor

4. Localised Sediment Disturbance on Benthic Communities, Invertebrates and Fish

Screw piling is known to increase turbidity, and may also introduce toxicants into the water column and increase overall bioavailability of contaminants through disturbance of contaminated sediments. However, the extent of sediment disturbance is expected to be less than that generated during removal of the existing piles, and the increase in suspended sediment is expected to be localised. Sensitivities of benthic communities, invertebrates and fish have been assessed as **low**.

Evaluation of Effects

Magnitude of Effects – Sediment Disturbance	Negligible	Small	Medium	Large
Applicable Criteria	Affects a specific group of localised individuals within a population over a short time period (one generation or less), but does not affect other trophic levels or the population itself.			

Mitigation Measures

Silt curtains will be installed prior to any construction works.

Residual Effects

While the sensitivity of benthic communities, invertebrates and fish species is considered to be **low**, the magnitude of impact on these species was found to be **small**. Accordingly, the overall significance of sediment disturbance on benthic communities, invertebrates and fish species is considered **negligible**.

Category	Effect before Mitigation	Residual Effect
Magnitude of Localised Sediment Disturbance	Small	Small
Sensitivity of Benthic Communities, Invertebrates and Fish	Low	Low
Significance of Localised Sediment Disturbance on Benthic Communities, Invertebrates and Fish	Negligible	Negligible

Positive Effects

The replacement of 185 existing piles with approximately 80 new piles will result in an increased benthic area unoccupied by structures and therefore create additional habitat available for benthic communities to colonise.

Installation of Marine Structures

1. Sources of Effects

The key source of disturbance during this activity is the installation of a newly configured marine structure covering an area of 3,392 m², which is expected to result in generation of underwater noise and vibration. These effects and their sensitive receptors are discussed below:

2. Generation of Underwater Noise and Vibration on Fish

As previously discussed, fish are very sensitive to sound. For the purpose of this evaluation, the sensitivity of fish has been assessed as **low**.

Evaluation of Effects

Magnitude of Effects – Generation of Underwater Noise and Vibration	Negligible	Small	Medium	Large
Applicable Criteria	Affects a specific group of localised individuals within a population over a short time period (one generation or less), but does not affect other trophic levels or the population itself			

Mitigation Measures

No additional mitigation measures are required for this action.

Residual Impacts

While the sensitivity of fish is considered to be **low**, the magnitude effect of underwater noise and vibration on these species was found to be **small**. Accordingly, the overall significance of installation of the marine structure and subsequent noise generation on fish is considered **negligible**.

Category	Effect before Mitigation	Residual Effect
Magnitude of Generation of Underwater Noise and Vibration	Small	Small
Sensitivity of Fish	Low	Low
Significance of Generation of Underwater Noise and Vibration on Fish	Negligible	Negligible

3. Generation of Underwater Noise and Vibration on Sydney Aquarium

Marine species housed within Sydney Aquarium are sensitive to sound. For the purpose of this evaluation, the sensitivity of Sydney Aquarium’s protected species has been assessed as **high**.

Evaluation of Effects

Magnitude of Effects – Generation of Underwater Noise and Vibration	Negligible	Small	Medium	Large
Applicable Criteria	Immeasurable, undetectable or within the range of normal natural variation			

Mitigation Measures

The presence of suitably experienced personnel at the aquarium facility means that behavioural changes of important marine fauna within Sydney Aquarium during noise-intensive activities would likely be observed rapidly. Any reports of adverse effects by the Aquarium would be investigated by SHFA.

Residual Impacts

While the sensitivity of species housed in Sydney Aquarium is considered to be **high**, the magnitude of impact of underwater noise and vibration on these species was found to be **negligible**. Accordingly, the overall significance of installation of the marine structure and subsequent generation of underwater noise and vibration on Sydney Aquarium’s protected species is considered **negligible**.

Category	Effect before Mitigation	Residual Effect
Magnitude of Underwater Noise and Vibration	Negligible	Negligible
Sensitivity of Sydney Aquarium	High	High
Significance of Underwater Noise and Vibration on Sydney Aquarium	Negligible	Negligible

4. Positive Effects

Removal of the existing marine structure (4,365 m²) and replacement by a newly configured marine structure (3,392 m²) will result in an increased benthic area unoccupied by structures and therefore create more available habitat for benthic communities colonisation.

Long-Term Presence of Marine Structures

Long-term presence of installed structures includes approximately 80 piles and a newly configured marine structure. These structures will create habitats and a positive effect for invertebrate species that colonise these structures and species of fish seeking shelter.

Construction Logistics

1. Vessel Anchoring

Effects Description

Vessel anchoring can cause increases in turbidity, and may also introduce toxicants into the water column and increase overall bioavailability of contaminants through disturbance of contaminated sediments. This activity can also result in habitat damage. However, existing vessel movements and anchoring within the AOI means that this effect will not be in excess of what already exists. Operational discharges from vessels would all be within applicable local and international standards with respect to type and treatment, and are unlikely to affect marine organisms. These effects and their sensitive receptors are discussed below:

Sediment Disturbance on Benthic Communities and Fish

The potential impacts from sediments disturbance include increased suspended solids, the potential for mobilisation of contaminants, and resettlement of suspended sediments onto the seabed. Sensitivities of benthic communities and fish have been assessed as **low**.

Evaluation of Effects

Magnitude of Effects – Sediment Disturbance	Negligible	Small	Medium	Large
Applicable Criteria	Immeasurable, undetectable or within the range of normal natural variation			

Mitigation Measures

Silt curtains will be installed prior to any construction works.

Residual Effects

While the sensitivity of benthic communities and fish species is considered to be **low**, the magnitude of impact on these species was found to be **negligible**. Accordingly, the overall significance of sediment disturbance on benthic communities and fish species is considered **negligible**.

Category	Effect before Mitigation	Residual Effect
Magnitude of Sediment Disturbance	Negligible	Negligible
Sensitivity of Benthic Communities and Fish	Low	Low
Significance of Sediment Disturbance on Benthic Communities and Fish	Negligible	Negligible

2. Vessel and Equipment Noise

Sources of Effects

The key source of disturbance is noise generated by vessels and equipment used on these vessels. These effects and their sensitive receptors are discussed below.

Generation of Underwater Noise and Vibration on Fish

Noise generated from project vessels and equipment will not be too dissimilar from the existing noise levels due to the amount of vessel movements and other activities occurring within the AOI. For the purpose of this evaluation, the sensitivity of fish has been assessed as **low**.

Evaluation of Effects

Magnitude of Effects – Generation of Underwater Noise and Vibration	Negligible	Small	Medium	Large
Applicable Criteria	Immeasurable, undetectable or within range of normal natural variation			

Mitigation Measures

Noise generating equipment used at the site will be maintained in accordance with manufacturer’s recommendations, and any malfunction that results in elevated noise levels above those normally expected for the equipment will be immediately investigated and remedied.

Residual Impacts

While the sensitivity of fish is considered to be **low**, the magnitude effect of noise on these species was found to be **negligible**. Accordingly, the overall significance of vessel and equipment operation and subsequent generation of underwater noise and vibration on fish is considered **negligible**.

Category	Effect before Mitigation	Residual Effect
Magnitude of Underwater Noise and Vibration	Negligible	Negligible
Sensitivity of Fish	Low	Low
Significance of Underwater Noise and Vibration on Fish	Negligible	Negligible

Generation of Underwater Noise and Vibration on Sydney Aquarium

Underwater noise and vibration generated from project vessels and equipment will not be in excess of existing noise levels due to the amount of vessel movements and other activities occurring in the waters surrounding the Aquarium. For the purpose of this evaluation, the sensitivity of Sydney Aquarium's protected species has been assessed as **high**.

Evaluation of Effects

Magnitude of Effects – Generation of Underwater Noise and Vibration	Negligible	Small	Medium	Large
Applicable Criteria	Immeasurable, undetectable or within range of normal natural variation			

Mitigation Measures

No additional mitigation measures beyond those proposed above are required for this action.

Residual Impacts

While the sensitivity of species housed in Sydney Aquarium is considered to be **high**, the magnitude of impact of underwater noise and vibration on these species was found to be **negligible**. Accordingly, the overall significance of vessel and equipment operation and subsequent generation of underwater noise and vibration on Sydney Aquarium's protected species is considered **negligible**.

Category	Effect before Mitigation	Residual Effect
Magnitude of Underwater Noise and Vibration	Negligible	Negligible
Sensitivity of Sydney Aquarium	High	High
Significance of Underwater Noise and Vibration on Sydney Aquarium	Negligible	Negligible

8.15.4.4 Unplanned Events

1. Marine Hydrocarbon Spill

Effects Description

The most likely unplanned spill or release of fuels is the accidental spill during refuelling of equipment or due to a vessel collision. Fuels, hydraulic fluids and lubricating oils have the potential to impact on local water and sediment quality. The construction vessels are expected to use marine diesel, which is a middle petroleum distillate that typically undergoes rapid dispersion and evaporation in the marine environment when subjected to weathering. Refuelling of barges will not occur at the Project site, but will be undertaken at an approved refuelling facility. Due to the size of the vessels and the availability of resources (being within the confines of the harbour), spills are expected to be small in size and immediately responded to.

Given the localised nature of the accidental spills outlined above, due to the small quantities considered, the severity of effects from the accidental spill of hydrocarbons or chemicals is considered to be **medium**.

Severity of Effect	Low	Medium	High
Applicable Criteria	Localised environmental damage, no sensitive resources effected and degradation of spilled materials and full recovery of affected resources		

Due to the range of operations that could result in an accidental spill and the access to emergency responses, it is considered unlikely that a small accidental spill may occur at some stage during the Project.

Likelihood of Occurrence	Extremely Unlikely	Unlikely	Possible	Likely
Applicable Criteria	The event is unlikely but may occur at some time during normal operating conditions			

Mitigation and Control Measures

Vessels used during the Project are legally required to comply with Annex 1- Oil of the International Convention for the Prevention of Pollution (MARPOL), under the Ports and Maritime Administration Act 1995, the Marine Safety Act 1998 and the Marine Pollution Act 1987. Vessels are required to store fuels, oils and chemicals in bunded areas on board. Emergency Response Plans are also required on board in addition to spill kits on each vessel for the immediate containment of any spill.

With the implementation of the above mitigation measures, including the immediate response to any discharge or oil from the Project vessels, the severity effects from the accidental spill of fuel, oil or chemicals, is considered to be **Low**

Severity of Effect	Low	Medium	High
Applicable Criteria	Some damage to the environment/ very localised, no sensitive resources effected and rapid degradation of spilled materials and rapid recovery of affected resources		

With these mitigation and control measures in place, the likelihood of an accidental spill of fuels, oils and chemicals, is considered to be **unlikely**.

Likelihood of Occurrence	Extremely Unlikely	Unlikely	Possible	Likely
Applicable Criteria	The event is unlikely but may occur at some time during normal operating conditions			

Residual Effect

Category	Effect before Mitigation	Residual Effect
Magnitude of Effects from a Marine Spill	Medium	Low
Likelihood	Unlikely	Unlikely
Significance of Effects	Minor	ALARP

2. Marine Vessel Incident

Effects Description

Vessel collisions could cause debris and chemicals to enter the harbour. Sunken debris or the sinking of a vessel would cause sediment disturbance, and therefore a potential effect on water quality. Additionally, a vessel collision would potentially result in the spill of fuels, oils or chemicals. An incident due to a vessel collision is considered unlikely due to the low speed of vessel traffic and the sheltered conditions of the harbour. Additionally, the work barges will be stationary for the majority of the time they are working in the bay.

Given the already contaminated nature of the water and sediment within the Project Area, and the use of silt curtains during operation, the severity of effects from vessel collisions is considered to be **medium**.

Severity of Effect	Low	Medium	High
Applicable Criteria	Localised environmental damage, no sensitive resources effected and degradation of spilled materials and full recovery of affected resources		

Due to the low speed of vessel traffic and the sheltered conditions of the harbour range of operations, it is considered **unlikely** that vessel collisions will occur at some stage during the Project.

Likelihood of Occurrence	Extremely Unlikely	Unlikely	Possible	Likely
Applicable Criteria	The event is unlikely but may occur at some time during normal operating conditions			

Mitigation and Control Measures

Vessels used during the Project are legally required to comply with Annexes of the International Convention for the Prevention of Pollution (MARPOL), under the Ports and Maritime Administration Act 1995, the Marine Safety Act 1998 and the Marine Pollution Act 1987. Vessels are required to store fuels, oils and chemicals in bunded areas on board and refuelling will only occur in calm conditions. Emergency Response Plans are also required on board in addition to spill kits on each vessel for the immediate containment of any spill. In addition to pollution controls, these regulations provide for standards of crew training, watchkeeping and navigational safety to minimise the risk of a collision occurring.

With these mitigation and control measures in place, the likelihood of an accidental spill of fuels, oils and chemicals, is considered to be **unlikely**.

Likelihood of Occurrence	Extremely Unlikely	Unlikely	Possible	Likely
Applicable Criteria	The unplanned event is extremely unlikely to occur under normal operating conditions but may occur in exceptional circumstances			

With the implementation of the above mitigation measures, the severity of an effects from the accidental spill of fuel, oil or chemicals, is considered to be **Low**.

Severity of Effect	Low	Medium	High
Applicable Criteria	Some damage to the environment/ very localised, no sensitive resources effected and rapid degradation of spilled materials and rapid recovery of affected resources		

Residual Effects

Category	Effect before Mitigation	Residual Effect
Magnitude of Effects from a Vessel Collision	Medium	Low
Likelihood	Unlikely	Extremely Unlikely
Significance of Effects	Minor	ALARP

3. Dropped Objects

Effects Description

The Project Area is relatively shallow (<8 m in depth) and therefore any dropped objects should be easily retrieved. These objects though, depending on their size, may create localised sediment disturbance and plumes.

Given the already contaminated nature of the water and sediment within the Project Area, and the use of silt curtains during operation, the severity of effects from dropped objects is considered to be **low**.

Severity of Effect	Low	Medium	High
Applicable Criteria	Some damage to the environment/ very localised, no sensitive resources effected.		

Mitigation and Control Measures

Vessels used during the Project are legally required to comply with annexes of the International Convention for the Prevention of Pollution (MARPOL), under the Ports and Maritime Administration Act 1995, the Marine Safety Act 1998 and the Marine Pollution Act 1987. Vessels are required to store drums, objects in bunded areas or secure areas on board.

Due to the range of operations that could result in an accidental spill and the access to emergency responses, it is considered **unlikely** that objects may be dropped overboard at some stage during the Project.

Likelihood of Occurrence	Extremely Unlikely	Unlikely	Possible	Likely
Applicable Criteria	The event is unlikely but may occur at some time during normal operating conditions			

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With the implementation of the above mitigation measures, the severity of an effects from the accidental spill of fuel, oil or chemicals, is considered to be **Low**.

Severity of Effect	Low	Medium	High
Applicable Criteria	Some damage to the environment/ very localised, no sensitive resources effected and quick recovery of dropped objects.		

Residual Effect

Category	Effect before Mitigation	Residual Effect
Magnitude of Effects from a Dropped Object	Low	Low
Likelihood	Unlikely	Unlikely
Significance of Effects	ALARP	ALARP

8.15.5 Operational Phase Considerations

The impact of other operational phase activities is considered to be neutral when compared to existing operations, as no intensification of use is proposed.

8.15.6 Conclusion and Proposed Additional Mitigation Measures

The Flora & Fauna Impact Assessment concludes that with the implementation of the recommended management and mitigation measures, the proposal will result in impacts which are negligible or minor. For unplanned events, the effects were found to be as low as reasonably practicable and no further mitigation measures were considered necessary.

Table 27: Summary of Flora & Fauna Impact Residual Effects

Construction Activity & Impact	Residual Effect
Removal of Marine Structures	
Increase in light impact on fish	Negligible
Noise & vibration impact on fish	Negligible
Noise & vibration impact on species housed in Aquarium	Negligible
Removal of Piles	
Habitat impact on attached invertebrates	Negligible
Habitat impact on fish	Negligible
Sediment impact on benthic community, invertebrates and fish	Negligible
Sediment impact species housed in Aquarium	Minor
Noise & vibration impact on fish	Negligible
Noise & vibration impact on species housed in Aquarium	Minor
Pile Installation	
Noise & vibration impact on fish	Negligible
Noise & vibration impact on species housed in Aquarium	Minor
Sediment impact on benthic community, invertebrates and fish	Negligible
Structure Installation	
Noise & vibration impact on fish	Negligible
Noise & vibration impact on species housed in Aquarium	Negligible
Construction Logistics	
Vessel anchoring impact	Negligible
Vessel & equipment noise impact on fish	Negligible
Vessel & equipment noise impact on species housed in Aquarium	Negligible

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The following additional mitigation measures have been identified to minimise effects on water and sediment quality:

1. Appropriate management of noise generating equipment
2. Suitably qualified personnel should monitor behaviour of important fauna within Sydney Aquarium during noise-sensitive activities. Any reports of adverse effects should be reported to and investigated by the Authority
3. Silt curtains and booms will be installed prior to any works and suitably maintained during demolition and construction works to contain suspended sediment and limit spread of turbidity and contaminated sediments.
4. Vessels used during the construction will be legally required to comply with:
 - Annexes of the International Convention for the Prevention of Pollution (MARPOL 93/98) including Annexes relating to the discharge of oil, noxious liquid substances, sewage, garbage and air
 - *Ports and Maritime Administration Act 1995*, the *Marine Safety Act 1998* and the *Marine Pollution Act 1987*; this legislation requires vessels to store fuels, oils and chemicals in banded areas on board and refuelling to only occur in calm conditions; Emergency Response Plans are also required on board in addition to spill kits on each vessel for the immediate containment of any spill.
5. Preparation and implementation of an Environmental Management Plan including procedures minimising risk of unplanned events relating to spills, collisions and avoiding material entering the waterway, including:
 - Only suitable and appropriately certified vessels are used on the project
 - Only qualified and experienced vessel operators may work on the project
 - Minimum volumes on site and spill kits to be carried on all vessels
 - Oil spill contingency plans to be understood and actioned if necessary by vessel operators including immediate response to any discharge
 - Appropriate measures to prevent material entering the waterway during concrete cutting
 - Notification, reporting and corrective action procedures in the event of a pollution incident are in place

8.16 Air Quality & Odour

8.16.1 Potential Issues

This section addresses SEARs Key Issue 10 as stated below:

1. An Air Quality Impact Assessment including odour during construction and operation prepared in accordance with the relevant Environmental Protection Authority guidelines shall be submitted. This assessment must consider any potential impacts on nearby receptors.

Air quality issues may arise as a result of sawing and breaking of concrete, wind erosion of stockpiled demolition material and possible odour from exposed acid sulphate soils on removed piles.

An Air Quality Assessment has been undertaken for the proposal by Wilkinson Murray and their full report is included as Appendix 11. Extracts of the full report are included in the following sections for ease of reference.

8.16.2 Sensitive Receptors

There are a number of commercial receptors sensitive to noise and vibration located in the vicinity of the work sites, including businesses within Harbourside Shopping Centre and Cockle Bay Wharf complex, Helm Bar, Sydney Aquarium, Madame Tussauds and the Australian National Maritime Museum (ANMM).

The potentially most affected receptors are identified in Figure 46.

The nearest receptors to the proposed works are businesses along the eastern façade of the Harbourside Shopping Centre and the western façade of Cockle Bay Wharf complex. There is potential for proposed construction works to occur within approximately 20 metres of the nearest receptors.

There are no residential receptors within 200m of the proposed works.

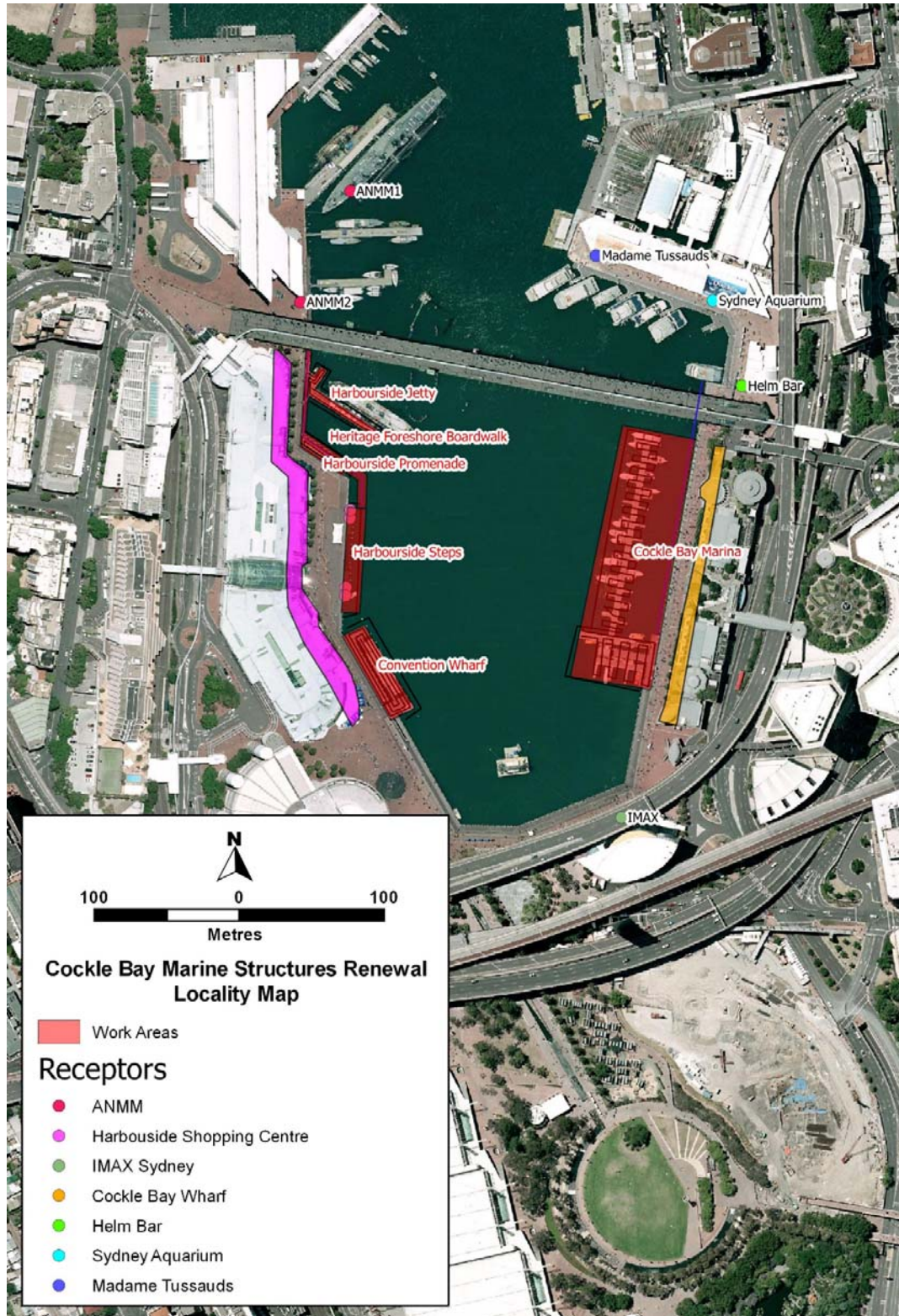


Figure 46: Air Quality Assessment - Locality Map

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8.16.3 Existing Environment

Local Climate

Long-term meteorological data for the surrounding area is available from the Bureau of Meteorology (BoM) operated Automatic Weather Stations (AWS) at Observatory Hill and Fort Denison. The Observatory Hill AWS is located approximately 300m east of the site and records observations of a number of meteorological data including temperature, humidity and rainfall. There is no anemometer at Observatory Hill, and therefore; observations of wind speed and direction are taken from the Fort Denison AWS, located approximately 2km east of the site.

Long-term climate statistics are presented in Table 28. Temperature data recorded at the Observatory Hill AWS indicates that January is the hottest month of the year, with a mean daily maximum temperature of 25.9°C. July is the coolest month with a mean daily minimum temperature of 8.1°C. June is the wettest month with an average rainfall of 132 mm falling over almost 9 days. There are on average 100 rain days per year, yielding 1213 mm of rain.

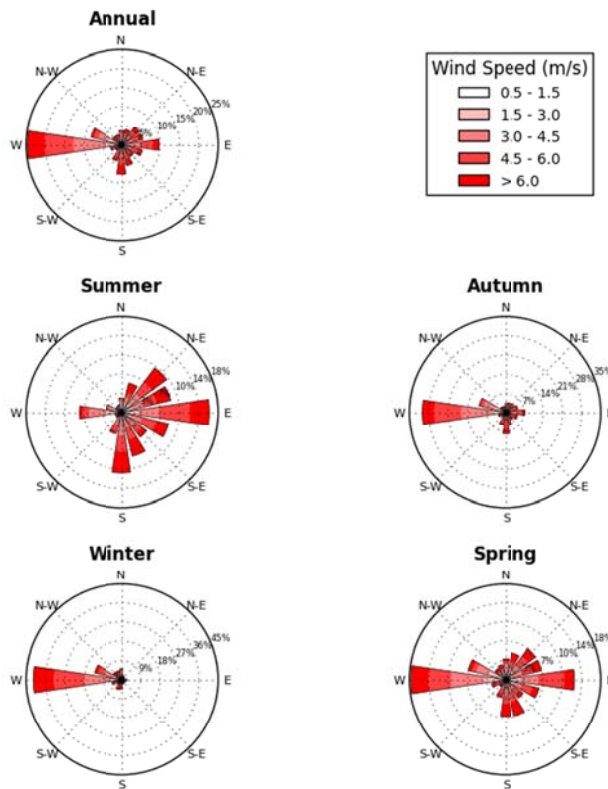
Table 28: Air Quality – Long Term Averages for Observatory Hill

Observation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
9am Mean Observations													
Temperature (°C)	22.5	22.3	21.1	18.2	14.6	11.9	10.9	12.5	15.7	18.5	19.9	21.6	17.5
Humidity (%)	71	74	74	72	74	74	71	66	62	61	66	67	69
3pm Mean Observations													
Temperature (°C)	24.8	24.9	24.0	22.0	19.4	16.9	16.4	17.5	19.2	20.7	22.1	23.8	21.0
Humidity (%)	62	64	62	59	57	57	51	49	51	56	58	59	57
Daily Minimum and Maximum Temperatures													
Minimum (°C)	18.7	18.8	17.6	14.7	11.6	9.3	8.1	9.0	11.1	13.6	15.6	17.5	13.8
Maximum (°C)	25.9	25.8	24.8	22.4	19.5	17.0	16.3	17.8	20.0	22.1	23.6	25.2	21.7
Rainfall													
Rainfall (mm)	101.1	118.0	129.7	127.1	119.9	132.0	97.4	80.7	68.4	76.9	84.3	77.3	1212.6
Rain days	8.6	9.0	9.8	9.0	8.7	8.7	7.5	7.2	7.2	7.9	8.4	8.0	100.0

Windrose plots showing the distribution of wind direction and wind speed at the Fort Denison BoM AWS between 2008 and 2013 and presented in Figure 47.

It should be noted that the area surround Cockle Bay features is well sheltered by nearby developments, and the prevailing winds will be of significantly lower speeds than those presented in **Error! Reference source not found..**

Figure 47: Air Quality Assessment – Windrose Plots – Fort Denison BOM AWS, 2008 - 2013



Local Air Quality

The NSW Office of Environment and Heritage (OEH) operates a network of air quality monitoring sites across the state. The nearest OEH air quality monitoring station to the Barangaroo site is located at Rozelle, approximately 3 km to the west.

Ambient pollution concentrations recorded at the Rozelle site between 1 July 2013 and 30 June 2014 have been used to establish the existing local air quality for this assessment and are summarised in Table 29.

TSP concentrations are no longer measured at the Rozelle site and therefore, the annual average background TSP concentration has been estimated using the measured PM₁₀ concentrations and based on the assumption that PM₁₀ typically accounts for approximately 50% of TSP.

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Table 29: Air Quality – Existing Ambient Pollutant Concentrations – Rozelle Monitoring Station

Pollutant	Averaging Period	Background Concentration ($\mu\text{g}/\text{m}^3$)
PM ₁₀	24 hour Maximum	59
	Annual Average	19
TSP ¹	Annual Average	39

1 Scaled from PM₁₀ concentrations

8.16.4 Air Quality Criteria

Due to the physical nature of the proposed construction activities, there is the potential for air pollution due to suspended dust particles. Dust emissions are usually caused by the following:

- Sawing or breaking of concrete;
- Wind erosion of exposed soil or material stockpiles; and,
- Wheel generated dust from construction traffic.

The AQIA presented herein is qualitative, however it is prudent to establish relevant quantitative air quality goals such that they would be used in the event that air quality monitoring was deemed necessary during the construction works.

Air quality criteria are benchmarks set to protect the general health and amenity of the community in relation to air quality. The sections below identify the applicable air quality criteria for the potential air emissions that would be generated by the proposed modification.

The air quality goals that are relevant to this study are sourced from the NSW EPA document *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (NSW DEC, 2005).

Particulate matter

The air quality goals for the relevant particulate matter pollutants relate to the total pollutant burden in the air and not just the pollutants from the Project, as such, consideration of background pollutant levels is required when using these goals to assess potential impacts.

Table 30 shows the criteria for each of the relevant dust metric considered in this assessment.

Table 30: Air Quality – NSW EPA Air Quality Impact Assessment Criteria

Pollutant	Averaging Period	Impact	Criterion
Total suspended particulates (TSP)	Annual	Total	90 $\mu\text{g}/\text{m}^3$
Particulate matter $\leq 10 \mu\text{g}/\text{m}^3$ (PM ₁₀)	Annual	Total	30 $\mu\text{g}/\text{m}^3$
	24-hour	Incremental	50 $\mu\text{g}/\text{m}^3$
Deposited dust (DD)	Annual	Total	2 $\text{g}/\text{m}^2/\text{month}$
	Annual	Incremental	4 $\text{g}/\text{m}^2/\text{month}$

Source: NSW DEC, 2005

8.16.5 Assessment of Construction Impacts

This section of the report presents a qualitative assessment of potential dust impacts from the proposed works. The likelihood of dust impacts from each major stage will be discussed.

Demolition of Harbourside Steps

The existing concrete steps would be sawn and removed by floating crane and barge. The concrete sawing of the steps is considered the most likely activity to generate nuisance dust emissions.

To control dust emissions during the removal of the existing concrete steps, water sprays should be used. Both the area undergoing sawing and any stockpiles should be kept wet to control dust emissions.

It is proposed to replace the steps with a floating pontoon public wharf, much of which is expected to be constructed off-site and floated in by barge. No significant potential sources of dust emissions have been identified in association with the establishment of the new pontoon wharf.

Demolition of Timber Structures

Structures other than Harbourside Steps proposed to be demolished are primarily timber structures. The structures will be dismantled and material removed by barge. It is not expected that any sawing of the timber structures would be required during the dismantling.

Sawing of dry timber has the potential to generate dust. However, since the existing above water structures are expected to be dismantled without any sawing, no significant emissions are identified. The timber piles will be sawn under the water and therefore, any sawdust will be suppressed.

New superstructure comprises timber decked floating pontoon structures. These structures are expected to be constructed off-site and floated in by barge.

Any above water sawing of the timber structure should be accompanied by water sprays to suppress fugitive dust emissions.

8.16.6 Dust Management

During construction works it is recommended that best practice management strategies are implemented to minimise any potential dust impacts.

Dust Mitigation

Detailed mitigation measures should be set out in the Construction Environmental Management Plan (CEMP) prepared by the contractor, once more certainty surrounding the construction methods and programme exists.

WM recommends that the following matters are addressed within the CEMP:

- Water sprays should be used as required to dampen haul routes and work areas to prevent excessive dust emissions from the site;
- Water sprays should be used on all above water sawing of timber and concrete structures;
- All stockpiles of demolished materials should be kept wet and removed from site as soon as practicable;
- Civil works should be programmed with a view to minimising the time that stockpiles are left exposed;
- Trucks transporting material to and from the site should be covered to reduce wind blown dust emissions and load spillages;
- All construction equipment should be maintained to ensure exhaust emissions comply with relevant State Legislation; and,
- No cutting or breaking or on-site mixing of concrete should occur during high winds.

Performance Monitoring

During the construction works, the adequacy of dust mitigation measures should be continuously assessed, with the focus of achieving:

- No visible dust for more than 15 continuous minutes during construction activities; and,
- No dust complaints received from nearby businesses or statutory authorities.
- The Site Manager should be responsible for visually monitoring dust levels.
- All complaints should be recorded in a register and if complaints are received on a regular basis, air quality monitoring should be conducted.

8.16.7 Acid Sulphate Soils

Acid sulphate soils occur throughout Sydney Harbour and may be present at locations where piles will be removed as part of the proposal. Exposure of acid sulphate soils can result in the release of gases such as hydrogen sulphide, sulphur dioxide and methane and associated odour impacts.

Any extracted piles containing acid sulphates soils may require appropriate treatment to avoid air quality contamination (odours)

8.16.8 Conclusion & Proposed Additional Mitigation Measures

The Air Quality Impact Assessment considers the level of impacts will be reduced to the most practicable extent through employment of appropriate mitigation measures.

The following additional mitigation measures have been identified to minimise effects on air quality:

1. All site neighbours will be notified of potential impacts well in advance of demolition works commencing on site
2. An Environmental Management Plan will be implemented to address air quality impacts, including:
 - Treatment of extracted piles if odour from acid sulphate soils becomes evident (eg. cover with tarpaulins or use of odour suppressant materials)
 - Water sprays will be used as required during concrete demolition and timber sawing.
 - Dust mitigation, monitoring and auditing procedures to ensure no visible dust for more than 15 continuous minutes and no complaints received from nearby businesses or statutory authorities, whilst minimising water usage
 - Appropriate management of stockpiled demolished material on site on work barges prior to transport to a licensed waste or recycling facility
 - On-site complaints and response process
3. The Authority's existing Customer Request Management System will be utilised to manage feedback, including procedures for recording and managing complaints

8.17 Noise & Vibration

8.17.1 Potential Issues

This section addresses SEARs Key Issue 11 as stated below:

1. A Noise and Vibration Impact Assessment during construction and operation prepared in accordance with the relevant Environment Protection Authority guidelines shall be submitted. This assessment must consider any potential impacts on nearby private receptors.

Potential impacts have been identified as:

- Noise impacts during construction
- Vibration impacts during construction
- Noise impacts during operation
- Vibration impacts during operation
- Noise and vibration impacts on fish and species housed in the Aquarium

Noise and vibration impacts on fish and species housed in the Aquarium are also addressed in Section 8.15: Flora and Fauna Impacts.

A Noise and Vibration Impact Assessment has been undertaken for the proposal by Wilkinson Murray and their full report is included as Appendix 12. The assessment has been prepared in accordance with the following standards and guidance:

- NSW Interim Construction Noise Guideline 2009 (DECC);
- NSW Industrial Noise Policy 2000 (EPA);
- Assessing Vibration: A Technical Guideline (DECCW); and
- German Standard DIN 4150, Part 3: Structural Vibration in Buildings: Effects on Structures

This approach satisfies the Secretary's Environmental Assessment Requirements for this proposal.

8.17.2 Noise & Vibration Receivers

There are a number of commercial receivers sensitive to noise and vibration located in the vicinity of the site. The potentially most affected receivers, which have been considered for the purpose of the assessment are presented in Figure 48 and Table 31. There are no residential receivers within 200m of the proposed works.

8.17.3 Existing Acoustic Environment

In order to establish appropriate noise management levels for the project, it is necessary to establish the existing ambient noise environment in the study area. With the agreement of Lend Lease, the results of recent background noise measurement at Darling Harbour Live during RDO were used. It is considered that the background noise levels measured outside Harbourside Shopping Centre on Monday, 1 December 2014 and Tuesday, 2 December 2014 (during construction RDOs) are broadly representative of the background noise levels occurring throughout the respective localities of the study area. The rating background level (RBL) for the relevant assessment periods, namely between 8.00am and 12.00pm (Monday to Saturday) and 2.00pm and 5.00pm (Monday to Friday), is 59dBA.

The RBL represents the background noise in the area, and is determined from measurement of L_{A90} noise levels. Importantly, noise from the source(s) subject to assessment must be absent to determine the RBL. The full methodology for calculating RBL values from measured L_{A90} levels is set out in the NSW Industrial Noise Policy (INP). The RBL of 59dBA forms the basis of the construction noise management levels for the project.

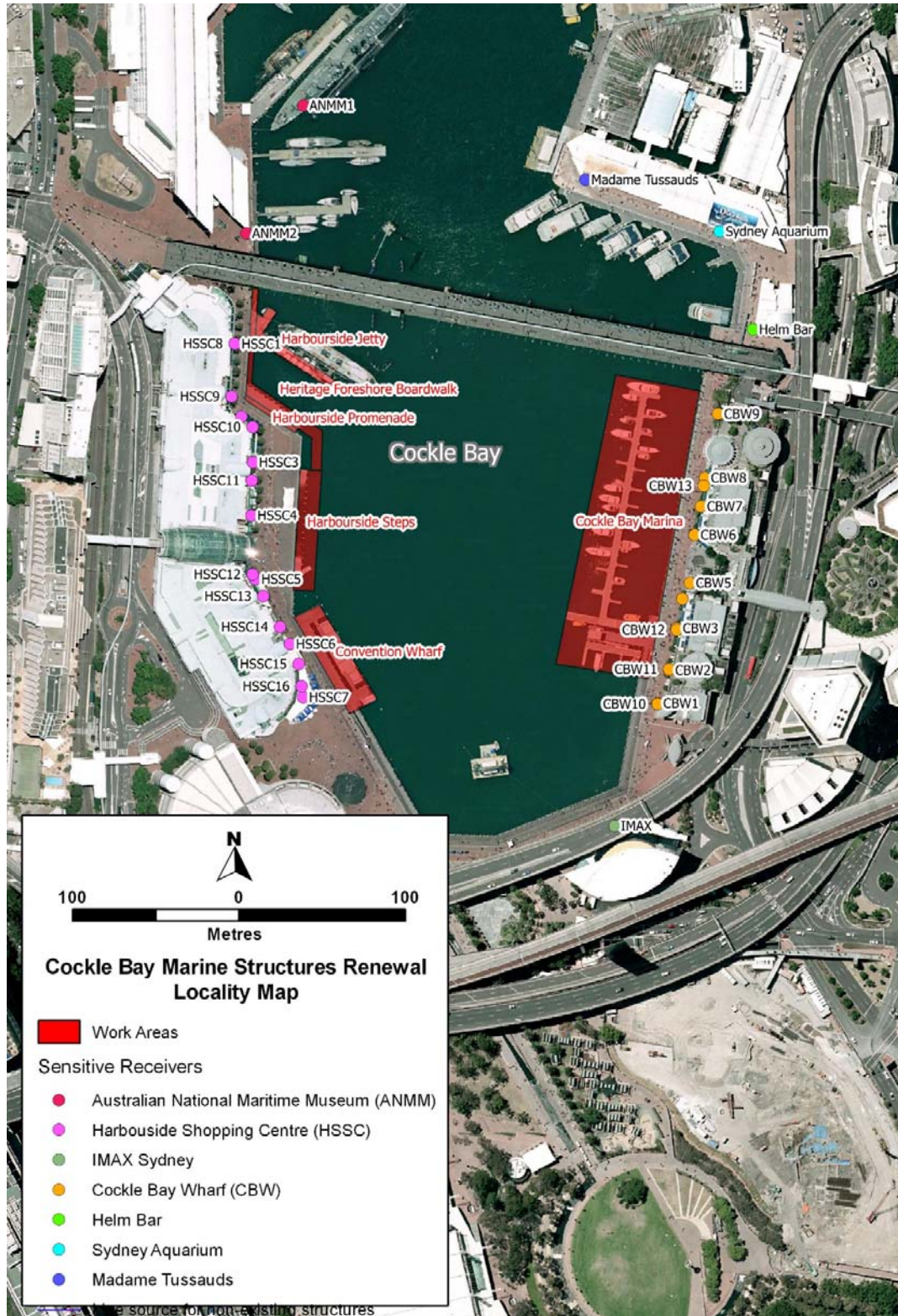


Figure 48: Noise & Vibration Assessment – Locality Map

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Table 31: Noise & Vibration Receiver List

ID	Location	Floor	Function
ANMM1	HMAS Vampire	-	Museum
ANMM2	Australian National Maritime Museum	GF	Museum
CBW1	Home Nightclub	GF	Night Club
CBW2	Tokio Hotel	GF	Bar
CBW3	Nick's Seafood	GF	Restaurant
CBW4	Nick's 103	GF	Cafe
CBW5	Lindt Cafe	GF	Cafe
CBW6	Adria Rybar & Grill	GF	Bar Restaurant
CBW7	I'm Angus Steakhouse	GF	Restaurant
CBW8	Baia The Italian	GF	Restaurant
CBW9	Pontoon Bar	GF	Bar
CBW10	Home Nightclub	1st	Night Club
CBW11	Tokio Hotel	1st	Bar
CBW12	Blackbird Cafe	1st	Bar Restaurant
CBW13	Dockside	1st	Function Venue
CBW14	Pontoon Bar	1st	Bar
Helm Bar	Helm Bar	GF	Bar
HSSC1	Margaritaville	GF	Restaurant
HSSC2	Blue Fish	GF	Restaurant
HSSC3	Waterfront Grill	GF	Restaurant
HSSC4	Olivio	GF	Restaurant
HSSC5	Passello	GF	Restaurant
HSSC6	Watershed	GF	Bar
HSSC7	Cyren	GF	Restaurant
HSSC8	Hurricanes	1st	Resaurant
HSSC9	Festival Cafe	1st	Café Bar
HSSC10	Dragon Boat	1st	Bar Restaurant
HSSC11	Criniti's	1st	Restaurant
HSSC12	Thai Foon	1st	Restaurant
HSSC13	Zaaffran	1st	Restaurant
HSSC14	Kamikaze	1st	Restaurant
HSSC15	Cohibar	1st	Bar
HSSC16	Hard Rock Cafe	1st	Bar Restaurant
IMAX	IMAX	GF	Movie Theatre
Madame Tussauds	Madame Tussauds Sydney	GF	Museum
Sydney Aquarium	Sydney Aquarium and Wildlife Centre	GF	Aquarium

8.17.4 Construction Noise & Vibration Criteria

Quantitative Assessment Method for Airborne Construction Noise

The quantitative assessment method set out in the ICNG has been used to assess the potential impacts from construction noise. This document guides EPA in setting statutory conditions in licences or other regulatory instruments for construction noise.

The ICNG recommends noise management levels of $L_{Aeq,15min}$ 60dBA (externally) for external passive recreational areas, such as outdoor dining areas. For indoor sensitive land use such as restaurants/coffee bars, museum foyer and exhibition spaces, the recommended 'maximum' internal management levels of $L_{Aeq,15min}$ 50dBA, 50dBA and 45dBA, respectively, as taken from AS2107 Acoustics – Recommended design sound levels and reverberation times for building interior should be used.

However, people's reaction to noise from construction will depend on the time of day that works are undertaken as background noise levels change. For example, people in residences are usually most annoyed by work at night time as it has the potential to disturb sleep (during times of low background noise level). As such, it is necessary to take into account the ambient noise environment.

Darling Harbour is a large recreational and pedestrian precinct where the background noise level is already high. It is therefore considered necessary to examine the rating background levels in conjunction with the recommended outdoor noise management levels mentioned above to determine appropriate project-specific construction noise management levels. Where the recommended NML for outdoor sensitive land use is lower than rating background level plus 10dB (NML for residential use), the latter has been adopted.

Project-Specific Construction Noise Management Levels

For the purpose of this assessment, the daytime RBL determined by monitoring has been used to establish the construction noise management level for outdoor sensitive land uses surrounding the site. For indoor sensitive land use, the ICNG recommended noise management levels have been adopted. A conservative estimate of the difference between internal and external noise level of 25dB has been assumed for fixed windows and 15dB has been assumed for open windows /doors. In accordance with the above process, the following construction noise management levels (assessed externally) are applicable during the nominated construction hours:

- Australian National Maritime Museum (HMAS Vampire) 69dBA (based on RBL + 10dB)
- Australian National Maritime Museum (internal) 70dBA (indoor 45dBA)
- Harbourside Shopping Centre (Outdoor Restaurants) 69dBA (based on RBL + 10dB)
- IMAX Foyer 65dBA (indoor 50dBA)
- Cockle Bay Wharf Complex (Outdoor Restaurants) 69dBA (based on RBL + 10dB)
- Helm Bar (Outdoor Restaurants) 69dBA (based on RBL + 10dB)
- Sydney Aquarium 70dBA (indoor 45dBA)
- Madame Tussauds 70dBA (indoor 45dBA)

The ICNG does not include any criteria to assess off-site maritime traffic noise associated with the construction. Noise from maritime traffic associated with the proposed construction would be minimised as much as practicable by limitations on construction hours and maritime vessel noise limits.

Regardless, given the existing volume of traffic on the water-way within the study area, it would be expected that additional maritime traffic movements associated with the construction would not generate a material rise in traffic noise during the construction phase. Additionally, construction maritime traffic noise would provide a relatively minor contribution with respect to the actual construction activities.

8.17.5 Assessment Method for Construction Vibration

Construction work is generally considered an intermittent source of vibration. When assessing vibration, there are two components that require consideration:

- human exposure to vibration; and
- the potential for building damage from vibration.

Furthermore, whilst not discussed in guidelines, the vibration from construction has the potential to impact on the marine environment housed in the Sydney Aquarium so this aspect also needs to be considered.

Human Exposure to Vibration

The DECCW's Assessing Vibration: A Technical Guideline provides guidance for assessing human exposure to vibration. The publication is based on British Standard BS 6472:1992. Intermittent vibration is best assessed by the Vibration Dose Value (VDV) which is based on the weighted root mean quartic (rmq) acceleration. However, for simplicity of assessment and monitoring, a peak component particle velocity (PCPV) goal (in the vertical direction) is preferred.

Table 32 sets out PCPV values for continuous and impulsive vibration as specified by Assessing Vibration: A Technical Guideline. The impulsive vibration goals are shown in brackets.

Table 32: Human Comfort Vibration Goals – PCPV (mm/s)

Place	Day (7.00am-10.00pm)		Night (10.00pm-7.00am)	
	Preferred	Maximum	Preferred	Maximum
Residences	0.28 (8.6)	0.56 (17.0)	0.20 (2.8)	0.40 (5.6)
Offices, Places of Worship	0.56 (18.0)	1.1 (36.0)	0.56 (18.0)	1.1 (36.0)
Workshops	1.1 (18.0)	2.2 (36.0)	1.1 (18.0)	2.2 (36.0)

Note: Impulsive goals are shown in brackets – These are most relevant to activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading. The commercial/church criteria only apply when the premises' are occupied.

As seen in Table 32, the Guideline does explicitly state the vibration goals for public areas, such as café, restaurant, bar and museum. For the purpose of this assessment, the maximum vibration goal for residences has been adopted to assess these sensitive public areas, which is also in line with the preferred goal for offices and places of worship.

For Sydney Aquarium and IMAX Theatre, the vibration impacts are assessed using a different approach as described below.

Effects of Vibration

Humans are far more sensitive to vibration than is commonly realised. They can detect and possibly even be annoyed by vibration levels which are well below those causing any risk of damage to a building or its contents.

The actual perception of motion or vibration may not, in itself, be disturbing or annoying. An individual's response to that perception, and whether the vibration is "normal" or "abnormal", depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as "normal" in a car, bus or train is considerably higher than what is perceived as "normal" in a shop, office or dwelling.

Human tactile perception of random motion, as distinct from human comfort considerations, was investigated by Diekmann and subsequently updated in German Standard DIN 4150 Part 2-1975. On this basis, the resulting degrees of perception for humans are suggested by the vibration level categories given in Table 33.

Table 33: Vibration Levels and Human Perception of Motion - PPV

Approximate Vibration Level	Degree of Perception
0.10 mm/s	Not felt
0.15 mm/s	Threshold of perception
0.35 mm/s	Barely noticeable
1 mm/s	Noticeable
2.2 mm/s	Easily noticeable
6 mm/s	Strongly noticeable
14 mm/s	Very strongly noticeable

Note: These approximate vibration levels (in floors of building) are for vibration having a frequency content in the range of 8 Hz to 80 Hz.

A review of the information in Table 33 suggests that people will just be able to feel floor vibration at levels of about 0.15 mm/s, and that the motion becomes “noticeable” at a level of approximately 1 mm/s.

It is considered that the human perception of motion as described above would be a good starting point to screen the vibration impacts upon the marine environment housed in the Sydney Aquarium.

Ground-borne noise at IMAX Theatre

Ground-borne noise is noise generated by vibration transmitted through the ground into a structure. Ground-borne noise caused by, for example, piling or underground works can be more noticeable than airborne noise. For this project, the IMAX Theatre is considered to be highly sensitive to external noise, and is likely to be impacted by ground-borne noise. It is considered that exceedance of a ground-borne noise level of 35dBA inside the IMAX Theatre indicates when management actions should be implemented. This level recognises the temporary nature of construction and is based on the recommended maximum internal design sound level for ‘cinema’ type space as specified in AS 2107.

Building Damage from Vibration

There are currently no Australian Standards or guidelines for assessing the potential for building damage from vibration. It is common practice to derive goals from international standards.

British Standard BS 7385:1993 and German Standard DIN 4150:1999 both provide goals, below which vibration is considered insufficient to cause building damage. Of these, DIN 4150 is the more stringent. Table 34 summarises the goals specified in DIN 4150-3:1999.

Table 34: Guideline Values for Vibration Velocity to be used when Evaluating the Effects of Short-term Vibration on Structures

Type of Structure	Guideline Values for Velocity – PCPV (mm/s)		
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz
Buildings used for commercial purposes, industrial buildings, and buildings of similar design	20	20 to 40	40 to 50
Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20
Structures that, because of their particular sensitivity to vibration, cannot be classified under either of the other classifications and of great intrinsic value	3	3 to 8	8 to 10

With regard to these levels DIN 4150 states, “*experience has shown that if these values are complied with, damage that reduces the serviceability of the building will not occur. If damage nevertheless*

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occurs, it is to be assumed that other causes are responsible. Exceeding [these] values does not necessarily lead to damage; should they be significantly exceeded, however, further investigations are necessary.”

For general construction vibration, the dominant frequency of vibration is typically in the range 31.5 – 100 Hz. Because the dominant frequency of vibration cannot be determined with certainty, this assessment has adopted a conservative goal of 20mm/s for commercial and industrial buildings. This goal would apply on the foundations of the building.

8.17.6 Construction Noise Assessment

Noise Modelling Methodology and Assumptions

Construction noise emissions from the site have been modelled using the ISO9613-2 noise prediction algorithm in SoundPLAN (ver 7.1) acoustic noise prediction software. Factors that are addressed in the noise modelling are:

- Equipment noise emission levels and location;
- Screening from structures (1.8m high site hoarding);
- Receiver locations;
- Ground topography;
- Noise attenuation due to geometric spreading;
- Ground absorption;
- Atmospheric absorption; and
- Meteorological conditions that may influence noise levels.

Construction Stages & Noise Sources

Noise impacts for each construction stage have been calculated based on the assumed equipment schedules and sound power levels provided in Table 35 below.

Table 35: Assumed Equipment Schedules

Activity	Significant Noise Source	Sound Power Level L _{Aeq} (dBA)
Removal of Existing Superstructure / Piles	Crane Barge	106
	Electric Saw / Angle Grinder / Electric Drill	108
Removal of Concrete Steps	Crane Barge	106
	Concrete Saw	114
Installation of Piles	Crane Barge	106
	Bored/Screw Piling	106
Installation of New Structures	Crane Barge	106
	Electric Saw / Angle Grinder / Electric Drill	108
	Miscellaneous Hand Tools	100

These sound power levels have been applied in the predictions of worst-case noise that may arise during construction stages. Note that in Table 35, ‘Activity’ describes the stage of construction and ‘Significant Noise Source’ describes the noisier plant/equipment that are likely to be used during the construction stage. For the purpose of this assessment, it has been assumed that one of each of the identified plant items would operate and all plant would operate concurrently during the 15-minute assessment period during each stage.

The predicted LAeq,15min construction noise levels are provided for each construction activity. The worst-case predicted noise levels at all identified sensitive receivers has been identified and exceedance of the project-specific noise management levels are identified below.

Noise Prediction – Harbourside Jetty

- Removal of Timber Structures – Predicted noise levels are below the NML at most locations with the exception of Hurricanes (HSSC8) and Festival Café (HSSC9);
- Piling – The predicted noise levels will comply with the NML at all locations except Margaritaville; and
- Installation of New Structures – Predicted noise levels are below the NML at most locations with the exception of Hurricanes (HSSC8) and Festival Café (HSSC9).

Noise Prediction – Harbourside Promenade

- Removal of Timber Structures – Predicted noise levels are below the NML at most locations with the exception of Hurricanes (HSSC8), Festival Café (HSSC9) and Dragon Boat (HSSC10);
- Piling – The predicted levels will generally comply with the NML except for small exceedances at Blue Fish, Hurricanes, Festival Café and Dragon Boat; and
- Installation of New Structures – Predicted noise levels are below the NML at most locations with the exception of Hurricanes (HSSC8), Festival Café (HSSC9) and Dragon Boat (HSSC10).

Noise Prediction – Harbourside Steps

- Removal of Timber Structures – Predicted noise levels are below the NML at most locations with the exception of Kamikaze (HSSC14) and Cohibar (HSSC15);
- Piling – The NML will not be exceeded by the predicted levels at any location; and
- Installation of New Structures – Predicted noise levels are below the NML at most locations with the exception of Kamikaze (HSSC14) and **Boardwalk**

Noise Prediction – Heritage Foreshore Boardwalk

- Piling – The predicted levels will generally comply with the NML except for small exceedances at Margaritaville, Blue Fish, Hurricanes, Festival Café and Dragon Boat; and
- Installation of New Structures – Predicted noise levels are below the NML at most locations with the exception of Margaritaville (HSSC1), Hurricanes (HSSC8), Festival Café (HSSC9) and Dragon Boat (HSSC10).

Noise Prediction – Convention Wharf

- **Removal of Timber Structures** – Predicted noise levels are below the NML at most locations with the exception of Zaaffran (HSSC13), Kamikaze (HSSC14), Cohibar (HSSC15) and Hard Rock Café (HSSC16);
- **Piling** – The predicted levels will comply with the NML except at Zaaffran, Kamikaze, Cohibar and Hard Rock Café; and
- **Installation of New Structures** – Predicted noise levels are below the NML at most locations with the exception of Zaaffran (HSSC13), Kamikaze (HSSC14), Cohibar (HSSC15) and Hard Rock Café (HSSC16).

Noise Prediction – Cockle Bay Marina

- **Removal of Timber Structures** – Predicted noise levels are below the NML at most locations with the exception of Home Nightclub (CBW1), Tokio Hotel (CBW2), Blackbird Cafe (CBW12), Dockside (CBW13) and Pontoon Bar (CBW14);
- **Piling** – The predicted levels will exceed the NML at only a few locations: Home Nightclub, Tokio Hotel, Blackbird Café and Pontoon Bar; and
- **Installation of New Structures** – Predicted noise levels are below the NML at most locations with the exception of Home Nightclub (CBW1) and Tokio Hotel (CBW2).

Sources of Noise Exceedances

Where exceedances of the NML have been identified in this section, the likely causes of such exceedances will be:

- Removal of Structures – combination of equipment, except during concrete removal the concrete saw will dominate;
- Piling – the bored or screw piling rig; and
- Installation of New Structures – Hand tools and barge.

8.17.7 Construction Vibration Assessment

Activities undertaken during construction may generate ground vibration. With respect to the construction plant anticipated, the highest levels of vibration would be expected to occur during construction phases using a piling rig.

Results from vibration monitoring trials of bored piling rigs operating, as previously undertaken by WM, are set out in Table 36. These levels were measured at other sites throughout NSW and provide a guide to the levels that may occur due to similar activities undertaken on the subject site. It should be noted however, that actual levels would depend on the specific site geological conditions. The PPV levels in the table are almost the same as the vertical PCPV levels.

Table 36: Measured Vibration Levels from Various Construction Plant

Source	PPV Vibration Level (mms ⁻¹) at Distance					
	5m	10m	20m	30m	40m	50m
Bored Piling*	-	0.2	<0.1	-	-	-

Note: * The vibration level from screw piling is anticipated to be similar to bored piling.

As shown in Table 36, vibration levels reduce substantially with distance. Based on the vibration levels generated from bored piling, the following can be concluded:

- The separation distances between the closest identified receiver and the Cockle Bay Marine Structures Renewal works sites are sufficient to ensure that these activities would not generate any material vibration impacts;
- There is some potential for exceedance of the human comfort criteria at receivers with less than 10m setback distance from the works, depending on the response of the ground;
- The Sydney Aquarium and the IMAX Theatre are both more than 90m away from the works and the vibration levels are predicted to be in the magnitude of or less than 0.01mm/s. On this basis, the vibration impacts at the Sydney Aquarium and the IMAX Theatre would be minimal and the effect of vibration is unlikely to be felt by humans (refer to **Error! Reference source not found.**); and
- The predicted vibration level of 0.01mm/s at the base of the IMAX Theatre equates to ground-borne noise of well below 35dBA inside the theatre.

For the above reasons, it is recommended that during the early stage of piling vibration measurements are undertaken on site to confirm that piling can comply with the maximum level of 0.56 mm/s at the closest sensitive receiver. This testing should consider the recommendations of *Assessing Vibration: A Technical Guideline*, giving due consideration to the vibration dose method described by the guideline.

8.17.8 Noise and Vibration Impacts during Operational Phase

Noise and vibration impacts during the operational phase are likely to result from engine noise from vessels and from human activity, including crowd conditions.

As the proposed use is the same as the existing and there is no intensification of use, noise and vibration impacts during operation are expected to be neutral. However, the Authority will utilise its existing protocols to ensure noise levels are managed within acceptable tolerances during the operational phase.

8.17.9 Conclusion and Proposed Additional Mitigation Measures

The construction noise and vibration impact assessment indicates that vibration levels are likely to comply with reasonable criteria to protect buildings from damage and humans from disturbance. However, some predicted noise levels will exceed the noise management levels identified in the *Interim Construction Noise Guideline* published by the EPA. The exceedances are expected to be small.

Vibration impact on the marine environment housed in Sydney Aquarium and ground-borne noise impact inside the IMAX Theatre would be minimal. Potential for exceedance of the human comfort vibration criteria has, however, been noted at receivers with a setback distance of less than 30m from the works.

A number of mitigation measures have been identified that, if employed, would be expected to effectively reduce the level of impacts to the most practicable extent.

Based on Wilkinson Murray's recommendations in the Noise and Vibration Impact Assessment and the Authority's own experience of managing similar projects, the following additional mitigation measures are proposed:

Construction Phase

1. Screwed piles will be specified to minimise noise and vibration impacts
2. A noise respite period from 12:00 – 14:00 will be implemented
3. All site neighbours will be notified of potential impacts well in advance of works commencing on site; receivers likely to be impacted by noise or vibration will be provided with a briefing, including a programme of when impacting activities are likely to occur
4. An Environmental Management Plan will be implemented to address noise and vibration impacts, including:
 - a. Requirement for site inductions to make site personnel aware of noise and vibration impacts limiting requirements such as noise limits, appropriate use of equipment and machinery and cumulative impacts
 - b. Implementation of a noise monitoring and auditing procedure to verify compliance with predicted noise levels
 - c. Confirmation that piling complies with the maximum level of 0.56mm/s at the closest sensitive receiver
 - d. Prevention, non-conformance and corrective action procedures
5. The Authority's existing Customer Request Management System will be utilised to manage feedback, including procedures for recording and managing complaints

Operational Phase

6. Operational phase – the Authority will utilise its existing ranger services to ensure noise levels are managed within acceptable tolerances during the operational phase.

9 Summary of Additional Environmental Mitigation Measures to be Implemented

Most potential impacts of the proposal have been addressed through design. The following table identifies additional mitigation measures to be implemented.

Table 37: Summary of Additional Mitigation Measures

Impact	Proposed Additional Mitigation Measures
Public Safety	<p>Design Phase</p> <ol style="list-style-type: none"> The Authority will consult with RMS Wharf Safety during detailed design to ensure the public wharf design meets all applicable WHS and DDA requirements
Public Access	Nil
Visual Impacts	Nil
Event Management & Recreational Capacity	Nil
Sustainability	Nil
Sea Level Rise	Nil
Infrastructure Servicing	Nil
Waste Management	<p>Construction Phase</p> <ol style="list-style-type: none"> The Contractor will be prohibited from depositing waste in the public domain, either Cockle Bay or its surrounds. All demolished material which cannot be reused or recycled will be taken to a licensed waste facility All demolished material transported from the site will be adequately contained to prevent any material entering the water The project will be required to comply with NSW Government Sustainability Policy – WRAPP Reporting Guidelines 2011 Waste management procedures compliant with EPA guidelines will be documented in the Contractor's Environmental Management Plan
Heritage	<p>Construction Phase</p> <ol style="list-style-type: none"> Piling works will to be carried on with an Exception under Section 139(4) of the Heritage Impact Act 1977.
Navigation & Safety	<p>Construction Phase</p> <ol style="list-style-type: none"> Lighting and buoyage will be provided in accordance with the Harbour Master's and Roads and Maritime Services requirements to segregate the on-water construction zone. The Harbour Master and Roads and Maritime Services will be consulted further with respect to requirements for the construction phase of the proposal prior to construction Appropriate communication of service changes will be made in advance of construction impacts <p>Operational Phase</p> <ol style="list-style-type: none"> Vessel sizes will be limited to 15m for recreation users and 35m for commercial users during routine operation; larger vessels may only access the bay on an as needed basis following risk assessment Detailed operational protocols will be implemented prior to putting the new facilities into service to ensure safe and equitable maritime access The Harbour Master and Roads and Maritime Services will be consulted further with respect to their requirements for the operational phase of the proposal
Transport, Traffic & Parking	<p>Construction Phase</p> <ol style="list-style-type: none"> The Construction Management Plan will include measures to minimise impacts on transport, traffic, parking and pedestrian movement along the waterfront.

Impact	Proposed Additional Mitigation Measures
Water Quality & Contamination	<p>Construction Phase</p> <ol style="list-style-type: none"> 1. The Harbour Master will be consulted further with respect to pollution prevention measures for the construction phase of the proposal to ensure that all pollution prevention measures have been addressed, including access to stormwater drains within the site boundary. 2. Any disturbance of the seabed will be subject to the approval of the Harbour Master in accordance with clauses 67 and 69 of the Management of Water and Waterside Lands Regulations - NSW 3. Piles will be completely withdrawn from the seabed. In the event a pile cannot be fully removed, it will be cut off at the seabed using an appropriate cutting sleeve to reduce seabed disturbance 4. Silt curtains and booms will be installed prior to any works and suitably maintained during demolition and construction works to contain suspended sediment and limit spread of turbidity and contaminated sediments. 5. Vessels used during the construction will be legally required to comply with: <ul style="list-style-type: none"> • Annexes of the International Convention for the Prevention of Pollution (MARPOL 93/98) including Annexes relating to the discharge of oil, noxious liquid substances, sewage, garbage and air • <i>Ports and Maritime Administration Act 1995</i>, the <i>Marine Safety Act 1998</i> and the <i>Marine Pollution Act 1987</i> 6. An Environmental Management Plan will be implemented including procedures for minimising risk of unplanned events relating to spills, collisions and avoiding material entering the waterway 7. The Harbour Master and the Environmental Protection Authority will be consulted further with respect to pollution prevention measures for the construction phase of the proposal to ensure that all pollution prevention measures have been addressed, including access to stormwater drains within the site boundary. <p>Operational Phase</p> <ol style="list-style-type: none"> 8. The Authority will utilise its operational ranger services to ensure the potential for contamination is minimised during the operational phase. 9. The Authority will consult with the Environmental Protection Authority in relation to best practice management requirements prior to the new facilities being put into operation
Flora & Fauna	<p>Construction Phase</p> <ol style="list-style-type: none"> 1. The Contractor will be required to appropriately manage noise generating equipment 2. Suitably qualified personnel should monitor behaviour of important fauna within Sydney Aquarium during noise-sensitive activities. Any reports of adverse effects should be reported to and investigated by the Authority 3. Silt curtains and booms will be installed prior to any works and suitably maintained during demolition and construction works to contain suspended sediment and limit spread of turbidity and contaminated sediments. 4. Vessels used during the construction will be legally required to comply with: <ul style="list-style-type: none"> • Annexes of the International Convention for the Prevention of Pollution (MARPOL 93/98) including Annexes relating to the discharge of oil, noxious liquid substances, sewage, garbage and air • <i>Ports and Maritime Administration Act 1995</i>, the <i>Marine Safety Act 1998</i> and the <i>Marine Pollution Act 1987</i> 5. An Environmental Management Plan will be implemented, including procedures for minimising risk of unplanned events relating to spills, collisions and avoiding material entering the waterway

Impact	Proposed Additional Mitigation Measures
Air Quality & Odour	<p>Construction Phase</p> <ol style="list-style-type: none"> 1. All site neighbours will be notified of potential impacts well in advance of demolition works commencing on site 2. An Environmental Management Plan will be implemented to address air quality impacts 3. The Authority's existing Customer Request Management System will be utilised to manage feedback, including procedures for recording and managing complaints
Noise & Vibration	<p>Construction Phase</p> <ol style="list-style-type: none"> 1. Screwed piles will be specified to minimise noise and vibration impacts 2. A noise respite period from 12:00 – 14:00 will be implemented 3. All site neighbours will be notified of potential impacts well in advance of works commencing on site; receivers likely to be impacted by noise or vibration will be provided with a briefing, including a programme of when impacting activities are likely to occur 4. An Environmental Management Plan will be implemented to address noise and vibration impacts, including: <ol style="list-style-type: none"> a. Requirement for site inductions to make site personnel aware of noise and vibration impacts limiting requirements such as noise limits, appropriate use of equipment and machinery and cumulative impacts b. Implementation of a noise monitoring and auditing procedure to verify compliance with predicted noise levels c. Confirmation that piling complies with the maximum level of 0.56mm/s at the closest sensitive receiver d. Prevention, non-conformance and corrective action procedures 5. The Authority's existing Customer Request Management System will be utilised to manage feedback, including procedures for recording and managing complaints <p>Operational Phase</p> <ol style="list-style-type: none"> 6. Operational phase – the Authority will utilise its existing ranger services to ensure noise levels are managed within acceptable tolerances during the operational phase.

10 Approvals Required

The following approvals have been identified for this proposal:

1. Exception under Section 139(4) of the Heritage Impact Act 1977 prior to disturbance of the seabed
2. Harbour Master approval under Clause 67 of the Management of Waters and Waterside Lands Regulations for works disturbing the bed of a Special Port Area

11 Conclusion & Justification of the Proposal

Cockle Bay is central to the function and appeal of Darling Harbour and supports the future success of the International Convention Centre, due to open in late 2016. Darling Harbour is one of the most popular visitor destinations in Sydney, attracting over 26 million people a year. It is a place of gathering and celebration. The proposed renewal of marine structures within Cockle Bay aims to retain the international standard of this precinct, improve public access and safety and deliver improved event and recreational opportunities.

The Authority is committed to creating extraordinary places the world talks about and the new facilities at Cockle Bay will be unique within Sydney Harbour. A number of alternatives were considered including doing nothing and undertaking a basic safety upgrade. These alternatives come with high maintenance costs or upgrade costs and will not resolve underlying conflicts between users of the bay. The proposed renewal represents a total reconfiguration of existing facilities to better meet user requirements and contribute to Sydney's premier place of celebration.

The Authority is seeking to renew the marine structures in Cockle Bay as part of the transformation of Darling Harbour. This proposal supports the Government's vision of Darling Harbour as Sydney's premier gathering place and leading urban entertainment precinct. The design quality of the proposal will be keeping with the vision for Cockle Bay as the water forecourt of the new International Convention Centre Sydney. The proposal will optimise Cockle Bay as a unique events and activation space, whilst providing water-based transport and leisure options to International Convention Centre Sydney patrons, other precinct visitors and the people of Sydney.

The key reasons for renewal of the marine structures in Cockle Bay at this time are:

- **Asset risk management:** The existing marine structures in Cockle Bay present compliance risk and are at or near the end of their useful life. Significant investment is required in the short term to maintain existing functionality. Rather than maintaining the existing assets or replacing like-for-like, an opportunity exists to achieve significant functional, heritage and urban design outcomes by re-designing the existing scheme. This provides a cost effective alternative with benefits not achievable without redeveloping the site.
- **Authority's corporate objectives:** The Authority aims to create exceptional places the world talks about and recognises Cockle Bay as the water forecourt of the new ICC Sydney. As owner of the Cockle Bay and its surrounds, it aims to modernise facilities in the Bay to support Darling Harbour's strategic economic value as NSW's leading integrated meetings, incentive, conference, exhibition and entertainment precinct. The Government's \$3 billion investment in the new ICC Sydney demands a level of design quality and aesthetic consistent with that investment.
- **The Government's Sydney Harbour and maritime agenda:** The NSW Government, through its recently released *Plan for Growing Sydney*, has reaffirmed its commitment to improving public access to the harbour and its foreshores, and maintaining its ongoing role as a focus for major civic events and celebrations. Cockle Bay is central to delivering on that commitment as it is the most highly visited harbourside destination in Sydney, providing rare access for recreational vessels to the CBD. The Sydney Harbour Boating Destinations Plan, part of the Government's Maritime Policy Agenda, is designed to increase the number of services and amenities available to the general boating public on Sydney Harbour.

The Authority has undertaken extensive consultation in developing the proposal in accordance with the NSW Government's Major Project Consultation Guidelines 2005. The proposal as documented appropriately responds to all stakeholder input and feedback, with only minor exception.

Most potential impacts have been mitigated through the design process, including:

- Public Access
- Visual Impacts
- Event Management & Recreational Capacity Impacts
- Sustainability Impacts
- Sea Level Rise Impacts
- Infrastructure Servicing Impacts

No additional mitigations are required for these impact categories.

Construction will be staged with consideration to the precinct's busy events programme and is expected to take place during February-May 2016 and August-December 2016.

Cockle Bay Marine Structures Renewal Environmental Impact Statement

The proposal will not have a direct or indirect impact on Pymont Bridge or the Woodward Water Feature. The proposal will not diminish the heritage significance of the South Steyne. There is an acceptable impact on possible archaeological remains associated with former wharves and works will be done with an Exception under Section 139(4) of the Heritage Impact Act 1977.

Impacts requiring further mitigation largely relate to construction and are typical for proposals of this nature, including appropriate management to ensure adequate navigation safety and pollution control during works and to minimise impacts to vessel and user access, water quality, flora and fauna, air quality and noise and vibration. The impact of construction on the events programme is expected to be minimal. Vehicular, pedestrian and maritime access impacts during construction are also expected to be minimal. Water quality and sediment, flora and fauna and air quality impacts have been assessed variously as minor, negligible and ALARP (as low as reasonably possible).

Despite the use of screw piles, there will be minor exceedances of the noise management level at some receivers during the works. However, these are considered acceptable in light of the surrounding uses. Construction will not generate any material vibration impacts on identified receivers.

Additional mitigation measures for the operational phase relate to the safe and appropriate use of the new facilities and will be developed following appropriate consultation with the relevant Authorities.

Even though construction is planned concurrent with other major developments in the precinct, the proposal is not expected to result in cumulative impacts.

On balance, the public benefits arising from the proposal are significant and it is suggested that the proposal be approved.

Appendices

1. Secretary's Environmental Assessment Requirements (SSD 6611)
2. Design Documentation: Site Survey
3. Design Documentation: Drawings
4. Design Documentation: Geotechnical Report
5. Quantity Surveyor's Report
6. Maritime Archaeological Survey and Heritage Impact Statement
7. Navigation and Safety Assessment
8. Transport and Parking Impact Assessment
9. Water and Sediment Impact Assessment
10. Flora & Fauna Impact Assessment
11. Air Quality Impact Assessment
12. Noise and Vibration Impact Assessment