

REPORT

Barangaroo South Stage 1B Public Domain

Navigation Impact Assessment

Client: Lend Lease
Reference: PA1475_R003.FD02
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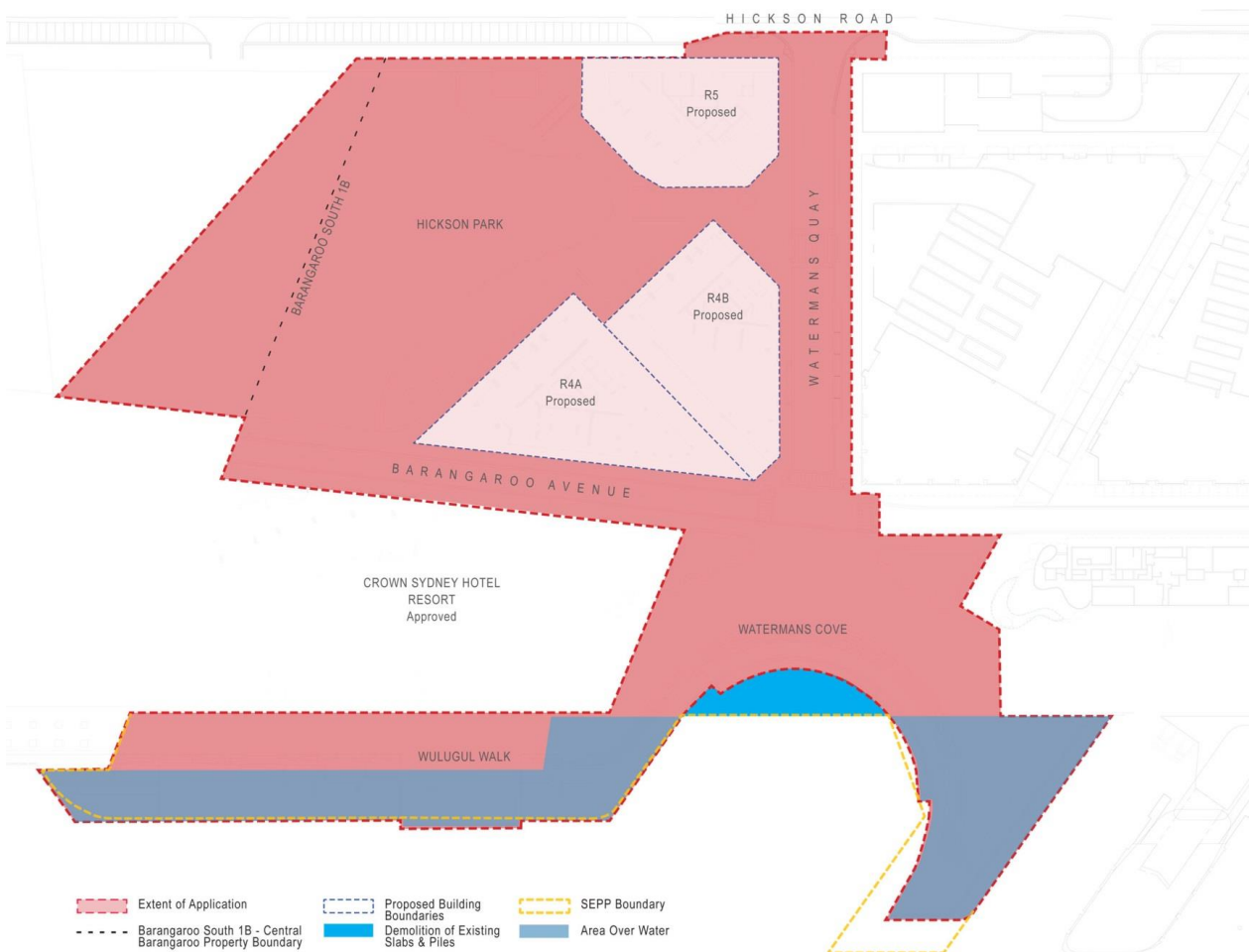
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1 INTRODUCTION

1.1 Background

Barangaroo is located on the north-western edge of the Sydney Central Business District, bounded by Sydney Harbour to the west and north, the historic precinct of Millers Point (for the northern half), The Rocks and the Sydney Harbour Bridge approach to the east; and bounded to the south by a range of new development dominated by CBD commercial tenants.

The Stage 1B Public Domain site is generally located to the north of the Stage 1A site, on land identified as public domain between and around Blocks 4A, 4B and Y in the approved Concept Plan (Mod 8), as shown in **Figure 1**. The majority of the site is legally described as Lot 212 in DP 1217691 but also includes an area of Darling Harbour. It is noted that an additional area of Darling Harbour was added to the site by the Planning Assessment Commission in their determination of Concept Plan MOD 8. This additional area is reflected in the site area identified in **Figure 1**.



(Source: JBA)

Figure 1 Site plan

1.2 Scope of Work

This report addresses Key Issue 10 Maritime Navigation in the Secretary's environmental assessment requirements (SEARs) which states:

- provide a Navigation Impact Assessment (NIA). The NIA shall include consideration of impacts and a formal risk assessment on the navigation of cruise ships, bulk carriers and other commercial vessels; and
- the NIA shall also demonstrate that adequate clearance is maintained at all times during construction of Waterman's Cove, the public pier and community building and also during operation of the proposed boat set down/pick up locations (including water taxi drop-off) and that the proposal will not adversely impact on ferry navigation, safety and service operation.

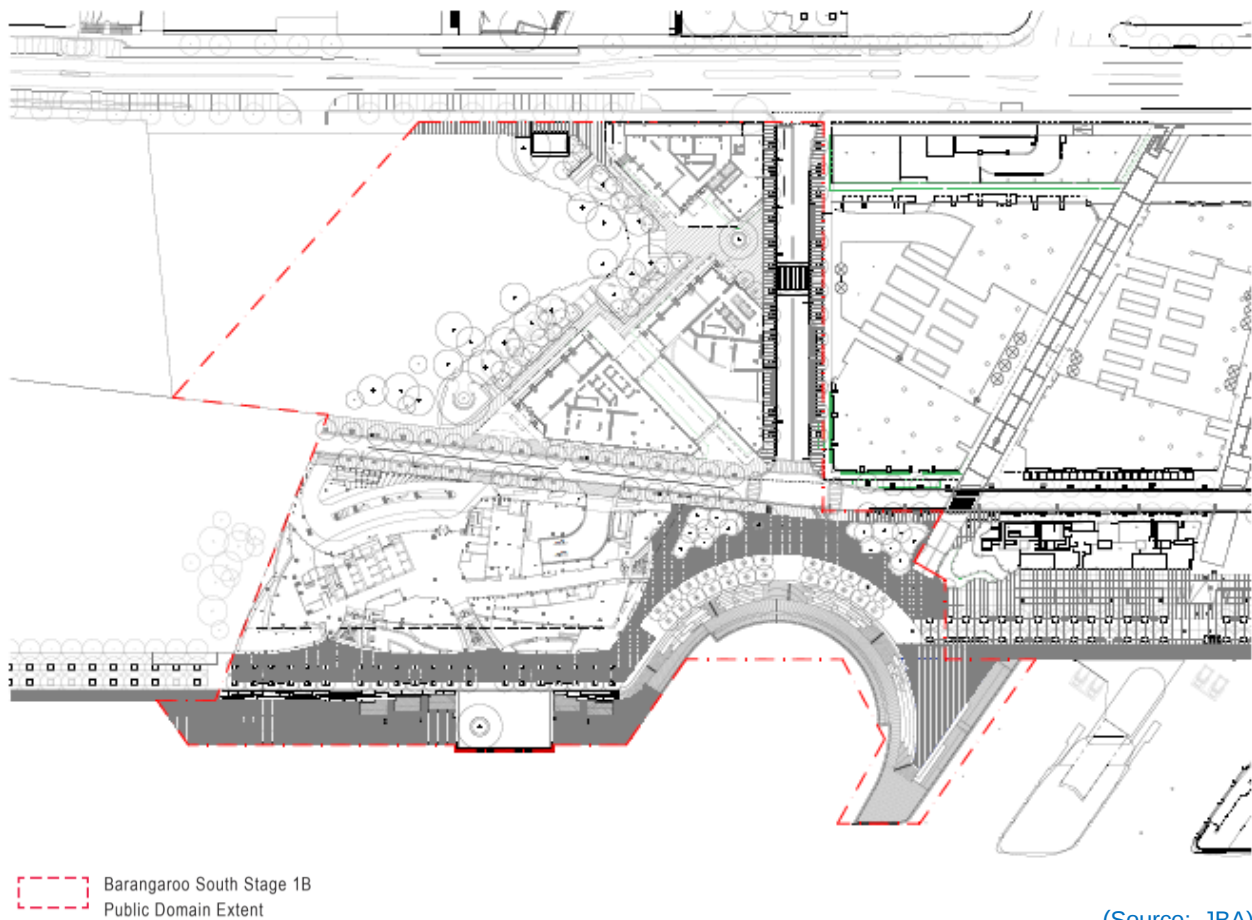
2 DESCRIPTION OF PROPOSED DEVELOPMENT

2.1 General

The State Significant Development (SSD) application will seek consent for all public domain works within 'Stage 1B' of the Barangaroo South Site. The extent of public domain works is illustrated on the site plan prepared by Lend Lease in **Figure 1**, and the preliminary indicative design drawing in **Figure 2**.

The public domain works include the construction of Waterman's Cove and Public Pier along the foreshore, the provision for a potential future building on the Public Pier, public domain works associated with Hickson Park as well as all typical public domain features such as trees and other landscape features, walkways, street paving, street furniture, lighting, roads and planting. Various services and infrastructure such as power and water with Landowner Consent will also be included in the public domain to enable it to be used for a range of different activities. Opportunity for boat set down/pick up (i.e. no berthing), including the potential for water taxi drop off and pick up is also included in the design.

Staging of the proposed public domain works will be a key component in order to accommodate the efficient and timely construction of the works and to integrate with the construction of the residential buildings R4A, R4B and R5 located within the Stage 1B Site and The Crown Sydney Hotel Resort.



(Source: JBA)

Figure 2 Preliminary indicative design

The particular waterfront elements of the Barangaroo South Stage 1B Public Domain that are relevant to this report are listed below and described in the following sections. The description includes an outline of the expected construction methodology.

- Wulugul Boardwalk and Pontoon;
- Watermans Cove and Public Pier.

2.2 Wulugul Boardwalk and Pontoon

2.2.1 Proposed Structure

The proposed Wulugul Boardwalk and Pontoon, showing key dimensions and levels, are shown in **Figure 3**. The structure comprises a fixed boardwalk over the majority of its length with a floating pontoon and hinged gangway at the northern end. The structure extends approximately 14m into Darling Harbour beyond the face of the existing vertical caisson wall. The fixed boardwalk level steps down from 2.50m AHD in the south to a minimum of 2.0m AHD in the north at the top of the gangway leading to the pontoon.

A typical section through the fixed boardwalk near the northern end (deck level 2.0m AHD) is shown in **Figure 4**. A view of the boardwalk and pontoon looking south, drawn at Lowest Astronomical Tide (-0.925m AHD), is shown in **Figure 5**.

The proposed fixed boardwalk is supported by tubular steel piles (refer **Figure 4**). Situated above the piles would be precast concrete headstocks, timber or precast concrete girders and timber decking. The floating pontoon is restrained in place by a series of steel tubular piles along the landward side (refer **Figure 5**). The pontoon is likely to be fabricated from steel or precast concrete with timber board decking.

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(Source: Grant Associates)

Figure 3 Wulugul Boardwalk and Pontoon showing key levels

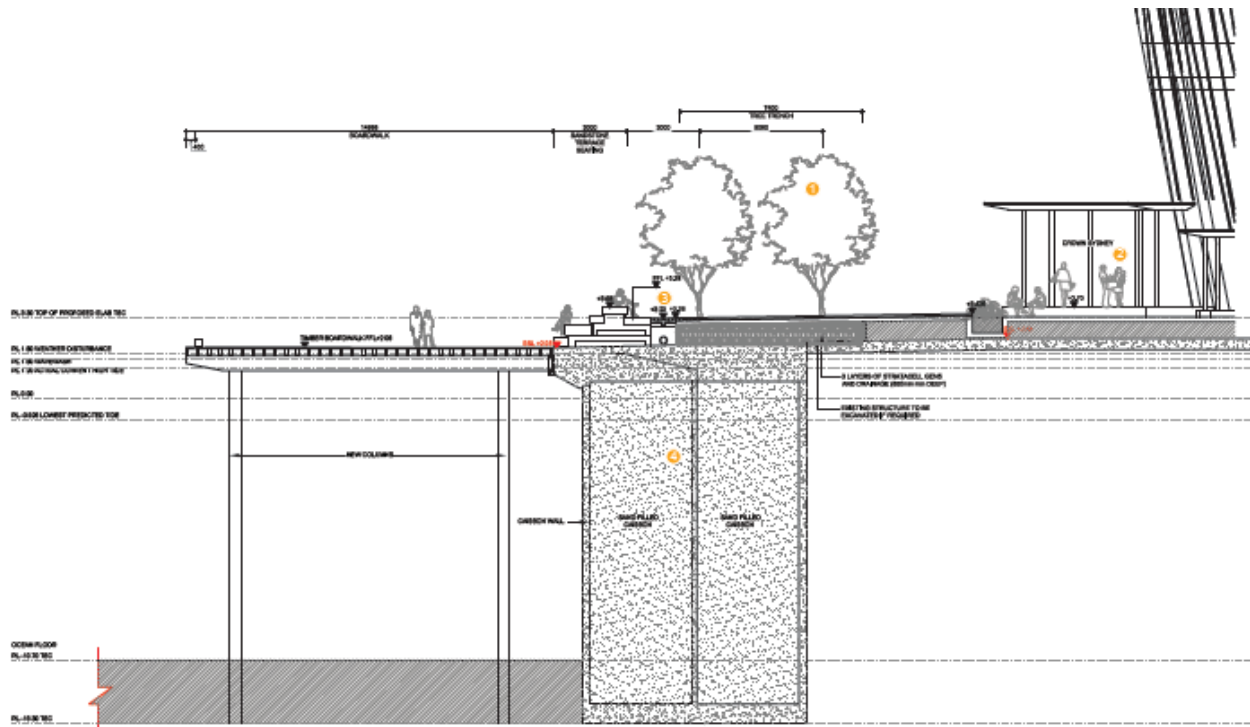


Figure 4 Wulugul Boardwalk – section

(Source: Grant Associates)



Figure 5 Wulugul Boardwalk and Pontoon – view looking south

(Source: Grant Associates)

2.2.2 Construction Methodology

The proposed construction methodology would involve a combination of water based and land based plant.

Water based plant would be utilised for installation of piling and precast headstocks for the fixed boardwalk. The barge involved in these works would be approximately 54m long and 24m wide. It would be oriented primarily north/south during piling operations (approximately 75% of the time).

Land based plant and equipment would be primarily utilised for installation of the girders and decking for the boardwalk. Some movements by small work boats would also take place.

The pontoon would be fabricated off site, transported to a suitable offloading point in the Harbour elsewhere, and towed into position.

The total duration of the water based component of the works, involving the barge, is estimated to be approximately 4 months.

2.3 Watermans Cove and Public Pier

2.3.1 Proposed Structure

The proposed Watermans Cove and Public Pier are shown in **Figure 6**.

The Cove is framed by the Public Pier in the south and Wulugul Boardwalk in the north. A small section of existing suspended wharf structure and piling would be demolished to complete the shape of the Cove (refer **Figure 1**). No berthing facilities are proposed within the Cove.

The levels around the Cove step down from an upper concourse level of 3.5m AHD to a minimum level near the waters edge of 1.50m AHD. A typical section through the Cove is shown in **Figure 7**. A view of the Cove foreshore looking north west is shown in **Figure 8**. The main boardwalk and lower boardwalk would be timber structure with timber decking boards.

Approximately 20 existing piles would be removed to create the inner shape of the Cove. It would be normal practice to cut the piles off at or below seabed level so they do not form a hazard to navigation. In this case, however, it is proposed to restrict navigation to the inner portion of the Cove and include aquatic eco-engineering works, utilising the piles, to improve bio-diversity, as discussed further below.

Wherever possible, existing piles would be utilised to support the boardwalks and steps of the Cove. Where new piles are required due to the required geometry of the Cove, tubular steel piles would be installed.

The Public Pier would extend into Darling Harbour by a distance of approximately 50m measured from the face of the existing vertical caisson wall. The proposed level of the timber boardwalk around the northern and western perimeter of the Pier is 1.80m AHD; the boardwalk then grades back up on the southern side to meet the existing level on Wulugul Walk.

The Public Pier would be supported on steel tubular piles. Situated above the piles would be precast concrete headstocks then either timber girders and decking (perimeter boardwalk) or precast concrete deck planks (below future building structure).

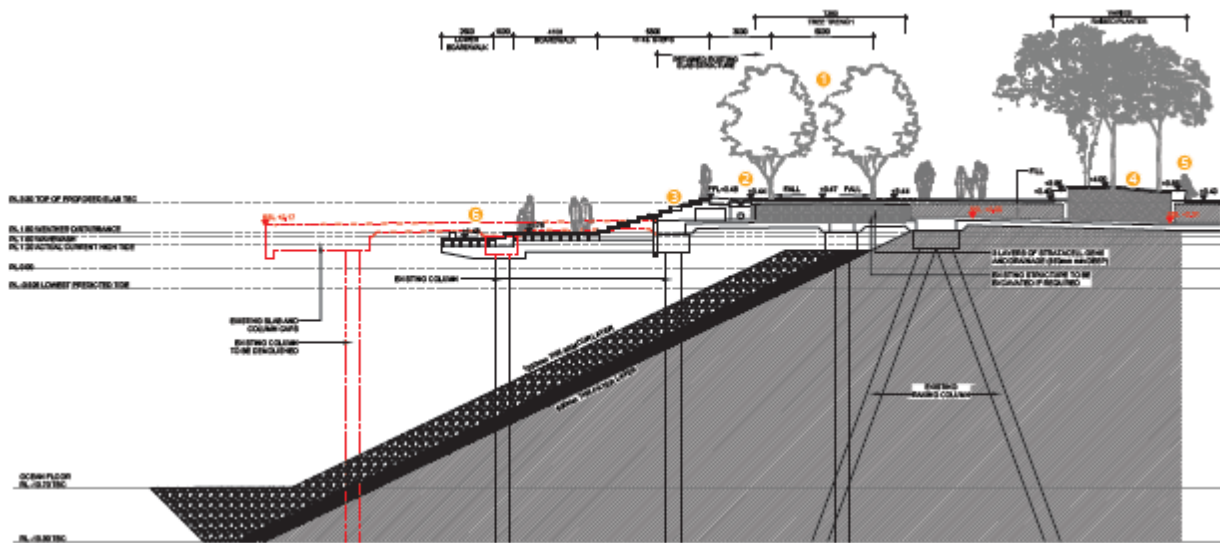
As noted above, it is proposed to include aquatic eco-engineering works to improve bio-diversity in the inner area of Cove where piles are to be cut off. In principle the proposal is to cut off the approximately 20 piles below Lowest Astronomical Tide (-0.925m AHD) but above the seabed level and attach structure complexity to the piles in this subtidal area in the form of concrete reef balls and steel plates and the like to promote aquatic colonisation and recruitment, and improve bio-diversity.

It is intended that detailed design of the subtidal structure would be undertaken in consultation with the NSW Department of Primary Industries and the University of New South Wales Sydney Institute of Marine Science (SIMS). The development and monitoring of the aquatic eco-engineering works could form part of the SIMS Sydney Harbour Research Program.



(Source: Grant Associates)

Figure 6 **Watermans Cove and Public Pier**



(Source: Grant Associates)

Figure 7 Watermans Cove – typical section



(Source: Grant Associates)

Figure 8 Watermans Cove – view looking north west

2.3.2 Construction Methodology

The proposed construction methodology would involve a combination of water based and land based plant.

Water based plant would be utilised for installation of piling and precast headstocks. The barge involved in these works would be approximately 54m long and 24m wide. It would be oriented primarily north/south for the Public Pier works and primarily east/west for the Watermans Cove works.

Land based plant and equipment would be primarily used for installation of the girders, decking and precast deck planks. Some movements by small work boats would also take place.

The total duration of the water based component of the works, involving the barge, is estimated to be approximately 4 months each for Watermans Cove and the Public Pier.

3 SITE INSPECTION

A site inspection was undertaken on Friday 16 September 2016 between 3:30 pm and 5:15 pm. The site inspection coincided with departure of the P&O cruise ship *Pacific Pearl* from the White Bay Cruise Terminal, which was scheduled for 4:00 pm. The ship is one of the larger vessels which regularly docks at White Bay and is shown in **Figure 9**. The dimensions of the ship are:

Length Overall (LOA)	245.6m
Summer Draft	8.2m
Beam	32.2m

The *Pacific Pearl* was docked at the White Bay Cruise Terminal with the port side against the wharf. As such, the ship was pointing in the sailing direction and a 180 degree turn was not required. The ship was assisted by one tug boat, which was tethered to the stern (refer **Figure 10**). As the cruise ship departed White Bay and Darling Harbour, the majority of boating traffic ceased. It is estimated the cruise ship remained more than 150m from the proposed pick-up/ drop-off pontoon at all times.

A range of smaller vessels including First Fleet Ferries, RiverCat Ferries, Captain Cook Charter Vessels, Fantasea Charter Vessels, water taxis and recreational craft were observed. The largest of these vessels was the Captain Cook vessel, *John Cadman 2* at 39m LOA. It is thought that a number of charter vessels exceeded the speed limit inside the 8 knot zone.

Vessels generally remained more than approximately 80m from the foreshore. However, it is noted that maritime construction works were underway near the proposed Public Pier and Barangaroo Ferry Hub. A large work barge was onsite and Special Navigation Markers were placed around the construction area. This essentially forced boating traffic exiting King Street Wharf and Cockle Bay towards the centre of Darling Harbour and away from the foreshore.



Figure 9 P&O cruise ship Pacific Pearl passing Barangaroo site at approximately 4:30 pm 16/9/16



Figure 10 Tug tethered to stern of Pacific Pearl when passing Barangaroo site at approximately 4:30 pm 16/9/16

4 EXISTING SITE CONDITIONS

4.1 Site History

Millers Point and the Barangaroo site have played a pivotal role in the growth of Sydney as a major port city. A brief history of the site is provided below:

- 1820's - first wharf built at Walsh Bay followed by the wharves at Millers Point.
- 1840's - gasworks constructed at Barangaroo to power the city's first gas street lights.
- 1900 - NSW Government seized control of Millers Point and Barangaroo to rebuild the wharves and shipping infrastructure. The government's Sydney Harbour Trust constructed long wharves and warehouses.
- 1921 – gas works decommissioned.
- 1960s – modification of wharves as a result of containerisation of shipping and desire for a RORO (roll on roll off) facility. A large concrete apron was built and the previous built environment was demolished.
- 2003 - NSW Government announced that the stevedoring wharves at East Darling Harbour would be transformed into a new urban precinct. The site was not economical as heavy freight rail could not access the site.
- 2007 – container trade and RORO operations ceased.
- 2013 – Cruise Terminal operations ceased with terminal built at White Bay.

4.2 Water Depths

Water depths in the vicinity of Barangaroo, in metres below Chart Datum (CD), are shown in **Figure 11**. The base mapping in this Figure was derived from the hydrographic chart AUS 202. Chart Datum is zero on the Fort Denison Tide Gauge and is approximately 0.925m below Australian Height Datum (AHD). Zero metres AHD is approximately equal to mean sea level at present.

Seabed elevations near Barangaroo vary between approximately -10m and -12m CD (that is, about -10.9m to -12.9m AHD). These depths are generally consistent along the face of the existing Darling Harbour wharves as this area has been previously dredged and maintained at these depths to suit the former port and cruise ship operations at the site.

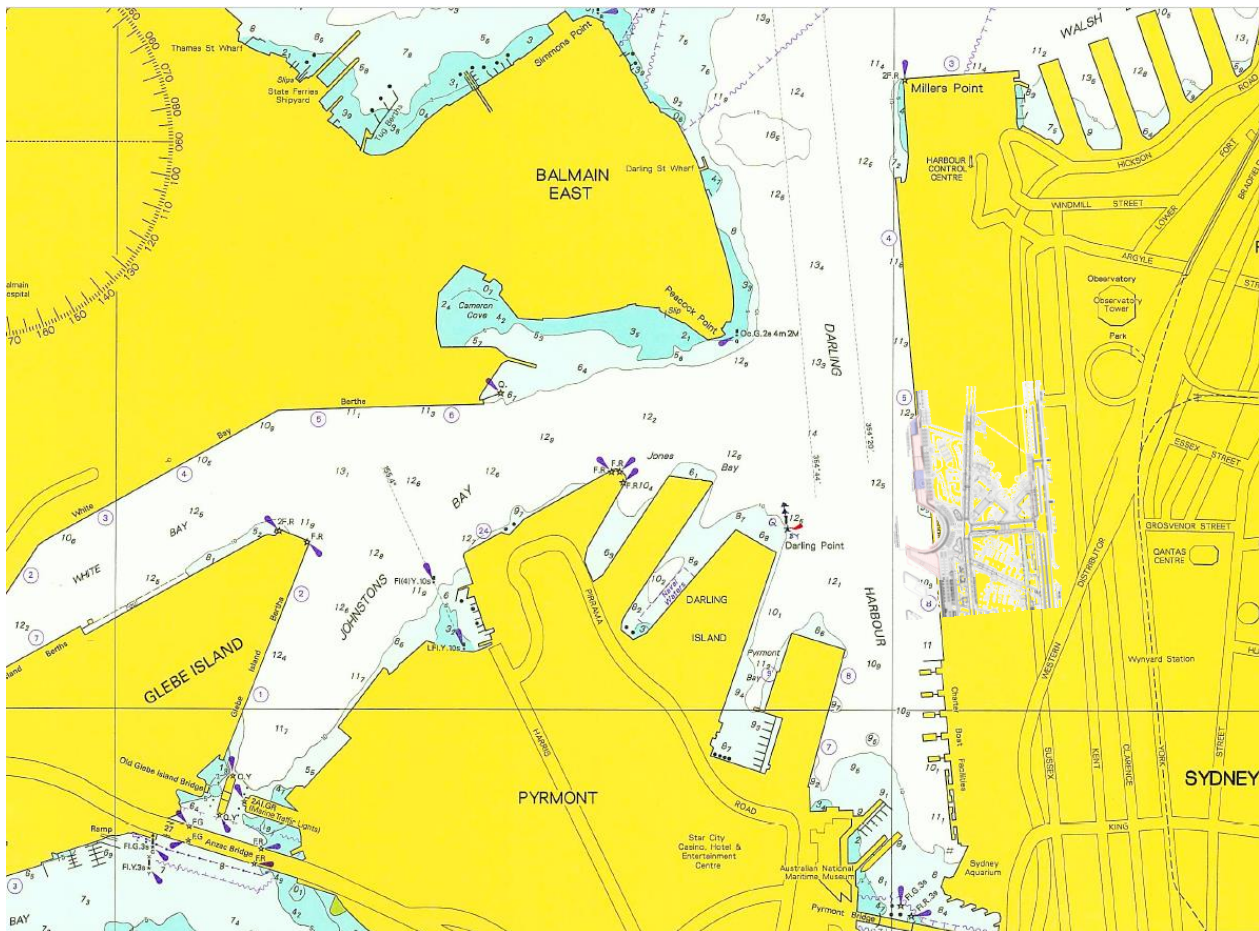


Figure 11 Water depth near the proposed site with current concept design overlaid

4.3 Water Levels

4.3.1 Predicted Tides

Water levels in Sydney Harbour are largely governed by tide. Predicted tidal planes at Camp Cove are presented in in **Table 1**.

Table 1 Tidal Planes for Sydney Harbour (OEH, 2015)

Tidal Planes		Metres relative to Chart Datum
Mean High Water Springs	MHWS	1.56
Mean High Water	MHW	1.43
Mean High Water Neaps	MHWN	1.31
Mean Sea Level	MSL	0.94
Mean Low Water Neaps	MLWN	0.56
Mean Low Water	MLW	0.44
Mean Low Water Springs	MLWS	0.32
Indian Spring Low Water	ISLW	0.07

4.3.2 Actual Water Levels

Elevated water levels vary from predicted tide levels for a combination of reasons including oceanic surges during storms, local wind set up and wave setup. Freshwater flooding does not significantly influence still water levels in Sydney Harbour. Water levels are further increased above the still water level at the shoreline associated with wave runup. The magnitude of wave runup is affected by a range of factors including wave height, wave period, shoreline type and slope.

Present day design elevated water levels for Sydney Harbour are presented in **Table 2**, based on extreme value analysis of data from the Fort Denison tide gauge data collected between June 1914 and December 2009 (DECCW, 2010). The design still water levels inherently incorporate allowance for all components of elevated ocean water levels (including tides, meteorological influences and other water level anomalies), however they exclude wave setup and wave runup influences. These levels only apply at present, and would need to be increased for future planning periods to take account of climate change (in particular projected sea level rise). *Guidelines for design of maritime structures (AS4997:2005)* recommends a sea level rise allowance of 0.2m to 0.4m for structural design life of 50 to 100 years respectively, and notes that these values are updated by IPCC from time to time.

Table 2 Present day design still water levels for Sydney Harbour

Average Recurrence Interval (years)	Still Water Level (m CD)
0.02	1.90
0.05	1.98
0.1	1.93
1	2.17
10	2.28
50	2.34
100	2.37

4.4 Wave Climate

4.4.1 Wind Waves

Wind waves are generated when the wind blows across a body of water. The height and period of these waves depend on the wind speed, the distance over which the wind blows and the water depth. The key wind wave fetches affecting the site are from the west and north-west across Darling Harbour and Johnstons Bay. Design wind velocities for the site were obtained from *Australian Standard Structural Design Action Part 2: Wind Actions (AS/NZS1170.2:2011)*. The data was converted to 1-hour wind speeds using methods outlined in the *Coastal Engineering Manual (USACE, 2008)*. Wind wave hindcast procedures set out in the *Coastal Engineering Manual* were used to predict the incident wind wave climate at the site, which is summarised in **Table 3**.

Table 3 Incident wind wave climate at the proposed pick-up/ drop-off pontoon

Direction	W		N	
Fetch	1.5 km		3.5 km	
Average depth	12m		15m	
Average Return Period	H_s (m)	T (s)	H_s (m)	T (s)
1 year	0.44	1.8	0.42	1.8
50 year	0.60	2.0	0.58	2.0
Notes (1)	Significant wave height H_s is the average of the highest 1/3 of waves in a wave train. $H_{max} \sim 1.5H_s$			

4.4.2 Boat Wash

Boat generated waves are governed by the submerged shape of the boat hull, the boat speed and the water depth. Typically boat waves exhibit a diverging component which emanates at the bow, and a transverse component that follows behind the stern. The boat speed relative to the water depth can affect the form of the waves. Boat waves attenuate with distance from the sailing line.

Based on RHDHV's experience with boat wave measurements in Sydney Harbour and other published data, the estimated design boat wave climate is summarised in **Table 4**. These waves could occur on a daily basis.

Table 4 Incident boat wave climate at the proposed pick-up/ drop-off pontoon, within an 8 knot zone

Vessel Type	H_{max} (m)	T (s)
Power Boat (including water taxi)	0.3	2 to 3
High-Speed Catamaran Ferries and Twin Hull Charter Vessels	0.4	3 to 5
Pilot Boats, Tugs and Barges	0.35	1.5 to 3
Source:	RHDHV database	

The site lies within an 8 knot zone, which limits the height and period of vessel wash. However, Roads and Maritime or NSW Police vessels may exceed the speed limit if in pursuit of another vessel. The incident wave height for these vessels, exceeding 8 knots, would be up to 0.8m with a period of 2 to 3 seconds. Transmitted far field boat waves generated by high speed catamaran ferries travelling at speeds higher than 8 knots could have periods up to 7 seconds in the vicinity of Barangaroo but wave heights would not exceed that given in **Table 4** (NSW Maritime, 2005).

4.5 Currents

Darling Harbour is located on the southern side of Port Jackson (Sydney Harbour). Darling Harbour and its tributaries are relatively short, which limits tidal prism (volume of water in an estuary between mean high tide and mean low tide, or the volume of water leaving an estuary over an ebb tide cycle) and the tidal current at any one location. As such, tidal currents are expected to be small (less than 0.5 knots from Aus 202).

Wind generated currents are generally taken as 2% to 3% of the wind speed, up to a maximum wind speed of about 7m/s after which the shear mechanism becomes oscillatory (wave generation takes over) rather than unidirectional. Hence, maximum wind induced currents would be approximately 0.2m/s.

Propeller wash from vessels depends mainly on the size of the propeller and the installed engine power. Propeller wash can be as high as 10m/s immediately behind the propeller, but this usually diminishes quickly away from the vessel due to entrainment of surrounding water. Propeller induced currents generated by RiverCat and HarbourCat ferries are described in NSW Maritime (2005). Five metres behind the propeller these vessels could generate currents up to 4.6m/s and 3.6m/s respectively, reducing to 1.6m/s and 0.9m/s respectively at a distance of 20m. Propeller wash from SuperCat ferries and charter vessels would be similar to that from RiverCats.

Large cruise ships approaching the White Bay Cruise Terminal would produce larger propeller currents. *Pacific Jewel* is a cruise ship currently operated by P&O Cruises Australia, which regularly berths at the White Bay Cruise Terminal. The ship is fitted with two propellers with a combined engine power of 24,000 kW. At 20% power to the main engines, considered a reasonable upper limit for manoeuvring in the harbour, and at a distance of 30m, the propeller wash would be approximately 5m/s reducing to around 1.5m/s at 100m from the vessel (Verhey, 1985).

5 EXISTING AND PROPOSED NAVIGATION USE

5.1 Legislation

The legislation to be observed when navigating in Sydney Harbour includes:

- NSW Government legislation
 - Marine Safety Act 1998
 - Marine Safety (General) Regulation 2016
 - Ports and Maritime Administration Act 1995
 - Port and Maritime Regulation 2012
 - Maritime Services Act 1935
 - Management of Waters & Waterside Lands Regulation
 - Work Health and Safety Act 2011
 - Work Health and Safety Regulation 2011
- Commonwealth Government legislation
 - Navigation Act 2012
 - Shipping Registration Act 1981
 - Maritime Safety (Domestic Commercial Vessel) National Law Act 2012
 - Marine Safety (Domestic Commercial Vessel) National Law Regulation 2013
 - Maritime Transport & Offshore Facilities Security Act 2003
 - Maritime Transport & Offshore Facilities Security Regulations

The Navigation Act 2012 provides the legislative power for Australia to implement the following treaties developed by the International Maritime Organization, the International Labour Organization and United Nations Conferences:

- International Convention for Standards of Training, Certification and Watchkeeping for Seafarers (STCW)
- Maritime Labour Convention (MLC)
- International Convention on Load Lines (Load Lines)
- International Convention for the Safety of Life at Sea (SOLAS)
- Convention on the International Regulations for Preventing Collisions at Sea 1972 (COLREGS)
- International Convention for Safe Containers (CSC)
- International Convention on Tonnage Measurement of Ships
- International Convention for the Prevention of Pollution from Ships (MARPOL)
- Convention of Limitation of Liability for Maritime Claims
- International Convention on Salvage
- United Nations Convention on the Law of the Sea (UNCLOS) - in certain parts

5.2 Navigation Rules

The Convention on the International Regulations for Preventing Collisions at Sea 1972 (COLREGS) applies to all vessels upon the high seas and in all waters connected therewith navigable by seagoing

vessels. It is an international document that defines the navigation rules to be followed to prevent collisions between two or more vessels.

The NSW Marine Safety (General) Regulation 2016 adopts the Convention on International Regulations for Preventing Collisions at Sea 1972 (COLREGS) and includes minor modifications and additional special rules applicable to NSW waterways. The RMS is the NSW Government authority with responsibility for marine safety and regulation of commercial and recreational boating, including enforcement of the Regulations.

The RMS produced the NSW Boating Handbook (RMS, 2016), which is an interpretation of the law and legislation provided in **Section 5.1**. It intends to use plain English and specific boating terminology. It notes that, “while care was taken with the production of this handbook by Roads and Maritime Services, its purpose is to act as a general guide and to provide information in the form of a broad overview only.” The Handbook provides boating information for operating on NSW waters including:

- basic boat handling;
- water traffic rules;
- navigation marks and signs;
- navigation at night; and,
- other boating activities.

The basic navigation rules dictate:

- vessels must always be navigated on the starboard (right) side of a river or channel;
- when two power driven vessels meet head on, each must alter course to starboard (to the right) and pass at a safe distance;
- in a crossing situation, vessel must give way to the right and in doing so, alter course to starboard;
- a skipper may overtake another vessel on either side but only when it is safe and the overtaking boat must stay well clear.

In addition to the authority granted to RMS, the port of Sydney Harbour falls within the jurisdiction of the Port Authority of NSW (PANSW). Directions given by the Sydney Port’s Harbour Master for navigation in Sydney Harbour are authorised under Part 7 of the Marine Safety Act 1998. As such, the Master of any vessel within the Port of Sydney Harbour shall comply with direction given by the Harbour Master.

The Sydney Harbour Superyacht Guidelines (RMS and PANSW, 2015) provides an overview of rules and regulations applicable to superyachts with an overall length in excess of 30m. These include additional speed restrictions, compulsory participation in the Sydney Ports Vessel Traffic Service (VTS) and compulsory pilotage service for commercial and charter vessels. The VTS is responsible for monitoring the movement of participating vessels to improve safety and efficiency and protects the port’s environment and infrastructure from possible adverse effects.

The requirement for tug assistance in Sydney Harbour is outlined in Section 2.101.6 of the Harbour Masters Directions. The document states all vessels greater than 100m must have a minimum of one tug in attendance inward, and all vessels greater than 130m must have a minimum of one tug for all movements.

5.3 Existing Navigation Information

The RMS Boating Handbook (2016) provides a succinct summary of Sydney Harbour and notes “Sydney Harbour is a unique waterway that is used extensively by a diverse range of recreational and commercial boats including large ships, ferries, charter boats, cruisers, yachts, runabouts, sailing skiffs, dinghies, sailboards, rowing shells, kayaks and dragon boats. The Harbour is an extremely busy waterway that requires boaters to be aware of their responsibilities and to take care when boating in busy navigational channels, and make allowances for commercial activity. There is a need to consider paddlers, rowers and sailors as well as accommodating the needs of commercial operators, and those wishing to cruise, ski and fish on the Harbour” (RMS, 2016).

The Boating Safety Plan for Sydney Harbour and its Tributaries (Transport for NSW, 2014) notes the Inner Harbour extends from the start of Port Jackson at Yurulbin Point to a line between Kirribilli Point and the Opera House. This area incorporates Sydney Cove, Darling Harbour and White, Blackwattle, Johnstons and Rozelle Bays, which are the key areas to be assessed as part of the Navigation Impact Assessment herein. It is noted that the Inner Harbour is a higher traffic area. A number of complaints relating to boating activities on Sydney Harbour were received by RMS in the five years to 30 June 2012. Darling Harbour received a relatively high number of complaints, which were primarily related to the following issues:

- excessive noise from vessels;
- vessels creating excessive wash;
- vessels travelling at high speed.

A total of 1802 infringements were issued by RMS in Sydney Harbour in the five years to 30 June 2012 with over 20% of the infringements occurring in Darling Harbour. The complaints and infringements indicate Darling Harbour is a high traffic area.

5.3.1 Darling Harbour

Access to the Inner Harbour including Darling Harbour and Barangaroo is limited by the clearance under the Sydney Harbour Bridge, which is a single span arch bridge with a clear headway at the centre of the bridge of 53.4 metres at Indian Spring Low Water. There are two painting gantries which reduce the headway by 3.3 metres.

Vessels heading into Darling Harbour, from Sydney Harbour, enter an 8 knot zone, which is in line with the northern end of Millers Point and Balmain East Ferry Wharf. Generally speaking, Darling Harbour is used as a thoroughfare to access:

1. Cockle Bay and King Street Wharf; or,
2. Johnstons Bay, White Bay, Glebe Island, Rozelle Bay and Blackwattle Bay.

All of these bays, islands and wharves lie within an 8 knot or 4 knot zone.

Consistent with the starboard basic navigation rule, vessels travelling upstream to access the aforementioned bays and boating facilities navigate along the western side of the waterway while vessels travelling downstream and heading towards Sydney Harbour navigate on the eastern side of the waterway. Vessels are required to cross the general navigation routes when they enter or leave the various bays and boating facilities.

5.3.2 King Street Wharf

King Street Wharf at Darling Harbour is located south of Barangaroo and is a major hub for commercial vessel activity for Sydney Ferries and a number of private ferries, water taxis, commercial adventure vessel operations and other commercial vessels. The King Street Wharf includes four leased wharves, four “common user” wharves and a ferry wharf. The leased wharves are used by charter vessels such as the *Captain Cook Explorer*, the Blue Line Vessels and *Sydney 2000* (which, at 63m in length, is the largest known vessel to access King Street Wharf). The “common user” berths are used by water taxis, and access by other vessels (typically up to 40m in length, or 44m for Wharf 9) can be arranged through RMS’s wharf booking system, which allows berthing for up to 15 minutes. The ferry wharf is used by Sydney Ferries for their Rydalmere/Parramatta services that operate 35m long RiverCat vessels.

The King Street Wharf berths extend approximately 68m beyond the face of the wharf and vessels exiting these berths are required to sound their horn three times before moving astern into the channel, as per RMS regulations. Vessels passing the King Street Wharf berths typically travel some distance to the west of the berths to provide open water between themselves and any vessels which might depart the wharves. Vessels travelling north past King Street Wharf typically travel within a tapering navigation channel which widens considerably as vessels travel further north.

King Street Wharf and Cockle Bay lie within a 4 knot zone.

5.3.3 Cockle Bay

Cockle Bay is located south of the Kings Street Wharf. Vessels accessing the area include the Matilda Cruises fleet of charter vessels berthed near the Aquarium, small private motor cruises berthed at the Darling Harbour Marina (day use only), Sydney Ferries First Fleet ferries using the Darling Harbour (Aquarium) and Pyrmont Bay (Casino/Maritime Museum) ferry wharves and other smaller craft such as water taxis and jet boats accessing Darling Harbour south of the Pyrmont Bridge.

Pyrmont Bridge restricts access to Darling Harbour Marina. The horizontal clearance of the swing span is 21.4 metres on the Pyrmont side and the clear headway under the side spans is 7.4 metres above low water.

5.3.4 White Bay and Glebe Island

The White Bay and Glebe Island precinct is an essential port facility close to the centre of Sydney. In the past, the precinct served as a container terminal and RORO terminal. The precinct is currently an important facility for dry bulk imports, the cruise industry and bunkering (refuelling). Individual berths at the facility are outlined in **Table 5**.

Table 5 Berths at Glebe Island and White Bay.

Berth	Depth of Berth (m LAT)	Size of Berth
Glebe Island 1	11.9	232 x 35
Glebe Island 2	11.8	234 x 35
Glebe Island 7	10.7	229 x 35
Glebe Island 8	8.1	115 x 35
White Bay 2	10.6	141 x 35

White Bay 3	10.7	260 x 35
White Bay 4	11.1	254 x 35
White Bay 5 (Cruise Terminal)	11.0	333 x 35

The dry bulk facility is able to handle commodities such as bulk cement, gypsum, sugar, salt, oils, lubricants and tallow. In addition, the terminal comprises of storage facilities and batching plants to cater for dry bulk imports. Clients include Sugar Australia, Cement Australia and Gypsum Resources Australia.

The White Bay Cruise Terminal was completed in 2013. Approximately 230,000 passengers pass through the White Bay Cruise Terminal per year. The number of passengers is forecasted to increase to 530,000 per annum by 2045 (PANSW, 2016).

Baileys Marine Fuels operate a bunkering facility at the eastern end of the quay at White Bay. A large range of vessels from small recreational craft to ferries and charter vessels are bunkered at the site. Vessels are expected, where possible, to approach the facility from the east and berth starboard side alongside. On leaving, vessels are to cross to the southern side of the channel before proceeding east. This navigation procedure conforms to the navigation rules in **Section 5.2**.

In addition to the White Bay and Glebe Island facilities, the NSW Police Marine Area Command is located in Camerons Cove, immediately east (downstream) of White Bay. A ferry terminal is also located at the Glebe Island Exhibition Centre. However, this is only to be used when the Exhibition Centre is in use.

Johnstons Bay is an 8 knot zone. The entrance to Johnstons Bay and its tributaries, including White Bay, Glebe Island, Rozelle Bay and Blackwattle Bay, is to the north of the area, where the boardwalk and pick-up/ drop-off pontoon is proposed. All but the largest vessels would navigate this stretch of the harbour without regard to the proposed boardwalk and pick-up/ drop-off pontoon. For the largest cruise liners, cargo ships and bulk carriers, navigation into Johnstons Bay and White Bay requires some level of manoeuvring in the Darling Harbour and Johnstons Bay turning basins. Based on "Sydney Port Passage Planning 2012"¹, these designated turning basins are 360m diameter and 320m diameter respectively (refer **Figure 12**).

Depending on vessel size and operating procedures, large vessels make way into Darling Harbour with the bow near the Barangaroo RORO ramp (Popes Landing), swing the stern to port (into Johnstons Bay) either under their own power or with tug boat assistance and come astern towards White Bay. Alternatively, they could make way into Darling Harbour as far south as the turning basin, rotate (either under their own power or with tug boats) and make way bow first into White Bay.

5.3.5 Blackwattle Bay and Rozelle Bay

Blackwattle Bay and Rozelle bay lie within a 4 knot zone. Access to the bays is limited by Glebe Island Bridge and Anzac Bridge. The opening width through the swing spans of Glebe Island Bridge is 18.8 metres on the eastern (Pyrmont) side. Clear headway under each swing-span varies from 4.9 metres at the inner end to 6.8 metres at the outer end. Anzac Bridge is a single span, fixed arch bridge with a maximum clearance of 28.5 metres above high water.

The bays are characterised by berthing facilities for commercial and other large vessels. Facilities include:

¹ Online at http://www.sydneyports.com.au/port_operations/navigation_and_pilotage/passage_planning.

- the Sydney Fish Markets;
- a superyacht marina;
- Rozelle Bay dry stack facility for smaller private craft;
- NSW Maritime Division of RMS;
- working maritime precinct, which is extensively utilised by construction barges and smaller craft;
- rowing clubs and dragon boat clubs; and,
- Blackwattle Bay is a designated anchoring area for visiting vessels.

5.4 Future Navigation

Future and proposed navigation including the subject pick-up/ drop-off pontoon would contribute to the boating traffic. Conversely, the pontoon may reduce demand for nearby public wharves serviced by taxis and reserved by commercial craft under RMS Wharf Booking System.

The Barangaroo Ferry Hub is under construction . It would initially comprise two wharfs with a third wharf to be constructed when the demand for ferry services necessitates it. The ferry hub would increase daily traffic navigating through Darling Harbour.

In addition, there are plans for the Bays Precinct, which includes, Glebe Island, White Bay, White Bay Power Station, Rozelle Bay, Rozelle Rail Yards and Blackwattle Bay, including Sydney Fish Market (NSW Government, 2012). The plans incorporate a range of maritime facilities including commercial vessel berthing facilities and dry storage facilities. The plan focuses on the transformation and rejuvenation of 5.5 kilometres of Sydney Harbour foreshore to create places for cultural, maritime, recreational, retail, residential, research and development, education, and commercial uses. As such, it is not envisaged that navigation demand would significantly increase.

The size of the largest cruise ships which currently access the White Bay Cruise Terminal is expected to increase. The size of the vessels that can enter White Bay is limited by the clearance under the Sydney Harbour Bridge. However, the PANSW advised vessels up to 300m long could be expected to access White Bay and Glebe Island in the future.

5.5 Navigation Plan

The RMS Boating Map is provided in **Figure 12**, which is overlaid by the Sydney Harbour Pilot Sheet #11 provided by the PANSW. The general direction of navigation in Darling Harbour is marked on the map by the red and green arrows.



6 CONSULTATION WITH RELEVANT AUTHORITIES

6.1 Roads and Maritime Services (RMS)

RMS was consulted prior to engagement for the project herein. RMS personnel (Geoff Monkhouse and Dan Deummer) advised they would review the assessment and make recommendations regarding its acceptability. In addition, RMS indicated that RHDHV's assessment in this matter would need to pay due attention to visibility and the potential for obstruction to views, and to the high wash environment at the site.

Additional consultation was undertaken and the following points were raised:

- The Barangaroo Transport Management Plan (TMP), which is being developed for the Barangaroo Ferry Hub, is currently a draft document and it is not available to the public. The Draft TMP has been reviewed by PANSW. It would be finalised one month prior to commencement of the Barangaroo Ferry Hub.
- The 4 knot zone near King Street wharf will be extended to a line between the RORO ramp and Darling Island.
- The TMP will designate a waiting area on the right hand side of the approach channel to King Street Wharf. The waiting area would service vessels queuing to access the King Street wharves or Barangaroo Ferry Hub. The waiting area would not apply to queueing for the proposed pick-up/drop-off pontoon.
- The proposed pick-up/drop-off pontoon would be specified as a 15 minute maximum berthing time, which is the berthing time allowed for pick-up/ drop-off at most other wharves in Darling Harbour in accordance with the RMS Wharf Access Policy.
- Navigation markers required near the proposed development would be relatively simple and would comprise one port marker at the western end of the infrastructure and a special marker would be provided noting shallow water in Watermans Cove. (Note: the western extent of infrastructure would be the Public Pier).

6.2 Port Authority of NSW (PANSW)

Sydney Harbour falls within the jurisdiction of the PANSW. They manage the navigation, security and operational safety needs of commercial shipping on Sydney Harbour, particularly shipping in and out of White Bay and Glebe Island.

PANSW established the recommendations in the SEARs, outlined in **Section 1.2**, which included the requirement for a formal risk assessment. The risk assessment was completed by PANSW pilots. A brief report summarising the risk assessment was prepared, which is appended in **Attachment A**. The report made five (5) recommendations to assist with the management of the increased risk associated with the installation of the proposed public pier, boardwalk and pontoon. The recommendations are additions to the controls already in place under the Port Safety Management Systems and they comprised:

1. No vessels are to use the pontoon for berthing or transferring passengers whilst a large vessel (cruise ships, bulk carriers and other commercial vessels) is manoeuvring in the swing basin.
2. The pontoon and boardwalk to be adequately lit on the water side of the structure. Lighting is to include white strip lighting. Navigation aids are not required.

3. During the construction phase, no associated barges or equipment should be located outside of the proposed footprint whilst a large vessel is transiting the area. Construction of the project will require additional consultation between the Contractor and PANSW once the construction methodology is known as it is likely that barges and floating plant would extend beyond the proposed footprint.
4. Make pilots aware of reduced margin area so additional manoeuvring room can be allowed. This is to be managed by PANSW and no action is required from Lend Lease.
5. Make pilots and escort vessel personnel aware of the reduced manoeuvring room to ensure small vessels keep clear of vessel and tug wash. This is to be managed by PANSW and no action is required from Lend Lease.

The report concluded that if the additional controls identified above are implemented, the proposed new infrastructure should have minimal impact on operations currently undertaken by the PANSW.

7 NAVIGATION IMPACT ASSESSMENT

7.1 General

The proposed development includes the following elements which have the potential to impact on navigation within Darling Harbour:

- a boardwalk approximately 14m wide;
- a floating pontoon to cater for water taxis, which would include fender piles approximately 1m seaward of the face of the pontoon; and
- a public pier with provision for a potential future building.

The potential impact on navigation and any mitigation measures recommended for each of the above structures is discussed in the following sections. It is noted that boating traffic would not be permitted in Watermans Cove and that the Public Pier would not cater for berthing or pick-up/ drop-off activities.

Consideration has also been given to the methods expected to be employed in the construction of each of the above structures.

7.2 Boardwalk and Pontoon

7.2.1 Navigation of Vessels

As noted in **Section 6.2**, PANSW concluded that the proposed new boardwalk and pontoon should have minimal impact on operations currently undertaken by the PANSW, if additional controls outlined in **Section 6.2** are implemented. The PANSW study primarily considered navigation of cruise ships, bulk carriers and other commercial vessels accessing White Bay and Glebe Island. A brief discussion of site access and navigation impact of vessels accessing King Street Wharf is provided below.

The boardwalk and pontoon would project 14m out into the waters of Darling Harbour, relative to the existing foreshore alignment. In accordance with the navigation rules as they apply in Darling Harbour, vessels berthing at the pick-up/ drop-off pontoon would approach the facility from the south and berth starboard side alongside the pontoon. This would require vessels entering the site from Sydney Harbour to traverse the western side of Darling Harbour and travel past the pontoon before turning around and crossing to the eastern side of the channel to approach the pontoon. On leaving the pontoon, vessels would head in a northerly direction (refer **Sections 5.2** and **5.3.1**).

No standard channel widths exist in Sydney Harbour. The narrowest channel width near the site and within the Darling Harbour 8 knot zone is currently between the RORO ramp (Popes Landing) and Darling Island Wharf, which is approximately 300m. The boardwalk would not reduce the channel width as it does not extend seaward of the RORO ramp. When a vessel (water taxi) is berthed at the pontoon, the channel width to Darling Island Wharf (the nearest point on the opposite shore) would be greater than 330m. The width to the nearest point on the opposite shore increases due to the shape of Darling Harbour and location of the pontoon relative to the RORO ramp. The channel width comparison demonstrates that the pontoon and a vessel at the pontoon (water taxi) would not decrease the existing minimum channel width.

PANSW notes that the boardwalk and pontoon do not impinge upon the current turning circle and are approximately 5m outside of the 195m turning circle for a 10m draft ship. When a vessel is at the pontoon, it is possible the vessel could impinge on the turning circle. As such, PANSW states that no vessels are to

use the pontoon for berthing or transferring passengers whilst a large vessel (cruise ships, bulk carriers and other commercial vessels) is manoeuvring in the swing basin. It is suggested that the berthing time at the pontoon is specified as 15 minutes maximum in accordance with the RMS Wharf Access Policy.

Provided the PANSW recommendations are implemented, the boardwalk and pontoon would have minimal impact on navigation in Darling Harbour and the risk of any impact is deemed to be acceptable by PANSW.

7.2.2 Currents and Wave Action

The pontoon and fender piles would be designed to ensure safe berthing under the expected currents and wave conditions at the site. Waves are not expected to be an issue unless vessels are regularly exceeding the 8 knot speed limit within Darling Harbour. Currents may be high when a cruise ship, bulk carrier or other commercial vessel is navigating near the site. However, PANSW have specified that no vessels are to use the pontoon for berthing or transferring passengers whilst a large vessel is manoeuvring in the swing basin. As such, the impact of current on berthed vessels would not be an issue. The pontoon and its restraint system would need to be designed for the high currents associated with the manoeuvring of large vessels.

7.3 Public Pier

The Public Pier is situated further south than the Boardwalk and Pontoon, more remote from the operation of cruise ships, bulk carriers and other commercial vessels accessing White Bay and Glebe Island. Accordingly the Public Pier is not of significant concern for PANSW.

As noted in **Section 2.3.1**, the Public Pier would extend into Darling Harbour by a distance of approximately 50m measured from the face of the existing vertical caisson wall. As currently planned, this distance is less than the projection of the proposed ferry wharves in the Barangaroo Ferry Hub, though it is recognised that Concept Plan MOD 8 provides the potential for a structure to extend to a point equal to the ferry wharves. There are no berthing facilities associated with the Public Pier. The proposed level of the boardwalk around the western end of the Pier is relatively low at 1.8m AHD and any potential future building on the Pier would be set well back from the outer edge of the Pier thus not impacting on sight lines for navigation.

In the Barangaroo Ferry Hub Environmental Impact Statement (EIS), navigation and safety issues associated with a potential ferry hub at Barangaroo were considered. These considerations were in the full knowledge of the proposed Public Pier. Significantly, the EIS did not refer to any navigation or safety issues as a consequence of the proposed Pier. This is considered reasonable on the basis of the orientation, clearance and limited maximum projection of the Pier, and absence of any proposed berthing facilities at the Pier.

In the Barangaroo Ferry Hub EIS, it was recommended that preparation and implementation of a Vessel Traffic Management Plan take place prior to commencement of operations at the Barangaroo Ferry Hub, supported by a risk assessment. This Plan and risk assessment was in the context of possible congestion of vessels and adverse impact on waiting times. The Public Pier was not referred to in this discussion and would not be expected to impact on congestion as it is located outside the navigation channel and does not introduce any additional vessels to the area.

The clearance provided between the northern face of the northernmost ferry wharf and the Public Pier is greater than the width of the berth boxes provided within the Ferry Hub. Accordingly, the Public Pier

would not be expected to impact on navigation and safety. However, as an added precaution, it is recommended that fender piles be installed adjacent to the southern side of the Public Pier to delineate a berth box for the northernmost ferry berth. This would guard against any accidental vessel collision with the southern side of the Public Pier which includes a public boardwalk along its edge.

In all, three free standing fender piles are recommended along the southern side of the Pier located approximately 5m off the Pier and spaced at approximately 20m intervals.

7.4 Construction Issues

The construction methodology for the boardwalk, pontoon and public pier, as described in **Sections 2.2.2** and **2.3.2** involves use of a barge approximately 54m long and 24m wide, which may give rise to some temporary navigational impacts.

Prior to the undertaking of any works, the Contractor should develop a detailed work method plan for all water-based construction activities that would form the basis of subsequent detailed consultation between Lend Lease, PANSW, RMS, Transport for NSW, and other relevant stakeholders. No works would commence without the approval of PANSW and RMS, where required. In order to manage the potential for construction impacts, as a mitigation measure, a Construction Vessel Traffic Management Plan should be prepared in consultation with the relevant authorities.

It is considered that satisfactory construction arrangements could be achieved, as is the common situation during marine construction in busy harbours, but is expected to involve temporary relocation of barges in the northern area of the site during a shipping movement, at the direction of PANSW.

8 CONCLUSIONS

It is considered that the proposed boardwalk, pick-up/drop-off pontoon and Public Pier would have no significant impact on navigation, provided the existing navigation controls are observed and recommendations of PANSW and RHDHV are implemented.

PANSW recommendations include:

1. No vessels are to use the pontoon for berthing or transferring passengers whilst a large vessel is manoeuvring in the swing basin.
2. The pontoon and boardwalk are to be adequately lit on the water side of the structure.
3. During the construction phase, no associated barges or equipment should be located outside of the proposed footprint whilst a large vessel is transiting the area.
4. Pilots are to be made aware of the reduced margin area so additional manoeuvring room can be allowed.
5. Pilots and escort vessels are to be made aware of the reduced manoeuvring room to ensure small vessels keep clear of vessel and tug wash.

Further recommendations made by RHDHV include:

- maximum berthing time at the pontoon to be signposted and specified as 15 minutes;
- all vessels at the pontoon should maintain a listening watch to VHF Ch 13 and this should be signposted on the pontoon. This is the Sydney Harbour working channel and it is currently a requirement for example for superyachts over 30m to maintain a listening watch to this channel;
- when required, all vessels shall stand off the pontoon, outside the designated PANSW turning circle, or as specified by the Harbour Master;
- fender piles be installed along the southern side of the Public Pier to delineate the berth box for the northernmost ferry berth in the Barangaroo Ferry Hub and guard against accidental collision with the Pier;
- a Construction Vessel Traffic Management Plan be prepared in consultation with relevant authorities including PANSW and RMS.

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Open



Attachment A – Barangaroo Jetty and Pontoon Development Report by Port Authority of NSW

2016

Barangaroo Jetty and Pontoon Development



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1 Executive Summary

In October 2016 Royal HaskoningDHV acting for Lend Lease / Crown Resorts, requested confirmation from the Port Authority of New South Wales, that a proposed Jetty / Pontoon and boardwalk would not impact upon the navigation of cruise ships and bulk carriers approaching and departing Glebe Island and White Bay, and any typical requirements which may be imposed on vessels using the facility.

Two active pilots from the ports of Sydney were tasked with preparing a report for Royal HaskoningDHV. The current group of pilots were consulted to determine any concerns they may have with the structure and a risk assessment was also conducted to determine acceptable risk.

During the preparation of the report, the Cruise vessel Noordam, which is the largest vessel currently transiting the area, visited the Port of Sydney and berthed at the White Bay Cruise Terminal. The opportunity was taken to simulate the structure with the use of buoys for the arrival of the vessel.

This report makes 5 recommendations in addition to those controls already in place under Port Safety Management Systems to assist with the management of the increased risk associated with the installation of the proposed jetty and pontoon:

1. No vessels are to use the pontoon for berthing or transferring passengers whilst a large vessel is manoeuvring in the swing basin.
2. The pontoon and boardwalk to be adequately lit on the water side of the structure.
3. During the construction phase, no associated barges or equipment should be located outside of the proposed footprint whilst a large vessel is transiting the area.
4. Make pilots aware of reduced margin area so additional manoeuvring room can be allowed.
5. Make pilots and escort vessel personnel aware of the reduced manoeuvring room to ensure small vessels keep clear of vessel and tug wash.

If the additional controls identified in this report are implemented, the proposed new infrastructure should have minimal impact on operations currently undertaken by the Port Authority.

2 Background

At the request of Royal HaskoningDHV acting for crown Resorts, Port Authority of NSW Pilots prepared this Navigation Impact Assessment for a proposed drop-off/pick-up pontoon, associated jetty and public pier at Barangaroo.

2.1 Scope

Prepare a Navigation Impact Assessment for a proposed drop-off/pick-up pontoon at the Crown Resort site fronting Darling Harbour. The assessment is to consider the impact of the proposal on safety, navigation and sight lines for vessels operating in and around Darling Harbour.

It is intended that the pontoon would serve water taxis and superyachts up to 55 m in length. The Navigation Impact Assessment is to be prepared with consideration of existing boating activities and other planned works in the vicinity including the Barangaroo Ferry Hub and Public Pier (incorporating potential community building) immediately south of the site.

Of particular interest is the navigation of cruise ships and bulk carriers approaching and departing Glebe Island and White Bay.

2.2 Location

The proposed structure is located in the middle of the Barrangaroo Site along Darling Harbour Foreshore. It would extend a maximum 17.0 metres into Darling Harbour in the Northern section and approximately 45.0 metres in the Southern hooked section.

The Northern starting point is to be 89 metres north of the northern edge of the currently disused ferry ramp extending to 163 metres south of the southern edge of the currently disused ferry ramp.

3 Project Methodology and Tasks

Given the specific requirements of Royal HaskoningDHV's project brief, PANSW proposed and used the following project methodology and associated tasks during the conduct of this review.

3.1 Inception Meeting and Request for Information/Data

The Inception meeting enabled confirmation of the project objectives and Royal HaskoningDHV's expectations, and agreement on timelines and output deliverables. During this meeting, information and data available was noted and supplied where possible. Other information was requested by PANSW to be made available at a later stage.

3.2 Research and Literature Review

PANSW undertook a period of research and review of all available literature including pilotage procedures, pilotage passage plans, port operating procedures, Harbour Masters instructions and Directions, and review of previous recorded tracks of vessels moving within the area of concern.

3.3 Witness Vessel Manoeuvres and Recordings

An additional pilot boarded the passenger vessel Noordam on an arrival into White Bay cruise terminal to monitor the proximity of the proposed pontoon and boardwalk which was indicated by buoys placed by PANSW prior to the arrival of the vessel.

Previous recordings taken on pilots Portable Pilotage Units (PPU's) manoeuvres of vessels arriving and departing were also examined.

3.4 Consultation with Majority of Pilots

Additional feedback was requested from the pilot group as to concerns that may have been held with respect to the project.

3.5 Risk Assessment

The risk assessment was completed in good faith by operational pilots who, while experts in their field, are not risk engineers. When interpreting the results of the risk assessment this limitation must be taken into account.

3.6 Consolidation

PANSW has consolidated its findings, the literature review, input from consultations, and the pilotage observation trip into the report.

3.7 Limitations of this Review

This review has been undertaken based on current ship sizes and types transiting the area of Darling Harbour. There will undoubtedly be scenarios and situations that occur from time to time that have not been considered, and whilst some general conclusions can be drawn based on the observations and experience of the pilot group, this assessment cannot be considered to be an all-inclusive assessment of all aspects of vessel operations and the associated levels of safety.

Likewise the review has been conducted based on the understanding that there will be no craft using or attached to the pontoon or boardwalk. However the review does consider the hazards associated with small craft whilst a large ship is manoeuvring in the area.

4 Review of Relevant Literature

4.1 Documentation Gathered and Reviewed

In conducting this analysis, the following specific documentation was reviewed by PANSW:

1. Electronic Mail from Royal HaskoningDHV - Engineer Coastal and Maritime, Rick Plain outlining scope for assessment.
2. Plans provide by Royal HaskoningDHV showing location and dimensions of the planned project.
 - BAR418-SIN-SB70 1B
 - BAR418-SIN-SB61 RMS
3. Hydrographic chart AUS 202 Port Jackson Central Sheet.
4. Port Authority of NSW Hydrographic Survey of Darling Harbour SDH 009-A
5. Pilots passage planning chartlet showing ship turning area (taken from AUS 202)
6. Port Jackson Passage Plan (Pilots form PF04) from Pilot Safety Management System.
7. Section 10.5 subsection 5.7.7 Port authority NSW Pilots PSMS (Pilots Safety Management System)
8. Extract from PANSW Harbour Masters Directions, Table E, section 2.101.6, page 35
9. Review of Pilot PPU's (Portable Pilot Unit's) tracks of previous vessels transits
10. PANSW Risk Assessment of Navigation Impact Study of Crown Resort's proposed Drop-off/Pick-up Pontoon Oct 2016.

4.2 Key Observations from Literature Review

4.2.1 Plan BAR418-SIN-SB701B

The Northern Boardwalk extends 15 metres out into Darling Harbour from the existing Shoreline, and approximately 100m North of the existing Ro-Ro Ramp.

The Sickie shaped structure south of the Ro-Ro ramp, named the public pier extends approximately 45m out into Darling Harbour.

4.2.2 AUS202

There are no depth concerns imposed by the structure for current trading vessels.

Leads exist on Goat Island which provide an excellent transit for pilots confirming the ships bridge position, 100m from the existing wharf face at Barangaroo.

Ships departing and arriving White Bay head out, currently use various structures above Hickson Rd as leads. The proposed Jetty structure will not interfere with these leads however ongoing building works on Barrangaroo may block these sighting leads. The jetty structure may then be required to provide a lead.

4.2.3 Pilots passage planning chartlet showing ship turning area (taken from AUS 202)

The structure does not impinge upon the current turning circle and is approximately 5m outside of the 195m @ 10metre draft turning circle. (see Diagram 3 in the Appendix)

4.2.3 PANSW Harbour Masters Directions

Section 2.101.6 of the Harbour Masters Directions in table E and A requires all vessels greater than 100m to have a minimum of one tug in attendance inward, and all vessels greater than 130m must have a minimum of one tug for all movements.

4.2.4 Recorded tracks from various pilots PPU's

Arriving cruise vessels that berth Port side too at White Bay are swung bow to Port in the Darling Harbour Swing Basin.

Cruise vessels departing White Bay Starboard Side too are also backed up to Darling Harbour and swung bow to Starboard.

Having reviewed approximately 30 passages both inward and outward the nearest point of approach to the proposed jetty and pontoon structure during an arrival was 25m, and for a departure 85m. These manoeuvres therefore are considered the most impacted upon by the proposed jetty/pontoon. (See Diagrams 4 and 5 in the Appendix)

4.2.5 Email Communication with Royal Haskoning.

Initial and follow-up request for information from Royal HaskoningDHV provided the following information.

- The public pier and boardwalk would be piled structures and the floating pontoon would be restrained by piles. All piles are expected to be driven steel tubular piles. The building on top of the public pier will be piled independently of the pier, if it goes ahead. Lend Lease were completing a structural assessment of the RORO ramp (results were not available at the time of this report), to determine if the foundations are adequate. We haven't received an update on the status of the assessment and the RORO ramp may require additional piles.
- It is intended to raise the RORO ramp by 600 to 800 mm. However, the footprint will not change.
- Construction is likely to commence late 2017 at the earliest.
- It is only the pontoon that would be used for berthing. Lend Lease' intention is for the pontoon to be used for taxi pick-up/drop-off only while Crown Resorts intention is to also cater for super yachts up to 55 m. It is expected that such activities would be suspended during shipping activities.
- As much of the work as possible will be undertaken from land. However, piling and installation of headstocks for the public pier, boardwalk and pontoon will be undertaken from the water utilising equipment mounted on a barge. Based on advice from Lend Lease, the size of the barge would be 54 m long and 24 m wide. The orientation of the barge and estimated duration of the water based component of work, involving a barge, would be as follows:
 - For boardwalk and pontoon: orientated primarily north-south, parallel to foreshore (approximately 75% of the time). Duration of work would be approximately 4 months.
 - For Waterman's Cove: orientated east-west and duration of work would be approximately 4 months.
 - For public pier: orientated north-south and duration of work would be approximately 4 months.

5 Observation aboard MV Noordam

The proposed Jetty and pontoon structure was simulated with the use of buoys placed on the extremity of the proposed jetty location. (See Diagram 6 in the appendix) The Noordam was then brought into the port to berth port side too at White Bay Cruise Terminal. Visual observations were then made from the Noordam and a Port Authority vessel to observe the effects. The Noordam is a 285.4m LOA Cruise ship with a 32m beam, and is currently the largest passenger vessel transiting the Darling Harbour Area.

According to the pilot's portable pilotage unit, the ship came no closer than 84m from the buoys. (See diagram 7 in the appendix)

It was observed that the buoys were heavily moved around by the ships bow thrust wash and highlighted a concern that no vessels should be moored at or use the jetty whilst a ship manoeuvred in the area. (See Diagram 8 in the appendix)

6 Perceived Concerns and Proposed Mitigating Controls

1. The proximity of small craft to large manoeuvring vessels with the inherent risk of damage to these small vessels due to the ships and tugs wash. This may also apply to the pontoon structure.
 - PANSW currently provides an escort vessel for all piloted ships trading within Port Jackson. This escort can be utilised to clear small traffic from the area.
 - During observation of manoeuvring of the passenger vessel Noordam from a small Port Authority vessel, significant wash from the vessels bow thruster was noted in the area of the new pontoon area. This had a marked effect on the vessel and effectively pushed the port Authority vessel toward the proposed pontoon. (See Diagram 8 in the appendix)
2. A vessel departing White bay which is berthed head in must swing on departure. The vessel is backed into Darling Harbour, and then turned to seaward. When the ships engine is fired ahead to reduce sternway, the propeller wash may be directed into the hooked cove and there is a danger of the wash causing damage to the shore facilities. (See Diagram 4 in the appendix)
 - In reviewing historical data we observed that the normal closest point of approach is approximately 100m. In addition the construction of the structure being on piers allows wash to pass through and away.
3. Whilst not reducing the size of the swing basin, the structure does reduce the safety margin zone of the manoeuvre. (see Diagram 3 in the appendix)
 - All vessels greater than 130m are required to have at least one tug in attendance, to assist in the event of a failure, and therefore assist in mitigating the change in risk.
4. Smalls vessels berthed at the floating pontoon are likely to be heavily affected by the ships wash during manoeuvring. (see Diagram 8 in the appendix)
 - It has been advised that the berth is purely for drop off and pick up and therefore should not be a concern, however the point is raised due the possibility that vessels will stay longer than they should.
5. Larger super yachts berthed at the pontoon may also be affected by the ships wash but also reduce safety margins by up to another 10m (yachts beam).

- It has been advised that the berth is purely for drop off and pick up and therefore should not be a concern, however the point is raised due the possibility that vessels will stay longer than they should.
6. Persons standing on the pontoon may be affected by the movement of the pontoon whilst a ship is manoeuvring.
- It has been advised that the pontoon will be secured by piles and therefore movement should be minimal.
7. Reduced space for ferries to pass between the ship and shore when proceeding to and from the Barrangaroo Ferry Hub / King Street Wharves.
- Historic evidence has shown that the commercial ferries currently operating out of Circular Quay and King Street Wharves provide adequate room for larger ships manoeuvring and therefore should not pose a safety risk however they may be delayed slightly longer than currently.
8. Lighting of the jetty is a concern, due to the back scatter of the building on the shore, making it difficult to see an unlit structure at the waterline.
- It is suggested that the outer face of the jetty and pontoon be lit near the waterline to provide a better visual reference of the proximity of the structure.
9. During the construction phase of the jetty pontoon, a 54m barge is likely to be used to Drive the piles. This barge is likely to have an impact upon the safe navigation of vessels swinging in Darling Harbour.
- Further consultation will be required as to where the barge will need to be positioned in order to carryout it operations, as there may be a need for it to be removed / shifted clear prior to a vessel swinging in the area.

7 Conclusions

Having considered risks and hazards imposed by constructing the proposed Jetty / Pontoon and boardwalk, and conducting a Risk Assessment to determine the severity of introduced risks and how they can best be mitigated by adding controls or ensuring current controls are maintained. The proposed structure is deemed acceptable and should not unduly affect the safe navigation of Vessels transiting both inward and outward through Darling Harbour.

It should however be noted that whilst there is no impact on the vessels comfort zone for navigation, the safety margin will be reduced.

Likewise it should be highlighted that the pontoon would not be deemed suitable to moor at or be used by a small craft whilst a large vessel is manoeuvring in the swing basin, due to the turbulence created by the ships thruster and tug wash.

This report makes 5 recommendations in addition to those controls already in place under Port Safety Management Systems to assist with the management of the increased risk associated with the installation of the proposed jetty and pontoon:

1. No vessels are to use the pontoon for berthing or transferring passengers whilst a large vessel is manoeuvring in the swing basin.
2. The pontoon and boardwalk to be adequately lit on the water side of the structure.
3. During the construction phase, no associated barges or equipment should be located outside of the proposed footprint whilst a large vessel is transiting the area.
4. Make pilots aware of reduced margin area so additional manoeuvring room can be allowed.
5. Make pilots and escort vessel personnel aware of the reduced manoeuvring room to ensure small vessels keep clear of vessel and tug wash.

If the additional controls identified in this report are implemented, the proposed new infrastructure should have minimal impact on operations currently undertaken by the Port Authority.

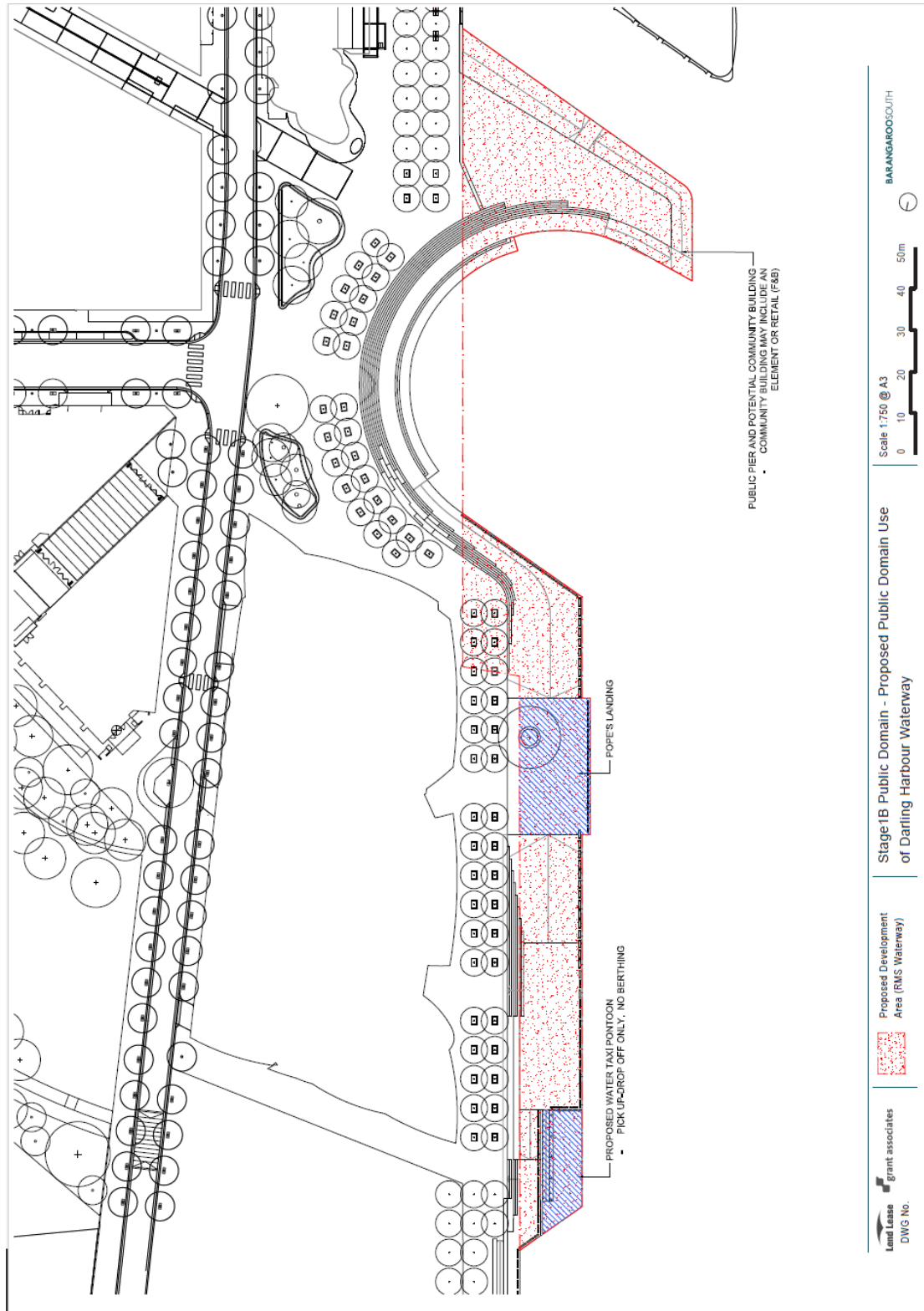


Diagram 2: Proposed Jetty, pontoon and cove

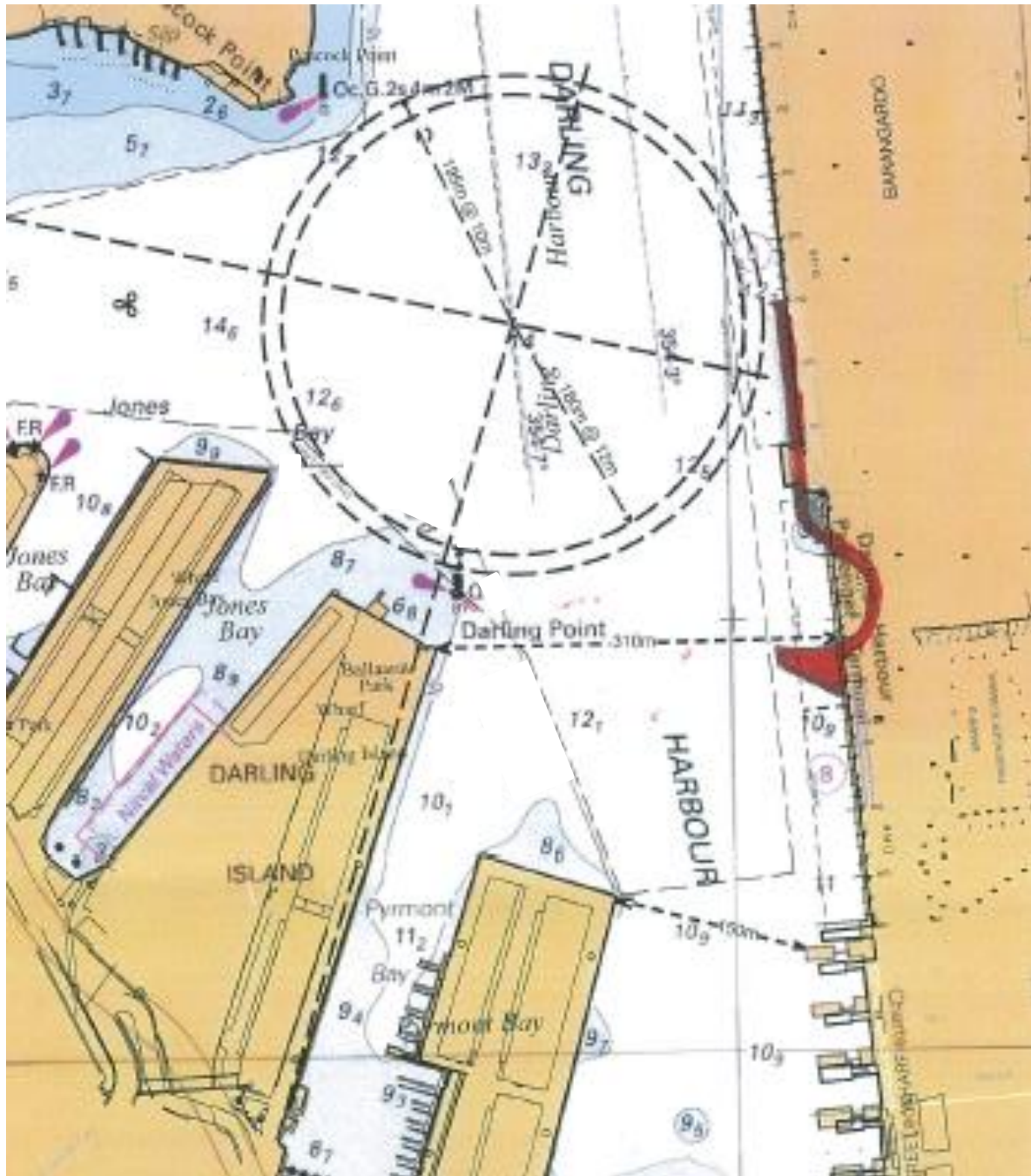


Diagram 3: Darling Harbour chartlet showing swing circle and proposed works.



Diagram 4: Recording of vessel reversing into swing basin and indication of propeller wash as engine fires ahead



Diagram 5: Recording of arriving vessel during swing and closest points of approach to existing shoreline



Diagram 6: Proposed Jetty/pontoon structure marked by small round buoys.

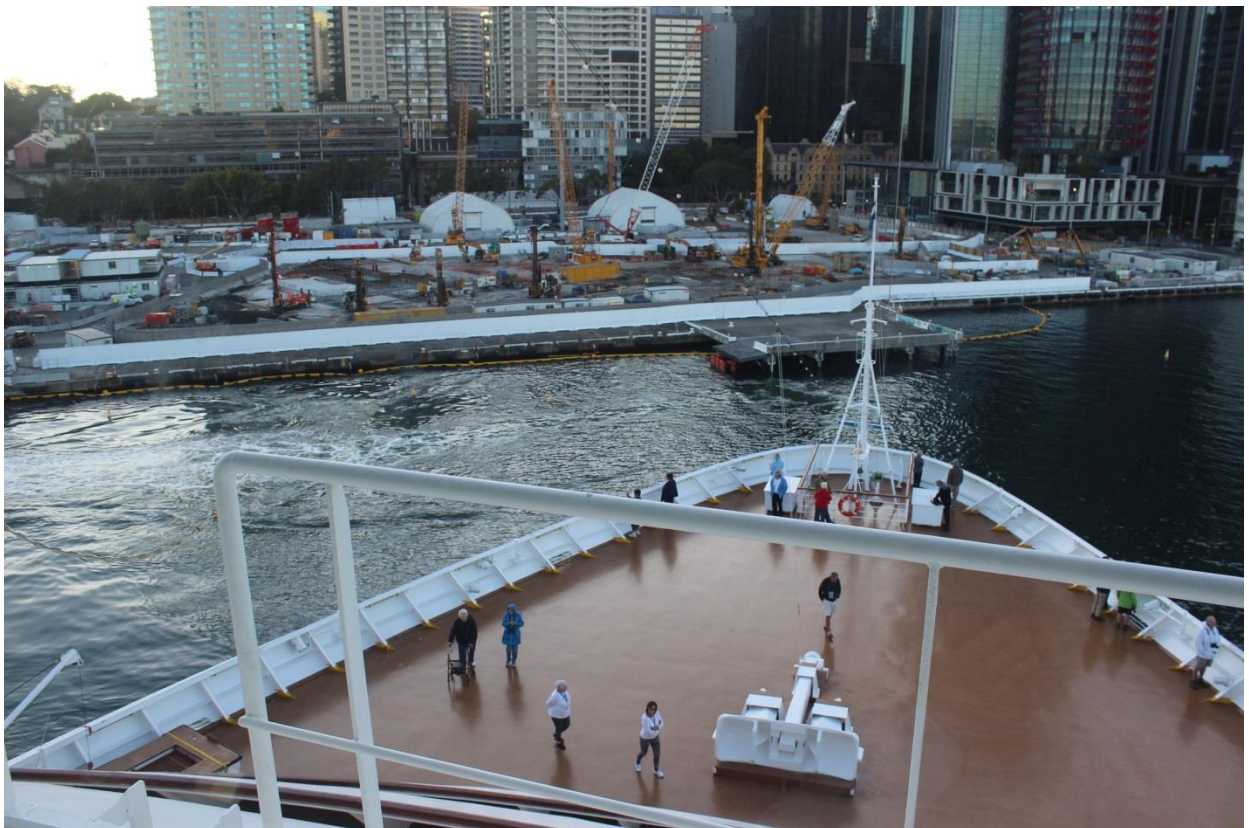


Diagram 7: Noordam arrival half way through swing and proximity to existing ro-ro ramp.



Diagram 8: Wash produced by ship's bow thruster in the vicinity of the proposed jetty during the swing of the Noordam arrival.