Wollongong Harbour Public Pontoon

Review of Environmental Factors

Transport for NSW

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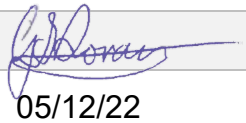
Signed:	
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Executive summary

The proposal

Transport for NSW proposes to construct a new public pontoon and permanent unloading zone at Belmore Basin (the proposal) as part of the Wollongong Harbour Master Plan developed by Transport for NSW in 2020.

Key features of the proposal include:

- Installation of a 25 metre by five metre pontoon, with a fixed ramp and four restraint piles near the end of the central pier to provide safer access for trawlers, charter vessels, yachts and other recreational craft. The pontoon is to be oriented in line with prevailing wave direction
- Installation of a new five metre by five metre fixed platform and 20 metre by 1.8 metre gangway to access the new pontoon
- Installation of two restraint piles on either end of the pontoon to minimise impacts from vessels
- Line-marking of existing pavement to provide a permanent unloading zone.

Construction is expected to commence late 2022 and would take around three months to complete.

Key features of the proposal are shown in Figure 3-1.

Need for the proposal

The need for the proposal was identified in response to the Wollongong Harbour Master Plan (TfNSW, 2020d) (WHMP). The WHMP proposes development opportunities around Wollongong Harbour to accommodate for future projected population growth and increased tourism, while still maintaining its historic use and purpose as the “active working heart of the city”.

The short to medium term vision of the WHMP highlights 12 development opportunities for the harbour capable of being realised over the next five to 15 years. Out of the opportunities, the proposal falls under the Early Works scope of works.

Currently, Belmore Basin lacks equitable and safe access for embarking and disembarking marine vessels and recreational craft. The proposal will improve user access to the central pier and marine vessels, encouraging recreational and supporting commercial activity at Wollongong Harbour.

Proposal objectives

The objectives of the proposal are to:

- Improve access to trawlers, charter vessels, yachts and other recreational craft
- Provide safer access for marine vessel users
- Enhance user safety and comfort through design
- Accommodate for projected growth in tourism and users of Belmore Basin
- Allow equitable access for users of all mobility levels
- Provide designated area for ongoing pick up/drop off and loading/unloading activities.

Options considered

During the concept design stage in 2019, four concept design options, in addition to the 'Do nothing' option, were considered (AECOM, 2019a). These options were developed based on the strategic design, user needs analysis and the site-specific requirements.

The following options were considered:

- 'Do nothing' – no construction of the waterside features, access for users remains unchanged
- Option 1 – new pontoon, gangway and fixed platform parallel to south west end of central pier and new pontoon and gangway parallel to northern wall, resulting in a total of 41 berths
- Option 2 – new pontoon, gangway and fixed platform parallel to south east end of central pier and new pontoon and gangway parallel to northern wall, resulting in a total of 43 berths
- Option 3 – new pontoon, gangway and fixed platform parallel to south west end of central pier and new pontoon parallel to northern wall with gangway parallel to eastern wall, resulting in a total of 39 berths
- Option 4 – new pontoon, gangway and fixed platform parallel to south east end of central pier and new pontoon parallel to northern wall with gangway parallel to eastern wall, resulting in a total of 41 berths.

Common to options 1 to 4 was a permanent unloading zone, fender/mooring piles and access ladders.

Options were presented to stakeholders on 21 November 2019 to determine and refine the preferred option. With consideration of the stakeholder feedback, Option 1, featuring a new pontoon parallel to the south west end of the central pier, was progressed through to development as the preferred option.

The preferred option was refined based on stakeholder feedback. A detailed description of the refined design is included in section 2.6.

The new waterside features, including the proposed pontoon, gangway, fixed platform and restraint piles, as well as the permanent unloading zone of the preferred option is assessed in this REF. The other features of the preferred option, including the refuelling station and the fenders are beyond the scope of this REF.

Statutory and planning framework

The proposed facility is a wharf or boating facility within the meaning of the *State Environmental Planning Policy (Transport and Infrastructure) 2021* (SEPP TI).

The proposal is for a wharf or boating facility and is to be carried out by Transport for NSW and can therefore be assessed under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Development consent from Wollongong City Council (WCC) is not required.

The proposal is not located on land reserved under the *National Parks and Wildlife Act 1974* (NPW Act).

Community and stakeholder consultation

Key agency stakeholders were invited to provide feedback on the proposal's initial concept design options on 11 September 2019. Community consultation on the preferred concept design was undertaken on 21 November 2019. Following consultation, the preferred concept design was refined based on stakeholder feedback.

Consultation with the WCC and Department of Primary Industries (DPI) Fisheries was undertaken during the preparation of this REF. Feedback received from the consultation with these two agencies has been addressed in this REF.

Stakeholder consultation will continue during the public display of the REF to capture community feedback. Should the proposal proceed to construction, consultation with the community and stakeholders would continue throughout the construction phase.

Environment impacts

The main environmental impacts of the proposal and the safeguards and management measures to address the impacts are summarised in the following sections.

Land surface and hydrology

A construction and operational assessment were conducted using published mapping and data to define the existing physical characteristics of the terrestrial environment and the physical and hydrodynamic characteristics of the aquatic environment. The assessments considered how the proposed construction activities and final proposal infrastructure would affect the physical and hydrodynamic characteristics of the aquatic and terrestrial environment.

During construction, disturbance to sediments and the seabed would occur as a result of the installation of the waterside features. Minor earthworks required also has the potential to lead to erosion and sedimentation of the harbour and encountering contaminated land. These temporary disturbances are expected to be localised, minor and limited to the construction phase. Impacts would be minimised through the work methodology and the safeguards in Chapter 7.

During operation, marine vessel movement and volume are anticipated to be similar to pre-proposal levels. Hence, impacts to land surface and hydrology during operation of the proposal are expected to be low.

Biodiversity

A biodiversity assessment report (BAR) was undertaken to assess the potential impacts to biodiversity as a result of the proposal. Construction impacts to terrestrial vegetation, habitat and fauna from the proposal are considered negligible as the landside element of the proposal is limited to existing hardstand surfaces.

The waterside portion of the study area consists of a steep artificial sandstone seawall with large rubber tyres, subtidal low relief rocky reef with macroalgae, unvegetated soft sediment with debris and a small patch of *Halophila* sp. seagrass. No mangroves or saltmarsh occur in or next to the study area. The subtidal habitat in the study area forms potential habitat for the threatened White's Seahorse (*Hippocampus whitei*) which is listed as endangered under the *Fisheries Management Act 1994* (FM Act) and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Construction of the waterside elements would result in the permanent loss of localised epifauna and infauna. However, this loss would be expected to recolonise following disturbance. The presence of *Halophila* sp. may be seasonal in nature, the species is considered a pioneering species and similarly, would potentially recolonise the area following a disturbance.

Construction disturbance to marine fauna would be temporary in nature and may cause mobile marine fauna to move away from unfavourable conditions and return once disturbance is removed.

During operation, habitat would become available, with the additional piles creating habitat for sessile marine species. The gangway and pontoon components would sit permanently on or above the water's surface and avoid impacts to the seabed. Light penetrating decking

would be utilised for the pontoon and gangway to allow sufficient light to penetrate the substrate and allow seagrass and marine vegetation to grow, therefore, impacts to seagrass and/or marine vegetation are considered negligible.

The structures of the proposal are not expected to substantially alter coastal processes or the hydrology of the study area or the wider harbour. These structures are not considered to interfere with fish passage nor likely to alter localised hydrodynamics. Similarly, the proposal would not fragment or isolate threatened species populations or substantially impact any species' lifecycle, if present. Therefore, the proposal is unlikely to significantly impact coastal and marine biodiversity.

Consultation with DPI Fisheries on 21 February 2022 confirmed that a permit under section 205 of the FM Act would not be required.

Landscape character and visual impact

A landscape character and visual impact assessment was undertaken to identify the overall visual changes and impact of the proposal on the study area and its surroundings when viewed from key viewpoints.

Landscape character and visual impacts (LCVI) during construction are expected due to the presence of a construction zone and associated activities, plant and equipment which are not typical of the landscape character. However, these impacts would be temporary and limited to the duration of construction.

During operation, the LCVI rating from a close proximity viewpoint is considered to be negligible as the proposal would mostly be hidden behind the edge of Belmore Basin. On the other hand, the LCVI rating from a viewpoint 100 metres away, would be considered moderate. The proposal would be fully visible to surrounding receivers but given the conformity of the design and the distance to the viewpoint, the proposal would blend in with the surrounding landscape.

Overall, the LCVI rating for the proposal would be considered low.

Non-Aboriginal heritage

A Statement of Heritage Impact (SOHI) (Austral Archaeology, 2022) was prepared to assess the potential impacts to listed heritage items and potential archaeological remains as a result of the proposal.

Construction works have the potential to impact heritage listed items directly and indirectly. However, due to the limited footprint of the proposal and proposal area, the construction of the proposal will not directly impact the heritage listed 'Harbour Steps' located within the study area.

Indirect impacts through the vibrations of plant may occur to erect heritage structures in close proximity to the study area. Section 6.4.3 details the potential vibrational impacts the proposal poses to heritage structures.

No impacts to non-Aboriginal heritage listings are expected during operation of the proposal.

Justification and conclusion

The need for the proposal was justified under the WHMP as Belmore Basin does not currently provide equitable and safe access for marine vessel and recreational craft users. The assessment of the environmental and social impacts has determined that the proposal is not likely to have a significant impact and therefore, assessment under Division 5.2 of the EP&A Act is not required.

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Appendices

1 Introduction

This chapter introduces the proposal and provides the context of the environmental assessment and outlines the purpose of the report.

1.1 Proposal identification

Transport for NSW proposes to construct a new public pontoon and permanent unloading zone at Belmore Basin (the proposal) as part of the Wollongong Harbour Master Plan (WHMP) developed by Transport for NSW in 2020.

The proposal is located within the local government area (LGA) of Wollongong City Council (WCC). Wollongong is located in the Illawarra region of New South Wales, approximately 80 kilometres south of Sydney.

Situated within Wollongong Harbour, between Flagstaff Hill Park and the Wollongong Breakwater Lighthouse, Belmore Basin serves as a marina for trawlers, charter vessels, yachts and other recreational craft. Belmore Basin is accessed by water through Wollongong Harbour between the central and southern pier. Access by land is from the northern loop of Endeavour Drive.

Figure 1-1 shows the regional setting of the proposal while Figure 1-2 shows the local setting and existing features.

The proposal will improve user access to the central pier and marine vessels. The key features of the proposal would include:

- Installation of a 25 metre by five metre pontoon, with a fixed ramp and four restraint piles, near the end of the central pier to provide safer access for trawlers, charter vessels, yachts and other recreational craft. The pontoon is to be orientated in line with the prevailing wave direction
- Installation of a new five metre by five metre fixed platform and 20 metre by 1.8 metre gangway to access the new pontoon
- Installation of two restraint piles on either end of the pontoon to minimise impacts from vessels
- Line-marking of existing pavement to provide a permanent unloading zone.

The key features of the proposal are shown in Figure 3-1, Chapter 3 describes the proposal in greater detail.

The proposal would take around three months to complete with construction starting in late 2022. During construction, the southern end of the central pier will be closed.

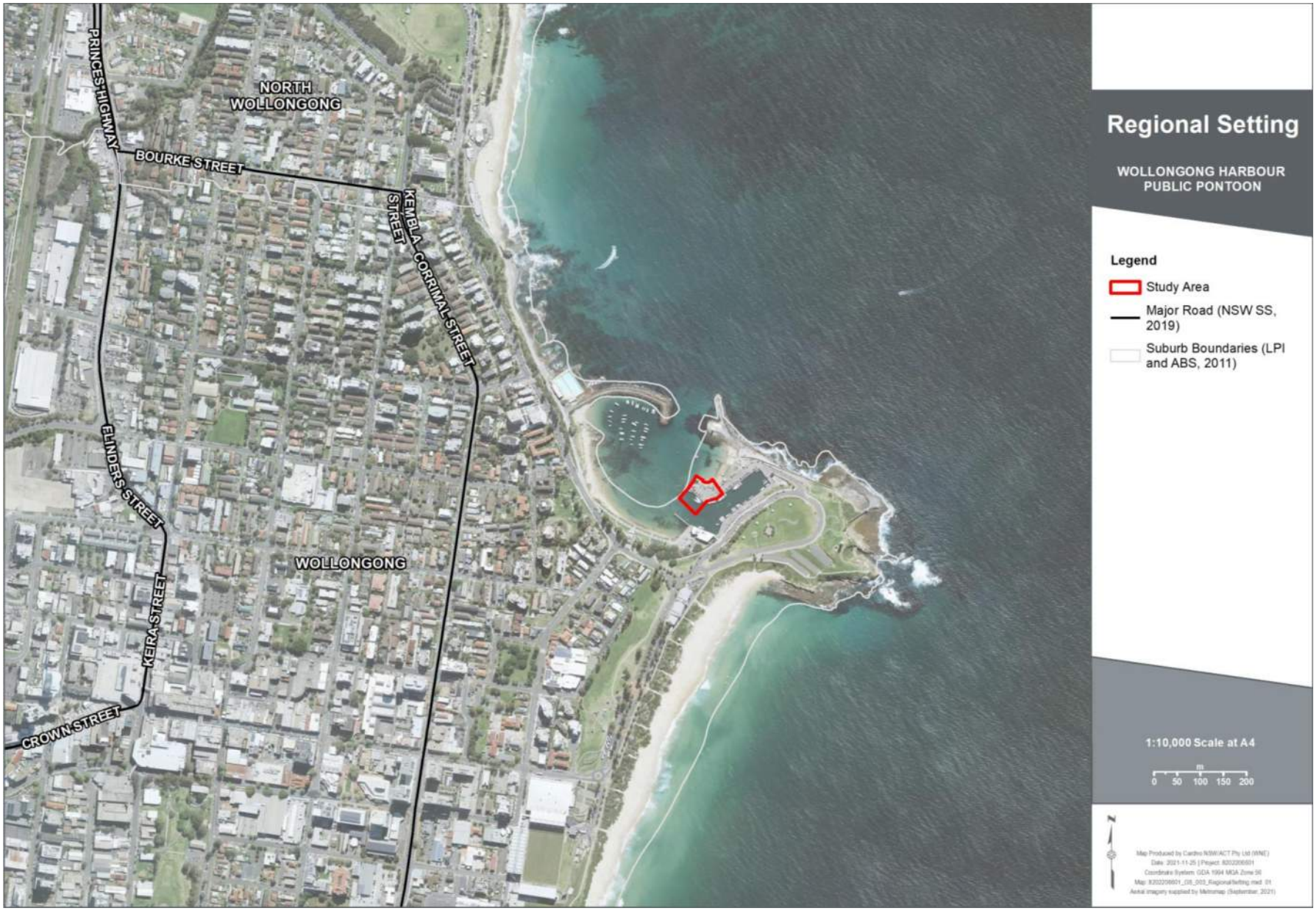


Figure 1-1: Regional setting of the proposal

Figure 1-2: Local setting and existing features of the proposal

1.2 Purpose of the report

This review of environmental factors (REF) has been prepared by Cardno now Stantec on behalf of Transport for NSW. For the purposes of these works, Transport for NSW is the proponent and the determining authority under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The purpose of the REF is to describe the proposal, to document the likely impacts of the proposal on the environment, and to detail mitigation and management measures to be implemented.

This REF has been developed in accordance with Section 170 and 171 of the Environmental Planning & Assessment Regulations 2021, the *Biodiversity Conservation Act 2016* (BC Act), the *Fisheries Management Act 1994* (FM Act), and the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) to ensure that all relevant environmental factors have been assessed and incorporated in the preparation of this document.

In doing so, the REF helps to fulfil the requirements of Section 5.5 of the EP&A Act including that Transport for NSW examine and take into account to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity.

The findings of the REF would be considered when assessing:

- Whether the proposal is likely to have a significant impact on the environment and therefore the necessity for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning under Division 5.2 of the EP&A Act.
- The significance of any impact on threatened species as defined by the BC Act and/or FM Act, in Section 1.7 of the EP&A Act and therefore the requirement for a Species Impact Statement or a Biodiversity Development Assessment Report.
- The potential for the proposal to significantly impact any matter of national environmental significance or Commonwealth land and the need to make a referral to the Australian Government Department of Climate Change, Energy, the Environment and Water (DCCEEW) for a decision by the Commonwealth Minister for the Environment on whether assessment and approval is required under the EPBC Act.

2 Need and options considered

This chapter describes the need for the proposal in terms of its strategic setting and operational need. It identifies the various options considered and the selection of the preferred option for the proposal.

2.1 Strategic need for the proposal

The proposal forms a part of the short to medium term vision of the Wollongong Harbour Master Plan (TfNSW, 2020d) (WHMP). The WHMP proposes development opportunities around Wollongong Harbour based on a 12-month investigation and community consultation process. The aim of the WHMP is to develop Wollongong Harbour to accommodate for future projected population growth and increased tourism, while still maintaining its historic use and purpose as the “active working heart of the city”.

The short to medium term vision of the WHMP highlights 12 development opportunities for the harbour capable of being realised over the next five to 15 years. Out of the opportunities, the proposal falls under the Early Works scope of works.

The proposal was also developed to respond to the objectives of various Government policies described below.

2.1.1 State

Wollongong Harbour Masterplan

The WHMP was developed with consideration to five key principles:

- Scenic character – developments would conform to the existing physical form and function of Wollongong Harbour
- A place to play – developments would maintain, and not compromise, the existing activities available to the public at Wollongong Harbour
- A working harbour – developments would not compromise the existing commercial uses of Wollongong Harbour
- A place of experience – developments would maintain the existing event space function of Wollongong Harbour
- Access all areas – developments would improve access to and around Wollongong Harbour.

The proposal has been developed in line with the five key principles outlined in the WHMP.

Maritime Infrastructure Plan

The Maritime Infrastructure Plan (MIP) (TfNSW, 2018) sets out a strategic and coordinated approach to prioritising and delivering maritime infrastructure in NSW. The aim of the MIP is to maximise the benefits of investment in maritime infrastructure for recreational and commercial boaters. This includes the full range of assets and facilities required to support industries such as commercial fishing, aquaculture and tourism sectors.

Within the MIP, Wollongong is recognised as a key regional city with a strong tourism sector and has significant potential to grow in the boating sector.

Boating Now Program

The Boating Now program supports the MIP in delivering new and upgraded recreational boating infrastructure across NSW in partnership with councils and industry. The program provides grant funding to improve maritime infrastructure and facilities across NSW.

The proposal is supported by the Boating Now program and is one of the 73 successful projects approved for Round 2 funding from the program.

2.1.2 Local

Our Wollongong 2028

Our Wollongong 2028 (WCC, 2018) is the community strategic plan (CSP) adopted by WCC in 2018. The 2028 CSP builds on the visions and goals outlined in the Wollongong 2022 CSP. Developed in consultation with the community, the 2028 CSP outlines the issues and challenges identified to be addressed over the next 10 years.

The 2028 CSP highlights six community goals to be targeted:

- We value and protect our environment
- We have an innovative and sustainable economy
- Wollongong is a creative, vibrant city
- We are connected and engaged community
- We have a healthy community in a liveable city
- We have affordable and accessible transport.

The proposal supports the objectives to develop a healthy community in a liveable city. The waterside features of the proposal will improve safe access and encourage more users to participate in recreational and lifestyle activities.

The Blue Mile Master Plan

The Blue Mile Master Plan (the Blue Mile) (WCC, 2007) is a long-term plan that proposes a range of city foreshore improvements between the stretch of foreshore from the Wollongong Golf Course to Fairy Creek, North Wollongong. The Blue Mile aims to improve public infrastructure and recreation and tourism experiences to fully realise the potential of the iconic urban beach and foreshore as a major people-oriented place and the focus for public activities.

The objectives of the Blue Mile are:

- Establish high quality open space
- Improve pedestrian and cycle access to and along the foreshore
- Provide high quality facilities of distinctive local design that respond to and enhance the unique natural environment
- Provide a range of facilities for families, visitors and local residents
- Ensure design proposal maximise the safety of visitors
- Improve vehicular access and parking opportunities
- Integrate public art into design proposals.

The proposal supports the aim and objectives of the Blue Mile by improving safe access for users of Belmore Basin and introducing a permanent unloading zone to access the waterside features of the proposal.

Wollongong Coastal Zone Management Plan

Coastal Zone Management Plans (CZMP) provide sustainable plans for all coastal areas. Wollongong's Coastal Zone Management Plan: Implementation Plan (BMT WBM, 2017) was prepared to manage coastal hazards along the Wollongong coastline, as per the requirements of the *Coastal Management Act 2016* (CM Act).

The proposal has been designed to comply with Australian Standard (AS) for marine structures and will not increase the risk of erosion or coastal inundation and does not require further consideration under the CZMP.

2.2 Existing infrastructure

The existing infrastructure at Belmore Basin includes both waterside and landside elements for users of Wollongong Harbour. Currently, Belmore Basin does not include docking infrastructure for marine vessel users.

Table 2-1 summarises the existing waterside and landside elements; and descriptions of current infrastructure.

Table 2-1: Existing infrastructure

Element	Description
Land ownership	Both waterside and landside of Belmore Basin is owned by Crown Land.
Waterside	
Berthing infrastructure	• 44x berth allocations • Timber mooring piles • Access ladders • Mooring cleats • Large rubber tyre fenders
Boating infrastructure	• Concrete ramp
Landside	
Waste infrastructure	• 2x general waste and recycling bins • 1x tackle bin
Parking infrastructure	• Marked parallel and 90° angle parking spaces • Unmarked parallel and 90° angle parking spaces • No stopping or parking between 10pm to 5am
Safety/Utility infrastructure	• Lighting poles • 2x lifebuoys • 1x timber bench seat
Local businesses	• Yachties Café • Harbourfront Seafood • Bombora Seafood • Nonabel • Aquilla Fishing Charters

Element	Description
	• Krista Fishing Charters • Wollongong Yacht Club

2.3 Proposal objectives and development criteria

2.3.1 Proposal objectives

The objectives of the proposal are to:

- Improve access to trawlers, charter vessels, yachts and other recreational craft
- Provide safer access for marine vessel users
- Enhance user safety and comfort through design
- Accommodate for projected growth in tourism and users of Belmore Basin
- Allow equitable access for users of all mobility levels
- Provide designated area for pick up/drop off and loading/unloading activities.

2.3.2 Urban design objectives

Urban design objectives for the proposal include:

- Integrate the proposal within its local area, taking into consideration the nature of the site, local context and the surrounding biodiversity
- Integrate the proposal with its future urban context
- Comply with *Disability Discrimination Act 1995* (DDA) standards
- Create a high quality, secure and positive addition to the public domain.

2.4 Options considered

This section describes the options considered to deliver the proposal.

2.4.1 Methodology for selection of options

The method by which Transport for NSW developed options for the proposal considered:

- Existing and future users of Belmore Basin
- Engineering design requirements
- User safety and comfort
- Environmental and social constraints
- Build cost and sustainability
- Accessibility offered
- Stakeholder feedback.

2.4.2 Identified options

Four concept design options, in addition to the 'Do nothing' option, were considered during the initial concept design stage in 2019 for the proposal (AECOM, 2019a). These options were developed based on the strategic design, user needs analysis and the site-specific requirements.

The following options were considered:

- 'Do nothing' – no construction of the waterside features, access for users remains unchanged
- Option 1 – new pontoon, gangway and fixed platform parallel to south west end of central pier and new pontoon and gangway parallel to northern wall, resulting in a total of 41 berths
- Option 2 – new pontoon, gangway and fixed platform parallel to south east end of central pier and new pontoon and gangway parallel to northern wall, resulting in a total of 43 berths
- Option 3 – new pontoon, gangway and fixed platform parallel to south west end of central pier and new pontoon parallel to northern wall with gangway parallel to eastern wall, resulting in a total of 39 berths
- Option 4 – new pontoon, gangway and fixed platform parallel to south east end of central pier and new pontoon parallel to northern wall with gangway parallel to eastern wall, resulting in total of 41 berths.

Common to options 1 to 4 was a permanent unloading zone, fender/mooring piles and access ladders.

2.4.3 Analysis of options

The options summarised in section 2.4.2 were presented to stakeholders on 21 November 2019 to determine and refine the preferred option.

Key feedback from the stakeholders that influenced the layout and concepts is summarised in Table 2-2.

Table 2-2: Stakeholder feedback (Source: AECOM, 2019a)

Element	Feedback
Fuelling provision	Preference for potential fuelling area to be along the western wall, and not located on the pontoon. This preference was noted by the Trawler and Charter vessel representatives. There is the opportunity for yachts to be fuelled from the pontoon.
Common user berth	Location of a pontoon parallel to the south west end of the central pier (as per Option 1) acceptable.
Northern wharf	Implementing a pontoon along the northern wall is not acceptable. Concerns raised with vessels being offset from the wharf as a result of the pontoon, which will further constrain the basin. Access ladders deemed to be a safe means of vessel access along the wharf on the northern wall of the basin.

Element	Feedback
Berthing infrastructure	Concerns raised about the level of energy abruption and impact on larger vessels (such as the Trawlers) when berthing against the berthing piles; and the need for fenders to be provided.
Mooring infrastructure	Concerns raised about the robustness of the mooring cleats for the larger vessels (such as the Trawlers).

2.5 Preferred option

As a result of the consideration of the stakeholder feedback, Option 1, featuring a new pontoon parallel to the south west end of the central pier, was progressed through to development as the preferred option. Fuelling provisions and fenders are not included in the scope of works and therefore will not be assessed as a part of this REF.

2.6 Design refinements

Option 1 was considered to be the most preferable option. Refinements were made to the design of Option 1 to take into account the feedback received from stakeholders. The refined design features for Option 1 are outlined below:

- A new pontoon accessed via a fixed platform and gangway, parallel to the south west end of the central pier
- A permanent unloading zone
- A total of 43 berth allocations within the harbour including 41 mooring piles
- Eight restraint piles
- 38 access ladders.

2.7 This proposal

The new waterside features, including the proposed pontoon, gangway, fixed platform and restraint piles, as well as the permanent unloading zone of the preferred option is assessed in this REF and described in detail in Chapter 3.

The other features of the preferred option, including the refuelling station and the fenders, are not included in the scope of this REF.

3 Description of the proposal

This chapter describes the proposal and provides descriptions of existing conditions, the design parameters including major design features, the construction method and associated infrastructure and activities.

3.1 The proposal

The proposal is to construct a new public pontoon and permanent unloading zone at the Belmore Basin marina of Wollongong Harbour.

The key features of the proposal would include:

- Installation of a 25 metre by five metre public pontoon, with a fixed ramp and four restraint piles, near the end of the central pier to provide safer access for trawlers, charter vessels, yachts and other recreational craft. The pontoon is to be oriented in line with prevailing wave direction
- Installation of a new five metre by five metre fixed platform and 20 metre by 1.8 metre gangway to access the new pontoon
- Installation of two restraint piles on either end of the pontoon to minimise impacts from vessels
- Line-marking of existing pavement to provide a permanent unloading zone.

Figure 3-1 shows the key features of the proposal.

For the purposes of the REF the study area, proposal area, compound area, waterside features and permanent unloading zone as seen in Figure 3-1, have been defined as follows:

- Study area – the area around the proposal area required for specialist studies
- Proposal area – the area around the proposed works required for construction, including the compound area
- Compound area - temporary facility required for construction, including an accommodation block and materials storage laydown area
- Waterside features – the key construction features of the proposal that are located within the water, including the proposed pontoon, gangway, fixed platform and restraint piles
- A permanent unloading zone.

Figure 3-1: Proposed study and proposal area.

3.2 Design

3.2.1 Design criteria

The proposal has been designed to NSW and Australian engineering and safety standards including:

- Standards Australia: AS 3962:2020 Marina Design
- National Construction Code 2019 Volumes 1, 2 and 3 (NCC) (Formerly BCA)
- Australian Maritime Safety Authority (AMSA): navigation and safety
- Disability Discrimination Act 1995 (DDA).

These standards provide guidance on:

- Maintaining vessel navigational channel
- Access and safety requirements
- Operation and stability during extreme storms, accounting for wind, wave and current conditions
- Dimensional requirements for channel widths, water depths, berth sizes, walkways, fingers, mooring and boarding points, and gangway requirements
- Loading and stability requirements.

3.2.2 Engineering and development constraints

Table 3-1 lists the main constraints to the development and describes how they have been addressed in the concept design.

Table 3-1: Engineering and development constraints

Constraint	Concept design provision
Heritage The Wollongong Local Environmental Plan 2009 (Wollongong LEP) lists three local heritage items are within the proposal area: Harbour Steps (Wollongong LEP ID: 6419), Harbour Steps (Wollongong LEP ID: 6418) and Stone Steps (Wollongong LEP ID: 6364).	The design of the proposal will be sensitive to the heritage conservation values of the area and developed in consultation with Transport for NSW and WCC heritage advisors.
Wind, wave, current and climate change	The design of the proposal will allow it to be used in all tidal ‘states’ (i.e. Highest Astronomical Tide (HAT) and Lowest Astronomical Tide (LAT), with an additional allowance and climate change adaptation and sea level rise). This is to be included in the final design.
Accessible access	The design of the proposal will be accessible to users of all mobility levels and will meet the standards of the DDA

Constraint	Concept design provision
	and current legislative standards for disabled access.
Local businesses	The design of the proposal will improve safety and access for charter vessels and passengers. The design of the proposal area will maintain access to Yachtie's Café throughout the construction period.

3.2.3 Major design features

This section describes the proposals main design features.

Pontoon

The waterside features would consist of a pontoon that is a rectangular floating structure 25 metres long and five metres wide. Light penetrating decking would be used for the pontoon to allow sufficient light to penetrate the marine substrate. The pontoon will be used for boarding of trawlers, charter vessels, yachts and other recreational craft. The pontoon will be orientated parallel to the existing shoreline and in line with the prevailing wave direction. This alignment will minimise vessel motion and enhance user safety and comfort. The pontoon would be supported by a fixed platform and four restraint piles.

A total of four restraint piles will be installed to minimise wear and prolong the life of the pontoon. These restraint piles will be installed in pairs on the northern and southern ends of the pontoon.

Gangway and fixed platform

The waterside features would also include access to the pontoon via a 20 metre long and 1.8 metre wide gangway attached to a five metre by five metre fixed platform. Light penetrating decking with a minimum deck mesh size of 30mm by 30mm would be used for the gangway to allow sufficient light to penetrate the marine substrate. The fixed platform will be connected to the shoreline about 30 metres south east of the heritage listed harbour steps.

Permanent unloading zone

An approximately 15 metre by six metre area on the existing shore will be a designated unloading area. Line markings and signage would be erected for the temporary parking area. The permanent unloading zone will be used for the pick-up and drop-off of users of the pontoon and the loading and unloading of equipment during construction and operation.

3.3 Construction activities

The appointed construction contractor would confirm the final construction activities in discussion with Transport for NSW. As such, this section only indicates a likely method and work plan as it may vary due to the identification of additional constraints before work starts, detailed design refinements, community and stakeholder consultation feedback, and Contractor requirements/limitations. Should the work method differ from what is proposed in this REF, the Contractor would consult Transport for NSW to

determine if additional assessment is needed. Some additional land would be needed temporarily to support construction, as described in section 3.4.

3.3.1 Work methodology

The proposal would be built under Transport for NSW specifications as managed by a Contractor under a construction environmental management plan (CEMP). These specifications cover environmental performance and management supplemented by aspects such as materials storage and management, and erosion and sediment control.

The proposal would likely comprise a sequence of work activities similar to the following:

- Establishment of security fencing around the landside of the proposal area
- Establishment of the compound area (Figure 3-1) with an accommodation block and storage and materials laydown area within the security fencing
- Mobilisation of the water-based plant by utilising the nearby slipway or an appropriate installation point. This is to be confirmed by the Contractor along with any temporary works required and statutory approvals)
- Installation of the pontoon piles using a torqued head pile equipment. The piles will have cutting teeth installed on the cutting face. A water swivel will pump water through the centre of the pile to remove the rock cuttings
- Installation of the pontoon using a shore-based crane. The pontoon is constructed offsite and is lifted from the transporter and placed into position
- Installation of the gangway using the shore-based crane. The gangway is constructed offsite and is lifted from the transporter and placed into position
- Fit-out completed pontoon structure with electrical and water services.

These work activities are only indicative and subject to change once the detailed design methodology is finalised.

3.3.2 Construction hours and duration

This section describes the time it would take to build the proposal and the working hours.

Start date and length of construction

Construction of the proposal would take around three months starting in late 2022. Construction may not be continuous as it would rely on materials delivery and the manufacture of the prefabricated components. The construction program would be affected by the need to coordinate with Council and other key stakeholders (refer to Chapter 5) and depends on the weather and/or swell conditions.

Working hours

Construction would be undertaken within the standard working hours as defined in the Interim Construction Noise Guideline (ICNG) (DECC, 2009). Standard working hours are as follows:

- Monday to Friday: 7am to 6pm
- Saturday: 8am to 1pm
- Sunday and Public holidays: No work.

3.3.3 Plant and equipment

The plant and equipment needed to build the proposal would be typical of any construction site and would vary depending on the construction activity. The largest and most complex equipment needed would be to lift and install the prefabricated units and undertake the piling work. The following plant and equipment would likely be used to build the proposal however, this would be confirmed by the Contractor:

- Barge mounted excavator with piling equipment
- Workboats to manoeuvre barges
- Driving tools
- Sediment curtains
- Generators
- Powered hand tools
- Refuelling equipment bunded
- Site security fencing
- Site storage containers, accommodation and amenities blocks
- Land-based crane or excavator.
- Mobile crane
- Heavy vehicles.

3.3.4 Earthworks

Minor earthworks are expected for the proposal. Minor earthworks will be required for the installation of services to the waterside features as well as the signage for the permanent unloading zone.

3.3.5 Source and quantity of materials

Various standard construction materials would be needed to build the proposal. They would be either transported or shipped (barged) to site as prefabricated units ready for installation, or delivered in small quantities for use as needed. The main materials needed to build the proposal would comprise:

- Prefabricated pontoon
- Prefabricated gangway
- Restraint piles
- Electrical cabling and other electronic infrastructure
- Water infrastructure
- Additional materials such as relatively small quantities of paint, oils, fuels and other materials.

Materials would be sourced from overseas and local commercial suppliers, using local suppliers wherever feasible and cost effective.

3.3.6 Traffic management and access

Maritime and road traffic management would be required while certain elements of the proposal are being built and installed. This would involve:

- Introduction of construction traffic and traffic management at Lot 1 Endeavour Drive Parking
- Restricted car parking at Lot 1 Endeavour Drive Parking
- Restricted access into Belmore Basin for waterside users
- Restricted vessel berthing at Belmore Basin
- No access to end of central pier at Belmore Basin for both land and waterside users.

Access to existing recreational and commercial facilities at Belmore Basin, such as the beach, boat ramps, Yachtie's Café and Wollongong Breakwater Lighthouse, would be maintained throughout the construction period.

A Traffic and Parking Impact Assessment (see Appendix F) was undertaken to address the traffic, parking and pedestrian impacts of the proposal. It is unlikely that the proposal would have a significant impact on the existing conditions of the locality.

A Traffic Guidance Scheme (TGS) would be prepared to ensure safe, continued use of Belmore Basin for landside users during the construction period.

3.4 Ancillary facilities

A temporary compound area with an accommodation block and materials and storage laydown area would be located at the end of the central pier at Belmore Basin (refer Figure 3-1).

The pontoon and gangway would be prefabricated at an off-site facility. The operation of this off-site facility does not form part of this proposal but would have the necessary approvals in place for such activities to be undertaken.

3.5 Public utility adjustment

The proposal would require electrical and water service connections to the waterside features post construction.

Power would be reticulated under the gangway to the pontoon in marine-grade polyvinyl chloride (PVC) conduits. Flexible PVC conduits would be used at the gangway connection to the landside and to the pontoon. A new distribution board would be installed in the existing electrical switch room within the service pod. All lighting and power circuits as well as other electrical loads on the gangway and the new pontoon would be supplied from the new distribution board.

Final public utility requirements would be confirmed during detailed design.

3.6 Property acquisition

No property would be acquired under the proposal. The additional land needed to support construction would be used under existing agreement with Crown Lands. Wollongong Harbour and Belmore Basin are under management of TfNSW. Consultation with and further approval from Crown Lands is not required.

4 Statutory planning framework

This chapter provides the statutory and planning framework for the proposal and considers the provisions of relevant State Environmental Planning Policies (SEPPs), LEPs and other legislation.

4.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning & Assessment Act 1979* (EP&A Act) and *Environmental Planning & Assessment Regulation 2021* (EP&A Regulation) provide the statutory framework for environmental assessments and approvals in NSW.

Section 5.1 of the EP&A Act includes the definition of a *determining authority* which, in this case, is Transport for NSW being the public authority by or on whose behalf the activity is to be carried out and whose approval is required in order to enable the activity to be carried out.

Section 5.5 to the EP&A Act sets out the duty of the determining authority to consider the environmental impact of a proposed development or activity prior to issuing approval. Relevant to this case, Section 5.5 states as follows:

> *(1) For the purpose of attaining the objects of this Act relating to the protection and enhancement of the environment, a determining authority in its consideration of an activity shall, notwithstanding any other provisions of this Act or the provisions of any other Act or of any instrument made under this or any other Act, examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity."*

In accordance with Section 5.7 of Part 5 of the EP&A Act, further consideration of whether the proposed development is, or is not likely to, significantly affect the environment is required following the choice of the final design. If significant impact is determined to be likely by way of a Review of Environmental Factors (REF), an Environmental Impact Statement (EIS) is required. If significant impact is not likely, the REF will be sufficient. Relevant provisions of Section 5.7 are as follows:

> *(1) A determining authority shall not carry out an activity, or grant an approval in relation to an activity, being an activity that is a prescribed activity, an activity of a prescribed kind or* ***an activity that is likely to significantly affect the environment****, unless:*
>
> > *(a) the determining authority has obtained or been furnished with and has examined and considered* ***an environmental impact statement*** *in respect of the activity."*

A REF must be prepared and assessed under Division 5.1 of Part 5 of the EP&A Act, with Transport for NSW as the determining authority.

4.1.1 State Environmental Planning Policies

State Environmental Planning Policy (Transport and Infrastructure) 2021

State Environmental Planning Policy (Transport and Infrastructure) 2021 (SEPP TI) aims to facilitate the effective delivery of infrastructure across the State.

Section 2.79(4) of the SEPP TI permits development for the purpose of wharf or boating facilities in the following circumstances:

Development for the purpose of wharf or boating facilities to be carried out on any land by or on behalf of a public authority without consent. However, such development may only be carried out on land reserved under the National Parks and Wildlife Act 1974 (NPW Act) if the development is authorised by or under that Act.

Section 2.79(5) of the SEPP TI lists certain activities permitted in connection to wharf or boating facilities. These permitted activities include the alteration, demolition or relocation of a local heritage item and the alteration or relocation of a State heritage item.

As the proposal is for the purpose of boating facilities, not within land reserved under the NPW Act and is to be carried out by Transport for NSW, a public authority, it can be assessed under Division 5.1 of the EP&A Act. Development consent from Council is not required.

State Environmental Planning Policy (Resilience and Hazards) 2021

The *State Environmental Planning Policy Resilience and Hazards 2021* (RH SEPP), Chapter 2, Coastal Management gives effect to the objectives of the new *Coastal Management Act 2016* from a land use planning perspective, specifying how development proposals are to be assessed if they fall within the coastal zone.

The proposal falls within land identified as coastal environment area under Section 2.10, and coastal use area under Section 2.11 of the SEPP Chapter 2, Coastal Management. Development within land specified under Section 2.10 and Section 2.11 requires consent from the consent authority.

However, as the proposal is considered development without consent under Section 2.79(4) of SEPP TI, the proposal does not trigger an approval or development consent under the RH SEPP. As such, the provisions of the RH SEPP have not been considered further.

As noted in the SEPP TI section above, consideration has been made to the changes of SEPPs since this assessment was undertaken. The provisions of the RH SEPP are consistent with the assessment undertaken as part of this REF.

4.1.2 Local Environmental Plan

Wollongong Local Environmental Plan 2009

The proposal is located within the Wollongong LGA. Local development control and land use zoning and planning in this LGA is currently governed under the Wollongong Local Environmental Plan (LEP).

As the development can be undertaken without consent in accordance with Part 5.1 of the EP&A Act, the proposal is not subject to local environmental planning policy or development control. However, the Wollongong LEP is useful in identifying the proposal's consistency with the LEP's land use and planning policy as described in Table 4-1 below.

Table 4-1: Relevant LEP land use zoning policies

Objective	Proposal consistency
IN4 – Working Waterfront	
• To retain and encourage waterfront industrial and maritime activities • To identify sites for maritime purposes and for activities that require direct waterfront access • To ensure that development does not have an adverse impact on the environmental and visual qualities of the foreshore • To encourage employment opportunities • To minimise any adverse effect of development on land uses in other zones • To encourage development that is compatible with the characteristics of Wollongong Harbour and Belmore Basin.	• The proposal will encourage maritime activities by improving access to marine vessels • The proposal has been designed to be compatible with the characteristics of Wollongong Harbour and Belmore Basin.
RE1 – Public Recreation	
• To enable land to be used for public open space or recreational purposes • To provide a range of recreational settings and activities and compatible land uses • To protect and enhance the natural environment for recreational purposes • To cater for the development of a wide range of uses and facilities within open spaces for the benefit of the community.	• The proposal will be used for recreational purposes • The proposal will support recreational activities.
W2 - Recreational Waterways	
• To protect the ecological, scenic and recreation values of recreational waterways • To allow for water-based recreation and related uses	• The proposal will protect the recreational values of recreational waterways • The proposal will allow for water-based recreational uses.

Objective	Proposal consistency
• To provide for sustainable fishing industries and recreational fishing • To provide for the sustainable and viable economic use of Lake Illawarra and other waterways.	
W3 - Working Waterways	
• To enable the efficient movement and operation of commercial shipping, water-based transport and maritime industries • To promote the equitable use of waterways, including appropriate recreational uses • To minimise impacts on ecological values arising from the active use of waterways • To provide for sustainable fishing industries.	• The proposal will support the operation of water-based transport and maritime industries by improving access for users • The proposal will promote the equitable use of waterways.

4.2 Other relevant NSW legislation

Table 4-2 below lists the NSW legislation relevant to the proposal or the land on which the proposal would be built.

Table 4-2: Other relevant NSW legislation

Legislation and application	Relevance to proposal and further requirements
NPW Act: provides for the protection of Aboriginal heritage values, national parks and ecological values. Makes it an offence to harm Aboriginal objects, places or sites without permission.	A desktop review of the Aboriginal Heritage Information Management System (AHIMS) in accordance with Stage 1 of the Procedure for Aboriginal cultural heritage consultation and investigation revealed no known Aboriginal sites or places within 200 metres of the proposal (Appendix E). As such, an Aboriginal heritage impact permit (AHIP) under the NPW Act is not required for the proposal. Section 6.7 provides further details.
Heritage Act 1997 (Heritage Act): provides for the protection of conservation of buildings, works, maritime heritage (wrecks), archaeological relics and places of heritage value through their listing on	A Statement of Heritage Impact (SoHI) has been prepared to assess the potential impacts to listed heritage items and potential archaeological remains as a result of the proposal.

Legislation and application	Relevance to proposal and further requirements
various State and local registers. Makes it an offence to harm any non-Aboriginal heritage values without permission.	The SoHI concluded that the proposal will have a negligible impact on known heritage values within and surrounding the study area. Section 6.6 provides further details.
Roads Act 1993: provides for the construction and maintenance of public roads. Requires consent to dig up, erect a structure or carry out work in, on or over a road.	The proposal area is confined to the end of the central pier at Belmore Basin. No works are proposed on or over a road.
FM Act: provides for the protection of fishery resources and values for current and future generations. Makes it an offence to harm fisheries and resources without an appropriate assessment, inclusion of safeguards and/or the appropriate permissions to carry out certain work.	A biodiversity assessment report (BAR) was undertaken to assess the impacts to terrestrial and aquatic biodiversity (refer section 6.3). The BAR identified that the proposal would directly impact areas of low density *Halophila* sp. seagrass, low relief rocky reef macroalgae and soft unvegetated sediment. Due to the presence of suitable habitat in the study area, seven threatened species were considered to have a moderate likelihood of occurrence. However, as the habitat is suboptimal, it was determined that the proposal is unlikely to have a significant impact on the threatened species. Notification to the Department of Primary Industries (DPI) Fisheries was undertaken in accordance with Section 199 of the FM Act (refer section 5.5). DPI Fisheries confirmed that no permit under section 205 of the FM Act would be required.
BC Act: provides for a strategic approach to conservation in NSW. It includes provisions for risk-based assessment of native plant and animal impacts, including a Biodiversity Assessment Method (BAM) to assess the impact of actions on threatened species, threatened ecological communities (TECs) and their habitats.	Under the BC Act, an assessment of significance must be completed to determine the significance of impacts to threatened species, populations and/or communities or their habitat. The BAR (refer section 6.3) identified that seven threatened species under the BC and FM Act were considered to have a moderate likelihood of occurrence in the study area. Of these, it was determined that six species would unlikely occur due to the suboptimal habitat. As such, an assessment of

Legislation and application	Relevance to proposal and further requirements
	significance (AoS) under the BC Act was only prepared for White's Seahorse (*Hippocampus whitei*). The assessment concluded the proposal is unlikely to significantly impact the threatened species and a Species Impact Statement (SIS) is not required.
Protection of the Environment Operations Act 1997 (PoEO Act): focuses on environmental protection and provisions for the reduction of water, noise and air pollutions and the storage, treatment and disposal of waste. Introduces licencing provisions for scheduled activities that are of a nature and scale that have potential to cause environmental pollution. Also includes measures to limit pollution and manage waste.	The proposal would not involve undertaking or carrying out a scheduled activity. If standard controls set out in Transport for NSW guidelines and quality assurance specification are implemented and monitored, there is unlikely to be any material harm, water, noise or air pollution impact (refer to Chapter 7). Appropriate waste management controls would be introduced to classify, store, transport, and dispose of all construction and work-generated waste.
Marine Pollution Act 2012: sets out provisions to prevent pollution in the marine environment.	The proposal is unlikely to result in any oil, noxious liquid, pollutant, sewage or garbage discharge as controlled under this Act, providing relevant standard controls are implemented and monitored (refer to Chapter 7).
Crown Lands Management Act 2016 (Crown Lands Act): to provide for the ownership, use and management of the Crown land of New South Wales, to provide clarity concerning the law applicable to Crown land, to require environmental, social, cultural heritage and economic considerations to be taken into account in decision-making about Crown land, to provide for the consistent, efficient, fair and transparent management of Crown land for the benefit of the people of NSW, and to provide for the management of Crown land having regard to the principles of Crown land management.	Wollongong Harbour and Belmore Basin are identified as Crown Lands. However, Wollongong Harbour and Belmore Basin are under management of TfNSW. Further approval from Crown Lands is not required however informal ongoing consultation will continue.
Contaminated Land Management Act 1997 (CLM Act)**:** Must report to EPA if contaminated land is encountered during the works that meets the duty to report	The Contamination Assessment Report DTIRIS 15/190 – Wollongong Harbour Central Pier (CAR) (Coffey, 2016) prepared for the proposal details the site

Legislation and application	Relevance to proposal and further requirements
contamination requirements under Section 60 of this Act Aims to establish a process for investigating and (where appropriate) remediating land that the EPA considers to be contaminated significantly enough to require regulation under Division 2 of Part 3. The Act aims to set out accountabilities for managing contamination if the EPA considers the contamination is significant enough to require regulation under Division 2 of Part 3.	history and contaminants of potential concern (COPC). The CAR identified contamination from lead, asbestos, petroleum hydrocarbon and heavy metals in close proximity to the study area that potentially pose unacceptable risks to human health and the environment. Section 6.1 provides further details.
Biosecurity Act 2015 (Biosecurity Act): The object of this Act is to provide a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, dealing with biosecurity matter, carriers and potential carriers, and other activities that involve biosecurity matter, carriers or potential carriers.	Three priority weeds listed under the Biosecurity Act for the Greater Sydney region were recorded in the vegetated areas in the study area during the field survey for the BAR. Reporting and managing biosecurity risks in the marine environment is considered a general biosecurity duty under the Biosecurity Act.
Water Management Act 2000 (WM Act): defines certain types of development and activities to be carried out within 40 metres of a waterbody's mean high-water mark (MHWM) as controlled activities that require approval.	The proposal is located within 40 metres of a shoreline MHWM. However, as a public authority, Transport for NSW is exempt from the need to obtain a controlled activity approval under Clause 38 of the *Water Management (General) Regulation 2011*.

The proposal is mapped as coastal environment area and coastal use area under the RH SEPP. The RH SEPP gives effect to the objectives of the CM Act.

Table 4-3 lists the objectives of the CM Act and whether the proposal is consistent with the objectives.

Table 4-3: Coastal Management Act 2016 Clauses 8 and 9 objectives

Objectives	Relevance to proposal
8 (2)(a) to protect and enhance the coastal environmental values and natural processes of coastal waters, estuaries, coastal lakes and coastal lagoons, and enhance natural character, scenic value, biological diversity and ecosystem integrity	The proposal would not significantly impact on the coastal environmental values and natural processes of coastal waters. Biological diversity and ecosystem integrity are unlikely to be impacted.

Objectives	Relevance to proposal
8 (2)(b) to reduce threats to and improve the resilience of coastal waters, estuaries, coastal lakes and coastal lagoons, including in response to climate change	The proposal would have a neutral impact to coastal waters and estuaries.
8 (2)(c) to maintain and improve water quality and estuary health	The proposal would maintain the long-term water quality and ecological environment provided the safeguards and management measures in this Chapter 7 of this REF are implemented.
8 (2)(d) to support the social and cultural values of coastal waters, estuaries, coastal lakes and coastal lagoons	Social and cultural values have been considered in the design process by providing safe access for Belmore Basin users to marine vessels.
8 (2)(e) to maintain the presence of beaches, dunes and the natural features of foreshores, taking into account the beach system operating at the relevant place	Beaches and dunes would not likely be impacted by the proposal.
8 (2)(f) to maintain and, where practicable, improve public access, amenity and use of beaches, foreshores, headlands and rock platforms	The proposal would likely have short term impacts to public access to the end of the central pier, however the proposal would provide long term improvements to access.
9 (2)(a) to accommodate both urbanised and natural stretches of coastline. (i) the type, bulk, scale and size of development is appropriate for the location and natural scenic quality of the coast, and	The proposal is appropriate for the location and consistent with adjoining boating infrastructure.
(ii) adverse impacts of development on cultural and built environment heritage are avoided or mitigated, and	Heritage impacts have been considered in sections 6.6 and 6.7, and safeguards and management measures are detailed in Chapter 7.
(iii) urban design, including water sensitive urban design, is supported and incorporated into development activities, and	Urban design has been considered during the design process.
(iv) adequate public open space is provided, including for recreational activities and associated infrastructure, and	During construction, the proposal would impact the users of Belmore Basin and limit access to the area for fishing, recreation and berthing.
(v) the use of the surf zone is considered	The proposal would not impact the surf zone.

Objectives	Relevance to proposal
9 (2)(b) to accommodate both urbanised and natural stretches of coastline.	The proposal would retain a coastline similar to the existing environment.

4.3 Strategic Plans

4.3.1 Illawarra Shoalhaven Regional Plan

The Illawarra Regional Plan 2041 sets the strategic framework for the region, aiming to protect and enhance the region's assets and plan for a sustainable future. It is a 20-year land use plan prepared in accordance with section 3.3 of EP&A Act and applies to the local government areas of Wollongong, Shellharbour, Kiama and Shoalhaven.

The Plan sets out 30 individual objectives aimed at driving growth and change within the region. These objectives and the broader plan have been developed in collaboration with Local and State Government agencies. The proposal aligns with the intent of these objectives through the enhancement of public infrastructure while incorporating environmental, social and economic considerations throughout the project life cycle.

4.3.2 Wollongong Local Strategic Planning Statement 2020

Wollongong City Council (WCC) has prepared a Local Strategic Planning Statement to provide a 20-year land use planning vision for the City. It has drawn on many existing local and regional strategies and plans developed, exhibited and adopted by council.

A Local Strategic Planning addresses the following criteria to support growth within the Wollongong LGA:

- Jobs and Economic Growth
- Housing for All
- Inclusive and connected communities
- Climate Action and Resilience
- Protect the Natural Environment
- Enabling Infrastructure and Transport
- Key Localities- local strategies, character and visions.

The study area of this REF falls within the footprint of the Wollongong Local Strategic Planning Statement (Ward two) and aligns with the relevant objectives identified in the Plan.

4.4 Commonwealth legislation

4.4.1 Environment Protection and Biodiversity Conservation Act 1999

Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) a referral is required to the Australian Government for proposed 'actions that have the potential to significantly impact on matters of national environmental significance

(MNES) or the environment of Commonwealth land'. These are considered in Appendix A and Chapter 6 of the REF.

The study area is not part of any World Heritage sites, National Heritage places, wetlands of international importance, Commonwealth marine areas, the Great Barrier Reef Marine Park, nor is it associated with nuclear actions or water resources associated with coal seam gas development or large coal mining development.

The assessment of the proposal's impact on MNES and the environment of Commonwealth land found that there is unlikely to be a significant impact on relevant MNES or on Commonwealth land. Accordingly, the proposal has not been referred to the Australian Government Department of Climate Change, Energy, the Environment and Water (DCCEEW) under the EPBC Act.

4.4.2 Disability Discrimination Act 1992

The DDA is the Commonwealth legislation that seeks to provide equity for people with disabilities. The main objectives of the DDA include the elimination, as far as possible, of discrimination against persons on the grounds of disability in relation to access to premises and the provision of facilities and services. The proposal has been designed to respond to the requirements of this Act.

4.4.3 Commonwealth Native Title Act 1993

The *Commonwealth Native Title Act 1993* aims to recognise and protect native title. It does this through establishing ways and standards in which future dealings affecting native title may proceed, including providing procedural rights for registered native title claimants and native title holders in relation to acts which affect native title. This is monitored through the National Native Title Tribunal.

4.5 Confirmation of statutory position

The proposal is categorised as development for the purpose of wharf or boating facilities to be carried out on any land by or on behalf of a public authority. Under Section 2.79(4) of the SEPP TI, the proposal is permissible without consent. The proposal is not State significant infrastructure and is subject to environmental impact assessment under Division 5.1 of the EP&A Act.

Accordingly, Transport for NSW, as a public authority, is the determining authority for the proposal, with this REF fulfilling the obligation under Section 5.5 of the EP&A Act 'to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the activity'.

5 Consultation

This chapter discusses the consultation undertaken to date for the proposal and the consultation proposed for the future.

5.1 User Needs Analysis

The Wollongong Harbour | Belmore Basin Mooring Plan and Concept Design for Supporting Infrastructure User Needs Analysis (UNA) (AECOM, 2019b) was undertaken as part of the Wollongong Harbour | Belmore Basin Mooring Plan and Concept Design for Supporting Infrastructure Concept Design Report (CDR) (AECOM, 2019a).

The purpose of the UNA was to:

- Collate data
- Understand the needs of the main users of Belmore Basin
- Consider all feedback to inform the concept design.

5.1.1 Community and stakeholder involvement

Representatives from user groups of Belmore Basin were invited on site to provide suggestions and investigate user needs on 11 September 2019. Representatives from charter vessel owners, trawler fishermen, the Wollongong Yacht Club and the Wollongong Paddlers were present.

Table 5-1 summarises the key issues identified. No additional amenities will be provided.

Table 5-1: Summary of key issues raised during UNA (Source: AECOM, 2019b)

Topic	Issue
Access	• Safe vessel access (for all users) • Consistent / safe boat ladder access • Water level access for recreational boats.
General	• Parking management and anti-social driver behaviour • General harbour management including governance.
Berthing	• Consistent approach to mooring including alternatives to quay side bollards for smaller boats • Tyres seen as acceptable as fenders but seem to be causing damage to boats and harbour wall • General damage being caused to the harbour wall by ‘ad hoc’ moorings, fenders and attachments
Amenities	• Need for some sort of centralised common users facility including amenities, storage and club house • The slipway was noted as an important piece of marine infrastructure to allow maintenance to both recreational and commercial vessels.

5.2 Concept Design Feedback

Key stakeholders were invited to provide feedback on the proposal's concept design on 21 November 2019.

The purpose of this consultation was to:

- Inform stakeholders of the proposal by displaying the concept design
- Obtain feedback from the stakeholders on the proposal
- Consider all feedback and provide responses.

5.2.1 Community and stakeholder involvement

Four concept design options were presented to key stakeholders.

Table 5-2 summarises the key feedback that influenced the layout and concepts of the preferred concept design of the proposal.

Table 5-2: Summary of feedback raised during concept design feedback (Source: AECOM, 2019b)

Topic	Feedback
Fuelling provision	Preference for this to be between Berths 14 and 15, and not located on the pontoon. This preference was noted by the Trawler and Charter vessel representatives. There is the opportunity for yachts to be fuelled from the pontoon via petrol tankers however no allowance has been made for permanent refuelling facilities.
Common User Berth	Location of a floating pontoon on the end of the Central Pier acceptable.
Northern Wharf	Implementing a pontoon at the northern wharf is not acceptable. Concerns raised with vessels being offset from the wharf as a result of the pontoon, which will further constrain the basin. Access ladders deemed to be a safe means of vessel access along the wharf on the northern sea wall of the basin.
Berthing Infrastructure	Concerns raised about the level of energy abruption and impact on larger vessels (such as the Trawlers) when berthing against the berthing piles; and the need for fenders to be provided.
Mooring Infrastructure	Concerns raised about the robustness of the mooring cleats for the larger vessels (such as the Trawlers).

5.3 Aboriginal community involvement

Aboriginal heritage impacts have been considered under the four-stage *Procedure for Aboriginal Heritage Cultural Heritage Consultation and Investigation* (PACHCI) (RMS, 2011). The PACHCI is outlined in Table 5-3.

Table 5-3: Summary of the Procedure for Aboriginal Cultural Heritage Consultation and Investigation

Stage	Description
Stage 1	Initial desktop assessment
Stage 2	Site survey and further assessment
Stage 3	Formal consultation and preparation of a cultural heritage assessment report
Stage 4	Implement environmental impact assessment recommendations

Stage 1 of the PACHCI process was completed for the proposal on 19 November 2021 (Appendix E). A desktop review of the AHIMS revealed no known Aboriginal sites or places within 200 metres of the proposal. As such, an AHIP under the NPW Act is not required for the proposal and no further consultation is necessary.

5.4 SEPP TI consultation

Appendix B contains a SEPP TI consultation checklist that documents how SEPP TI consultation requirements have been considered.

Pertaining to the SEPP TI, Transport for NSW is required to consult with WCC under clause 13 (Consultation with Councils – development with impacts on council related infrastructure) and clause 14 (Consultation with Councils – development with impacts to local heritage) due to the potential impacts on:

> *Clause 13(1)e – Installation of a temporary structure on, or the enclosing of, a public place that is under a council's management or control that is likely to cause a disruption to pedestrian or vehicular traffic that is not minor or inconsequential*
>
> *Clause 14(1)a – Development that is likely to affect the heritage significance of a local heritage item, or of a heritage conservation area, that is not also a State heritage item, in a way that is not minor or inconsequential.*

A formal SEPP TI letter for the proposal was issued on 18 November 2021 to WCC.

Issues that have been raised as a result of this consultation are outlined below in Table 5-4.

Table 5-4: Issues raised through SEPP TI consultation

Issue raised	Response/where addressed in REF
General	
It is unclear how this project 'fits' within the Master Plan implementation. It is understood that Maritime Infrastructure Delivery Office (MIDO) has a number of projects in development or proposed for delivery in Wollongong Harbour.	The proposal forms a part of the short to medium term vision of the WHMP, addressed in section 2.1.
Wollongong is hosting the Union Cycliste Internationale (UCI) Road World Championships in	Noted. Construction of the proposal will commence after

Issue raised	Response/where addressed in REF
September 2022. No construction activity should be commenced or underway during the lead up and the actual event. Course details are now available on the wollongong2022.com.au website. It is noted that the project is likely to start following the UCI event which will limit impact during UCI.	the UCI Road World Championships.
A Traffic Impact Assessment Study (TIAS) will need to be prepared by a suitably qualified consultant and be prepared in accordance with Table 2.1 of the Guide to Traffic Generating Development (RTA, 2002) and include the following: • A car parking / traffic impact assessment should refer to AS2890, AUSTROADS and Transport for NSW current standards • Recommendations as to the provision of new pedestrian facilities such as pedestrian footways, pedestrian refuges and / or necessary upgrading of any existing footway, in order to encourage pedestrian access to all transport modes from the proposed land use/development • The findings of the analysis are to be addressed in the Car Parking / Traffic Impact Assessment Study with appropriate recommendations as to whether road upgrading, car park upgrades and / or other traffic management works are necessary to enable the proposed development.	Noted. A TIAS will be prepared prior to construction by a suitably qualified consultant and address the points listed. Refer to section 6.8 for more details.
Where the proposed development land use does not identify within the Guide to Traffic Generating Development (RTA, 2002), a parking demand analysis is to be completed addressing the following: The car parking component of the study must include: • A detailed car parking survey of similar development located in localities which demonstrate similar traffic and parking demand characteristics • Assessment of the current traffic flow conditions in the local road network and performance of key intersections in the locality	The proposal falls under an identified land use within the Guide to Traffic Generating Development (RTA, 2002). A parking demand analysis is not required.

Issue raised	Response/where addressed in REF
• Assessment of existing on-street car parking and whether the locality is experiencing traffic and on-street parking congestion issues • (d) Anticipated traffic generation rate for the development • Assessment as to likely impact of the development on traffic flows and traffic safety within the local road network and the demand for on-street parking in the future as a result of the proposed development; and • Assessment of the on-site car parking requirements based on the detailed car parking survey of other similar developments and localities.	
The development of the pontoon, by increasing boating services and facilities will increase demand on existing infrastructure and allied services such as toilets, lighting, fish cleaning facilities, fish line recycling bins, pedestrian access, car parking, way finding signage etc. Planning and provision of key allied assets should be considered as part of the proposal.	Existing infrastructure and utilities have been considered in section 2.2 and section 6.12.
A risk assessment and safety management plan for the area including the proposed pontoon should be undertaken and implemented.	Hazards and risks have been assessed in section 6.12.
Coordination and consultation with Property + Recreation and Events team at Council is recommended. The pontoon would potentially be impacted by fireworks exclusion zones or other significant events impacting on the Harbour precinct. MIDO will need to ensure through any lease or licence that the area can be kept free of individuals and boats for New Year's Eve and Australia Day (or any other event) if required.	Noted. Transport for NSW will consult with Property + Recreation and Events team at Council to coordinate exclusion zones and restricted access during special events.
The current proposal could create further conflict with the current location of bins – we note the Master Plan includes provision of service truck turning bay in line with Master Plan (12) - this should be considered as part of the proposal.	Access to existing waste infrastructure will not be impacted during construction or operation of the proposal. The proposal will not interfere with the provisioned service truck turning bay.
Heritage	
The proposed pontoons will need to be carefully designed with consideration to attachment	Potential non-Aboriginal heritage impacts and

Issue raised	Response/where addressed in REF
methodologies and potential impacts on significant Harbour Fabric. It is noted that this is highlighted in the concept considerations.	safeguards are addressed in section 6.6.
Guidance should be sought from the Wollongong Harbour Conservation Management Strategy, and advice obtained from a suitably qualified and experienced heritage consultant to consider the pontoon design options to limit potential impacts. The heritage impacts of associated infrastructure and improvements will also require careful thought and consideration.	
Construction of supporting infrastructure including car parking re-configuration, installation of turfed areas, installation of Surf Ski racks and other park furniture, and shower facilities and associated water supply have the potential to impact on archaeological sites and resources. The potential archaeological impacts will require careful consideration and planning and will need to be addressed within the approval process under the Heritage Act.	
It is unclear whether the proposed works will require a Development Consent process from Council, but if so, an Integrated Development Application would be anticipated to be the preferred method of approval.	Development Consent is not required from Council as indicated in Chapter 4.
Council's heritage staff would appreciate being kept informed of the progression of the proposal and of project progression.	Noted. Transport for NSW will inform Council's heritage staff of progression of the proposal.
The lands and waters on which Wollongong Harbour is located are known to have a high level of cultural significance to the local Aboriginal Community, and represent a significant food gathering area which was used extensively by local Aboriginal Communities for thousands of years prior to 'settlement'. Consideration should be given to engagement with the Local Aboriginal Community in relation to the proposal and any Aboriginal Cultural Heritage issues that may be relevant.	Potential Aboriginal heritage impacts are addressed in section 6.7.
Adjacent Proposals	
You are also advised that Council has been contacted by Wollongong Yacht Club regarding a proposal for an Open Sports Club (OSC) adjacent to this site in response to the endorsed Master Plan for Wollongong Harbour.	Noted. Transport for NSW will liaise with Wollongong Yacht Club to minimise cumulative impacts from adjacent proposals. Cumulative impacts are addressed in section 6.15.

5.5 Government agency and stakeholder involvement

The following government agencies and stakeholders have been consulted regarding the proposal:

- DPI Fisheries.

Issues that have been raised as a result of consultation with these agencies and stakeholders are outlined in Table 5-5.

Table 5-5: Issues raised through government agency consultation

Agency	Issue raised	Response/where addressed in REF
DPI Fisheries	A copy of the completed REF and BAR is to be provided to DPI Fisheries and will constitute a s199 notification for dredging and reclamation.	Noted, a copy of the draft REF and BAR were provided to DPI Fisheries on 8 February 2022.
	No objections to the proposal as proposed.	Noted.
	A section 205 permit under Part 7 of the FM Act is not required for this proposal.	Noted.
	No relocation of seahorses is required.	Noted and addressed in section 6.3.
	Erosion and sediment mitigation devices are to be erected in a manner consistent with current Best Practice Management (i.e. Managing Urban Stormwater: Soils and Construction 4th Edition Landcom, 2004). These are to be maintained in good working order for the duration of the pontoon installation works	Noted and addressed in section 7.2.
	DPI Fisheries (1800 043 536) and the EPA (131 555) is to be notified immediately if any fish kills occur in the vicinity of the works. In such cases, all works other than emergency response procedures are to cease until the issue is rectified and approval is given by DPI Fisheries and/or the EPA for the works to proceed.	Noted and addressed in section 7.2.

5.6 Ongoing or future consultation

This REF will be placed on public display for comment by Government agencies, stakeholders and the community. Following the public display period, Transport for NSW will collate and consider the submissions received then determine whether the

proposal should proceed as described or whether any changes are required. Transport for NSW will also decide if any additional environmental assessment, safeguards or management measures are needed.

A submissions report will be published, which will respond to the comments received. Transport for NSW will notify those who made submissions and distribute a community update. The update will summarise the submissions report process and the actions Transport for NSW took to address these comments. Transport for NSW will also meet with affected residents, businesses and other stakeholders, if required.

6 Environmental assessment

This section of the REF provides a detailed description of the potential environmental impacts associated with the construction and operation of the proposal. All aspects of the environment potentially impacted upon by the proposal are considered. This includes consideration of the factors required under clause 171(1) of the Environmental Planning and Assessment Regulation 2021. The factors specified in clause 171(2) of the Environmental Planning and Assessment Regulation 2021 are also considered in Appendix A.

Site-specific safeguards and management measures are provided to mitigate the identified potential impacts.

6.1 Land surface and hydrology

This section describes the existing land surface and hydrology and potential impacts associated with the proposal.

6.1.1 Methodology

Waterside

Published mapping and data were used to define the hydrodynamic and physical characteristics of the aquatic environment. This included:

- Hydrographic and bathymetric mapping and data
- Climate data (BoM, 2021a)
- NSW Tide Tables (BoM, 2021c)
- Revised Wollongong Harbour Coastal Processes and Hazard Study (Cardno, 2007).

Landside

Published mapping and data were used to define physical characteristics of the terrestrial environment. This included review of:

- Wollongong 1:50,000 Geological Series Sheet 9029-11 (Bowman & Stewart, 1974)
- NSW EPA online contaminated land register and notified sites
- Wollongong LEP Acid Sulfate Soils (ASS) risk maps
- CDR (AECOM, 2019a)
- Wollongong Harbour Remediation Project REF (PWA, 2017)
- CAR (Coffey, 2016).

Construction assessment

The assessment considered how the proposed construction activities, work methods, and required management controls would temporarily affect the physical characteristics of the aquatic and terrestrial environment including localised sediment and pollutant disturbance and dispersion.

Operational assessment

The operational assessment considered how the final aquatic and terrestrial infrastructure would potentially result in hydrodynamic changes in terms of erosion and scour.

6.1.2 Existing environment

Waterside

The study area is located within Wollongong Harbour, approximately one kilometre north east of the Wollongong city centre, along the south coast of NSW. Wollongong Harbour is a tide dominated, open entrance harbour leading into the Pacific Ocean.

Tides

Water levels for Wollongong Harbour are subject to ocean tides. The nearest major station monitoring tide and sea levels is Port Kembla, approximately 5.8 kilometres south of Wollongong Harbour. The tide and sea level conditions at Port Kembla are as follows (BoM, 2021c; Cardno, 2007):

- Water levels are dominated by semi-diurnal astronomical tides meaning that two high and two low tides normally occur each day
- Tidal range up to approximately two metres
- Australia Height Datum (AHD) is approximately 0.87 metres above LAT (0.0 metres)
- Mean sea level is 0.914 metres chart datum (CD)
- Maximum recorded sea level of 2.2 metres CD (August 2001)
- Minimum recorded sea level of -0.2 metres CD (December 1994).

Currents

Local currents may be attributed to tidal flows, wind shear, propeller wash and localised flows at stormwater outlets. Currents may also be generated by the passing of other vessels nearby.

Waves and bathymetry

The offshore wave climate along the Wollongong coast is dominated by south and southeast swell conditions. Mean wave conditions are typically wave heights of approximately 1.5 metres with wave periods of six seconds (Cardno, 2007).

Wollongong Harbour wave conditions are mainly influenced by diffraction between the breakwaters. Reflections from vertical structures, most significantly near the boat ramp, also influence wave conditions within the harbour (Cardno, 2007).

Wave conditions along the breakwaters are strongly influenced by the local bathymetry. To the east of the eastern breakwater, the offshore bathymetry features steep transitions that cause complex wave transformation. As a result, the breakwaters are potentially exposed to large breaking wave conditions (Cardno, 2007).

The Wollongong Harbour is also subjected to vessel generated waves which are governed by the submerged shape of the boat hull, the boat speed and the water depth.

Storm surge

During extreme events, the water level can be elevated higher than the predicted tidal level due to barometric pressure, wind and wave setup. This increase in water level due to reduced barometric pressure and wind setup is known as storm surge.

The south coast region of the NSW coastline is subject to storm surge during intense storm systems commonly referred to as 'East Coast Lows' (ECL). These storms can form from strong frontal systems passing through the southern Tasman Sea or from remnant tropical weather systems. The 100-year ARI storm surge level is 1.8 metre AHD at Wollongong Harbour and 1.85 metre AHD within Belmore Basin, based on Delft3D-FLOW modelling by Cardno (2007).

Long period oscillations (Seiching) have been observed in Belmore Basin (Wollongong Harbour) over a long period of time. Due to the reflective nature of the edge treatments in the basin, a standing wave can be developed inside the basin when external forcing near the natural period of oscillation of the basin is applied. Seiching is most frequently observed during south-easterly and east-south-easterly storm wave conditions.

Wind conditions

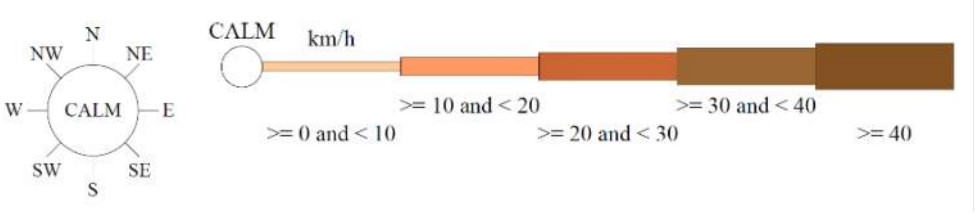
Bellambi (Bellambi AWS) weather station (station number 068228), the closest available weather station, is located about 7.6 kilometres to the north of the study area. Annual morning and afternoon wind rose directional data is summarised in Table 6-1 (BoM, 2021a) and shown in Figure 6-1.

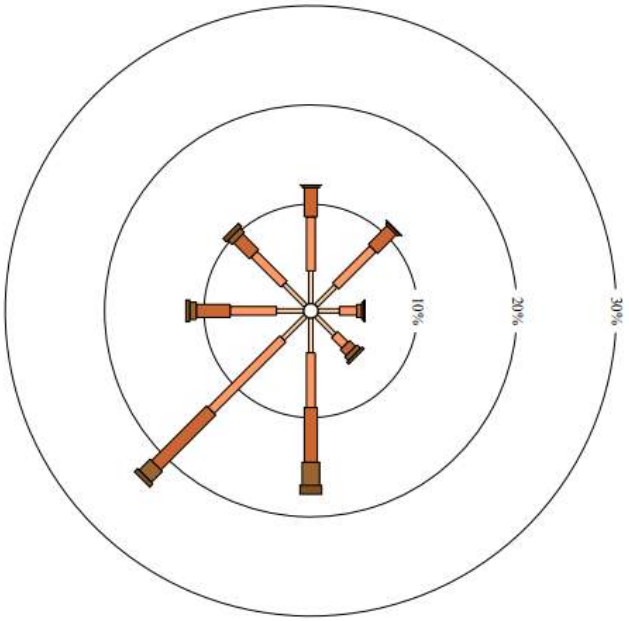
Afternoon winds are generally stronger than morning winds, averaging 23.3 kilometres per hour with morning winds averaging 17 kilometres per hour (BoM, 2021a).

Table 6-1: Annual wind conditions at Bellambi (Bellambi AWS) weather station (Source: BoM, 2021a)

	N	NE	E	SE	S	SW	W	NW	Calm
9am	12%	11%	5%	6%	18%	23%	12%	11%	4%
3pm	12%	28%	8%	12%	22%	5%	8%	3%	<0.5%

Bellambi (Bellambi AWS) Site No. 068228
29 April 1997 to 10 August 2021





9am (Calm 4%)

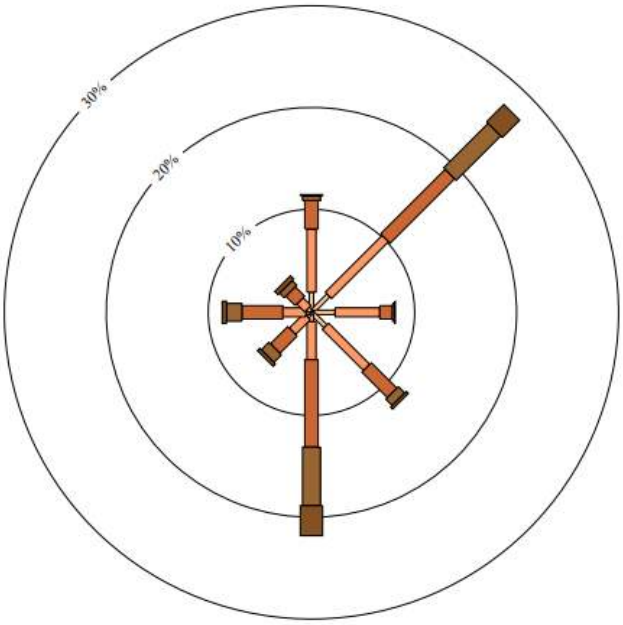


Figure 6-1 Annual Bellambi rose of wind direction versus wind speed (Source: BoM, 2021a)

3pm (Calm <0.5%)

Acid sulfate soils

A review of the Wollongong LEP ASS risk maps revealed that some areas of Belmore Basin lies within Class 5 ASS risk potential. ASS are not typically found in Class 5 areas but are located within 500 metres to adjacent Class 1, 2, 3 or 4 areas.

ASS risk within the study area is not defined on the Australian Soil Resource Information System (ASRIS).

Landside

The landside portion of the study area encompasses the end of the central pier of Belmore Basin at Wollongong Harbour.

Geology and topography

The Wollongong 1:50,000 Geological Series Sheet 9029-11 (Bowman & Stewart, 1974) accessed from NSW DPIE indicates the study area is underlain by Budgong Sandstone of the Shoalhaven Group. Budgong Sandstone is typically red, brown and grey volcanic sandstone. The bedrock lies close to the surface, protruding from the seabed in numerous locations inside the Wollongong Harbour.

The landside topography of the study area is generally level as the central pier of Belmore Basin is a man-made concrete and asphalt structure (PWA, 2017). Within the study area, the decommissioned pilot's slipway has a steep gradient across a length of approximately 17 metres, from the central pier into the harbour. The central pier itself sits approximately two metres above the surface of water.

Soils

Soil within Wollongong Harbour likely consists of natural silty clay residual soils, weathered sandstone and fill soils that were locally re-worked from the adjacent Belmore Basin excavation. Fine to medium grained marine sands are likely present along the western boundary of the Wollongong Harbour (Coffey, 2016). Along Brighton Beach, areas are composed of a finer fraction of soils overlying coarser alluvial deposits (Cardno, 2007).

Contamination

A contamination assessment was undertaken for the central pier (Coffey, 2016) to understand potential contamination risks for proposed upgrades to Wollongong Harbour. The assessment identified lead, tributyltin (TBT), copper, zinc and petroleum hydrocarbon contaminants in soil and groundwater samples associated with the former ship maintenance facilities on the central pier. The contaminated site lies adjacent to the study area.

The contamination assessment also conducted a search of the Public Register under the PoEO Act and found one surrendered environmental protection licence (EPL) located at Belmore Basin. Surrendered in 2013, the EPL was licenced to Wyemelt Pty Ltd operating as Wollongong Slipway Services. The licence was for the fee-based activity of boat construction and maintenance associated with scheduled activity of marinas and boat repairs. The location of this operation correlates with the contamination identified by Coffey (2016). This site was remediated with the audit for the remediation works completed in 2020 by GHD.

A desktop review of the NSW EPA Contaminated Land Record of Notices and contaminated sites notified to the EPA was conducted on 18 November 2021. The Contaminated Land Record of Notices did not list any known contaminated sites within 200 metres of the study area. One contaminated site notified to the EPA was identified

adjacent to the study area. Details of the site are summarised in Table 6-2. The location of the site correlates to the PoEO Act Public Register site and the contamination identified in the CAR (Coffey, 2016).

Table 6-2: Contaminated sites notified to the EPA

Site Name	Address	Activity	EPA Management Class	Distance and Direction
Wollongong Harbour Central Spur	Belmore Basin	Other Petroleum	Regulation under CLM Act not required	Adjacent to north east of study area

Acid sulfate soils

A review of the Wollongong LEP ASS risk maps revealed that the central pier lies within Class 5 ASS risk potential. ASS are not typically found in Class 5 areas but are located within 500 metres to adjacent Class 1, 2, 3 or 4 areas.

6.1.3 Potential impacts

Construction

Waterside

Hydrodynamic effects

The proposal involves activities that would cause physical disturbance to the aquatic environment. This includes piling and the installation of the prefabricated elements of the waterside features. The scale of the disturbance would be minimal and insufficient to cause any dynamic changes in current speed, wave characteristics, saline/freshwater mixing or flushing during construction.

Localised sediment disturbance and smothering

Potential disturbance of seabed sediments during installation of waterside elements would be localised and temporary in nature.

Locally, the distributed coarser sediments would settle out of suspension almost immediately while the finer sediments could mobilise over a greater area as they would remain buoyant in the water column. Disturbance of sediments would be minimised through the work methodology, including applying silt curtain mitigation techniques and progressing the work in sections which would allow sediments to settle between works.

Erosion and scour

Any work taking place in the aquatic environment has the potential to cause erosion and scour. This is caused from introducing new structures typically on, or close to, the seabed, as this may alter sediment transport patterns.

During construction of the proposal, the temporary use of jack-ups during lifting and piling work would be the only equipment that would impact on the seabed. However, the associated equipment would typically only be in place short term. Some localised impacts are expected within a few metres of where the jack point would be temporarily installed, however this would be an insufficient amount of time to cause any material scour or erosional impacts.

Contamination and ASS

Parts of the waterside portion of the study area are classed as Class 5 ASS risk. Class 5 areas do not typically contain ASS. Therefore, impacts to potential ASS are expected to be low. Due to the recent remediation works at the harbour and in accordance with the findings of the contamination assessment undertaken by Coffey (2016), it is unlikely that contaminated material will be disturbed as a result of the proposed works.

Landside

Erosion and sedimentation

Construction of the proposal would involve minor earthworks associated with the installation of service cabling to the waterside features and the installation of signage for the permanent unloading zone.

During construction, soils and loose concrete fragments would be exposed, potentially leading to erosion and sedimentation of the harbor. However, given the minor nature of the earthworks, erosion and sedimentation impacts are expected to be low. This would be managed through the implementation of management measures and controls to reduce the impact of erosion and sedimentation.

Contamination and ASS

The CAR (Coffey, 2016) identified a contaminated site adjacent to the north east of the study area. Coffey (2016) concluded that the lead and asbestos contamination may present a risk to future users of the contaminated site. Further, petroleum hydrocarbon contamination may present an unacceptable risk to future site users through direct contact and vapour inhalation. Both heavy metal and petroleum hydrocarbon contamination in soil and groundwater could migrate over time towards Belmore Basin. The minor earthworks, required for the signage installation, utilities installation and for the permanent unloading zone is unlikely to disturb contaminated materials given the limited footprint of the works.

Accidental material spill within the compound area may occur from storing, handling and/or transferring the required small volumes of welding materials, lubricants, solvents, fuels, oils and diesels. Potential impacts would be mitigated through the appropriate management of the storage of such materials.

The central pier is identified as having Class 5 ASS risk. Class 5 areas do not typically contain ASS. Therefore, impacts to potential ASS are expected to be low.

Operation

Waterside

Erosion and scour

New piles will be installed for the proposal. As water flows around these structures there is the potential to create local scour and erosion. However, the only expected impacts would be limited to within a few metres of each pile given that:

- The low dynamic character close to the bed around the piles located within the sub-benthic sediments
- The limited amount of sediment substrate locally
- No bed anchoring will occur, only anchoring through use of existing land side bollards.

Local sediment conditions would adjust over time.

Sedimentation

During operation, marine vessel movement and volume are expected to be similar to pre-proposal conditions. As such, impacts to sedimentation are expected to be low.

Landside

New signage and line marking for the permanent unloading zone will be installed on the land side of the study area. The existing asphalt hard surface will be utilised and no landside operational impacts to land surface and hydrology is anticipated to result from the proposal.

Transport, access and parking is discussed in detail in section 6.8.

6.1.4 Safeguards and management measures

Table 6-3 lists the safeguards and management measures that would be implemented to protect the land surface and hydrology to account for the impacts identified in section 6.1.3.

Table 6-3: Land surface and hydrology safeguards and management measures

ID	Impact	Environmental safeguards	Responsibility	Timing
LS1	Soil and water	A soil and water management plan (SWMP) will be prepared and implemented as part of the CEMP. The SWMP will identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks will be addressed during construction.	Contractor	Pre-construction
LS2	Soil and water	Any excavated sediments or soil that require disposal will be sampled, tested and classified in accordance with the EPA's *Waste Classification Guidelines: Part 1 Classifying Waste* (EPA, 2014) prior to being disposed of at a waste facility licensed to accept the relevant class of waste. Any materials classified as Hazardous Waste may require treatment or an immobilisation approach in accordance with Part 10 of the *Protection of the Environment Operations (Waste) Regulation 2014* prior to off-site disposal.	Contractor	Construction
LS3	Contaminated land	If unexpected contaminated areas are encountered during construction, appropriate control measures will be implemented to manage the immediate risks of contamination. All other works that may impact on the contaminated area will cease until the nature and extent of the contamination has been confirmed and any necessary site-specific controls or further actions identified in consultation with the Transport for NSW Environment Manager and/or EPA.	Contractor	Construction
LS4	Contaminated land	The piling activity will mitigate the risk of sediment dispersal by applying industry best practice of minimising sediment disturbance during construction using pilling methods or any other seabed interference.	Contractor	Construction

ID	Impact	Environmental safeguards	Responsibility	Timing
LS5	Erosion and scour	No bed anchoring is to occur. The barge must use land side anchor points.	Contractor	Construction
LS6	Erosion and scour	The contractor will consider the swell conditions when implementing the silt curtain. Works associated with positioning barges, drilling and pile driving will occur during calm conditions and must not occur when a weather alert has been issued to prevent excessive scouring and other impacts.	Contractor	Construction
LS7	Erosion and sedimentation	Prior to commencement of construction activities, a sediment control device (such as sediment boom and curtain) will be installed around the site to contain disturbed sediment from the water surface by allowing suspended sediments to settle back on the bottom of the seabed overtime. The silt boom and curtain will be installed in accordance with the manufacturers specification for installation. Installation will be undertaken during high tide periods from a boat as tides, currents, the weather and wind could impact the level of erosion and sedimentation. The device will be designed to rise and fall with the tide to prevent disturbance. Inspection of the device will be undertaken on a daily basis after ebbing tides, with additional inspection carried out following storm events. Prior to removing the sediment control device, conditions within the curtain will be assessed visually and with a field instrument to verify that sediment has settled resulting in similar water turbidity to that outside the curtain.	Contractor	Construction
LS8	Erosion and sedimentation	Site specific Erosion and Sediment Control Plan/s will be prepared and implemented as part of the SWMP. Control measures are to be implemented and maintained (in accordance with the *Managing Urban Stormwater, Soils and Construction Guidelines* “the Blue Book” (Landcom, 2004)) to: • Minimise sediment dispersal during piling	Contractor	Pre-construction

ID	Impact	Environmental safeguards	Responsibility	Timing
		• Prevent sediment moving off-site and sediment laden water entering any water course, drainage lines, or drain inlets • Reduce water velocity and capture sediment on site • Minimise the amount of material transported from site to surrounding pavement surfaces • Divert clean water around the site.		
LS9	Erosion and sedimentation	Visual monitoring of local water quality (i.e. turbidity, hydrocarbon spills/slicks) will be undertaken on a regular basis each day as works are undertaken to identify any potential spills or deficient silt curtains or erosion and sediment controls. Results of the observations are required to be recorded. Records are required to be kept on the site and to be made available for inspection by persons authorised by Transport for NSW.	Contractor	Construction
LS10	Design changes	If there are significant changes to the design or layout of piles then further delineation assessment of the known contamination will be undertaken to evaluate the vertical and lateral extent of sediment impact prior to work commencement.	Transport for NSW	Detailed design

6.2 Water quality

This section describes the existing water quality at Wollongong Harbour and potential impacts associated with the proposal.

6.2.1 Methodology

Published mapping and data were used to define the water quality characteristics of the study area. This included:

- State of the Beaches Annual Reports 2011-2021 (DPIE, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021d)
- Beachwatch Enterococci data download (DPIE, 2021b, 2021c)
- Wollongong Harbour Remediation Project REF (PWA, 2017)
- Revised Wollongong Harbour Coastal Processes and Hazard Study (Cardno, 2007).

6.2.2 Existing environment

Several stormwater drains discharge into Wollongong Harbour, with the largest of these a box culvert in the middle of Brighton Beach (Cardno, 2007). Stormwater is mainly generated under high rainfall events and runoff is expected to flow in all directions into the surrounding harbour (PWA, 2017).

As water quality is not currently monitored within Wollongong Harbour, beach quality data was reviewed for Wollongong City Beach located approximately two kilometres south of Wollongong Harbour and North Wollongong Beach located approximately 550 metres north of Wollongong Harbour.

Since 2011, State of the Beaches Annual Reports for Wollongong City Beach (DPIE, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021d) indicate microbial water quality is considered suitable for swimming almost all of the time, with a few potential sources of faecal contamination. Enterococci levels increase slightly with increasing rainfall and occasionally exceed the safe swimming limit following 20 millimetres of rain or more.

Similarly, since 2011, State of the Beaches Annual Reports for North Wollongong Beach (DPIE, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021d) indicate microbial water quality is considered suitable for swimming most of the time, although may be susceptible to pollution after heavy rain, with potential sources of faecal contamination. Enterococci levels increase slightly with increasing rainfall and occasionally exceed the safe swimming limit following 20 millimetres of rain or more.

Groundwater occurs from approximately 1.7 metres to 2.5 metres below the ground surface and discharges to Belmore Basin (PWA, 2017).

6.2.3 Potential impacts

Construction

The main impact to water quality during construction would be from the disturbance to sediments during placement and removal of piles. Impacts associated with the works and potential pollutants are discussed in section 6.1.3.

Accidental material spill within the compound area may occur from storing, handing and/or transferring the required small volumes of welding materials, lubricants, portaloo chemicals, solvents, fuels, oils and diesels. Equipment including the portaloo must be contained within the fenced site compound to prevent antisocial behaviour.

The materials required for the proposal would be generally inert and harmless except for the small quantities of welding materials, lubricants, solvents, fuels and oils. As such, there would be some potential for accidental spills, including:

- Accidents during loading, unloading and installation work
- Potential equipment rollover, mainly the crane if the supports are not cleanly down or are located on unstable ground
- Leaks and drips from poorly maintained machinery and equipment
- The mismanaged storage of waste materials, including potential for debris to enter the water.

These risks would be greater when undertaking work over, or in, the waterway namely:

- Drilling / hammering the piles
- Transferring equipment and machinery
- Installing the new piles and structures.

The primary impact from spills would be a decline in water quality which would have a likely impact upon the aquatic environment. The impact would depend on the quantity and type of material spilt. However, providing relevant standard controls such as those identified in section 6.1.4 and section 6.2.4 are implemented, the impacts are expected to be minimised.

Operation

No significant impacts to water quality are anticipated during operation of the proposal, as marine vessels would operate similarly to the current movements. No additional sediment disturbance is anticipated.

There is the potential for an accidental spill or discharge during operation. This would be most likely during berthing at the new pontoon. While this is the case, the same potential exists from the current berthing activities at Belmore Basin and would be managed under the standard controls already in place. As such, the impacts are expected to be safeguarded against and therefore minimised.

6.2.4 Safeguards and management measures

Table 6-4 lists the safeguards and management measures that would be implemented to protect the water quality to account for the impacts identified in section 6.2.3.

Table 6-4: Water quality safeguards and management measures

ID	Impact	Environmental safeguards	Responsibility	Timing
WQ1	Accidental spill	A spill management plan will be developed as part of the CEMP and communicated to all staff working on site. Appropriate land and aquatic/marine spill kits are to be maintained on site and on barges. Aquatic/marine spill kits must be specific for working within the marine environment. The spill kit must be appropriately sized for the volume of potentially polluting liquids stored at the work site. All workers will be advised of the location of the spill kit and trained in its use.	Contractor	Pre-construction / Construction
WQ2	Accidental spill	If an incident (e.g. spill) occurs, the *Environmental Incident Classification and Reporting Procedure* (RMS, 2018) will be followed and the Transport for NSW Contract Manager notified as soon as practicable.	Contractor	Construction
WQ3	Accidental spill	In the event of a maritime spill, the incident emergency plan will be implemented in accordance with Port Authority of NSW's response to shipping incidents and emergencies outlined in the *NSW State Waters Marine Oil and Chemical Spill Contingency Plan* (RMS, 2016d). Fisheries NSW must also be notified.	Contractor	Construction
WQ4	Accidental spill	Emergency contacts will be kept in an easily accessible location on vehicles, vessels, plant and site office. All workers will be advised of these contact details and procedures.	Contractor	Pre-construction / Construction

ID	Impact	Environmental safeguards	Responsibility	Timing
WQ5	Accidental spill	Vehicles, vessels and plant must be properly maintained and regularly inspected for fluid leaks.	Contractor	Construction
WQ6	Accidental spill	No vehicle or vessel wash-down or re-fuelling will occur on-site.	Contractor	Construction
WQ7	Accidental spill	Any chemicals or fuels stored at the site or equipment barges will be stored in a bunded area.	Contractor	Construction

6.3 Biodiversity

This section summarises the proposal's aquatic and terrestrial biodiversity. Appendix C contains a supporting technical paper prepared by Cardno (Cardno, 2022).

6.3.1 Methodology

The assessment included a desktop review of published State and Commonwealth records, data and literature to confirm the likely presence of threatened flora, fauna and endangered communities in the local environment. This was followed by a site walkover and aquatic survey of the environment within the study area. The study locality refers to an area within ten kilometres of the proposal area (for the purpose of the background search).

The following published records were reviewed:

- Wollongong 1:50,000 Geological Series Sheet 9029-11 (Bowman & Stewart, 1974)
- DPIE Sharing and Enabling Environmental Data (SEED) in NSW. Illawarra Plant Community Type Vegetation Map (2016)
- DPIE - Environment, Energy and Science (EES) Vegetation Classification
- NSW BioNet
- DPIE-EES Threatened Biodiversity Data Collection (TBDC):
    - DPI Fish Communities and Threatened Species Distribution of NSW (NSW DPI, 2022)
    - DPI Threatened species lists
    - DPI Listed Protected Fish Species
    - DPI Fisheries Spatial Data Portal. Estuarine Macrophytes 2018
- DCCEEW Protected Matters Search Tool (PMST)
- Atlas of Living Australia
- National System for the Prevention and Management of Marine Pest Incursions.

Sensitive ecological sites were identified through searches of the following:

- Regional Conservation Plans prepared by the former NSW Office of Environment and Heritage (OEH)
- Areas of Outstanding Biodiversity Value (AOBV) register
- Important Habitat to threatened species as mapped for the BAM (accessed through the Biodiversity Offsets and Agreement Management System (BOAMS))
- DPI Critical Habitat register
- DPI key fish habitat maps
- DCCEEW Register of Critical Habitat
- BoM's Groundwater Dependent Ecosystems (GDEs) Atlas
- DCCEEW Directory of Important Wetlands Australia
- RH SEPP maps

- Locations of NSW marine parks and reserves available from NSW DPI Marine Parks.

The impact assessment was prepared in accordance with *Environmental Impact Assessment Practice Note: Biodiversity Assessment* (EIA-N06, RMS, 2016b) with consideration of the:

- *Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects* (RTA, 2011)
- *Guidelines for Biodiversity Offsets* (RMS, 2016c).

Further detail on the methodology for the assessment of biodiversity is provided in Appendix C.

6.3.2 Existing environment

Waterside

Protected areas

There are no Coastal Wetland or Littoral Rainforests, as defined in the HR SEPP, in the study area. The closest Coastal Wetland Proximity Area and Coastal Wetland is Puckeys Estate Nature Reserve, approximately 0.9 kilometres and one kilometre north-west, respectively. The closest Littoral Rainforest is approximately 9.3 kilometres south of the study area at Korrungulla Wetlands.

There are no nationally important wetlands or Ramsar Wetlands in the study area or the wider study locality. No Aquatic Reserves or Marine Parks occur within the study area or the study locality.

The study locality and the study area lie outside of any Commonwealth marine areas. Further, the study area does not reside within any Commonwealth marine reserves. The closest marine reserve is Hunter Commonwealth Marine Reserve, approximately 59 kilometres south of the study area.

Marine vegetation and habitat

The waterside portion of the study area comprised of artificial seawall with steps, intertidal and subtidal areas surrounding the central pier.

A review of available mapped marine vegetation (DPI, 2022) revealed no seagrass, mangroves or saltmarsh present within the study area. The nearest occurrence of mangrove and/or saltmarsh vegetation and mapped seagrass were associated with the Gurungaty waterway, over two kilometres south west of the study area. Extensive seagrass meadows are located 2.6 kilometres south west of the study area at Lake Illawarra.

DPI Fisheries identify three types of key fish habitat (KFH) in their *Policy and Guidelines for Fish Habitat Conservation and Management* comprising:

- Type 1 (highly sensitive KFH)
- Type 2 (moderately sensitive KFH)
- Type 3 (minimally sensitive KFH).

Three distinct fish habitat zones were mapped during the field survey:

- Vertical subtidal rocky reef habitat (Type 2 KFH)
    - The lower portions of the vertical wooden piles and consolidated seawall structure were colonised by habitat-forming species commonly

found on subtidal rocky reefs such as Kelp (*Ecklonia radiata*), *Padina* sp., brown filamentous algae and sponges (*Phylum Porifera*). Dislodged seawall fragments, natural rock rubble and solid waste were also observed within one metre of the toe of the seawall and contained a similar subtidal rocky reef assemblage. These areas made up <0.01 hectares of the study area and were considered low relief.

- Subtidal soft sediment (Type 3 KFH)
    - Subtidal unvegetated soft sediment habitat occupied the largest portion of the study area (approximately 0.9 hectares) and mostly comprised of bare sand, rock rubble and some solid waste. No visible epifauna (fauna that live on the surface of the seafloor) were observed during this survey. However, infauna (fauna that live in the sediment) activity was observed during the field survey. Soft sediment epifauna and infauna play a central role in ecosystem functions by forming basal elements of many food chains.
- Seagrass (Type 2 KFH)
    - A small, low density patch of pioneering seagrass species *Halophila* sp. was recorded in the study area. The patch made up <0.01 hectares of the study area and was considered Type 2 as the area was less than five square metres.

Marine habitat within the study area is shown on Figure 6-2.

Figure 6-2: Indicative location of marine habitat within the study area (Cardno 2022)

Protected and threatened species and populations

All marine vegetation, including seagrass, saltmarsh, mangroves and macroalgae, are protected under the FM Act. The study area does not encompass saltmarsh or mangroves. However, seagrass *Halophila sp*. were found within the soft sediment and macroalgae colonised low relief rocky reefs.

Seagrass and macroalgae are considered as marine vegetation and Part 7 Division 4 of the FM Act protects marine vegetation from 'harm' in the form of gathering, cutting, pulling up, destroying, poisoning, digging up, removing, injuring or preventing light from reaching or otherwise harm marine vegetation or any part of it.

A review of the DPEE - EES BioNet database, DPI Threatened species list and the DCCEEW PMST revealed 24 threatened aquatic species (including marine plants, marine mammals, marine reptiles, fish and elasmobranchs) listed under the FM Act and/or EPBC Act with potential to occur in the study locality. A full list is provided in Appendix C.

No threatened species were observed during the field survey although visibility in the intertidal and subtidal areas was poor. However, potential habitat for some threatened species occurs in the study area. An assessment of the likelihood of occurrence of all threatened species based on the study area habitat was carried out to determine the potential for these species to occur within the study area.

Due to the presence of suitable habitat in the study area and/or known populations in the harbour, two threatened aquatic species were considered to have a moderate likelihood of occurrence. These are:

- Black Rockcod (*Epinephelus daemelii*) listed as vulnerable under the FM Act and vulnerable under the EPBC Act
- White's Seahorse (*Hippocampus whitei*) listed as endangered under the FM Act and EPBC Act.

Some species of fish have been formally protected because they are naturally scarce or their numbers have been substantially reduced over recent decades. These species are protected to help prevent them becoming threatened in the future. Twenty-two marine fauna protected under the FM Act have potential to occur within the study locality. These are listed in Appendix C.

The marine vegetation and subtidal areas of the study area form potential habitat however, these habitats are characteristic of many nearshore areas in the study locality.

Marine pests and diseases

A 2000 survey at Port Kembla, approximately 3.5 kilometres south of the study area, found 49 introduced and cryptogenic species within the Port. Two of these species were toxic dinoflagellates, *Alexandrium* sp. (*catanella* type) and *Alexandrium ostenfeldii*/*peruvianum*, listed as target introduced marine pest species by the Australian Ballast Water Management Advisory Council (ABWMAC). Dinoflagellate blooms of these species in the water column produces neurotoxins, which may cause fish kills and accumulate in commercially important invertebrates which can become toxic to humans.

The remaining 47 species were recognised as exotic species introduced in both historic and modern times by vessels but are not listed as 'pest' species with potential to pose any significant economic or environmental threats in this area (Pollard & Pethebridge, 2002). Two other species, recognised as pest species in Sydney and Batemans Bay (of which the study area lies between), were not identified in the Port during the 2000 survey. These were the European green shore crab (*Carcinus*

maenas) and *Caulerpa taxifolia*. Both the European green shore crab and *C. taxifolia* prefer estuarine environments over exposed coastal shores and were not observed during the field survey.

Landside

Protected Areas

The study area does not fall in nor is it next to any National Parks, Conservation Reserves, Nature Reserves or Regional Parks. The closest National Parks estate is Flinders Islet, approximately 2.45 kilometres south-east of the study area which forms part of Five Islands Nature Reserve. Five Islands Nature Reserve is an important breeding site for numerous threatened and/or protected migratory/marine seabird species. Due to the close proximity of the Five Islands Nature Reserve and wide foraging ranges of the seabirds, many have potential to overfly or swim through the study area.

Terrestrial vegetation and habitat

The study area was highly modified. Vegetation within the study area was not remnant nor could be classified as plant community types (PCTs). The study area was predominantly hardstand with a small portion of exotic landscaped grass near the Wollongong Yacht Club building. The exotic weeds House Holy Fern (*Cyrtomium falcatum*), Hairy Fleabane (*Erigeron bonariensis*) and Spreading Pellitory (*Parietaria judaica)* were observed growing within the upper foreshore between crevices.

Local and vagrant seabirds may use the existing wharf structure as perching areas while foraging in the area or attracted to recreational fishing activities from the existing wharf and harbour. Thus, species likely to use the study area are those common to urban areas including Silver Gull (*Chroicocephalus novaehollandiae*), Cormorants (*Phalacrocorax* spp.) and Australian Pelican (*Pelecanus conspicillatus*).

The study area is considered potential foraging and roosting habitat for microchiropteran bats (microbats). Microbats may also roost in the crevices of existing harbour structures, including crevices within the seawall, and the nearby commercial buildings. The crevices within the seawall were unable to be safely inspected.

The volume of pedestrian and vessel traffic in the study area is likely to be a deterrent for species that are not adapted to disturbance.

Protected and threatened species, populations and ecological communities

A review of the DPE-EES BioNet database, DPI Threatened species list and the DCCEEW PMST identified 119 threatened terrestrial species listed under the BC Act and/or EPBC Act with potential to occur in the study locality. A full list is provided in Appendix C.

No threatened species were observed during the field survey, however, potential habitat for some threatened species occurs in the study area. Due to the presence of suitable habitat in the study area and/or known populations in the harbour, five threatened terrestrial species were considered to have a moderate likelihood of occurrence. These are:

- White-bellied Sea Eagle (*Haliaeetus leucogaster*) listed as vulnerable under the BC Act
- Eastern Osprey (*Pandion cristatus*) listed as vulnerable under the BC Act
- Little Bent-winged Bat (*Miniopterus australis*) listed as vulnerable under the BC Act

- Large Bent-winged Bat (*Miniopterus orianae oceanensis*) listed as vulnerable under the BC Act
- Southern Myotis (*Myotis macropus*) listed as vulnerable under the BC Act.

No remnant vegetation or PCTs occur within the study area and therefore no TECs occur within the study area.

Priority weeds

One priority weed listed under the *Biosecurity Act 2015* was recorded in the study area. Spreading Pellitory (*Parietaria judaica*) is regulated under the general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable. Marine pests such as Caulerpa (*Caulerpa taxifolia*) have the potential to be introduced from the barge and any boats used to undertake the works. Inspections will be caried out on any vessels to be utilised prior to launching in the harbour.

6.3.3 Potential impacts

Construction

Waterside

Direct impacts to fauna, vegetation and habitat

The proposal would not require large-scale disturbance of the seabed. The proposal would require the installation of four restraint piles in subtidal habitat in the harbour. All four piles would be drilled into soft unvegetated sediment (Type 3 KFH) via torqued head, resulting in a permanent loss of localised epifauna and infauna from the unvegetated soft sediment.

The soft sediment habitats in the study area are characteristic of the majority of subtidal habitat within the harbour. Community assemblages are generally ubiquitous and quick to recolonise following disturbance. Thus, the loss of these small areas would not be a substantial loss.

Disturbances from piling include noise and vibration and alterations to water quality. Tolerance to changes in noise, vibration and water quality may vary among species, but the response is generally similar (i.e. movement away from unfavourable conditions). Marine fauna in the harbour are likely to be exposed to an ambient level of noise and changes in water quality from existing marine activities and runoff. These species are also likely to recolonise the study area once conditions return to pre-construction levels.

Indirect impacts to fauna, vegetation and habitat

A small patch of low density *Halophila* sp. (Type 2 KFH) and macroalgae (Type 2 KFH) were identified within the study area, both of which are in proximity to the piling locations. There is potential for coarse and fine debris to be mobilised during piling and propeller damage (on low tide). This can crush, damage and/or smother marine vegetation and habitat depending on the size of debris. Mobilisation of finer debris (i.e. sediments) can also result in the mobilisation of contamination known to persist in study area sediments. Depending on the volume and the size of fine debris, wave, tide and current actions, finer particles may not reside in the area for long and this may only be a temporary disturbance to marine vegetation and habitat.

Waterside construction activities would result in vessel and barge movements in and around the study area. This has potential to temporarily increase the frequency of

vessel wash impact to scour soft sediment areas. Seagrass meadows and sessile fauna can be scoured from the seawall. Epifauna, including scattered colonies of macroalgae on hard substratum, and infauna in soft sediment habitats can be removed/dislodged. However, as large and small vessels currently frequent the study area, the community assemblages are likely to be well-adapted to vessel wash and scour. Thus, impacts as a result of vessel and barge movements are unlikely to substantially impact marine vegetation and associated assemblages in the study area.

Proposal construction activities are unlikely to substantially impact mobile marine fauna occurring within the study area. Fish are highly mobile and temporary disturbance from the movement of vessels, piling would be minor, as similar and higher condition habitat are abundant and wide-ranging in the harbour and study locality.

An increase in vessel and barge activity during construction is associated with an increased risk of vessel strikes with marine mammals/reptiles and elasmobranchs. The proposal area is considered suboptimal habitat for most marine mammals and very few individuals, if any, would occur during construction. The increased risk of vessel strike, however, is proportional to the increase in vessel traffic for the proposal relative to overall vessel traffic. This proportional increase is considered to be very small. Given marine reptiles and marine mammals regularly breach the surface to breathe, the risk of vessel strike to these species could be managed by having observers monitoring potential encroachment of individuals. Vessel strike can also be mitigated by slow boat speeds that avoid collisions or result in minor harm from which fauna may recover.

Waterside proposal activities have potential to introduce marine pests, if controls are not implemented.

Impacts to protected and threatened species and populations

Waterside construction activities have potential to impact potential habitat for the White's Seahorse. Potential habitat in the study area would be made available for the White's Seahorse following the completion of construction thus, proposal impacts to potential foraging habitat for the White's Seahorse would only be temporary and limited to the construction phase.

Landside

Impacts to fauna, vegetation and habitat

The proposal would require the construction of a designated temporary car park and temporary compound area, limited to the hardstand areas. No vegetation removal is required.

Landside construction activities would also create noise and vibration in the study area and the responses of terrestrial fauna are likely to be similar to that of mobile marine fauna (i.e. move away from unfavourable conditions and return once disturbance is removed).

Impacts of the proposal are considered negligible.

Impacts to protected and threatened species and populations

Given the highly urbanised, coastal and exposed location of the study area, impacts to terrestrial flora and fauna are considered negligible. The proposal is unlikely to significantly impact threatened species and disturbances to potential habitat would largely be temporary.

Operation

Waterside

Direct impacts to fauna, vegetation and habitat

The gangway and pontoon components of the proposal would sit permanently on or above the water's surface and avoid impacts to the seabed. Light penetrating decking (30mm by 30mm mesh) would be utilised for the gangway to allow sufficient light to penetrate the substrate and allow seagrass and marine vegetation to grow therefore impacts to seagrass and/or marine vegetation are considered negligible.

The structures of the public pontoon are not expected to substantially alter coastal processes or hydrology of the study area or the wider harbour. Further, they are not considered to interfere with fish passage nor likely to alter localised hydrodynamics and unlikely to produce substantial impacts to marine biodiversity.

Indirect impacts to fauna, vegetation and habitat

There is potential for unvegetated soft sediment habitat to be scoured from vessel motors while docking and departing the new public pontoon. However, these habitats are quick to recover. Sediment mobilisation from vessels may affect nearby rocky reef and seagrass habitat, however, communities in the study area are likely to be well-adapted to turbidity and sedimentation from stormwater runoff and from existing vessel traffic.

Impacts to protected and threatened species and populations

Operational impacts of the pontoon and gangway would not shade available habitat for the White's Seahorse as light penetrating decking would be utilised. These are also very small proportions of available habitat in their distribution and the installation of new piles and structures would provide similar, if not the same habitat for these species during operation. Based on this, the proposal is unlikely to significantly impact White's Seahorse.

Landside

No operational impacts to biodiversity are expected.

Conclusion on significance of impacts

The proposal is not likely to significantly impact threatened species, populations or ecological communities or their habitats, within the meaning of the BC Act or FM Act and therefore a SIS, entry into the Biodiversity Offsets Scheme or Biodiversity Development Assessment Report (BDAR) are not required.

The proposal is not likely to significantly impact threatened species, populations, ecological communities or migratory species, within the meaning of the EPBC Act. A referral to the Australian Government DCCEEW is not required for biodiversity matters.

6.3.4 Safeguards and management measures

Table 6-5 lists the safeguards and management measures that would be implemented to protect the water quality to account for the impacts identified in section 6.2.3.

Table 6-5: Biodiversity safeguards and management measures

ID	Impact	Environmental safeguards	Responsibility	Timing
B1	All proposal impacts	Integrate the management of flora and fauna into the construction environmental management plan (either as a standalone flora and fauna management plan or a subplan). This is to include all terrestrial and marine flora and fauna and include but not be limited to such measures as: • Documenting and establishing site clearing limits and include on sensitive area plans • Establishing no go zones (including no anchoring zones in seagrass) and go slow zones (i.e. vessel speed restricted areas) and include on sensitive area plans • Pre-construction surveys, weed management and unexpected finds measures in line with the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA, 2011).	Contractor	Pre-construction
B2	Removal of marine vegetation and habitat	As part of the detailed design process, provide evidence of opportunities explored to promote colonisation of habitat-forming species. Examples include the installation of structures which provide habitat complexity (i.e. designs available as part of the Living Seawalls Project).	Transport for NSW and Contractor	Detailed design
B3	Fish kill	DPI Fisheries (1800 043 536) and the EPA (131 555) are to be notified immediately if any fish kills occur in the vicinity of the works. In such cases, all works other than emergency response procedures are to cease until the	Contractor	Construction

ID	Impact	Environmental safeguards	Responsibility	Timing
		issue is rectified and approval is given by DPI Fisheries and/or the EPA for the works to proceed.		
B4	Aquatic impacts	Aquatic habitat will be protected in accordance with Guide 10: Aquatic habitats and riparian zones of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA, 2011) and Section 3.3.2 Standard precautions and mitigation measures of the *Policy and guidelines for fish habitat conservation and management* (DPI, 2013).	Contractor	Construction
B5	Aquatic impacts	Piling to stop if marine mammals, reptiles or Little Penguins are observed within approximately 100 metres of the proposal area and only to recommence once they have moved beyond 100 metres of the study area or are not seen for at least 20 minutes.	Contractor	Construction
LS5	Removal of marine vegetation and habitat	No bed anchoring is to occur. Existing land-based anchor points are to be used.	Contractor	Construction
LS6	Aquatic impacts	Work associated with positioning barges, drilling and pile driving will occur during calm conditions to prevent excessive scouring and other impacts. Calm conditions would be determined by a multitude of factors, including swell, wind and the current.	Contractor	Construction
B6	Changes to coastal processes	The detailed design will aim to avoid/minimise any impact to coastal processes and hydrology.	Contractor	Detailed design
B7	Injury and mortality of fauna	Fauna will be managed in accordance with Guide 9: Fauna handling of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA, 2011).	Contractor	Construction

ID	Impact	Environmental safeguards	Responsibility	Timing
B8	Invasion and spread of weeds, pests and diseases	Weed species will be managed in accordance with *Guide 6: Weed management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA, 2011).	Contractor	Construction
B9	Invasion and spread of weeds, pests and diseases	Waterside equipment and vessels to be sourced from local suppliers where possible. Equipment and vessels must be cleaned and inspected prior to entering the proposal area. If any marine pests are encountered during waterside construction activities, the area of infestation must be isolated/not disturbed and DPI Fisheries notified promptly.	Contractor	Construction
B10	Invasion and spread of weeds, pests and diseases	Occurrence of any marine pests must be reported to DPI Fisheries.	Contractor	Construction
B11	Shadowing of seabed	The pontoon design will utilise 30mm by 30mm mesh decking, a freeboard of 0.5 -0.7m and a landing at about 3.5m above MHWM to allow for light penetration below the structure.	Contractor	Detailed design

6.4 Noise and vibration

This section summarises the proposals noise and vibration impacts.

6.4.1 Methodology

A construction noise assessment was undertaken using the NSW Roads and Maritime Services (Roads and Maritime) Construction Noise Estimator. The assessment reviewed how the proposed activities, methods and scheduling would affect noise sensitive receivers in the local area.

The construction noise assessment was completed based on distance of the receiver to the noisiest plant. The Construction Noise Estimator considers particular 'categories' of tools to derive the estimated noise levels. The noisiest plant to be used for construction will be 'driving tools' which have an equivalent sound power level to a microdrilling rig (Soilmec SM-5). Use of hand power tools for the proposed activities contribute towards standard construction noise and are not considered the nosiest plant for the purpose of this construction noise assessment. Hand power tools, however have been used to assess standard construction noise and any associated impacts.

The representative noise environment for Wollongong Harbour was determined to be Category R2 with direct line of sight to receiver during standard working hours.

Table 6-6 shows the rating background level (RBL) and the noise management level (NML) of the parameters used for the nosiest plant (microdrilling rig (Soilmec SM-5) and standard (hand power tools) construction noise assessment.

Table 6-6: RBL and NML for construction noise assessment parameters

Noise area category		R2
RBL or L_{A90} Background level (dB(A))	**Day**	45
	Evening	40
	Night	35
$L_{Aeq(15minute)}$ Noise Management Level (dB(A))	**Day**	55
	Day (OOHW)	50
	Evening	45
	Night	40
Noisiest plant		Microdrilling Rig (Soilmec SM-5)
Standard construction noise		Hand power tools (2-3 tools)
Is there line of sight to receiver?		Yes

No operational noise assessment was undertaken as current operations and usage at Belmore Basin are expected to remain similar after construction of the proposal. Hence, operational noise levels of the proposal are not expected to alter significantly from existing noise levels.

6.4.2 Existing environment

Wollongong Harbour is a working harbour and popular area for recreational visitors and tourists where noise volumes are typical for harbours of its nature. The dominant noise source in the existing environment would be marine vessel noise from waterside users. Other noise sources include road traffic noise from Cliff Road and Endeavour Drive, as well as motor vehicle noise around Belmore Basin.

Sensitive noise receivers within the immediate vicinity of the proposal only include non-residential receivers. The closest residential receivers are approximately 185 metres south west of the proposal.

The distance of sensitive noise receivers to the proposal are listed in Table 6-7.

Table 6-7: Distance of sensitive noise receivers to the proposal

Description	Land use	Approximate Distance to Study Area (m)
Yachties' Café	Commercial	Within
Wollongong Yacht Club	Commercial	Within
Harbourfront Seafood	Commercial	60
Nonabel	Commercial	70
Aquilla Fishing Charters	Commercial	75
Bombora Seafood	Commercial	75
Cove Beach	Recreation	85
Krista Fishing Charters	Commercial	100
Brighton Lawn Reserve	Recreation	110
Chodat Fitness	Commercial	115
Five Islands Outrigger Canoe Club	Commercial	125
Five Island Charters	Commercial	155
Flagstaff Hill	Recreation	150
Levendi Café	Commercial	155
Normies Ice Cream and Gelato	Commercial	160
Wollongong City Beach	Recreation	165
Residential	Residential	185
Steamers Bar and Grill	Commercial	190
City Beach Function Centre	Commercial	195
Old Court House	Commercial	200

There are also six local heritage items listed in the Wollongong LEP within 200 metres of the study area. Of the listed heritage items, three include heritage structures that

would be sensitive to construction vibrations. Details of these heritage items and their distance to the study area are discussed in section 6.6.

6.4.3 Potential impacts

Construction

Noise

The results of the nosiest plant construction noise assessment were derived from calculations using noise levels of the driving tools, represented by a microdrilling rig (Soilmec SM-5), operating on constructions over water, during standard construction hours (Table 6-8 and Table 6-9). The results of the standard plant construction noise assessment were derived from calculations using noise levels of the hand power tools operating on constructions over water, during standard construction hours (Table 6-10 and Table 6-11).

Standard construction hours are as follows:

- Monday to Friday: 7am – 6pm
- Saturday: 8am – 1pm
- Sunday and public holidays: no work.

The results suggested that the driving tools would impact residential receivers up to a maximum of 280 metres away. Noise levels for residential receivers within 105 metres would be moderately intrusive while residential receivers within 40 metres of the proposal would experience highly intrusive noise levels. The mitigation measures suggested by the assessment include notification, phone calls and a respite offer.

Results from the standard construction noise (power tools) indicates residential receivers would be impacted up to a maximum of 175 metres away. Noise levels for residential receivers within 65 metres would be impacted by moderately intrusive noise, whilst residential receivers within 25 metres of the proposal would experience highly intrusive noise. The mitigation measures suggested by the assessment include notification, phone calls and a respite offer.

For non-residential receivers, the construction noise assessment indicated that the noise levels from the driving tools or the hand power tools would not exceed the NML for offices and retail outlets (similarly, hospitality businesses) during standard construction hours. However, mitigation measures would be implemented where noise levels exceed 75 dB(A) for an extended period of time for non-residential receivers within 40 metres of the proposed works during drilling works and 25 metres during standard construction activities. Mitigation measures would include notification, phone calls and a respite offer.

There are no residential receivers within 105 metres of the proposal. The closest residential receivers are located approximately 185 metres away. Further, noise levels are not expected to exceed maximum NML for non-residential receivers. Therefore, no significant impacts are expected from either nosiest plant or standard construction noise. Hence, mitigation measures suggested by the Construction Noise Estimator, are not required.

The relevant results of the construction noise assessment are highlighted in Table 6-8 for residential receivers and Table 6-9 for non-residential receivers.

Table 6-8: Distance based assessment (noisiest plant) – Category R2 residential receivers during standard work hours

		$L_{Aeq(15\ minutes)}$ noise level above background (L_{A90})												$LA_{eq(15minute)}$ 75 dB(A) or greater (Highly affected)			Sleep Disturbance LA_{max} 65 dB(A)
		5 to 10 dB(A)			10 to 20 dB(A)			20 to 30 dB(A)			> 30 dB(A)						
		Noticeable			Clearly Audible			Moderately intrusive			Highly intrusive						
	Affected Distance (m)	Measures	Within Distance (m)	Mitigation Level (dB(A))	Measures	Within Distance (m)	Mitigation Level (dB(A))	Measures	Within Distance (m)	Mitigation Level (dB(A))	Measures	Within Distance (m)	Mitigation Level (dB(A))	Measures	Within Distance (m)	Mitigation Level (dB(A))	Affected Distance (m)
Propagation across valley / over water	Day	280						N	105	65	N, PC, RO	40	75	N, PC, RO	40	75	
	Day (OOHW)	445			N, R1, DR	280	55	N, R1, DR	105	65	N, R1, DR, PC, SN	40	75	N, PC, RO	40	75	
	Evening	690			N, R1, DR	445	50	N, R1, DR	175	60	N, R1, DR, PC, SN	65	70	N, PC, RO	40	75	
	Night	1040	N	1040	40	N, R2, DR	690	45	N, PC, SN, R2, DR	280	55	AA, N, PC, SN, R2, DR	105	65	N, PC, RO	40	75	160
	Highly Affected	40												N, PC, RO	40	75	

N: Notification (letterbox drop or equivalent); SN: Special notifications; PC: Phone calls; RO: Respite offer; R1: Respite period 1; R2: Respite period 2; DR: Duration respite; AA: Alternative accommodation

Table 6-9: Distance based assessment (noisiest plant) – Category R2 non-residential receivers during standard work hours

					$L_{Aeq(15\ minutes)}$ noise level above NML						$LA_{eq(15minute)}$ 75 dB(A) or greater (Highly affected)		
		Standard Hours			<10 dB(A)			10 to 20 dB(A)					
		Period	NML	Affected distance (m)	Measures	Within Distance (m)	Mitigation Level (dB(A))	Measures	Within Distance (m)	Mitigation Level (dB(A))	Measures	Within Distance (m)	Mitigation Level (dB(A))
Propagation across valley / over water	Classroom at schools and other educational institutions	Day	55	280				N	105	65	N, PC, RO	40	75
	Hospital wards and operating theatres	Day	65	105							N, PC, RO	40	75
	Place of worship	Day	55	280				N	105	65	N, PC, RO	40	75
	Active recreation	Day	65	105							N, PC, RO	40	75
	Passive recreation	Day	60	175				N	65	70	N, PC, RO	40	75
	Industrial premise	Day	75	40							N, PC, RO	40	75
	Offices, retail outlets	Day	70	65							N, PC, RO	40	75

N: Notification (letterbox drop or equivalent); PC: Phone calls; RO: Respite offer

Table 6-10: Distance based assessment (standard construction noise) – Category R2 residential receivers during standard work hours

		$L_{Aeq(15\ minutes)}$ noise level above background (L_{A90})												$LA_{eq(15minute)}$ 75 dB(A) or greater (Highly affected)			Sleep Disturbance LA_{max} 65 dB(A)
		5 to 10 dB(A)			10 to 20 dB(A)			20 to 30 dB(A)			> 30 dB(A)						
		Noticeable			Clearly Audible			Moderately intrusive			Highly intrusive						
	Affected Distance (m)	Measures	Within Distance (m)	Mitigation Level (dB(A))	Measures	Within Distance (m)	Mitigation Level (dB(A))	Measures	Within Distance (m)	Mitigation Level (dB(A))	Measures	Within Distance (m)	Mitigation Level (dB(A))	Measures	Within Distance (m)	Mitigation Level (dB(A))	Affected Distance (m)
Propagation across valley / over water	Day	175						N	65	65	N, PC, RO	25	75	N, PC, RO	25	75	
	Day (OOHW)	280			N, R1, DR	175	55	N, R1, DR	65	65	N, R1, DR, PC, SN	25	75	N, PC, RO	25	75	
	Evening	445			N, R1, DR	280	50	N, R1, DR	105	60	N, R1, DR, PC, SN	40	70	N, PC, RO	25	75	
	Night	690	N	690	40	N, R2, DR	445	45	N, PC, SN, R2, DR	175	55	AA, N, PC, SN, R2, DR	65	65	N, PC, RO	25	75	95
	Highly Affected	25												N, PC, RO	25	75	

N: Notification (letterbox drop or equivalent); SN: Special notifications; PC: Phone calls; RO: Respite offer; R1: Respite period 1; R2: Respite period 2; DR: Duration respite; AA: Alternative accommodation

Table 6-11: Distance based assessment (standard construction noise) – Category R2 non-residential receivers during standard work hours

					$L_{Aeq(15\ minutes)}$ noise level above NML						$LA_{eq(15minute)}$ 75 dB(A) or greater (Highly affected)		
		Standard Hours			<10 dB(A)			10 to 20 dB(A)					
		Period	NML	Affected distance (m)	Measures	Within Distance (m)	Mitigation Level (dB(A))	Measures	Within Distance (m)	Mitigation Level (dB(A))	Measures	Within Distance (m)	Mitigation Level (dB(A))
Propagation across valley / over water	Classroom at schools and other educational institutions	Day	55	175				N	65	65	N, PC, RO	25	75
	Hospital wards and operating theatres	Day	65	65							N, PC, RO	25	75
	Place of worship	Day	55	175				N	65	65	N, PC, RO	25	75
	Active recreation	Day	65	65							N, PC, RO	25	75
	Passive recreation	Day	60	105				N	40	70	N, PC, RO	25	75
	Industrial premise	Day	75	25							N, PC, RO	25	75
	Offices, retail outlets	Day	70	40							N, PC, RO	25	75

N: Notification (letterbox drop or equivalent); PC: Phone calls; RO: Respite offer

Vibration

Construction vibration may be experienced by sensitive receivers, including residential receivers, business patrons, marine and terrestrial fauna and heritage structures, due to their proximity to the proposal.

The *Roads and Maritime Construction Noise and Vibration Guideline 2016* (CNVG) sets out minimum working distances for sensitive receivers including heritage structures outlined in Table 6-12. Potential equipment to be used on this proposal is highlighted yellow.

Table 6-12: Recommended minimum working distances for vibration intensive plant from sensitive receivers (Source: RMS, 2016a)

Plant item	Rating / Description	Minimum working distance		
		Cosmetic Damage (BS 7385)	Cosmetic damage (DIN 4150) Heritage and other sensitive structures	Human Response (OH&E Vibration Guideline)
Vibratory Roller	< 50 kN (Typically 1-2 t)	5 m	14 m	15 m to 20 m
	< 100 kN (Typically 2-4 t)	6 m	16 m	20 m
	< 200 kN (Typically 4-6 t)	12 m	33 m	40 m
	< 300 kN (Typically 7-13 t)	15 m	41 m	100 m
	> 300 kN (Typically 13-18 t)	20 m	54 m	100 m
	> 300 kN (> 18 t)	25 m	68 m	100 m
Small Hydraulic Hammer	(300 kg - 5 to 12 t excavator)	2 m	5 m	7 m
Medium Hydraulic Hammer	(900 kg – 12 to 18 t excavator)	7 m	19 m	23 m
Large Hydraulic Hammer	(1600 kg – 18 to 34 t excavator)	22 m	60 m	73 m
Vibratory Pile Driver	Sheet Piles	2 m to 20 m	50 m	20 m
Pile Boring	≤ 800 mm	2 m (nominal)	40 m	4 m
Jackhammer	Hand Held	1 m (nominal)	2 m	2 m

The minimum working distances are indicative and will vary depending on the particular item of plant, local geotechnical conditions and the dominant frequency of the construction vibration levels. They apply to cosmetic damage of typical light-framed residential buildings and heritage/fragile buildings and assume that construction vibration could include low frequency content with associated increased risk of cosmetic damage.

Construction vibration levels vary depending on the distance from the equipment in use, the energy level imparted to the ground by the construction process, and the bedrock type. The most significant vibration sources associated with the proposal would be the driving tools and the barge mounted excavator with piling equipment. These vibration sources are considered to be the equivalent to a vibratory pile driver as a conservative estimate. The proposal will utilise low vibration methods such as auguring to install piles to ensure vibration impacts are reduced.

If the minimum working distances outlined in Table 6-12 are met for the relevant plant, no vibration monitoring is required. However, if the minimum working distances cannot be met, vibration monitoring is recommended to confirm the minimum working distances for the nearby heritage items. It is noted that the location and distance of the heritage items on site are included in Section 6.6.2, specifically Table 6-17. The Harbour Steps are the only item within the Study Area, however these items are located more than 10m outside of the Proposal Area and more than 30m away from the pontoon and higher vibration frequency activities such as use of a medium hydraulic hammer. Additionally, further detailed analysis based on the frequency dependent guideline vibration levels in British Standard BS 7385-2:1993 - *Evaluation and Measurement for Vibration in Buildings - Guide to Damage Levels from Ground Borne Vibration* and German standard DIN 4150-3:2016 - *Vibration in Buildings - Part 3: Effects on Structures* may be utilised in conjunction with site-specific measurements to derive alternative cosmetic damage objectives and minimum working distances.

For heritage listed / fragile structures, specialist advice from an appropriately qualified structural engineer who is familiar with heritage structures is required to support any proposed relaxation of the initial cosmetic damage screening criterion. Any such relaxation shall be approved by Transport for NSW or under the environmental license as relevant.

Operation

Current operations and usage at Belmore Basin are expected to remain similar after construction of the proposal. Hence, operational noise and vibration levels of the proposal are not expected to alter significantly from existing noise and vibration levels.

6.4.4 Safeguards and management measures

Table 6-13 lists the noise and vibration safeguards and management measures that would be implemented to account for the impacts identified in section 6.4.3.

Table 6-13: Noise and vibration safeguards and management measures

ID	Impact	Environmental safeguards	Responsibility	Timing
NV1	Noise and vibration	Preparation of a construction noise and vibration management plan (CNVMP) based on recommendations provided within the ICNG and AS 2436-1981: *Guide to Noise Control on Construction, Maintenance and Demolition Sites*. This is to include, but not be limited to: • Plant controls: ○ Use of noise attenuating controls at the source, such as mufflers, acoustic screens, etc. ○ Maintain plant and equipment in good working order to prevent excess noise generation. ○ Locate static sources of noise such as the generators as remotely as possible from noise sensitive receivers ○ Use of broadband reversing alarms, or “quackers”, on mobile equipment in accordance with the relevant health and safety regulations ○ Use of temporary noise barriers where practical. The height and location of these barriers will be determined during preparation of the CNVMP when more information regarding the proposed plant to be used for each construction stage is available. ○ Investigate whether “at plant” mitigation or muffled plant is available for plant with high source noise levels such as rock	Contractor	Pre-construction

ID	Impact	Environmental safeguards	Responsibility	Timing
		hammers and piling rigs, and plant emitting continuous noise such as generators. ○ Acoustic curtains (generally loaded vinyl based products), attached to wire construction fencing or laid over steel scaffold can also provide practical temporary noise barriers. Acoustic curtains will be investigated for stationary plant within the worksites once a detailed schedule of works and plant is available. • Management and behavioural controls: ○ Ensure that managers effectively communicate acceptable and unacceptable work practices for the site, through staff site inductions, notice boards, and prestart meetings. ○ Avoid the need for reversing in the construction area by creating a loop road or similar. ○ Avoid dropping materials from height. ○ Workers will avoid shouting, minimise talking loudly, and avoid slamming vehicle doors. • Conducting noise and vibration monitoring during all construction phases/scenarios considering the potential exceedances for the purposes of assisting in noise mitigation and to verify the findings of this noise assessment. • Inclusion of safe working distances for plant and equipment. • Implementing a procedure where exceedances are recorded, works will be modified in consultation with the identified specialist to reduce vibration levels.		

ID	Impact	Environmental safeguards	Responsibility	Timing
		• Implementing a procedure for dealing with complaints to ensure that all complaints are registered and dealt with appropriately. • Conducting additional monitoring if complaints are received or proposed activities and number of plant exceed those assumed in this assessment. • Modifying work activities where noise or vibration is found to cause unacceptable impact. • Implementation of additional mitigation measures in accordance with the CNVG including notification, phone calls and a respite offer.		
NV2	Noise and vibration	Works would be carried out within standard daytime hours as follows: • 7am to 6pm Monday to Friday • 8am to 1pm Saturdays, no work on Sundays or public holidays. Works must not be carried out during evening or night-time hours. Should operations be required outside standard hours, an Out of Hours procedure detailing works schedule, approval process, communication requirements and management measures will be prepared.	Contractor	Construction
NV3	Noise and vibration	Prior to works occurring, notification will occur to potentially affected receivers in the following manner: • Details of the work activities, dates and hours, impacts and mitigation measures, indication of work schedule over the night-time period, any operational noise benefits from the work (where applicable) and contact telephone number. • Notification should be a minimum of seven calendar days prior to the start of work.	Transport for NSW / Contractor	Pre-construction

ID	Impact	Environmental safeguards	Responsibility	Timing
		• A contact telephone number and email address will be available for community feedback and complaints management.		
NV4	Vibration impact to heritage structures	If the minimum working distances for the relevant plant, outlined in CNVG cannot be met, a construction vibration assessment is to be undertaken to determine safe working limits based on proposed plant and where possible, smallest plant able to carry out required work should be utilized to minimize potential impacts. Where works are proposed within the safe working limits for the heritage structures, specialist advice would be sought from an appropriately qualified structural engineer who is familiar with heritage structures to assess if vibrations associated with the proposed works would potentially result in impacts to heritage structures.	Contractor	Pre-construction / Construction
NV5	Vibration impact to heritage structures	Regular inspections of the construction activities and work areas will be undertaken by engineers and any other required specialist to monitor and review the construction methodology to confirm the integrity of the heritage items. Assessment and monitoring of vibration impacts will adhere to: • British Standard BS 7385: Part 2: *Evaluation and Measurement for Vibrations in Buildings – Part 2 Guide to Damage Levels from Ground-Borne Vibration* German Standard DIN 4150, Part 3: *Structural Vibration in Buildings: Effects on Structures.*	Contractor	Pre-construction
NV6	Vibration	Where heritage buildings are located within the safe working distance zone, pre and post construction dilapidation surveys will be carried out.	Contractor	Pre-construction / Post-Construction
NV7	Vibration	Where buildings are located within the safe work distance zones (non-heritage structures), vibration monitoring will be carried out to ensure	Contractor	Pre-construction / Construction

ID	Impact	Environmental safeguards	Responsibility	Timing
		compliance with the required criteria. If exceedances are recorded, works will be modified accordingly to reduce vibration levels.		

6.5 Landscape character and visual impact

This section summarises the proposal's landscape character and visual impacts.

6.5.1 Methodology

The Transport for NSW 2020 *Guideline for landscape character and visual impact assessment*, outlines guidelines and procedures for the assessment of landscape character and visual impacts to the environment. Table 6-14 sets out the landscape character and visual impact (LCVI) rating matrix which assesses the scale, form and character (magnitude) of the works against the surrounding environment's capacity to absorb change of the nature of the proposal (sensitivity).

Table 6-14: Landscape character and visual impact rating matrix (Source: TfNSW, 2020c)

Sensitivity	Magnitude: High	Magnitude: Moderate	Magnitude: Low	Magnitude: Negligible
High	High	High-Moderate	Moderate	Negligible
Moderate	High-Moderate	Moderate	Moderate-Low	Negligible
Low	Moderate	Moderate-Low	Low	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

Two viewpoints of the proposal were assessed. One viewpoint, Figure 6-2, was assessed from approximately 30 metres away, to represent the landscape and visual impacts of the proposal from a highly visible direct line of view. The other viewpoint, Figure 6-3, was assessed from approximately 100 metres away, to represent the landscape and visual impacts of the proposal in relation to the surrounding landscape.

6.5.2 Existing environment

The landscape character of Belmore Basin is typical of a working marina surrounded by an urbanised environment.

Waterside of Belmore Basin is characterised by marine vessels and existing boating infrastructure. The edge of the Basin is made up of a stone wall that runs across the entirety of the Basin.

Landside of Belmore Basin is characterised by hardstand surfaces, motor vehicles and decommissioned slipway. South of the Basin, a large heritage wall runs parallel, separating the Basin from Endeavour Drive.

Users of Belmore Basin are able to experience views of Wollongong Harbour, Wollongong Breakwater Lighthouse, Flagstaff Point Lighthouse and the general streetscape of Cliff Road from the central pier. Similarly, views of Belmore Basin are able to be observed from Cove Beach, nearby businesses and recreational reserves.

The sensitivity of the location would be considered high due to the aesthetic value of the surrounding landscape.

6.5.3 Potential impacts

Construction

Landscape character and visual impacts during construction are expected due to the following construction components:

- Presence of equipment, barges and piling equipment
- Establishment of security fencing around the landside of the proposal area
- Establishment of compound area with an accommodation block and storage and materials laydown area within the security fencing
- Presence of plant and equipment.

Construction would impact the aesthetic values, overall amenity and setting associated with the existing environment. However, these impacts would be temporary and limited to the duration of construction.

Operation

From a westerly viewpoint approximately 30 metres away, the waterside features would mostly be hidden behind the edge of Belmore Basin. It is likely that only the fixed platform and restraint piles would protrude above the existing ground level. On the other hand, the temporary parking area would be fully visible from this viewpoint. However, the temporary parking area would only consist of line markings and signage that would be consistent in design with existing line markings and signage. This viewpoint would be reflective of the viewpoint experienced by the closest non-residential receiver, Yachties Café.

At this viewpoint, the magnitude of the proposal would be considered negligible in comparison to the existing surrounding landscape. The LCVI rating for this viewpoint would be considered negligible.

The westerly viewpoint from approximately 30 metres away can be seen in Figure 6-3.

From a northerly viewpoint approximately 100 metres away, the waterside features would be fully visible from the opposite side of Belmore Basin. However, the proposal was designed to integrate the waterside features within its local area, taking into consideration the nature of the site and local context. Therefore, given the conformity of the design and the distance to the viewpoint, the proposal would blend in with the surrounding landscape. This viewpoint would be reflective of the viewpoint experienced by the nearby non-residential receivers Harbourfront Seafood, Nonabel and Bombora Seafood.

At this viewpoint, the magnitude of the proposal would be considered low in comparison to the existing surrounding landscape. The LCVI rating for this viewpoint would be considered moderate.

The northerly viewpoint from approximately 100 metres away can be seen in Figure 6-4.

Overall, the LCVI rating for the proposal would be considered low.

Figure 6-3: Westerly viewpoint of the proposal from approximately 30 metres away (Source: Google Streetview, 2021)

Figure 6-4 Northerly viewpoint of the proposal from approximately 100 metres away (Source: Google Streetview, 2021)

**Red X designates the location of the proposal*

6.5.4 Safeguards and management measures

Table 6-15 lists the landscape character and visual amenity safeguards and management measures that would be implemented to account for the impacts identified in section 6.5.3.

Table 6-15: Landscape character and visual amenity safeguards and management measures

ID	Impact	Environmental safeguards	Responsibility	Timing
LV1	Landscape and visual	Urban design principles will be integrated throughout the detailed design and construction of the proposal and include: • Use of colours that blend into the landscape (as viewed from the harbour) and that complement the materiality of Belmore Basin should be considered	Transport for NSW	Detailed design
LV2	Landscape and visual	Hoarding will be erected around the construction compound where possible, to reduce visibility.	Contractor	Construction
LV3	Landscape and visual	If out of hours work is required, lighting will be directionally controlled (faced down where possible and away from receivers) to limit potential impacts of light spill on surrounding receivers, including residential properties.	Contractor	Construction
LV4	Landscape and visual	All impacted areas and ground surfaces will be reinstated as near as possible to their original state following the completion of works.	Contractor	Post-construction

6.6 Non-Aboriginal heritage

This section summarises the non-Aboriginal heritage impacts. Appendix D contains a supporting technical paper prepared by Austral Archaeology (Austral Archaeology, 2022).

6.6.1 Methodology

A SOHI was prepared in accordance with the guidelines outlined by the 1996 Heritage Office (now Heritage NSW) and Department of Urban Affairs and Planning document *Statements of Heritage Impact* as part of the *NSW Heritage Manual* and the requirements of the Wollongong LEP and Wollongong Development Control Plan (DCP) 2009.This SOHI was prepared in accordance with the principles contained in the most recent edition of *The Burra Charter: The Australian ICOMOS* (International Council on Monuments and Sites) *Charter for Places of Cultural Significance* (Australia ICOMOS, 2013).

Heritage listed items within and in the vicinity of the proposal area were identified through a search of the relevant state and federal statutory and non-statutory heritage registers, including:

- Commonwealth Heritage List (CHL)
- National Heritage List (NHL)
- State Heritage Register (SHR)
- Wollongong LEP
- Wollongong DCP
- Register of the National Estate (RNE).

A site inspection was conducted on 18 November 2021. The inspection consisted of a pedestrian survey of the harbour infrastructure surrounding Belmore Basin, with focus on listed heritage items in proximity to the study area and any materials which may be of heritage value.

6.6.2 Existing environment

Historical background

Pre-1830

By 1812, cedar cutting had become an important industry in the colony of European settlers in the area, with some cedar cutters travelling further into the regions of the Illawarra in their search for wood. At this time, the study area, then a ‘poorly sheltered sandy beach’, was used as the main landing port for small vessels.

During the 1820s, the Wollongong area quickly developed, particularly around the Wollongong Harbour, with the establishment of military barracks. In 1826, the 40th Regiment, under Captain Bishop, was stationed around the study area, resided in tents, whilst protecting the beach from attacks from the local Aboriginal people and bushrangers.

1830 to 1849

Colony Surveyor General Major Thomas Mitchell surveyed the Wollongong region in 1834 and within the year, the town of Wollongong was proclaimed by Governor

Bourke. The following year 1835, Mitchell proposed that the harbour's garrison be provisioned to protect smaller boats and that convict labour be used to reduce expenses. Two years later, Governor Bourke approved works for the harbour, and from 1837 to 1846, 300 convicts, overseen by guards, undertook excavation work under the Commanding Royal Engineer and Colonial Engineer, George Barney.

The plans proposed by Barney included a stone pier with a slipway for the Pilot boat, measuring 100 feet (30 metres) long, by 35 feet (10 metres) wide. The slipway was eight feet (2.5 metres) deep at low tide or 14 feet deep at high tide (four metres). During construction it was identified that additional works would be required and the basin was increased to 300 feet (91 metres) long and 150 feet (46 metres) wide.

During the development of the harbour, the larger blocks of stone excavated from the study area were deposited on the pier and the remaining spoil was used to create a marine road that extended from the head of the bay and formed part of the road from the town to the dock. In addition, an area located toward Pier Head was widened, and partially filled, to include a Pilot's slipway and stone steps, to access the outer harbour (with the steps still present in the study area).

By the time that the works were completed in 1842, the Wollongong Harbour included a quay, central pier and a curved dressed stone vertical sea wall basin, with lime mortar joints, and was known as the third port into NSW, with the other two ports at Sydney and Newcastle.

1850 to 1900

Ongoing maintenance for the study area continued over the next 18 years, with additions including moorings affixed to the Wollongong Harbour in 1855, however following the introduction of coal processing in the area, there was increased pressure on the harbour. As a result, additional works were requested by residents and workers.

In 1858, the Governor-General Sir William Dension and Mr E. O. Moriarty, the Engineer in Chief of Harbours and Rivers visited the study area, following a petition by the local people who requested an upgrade to the facilities. During this visit, the depth of water in the study area was around nine feet (three meters) but the coffer dam had not been completely removed, which resulted in some areas not being as deep. Combined with the mooring chains located across the harbour mouth and the anchorage, the area was deemed unsafe.

By 1859, plans for the extension and deepening of Wollongong Harbour were approved, with works beginning in 1861. It was soon apparent that these works would need to be adjusted and additional works would be required, with Wollongong Harbour increased from 300 feet (91 metres) deep to 455 feet (138 metres) deep. Other works were also necessary and by 1868, when works were completed, three high level staiths (which were able to load 3,000 tonnes of coal per day to ships), vertical stone sea-walls, (made from imported quartz sandstone and lithic sandstone) and a high coursed stone wall were also constructed. The boardwalk was extended towards the lighthouse and beach to the study area's sandstone wall.

On 6 October 1868, Wollongong Harbour was officially opened.

1900 to present

From the early 20th century, the study area and its usage as a passenger and coal port declined, as the popularity of Belmore Basin increased as a fishing port. In 1927, the Australian Iron and Steel Pty Ltd company discontinued shipments of coal from Belmore Basin, finding alternative railway facilities. Many of the earlier buildings were demolished and standing structures were repurposed for fishing and recreational activities before they too were demolished in the 1980s and roads were updated

around the study area. In 1987, Belmore Basin was appropriated for the 1987 Wollongong Harbour improvement purposes.

In 2009, a report on Wollongong Harbour was provided for the redevelopment of the harbour and foreshore. This report specified that the study area consisted of both commercial and recreational vessels but that some of the facilities were not suitable for tourism and commercial activities as they restricted vessel manoeuvring and that there were also stormwater management issues. This report also determined that the historic sandstone walls and fixtures were not to be impacted during any of proposed works.

The current harbour usage has 44 berths for trawler vessels, charter fishing vessels, recreational yacht club and multi-user/casual berths. The surrounding land currently consists of a fisherman's cooperative, general and trailer parking, game fishing gantry, pilot landing (historical and disused), yacht club building, a boat ramp, a substation, public space, slip way and slip way operational area, and a work compound.

Listed heritage items

Table 6-16 provides a summary of heritage register listings relevant to the study area.

Table 6-16: Summary of heritage register listings for the study area (Source: Austral Archaeology, 2022)

Register/Listing	Inclusion	Statutory Implication
NHL	No	None
CHL	No	None
RNE	Yes	None
SHR	Yes	Yes
Wollongong LEP	Yes	Yes
Wollongong DCP	Yes	Yes

Table 6-17 lists the heritage items located within 200 metres of the study area. Figure 6-5 shows the locations of these heritage items.

Table 6-17: Non-Aboriginal heritage items within 200 metres of the study area

Item	Listing	Approximate Distance from Study Area (m)
Harbour Steps	Wollongong LEP	Within
North Beach Precinct and Belmore Basin	SHR and DCP	Within
Crane Pedestal	Wollongong LEP	40
Stone Steps	Wollongong LEP	85
Breakwater Lighthouse	Wollongong LEP	105
Seawall	Wollongong LEP	105

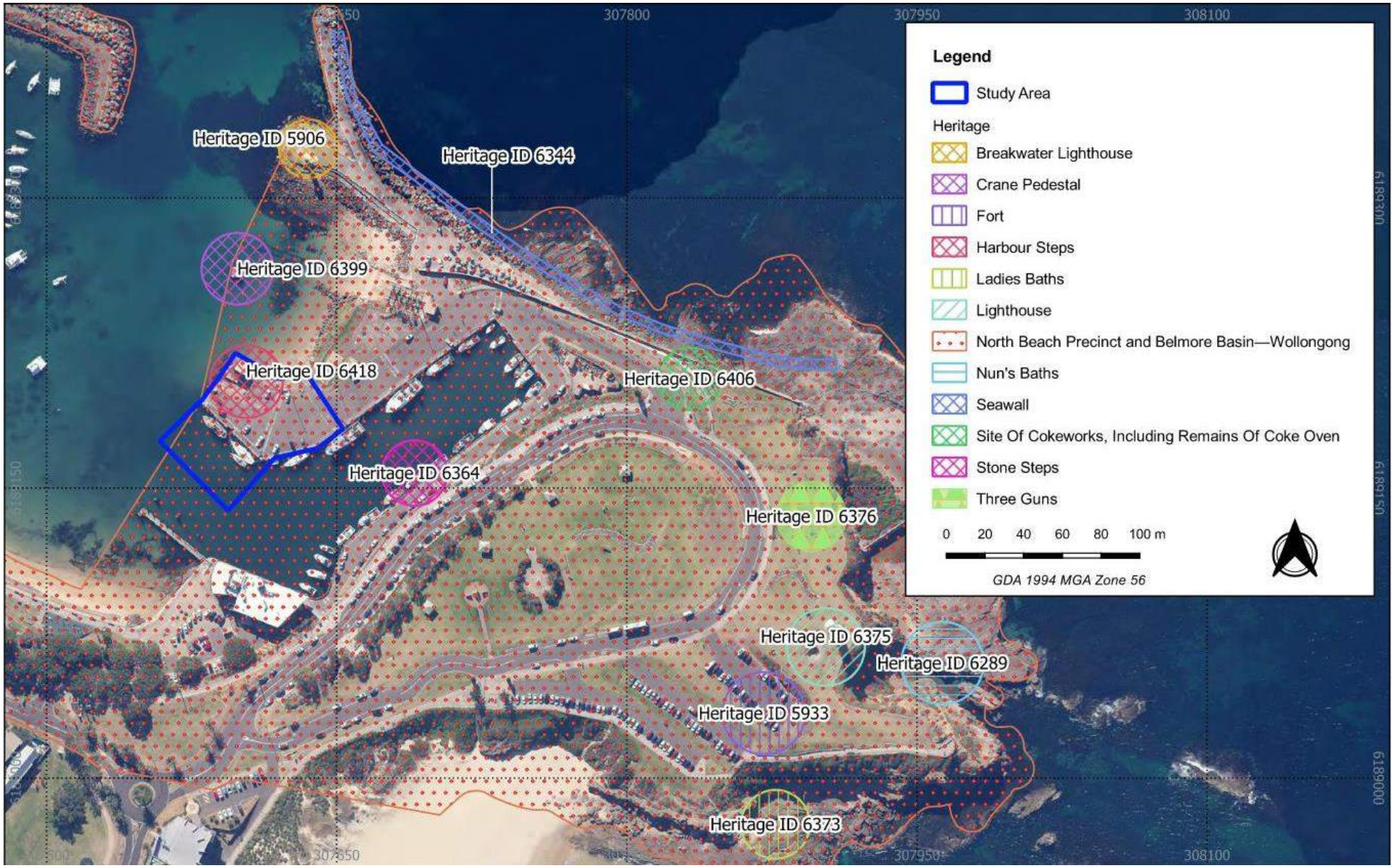


Figure 6-5 Non-Aboriginal heritage listings (Source: Austral Archaeology, 2022

Archaeology

The initial construction of the Belmore Basin within the study area was undertaken by convicts, and although the ongoing maintenance of the harbour would have removed some of the in situ historical archaeology, there is still evidence of historical use, including stone steps surrounding the study area. In addition, the basin was constructed from convict labour and there is the potential that evidence of their workmanship, including markings, are present within the study area.

It is therefore assessed that the study area has low potential to uncover subsurface historical deposits.

6.6.3 Potential impacts

Construction

Construction works have the potential to impact heritage listed items directly and indirectly.

Due to the limited footprint of the proposal and proposal area, the construction of the proposal will not directly impact the heritage listed ‘Harbour Steps’ located within the study area (Austral Archaeology, 2022). Site fencing will be utilised to ensure accidental impact of neighbouring heritage items does not occur.

Indirect impacts through the vibrations of plant may occur to erect heritage structures in close proximity to the study area. Section 6.4.3 details the potential vibrational impacts the proposal poses to heritage structures. This would be managed through low vibration methods such as auguring and monitored under the CEMP.

The installation of fencing around the proposal area will have a negligible temporary visual impact on the site and surrounding heritage (Austral Archaeology, 2022). Visual impacts during the construction phase would be short term and temporary in nature.

Similarly, during operation, the proposal will have negligible visual impact on views to Belmore Basin as the waterside features retain continuous use of the harbour for commercial and recreational activities (Austral Archaeology, 2022).

Operation

No impacts to non-Aboriginal heritage listings are expected during operation of the proposal.

6.6.4 Safeguards and management measures

Table 6-18 lists the Aboriginal heritage safeguards and management measures that would be implemented to account for the impacts identified in section 6.6.3.

Table 6-18: Non-Aboriginal heritage safeguards and management measures

ID	Impact	Environmental safeguards	Responsibility	Timing
H1	Archaeological significance	A heritage induction will be provided to workers prior to construction, informing them of the significance and location of known heritage items and the implementation of the *Unexpected Heritage Item Procedure* (RMS, 2015) if unanticipated heritage items or deposits are located during construction.	Contractor	Pre-construction
H2	Unexpected finds	Archaeological remains will be managed under the *Unexpected Heritage Items Procedure* (RMS, 2015) if unanticipated heritage items or depositions are located during construction. Under this procedure: • If archaeological 'works' such as evidence of former road surfaces or streetscape elements are unexpectedly encountered during construction works and would be impacted, archaeological investigation and recording would be undertaken prior to impacts If historical archaeological relics are unexpectedly encountered during the works, all works in the immediate vicinity are to cease immediately and Heritage NSW be notified. A qualified archaeologist is to be contacted to assess the situation and consult with the Heritage NSW regarding the most appropriate course of action. 'Relics' cannot be impacted without appropriate approvals under the Heritage Act.	Contractor	Construction
H3	Vibration impact to	If vibration monitors are attached to the heritage items, consultation with the relevant authority will be undertaken to ensure that monitors can be	Contractor	Construction

ID	Impact	Environmental safeguards	Responsibility	Timing
	heritage structures	installed. Installation should consider future removable without causing damage. Bees wax may be a suitable attachment method.		
H4	Heritage items	Prior to the start of construction, the stability of the heritage walls will be confirmed. Any fixings into the heritage walls should be of suitable materials and limited in their surface impacts. Heritage items will be fenced off where possible to prevent any accidental impacts to these items.	Contractor	Construction
H5	Design change	If design changes result in additional earthworks, further archaeological assessment and management will be required. Any project redesign resulting in new ground disturbance, vegetation removal, or new features must be assessed in an addendum to the SoHI (Austral Archaeology, 2022).	Transport for NSW	Detailed design / Pre-construction
H6	Design change	Should the actual development be altered significantly from the proposed concept design, then a reassessment of the heritage/archaeological impact may be required. This includes any impacts not explicitly stated in the SoHI (Austral Archaeology, 2022) or this REF.	Transport for NSW	Detailed design / Pre-construction
H7	Heritage archive	A copy of the SOHI (Austral Archaeology, 2022) should be lodged in the local history section of the local library, and in the library maintained by Heritage NSW.	Transport for NSW	Pre-construction

6.7 Aboriginal cultural heritage

This section summarises the proposal's Aboriginal heritage impacts.

6.7.1 Methodology

The assessment included a desktop review of published records, data and literature, including a records search of the AHIMS to confirm the presence of Aboriginal items or places in the local area. The AHIMS is attached in Appendix E.

The PACHCI assessment was completed for Aboriginal heritage assessment in reference to the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* (DECCW, 2010).

6.7.2 Existing environment

Wollongong Harbour does not form part of a National Native Title Register; however, it is noted an application has been lodged by the South Coast People, however this has been extinguished at this location.

A basic search of the AHIMS database was conducted on 19 November 2021 of Belmore Basin with a 200-metre buffer. The search identified four known Aboriginal heritage sites within the buffer zone.

An extensive search revealed that the four sites were actually three sites as one was the same as another. Table 6-19 details the sites and their distance from the study area.

Table 6-19: AHIMS sites within 200-metre buffer of Belmore Basin

ID	Name	Context	Site Features	Approximate Distance to Study Area (m)
52-3-0757	Wollongong Harbour	Open Site	Shell Artefact	390
58-4-0688	Brighton Lawn Park 1	Open Site	Shell Artefact	350
52-2-1686	Belmore Basin	Open Site	Shell Artefact	390

6.7.3 Potential impacts

Construction

The proposal footprint is limited to the study area which is located on heavily disturbed land from past land use and development described in section 6.6.2 and is characterised by man-made hardstand surfaces on the landside.

Consequently, in addition to the distance, the proposal is unlikely to result in harm to known Aboriginal heritage sites listed in Table 6-19.

Similarly, is it also unlikely for the construction works to encounter unexpected Aboriginal objects and sites as the site is heavily disturbed and a man-made land feature.

Operation

No impacts to Aboriginal heritage items are anticipated during operation of the proposal as no significant change to the existing operation is proposed.

6.7.4 Safeguards and management measures

Table 6-20 lists the Aboriginal heritage safeguards and management measures that would be implemented to account for the impacts identified in section 6.7.3.

Table 6-20: Aboriginal heritage safeguards and management measures

ID	Impact	Environmental safeguards	Responsibility	Timing
AH1	Aboriginal heritage	Should the scope of the proposed work change, consultation with Transport for NSW's Aboriginal Cultural Heritage Officer and regional environmental staff must be undertaken to reassess any potential impacts on Aboriginal cultural heritage.	Transport for NSW	Pre-construction / Construction
AH2	Aboriginal heritage	All site personnel are to be made aware of the known AHIMS sites (52-3-0757, 58-4-0688 and 52-2-1686) in the form of Aboriginal site awareness during induction.	Contractor	Construction
AH3	Unexpected heritage finds	The *Unexpected Heritage Items Procedure* (RMS, 2015) will be followed in the event that (an) unknown or potential Aboriginal object(s), including skeletal remains, is/are found during construction. This applies where Transport for NSW does not have approval to disturb the object(s) or where a specific safeguard for managing the disturbance (apart from the procedure) is not in place. Work will only restart once the requirements of that procedure have been satisfied.	Contractor	Construction

6.8 Traffic, Transport and Access

This section describes the land and maritime based traffic, transport and access impacts associated with the proposal.

6.8.1 Methodology

A qualitative assessment of transport, traffic and access (see Appendix F) was performed and considers the following:

- Desktop assessment of existing transport options near the proposal
- Evaluation of construction and operation impacts to maritime and landside transport.

6.8.2 Existing environment

Waterside

Wollongong Harbour is a working harbour utilised by commercial trawlers and charter vessels for fishing. Currently, three charter organisations operate in Wollongong Harbour, using Belmore Basin as a base. As one of only a few protected harbours along the south coast, the harbour is also enjoyed by recreational users including the Wollongong Yacht Club. Non-motorised craft such as kayaks, paddleboards and sailing boats are also popular recreational usages of the harbour.

Wollongong Harbour currently only supports private marine vessels and recreational craft. There are no existing public, water-based transport options.

Belmore Basin has 44 allocated berths available for marine vessel berthing. Vessels berthed at Belmore Basin are predominantly trawlers and charter boats that occupy more than one berth allocation. Private yachts and sailing boats are predominantly anchored in Wollongong Harbour.

Landside

Road Network

Wollongong Harbour is accessed via Endeavour Drive and Cliff Road. Endeavour Drive is a loop road that provides access to Belmore Basin, Flagstaff Hill and Flagstaff Point and their associated attractions and amenities. The road is separated from Belmore Basin to the north west by an elevated stone retaining wall.

Endeavour Drive is connected to Cliff Road by a three-way roundabout, south west of the study area.

Cliff Road runs north south, parallel to Wollongong Harbour in the east. The road separates the harbour from low density residential areas and provides access to Cove Beach, Brighton Lawn Reserve and local businesses.

The road network within the vicinity of Wollongong Harbour is characteristic of a high pedestrian traffic area and speed limits of 40 kilometres per hour are enforced.

Parking

Parking at Belmore Basin is available at Lot 1 Endeavour Drive Parking and is restricted between 5am to 10pm daily. There is no stopping or parking between the hours of 10pm to 5am.

There are seven trailer parking spaces within the study area and approximately 25 unmarked car parking spaces. Along Belmore Basin, outside the study area, an additional approximately 35 unmarked and 40 marked car spaces are available.

Bus network

The nearest bus stop to the study area is Cliff Road after Harbour Street (Stop ID 2500336). The bus stop is served by routes 55A, 57 and 887.

Bus route 55A (the Gong Shuttle) is a free anti-clockwise one-way service from the University of Wollongong through North Wollongong, Gwynneville, Wollongong, Fairy Meadow and back to the University. From Monday to Friday, the service operates between 7am to 9:40pm. On Saturdays, Sundays and public holidays, the service operates between 9:40am to 4:40pm. The route services 18 stops in total.

Bus route 57 is a one-way service from Wollongong to Shellharbour via Warrawong. From Wollongong, the route travels through Port Kembla, Spring Hill, Cringila, Lake Heights Warrawong, Primbee, Windang, Lake Illawarra, Warilla, Mount Warrigal, Barrack Heights, Shellharbour, Oak Flats, Albion Park Rail, Yallah, Dapto, Kembla Grange, Unanderra, Figtree, West Wollongong and North Wollongong. From Monday to Friday, the service operates between 5:58am to 11:32pm. On Saturdays, the service operates between 7:06am to 11:32pm while on Sundays and public holidays, the service operates between 9:10am to 7:10pm. The route services 139 stops in total.

Bus route 887 is a loop service from Wollongong to Campbelltown via Appin. From Wollongong, the route travels through North Wollongong, Keiraville, Cataract, Appin, Gilead, Rosemeadow, Ambarvale and Campbelltown. From Monday to Friday, the service operates between 5:10am to 7:36pm. On Saturdays, Sundays and public holidays, the service operates between 7:15am to 5:12pm. The route services 60 stops in total.

Train network

The closest train station to the study area is North Wollongong station located approximately 1.65 kilometres to the north west. The station is on the South Coast Line (SCO), which is an intercity train network, directly connecting Wollongong with Sydney. Train times and frequency are highly variable as the line operates a full route as well as an express.

Pedestrian and bicycle network

Pedestrian access to Belmore Basin is via the pedestrian footpath along Endeavour Drive when entering from the east and via Brighton Lawn Reserve on Cliff Road when entering from the west.

Cyclist share the same access points as pedestrians, however, must travel on Endeavour Drive and Cliff Road as footpaths are not shared. Bicycle racks are available at Brighton Lawn Reserve.

No pedestrian or bicycle paths are within the study area. Pedestrians and cyclists share access within Belmore Basin with motor vehicles.

6.8.3 Potential impacts

Construction

Waterside

Construction of the waterside features will involve a barge mounted excavator. The barge will likely occupy the waterside proposal area. Access to the waterside portion of the proposal area will be restricted. However, movement and access to the remainder of Belmore Basin will be maintained. Trawler, charter and recreational operations are unlikely to be impacted.

The waterside construction will result in a loss of three berthing allocations.

Landside

Construction vehicles would access the proposal via Endeavour Drive. It is anticipated that most materials and equipment required for waterside and landside elements of the proposal would be delivered by road. A land-based crane will be used for construction and a maximum of six major heavy vehicles would be used for deliveries to site. The additional construction traffic expected within the area is considered minor and would be unlikely to affect the capacity of the road network.

The existing bus and train services would remain operational with no change during construction.

Pedestrian and cyclist access on the central pier would be impacted during construction. The proposal area will be fenced off and access to this area will be restricted. Users of Belmore Basin will still be able to access all other parts and amenities outside of the proposal area, including Yachties Café.

Construction activities will result in temporary loss of approximately 17 unmarked car parking spaces. The ancillary facilities identified in section 3.4 do not include provision for extended light vehicle parking. It is anticipated that any parking requirements during construction would utilise the existing parking available at Belmore Basin.

The loss of car parking spaces during construction would be short term given the temporary nature of construction activities. Further, given the quantity of alternative parking areas in the surrounds, including Endeavour Drive Parking and Lot 2 Endeavour Drive Parking, the impacts to parking would unlikely impact the capacity of Belmore Basin. Final access and parking arrangements would be confirmed by the Contractor.

Operation

Waterside

During operation, the waterside features will result in a loss of three berths at the end of the central pier. However, the loss of the berths is unlikely to negatively impact the current operations of the commercial vessels berthed at Belmore Basin given the number of available berthing allocations. The design has also considered ensuring existing manoeuvres of vessels within the harbour will not be impacted.

Positive impacts from the proposal include the introduction of a DDA compliant public pontoon and increasing safe access for trawlers, charter vessels, yachts and other recreational craft.

Landside

During operation, the new unloading zone will result in a loss of approximately four unmarked car parking spaces. However, given the quantity of alternative parking areas

in the surrounds, including Endeavour Drive Parking and Lot 2 Endeavour Drive Parking, the loss of car parking spaces would unlikely impact the capacity of Belmore Basin.

Further, the proposal will introduce a designated area for users of Belmore Basin to load and unload equipment and recreational craft. The permanent unloading zone will minimise the need for users to carry these items over long distances.

6.8.4 Safeguards and management measures

Table 6-21 lists the transport, access and parking safeguards and management measures that would be implemented to account for the impacts identified in section 6.8.3.

Table 6-21: Land transport, access and parking safeguards and management measures

ID	Impact	Environmental safeguards	Responsibility	Timing
T1	Land transport and parking	A TMP will be prepared and will include the following: • Final access and parking arrangements • Alternate pedestrian and cyclist access around the construction area • Measures to ensure light vehicle parking is strictly in accordance with WCC requirements and prevents parking on footpaths and grassed areas adjacent to the proposal area.	Contractor	Pre-construction
T2	Water transport	A maritime navigation exclusion zone will be established during construction to prevent unauthorised vessels entering the area. This zone will be clearly defined to communicate access for all water users.	Contractor	Pre-construction / construction
T3	Water transport	A Maritime TMP will be prepared and implemented during the waterside construction work. The Maritime TMP will be prepared in consultation with Transport for NSW. In addition, the proposal will: • Fit all buoys with lights • Prepare Response Plans for emergencies and spills for all construction vessels • Fit the barge with an Automatic Identification System (AIS)	Contractor	Pre-construction / construction

ID	Impact	Environmental safeguards	Responsibility	Timing
		• Retrieve any material associated with the construction of the development that enters the water to prevent the obstruction of vessel movements • Prepare a Communications Plan for implementation during the work which must include 24/7 contact details, protocols for enquiries, complaints and emergencies. Any variation to the above will be agreed in advance with the Transport for NSW.		
T4	Water transport	Commercial, recreational operators and private services that use Belmore Basin will be advised of the restricted waterside access at least two weeks prior to closure.	Transport for NSW	Pre-construction / construction

6.9 Socio-economic

This section summarises the proposal's socio-economic impacts.

6.9.1 Methodology

The socio-economic impact assessment (SEIA) assesses the socio-economic impact of the proposal in accordance with the *Environmental Impact Assessment Practice Note EIA-N05 – Socio-economic assessment* (TfNSW, 2020b).

For the purpose of defining a boundary for assessing social and economic characteristics, the Australian Bureau of Statistics (ABS) geographic boundary referred to as Statistical Area Level 1 (SA1)-1154818 has been used, with the statistics of Wollongong LGA used as a comparison. SA1-1154818 is the main statistical catchment area for Wollongong Harbour down to Marina Drive.

The following data sources were used to define the socio-economic baseline:

- Data on population and demography, income and employment, and business and industry were sourced from the ABS Census 2016
- Available mapping and imagery from Metromap and Google maps.

6.9.2 Existing environment

The proposal is located within the Wollongong LGA, which is approximately 684 square kilometres in size. The major Wollongong LGA suburbs are Helensburgh, Otford, Stanwell Park, Coalcliff, Scarborough, Wombarra, Coledale, Austinmer, Thirroul, Bulli, Woonona, Corrimal, Bellambi, Towradgi, Balgownie, Fairy Meadow, North Wollongong, Wollongong, Mount Kembla, Figtree, Unanderra, Port Kembla, Berkeley, Primbee, Windang, Wongawilli, Dapto and Yallah.

The proposal is situated in the ABS geographic boundary SA1-11154818. SA1-11154818 is approximately 0.3 square kilometres in size and is the main catchment area for Wollongong Harbour. It is located in the suburb of Wollongong and includes parts of Cliff Road and Marina Road and the entirety of Endeavour Drive.

Population and demography

At the time of the 2016 Census, there were no residents in SA1-11154818.

Comparatively, the Wollongong LGA had approximately 203,630 residents. Of these, 49.4 per cent were female and 50.6 per cent were male with a median age of 39. Aboriginal and Torres Strait Islander people made up 2.6 per cent of the population. Wollongong LGA experienced a 5.8 per cent population growth between 2011 and 2016 (ABS, 2016).

Transport and access

At the time of the 2016 Census, there were no residents in SA1-11154818.

Comparatively, the majority (73.6 per cent) of employed residents in Wollongong LGA travelled to work by car, either as a driver or as a passenger, while 7.5 per cent used public transport (train, bus, ferry, tram/light rail) as at least one of their methods of travel to work. Residents who walked to work made up three per cent of the census and 3.5 per cent of residents worked from home (ABS, 2016).

The transport network is described in further detail in section 6.8.

Economic profile

At the time of the 2016 Census, there were no residents in SA1-11154818.

Comparatively, in 2016, the median weekly household income in Wollongong LGA was $1,339 which was lower than that for the State of NSW at $1,486.

55.2 per cent of the Wollongong LGA labour force were employed full-time while 32.7 per cent were employed part-time and 7.1 per cent were unemployed. The most common occupations included professionals (23.2 per cent), technicians and trade workers (14.8 per cent) and clerical and administrative workers (13.6 per cent). Employment in Wollongong LGA was mainly in hospitals (except psychiatric hospitals) (4.4 per cent), higher education (3.2 per cent) and aged care residential services (2.6 per cent).

Local business and services

Wollongong Harbour is located primarily within a low-density commercial and recreational area. Local businesses and service providers within 200 metres of the study area are listed in Table 6-22.

Table 6-22: Local businesses and service providers

Description	Approximate Distance to Study Area (m)
Yachties' Café	Within
Wollongong Yacht Club	Within
Harbourfront Seafood	60
Nonabel	70
Aquilla Fishing Charters	75
Bombora Seafood	75
Krista Fishing Charters	100
Chodat Fitness	115
Five Islands Outrigger Canoe Club	125
Five Island Charters	155
Levendi Café	155
Normies Ice Cream and Gelato	160
Steamers Bar and Grill	190
City Beach Function Centre	195
Old Court House	200

Social infrastructure

Social infrastructure refers to community facilities, services and networks which help individuals, families, groups and communities meet their social needs, maximise their potential for development and enhance community well-being.

Social infrastructure located within the 200 metres of the study are listed in Table 6-23.

Table 6-23: Local social infrastructure

Description	Land use	Approximate Distance to Study Area (m)
Belmore Basin	Marina	Within
Cove Beach	Beach	85
Wollongong Breakwater Lighthouse	Attraction	110
Brighton Lawn Reserve	Park	110
Brighton Lawn Reserve playground	Park	110
Wollongong Harbour breakwall	Attraction	115
War memorial	Attraction	125
Flagstaff Hill	Park	150
Wollongong City Beach	Beach	165
Bus stop ID 2500336	Transport	170

6.9.3 Potential impacts

Construction

The project would be constructed over a duration of three months, during which, the proposal area will be closed. Works will be undertaken outside key high use periods such as summertime and holiday periods.

During construction, access to Belmore Basin will be restricted around the proposal area. All other areas of Belmore Basin will remain open and accessible. A maritime exclusion zone would be required around the proposal area during construction to prevent unauthorised entry of commercial and recreational vessels. The local bus network will remain operational and no impacts are expected. Detailed impacts to traffic, transport and access are discussed in section 6.8.

Noise and vibration impacts, landscape character and visual impacts and air quality impacts from construction activities would disrupt the amenity of the local area. This would impact visitors and local businesses in the surrounding area due to construction works and the presence of plant and equipment. However, these impacts would be considered minor with the implementation of safeguards and management measures. Detailed impacts to noise and vibration are discussed in section 1.1, landscape character and visual impacts are discussed in section 6.5 and air quality impacts are discussed in section 6.10.

Construction impacts to the social economy would be temporary and restricted to the duration of construction. These impacts be offset by the benefits of the proposal.

Further, construction activity would generate demand for services such as recruitment agencies, construction companies, suppliers and construction services. Local businesses are expected to benefit from the presence of construction personnel.

Operation

During operation, the proposal will provide marine vessel and recreational craft users of all mobility levels with safer and easier access when embarking and disembarking. Users of Belmore Basin would also benefit from a designated permanent unloading zone for loading and unloading, minimising the need to travel long distance with their equipment.

The proposal has been designed with the surrounding landscape in mind and will conform with existing landscape characteristics. Hence, LCVI would be considered low (refer section 6.5.3).

No significant noise and vibration impacts are expected during operation as vessel numbers and movement are not expected to increase significantly (refer section 6.4.3).

Overall, the proposal is expected to benefit and positively impact the community during operation.

6.9.4 Safeguards and management measures

Table 6-24 lists the socio-economic safeguards and management measures that would be implemented to account for the impacts identified in section 6.9.3.

Table 6-24: Socio-economic safeguards and management measures

ID	Impact	Environmental safeguards	Responsibility	Timing
SE1	Socio-economic	A Communications and Stakeholder Engagement Plan will be developed prior to the commencement of construction and would be implemented during construction to provide timely and accurate information to stakeholders during construction. It would include (as a minimum): • Mechanisms to provide details and timing of proposed activities to affected residents and local businesses, including changes to traffic, public transport services and access • A contact name and telephone number for complaints The Plan will be prepared in accordance with the Community Involvement and Communications Resource Manual (RTA, 2008). • A webpage and free-call number will be established for enquiries regarding the proposal, and will remain active for the duration of construction. • Contact details will be clearly displayed at the entrance to the site. All enquiries and complaints will be tracked through a tracking system, and acknowledged within 24 hours of being received.	Transport for NSW / Contractor	Pre-construction / construction
SE2	Sustainability	Investigate opportunities to incorporate community health and wellbeing initiatives in the design and construction of the proposal.	Transport for NSW	Detailed design / construction

6.10 Air quality

This section describes the existing air quality and potential impacts associated with the proposal.

6.10.1 Methodology

Publicly available mapping and data were used to define the air quality characteristics of the study area. This included:

- Climate data (BoM, 2021a)
- Monthly rainfall data (BoM, 2021b)
- EPA Air Quality Data (DPIE, 2021a).

6.10.2 Existing environment

The existing air quality near the location of the study area is primarily influenced by emissions from motor vehicles and residential activities. Air quality is also influenced by the prevailing weather and climatic conditions, bushfires and other natural factors such as pollen.

The nearest long-term air quality monitoring site is located in Gwynneville, Wollongong which is part of the Illawarra monitoring network. A review of air quality data within the last 10 years indicates that average yearly pollutant levels are largely compliant with recommended levels and generally categorised as ‘Good’ based on the Air Quality Category (AQC) (DPIE, 2021a).

The closest BoM monitoring station to the study area with rainfall data is Port Kembla (BSL Central Lab) weather station 068131, approximately six kilometres south west. Monthly rainfall data from the station (BoM, 2021b) reports that the average annual rainfall recorded at Port Kembla is 1096.7 millimetres.

Bellambi weather station (station number 068228) is located approximately 7.6 kilometres north of the study area. Morning and afternoon wind rose directional data is shown in Table 6-1 (BoM, 2021a) and Figure 6-1 (BoM, 2021a). Afternoon winds are generally stronger than morning winds, averaging 23.3 kilometres per hour with morning winds averaging 17 kilometres per hour (BoM, 2021a).

6.10.3 Potential impacts

Construction

During the construction of the proposal, temporary impacts on air quality may arise from:

- Minor generation of particles and dust from minor earthworks
- Minor emissions (primarily diesel exhaust) from plant and machinery
- Minor emissions from construction traffic and barge.

These impacts are expected to be short-term, low intensity and be able to be managed through identified safeguard and management measures.

Operation

Existing operation levels of Wollongong Harbour as a working harbour are not expected to increase. Hence, no additional impacts to air quality are expected from the operation of the proposal.

6.10.4 Safeguards and management measures

Table 6-25 lists the air quality safeguards and management measures that would be implemented to account for the impacts identified in section 6.10.3.

Table 6-25: Air quality safeguards and management measures

ID	Impact	Environmental safeguards	Responsibility	Timing
AQ1	Air quality	Air quality during construction will be considered and addressed within the CEMP and will include methods to manage work during dry weather, strong winds or other adverse weather conditions as required. As a minimum, the following measures will be included: • Measures to ensure dust emissions from construction activities are minimised as far as practical • Covering all loaded trucks and vessels • Machinery to be turned off rather than left to idle when not in use • Maintenance of all vehicles, including trucks and vessels entering and leaving the site in accordance with the manufacturers specifications to comply with all relevant legislation • Maintenance of all plant and equipment to ensure good operating conditions and exhaust emissions comply with the PoEO Act • Maintaining the work site in a condition that minimises fugitive emissions such as minor dust • Appropriate sediment and erosion controls for any exposed earth or stockpiled waste.	Contractor	Pre-construction / construction
AQ2	Sustainability	During construction, the Contractor is to monitor performance of their non-road diesel plant and equipment against United States Environmental	Contractor	Construction

ID	Impact	Environmental safeguards	Responsibility	Timing
		Protection Agency (US EPA), European Union (EU) or equivalent emissions standards using Transport for NSW *Air Emissions Workbook - DMS-FT-439*.		

6.11 Waste management

This section describes existing waste management and potential impacts associated with the proposal.

6.11.1 Methodology

The assessment considered the impacts associated with:

- Resource use and materials management during construction
- Waste generation, management and disposal during construction
- The proposal's ability to respond to waste management and resource conservation plans, policies and guidelines.

The basis of assessment was to consider the hierarchy of avoiding waste generation and primary resource use in favour of reduction, reuse and recycling, consistent with the *Waste Avoidance and Resource Recovery Act 2001* (WARR Act).

6.11.2 Existing environment

Two public waste bin stations are provided at Belmore Basin and are managed by WCC as part of existing operations. Each waste bin station includes one general waste bin and one recycling bin. One waste bin station is located within the study area near the boat ramp while the other waste bin station is located near the decommissioned slipway approximately 90 metres away. There is the potential for litter to enter Wollongong Harbour and Belmore Basin from existing activities.

Recreational fishing may be undertaken from the Wollongong Harbour and Belmore Basin.

In terms of resource use, the central pier has required ongoing maintenance and repair over time. This has required the use of replacement materials that match the nature of existing materials, to maintain the heritage value of the pier.

6.11.3 Potential impacts

Construction

Waste management

Construction activities would generate various waste streams that would need to be managed and disposed of. Potential wastes include:

- Waste fuels, oils, liquids and chemicals
- Packaging wastes such as cardboard, timber, paper and plastic
- General garbage and sewage from the temporary compound
- Potential for contaminated soils and sediment (refer section 6.1)
- Various building material wastes (including metals, plastics and concrete)
- Earthworks spoil
- Asphalt and concrete

- General waste, including food, litter, putrescible amenities waste and other wastes generated by the construction workers.

Ancillary facilities would be contained within the site compound, and include a portable toilet and small shipping container/shed. Minimal storage of materials is anticipated, but may include precast materials and some plant and equipment. Where feasible, materials would be barged, including fuels, oils and other required liquids which would be stored in bunded containers. All waste removed from the proposal area would be transferred by a licenced contractor to a licenced receiving facility.

Any excavated material would be reused where suitable or classified before being disposed to an appropriately licenced facility in accordance with *Waste Classification Guidelines: Part 1 Classifying Waste* (EPA, 2014). Where necessary, this would include sampling and analysis.

Resource use

Transport for NSW adopts a resource reduction strategy based on using:

- Alternative low-energy, high recycled content materials where they are cost and performance competitive and comparable in environmental performance
- Locally sourced materials, noting that most of the materials needed to build the proposal are widely available and typically in abundant supply in the local market
- Alternative forms of material sourcing to reduce the distances or methods travelled to supply materials.

Operation

The proposal will divert passenger embarking and disembarking to the new public pontoon. It will also divert motor vehicles to the new permanent unloading zone for loading and unloading. Although the number of landside users of Belmore Basin are not expected to increase significantly, the proposal will likely increase the local foot traffic within the proposal area. Recreational fishing may also be undertaken at the new public pontoon.

As a result, increased waste may be generated locally within the proposal area. However, given the proximity of the general waste bin station provided within the study area, incidences of littering should be minimal.

6.11.4 Safeguards and management measures

Table 6-26 lists the waste management safeguards and management measures that would be implemented to account for the impacts identified in section 6.11.3.

Table 6-26: Waste management safeguards and management measures

ID	Impact	Environmental safeguards	Responsibility	Timing
WM1	Waste	A waste management plan (WMP) will be prepared in accordance with the WARR Act. A WMP is to be prepared as part of the CEMP and would include measures to minimise waste, outline methods of disposal, reuse and recycling and monitoring, as appropriate. This is to include the following: • Appropriate measures to avoid and minimise waste associated with the proposal should be investigated and implemented where possible • Waste management, littering and general tidiness will be monitored during routine site inspections.	Contractor	Pre-construction / Construction
LS2	Waste	Any excavated sediments or soil that require disposal will be managed in accordance with the EPA's W*aste Classification Guidelines: Part 1 Classifying Waste* (EPA, 2014) prior to being disposed of at a waste facility licensed to accept the relevant class of waste. Any materials classified as Hazardous Waste may require treatment or an immobilisation approach in accordance with Part 10 of the *Protection of the Environment Operations (Waste) Regulation 2014* prior to off-site disposal.	Contractor	Construction
WM2	Resource use	Recycled, durable, and low embodied energy products will be considered to reduce primary resource demand in instances where the materials are cost and performance competitive and comparable in environmental performance (e.g. where quality control specifications allow).	Transport for NSW	Detailed design

ID	Impact	Environmental safeguards	Responsibility	Timing
WM3	Sustainability	During construction, the Contractor is to monitor waste and recycling quantities using Transport for NSW *Waste Data Collection Workbook – DMS-FT-436* to support compulsory requirement 4 of the *Sustainable Design Guidelines* (SDG) *v4.0 rating tool* (TfNSW, 2017).	Contractor	Construction

6.12 Hazards and utilities

This section describes the existing hazards, utilities and potential impacts associated with the proposal.

6.12.1 Methodology

The assessment considered the impacts associated with potential hazards and risks, and utilities during construction and operation of the proposal.

6.12.2 Existing environment

Currently, embarking and disembarking at Belmore Basin requires the use of access ladders which have minimal safety measures in place and are not accessible to all mobility levels and increases the likelihood of fall risk. Other risks include boating strike, plant rollover and vandalism.

The CAR (Coffey, 2016) identified contamination to the soils and groundwater adjacent to the study area (refer section 6.1.2).

The following services were identified within the study area in the CDR (AECOM, 2019a):

- Lighting
- Power
- Potable water.

It is noted that in addition to these three services, there is potential for unknown services to exist within the study area.

6.12.3 Potential impacts

Construction

The following hazards and risks would be associated with the proposal during construction:

- Construction materials, waste and/or other objects have the potential to fall or be blown over by the wind from the landside construction area, construction barge or other construction vessels into the harbour causing water pollution and risk to human health
- Vandalism of construction materials, including portaloos, equipment storage and the plant
- Physical injury to construction workers due to various hazards and risks associated with the construction activities (e.g. piling or underwater construction activities)
- Physical injury to public due to various hazards and risks associated with the construction activities
- Risk to human health or the environment from spillage of materials and/or wastes on land or into the water

- Risk to human health or the environment from the dispersion of potentially contaminated sediments
- Risk to human health or the environment from air quality related impacts from dust generated during construction activities
- Potential impacts to known and unknown utilities.

Operation

The proposal has been designed to comply with relevant standards, minimising risk to user welfare during operation, and improving accessibility.

The installation of restraint piles would assist marine vessels berthing and disembarking at the public pontoon.

Vessel movements to the public pontoon and Belmore Basin would continue to be managed through standard maritime procedures.

6.12.4 Safeguards and management measures

It is expected that hazard safeguards and management measures will be identified and appropriately managed in the design and construction risk management documentation for the project. Hazard safeguards and management measures would include but not be limited to those identified in Table 6-27.

Table 6-27: Hazards safeguards and management measures

ID	Impact	Environmental safeguards	Responsibility	Timing
HR1	Hazards and risks	Weather forecasts will be monitored during construction. In the unlikely event of a major weather event or strong marine winds/waves, equipment and materials will be secured on site or temporarily removed from the site, where possible.	Contractor	Construction
HR2	Hazards and risks	A Dial-Before-You-Dig assessment will be undertaken, followed by further investigations and assessment of impacts to local utilities.	Transport for NSW	Detailed design
HR3	Hazards and risks	Onsite service location will be carried out prior to undertaking any excavation or piling works to identify any additional cables not identified during design.	Contractor	Pre-construction
HR4	Hazards and risks	Daily shutdown procedures will be undertaken to ensure all construction equipment, facilities and amenities are locked and secure from vandalism and/or theft.	Contractor	Construction

6.13 Climate change

6.13.1 Strategic framework

The Intergovernmental Panel on Climate Change has produced climate change projections. In Australia, both the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the BoM have produced regional downscaled projections for Australia from these projections.

In 2014 the NSW Government published climate change 'snapshots' for each region in NSW, including the Illawarra region. The climate change predictions for Illawarra can be summarised as (OEH, 2014):

- Higher than average temperatures (maximum and minimum temperatures)
- The number of hot days will increase and the number of cold nights will decrease
- Rainfall is projected to decrease in winter, and increase in summer and autumn
- Average fire weather is projected to increase in spring, and severe fire weather days are projected to increase in summer and spring.

The NSW Coastal Planning Guideline: *Adapting to Sea Level Rise* (DoP, 2010) applies to the proposal. This guideline provides guidance on how the following eight criteria should be considered when designing development proposals:

- Development avoids or minimises exposure to immediate coastal risks (seaward of the immediate hazard line)
- Development provides for the safety of residents, workers or other occupants on-site from risks associated with coastal processes
- Development does not adversely affect the safety of the public off-site from a change in coastal risks as a result of the development
- Development does not increase coastal risks to properties adjoining or within the locality of the site
- Infrastructure, services and utilities on-site maintain their function and achieve their intended design performance
- Development accommodates natural coastal processes
- Coastal ecosystems are protected from development impacts
- Existing public beach, foreshore or waterfront access and amenity is maintained.

In October 2009 the NSW government released its *NSW Sea Level Rise Policy* (DECCW, 2009). The policy provided sea level rise planning benchmarks as follows:

- 40 centimetres by 2050
- 90 centimetres by 2100.

On 8 September 2012, the State government withdrew these benchmarks in order to provide more flexibility in considering local conditions when determining future hazards. Responsibility for adopting sea level rise projections for use in planning was transferred back to local government.

6.13.2 Potential impacts

Construction

Climatic factors would not constrain construction of the proposal except during adverse weather conditions such as prolonged heavy rain or high winds which may occur during the construction period. These may delay the completion of construction.

Construction would contribute to climate change through the generation of greenhouses gases from construction activities. A temporary increase in greenhouse gas emissions, primarily carbon dioxide, would be expected during construction of the proposal due to exhaust emissions from construction machinery and vehicles transporting materials and personnel to and from the site.

Due to the small scale of the proposal and the short-term temporary nature of the individual construction works, it is considered that greenhouse gas emissions resulting from the construction would be kept to a minimum through the implementation of the standard mitigation measures.

Recycled materials will be considered in the design where possible.

Operation

The proposal has minimised its exposure to climate change risks by including a pontoon, gangway and fixed platform which have been designed to provide appropriate clearances of existing tides, storm surge, sea and wave action whilst also considering projected sea level rise over the next 50 years. This has been considered in the freeboard of the design.

More extreme and more frequent heat events as a result of climate change may lead to more rapid degradation of the waterside features. This may result in additional maintenance requirements.

There would be some greenhouse gas emissions during maintenance of the proposal, although maintenance requirements have been considered in the materials used for the proposal and are considered minor.

Any climate change impacts of operating and maintaining the proposal are considered minor.

6.13.3 Safeguards and management measures

Table 6-28 lists the climate change and greenhouse gas safeguards and management measures that would be implemented to account for the impacts identified in section 6.13.2.

Table 6-28: Climate change and greenhouse gas safeguards and management measures

ID	Impact	Environmental safeguards	Responsibility	Timing
CC1	Climate change	The detailed design process will consider adaptation measures for climate change, including the following: • Design of pontoons, gangways and fixed platforms • Specifications of materials in design • Weather protection features.	Contractor	Detailed design

6.14 Sustainability

6.14.1 Sustainability in design

Transport for NSW is committed to minimising the impact on the natural environment using the Transport for NSW Sustainable Design Guidelines (SDG) to measure and drive sustainability performance. The SDG rating tool was developed to support Transport for NSW's ongoing commitment to sustainability to deliver environmental and social benefits as outlined in the Transport for NSW *Environment and Sustainability Policy* (TfNSW, 2020a).

The SDG rating tool sets targets across the following key areas:

- Climate change adaptation and resilience
- Energy management
- Waste and recycling
- Materials
- Water conservation
- Supply chain management
- Community benefit.

Key design elements and strategies developed during concept design will be used to further develop the design and construction.

6.14.2 Potential impacts

The design of the proposal has been based on the principles of sustainability, including aiming for a 'Silver' rating under the Transport for NSW SDG and the Transport for NSW Environmental Management System (EMS). These guidelines require a number of mandatory and discretionary initiatives to be applied.

6.14.3 Safeguards and management measures

Table 6-29 lists the sustainability safeguards and management measures that would be implemented to account for the impacts identified in section 6.14.2. Other safeguards and management measures that address sustainability are identified in section 6.9.4 (socio-economic), section 6.10.4 (air quality), section 6.11.4 (waste management) and section 6.13.3 (climate change).

Table 6-29: Sustainability safeguards and management measures

ID	Impact	Environmental safeguards	Responsibility	Timing
S1	Sustainability	The Contractor shall propose a suitably qualified and experienced person/s at a minimum 14 days prior to site establishment to be endorsed by Transport for NSW. The nominated person/s will be responsible for implementing the sustainability objectives for the project. Details of the nominated person/s, including defined responsibilities, duration and resource allocation throughout the appointment are to be submitted to Transport for NSW prior to the preparation of the Sustainability Management Plan.	Contractor	Detailed design
S2	Sustainability	Prior to commencement of construction, a Sustainability Management Plan shall be endorsed by Transport for NSW. The Plan will be provided prior to construction and include the following minimum components: • A completed electronic checklist demonstrating compliance with Transport for NSW SDG (7TP-ST-114) • The Contractors sustainability goals and targets, internal procedures, and implementation strategy.	Contractor	Detailed design
S3	Sustainability	The Contractor must comply with the Transport for NSW SDG.	Transport for NSW / Contractor	Detailed design / Construction

6.15 Cumulative impacts

Cumulative impacts relate to any combined impact resulting from multiple individual sources. These sources can occur in the past, present or future in comparison to the construction and operation of the proposal. The consideration of cumulative impacts is required to assess this combined impact in the context of the region.

6.15.1 Methodology

The proposal is located in the Wollongong LGA. Projects within the Wollongong LGA have been considered for the purposes of this cumulative impact assessment.

A search of the following databases was completed to identify any projects which might result in cumulative impacts with the proposal:

- DPE – major projects
- Southern Regional Planning Panel Register (SRPPR)
- WCC Development Application Register.

Projects identified on the above registers that may impact the proposal have been identified in Table 6-30.

6.15.2 Other projects and developments

No major projects were identified within 200 metres of the study area.

No developments within 200 metres of the study area were identified in the SRPPR.

Nine developments within 200 metres of the study area were identified in the WCC Development Application Register.

Consultation with Council (refer section 5.4) revealed an additional proposal in development by the Wollongong Yacht Club. The proposal is in its early stages and has yet to be submitted.

Additionally, WCC will be hosting the UCI Road World Championships from 18 - 25 September 2022. During this event, Council has expressed that no construction activity should be commenced or underway during the lead up to and during the event.

Past, present and future projects and developments are detailed in Table 6-30.

Table 6-30: Past, present and future projects and developments

Project/Development	Construction impacts	Operational impacts
DA-2013/1175/A Belmore Basin Foreshore, 2 Endeavour Drive, Wollongong Lodged: 18/8/2019 Rejected: 29/8/2019 Aqua Park - Wollongong Harbour Belmore Basin	No construction impacts are anticipated as the development has been completed.	No operational impacts are anticipated as the development has been completed.

Project/Development	Construction impacts	Operational impacts
PC-2019/1081 8/10 Harbour Street, Wollongong Lodged: 25/8/2019 Approved: 21/8/2019 Status: complete Residential - alterations and additions	No construction impacts are anticipated as the development has been completed.	No operational impacts are anticipated as the development has been completed.
PC-2019/1126 8/10 Harbour Street, Wollongong Lodged: 4/9/2019 Approved: 2/9/2019 Status: complete Residential - awning	No construction impacts are anticipated as the development has been completed.	No operational impacts are anticipated as the development has been completed.
DA-2017/831/B 10 Harbour Street, Wollongong Lodged: 18/12/2019 Approved: 3/8/2020 Status: complete Residential - alterations and additions Modification B - extend roof to the north west	No construction impacts are anticipated as the development has been completed.	No operational impacts are anticipated as the development has been completed.
DA-2013/1175/A Belmore Basin Foreshore, 2 Endeavour Drive, Wollongong Lodged: 10/1/2020 Approved: 24/11/2020 Status: complete Use of Foreshore sites (coastal strip between Wollongong No 2 Showground and Elliotts Road) for major events - all Tier 4 events, a maximum of 8 x Tier 3 events, a maximum of 6 x Tier 2 events and a maximum of 3 x Tier 1 events Modification A - changes to conditions of	No construction impacts are anticipated as the development has been completed.	No operational impacts are anticipated as the development has been completed.

Project/Development	Construction impacts	Operational impacts
consent and define event site boundaries		
DA-2013/1174/A Osborne Park, Cliff Road, Wollongong Lodged: 10/1/2020 Approved: 26/11/2020 Status: complete Use of Osborne Park for major events - all Tier 4 events Modification A - changes to conditions of consent and define event site boundaries	No construction impacts are anticipated as the development has been completed.	No operational impacts are anticipated as the development has been completed.
PC-2020/98 2 Hector Street, Wollongong Lodged: 30/1/2020 Approved: 23/1/2020* Status: complete Residential - patio cover	No construction impacts are anticipated as the development has been completed.	No operational impacts are anticipated as the development has been completed.
DA-2020/694 Belmore Basin Foreshore, 2 Endeavour Drive, Wollongong Lodged: 13/7/2020 Approved: 7/12/2020 Status: complete Commercial - alterations and additions to existing building for new restaurant tenancy	No construction impacts are anticipated as the development has been completed.	No operational impacts are anticipated as the development has been completed.
PC-2019/1126/A 8/10 Harbour Street, Wollongong Lodged: 5/11/2020 Approved: 2/11/2020* Status: complete Residential - alterations and additions Modification B - extend roof to the north west	No construction impacts are anticipated as the development has been completed.	No operational impacts are anticipated as the development has been completed.

Project/Development	Construction impacts	Operational impacts
2022 UCI Road World Championships Wollongong LGA 18 – 25 September 2022 International cycling event	No construction impacts are expected as construction of the proposal will not commence until after the event.	No operational impacts are expected as construction of the proposal will not commence until after the event.
Operational Sports Club (OSC) Lot 1 Endeavour Drive, Belmore Basin Sporting facility	No construction impacts are anticipated at this stage as the proposal for the OSC is still being developed.	No operational impacts are anticipated at this stage as the proposal for the OSC is still being developed.
Note: Approval dated earlier than lodgement date. Source: https://epathway.wollongong.nsw.gov.au/ePathway/Production/Web/GeneralEnquiry/EnquirySearch.aspx		

6.15.3 Potential impacts

No cumulative impacts during the construction and operation phase are anticipated as the developments listed on the WCC Development Register which are in proximity to the study area, refer Table 6-28, have been completed.

No cumulative impacts during the construction and operation phase are anticipated during the UCI Road World Championship as construction of the proposal will not commence until after the event.

At this stage, no cumulative impacts from the OSC proposal during the construction and operation phase are anticipated as the OSC proposal is still in the early development stage. However, Transport for NSW should liaise with Wollongong Yacht Club to coordinate works to minimise cumulative impacts to the environment.

6.15.4 Safeguards and management measures

Table 6-31 lists the cumulative impacts safeguards and management measures that would be implemented to account for the impacts identified in section 6.15.3.

Table 6-31: Cumulative impacts safeguards and management measures

ID	Impact	Environmental safeguards	Responsibility	Timing
C1	Cumulative construction impacts	Consultation with identified external stakeholders will include notification prior to the start of the works (in accordance with TfNSW community and stakeholder engagement toolkit). Updates on any delays or changes to the construction period will also be communicated.	Transport for NSW	Pre-construction / construction
C2	Cumulative construction impacts	Consultation will occur between Transport for NSW and Wollongong Yacht Club to determine and coordinate construction timing of this proposal and the OSC proposal in order to minimise cumulative impacts to the environment.	Transport for NSW	Pre-construction

7 Environmental management

This chapter describes how the proposal will be managed to reduce potential environmental impacts throughout detailed design, construction and operation. A framework for managing the potential impacts is provided. A summary of site-specific environmental safeguards is provided and the licence and/or approval requirements required prior to construction are also listed.

7.1 Environmental management plans (or systems)

A number of safeguards and management measures have been identified in the REF in order to minimise adverse environmental impacts, including social impacts, which could potentially arise as a result of the proposal. Should the proposal proceed, these safeguards and management measures would be incorporated into the detailed design and applied during the construction and operation of the proposal.

A CEMP will be prepared to describe the safeguards and management measures identified. The CEMP will provide a framework for establishing how these measures will be implemented and who would be responsible for their implementation.

The CEMP will be prepared prior to construction of the proposal and must be reviewed and certified by the Transport for NSW Environment Officer prior to the commencement of any on-site works. The CEMP will be a working document, subject to ongoing change and updated as necessary to respond to specific requirements.

7.2 Summary of safeguards and management measures

Environmental safeguards and management measures outlined in this REF will be incorporated into the detailed design phase of the proposal and during construction and operation of the proposal, should it proceed. These safeguards and management measures will minimise any potential adverse impacts arising from the proposed work on the surrounding environment. The safeguards and management measures are summarised in Table 7-1.

Table 7-1: Summary of safeguards and management measures

ID	Impact	Environmental safeguards	Responsibility	Timing
LS1	Soil and water	A soil and water management plan (SWMP) will be prepared and implemented as part of the CEMP. The SWMP will identify all reasonably foreseeable risks relating to soil erosion and water pollution and describe how these risks will be addressed during construction.	Contractor	Pre-construction
LS2	Soil and water	Any excavated sediments or soil that require disposal will be sampled, tested and classified in accordance with the EPA's *Waste Classification Guidelines: Part 1 Classifying Waste* (EPA, 2014) prior to being disposed of at a waste facility licensed to accept the relevant class of waste. Any materials classified as Hazardous Waste may require treatment or an immobilisation approach in accordance with Part 10 of the *Protection of the Environment Operations (Waste) Regulation 2014* prior to off-site disposal.	Contractor	Construction
LS3	Contaminated land	If unexpected contaminated areas are encountered during construction, appropriate control measures will be implemented to manage the immediate risks of contamination. All other works that may impact on the contaminated area will cease until the nature and extent of the contamination has been confirmed and any necessary site-specific controls or further actions identified in consultation with the Transport for NSW Environment Manager and/or EPA.	Contractor	Construction
LS4	Contaminated land	The piling activity will mitigate the risk of sediment dispersal by applying industry best practice of minimising sediment disturbance during construction using pilling methods or any other seabed interference.	Contractor	Construction

ID	Impact	Environmental safeguards	Responsibility	Timing
LS5	Erosion and scour/ Removal of marine vegetation and habitat	No bed anchoring is to occur. The barge must use existing land side anchor points.	Contractor	Construction
LS6	Erosion and scour	The contractor will consider the swell conditions when implementing the silt curtain. Works associated with positioning barges, drilling and pile driving will occur during calm conditions and must not occur when a weather alert has been issued to prevent excessive scouring and other impacts.	Contractor	Construction
LS7	Erosion and sedimentation	Prior to commencement of construction activities, sediment control device (such as sediment boom and curtain) will be installed around the site to contain disturbed sediment from the water surface by allowing suspended sediments to settle back on the bottom of the seabed overtime. The silt boom and curtain will be installed in accordance with the manufacturers specification for installation. Installation will be undertaken during high tide periods from a boat as tides, currents, the weather and wind could impact the level of erosion and sedimentation. The device will be designed to rise and fall with the tide to prevent disturbance. Inspection of the device will be undertaken on a daily basis after ebbing tides, with additional inspection carried out following storm events. Prior to removing the sediment control device, conditions within the curtain will be assessed visually and with a field instrument to verify that sediment has settled resulting in similar water turbidity to that outside the curtain.	Contractor	Construction
LS8	Erosion and sedimentation	Site specific Erosion and Sediment Control Plan/s will be prepared and implemented as part of the SWMP. Control measures willbe implemented and maintained (in accordance with the *Managing Urban Stormwater, Soils and Construction Guidelines* “the Blue Book” (Landcom, 2004)) to: • Minimise sediment dispersal during piling	Contractor	Pre-construction

ID	Impact	Environmental safeguards	Responsibility	Timing
		• Prevent sediment moving off-site and sediment laden water entering any water course, drainage lines, or drain inlets • Reduce water velocity and capture sediment on site • Minimise the amount of material transported from site to surrounding pavement surfaces • Divert clean water around the site.		
LS9	Erosion and sedimentation	Visual monitoring of local water quality (i.e. turbidity, hydrocarbon spills/slicks) will be undertaken on a regular basis each day as works are undertaken to identify any potential spills or deficient silt curtains or erosion and sediment controls. Results of the observations are required to be recorded. Records are required to be kept on the site and to be made available for inspection by persons authorised by Transport for NSW.	Contractor	Construction
LS10	Design changes	If there are significant changes to the design or layout of piles then further delineation assessment of the known contamination will be undertaken to evaluate the vertical and lateral extent of sediment impact prior to work commencement.	Transport for NSW	Detailed design
WQ1	Accidental spill	A spill management plan will be developed as part of the CEMP and communicated to all staff working on site. Appropriate land and aquatic/marine spill kits will be maintained on site and on barges. Aquatic/marine spill kits must be specific for working within the marine environment. The spill kit must be appropriately sized for the volume of potentially polluting liquids stored at the work site. All workers will be advised of the location of the spill kit and trained in its use.	Contractor	Pre-construction / Construction

ID	Impact	Environmental safeguards	Responsibility	Timing
WQ2	Accidental spill	If an incident (e.g. spill) occurs, the *Environmental Incident Classification and Reporting Procedure* (RMS, 2018) is to be followed and the Transport for NSW Contract Manager notified as soon as practicable.	Contractor	Construction
WQ3	Accidental spill	In the event of a maritime spill, the incident emergency plan will be implemented in accordance with Port Authority of NSW's response to shipping incidents and emergencies outlined in the *NSW State Waters Marine Oil and Chemical Spill Contingency Plan* (RMS, 2016d). Fisheries NSW must also be notified.	Contractor	Construction
WQ4	Accidental spill	Emergency contacts will be kept in an easily accessible location on vehicles, vessels, plant and site office. All workers will be advised of these contact details and procedures.	Contractor	Pre-construction / Construction
WQ5	Accidental spill	Vehicles, vessels and plant must be properly maintained and regularly inspected for fluid leaks.	Contractor	Construction
WQ6	Accidental spill	No vehicle or vessel wash-down or re-fuelling will occur on-site.	Contractor	Construction
WQ7	Accidental spill	Any chemicals or fuels stored at the site or equipment barges will be stored in a bunded area.	Contractor	Construction
B1	All proposal impacts	Integrate the management of flora and fauna into the construction environmental management plan (either as a standalone flora and fauna management plan or a subplan). This is to include all terrestrial and marine flora and fauna and include but not be limited to such measures as: • Documenting and establishing site clearing limits and include on sensitive area plans • Establishing no go zones and go slow zones (i.e. vessel speed restricted areas) and include on sensitive area plans Pre-construction surveys, weed management and unexpected finds measures in line with the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA, 2011).	Contractor	Pre-construction

ID	Impact	Environmental safeguards	Responsibility	Timing
B2	Removal of marine vegetation and habitat	As part of the detailed design process, provide evidence of opportunities explored to promote colonisation of habitat-forming species. Examples include the installation of structures which provide habitat complexity (i.e. designs available as part of the Living Seawalls Project).	Transport for NSW and Contractor	Detailed design
B3	Fish kill	DPI Fisheries (1800 043 536) and the EPA (131 555) are to be notified immediately if any fish kills occur in the vicinity of the works. In such cases, all works other than emergency response procedures are to cease until the issue is rectified and approval is given by DPI Fisheries and/or the EPA for the works to proceed.	Contractor	Construction
B4	Aquatic impacts	Aquatic habitat will be protected in accordance with Guide 10: Aquatic habitats and riparian zones of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA, 2011) and Section 3.3.2 Standard precautions and mitigation measures of the *Policy and guidelines for fish habitat conservation and management* (DPI, 2013).	Contractor	Construction
B5	Aquatic impacts	Piling to stop if marine mammals or reptiles are observed within approximately 100 metres of the proposal area and only to recommence once they have moved beyond 100 metres of the study area or are not seen for at least 20 minutes.	Contractor	Construction
LS6	Aquatic impacts	Work associated with positioning barges, drilling and pile driving will occur during calm conditions to prevent excessive scouring and other impacts. Calm conditions would be determined by a multitude of factors, including swell, wind and the current.	Contractor	Construction
B6	Changes to coastal processes	The detailed design will aim to avoid/minimise any impact to coastal processes and hydrology.	Contractor	Detailed design
B7	Injury and mortality of fauna	Fauna will be managed in accordance with Guide 9: Fauna handling of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA, 2011).	Contractor	Construction

ID	Impact	Environmental safeguards	Responsibility	Timing
B8	Invasion and spread of weeds, pests and diseases	Weed species will be managed in accordance with *Guide 6: Weed management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA, 2011).	Contractor	Construction
B9	Invasion and spread of weeds, pests and diseases	Waterside equipment and vessels to be sourced from local suppliers where possible. Equipment and vessels must be cleaned and inspected prior to entering the proposal area. If any marine pests are encountered during waterside construction activities, the area of infestation must be isolated/not disturbed and DPI Fisheries notified promptly.	Contractor	Construction
B10	Invasion and spread of weeds, pests and diseases	Occurrence of any marine pests must be reported to DPI Fisheries.	Contractor	Construction
B11	Shadowing of seabed	The pontoon design will utilise 30mm by 30mm mesh decking, a freeboard of 0.5 -0.7m and a landing at about 3.5m above MHWM to allow for light penetration below the structure.	Contractor	Detailed design

NV1	Noise and vibration	Preparation of a construction noise and vibration management plan (CNVMP) based on recommendations provided within the ICNG and AS 2436-1981: *Guide to Noise Control on Construction, Maintenance and Demolition Sites*. This is to include, but not be limited to:
		• Plant controls:
		  ○ Use of noise attenuating controls at the source, such as mufflers, acoustic screens, etc.
		  ○ Maintain plant and equipment in good working order to prevent excess noise generation.
		  ○ Locate static sources of noise such as the generators as remotely as possible from noise sensitive receivers
			Contractor	Pre-construction

ID	Impact	Environmental safeguards	Responsibility	Timing
		○ Use of broadband reversing alarms, or “quackers”, on mobile equipment in accordance with the relevant health and safety regulations ○ Use of temporary noise barriers where practical. The height and location of these barriers will be determined during preparation of the CNVMP when more information regarding the proposed plant to be used for each construction stage is available. ○ Investigate whether “at plant” mitigation or muffled plant is available for plant with high source noise levels such as rock hammers and piling rigs, and plant emitting continuous noise such as generators. ○ Acoustic curtains (generally loaded vinyl based products), attached to wire construction fencing or laid over steel scaffold can also provide practical temporary noise barriers. Acoustic curtains will be investigated for stationary plant within the worksites once a detailed schedule of works and plant is available. • Management and behavioural controls: ○ Ensure that managers effectively communicate acceptable and unacceptable work practices for the site, through staff site inductions, notice boards, and prestart meetings. ○ Avoid the need for reversing in the construction area by creating a loop road or similar. ○ Avoid dropping materials from height. ○ Workers will avoid shouting, minimise talking loudly, and avoid slamming vehicle doors. • Conducting noise and vibration monitoring during all construction phases/scenarios considering the potential exceedances for the		

ID	Impact	Environmental safeguards	Responsibility	Timing
		purposes of assisting in noise mitigation and to verify the findings of this noise assessment. • Inclusion of safe working distances for plant and equipment. • Implementing a procedure where exceedances are recorded, works will be modified in consultation with the identified specialist to reduce vibration levels. • Implementing a procedure for dealing with complaints to ensure that all complaints are registered and dealt with appropriately. • Conducting additional monitoring if complaints are received or proposed activities and number of plant exceed those assumed in this assessment. • Modifying work activities where noise or vibration is found to cause unacceptable impact. Implementation of additional mitigation measures in accordance with the CNVG including notification, phone calls and a respite offer.		
NV2	Noise and vibration	Works would be carried out within standard daytime hours as follows: • 7am to 6pm Monday to Friday • 8am to 1pm Saturdays, no work on Sundays or public holidays. Works must not be carried out during evening or night-time hours. Should operations be required outside standard hours, an Out of Hours procedure detailing works schedule, approval process, communication requirements and management measures will be prepared.	Contractor	Construction
NV3	Noise and vibration	Prior to works occurring, notification will occur to potentially affected receivers in the following manner: • Details of the work activities, dates and hours, impacts and mitigation measures, indication of work schedule over the night-time	Transport for NSW / Contractor	Pre-construction

ID	Impact	Environmental safeguards	Responsibility	Timing
		period, any operational noise benefits from the work (where applicable) and contact telephone number. • Notification should be a minimum of seven calendar days prior to the start of work. A contact telephone number and email address will be available for community feedback and complaints management.		
NV4	Vibration impact to heritage structures	If the minimum working distances for the relevant plant, outlined in CNVG cannot be met, a construction vibration assessment is to be undertaken to determine safe working limits based on proposed plant and where possible, smallest plant able to carry out required work should be utilized to minimize potential impacts. Where works are proposed within the safe working limits for the heritage structures, specialist advice would be sought from an appropriately qualified structural engineer who is familiar with heritage structures to assess if vibrations associated with the proposed works would potentially result in impacts to heritage structures.	Contractor	Pre-construction / Construction
NV5	Vibration impact to heritage structures	Regular inspections of the construction activities and work areas will be undertaken by engineers and any other required specialist to monitor and review the construction methodology to confirm the integrity of the heritage items. Assessment and monitoring of vibration impacts will adhere to: • British Standard BS 7385: Part 2: *Evaluation and Measurement for Vibrations in Buildings – Part 2 Guide to Damage Levels from Ground-Borne Vibration* • German Standard DIN 4150, Part 3: Structural Vibration in Buildings: Effects on Structures.	Contractor	Pre-construction
NV6	Vibration	Where heritage buildings are located within the safe working distance zone, pre and post construction dilapidation surveys will be carried out.	Contractor	Pre-construction / Post-Construction

ID	Impact	Environmental safeguards	Responsibility	Timing
NV7	Vibration	Where buildings are located within the safe work distance zones (non-heritage structures), vibration monitoring will be carried out to ensure compliance with the required criteria. If exceedances are recorded, works will be modified accordingly to reduce vibration levels.	Contractor	Pre-construction / Construction
LV1	Landscape and visual	Urban design principles will be integrated throughout the detailed design and construction of the proposal and include: Use of colours that blend into the landscape (as viewed from the harbour) and that complement the materiality of Belmore Basin should be considered	Transport for NSW	Detailed design
LV2	Landscape and visual	Hoarding will be erected around the construction compound where possible, to reduce visibility.	Contractor	Construction
LV3	Landscape and visual	If out of hours work is required, lighting will be directionally controlled (faced down where possible and away from receivers) to limit potential impacts of light spill on surrounding receivers, including residential properties.	Contractor	Construction
LV4	Landscape and visual	All impacted areas and ground surfaces will be reinstated as near as possible to their original state following the completion of works.	Contractor	Post-construction
H1	Archaeological significance	A heritage induction will be provided to workers prior to construction, informing them of the significance and location of known heritage items and the implementation of the *Unexpected Heritage Item Procedure* (RMS, 2015) if unanticipated heritage items or deposits are located during construction.	Contractor	Pre-construction
H2	Unexpected finds	Archaeological remains will be managed under the *Unexpected Heritage Items Procedure* (RMS, 2015) if unanticipated heritage items or depositions are located during construction. Under this procedure: • If archaeological 'works' such as evidence of former road surfaces or streetscape elements are unexpectedly encountered during construction works and would be impacted, archaeological investigation and recording would be undertaken prior to impacts	Contractor	Construction

ID	Impact	Environmental safeguards	Responsibility	Timing
		• If historical archaeological relics are unexpectedly encountered during the works, all works in the immediate vicinity are to cease immediately and Heritage NSW be notified. A qualified archaeologist is to be contacted to assess the situation and consult with the Heritage NSW regarding the most appropriate course of action. 'Relics' cannot be impacted without appropriate approvals under the *Heritage Act*.		
H3	Vibration impact to heritage structures	If vibration monitors are attached to the heritage items, consultation with the relevant authority will be undertaken to ensure that monitors can be installed. Installation should consider future removable without causing damage. Bees wax may be a suitable attachment method.	Contractor	Construction
H4	Heritage items	Prior to the start of construction, the stability of the heritage walls will be confirmed. Any fixings into the heritage walls should be of suitable materials and limited in their surface impacts. Heritage items will be fenced off where possible to prevent any accidental impacts to these items.	Contractor	Construction
H5	Design change	If design changes result in additional earthworks, further archaeological assessment and management will be required. Any project redesign resulting in new ground disturbance, vegetation removal, or new features must be assessed in an addendum to the SoHI (Austral Archaeology, 2022).	Transport for NSW	Detailed design / Pre-construction
H6	Design change	Should the actual development be altered significantly from the proposed concept design, then a reassessment of the heritage/archaeological impact may be required. This includes any impacts not explicitly stated in the SoHI (Austral Archaeology, 2022) or this REF.	Transport for NSW	Detailed design / Pre-construction
H7	Heritage archive	A copy of the SOHI (Austral Archaeology, 2022) should be lodged in the local history section of the local library, and in the library maintained by Heritage NSW.	Transport for NSW	Pre-construction
AH1	Aboriginal heritage	Should the scope of the proposed work change, consultation with Transport for NSW's Aboriginal Cultural Heritage Officer and regional environmental	Transport for NSW	Pre-construction / Construction

ID	Impact	Environmental safeguards	Responsibility	Timing
		staff must be undertaken to reassess any potential impacts on Aboriginal cultural heritage.		
AH2	Aboriginal heritage	All site personnel are to be made aware of the known AHIMS sites (52-3-0757, 58-4-0688 and 52-2-1686) in the form of Aboriginal site awareness during induction.	Contractor	Construction
AH3	Unexpected heritage finds	The *Unexpected Heritage Items Procedure* (RMS, 2015) will be followed in the event that (an) unknown or potential Aboriginal object(s), including skeletal remains, is/are found during construction. This applies where Transport for NSW does not have approval to disturb the object(s) or where a specific safeguard for managing the disturbance (apart from the procedure) is not in place. Work will only restart once the requirements of that procedure have been satisfied.	Contractor	Construction
T1	Land transport and parking	A TMP will be prepared and will include the following: • Final access and parking arrangements • Alternate pedestrian and cyclist access around the construction area • Measures to ensure light vehicle parking is strictly in accordance with WCC requirements and prevents parking on footpaths and grassed areas adjacent to the proposal area.	Contractor	Pre-construction
T2	Water transport	A maritime navigation exclusion zone will be established during construction to prevent unauthorised vessels entering the area. This zone will be clearly defined to communicate access for all water users.	Contractor	Pre-construction / construction
T3	Water transport	A Maritime TMP will be prepared and implemented during the waterside construction work. The Maritime TMP will be prepared in consultation with Transport for NSW. In addition, the proposal will: • Fit all buoys with lights	Contractor	Pre-construction / construction

ID	Impact	Environmental safeguards	Responsibility	Timing
		• Prepare Response Plans for emergencies and spills for all construction vessels • Fit the barge with an Automatic Identification System (AIS) • Retrieve any material associated with the construction of the development that enters the water to prevent the obstruction of vessel movements • Prepare a Communications Plan for implementation during the work which must include 24/7 contact details, protocols for enquiries, complaints and emergencies. Any variation to the above will be agreed in advance with the Transport for NSW.		
T4	Water transport	Commercial, recreational operators and private services that use Belmore Basin will be advised of the restricted waterside access at least two weeks prior to closure.	Transport for NSW	Pre-construction / construction
SE1	Socio-economic	A Communications and Stakeholder Engagement Plan will be developed prior to the commencement of construction and would be implemented during construction to provide timely and accurate information to stakeholders during construction. It would include (as a minimum): • Mechanisms to provide details and timing of proposed activities to affected residents and local businesses, including changes to traffic, public transport services and access • A contact name and telephone number for complaints. The Plan will be prepared in accordance with the Community Involvement and Communications Resource Manual (RTA, 2008). • A webpage and free-call number will be established for enquiries regarding the proposal, and will remain active for the duration of construction.	Transport for NSW / Contractor	Pre-construction / construction

ID	Impact	Environmental safeguards	Responsibility	Timing
		• Contact details will be clearly displayed at the entrance to the site. All enquiries and complaints will be tracked through a tracking system, and acknowledged within 24 hours of being received.		
SE2	Sustainability	Investigate opportunities to incorporate community health and wellbeing initiatives in the design and construction of the proposal.	Transport for NSW	Detailed design / construction
AQ1	Air quality	Air quality during construction will be considered and addressed within the CEMP and will include methods to manage work during dry weather, strong winds or other adverse weather conditions as required. As a minimum, the following measures will be included: • Measures to ensure dust emissions from construction activities are minimised as far as practical • Covering all loaded trucks and vessels • Machinery to be turned off rather than left to idle when not in use • Maintenance of all vehicles, including trucks and vessels entering and leaving the site in accordance with the manufacturers specifications to comply with all relevant legislation • Maintenance of all plant and equipment to ensure good operating conditions and exhaust emissions comply with the PoEO Act • Maintaining the work site in a condition that minimises fugitive emissions such as minor dust • Appropriate sediment and erosion controls for any exposed earth or stockpiled waste.	Contractor	Pre-construction / construction
AQ2	Sustainability	During construction, the Contractor is to monitor performance of their non-road diesel plant and equipment against United States Environmental Protection Agency (US EPA), European Union (EU) or equivalent emissions standards using Transport for NSW *Air Emissions Workbook - DMS-FT-439*.	Contractor	Construction

ID	Impact	Environmental safeguards	Responsibility	Timing
WM1	Waste	A waste management plan (WMP) will be prepared in accordance with the WARR Act. A WMP is to be prepared as part of the CEMP and would include measures to minimise waste, outline methods of disposal, reuse and recycling and monitoring, as appropriate. This is to include the following: • Appropriate measures to avoid and minimise waste associated with the proposal should be investigated and implemented where possible • Waste management, littering and general tidiness will be monitored during routine site inspections.	Contractor	Pre-construction / Construction
LS2	Waste	Any excavated sediments or soil that require disposal will be managed in accordance with the EPA's W*aste Classification Guidelines: Part 1 Classifying Waste* (EPA, 2014) prior to being disposed of at a waste facility licensed to accept the relevant class of waste. Any materials classified as Hazardous Waste may require treatment or an immobilisation approach in accordance with Part 10 of the *Protection of the Environment Operations (Waste) Regulation 2014* prior to off-site disposal.	Contractor	Construction
WM2	Resource use	Recycled, durable, and low embodied energy products will be considered to reduce primary resource demand in instances where the materials are cost and performance competitive and comparable in environmental performance (e.g. where quality control specifications allow).	Transport for NSW	Detailed design
WM3	Sustainability	During construction, the Contractor is to monitor waste and recycling quantities using Transport for NSW *Waste Data Collection Workbook – DMS-FT-436* to support compulsory requirement 4 of the *Sustainable Design Guidelines* (SDG) *v4.0 rating tool* (TfNSW, 2017).	Contractor	Construction
HR1	Hazards and risks	Weather forecasts will be monitored during construction. In the unlikely event of a major weather event or strong marine winds/waves, equipment and materials will be secured on site or temporarily removed from the site, where possible.	Contractor	Construction

ID	Impact	Environmental safeguards	Responsibility	Timing
HR2	Hazards and risks	A Dial-Before-You-Dig assessment will be undertaken, followed by further investigations and assessment of impacts to local utilities.	Transport for NSW	Detailed design
HR3	Hazards and risks	Onsite service location will be carried out prior to undertaking any excavation or piling works to identify any additional cables not identified during design.	Contractor	Pre-construction
HR4	Hazards and risks	Daily shutdown procedures will be undertaken to ensure all construction equipment, facilities and amenities are locked and secure from vandalism and/or theft.	Contractor	Construction
CC1	Climate change	The detailed design process will consider adaptation measures for climate change, including the following: • Design of pontoons, gangways and fixed platforms • Specifications of materials in design • Weather protection features.	Contractor	Detailed design
S1	Sustainability	The Contractor shall propose a suitably qualified and experienced person/s at a minimum 14 days prior to site establishment to be endorsed by Transport for NSW. The nominated person/s will be responsible for implementing the sustainability objectives for the project. Details of the nominated person/s, including defined responsibilities, duration and resource allocation throughout the appointment are to be submitted to Transport for NSW prior to the preparation of the Sustainability Management Plan.	Contractor	Detailed design
S2	Sustainability	Prior to commencement of construction, a Sustainability Management Plan shall be endorsed by Transport for NSW. The Plan will be provided prior to construction and include the following minimum components: • A completed electronic checklist demonstrating compliance with Transport for NSW SDG (7TP-ST-114)	Contractor	Detailed design

ID	Impact	Environmental safeguards	Responsibility	Timing
		• The Contractors sustainability goals and targets, internal procedures, and implementation strategy.		
S3	Sustainability	The Contractor must comply with the Transport for NSW SDG.	Transport for NSW / Contractor	Detailed design / Construction
C1	Cumulative construction impacts	Consultation with identified external stakeholders will include notification prior to the start of the works (in accordance with TfNSW community and stakeholder engagement toolkit). Updates on any delays or changes to the construction period will also be communicated.	Transport for NSW	Pre-construction / construction
C2	Cumulative construction impacts	Consultation will occur between Transport for NSW and Wollongong Yacht Club to determine and coordinate construction timing of this proposal and the OSC proposal in order to minimise cumulative impacts to the environment.	Transport for NSW	Pre-construction

7.3 Licensing and approvals

Provided the safeguards and management measures outlined in section 7.2 are implemented, no licences or approvals will be required for the proposal.

8 Justification and conclusion

This chapter provides the justification for the proposal taking into account its biophysical, social and economic impacts, the suitability of the site and whether or not the proposal is in the public interest. The proposal is also considered in the context of the objectives of the EP&A Act, including the principles of ecologically sustainable development as defined in Schedule 2 of the Environmental Planning and Assessment Regulation 2021.

8.1 Justification

The proposal forms a part of the short to medium term vision of the WHMP (TfNSW, 2020d). The aim of the WHMP is to develop Wollongong Harbour to accommodate for future projected population growth and increased tourism, while still maintaining its historic use and purpose as the “active working heart of the city”. The short to medium term vision of the WHMP highlights 12 development opportunities for the harbour capable of being realised over the next five to 15 years.

Consideration of alternatives and options for the proposal design was carried out. The preferred design of the proposal selected to best achieve the objectives outlined in section 2.3, while taking into account community consultation. The design efficacy was determined by comparison to the option of doing nothing and other options outlined in section 2.4.

Potential environmental and social impacts resulting from construction and operation of the proposal have been minimised through the safeguards and management measures outlined in Chapter 7.

The following sub-headings provide justification through considering the impacts and benefits of the proposal.

8.1.1 Social factors

The proposal would result in temporary social impacts whilst under construction such as noise and visual impacts. However, all construction related impacts would be appropriately managed prior to and during construction.

Operation of the proposal provides justification over the above temporary impacts, as it would benefit the community through providing equitable access, improving safety and overall user experience.

8.1.2 Biophysical factors

As discussed in section 6.3, no significant biodiversity impacts have been identified. Minor adverse impacts are expected as a result of marine soft sediment habitat loss during demolition and construction. Identified impacts would be managed through the safeguards and management measures outlined in this REF.

The design of the proposal includes tolerances to allow for sea level rise and extreme weather events, which would minimise ongoing maintenance.

8.1.3 Economic factors

Design of the proposal has incorporated measures to decrease the maintenance required for operation. The implementation of these measures would result in cost savings for the ongoing operation of the proposal.

8.2 Objects of the EP&A Act

The objects of the EP&A Act are considered in Table 8-1.

Table 8-1: Objects of the EP&A Act

Object	Comment
1.3(a) To promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources.	Through the assessment in Chapter 6, it has been identified that the proposal would not significantly impact on any natural or artificial resources. The proposal would result in community benefits through facilitation of a safe and accessible public pontoon.
1.3(b) To facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment.	The proposal's urban design includes high quality, durable and low impact materials to minimise ongoing maintenance requirements.
1.3(c) To promote the orderly and economic use and development of land.	The proposal includes continuation of the use of the proposal location as a berthing facility.
1.3(d) To promote the delivery and maintenance of affordable housing.	Not relevant to the project.
1.3(e) To protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats.	A BAR has been prepared for the proposal, which is summarised in section 6.3. The assessment concluded that no significant impact to aquatic or terrestrial ecology would result from the proposal.
1.3(f) To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage).	The identified mitigation measures would minimise any potential impacts of the proposal on Aboriginal and non-Aboriginal heritage items.
1.3(g) To promote good design and amenity of the built environment.	The proposal has been designed to be consistent with the urban design objectives identified in section 2.3.2.
1.3(h) To promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants.	The proposal would benefit the community through improving safety and access. The proposal aligns with this objective as it improves safe access to marine vessels for all users.
1.3(i) To promote the sharing of the responsibility for environmental planning	Not relevant to the project.

Object	Comment
and assessment between the different levels of government in the State.	
1.3(j) To provide increased opportunity for community participation in environmental planning and assessment.	Stakeholder consultation would continue during the public display of this document to capture feedback. Should the proposal proceed to construction, consultation with the community and stakeholders would continue throughout the work.

8.2.1 Ecologically sustainable development

Ecologically sustainable development (ESD) is development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends. The principles of ESD have been an integral consideration throughout the development of the project.

ESD requires the effective integration of economic and environmental considerations in decision-making processes. The four main principles supporting the achievement of ESD are discussed below.

The precautionary principle

The precautionary principle deals with reconciling scientific uncertainty about environmental impacts with certainty in decision-making. It provides that where there is a threat of serious or irreversible environmental damage, the absence of full scientific certainty should not be used as a reason to postpone measures to prevent environmental degradation.

Through the assessment of the potential impacts of the proposal in Chapter 6, it has been demonstrated that threats of serious or irreversible environmental damage do not exist for the proposal.

Notwithstanding, to account for the subjectivity of professional judgement applied in environmental assessment and modelling uncertainty, worst-case assumptions have been incorporated into the assessment, including the following:

- Conservative ‘worst case’ scenarios were considered while assessing environmental impact.
- Specialist studies were incorporated to gain a detailed understanding of the existing environment including biodiversity, landscape character and visual assessment, noise and vibration, socio-economic, non-Aboriginal heritage, PSI.
- Undertaking verification monitoring to validate results and allow modification of safeguards and mitigation controls accordingly.

Intergenerational equity

Social equity is concerned with the distribution of economic, social and environmental costs and benefits. Intergenerational equity introduces a temporal element with a focus on minimising the distribution of costs to future generations.

The proposal would result in benefit to the community through improvements to safety and overall user experience of Belmore Basin.

No potential impacts to future generations would be generated by the proposal.

Conservation of biological diversity and ecological integrity

Conservation of biological diversity and ecological integrity has been considered through the assessment of ecology provided in section 6.3, and Appendix C.

Providing the safeguard measures are implemented, the proposal would not have a material or significant impact on biological diversity and ecological integrity within the proposal footprint or surrounds.

Improved valuation, pricing and incentive mechanisms

The principle of internalising environmental costs into decision making requires consideration of all environmental resources which may be affected by the carrying out of a project, including air, water, land and living things.

The principle of internalising environmental costs into decision making requires consideration of all environmental resources which may be affected by the carrying out of a project, including air, water, land and living things.

Environmental, economic and social issues were considered in the rationale for the proposal and design options. Construction planning for the proposal would also be progressed in the most cost-effective way.

Safeguards and management measures detailed in Chapter 7, including avoiding, reusing, recycling, managing waste during construction and operation, would be implemented.

8.3 Conclusion

The proposed Wollongong Harbour public pontoon is subject to assessment under Division 5.1 of the EP&A Act. The REF has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

This has included consideration (where relevant) of conservation agreements and plans of management under the NPW Act, stewardship sites under the BC Act, wilderness areas, areas of outstanding value, impacts on threatened species, populations and ecological communities and their habitats and other protected fauna and native plants. It has also considered potential impacts to matters of national environmental significance listed under the Federal EPBC Act.

A number of potential environmental impacts from the proposal have been avoided or reduced during the concept design development and options assessment. The proposal as described in the REF best meets the project objectives but would still result in some impacts on water quality, biodiversity, traffic and transport, landscape character and visual assessment, non-Aboriginal heritage, socio-economic values and noise and vibration. Safeguards and management measures as detailed in this REF would ameliorate or minimise these expected impacts. The proposal would also increase safety and improve accessibility for users of marine vessels across all mobility levels. On balance the proposal is considered justified and the following conclusions are made.

Significance of impact under NSW legislation

The proposal would be unlikely to cause a significant impact on the environment. Therefore, it is not necessary for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning under Division 5.2 of the EP&A Act. A Biodiversity Development Assessment Report or Species Impact Statement is not required. The proposal is subject to assessment under Division 5.1 of the EP&A Act. Consent from Council is not required.

Significance of impact under Australian legislation

The proposal is not likely to have a significant impact on matters of national environmental significance or the environment of Commonwealth land within the meaning of the EPBC Act. A referral to the Australian DCCEEW is not required.

9 Certification

This REF provides a true and fair review of the proposal in relation to its potential effects on the environment. It addresses to the fullest extent possible all matters affecting or likely to affect the environment as a result of the proposal.

Cassy Baxter

Technical Lead – Environment South Coast

Cardno now Stantec

Date: XX

I have examined this REF and accept it on behalf of Transport for NSW.

Insert name

[Position title, eg Project Manager]

[Insert relevant Transport for NSW region/program]

Date: XX

10 References

Aecom (2019a) Concept Design Report, *Wollongong Harbour | Belmore Basin Mooring Plan and Concept Design for Supporting Infrastructure.*

Aecom (2019b) User Needs Analysis*, Wollongong Harbour | Belmore Basin Mooring Plan and Concept Design for Supporting Infrastructure*.

Austral Archaeology (2022) *Wollongong Harbour Wollongong New South Wales Statement of Heritage Impact*. Prepared by Austral Archaeology for Cardno.

Australia ICOMOS (2013) *The Burra Charter: the Australia ICOMOS Charter for Places of Cultural Significance*, Australia ICOMOS, Burwood, VIC. Australia International Council on Monuments and Sites.

BMT WBM (2017) *Coastal Zone Management Plan: Implementation Plan*. Prepared by BMT WBM on behalf of Wollongong City Council.

BoM (2021a) *Climate data online. Bellambi AWS.* Bureau of Meteorology. Available online: http://www.bom.gov.au/climate/data/ Accessed 17 November 2021.

BoM (2021b) *Monthly rainfall. Port Kembla (BSL Central Lab).* Bureau of Meteorology. Available online: http://www.bom.gov.au/climate/data/ Accessed 17 November 2021.

BoM (2021c) *NSW Tide Tables.* Bureau of Meteorology. Available online: http://www.bom.gov.au/oceanography/projects/ntc/monthly/ Accessed 19 November 2021.

Bowman, N & Stewart, R. (1974) *Wollongong 1:50,000 Geological Sheet 9029*, 1st edition. Geological Survey of New South Wales, Sydney.

Cardno (2007) *Revised Wollongong Harbour Coastal Processes and Hazard Study.* Prepared by Cardno (NSW/ACT) Pty Ltd on behalf of Wollongong City Council.

Cardno (2022) *Wollongong Harbour Public Pontoon Biodiversity Assessment Report. Prepared* by Cardno (NSW/ACT) Pty Ltd on behalf of Transport for NSW.

Coffey (2016) *Contamination Assessment Report DTIRIS 15/190 – Wollongong Harbour Central Pier.* Prepared by Coffey for NSW Department of Primary Industries.

DECCW (2009) *NSW Sea Level Rise Policy Statement*. Department of Environment, Climate Change and Water.

DECCW (2010) *Due Diligence Code of Practice for the Protection of Aboriginal objects in NSW*. Department of Environment, Climate Change and Water, September 2010.

DoP (2010) *NSW Coastal Planning Guidelines: Adapting to Sea Level Rise.* Department of Planning.

DPI (2013) *Policy and Guidelines for Fish Conservation and Management*, Wollongbar, NSW: NSW Department of Primary Industries.

DPI (2022) *Fisheries Data Portal*. Department of Primary Industries. Available online: https://webmap.industry.nsw.gov.au/Html5Viewer/index.html?viewer=Fisheries_Data_Portal Accessed January 2022.

DPIE (2012) *State of the beaches 2011-2012: Illawarra region. Beachwatch*. Department of Planning, Industry and Environment.

DPIE (2013) *State of the beaches 2012-2013: Illawarra region. Beachwatch*. Department of Planning, Industry and Environment.

DPIE (2014) *State of the beaches 2013-2014: Illawarra region. Beachwatch*. Department of Planning, Industry and Environment.

DPIE (2015) *State of the beaches 2014-2015: Illawarra region. Beachwatch*. Department of Planning, Industry and Environment.

DPIE (2016) *State of the beaches 2015-2016: Illawarra region. Beachwatch*. Department of Planning, Industry and Environment.

DPIE (2017) *State of the beaches 2016-2017: Illawarra region. Beachwatch*. Department of Planning, Industry and Environment.

DPIE (2018) *State of the beaches 2017-2018: Illawarra region. Beachwatch*. Department of Planning, Industry and Environment.

DPIE (2019) *State of the beaches 2018-2019: Illawarra region. Beachwatch*. Department of Planning, Industry and Environment.

DPIE (2020) *State of the beaches 2019-2020: Illawarra region. Beachwatch*. Department of Planning, Industry and Environment.

DPIE (2021a) *Air quality concentration data - updated hourly*. Available online: https://www.environment.nsw.gov.au/topics/air/monitoring-air-quality/sydney/monitoring-stations/cook-and-phillip-sydney-cbd Accessed 17 November 2021. Department of Planning, Industry and Environment.

DPIE (2021b) *Enterococci data download. North Wollongong Beach, 2011-2021.* Beachwatch Program. Available online: https://www.environment.nsw.gov.au/beachapp/report_enterococci.aspx Department of Planning, Industry and Environment.

DPIE (2021c) *Enterococci data download. Wollongong City Beach, 2011-2021.* Beachwatch Program. Available online: https://www.environment.nsw.gov.au/beachapp/report_enterococci.aspx Department of Planning, Industry and Environment.

DPIE (2021d) *State of the beaches 2020-2021: Illawarra region. Beachwatch*. Department of Planning, Industry and Environment.

DUAP (1995/1996) *Is an EIS Required? Best Practice Guidelines for Part 5 of the Environmental Planning and Assessment Act 1979 (Is an EIS required? guidelines)*. Department of Urban Affairs and Planning.

DUAP (1996) *Marinas and Related Facilities – EIS Guidelines*. Department of Urban Affairs and Planning.

EPA (2014) *Waste Classification Guidelines Part 1: Classifying waste*. Environment Protection Authority, Sydney.

Heritage Office and Department of Urban Affairs and Planning (1996) Statements of Heritage Impact, *NSW Heritage Manual*.

Landcom (2004) *Managing Urban Stormwater, Soils and Construction Guidelines* “the Blue Book”

OEH (2014) *Illawarra Climate change snapshot*. AdaptNSW. Office of Environment and Heritage.

PWA (2017) *Wollongong Harbour Remediation Project Review of Environmental Factors*. Public Works Advisory on behalf of Department of Industry – Lands.

RMS (2011) *Procedure for Aboriginal Heritage Cultural Heritage Consultation and Investigation (PACHCI)*. Roads and Maritime Services.

RMS (2015) *Unexpected Heritage Items. Heritage Procedure 02.* Roads and Maritime Services.

RMS (2016a) *Construction Noise and Vibration Guideline*. Roads and Maritime Services.

RMS (2016b) *Environmental Impact Assessment Practice Note: Biodiversity Assessment (EIA-N06).* Roads and Maritime Services.

RMS (2016c) *Guidelines for Biodiversity Offsets.* Roads and Maritime Services.

RMS (2016d) *NSW State Waters Marine Oil and Chemical Spill Contingency Plan.* Roads and Maritime Services.

RMS (2018) *Environmental Incident Classification and Reporting Procedure*. Roads and Maritime Services.

RTA (2002) *Guide to Traffic Generating Developments*. Roads and Traffic Authority.

RTA (2008) *Community Involvement and Communications Resource Manual*. Roads and Traffic Authority.

RTA (2011) *Biodiversity Guidelines: Protecting and Managing Biodiversity on RTA Projects.* Roads and Traffic Authority.

TfNSW (2017) *Sustainability Design Guidelines version 4.0*. Transport for NSW.

TfNSW (2018) *Maritime Infrastructure Plan*. Transport for NSW.

TfNSW (2019) *Carbon Estimate and Reporting Tool Manual*. Transport for NSW.

TfNSW (2020a) *Environment and Sustainability Policy*. Transport for NSW.

TfNSW (2020b) *Environmental Impact Assessment Practice Note EIA-N05 – Socio-economic assessment (EIA-N05) (Practice Note)*, Transport for NSW.

TfNSW (2020c) *Guideline for landscape character and visual impact assessment*. Transport for NSW.

TfNSW (2020d) *Wollongong Harbour Master Plan*. Transport for NSW.

WCC (2007) *The Blue Mile Master Plan*. Wollongong City Council.

WCC (2018) *Our Wollongong 2028*. Wollongong City Council.

Terms and acronyms used in this REF

Term/ Acronym	Description
ABS	Australian Bureau of Statistics
ABWMAC	Australian Ballast Water Management Advisory Council
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal heritage impact permit
AIS	Automatic Identification System
AMSA	Australian Maritime Safety Authority
AOBV	Areas of Outstanding Biodiversity Value
AQC	Air Quality Category
AS	Australian Standard
ASS	Acid sulfate soils
BAM	Biodiversity Assessment Method
BAR	Biodiversity assessment report
BC Act	*Biodiversity Conservation* Act *2016* (NSW)
BCA	Building Code of Australia
BDAR	Biodiversity Development Assessment Report
Biosecurity Act	*Biosecurity Act 2015* (NSW)
BOAMS	Biodiversity Offsets and Agreement Management System
BoM	Bureau of Meteorology
BS	British Standard
CAR	Contamination Assessment Report DTIRIS 15/190 – Wollongong Harbour Central Pier
CD	Chart datum
CDR	Wollongong Harbour | Belmore Basin Mooring Plan and Concept Design for Supporting Infrastructure Concept Design Report
CEMP	Construction environmental management plan
CHL	Commonwealth Heritage List

Term/ Acronym	Description
CLM Act	*Contaminated Land Management Act 1997* (NSW)
CM Act	*Coastal Management Act 2016* (NSW)
CNVG	Construction Noise and Vibration Guideline (RMS, 2016)
CNVMP	Construction noise and vibration management plan
Compound area	Temporary facility required for construction, including an accommodation block and materials storage laydown area
COPC	Contaminants of potential concern
Crown Lands Act	*Crown Lands Management Act 2016* (NSW)
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSP	Community strategic plan
CZMP	Coastal Zone Management Plan
DA	Development application
DCCEEW	Department of Climate Change, Energy, the Environment and Water
dB(A)	A-weighted decibels
DCP	Development Control Plan
DDA	*Disability Discrimination Act* 1992 (Cth)
DECC	Department of Energy and Climate Change (former)
DECCW	Department of Energy and Climate Change and Water (former)
Delft3D-FLOW	The Delft3D modelling system includes wind, pressure, tide and wave forcing, three-dimensional currents, stratification, sediment transport and water quality descriptions and is capable of using irregular rectilinear or curvilinear coordinates. The hydrodynamic module, Delft3D-FLOW, is based on the numerical finite-difference scheme developed by G. S. Stelling (1984) of the Delft Technical University in The Netherlands.
DIN	German Institute for Standardisation (Deutsches Institut für Normung)

Term/ Acronym	Description
DoP	Department of Planning (former)
DPC	Department of Premier and Cabinet
DPIE	Department of Planning, Industry and Environment
DUAP	Department of Urban Affairs and Planning (former)
ECL	East Coast Lows
EES	Environment, Energy and Science
EIA	Environmental impact assessment
EMS	Environmental Management System
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW). Provides the legislative framework for land use planning and development assessment in NSW
EPA	Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth). Provides for the protection of the environment, especially matters of national environmental significance, and provides a national assessment and approvals process.
EPL	Environmental protection licence
ESD	Ecologically sustainable development. Development which uses, conserves and enhances the resources of the community so that ecological processes on which life depends, are maintained and the total quality of life, now and in the future, can be increased
EU	European Union
Fixed platform	A landing used to connect the gangway to land
FM Act	*Fisheries Management Act 1994* (NSW)
Gangway	A landing used by passengers to board or exit ships/vessels
GDE	Groundwater Dependent Ecosystems
HAT	Highest Astronomical Tide
Heritage Act	*Heritage Act 1977* (NSW)

Term/ Acronym	Description
ICNG	Interim Construction Noise Guideline
ICOMOS	International Council on Monuments and Sites
kN	Kilonewton
L_{A90}	The “Energy Average Noise Level” during construction activities, evaluated over a measurement period of 15 minutes. This is the main parameter used to assess the construction noise impacts.
$L_{Aeq(15\ minutes)}$	The A-weighted noise level that is exceeded for 90% of each sampling period when measured in the absence of construction works under consideration and excluding extraneous noise. This is considered to represent the background noise.
LAT	Lowest Astronomical Tide
LCVI	Landscape character and visual impact
LEP	Local Environmental Plan. A type of planning instrument made under Part 3 of the EP&A Act.
LGA	Local Government Area
MIDO	Maritime Infrastructure Delivery Office
MIP	Maritime Infrastructure Plan
MHWM	Mean high water mark
MNES	Matters of national environmental significance under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.*
NCC	National Construction Code 2019 Volumes 1, 2 and 3
NHL	National Heritage List (NHL)
NML	Noise management level
NPW Act	*National Parks and Wildlife Act 1974* (NSW)
OEH	Office of Environment and Heritage (former)
OOHW	Out of hours work
OSC	Open Sports Club

Term/ Acronym	Description
Restraint piles	Foundations used to support marine structures and offshore platforms
PACHCI	Procedure for Aboriginal Heritage Cultural Heritage Consultation and Investigation
PC	Private certifier - construction certificate
PMST	Protected Matters Search Tool
PoEO Act	*Protection of the Environment Operations Act 1997* (NSW)
Pontoon	A floating structure serving as a dock
Proposal area	The area around the proposed works required for construction, including the compound area
PS SEPP	*State Environmental Planning Policy (Planning Systems) 2021*
PSI	Preliminary site investigation
Waterside features	The waterside key features of the proposal, including the proposed pontoon, gangway, fixed platform and restraint piles
PVC	Polyvinyl chloride
PWA	Public Works Advisory
RBL	Rating background level
REF	Review of Environmental Factors
RH SEPP	*State Environmental Planning Policy (Resilience and Hazards) 2021*
RMS	NSW Roads and Maritime Services
RNE	Register of the National Estate
Roads and Maritime	NSW Roads and Maritime Services
RTA	Roads and Traffic Authority (former)
SA1	Statistical Area Level 1
SCO	South Coast Line
SDG	Sustainable Design Guidelines
SEED	Sharing and Enabling Environmental Data
SEIA	Socio-economic impact assessment

Term/ Acronym	Description
SEPP	State Environmental Planning Policy. A type of planning instrument made under Part 3 of the EP&A Act.
SEPP TI	*State Environmental Planning Policy (Transport and Infrastructure) 2021*
SHR	State Heritage Register
SoHI	Statement of Heritage Impact
SRPPR	Southern Regional Planning Panel Register
Study Area	The area around the proposal area required for specialist studies
SWMP	Soil and water management plan
TBDC	Threatened Biodiversity Data Collection
TBT	Tributyltin
TEC	Threatened ecological communities
TfNSW	Transport for NSW
The Blue Mile	The Blue Mile Master Plan
The proposal	Construction of a new public pontoon and permanent unloading zone at Belmore Basin of Wollongong Harbour
TIAS	Traffic Impact Assessment Study
TMP	Traffic management plan
UCI	Union Cycliste Internationale
UNA	Wollongong Harbour | Belmore Basin Mooring Plan and Concept Design for Supporting Infrastructure User Needs Analysis
US EPA	United States Environmental Protection Agency
WARR Act	*Waste Avoidance and Resource Recovery Act 2001*
WCC	Wollongong City Council
WHMP	Wollongong Harbour Master Plan
WMP	Waste management plan
Wollongong LEP	*Wollongong Local Environmental Plan 2009*

Appendix A

Consideration of clause 171(2) factors and matters of national environmental significance and Commonwealth land

Clause 171(2) Checklist

This REF has been developed in accordance with Section 170 and 171 of the Environmental Planning & Assessment Regulations 2021 to ensure that all relevant environmental factors have been assessed and incorporated in the preparation of this document.

Factor	Impact
The environmental impact on the community? *During construction of the proposal, there would be impacts from construction related noise and visual impacts to surrounding receivers. Impacts would be minimised through implementing the safeguards and management measures identified in Chapter 7 of the REF.* *Operation of the proposal would improve user safety and access.*	Moderate, short-term negative Long term positive
The transformation of the locality? *The proposal has been designed to be coherent with the existing landscape character of Belmore Basin.*	Moderate, long term negative
The environmental impact on the ecosystems of the locality? *The assessment of biodiversity indicates there would be a minor impact to marine biodiversity during construction. Impacts to biodiversity would be minimised through implementing the safeguards and management measures identified in Chapter 7 of this REF.*	Minor, short term negative Negligible, long term
The reduction of the aesthetic, recreational, scientific or other environmental quality or value of the locality? *There would be temporary impacts during construction, including elevated noise levels and restricted recreational access.* *Landscape character and visual impacts have been assessed as low. Impacts have been reduced through design of the proposal.* *No long-term impacts to environmental quality and value are anticipated.*	Moderate, short term negative Low, long term negative Negligible long term
The effects on any locality, place or building that has— aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance, or (ii) other special value for present or future generations, *The proposal is not expected to directly impact heritage items during construction or operation. The heritage value of Belmore Basin may be temporarily impacted during construction due to the presence of a construction zone. However, impacts would be short term and restricted to the construction phase.* *Impact to heritage values would be minimised through implementing the safeguards and management measures identified in Chapter 7 of the REF.*	Low, short term negative Negligible, long term
The impact on the habitat of protected animals, within the meaning of the Biodiversity Conservation Act 2016*The assessment of*	Minor, short term negative

Factor	Impact
biodiversity indicates there would be a minor impact to biodiversity during construction. The proposal would result in a permanent loss of localised epifauna and infauna from the unvegetated soft sediment. *No threatened species were observed during the field survey, however, potential habitat for seven threatened fauna species with a moderate to high likelihood of occurrence occurs in the study area.* *Impacts to biodiversity would be minimised through implementing the safeguards and management measures identified in Chapter 7 of the REF.*	Negligible, long term
The endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air? *The proposal is unlikely to endanger any species of animal, plant or other form of life, whether living on land, in water or in the air.*	No impact
Long-term effects on the environment *The proposal would result in long term low landscape character and visual impacts. No other long-term negative effects on the environment are anticipated.* *The proposal would result in improvements in user safety and access at Belmore Basin.*	Low, long term negative Long term positive
Degradation of the quality of the environment *The proposal would result in localised sediment disturbance, piling and earthwork activities, which could result in temporary impacts to water quality.* *There is potential for accidental spills/leaks of fuel, oil or other chemicals to impact water quality during construction.* *Impacts would be minor with implementation of the safeguards and management measures identified in Chapter 7 of the REF.*	Low, short term negative
Risk to the safety of the environment *Construction related activities pose potential risks to the safety of the environment through spills/leaks of fuel, oil or other chemicals.* *Impacts would be minor with implementation of the safeguards and management measures identified in section 7 of the REF.*	Low, short term negative
Reduction in the range of beneficial uses of the environment *The proposal would not reduce the range of beneficial uses of the environment.*	No impact
Pollution of the environment *Construction related activities may result in pollution of the environment through spills/leaks of fuel, oil or other chemicals.* *Impacts would be minor with implementation of the safeguards and management measures identified in Chapter 7 of the REF.*	Low, short term negative

Factor	Impact
Environmental problems associated with the disposal of waste *All wastes generated by the proposal would be disposed of at an off-site facility which is licenced to receive such waste.* *There would be no significant environmental problems associated with waste disposal.*	Low, short term negative
Increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply *All resources required by the proposal are readily available and are not likely to become in short supply.*	No impact
The cumulative environmental effect with other existing or likely future activities *Assessment of cumulative impacts for the proposal is provided in section 6.15.* *At the time of assessment, there were no other projects to occur simultaneously with the proposal. Hence, no significant cumulative impacts have been identified for the proposal.* *The proposal design includes an allowance for sea level rise*	No impact
The impact on coastal processes and coastal hazards, including those under projected climate change conditions *Consideration of coastal processes and coastal hazards is detailed in section 6.1.* *No significant impacts to these issues are anticipated for the proposal.*	No impact
Any applicable local strategic planning statement, regional strategic plan or district strategic plan made under Division 3.1 of the Act *Consideration of local strategic plans is discussed in Section 4.1.2 of this report. The proposal is consistent with the objectives discussed in the Wollongong LEP.*	No impact
Any other relevant environmental factors *There are no other relevant environmental impacts anticipated from this proposal that have not already been discussed in this REF and the 171 checklist.*	No impact

Matters of National Environmental Significance and Commonwealth land

Under the environmental assessment provisions of the EPBC Act, the following MNES and impacts on the Commonwealth land are required to be considered to assist in determining whether the proposal should be referred to the Australian Government DCCEEW.

A referral is not required for proposed actions that may affect nationally listed threatened species, endangered ecological communities and migratory species. Impacts on these matters are still assessed as part of the REF in accordance with Australian Government significant impact criteria and taking into account relevant guidelines and policies.

Factor	Impact
Any impact on a World Heritage property? *The study area is not listed in the World Heritage register.*	No impact
Any impact on a National Heritage place? *Impacts to heritage items listed on the NHL and CHL as a result of the proposal would be limited to negligible, temporary visual impacts.*	Negligible
Any impact on a wetland of international importance? *There are no nationally important wetlands or Ramsar Wetlands in the study area or the wider study locality.*	No impact
Any impact on a listed threatened species or communities? *Two threatened species listed under the EPBC Act were considered to have a moderate likelihood of occurrence in the study area.* *The biodiversity assessment (refer section 6.3 and Appendix C) concluded that the proposal is not likely to significantly impact threatened species, populations, ecological communities or migratory species, within the meaning of the EPBC Act.*	Minor, short term
Any impacts on listed migratory species? *Two migratory species under the EPBC Act were considered to have a moderate likelihood of occurrence in the study area.* *The biodiversity assessment (refer section 6.3 and Appendix C) concluded that the proposal is not likely to significantly impact threatened species, populations, ecological communities or migratory species, within the meaning of the EPBC Act.*	Minor, short term
Any impact on a Commonwealth marine area? *The study area does not reside within any Commonwealth marine reserves. The closest marine reserve is Hunter Commonwealth Marine Reserve, approximately 59 kilometres south of the study area.*	No impact
Does the proposal involve a nuclear action (including uranium mining)?	No impact
Additionally, any impact (direct or indirect) on the environment of Commonwealth land?	No impact

Appendix B

SEPP TI consultation checklist

Transport and Infrastructure SEPP

Certain development types

Development type	Description	Yes/No	If 'yes' consult with	SEPP TI section
Car Park	Does the project include a car park intended for the use by commuters using regular bus services?	No	-	SEPP TI Section 2.112(2)(a)
Bus Depots	Does the project propose a bus depot?	No	-	SEPP TI Section 2.112(2)(b)
Permanent road maintenance depot and associated infrastructure	Does the project propose a permanent road maintenance depot or associated infrastructure such as garages, sheds, tool houses, storage yards, training facilities and workers' amenities?	No	-	SEPP TI Section 2.112(2)(c)

Development within the Coastal zone

Issue	Description	Yes/No /N/A	If 'yes' consult with	SEPP TI section
Development with impacts on certain land within the coastal zone	Is the proposal within a coastal vulnerability area and is inconsistent with a certified coastal management program applying to that land?	No	-	SEPP TI Section 2.14

Note: See interactive map here: https://www.planning.nsw.gov.au/policy-and-legislation/coastal-management. Note the coastal vulnerability area has not yet been mapped.

Note: a certified coastal zone management plan is taken to be a certified coastal management program

Council related infrastructure or services

Issue	Potential impact	Yes/No	If 'yes' consult with	SEPP TI section
Stormwater	Is the work likely to have a *substantial* impact on the stormwater management services which are provided by council?	No	-	SEPP TI Section 2.10(1)(a))
Traffic	Is the work likely to generate traffic to an extent that will *strain* the capacity of the existing road system in a local government area?	No	-	SEPP TI Section 2.10(1) (b)

Issue	Potential impact	Yes/No	If 'yes' consult with	SEPP TI section
Sewerage system	Will the work involve connection to a council owned sewerage system? If so, will this connection have a *substantial* impact on the capacity of any part of the system?	No	-	SEPP TI Section 2.10 (1)(c)
Water usage	Would the work involve connection to a council owned water supply system? If so, would this require the use of a *substantial* volume of water?	No	-	SEPP TI Section 2.10 (1)(d)
Temporary structures	Would the work involve the installation of a temporary structure on, or the enclosing of, a public place which is under local council management or control? If so, would this cause more than a *minor* or *inconsequential* disruption to pedestrian or vehicular flow?	Yes	WCC	SEPP TI Section 2.101)(e)
Road & footpath excavation	Would the work involve more than *minor* or *inconsequential* excavation of a road or adjacent footpath for which council is the roads authority and responsible for maintenance?	No	-	SEPP TI Section 2.10 (1)(f)

Local heritage items

Issue	Potential impact	Yes/No	If 'yes' consult with	SEPP TI section
Local heritage	Is there is a local heritage item (that is not also a State heritage item) or a heritage conservation area in the study area for the work? If yes, does a heritage assessment indicate that the potential impacts to the heritage significance of the item/area are more than *minor* or *inconsequential?*	Yes	WCC	SEPP TI Section 2.11

Flood liable land

Issue	Potential impact	Yes/No	If 'yes' consult with	SEPP TI section
Flood liable land	Is the work located on flood liable land? If so, would the work	No	-	SEPP TI

Issue	Potential impact	Yes/No	If 'yes' consult with	SEPP TI section
	change flood patterns to more than a *minor* extent?			Section 2.12
Flood liable land	Is the work located on flood liable land? (to any extent). If so, does the work comprise more than minor alterations or additions to, or the demolition of, a building, emergency work or routine maintenance	No	-	SEPP TI Section 2.12

Note: Flood liable land means land that is susceptible to flooding by the probable maximum flood event, identified in accordance with the principles set out in the manual entitled *Floodplain Development Manual: the management of flood liable* land published by the New South Wales Government.

Public authorities other than councils

Issue	Potential impact	Yes/No	If 'yes' consult with	SEPP TI clause
National parks and reserves	Is the work adjacent to a national park or nature reserve, or other area reserved under the *National Parks and Wildlife Act 1974*, or on land acquired under that Act*?*	No	-	SEPP TI Section 2.15(2)(a)
National parks and reserves	Is the work on land in Zone E1 National Parks and Nature Reserves or in a land use zone equivalent to that zone?	No	-	SEPP TI Section 2.15 (2)(b)
Aquatic reserves	Is the work adjacent to an aquatic reserve or a marine park declared under the *Marine Estate Management Act 2014*?	No	-	SEPP TI Section 2.15 (2)(c)
Artificial light	Would the work increase the amount of artificial light in the night sky and that is on land within the dark sky region as identified on the dark sky region map? (Note: the dark sky region is within 200 kilometres of the Siding Spring Observatory)	No	-	SEPP TI Sectio 2.15(2)(d)
Defence communications buffer land	Is the work on buffer land around the defence communications facility near Morundah? (Note: refer to Defence Communications Facility Buffer Map referred to in clause 5.15 of Lockhardt LEP	No	-	SEPP TI Section 2.15(2)(e)

Issue	Potential impact	Yes/No	If 'yes' consult with	SEPP TI clause
	2012, Narrandera LEP 2013 and Urana LEP 2011.)			
Mine subsidence land	Is the work on land in a mine subsidence district within the meaning of the *Mine Subsidence Compensation Act 1961*?	No	-	SEPP TI Section 2.15(2)(f)

Appendix C

Biodiversity assessment report

Wollongong Harbour Public Pontoon

Biodiversity Assessment Report

Transport for NSW

Wollongong Harbour Public Pontoon

Biodiversity Assessment Report

Transport for NSW | March 2022

Prepared by Cardno (NSW/ACT) Pty Ltd and Transport for NSW

<<TfNSW to provide Transport for NSW Publication Number and ISBN>>

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Approval and authorisation

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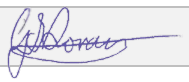
Accepted on behalf of Transport for NSW by:	Gareth Doran Programs Manager
Signed:	
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RevA	8/02/2022	JL	DZ
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Executive summary

Transport for NSW proposes to construct a new public pontoon and temporary parking area at Belmore Basin (the proposal) as part of the Wollongong Harbour Master Plan developed by Transport for NSW in 2020. The proposal includes the installation of four restraint piles, pontoon, gangway, fixed platform and designated temporary car park area.

A biodiversity assessment was completed to describe the existing coastal and marine environment within the study area and to assess impacts to coastal and marine biodiversity as a result of the construction and operation of the proposal. The biodiversity assessment was informed by a review of existing information and data in the study area and the wider study locality, as well as a field survey of the study area.

On the landside, there was no remnant native vegetation in the study area as it is predominantly hardstand with a small portion of landscaped grass near the Wollongong Yacht Club building. The marine portion of the study area consisted of a steep artificial sandstone seawall with large rubber tyres, subtidal low relief rocky reef with macroalgae, unvegetated soft sediment with debris and a small patch of *Halophila* sp. seagrass. No mangroves or saltmarsh occur in or next to the study area. The subtidal habitat in the study area forms potential habitat for one marine fauna.

Subtidal habitat in the study area forms potential habitat for one threatened marine species:

- White's Seahorse (*Hippocampus whitei*) listed as endangered under the *Fisheries Management Act* 1994 and *Environmental Protection and Biodiversity Conservation Act 1999*

The proposal is not expected to remove any vegetation (trees or shrubs) as the study area is largely hardstand. The risks of the spread/introduction of weeds and diseases and the potential for erosion and sediment mobilisation associated with construction activities would be managed during construction in accordance with the relevant Transport for NSW guidelines.

With respect to waterside impacts, four piles would be driven into subtidal soft sediment habitat, resulting in permanent loss of localised epifauna and infauna. However, this loss would be expected to recolonise following disturbance. The area is proportionally small compared to similar habitat in the study area and the wider harbour, and community assemblages are generally ubiquitous. The presence of *Halophila* sp. may be seasonal in nature, the species is considered a pioneering species and would potentially recolonise the area following a disturbance. Due to this seasonality, an additional seagrass survey may be required to further define the extent of the *Halophila* sp.

Waterside construction activities have potential to temporarily disturb the marine environment. Waterside construction activities would also create noise and vibration in the study area and the responses of mobile marine fauna are likely to be similar to that of terrestrial fauna (i.e. move away from unfavourable conditions and return once disturbance is removed). Following the completion of the work, habitat would become available, with the additional piles creating habitat for sessile marine species.

During operation, the gangway and pontoon components would sit permanently on or above the water's surface and avoid impacts to the seabed. Light penetrating decking (30x30mm mesh) would be utilised for the pontoon and gangway to allow sufficient light to penetrate the substrate and allow seagrass and marine vegetation to grow, therefore impacts to seagrass and/or marine vegetation are considered negligible.

Section 205 of the FM Act states that a permit to 'harm' marine vegetation would be required. However, through consultation with NSW DPI (Fisheries) (21 February 2022), this is not required for the piling associated with the proposal.

Sediment mobilisation and vessel wash and scour were also identified as likely proposal impacts. However, the study area is likely frequently exposed to elevated levels of sediment associated with rainfall and sea conditions, and vessel traffic. Thus, with the appropriate controls, a slight, temporary increase in these impacts is not expected to substantially impact marine biodiversity. Impacts from the introduction/spread of marine pests would also be managed during construction.

The structures of the proposal are not expected to substantially alter coastal processes or hydrology of the study area or the wider harbour. These structures are not considered to interfere with fish passage nor likely to alter localised hydrodynamics and unlikely to produce substantial impacts to marine biodiversity. Considering the above, the proposal is unlikely to significantly impact coastal and marine biodiversity.

The proposal would not fragment or isolate threatened species populations or substantially impact any species' lifecycle, if present. As per NSW DPI Fisheries advice on 21 February 2021 a targeted survey and relocation of seahorses is not required due to negligible impacts from the proposal. Species impact statements (SISs), entry into the Biodiversity Offsets Scheme or referrals are not required for the proposal.

Considering the above, the proposal is unlikely to significantly impact coastal and marine biodiversity.

Contents

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Appendices

1 Introduction

1.1 The proposal

Transport for NSW proposes to construct a new public pontoon and temporary parking area at Belmore Basin (the proposal) as part of the Wollongong Harbour Master Plan developed by Transport for NSW in 2020.

The proposal is located within the local government area (LGA) of Wollongong City Council (WCC). Wollongong is located in the Illawarra region of New South Wales (NSW), approximately 80 kilometres south of Sydney.

Situated within Wollongong Harbour, between Flagstaff Hill Park and the Wollongong Breakwater Lighthouse, Belmore Basin serves as a marina for trawlers, charter vessels, yachts and other recreational craft. Belmore Basin is accessed by water through Wollongong Harbour between the central and southern pier. Access by land is from the northern loop of Endeavour Drive.

Key features of the proposal include:

- Installation of a 25 metre by five metre pontoon, with a fixed ramp and four restraint piles, near the end of the central pier to provide safer access for trawlers, charter vessels, yachts and other recreational craft
- Installation of a new five metre by five metre fixed platform and 20 metre by 1.8 metre gangway to access the new pontoon
- Orientation of the new pontoon in line with the prevailing wave direction, which will assist to provide the lowest motions, to enhance user safety and comfort
- Installation of two restraint piles on either end of the pontoon to minimise impacts from vessels
- Introduction of designated permanent unloading zone for pick up/drop off and loading/unloading activities.

Construction is expected to commence in late 2022 and would take around three months to complete.

Key features of the proposal are shown in Figure 1-1.

Figure 1-1: Key features of the proposal

1.2 Legislative context

A Review of Environmental Factors (REF) is prepared to satisfy Transport for NSW duties under section 5.5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to "examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity" and in making decisions on the likely significance of any environmental impacts. This biodiversity impact assessment forms part of the REF being prepared for the Wollongong Harbour Public Pontoon and assesses the biodiversity impacts of the proposal to meet the requirements of the EP&A Act.

Section 7.2(1) (a) of the BC Act and Part 7A of the *Fisheries Management Act 1994* (FM Act) require that the significance of the impact on threatened species, and ecological communities is assessed using a five-part test (BC Act) or the seven-part test (FM Act). Where a significant impact is likely to occur, a species impact statement (SIS) must be prepared in accordance with the environment agency head's requirements or a Biodiversity Development Assessment Report (BDAR) must be prepared by an accredited assessor in accordance with the Biodiversity Assessment Method (BAM).

In September 2015, a "strategic assessment" approval was granted by the Federal Minister in accordance with the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The approval applies to Transport for NSW road works being assessed under Division 5.1 of the EP&A Act with respect to potential impacts on nationally listed threatened species, ecological communities and migratory species. Since this proposal is not considered under "road works", the strategic assessment approval does not apply.

Significance of impacts on nationally listed threatened species, ecological communities and migratory species are to be assessed in accordance with the *Matters of National Environmental Significance: Significant impact guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999* (Department of the Environment (DoE), 2013). If significant impacts are considered likely, then the action is deemed a controlled action and a referral is required.

1.3 Definitions

The following definitions are used in this report:

- Biodiversity Assessment Report (BAR) - this report
- The proposal - refers to that described in section 1.1
- Compound area - refers to the temporary facility required for construction (Figure 1-1: Key features of the proposal)
- Study area - refers to the proposal and surrounding areas covered by this BAR (approximately 0.4 hectares) (Figure 1-1: Key features of the proposal)
- Proposal area - refers to the area impacted by the proposed works from piling, installation of the pontoon, gangway, fixed platform and temporary parking area (Figure 1-1: Key features of the proposal)
- Study locality - refers to an area within ten kilometres of the Study area (for the purpose of the background research).

2 Methodology

2.1 Personnel

This BAR was prepared by the following personnel:

- Jake Ludlow (BSc) – Environmental Scientist (Ecology)
- Dilys Zhang (BSc Hons.) – Senior Environmental Scientist (Ecology)

2.2 Background research

A review of information and data was completed in January 2022 (before the field survey) to gain an understanding of biodiversity values within the study area and the broader study locality. Reviewed sources included:

- Wollongong 1:50,000 Geological Series Sheet 9029-11 (Bowman & Stewart, 1974)
- NSW Department of Planning and Environment (DPE) Sharing and Enabling Environmental Data (SEED) in NSW. Illawarra Plant Community Type Vegetation Map (2016)
- NSW DPE – Environment, Energy and Science (EES) Vegetation Classification
- NSW BioNet
- NSW DPE-EES Threatened Biodiversity Data Collection (TBDC):
- NSW Department of Primary Industries (DPI) Fish Communities and Threatened Species Distribution of NSW (NSW DPI, 2022a)
- NSW DPI Threatened species lists
- NSW DPI Listed Protected Fish Species
- NSW DPI Fisheries Spatial Data Portal. Estuarine Macrophytes 2018
- Commonwealth Department of Agriculture, Water and the Environment (DAWE) (formerly DoE) Protected Matters Search Tool (PMST)
- Atlas of Living Australia
- National System for the Prevention and Management of Marine Pest Incursions

Contemporary aerial imagery from MetroMap taken on 11 September 2021 was used to identify potential vegetation and habitat to assist in the creation of presumptive maps.

Sensitive ecological sites were identified through searches of the following:

- Regional Conservation Plans prepared by the former NSW OEH
- Areas of Outstanding Biodiversity Value (AOBV) register
- Important Habitat to threatened species as mapped for the BAM (accessed through the Biodiversity Offsets and Agreement Management System (BOAMS))
- NSW DPI Critical Habitat register
- NSW DPI key fish habitat maps
- Commonwealth DAWE Register of Critical Habitat
- the Bureau of Meteorology's (BoM's) Groundwater Dependent Ecosystems (GDEs) Atlas
- Commonwealth DAWE Directory of Important Wetlands Australia

- NSW State Environmental Planning Policy (Coastal Management) 2018 (Coastal Management SEPP) maps
- Locations of NSW marine parks and reserves available from NSW DPI Marine Parks

2.3 Habitat assessment

A habitat assessment was completed to assess the likelihood of occurrence of each threatened or migratory species, population or ecological community identified to potentially occur within the study locality. The likelihood of occurrence criteria is detailed in Table 2-1: Likelihood of occurrence criteria.

Species are considered 'likely to occur' (i.e. moderate to high likelihood of occurrence) where:

- The geographic distribution of the species is known or predicted to include the Interim Biogeographic Regionalisation for Australia (IBRA) subregion in which the proposal is located
- The proposal area contains habitat features or components associated with the species
- Past or current surveys undertaken in the proposal footprint indicate the species is present.

A test of significance (under the BC Act or FM Act) and/or an assessment of significance (under the EPBC Act; collectively known as Assessments of Significance (AoSs)) for species considered 'likely to occur' by the habitat assessment has been completed unless otherwise discussed in section 3.11.

Table 2-1: Likelihood of occurrence criteria

Likelihood	Criteria
Recorded	The species was observed in the study area during the current survey.
High	It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (ie for breeding or important life cycle periods such as winter flowering resources), has been recorded recently (within 20 years) in the locality (five kilometres) and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Moderate	Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent (ie for breeding or important life cycle periods such as winter flowering resources) on habitat within the study area, or habitat is in a modified or degraded state. Includes cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded.

Likelihood	Criteria
Low	It is unlikely that the species inhabits the study area and has not been recorded recently in the locality (five kilometres). It may be an occasional visitor, but habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent (ie for breeding or important life cycle periods such as winter flowering resources) on available habitat. Specific habitat is not present in the study area or the species are a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.
None	Suitable habitat is absent from the study area.

2.4 Field survey

Field surveys of the foreshore and marine areas within the study area were completed on 17 January 2022. The aims of the survey were to ground-truth the results of the background research and habitat assessment with particular consideration given to species of conservation concern likely to occur.

Presumptive vegetation and habitat maps, based on the results of the background research, were developed to facilitate the field surveys. The maps were created for the study area using ArcGIS 10.8 from an orthorectified aerial Metromap imagery captured on 11 September 2021. Potential vegetation and habitat were outlined on a preliminary map layer via on-screen digitising at a scale of no more than 1:800 to demarcate boundaries as polygons determined from imagery and from existing vegetation and habitat mapping (NSW DPI, 2018)

Presumptive map data were loaded onto a tablet connected to a Global Positioning System (GPS) receiver (for added accuracy) and field survey data collected on the tablet.

2.4.1 Weather and sea conditions

The weather and sea conditions during the field surveys are summarised in Table 2-2: Weather and sea conditions during the field survey (source: Bellambi BoM, 2022a) (BoM, 2022a). Conditions during the survey on 17 January 2021 were mostly sunny with light variable winds and moderate swell. There was up to 32.8 millimetres of rainfall in the area within seven days prior to the field survey and water visibility was generally less than 0.3 metres.

Table 2-2: Weather and sea conditions during the field survey (source: Bellambi BoM, 2022a)

Date	Temperature range (°C)	Rainfall (mm)	Wind direction	Max wind speed (km/h)	High tide	Low tide
17/01/2022	19.6-25.8	0	NNE	22	8:48am (1.70 m) 9:29pm (1.19 m)	2:11am (0.54 m) 3:38pm (0.34 m)

2.4.2 Vegetation surveys

The terrestrial portion of the study area was limited to a small mown grassed area. Thus, the categorisation of Plant Community Type (PCT) and TEC commensuration checks were not required. The vegetation survey was carried out in all vegetated areas within the terrestrial study area. A walkover of the study area was completed to describe and map the type, extent and condition of vegetation. The floristics of the site was also recorded.

Priority weeds listed for the Greater Sydney region were recorded and the extent of infestation described, if detected.

2.4.3 Targeted flora surveys

As the background research and habitat assessment did not identify any threatened flora with a moderate or high likelihood of occurrence, no targeted threatened flora surveys were completed or commissioned.

2.4.4 Targeted fauna surveys

No targeted fauna surveys were completed and threatened fauna presence was determined/assumed from an assessment of habitat features.

2.4.5 Aquatic surveys

Fieldwork was carried out using an underwater Remotely Operated Vehicle (ROV). Intertidal areas were inundated at the time of survey and the landward extent limited by a steep sandstone seawall and existing foreshore infrastructure. All safe and accessible areas below Highest Astronomical Tide (HAT) were surveyed from the shore.

Visibility of the harbour had been impacted by swell and rainfall in January 2021, with visibility limited to less than 0.3 metres. The vessel navigated to areas of potential marine vegetation and habitat to verify, describe and classify mapped areas on the presumptive map into categories below.

Seagrass meadows, where detected, were classified as follows:

- Species:
    - Halophila (*Halophila* sp.)
    - Zostera (*Zostera muelleri* subsp. *capricorni*)
    - Posidonia (*Posidonia australis*)
- Density:
    - High (greater than 50 per cent cover)
    - Medium (between 15 and 50 per cent cover, inclusive)
    - Low (less than 15 per cent cover).

Reef habitat, where detected, was classified into two major categories:

- Reef with monospecific macroalgal communities
- Reef with mixed macroalgal communities.

The complexity of reef habitat was also classified, habitat complexity was categorised as:

- High (greater than one-metre-high relief complex habitat associated with natural, unmodified shoreline, includes consolidated or boulder reef with/without macroalgae)

- Medium (0.5 to one metre medium relief complex habitat associated with natural or modified shoreline, includes consolidated or boulder reef with/without macroalgae)
- Low (less than 0.5 metres low relief reef with/without macroalgae).

2.5 Data analyses and mapping

Following completion of the field survey, polygons drawn on the presumptive maps were refined and reclassified as per the field data collected using the same methods described above for creating presumptive maps.

2.6 Limitations

Survey efficacy was influenced by a range of factors. Fieldwork for this study was completed during summer. For this type of survey, limitations are generally due to a single, short duration survey that does not account for seasonal or other temporal variation. The detection of certain species may be affected by:

- Seasonal migration (particularly migratory and transient species)
- Seasonal availability of food for fauna
- Weather conditions during the survey period (some species may go through cycles of activity related to specific weather conditions)
- Species lifecycle (cycles of activity related to breeding).

These potential limitations have been addressed by applying the precautionary principle in cases where the survey methodology may have given a false negative result (ie a species that could reasonably be expected to occur, based on previous records and available habitat, was not observed). All species (including threatened species) have been assessed on the basis of the presence of their habitat and the likely significance of that habitat to a viable local population

3 Existing environment

3.1 Coastal processes and hydrology

Wollongong Harbour is a tide dominated, open entrance harbour which leads to the Pacific Ocean. The water levels are influenced by semi-diurnal astronomical tides, with an approximate tidal range of up to two metres. Local currents may be attributed to tidal flows, wind shear, propeller wash and localised flows at stormwater outlets.

The off-shore wave climate nearby is predominantly from south and southeast swell conditions, producing mean wave heights of typically 1.5 metres with wave periods of six seconds (Cardno, 2007). Wave conditions are mainly influenced by diffraction between the breakwaters. Other influences include reflections from vertical structures (ie breakwall).

Afternoon winds are generally stronger than morning winds, with southwest winds most frequent in the morning and northeast winds in the afternoon (BoM, 2021a).

3.2 Soil and sediment properties

The Wollongong 1:50,000 Geological Series Sheet 9029-11 (Bowman & Stewart, 1974) accessed from NSW DPE indicates the study area overlays Budgong Sandstone of the Shoalhaven Group. Budgong Sandstone is typically red, brown and grey volcanic sandstone. The bedrock lies close to the surface, protruding from the seabed in numerous locations inside Wollongong Harbour.

The topography of the study area is generally level as the central pier of Belmore Basin is a manmade concrete and asphalt structure (PWA, 2017). Within the study area, the decommissioned pilot's slipway has a steep gradient across a length of approximately 17 metres, from the central pier into the harbour. The central pier itself sits approximately two metres above the surface of water.

3.2.1 Acid sulfate soils/sediments

Acid sulfate Soils/sediments (ASS) is the common name given to naturally occurring soils and sediments that contain iron sulfate (pyrite). Acid sulfate soils/sediments are defined as either:

- Actual ASS (AASS) - highly acidic soils or sediments with pH <4
- Potential ASS (PASS) - soils or sediments containing sulphuric material that have not been oxidised but have potential for oxidation to generate high acidity.

The Wollongong LEP ASS risk maps revealed that some areas of Belmore Basin lies within Class 5 ASS risk potential. ASS are not typically found in Class 5 areas but are located within 500 metres to nearby Class 1, 2, 3 or 4 areas. ASS risk within the study area is not defined on the Australian Soil Resource Information System (ASRIS).

3.2.2 Soil and sediment quality

Soil within Wollongong Harbour likely consists of natural silty clay residual soils, weathered sandstone and fill soils that were locally re-worked from the nearby Belmore Basin excavation. Fine to medium grained marine sands are likely present along the western boundary of Wollongong Harbour (Coffey, 2016). Along Brighton Beach, about 80 metres west of the study area, the sediments are composed of a finer fraction of soils overlying coarser alluvial deposits (Cardno, 2007).

A contamination assessment was undertaken for the central pier (Coffey, 2016) to understand potential contamination risks for the proposed upgrades to Wollongong Harbour. The assessment identified lead, tributyltin (TBT), copper, zinc and petroleum hydrocarbon contaminants in soil and groundwater samples associated with the former ship maintenance facilities on the central pier. The contaminated site approximately four metres northeast of the study area, and is generally associated with the ship repair yard and slipway (Coffey, 2016).

3.3 Water quality

Several stormwater drains discharge directly into Wollongong Harbour. The largest of these is a box culvert in the middle of Brighton Beach (Cardno, 2007). Stormwater is mainly generated under high rainfall events and runoff is expected to flow in all directions into the surrounding harbour (PWA, 2017). Recent recreational water quality ratings from NSW DPE, 2021 recreational water quality report indicate nearby North Wollongong and Wollongong City beaches water quality is rated as good and very good, respectively.

3.4 Terrestrial vegetation

The study area was highly modified. Vegetation within the study area was not remnant nor could be classified as PCTs. The study area was predominantly hardstand with a small portion of exotic landscaped grass near the Wollongong Yacht Club building. The exotic weeds House Holy Fern (*Cyrtomium falcatum*), Hairy Fleabane (*Erigeron bonariensis*) and Spreading Pellitory (*Parietaria judaica)* was observed growing within the upper foreshore between crevices (Plate 1).

The list of flora species recorded during the field survey is provided in Appendix A – Species recorded

Plate 1: a/b) House Holy Fern, Hairy Fleabane and Spreading Pellitory growing within the seawall crevices; c) Pilots slipway and exotic mown grass near Wollongong Yacht Club building; d) Proposed designated car park location and foreshore of central pier

3.5 Terrestrial fauna habitat

Local and vagrant seabirds may use the existing wharf structure as perching areas while foraging in the area or attracted to recreational fishing activities from the existing wharf and harbour. Thus, species likely to use the study area are those common to urban areas including Silver Gull (*Chroicocephalus novaehollandiae*), Cormorants (*Phalacrocorax* spp.) and Australian Pelican (*Pelecanus conspicillatus*).

The study area is considered potential foraging and roosting habitat for microchiropteran bats (microbats). Microbats may also roost in the crevices of the existing wharf structures (ie crevices within seawall) and the nearby commercial buildings. The crevices within the seawall were unable to be safely inspected.

The volume of pedestrian and vessel traffic in the study area is likely to be a deterrent for species that are not adapted to disturbance.

The list of fauna species recorded during the field survey is provided in Appendix A – Species recorded.

3.6 Priority weeds

One priority weed listed under the *Biosecurity Act 2015* was recorded in the study area. Spreading Pellitory is regulated under the general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.

3.7 Marine vegetation and habitat

The marine portion of the study area comprised of artificial seawall with steps, intertidal and subtidal areas surrounding the central pier (Plate 2).

A review of available mapped marine vegetation (NSW DPI, 2022) revealed no seagrass, mangroves or saltmarsh present within the study area. The closest occurrence of marine vegetation are mapped patches of mangrove and/or saltmarsh associated with the Gurungaty waterway, over two kilometres southwest of the study area. The nearest mapped seagrass is also located within the Gurungaty waterway, approximately two kilometres south-west of the study area. Extensive seagrass meadows are located 2.6 kilometres south-west of the study area at Lake Illawarra.

a)

Plate 2: a) Marine extent of the study area, consisting of steep sandstone seawall, wooden piles and large rubber tyres used as fenders.

The intertidal area was generally limited to the vertical sandstone seawall, lower portions of rubber tyres, the upper portions of existing wooden piles, tidal steps, pilots slipway and boat ramp within the study area. Generally, Sydney Rock Oyster (*Saccostrea glomerata*) colonised these areas and extended up to 0.7 metres below HAT (Plate 3).

The lower portions of the vertical wooden piles and consolidated seawall structure were colonised by habitat-forming species commonly found on subtidal rocky reefs such as Kelp (*Ecklonia radiata*), *Padina* sp., brown filamentous algae and sponges (*Phylum Porifera*) (Plate 4). Dislodged seawall fragments, natural rock rubble and solid waste were also observed within one metre of the toe of the seawall and contained a similar subtidal rocky reef assemblage. These areas were considered low relief.

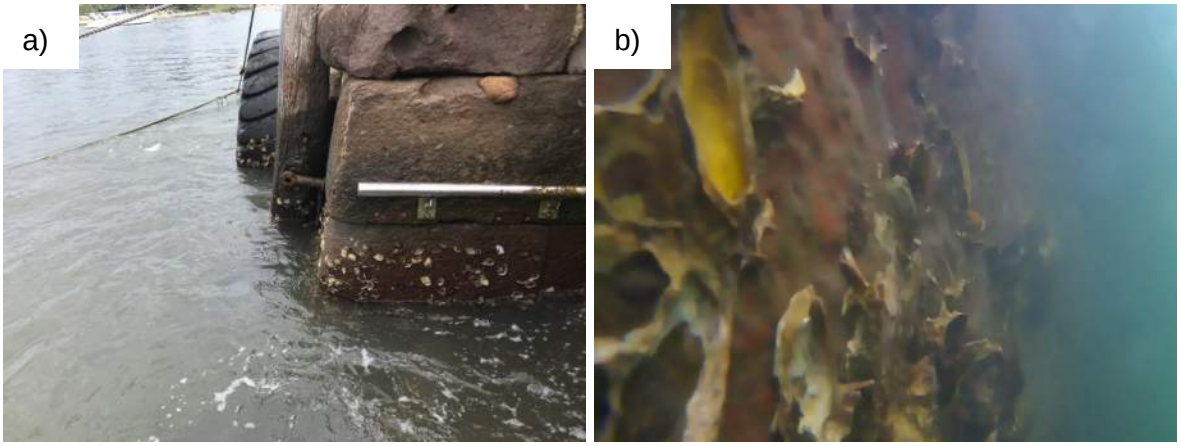

Plate 3: a/b) Representative intertidal habitat within the study area.

Subtidal unvegetated soft sediment habitat occupied the largest portion of the study area (about 0.9 hectares) and mostly comprised of bare sand, rock rubble and some solid waste (Plate 4). No visible epifauna (ie fauna that lives on the surface of the seafloor) were observed during this survey. However, infauna (ie fauna that lives in the sediment) activity (ie bioturbation) was observed during the field survey. Soft sediment epifauna and infauna play a central role in ecosystem functions by forming basal elements of many food chains (Gadd & Griffiths, 1977; Eyre & Ferguson, 2005; Connell & Gillanders, 2007).

A small low density patch of pioneering seagrass species *Halophila* sp. was recorded in the study area (Plate 4).

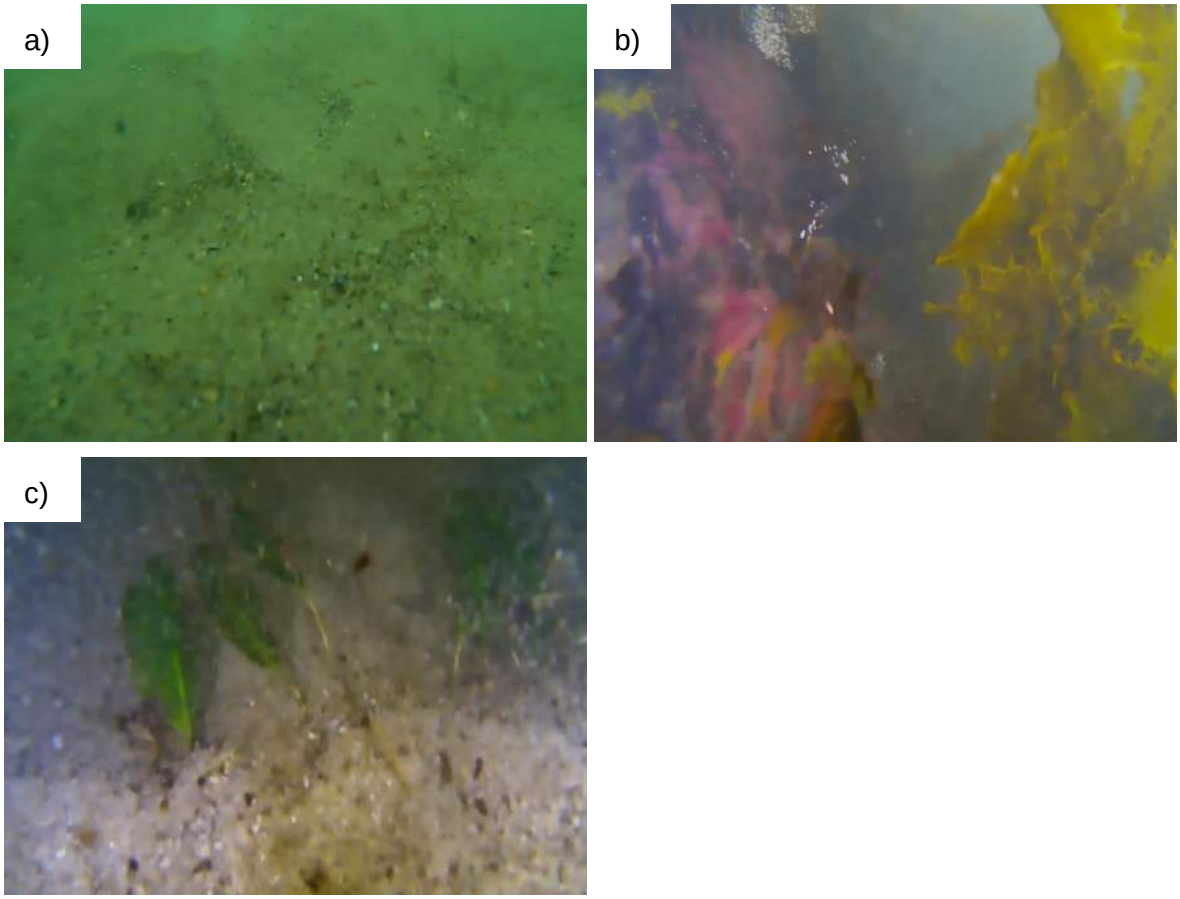

Plate 4: a) Representative unvegetated soft sediment; b) representative subtidal low relief rocky reef habitat on the seawall and lower portions of wooden piles; c) low density Halophila sp. among soft sediment.

The study area is mapped as Key Fish Habitat (KFH), and is considered a Class 1 waterway – Major KFH (NSW DPI, 2013; NSW DPI, 2022a). Habitat on existing piles are considered Type 2 – Moderately sensitive KFH as they meet the descriptions of rocky reefs and macroalgae were observed on these structures (NSW DPI, 2013). Intertidal and subtidal soft sediment areas are considered Type 3 – Minimally sensitive KFH as these areas were characterised by unstable or unvegetated sand. Seagrass is considered Type 2 – Moderately sensitive KFH attributed to the presence of *Halophila* sp. in areas less than five square metres.

Figure 3-1: Indicative locations of marine vegetation and habitat

Table 3-1: Areas of marine vegetation and habitat in the study area

Marine vegetation and habitat	Area in study area (ha)
Vertical subtidal rocky reef habitat (on wharf piles) and rubble – Type 2 KFH	<0.01
Subtidal soft sediment – Type 3 KFH	0.9
Seagrass – Type 2 KFH (<5 square metres)	<0.01
Total	**~0.9**

The marine vegetation and habitat within the study area is characteristic of many nearshore areas in the study locality. Subtidal consolidated rocky reef structures in the harbour provide habitat for a number of local and vagrant fish and other mobile species. These include threatened, protected and migratory species known to occur in the harbour (see sections section 3.11, section 3.12 and section 3.15.2). No threatened or migratory species were observed during the field survey.

The list of marine fauna species recorded during the field survey is provided in Appendix A – Species recorded.

3.8 Marine pests and diseases

There is potential for the introduction/spread of marine pests. Marine pests can be introduced to ports through hull fouling and discharge of ballast water as well as the use of contaminated equipment.

A 2000 survey at Port Kembla found 49 introduced (35) and cryptogenic (14) species within the Port (Pollard & Pethebridge, 2002). Two of these species were toxic dinoflagellates, *Alexandrium* sp. (*catanella* type) and *Alexandrium ostenfeldii*/*peruvianum*, listed as target introduced marine pest species by the Australian Ballast Water Management Advisory Council (ABWMAC). Dinoflagellate blooms of these species in the water column produces neurotoxins, which may cause fish kills, accumulate in commercially important invertebrates and become toxic to humans.

The remaining 47 species were recognised as exotic species introduced in both historic and modern times by vessels but are not listed as 'pest' species with potential to pose any significant economic or environmental threats in this area (Pollard & Pethebridge, 2002). Two other species, recognised as pest species in Sydney and Batemans Bay (of which the study area lies between), were not identified in the Port during the 2000 survey. These were the European green shore crab (*Carcinus maenas*) and *Caulerpa taxifolia*. Both the European green shore crab and *C. taxifolia* prefer estuarine environments over exposed coastal shores and was not observed during the field survey.

3.9 Threatened ecological communities

No remnant vegetation or terrestrial PCTs occur within the study area thus, no TECs occur within the study area. However, six TECs have been mapped within the locality (Figure 3-2: Threatened ecological communities mapped in study locality) (NSW SEED, 2016, NSW OEH, 2016). These, and their proximity to the study area, are detailed in Table 3-2: Threatened ecological communities (TECs) mapped within the study locality and their

proximity to the study area and presented in Figure 3-2: Threatened ecological communities mapped in study locality.

Table 3-2: Threatened ecological communities (TECs) mapped within the study locality and their proximity to the study area

Plant community type (PCT)	Associated TECs		Area in locality (ha)	Bearing and proximity of the closest occurrence to the study area
	BC Act	EPBC Act		
838	Illawarra Lowlands Grassy Woodland in the Sydney Basin Bioregion (endangered)	Illawarra and south coast lowland forest and woodland ecological community (critically endangered)	287.4	~6.8 km northwest
910	Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (endangered)	Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (critically endangered)	1.5	~9.3 km south
920* and 1126*	Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (endangered)	Subtropical and Temperate Coastal Saltmarsh (vulnerable)	0.4 and 4.2	~2.6 km, southwest
1803	Coastal Upland Swamp in the Sydney Basin Bioregion (endangered)	Coastal Upland Swamps in the Sydney Basin Bioregion (endangered)	287.4	~6.8 km, northwest
1913*	*Posidonia australis* seagrass endangered populations in Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie (endangered population under the FM Act)	*Posidonia australis* Seagrass Meadows of the Manning-Hawkesbury Ecoregion (endangered)	410.3	~8.0 km, south-west

*Marine vegetation discussed in section 3.7.

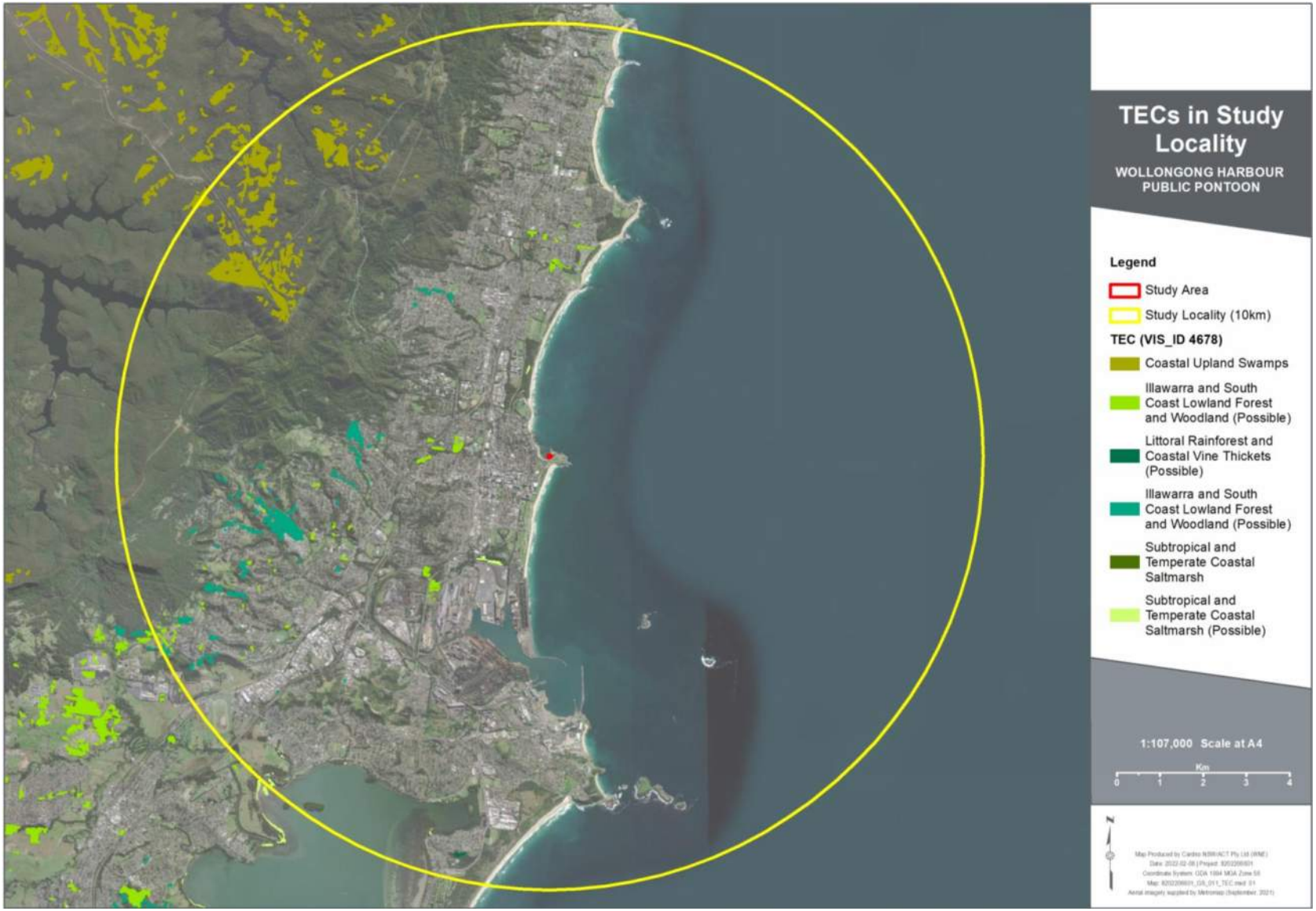

Figure 3-2: Threatened ecological communities mapped in study locality

3.10 Groundwater dependent ecosystems

There are no aquatic or terrestrial GDEs in the study area (BoM, 2022b). The closest mapped terrestrial GDE is located at Wollongong City Beach, approximately 350 metres south east of the study area.

3.11 Threatened species and populations

A review of the DPE-EES BioNet database, NSW DPI Threatened species list and the DAWE PMST revealed 143 threatened species and/or populations with potential to occur in the study locality. Those with records in the study locality are illustrated in Figure 3-2: Threatened ecological communities mapped in study locality Of the 143 threatened species, five were amphibians, 32 were flora (including two endangered populations), 65 were birds, six were fish/Syngnathids, five were elasmobranchs, 24 were mammals and six were reptiles. Migratory species listed under the EPBC Act are discussed in section 3.15.2**.**

No threatened species were observed during the field survey although visibility in the intertidal and subtidal areas was poor. However, potential habitat for some threatened species occurs in the study area.

An assessment of the likelihood of occurrence of all threatened species based on the study area habitat was carried out to determine the potential for these species to occur within the study area. Some of these habitats were not considered optimal/suitable due to the size, condition and level of disturbance. This was a consideration of the likelihood of occurrence assessment. Table 2-1: Likelihood of occurrence criteria provides the likelihood of occurrence criteria used in the assessment and Table 3-3: Likelihood of occurrence summary of threatened species provides a summary of the assessment. The rationale behind the assessment is attached in Appendix B - Habitat assessment table.

The likelihood of occurrence assessment found the majority of threatened species were either unlikely to occur or have a low likelihood of occurrence in the study area. However, due to the presence of suitable habitat in the study area in the harbour, seven species were considered to have a moderate likelihood of occurrence. These include:

- Black Rockcod (*Epinephelus daemelii*) listed as vulnerable under the FM Act and vulnerable under the EPBC Act
- White's Seahorse (*Hippocampus whitei*) listed as endangered under the FM Act and EPBC Act
- White-bellied Sea Eagle (*Haliaeetus leucogaster*) listed as vulnerable under the BC Act
- Eastern Osprey (*Pandion cristatus*) listed as vulnerable under the BC Act
- Little Bent-winged Bat (*Miniopterus australis*) listed as vulnerable under the BC Act
- Large Bent-winged Bat (*Miniopterus orianae oceanensis*) listed as vulnerable under the BC Act
- Southern Myotis (*Myotis macropus*) listed as vulnerable under the BC Act

The Black Rockcod is listed as vulnerable under the FM Act and the EPBC and was considered to have a moderate likelihood of occurrence in the study area due to the presence of potential habitat (ie rocky reef). The Black Rockcod distribution is centred around the NSW coast and adults are usually found in caves, gutters and beneath bommies on rocky reefs up to 50 metres in depth. Juveniles of this species prefer coastal rock pools while larger juveniles prefer rocky reefs in estuaries. This species has high site fidelity and is territorial. The habitat within the study area is considered suboptimal for the Black Rockcod (low relief subtidal rocky reef only). There is likely to be better conditioned habitat in the

study locality for this species and the occurrence of this species in the study area is likely to be restricted to transiting individuals. Therefore, impacts to this species as a result of the project is unlikely and would not be discussed further.

White's Seahorse is listed as endangered under the EPBC Act and FM Act and was considered to have a moderate likelihood of occurrence in the study area due to the presence of suitable habitat (ie subtidal rocky reef). They are usually found in sponge gardens, seagrass meadows and soft corals as well as artificial habitats such as swimming nets and jetty/wharves. The proposal has potential to present a risk to this species due to the presence of preferred habitat and their limited mobility. Thus, an AoSs under the EPBC Act and FM Act have been prepared to inform the impact assessment (Appendix C – Assessments of significance).

Both raptors, White-bellied Sea Eagle and Eastern Osprey were considered to have a moderate likelihood of occurrence in the study area due to the presence of potential foraging habitat and recent records within the study locality. Both species may fly over the study area, however are unlikely to linger or breed in the study area due to the high level of boat traffic. Based on this, the proposal is unlikely to impact these species and would not be considered further.

Three microbats, listed under the BC Act, were considered to have a moderate likelihood of occurrence in the study area (ie crevices in seawall). There is no breeding habitat in the study area however, some of the existing wharf structures have potential to provide roosting habitat and the entire study area form potential foraging habitat for these three species, albeit suboptimal for some species. All of these three species prefer to roost in caves, but are known to roost in man-made structures including in/under bridges/wharves/drains and buildings. The existing suboptimal habitat for these species is not expected to be impacted by the proposal, thus these species would not be considered further in this assessment.

Table 3-3: Likelihood of occurrence summary of threatened species

Scientific Name	Common Name	BC Act/FM Act*	EPBC Act*	Number of records (source)	Likelihood of occurrence
Amphibians					
Heleioporus australiacus	Giant Burrowing Frog	V	V	(PMST) / 47 (BioNet)	None.
Litoria aurea	Green and Golden Bell Frog	E	V	(PMST) / 464 (BioNet)	None.
Litoria littlejohni	Littlejohn's Tree Frog	V	V	(PMST)	None.
Mixophyes balbus	Stuttering Frog	E	V	(PMST)	None.
Pseudophryne australis	Red-crowned Toadlet	V	-	17 (BioNet)	None.
Flora					
Acacia bynoeana	Bynoe's Wattle, Tiny Wattle	E	V	(PMST)	None.

Scientific Name	Common Name	BC Act/FM Act*	EPBC Act*	Number of records (source)	Likelihood of occurrence
Allocasuarina glareicola	-	E	E	(PMST)	None.
Caladenia tessellata	Thick-lipped Spider-orchid	E	V	(PMST)	None.
Cryptostylis hunteriana	Leafless Tongue-orchid	V	V	(PMST)	None.
Cynanchum elegans	White-flowered Wax Plant	E	E	(PMST) / 43 (BioNet)	None.
Epacris purpurascens var. purpurascens	-	V	-	3 (BioNet)	None.
Genoplesium baueri	Yellow Gnat-orchid	E	E	(PMST)	None.
Gossia acmenoides	Gossia acmenoides population in the Sydney Basin Bioregion south of the Georges River	EP	-	9 (BioNet)	None.
Grevillea raybrownii	-	-	V	(PMST)	None.
Haloragis exalata subsp. exalata	Square Raspwort	V	V	(PMST)	None.
Melaleuca biconvexa	Biconvex Paperbark	V	V	(PMST)	None.
Melaleuca deanei	Deane's Melaleuca	V	V	(PMST)	None.
Persicaria elatior	Knotweed, Tall Knotweed	V	V	(PMST)	None.
Persoonia acerosa	Needle Geebung	V	V	(PMST)	None.
Persoonia hirsuta	Hairy Geebung	E	E	(PMST)	None.
Persoonia nutans	Nodding Geebung	E	E	(PMST)	None.

Scientific Name	Common Name	BC Act/FM Act*	EPBC Act*	Number of records (source)	Likelihood of occurrence
Pimelea spicata	Spiked Rice-flower	E	E	(PMST)	None.
Prasophyllum affine	Jervis Bay Leek Orchid	E	E	(PMST)	None.
Pterostylis gibbosa	Illawarra Greenhood	E	E	(PMST)	None.
Pterostylis saxicola	Sydney Plains Greenhood	E	E	(PMST)	None.
Pultenaea aristata	Prickly Bush-pea		V	(PMST) / 55 (BioNet)	None.
Rhizanthella slateri	Eastern Underground Orchid	V	E	(PMST)	None.
Rhodamnia rubescens	Scrub Turpentine	CE	-	(PMST) / 16 (BioNet)	None.
Rhodomyrtus psidioides	Native Guava	CE	CE	(PMST)	None.
Senna acclinis	Rainforest Cassia	E	-	2 (BioNet)	None.
Solanum celatum	-	E	E	3 (BioNet)	None.
Syzygium paniculatum	Magenta Lilly Pilly	V	V	(PMST) / 3 (BioNet)	None.
Thelymitra kangaloonica	Kangaloon Sun Orchid	CE	CE	(PMST)	None.
Thesium australe	Austral Toadflax, Toadflax	V	V	(PMST)	None.
Xerochrysum palustre	Swamp Everlasting	-	V	(PMST)	None.
Zieria granulata	Illawarra Zieria	E	E	(PMST) / 1 (BioNet)	None.
Birds					
Anthochaera phrygia	Regent Honeyeater	CE	CE	(PMST) / 1 (BioNet)	Low.
Ardenna carneipes	Flesh-footed Shearwater	V	M (J, R), Ma	(PMST) / 6 (BioNet)	Low.

Scientific Name	Common Name	BC Act/FM Act*	EPBC Act*	Number of records (source)	Likelihood of occurrence
Artamus cyanopterus	Dusky Woodswallow	V	-	1 (BioNet)	Low.
Botaurus poiciloptilus	Australasian Bittern	E	E	(PMST)	Low.
Calidris alba	Sanderling	V	M (B, C, J, R), Ma	(PMST) / 3 (BioNet)	Low.
Calidris canutus	Red Knot	E	CE, M (B, C, J, R), Ma	(PMST) / 3 (BioNet)	Low.
Calidris ferruginea	Curlew Sandpiper	E	CE, M (B, C, J, R), Ma	(PMST) / 1 (BioNet)	Low.
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	45 (BioNet)	Low.
Calyptorhynchus lathami	Glossy-black Cockatoo	V	-	5 (BioNet)	Low.
Charadrius leschenaultii	Greater Sand Plover	V	V, M (B, C, J, R), Ma	(PMST)	Low.
Circus assimilis	Spotted Harrier	V	-	1 (BioNet)	Low.
Daphoenositta chrysoptera	Varied Stilleta	V	-	1 (BioNet)	Low.
Dasyornis brachypterus	Eastern Bristlebird	E	E	(PMST) / 5 (BioNet)	Low.
Diomedea antipodensis	Antipodean Albatross	V	V, M (B), Ma	(PMST) / 3 (BioNet)	Low.
Diomedea antipodensis gibsoni	Gibson's Albatross	V	V	(PMST) / 4 (BioNet)	Low.
Diomedea epomophora	Southern Royal Albatross	-	E, M (B), Mi	(PMST)	Low.

Scientific Name	Common Name	BC Act/FM Act*	EPBC Act*	Number of records (source)	Likelihood of occurrence
Diomedea exulans	Wandering Albatross	E	E, M (B), Ma	(PMST) / 32 (BioNet)	Low.
Diomedea sanfordi	Northern Royal Albatross	E	E, M (B), Ma	(PMST)	Low.
Ephippiorhynchus asiaticus	Black-necked Stork	E	-	1 (BioNet)	Low.
Falco hypoleucos	Grey Falcon	E	-	(PMST)	Low.
Fregetta grallaria	White-bellied Storm-Petrel	V	V, Ma	(PMST)	Low.
Glossopsitta pusilla	Little Lorikeet	V	-	16 (BioNet)	Low.
Grantiella picta	Painted Honeyeater	V	V	(PMST)	Low.
Haematopus fuliginosus	Sooty Oystercatcher	V	-	104 (BioNet)	Low.
Haematopus longirostris	Pied Oystercatcher	E	-	4 (BioNet)	Low.
Haliaeetus leucogaster	**White-bellied Sea Eagle**	**V**	**Ma**	**(PMST) / 43 (BioNet)**	**Moderate.**
Hieraaetus morphnoides	Little Eagle	V	-	6 (BioNet)	Low.
Hirundapus caudacutus	White-throated Needletail	-	V, M (C, J, R), Ma	(PMST) / 5 (BioNet)	Low.
Ixobrychus flavicollis	Black Bittern	V	-	6 (BioNet)	Low.
Lathamus discolor	Swift Parrot	E	CE, Ma	(PMST) / 19 (BioNet)	Low.
Limosa lapponica baueri	Bar-tailed Godwit (baueri)	-	V	(PMST)	Low.
Limosa limosa	Black-tailed Godwit	V	M (B, J, R), Ma	1 (BioNet)	Low.

Scientific Name	Common Name	BC Act/FM Act*	EPBC Act*	Number of records (source)	Likelihood of occurrence
Lophoictinia isura	Square-tailed Kite	V	-	8 (BioNet)	Low.
Macronectes giganteus	Southern Giant-Petrel	E	E, M (B), Ma	(PMST) / 4 BioNet)	Low.
Macronectes halli	Northern Giant Petrel	V	V, M (B), Ma	(PMST) / 2 (BioNet)	Low.
Melithreptus gularis gularis	Black-chinned Honeyeater	-	V	1 (BioNet)	Low.
Neophema chrysogaster	Orange-bellied Parrot	CE	CE, Ma	(PMST)	Low.
Ninox connivens	Barking Owl	-	V	3 (BioNet)	Low.
Ninox strenua	Powerful Owl	-	V	84 (BioNet)	Low.
Numenius madagascariensis	Eastern Curlew	-	CE, M (B, C, J, R), Ma	(PMST) / 2 (BioNet)	Low.
Onychoprion fuscata	Sooty Tern	V	Ma	2 (BioNet)	Low.
Oxyura australis	Blue-billed Duck	V	-	2 (BioNet)	Low.
Pachyptila turtur subantarctica	Fairy Prion (southern)	-	V	(PMST)	Low.
Pandion cristatus	**Eastern Osprey**	**V**	**M (B), Ma**	**3 (BioNet)**	**Moderate.**
Pezoporus wallicus	Ground Parrot (eastern)	V	-	1 (BioNet)	Low.
Phoebetria fusca	Sooty Albatross	V	V, M (B), Ma	(PMST)	Low.
Pterodroma leucoptera	Gould's Petrel	V	E	(PMST)	Low.
Pterodroma neglecta neglecta	Kermadec Petrel (western)	V	V	(PMST)	Low.
Ptilinopus regina	Rose-crowned Fruit Dove	V	-	3 (BioNet)	Low.

Scientific Name	Common Name	BC Act/FM Act*	EPBC Act*	Number of records (source)	Likelihood of occurrence
Rostratula australis	Australian Painted Snipe	E	E, Ma	(PMST)	Low.
Sternula albifrons	Little Tern	E	M (B, C, J, R)	(PMST) / 3 (BioNet)	Low.
Sternula nereis nereis	Australian Fairy Tern	-	V	(PMST)	Low.
Stictonetta naevosa	Freckled Duck	V	-	1 (BioNet)	Low.
Thalassarche bulleri	Buller's Albatross	-	V, M (B), Ma	(PMST) / 1 (BioNet)	Low.
Thalassarche bulleri platei	Northern Buller's Albatross	-	V, M, Ma	(PMST)	Low.
Thalassarche carteri	Indian Yellow-nosed Albatross			(PMST)	Low.
Thalassarche cauta	Shy Albatross	V	E, M (B), Ma	(PMST) / 8 (BioNet)	Low.
Thalassarche eremita	Chatham Albatross		E, M (B), Ma	(PMST)	Low.
Thalassarche impavida	Campbell Albatross	-	E, M (B), Ma	(PMST) / 3 (BioNet)	Low.
Thalassarche melanophris	Black-browed Albatross	V	V, M (B), Ma	(PMST) / 20 (BioNet)	Low.
Thalassarche salvini	Salvin's Albatross		V, M, Ma	(PMST)	Low.
Thalassarche steadi	White-capped Albatross	-	V, M (B), Ma	(PMST)	Low.
Thinornis cucullatus cucullatus	Eastern Hooded Plover	CE	V, Ma	(PMST) / 3 (BioNet)	Low.
Tyto novaehollandiae	Masked Owl	V	-	5 (BioNet)	Low.

Scientific Name	Common Name	BC Act/FM Act*	EPBC Act*	Number of records (source)	Likelihood of occurrence
Tyto tenebricosa	Sooty Owl	V	-	12 (BioNet)	Low.
Rostratula australis	Australian Painted Snipe	E	E, Ma	(PMST)	Low.
Sternula albifrons	Little Tern	E	M (B, C, J, R)	(PMST) / 3 (BioNet)	Low.
Sternula nereis nereis	Australian Fairy Tern	-	V	(PMST)	Low.
Stictonetta naevosa	Freckled Duck	V	-	1 (BioNet)	Low.
Fish and Syngnathids					
Bidyanus bidyanus	Silver Perch	V	CE	(PMST/DPI)	Low.
Epinephelus daemelii	**Black Rockcod**	**V (FM Act)**	**V**	**(PMST/DPI)**	**Moderate.**
Hippocampus whitei	**White's Seahorse**	**E (FM Act)**	**E, Ma**	**(PMST/DPI)**	**Moderate.**
Maccullochella peelii	Murray Cod	-	V	(PMST)	Low.
Macquaria australasica	Macquarie Perch	E	E	(PMST/DPI)	Low.
Prototroctes maraena	Australian Grayling	E (FM Act)	V	(PMST)	Low.
Elasmobranchs					
Carcharias taurus	Grey Nurse Shark (east coast population)	CE (FM Act)	CE	(PMST/DPI)	Low.
Carcharodon carcharias	White Shark	V (FM Act)	V, Mi	(PMST/DPI)	Low.
Galeorhinus galeus	School Shark	-	CD	(PMST)	Low.
Rhincodon typus	Whale Shark	-	V, M	(PMST)	Low.
Sphyrna lewini	Scalloped Hammerhead	E	CD	(PMST)	Low.
Mammals					

Scientific Name	Common Name	BC Act/FM Act*	EPBC Act*	Number of records (source)	Likelihood of occurrence
Arctocephalus forsteri	New Zealand Fur Seal	V	Ma	(PMST)	Low.
Arctocephalus pusillus	Australian Fur Seal	V	Ma	(PMST) / 3 (BioNet)	Low.
Balaenoptera borealis	Sei Whale	-	V, M (B)	(PMST)	Low.
Balaenoptera musculus	Blue Whale	E	E, M (B)	(PMST)	Low.
Balaenoptera physalus	Fin Whale	-	V, M	(PMST)	Low.
Cercartetus nanus	Eastern Pygmy-possum	V	-	(PMST)	None.
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	(PMST)	None.
Dasyurus maculatus maculatus	Spot-tailed Quoll	V	E	(PMST) / 2 (BioNet)	None.
Eubalaena australis	Southern Right Whale	E	E, M	(PMST)	Low.
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	2 (BioNet)	None.
Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)	E	E	(PMST)	None.
Megaptera novaeangliae	Humpback Whale	V	V, M	(PMST)	Low.
Myotis macropus	Southern Myotis	V	-	3 (BioNet)	Moderate.
Miniopterus australis	Little Bent-winged Bat	V	-	1 (BioNet)	Moderate.
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	-	4 (BioNet)	Moderate.
Petaurus australis	Yellow-bellied Glider	V	-	5 (BioNet)	None.
Petaurus norfolcensis	Squirrel Glider	V	-	4 (BioNet)	None.

Scientific Name	Common Name	BC Act/FM Act*	EPBC Act*	Number of records (source)	Likelihood of occurrence
Petauroides volans	Greater Glider	-	V	(PMST)	None.
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	(PMST)	None.
Phascolarctos cinereus	Koala (combined populations of QLD, NSW and the Australian Capital Territory)	V	V	(PMST) / 11 (BioNet)	None.
Potorous tridactylus tridactylus	Long-nosed Potoroo (SE Mainland)	V	V	(PMST)	None.
Pseudomys novaehollandiae	New Holland Mouse	-	V	(PMST)	None.
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	(PMST)	None.
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	1 (BioNet)	None.
Reptiles					
Caretta caretta	Loggerhead Turtle	E	E, Mi, Ma	(PMST) / 1 (BioNet)	Low.
Chelonia mydas	Green Turtle	V	V, Mi, Ma	(PMST) / 4 (BioNet)	Low.
Dermochelys coriacea	Leatherback Turtle	E	E, Mi, Ma	(PMST)	Low.
Eretmochelys imbricata	Hawksbill Turtle	-	V, Mi, Ma	(PMST) / 1 (BioNet)	Low.
Hoplocephalus bungaroides	Broad-headed Snake	E	V	(PMST)	None
Natator depressus	Flatback Turtle	-	V, Mi, Ma	(PMST)	Low.

**V = vulnerable; E = endangered; CE = critically endangered; EP = endangered population; M = migratory (EPBC Act) (International agreements: B = Bonn; C = CAMBA; J = JAMBA; R = ROKAMBA); Ma = marine (EPBC Act)*

*Moderate or high likelihood of occurrence species are in **bold**.*

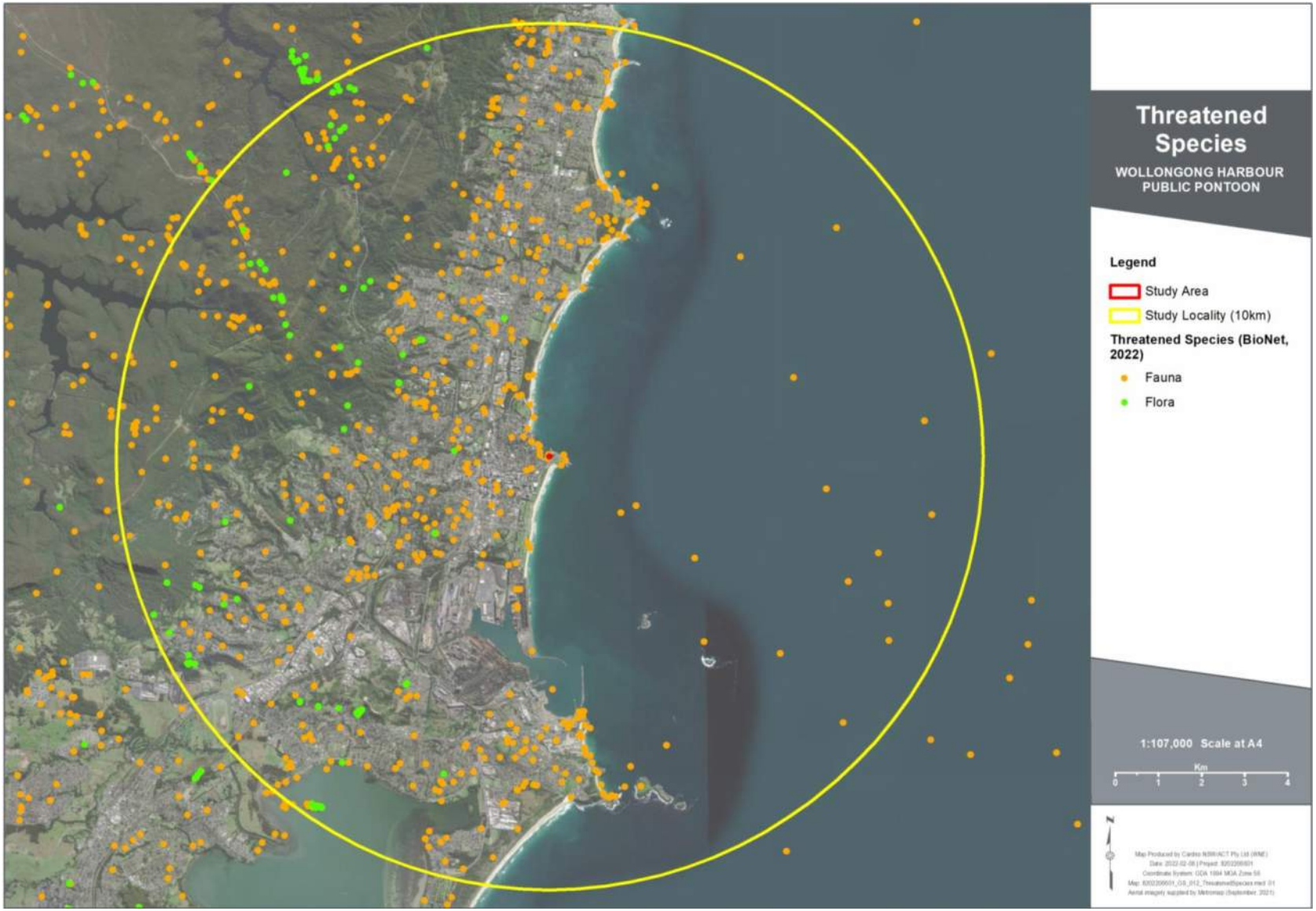

Figure 3-3: Threatened species records within the study locality.

3.12 Protected species

Some species of fish have been formally protected because they are naturally scarce or their numbers have been substantially reduced over recent decades. These species are protected to help prevent them becoming threatened in the future. Twenty-two marine fauna protected under the FM Act have potential to occur within the study locality. Fishing and collecting of these species without a permit will incur a penalty in accordance with Section 19 of the FM Act. An assessment of the likelihood of occurrence of all FM Act protected species, in accordance with the criteria set out in Table 2-1: Likelihood of occurrence criteria, was carried out to determine the potential for these species to occur within the study area (Appendix B - Habitat assessment table). A summary of the likelihood of occurrence assessment is provided in Table 3-4: Likelihood of occurrence summary of protected species.

The EPBC Act also provides for the protection of species. These are referred to as 'Marine' listed species. Their listing under the EPBC Act highlights the need for their conservation and management as protecting them from being killed, injured, taken, traded, kept or moved. Similar to the FM Act, all Syngnathids (Family: *Syngnathidae*) are also listed as Marine under the EPBC Act. The Protected Matters Search Tool and NSW DPI protected species list also identified/predicted the occurrence of nine bird species and twenty Sygnathids, one fish and one elasmobranch listed as Marine under the EPBC Act and/or protected (FM Act) with potential to occur in the study locality.

Generally, bird species identified were considered to have a low likelihood of occurrence with the exception of the Silver Gull (*Chroicocephalus novaehollandiae*). The Silver Gull was observed within the harbour, however this species is highly adapted to the urbanised environment and is highly mobile, thus impacts to this species from the proposal is considered unlikely and is not considered further in this assessment.

The subtidal area of the study area forms potential habitat for many of the protected Sygnathids and fish, however many of these species have a wide geographic range and the habitat within the study area is not considered unique.

All marine vegetation, including seagrass, saltmarsh, mangroves and macroalgae, are protected under the FM Act. The study area does not encompass saltmarsh or mangroves however, a small amount of seagrass was observed in subtidal soft sediment areas and macroalgae colonised existing seawall and scattered debris in soft sediment areas (see section 3.7). Macroalgae and seagrass are considered as marine vegetation and Division 4 of the FM Act protects marine vegetation from 'harm' in the form of gathering, cutting, pulling up, destroying, poisoning, digging up, removing, injuring or preventing light from reaching or otherwise harm marine vegetation or any part of it.

Table 3-4: Likelihood of occurrence summary of protected species

Scientific Name	Common Name	BC Act/FM Act*	EPBC Act*	Number of records (source)	Likelihood of occurrence
Birds					
Bubulcus ibis	Cattle Egret	-	Ma	(PMST)	Low.
Charadrius ruficapillus	Red-capped Plover	-	Ma	(PMST)	Low.
Chroicocephalus novaehollandiae	Silver Gull	-	Ma	(PMST)	**High.**

Scientific Name	Common Name	BC Act/FM Act*	EPBC Act*	Number of records (source)	Likelihood of occurrence
Eudyptula minor	Little Penguin	-	Ma	(PMST)	**Moderate.**
Merops ornatus	Rainbow Bee-eater	-	Ma	(PMST)	Low.
Neophema chrysostoma	Blue-winged Parrot	-	Ma	(PMST)	Low.
Pachyptila turtur	Fairy Prion	-	Ma	(PMST)	
Pelagodroma marina	White-faced Storm-Petrel	-	Ma	(PMST)	Low.
Stercorarius skua	Great Skua	-	Ma	(PMST)	Low.
Fish and Sygnathids					
Acentronura tentaculata	Shortpouch Pygmy Pipehorse	P (FM Act)	Ma	(PMST)	**Moderate.**
Festucalex cinctus	Girdled Pipefish	P (FM Act)	Ma	(PMST)	**Moderate.**
Filicampus tigris	Tiger Pipefish	P (FM Act)	Ma	(PMST)	Low.
Heraldia nocturna	Upside-down Pipefish	P (FM Act)	Ma	(PMST)	**Moderate.**
Hippichthys penicillus	Beady Pipefish	P (FM Act)	Ma	(PMST)	Low.
Hippocampus abdominalis	Big-belly Seahorse	P (FM Act)	Ma	(PMST)	**Moderate.**
Histiogamphelus briggsii	Crested Pipefish	P (FM Act)	Ma	(PMST)	**Moderate.**
Lissocampus runa	Javelin Pipefish	P (FM Act)	Ma	(PMST)	**Moderate.**
Maroubra perserrata	Sawtooth Pipefish	P (FM Act)	Ma	(PMST)	**Moderate.**
Notiocampus ruber	Red Pipefish	P (FM Act)	Ma	(PMST)	**Moderate.**
Odontaspis ferox	Herbsts nurse shark	P (FM Act)	-	(DPI)	Low.
Paraplesiops bleekeri	Eastern blue devil	P (FM Act)	-	(DPI)	**Moderate.**
Phyllopteryx taeniolatus	Common Seadragon	P (FM Act)	Ma	(PMST)	**Moderate.**

Scientific Name	Common Name	BC Act/FM Act*	EPBC Act*	Number of records (source)	Likelihood of occurrence
Solegnathus spinosissimus	Spiny Pipehorse	P (FM Act)	Ma	(PMST)	**Moderate.**
Solenostomus cyanopterus	Robust Ghostpipefish	P (FM Act)	Ma	(PMST)	**Moderate.**
Solenostomus paradoxus	Ornate Ghostpipefish	P (FM Act)	Ma	(PMST)	**Moderate.**
Stigmatopora argus	Spotted Pipefish	P (FM Act)	Ma	(PMST)	**Moderate.**
Stigmatopora nigra	Widebody Pipefish	P (FM Act)	Ma	(PMST)	**Moderate.**
Syngnathoides biaculeatus	Double-end Pipehorse	P (FM Act)	Ma	(PMST)	**Moderate.**
Trachyrhamphus bicoarctatus	Bentstick Pipefish	P (FM Act)	Ma	(PMST)	**Moderate.**
Urocampus carinirostris	Hairy Pipefish	P (FM Act)	Ma	(PMST)	**Moderate.**
Vanacampus margaritifer	Mother-of-pearl Pipefish	P (FM Act)	Ma	(PMST)	**Moderate.**

**P=protected (FM Act); Ma = marine (EPBC Act)*

*Moderate or high likelihood of occurrence species are in **bold**.*

3.13 Commercial and recreational fishing

A number of commercial fisheries are active in the study locality include the Eastern Rock Lobster Fishery, the Abalone Fishery and the Sea Urchin and Turban Snail Fishery. The Ocean Hauling Fishery and Trap and Line Fishery also operate in the Study Locality.

The NSW Eastern Rock Lobster Fishery is a small but valuable fishery worth approximately $12 million for the 2020/21 fishing period. The fishery extends from the Queensland border to the Victorian border and includes all waters under the NSW jurisdiction to approximately 80 miles off the coast. The fishery is characterised by inshore and offshore sectors varying in the size and specifications of traps (NSW DPI, 2022b). Eastern Rock Lobster (*Sagmariasus verreauxi*) is the main species harvested but Southern Rock Lobster (*Jasus edwardsii*) and Tropical Rock Lobster (*Panulirus longipes* and *P. ornatus*) are also occasionally caught.

The Abalone Fishery is a highly specialised fishery targeting the Blacklip Abalone (*Haliotis rubra*) on coastal reefs of NSW. In practice, most commercial abalone fishing takes place on the south coast of NSW, primarily from Jervis Bay to the Victorian border, with most abalone found close to the shore but fishing activity can occur in the Illawarra including the coastal reefs within the study area. Notwithstanding, the rocky reef directly affected by the proposal is not optimal habitat for abalone.

The NSW Sea Urchin and Turban Shell (SUTS) Fishery is a relatively small fishery with few divers participating due to constraints from high processing costs and a limited domestic market. Generally, commercial fishing for sea urchins occurs in NSW, VIC, TAS and SA, while the taking of turban shells commercially is mainly restricted to NSW waters. The

fishery targets three species of Sea Urchins (*Centrostephanus rodgersii*, *Heliocidaris erythrogramma* and *H. tuberculata*) and three species of Turban Shell (*Turbo torquatus*, *T. militaris* and *T. undulatus*). Fishing for Sea Urchins is generally constrained to the time of the year when roe, the most valuable part of the urchin, is well developed. For the Purple Urchin (*H. erythrogramma*), the roe is most developed from October to March and February to October for the Red Urchin (*C. rodgersii*) (NSW DPI, 2022b). Turban shells are harvested year round. Sea urchins inhabit intertidal and subtidal rocky shores and coastal waters up to 35 metres in depth and turban shells occur in intertidal and subtidal areas to a depth of 10 m. Both these habitats are likely to occur in sections of the study area.

The Ocean Hauling Fishery targets approximately 20 finfish species using commercial hauling and purse seine nets from beaches and in ocean waters within three nautical miles of the NSW coast (Coastal Waters). The catch is mainly made up of Pilchards (*Sardinops sagax*) 34 per cent, Sea Mullet (*Mugil cephalus*) 30 per cent, Australian Salmon (*Arripis trutta*) 17 per cent, Blue Mackerel (*Scomber australasicus*) eight per cent, Yellowtail Scad (*Trachurus novaezelandiae*) five per cent and Yellowfin Bream (*Acanthopagrus australis*) two per cent of the total catch (NSW DPI, 2022b). These species can be found in pelagic, coastal and estuarine environments during various stages of their development and may swim through the study area.

The Ocean Trap and Line fishery is a multi-method, multi species fishery targeting demersal and pelagic fish along the entire NSW coast, in continental shelf and slope waters (NSW DPI, 2021b). Snapper (*Pagrus auratus*), Yellowtail Kingfish (*Seriola lalandi*), Leatherjackets (Family: Monacanthidae), Bonito (Family: Scombridae) and Silver Trevally (*Pseudocaranx georgianus*) form the bulk of the commercial catch. Other target species include Rubberlip (grey) Morwong (*Nemadactylus douglassi*), Blue-eye Trevally (*Hyperoglyphe antarctica*), Sharks (elasmobranchs), Bar Cod (*Epinephelus ergastularius*) and Yellowfin Bream (*Acanthopagrus australis*).

Recreational fishing is widespread through the Illawarra Region, with recreational fishers targeting similar inshore species to commercial fishers. An estimate of recreational fishers from a census in 2003 totalled approximately 73,686 (or approximately 20.9 per cent of the population) (Henry and Lyle, 2003).

The majority of recreational fishers are shore-based, although a substantial component is boat-based with some snorkelers who spearfish, take abalone and rock lobsters. Within the study locality, there are a number of recreational fishing restrictions associated with the Port Kembla region including in the Port Kembla outer and inner harbour. The waters between the most eastern extremity of Red Point to the most eastern extremity of Windang are also closed to otter trawl nets used by commercial fisheries year round.

3.14 Wetlands and other areas of conservation significance

There are no Coastal Wetland or Littoral Rainforests, as defined in the Coastal Management SEPP, in the study area. The closest Coastal Wetland Proximity Area and Coastal Wetland is Puckeys Estate Nature Reserve, approximately 0.9 kilometres and one kilometre north-west, respectively. The closest Littoral Rainforest is about 9.3 kilometres south of the study area at Korrungulla Wetlands.

There are no nationally important wetlands or Ramsar Wetlands in the study area or the wider study locality. The study area does not fall in nor is it next to any National Parks, Conservation Reserves, Nature Reserves or Regional Parks. The closest National Parks estate is Flinders Islet, approximately 2.45 kilometres south-east which forms part of Five Islands Nature Reserve. Five Islands Nature Reserve is an important breeding site for numerous seabird threatened and/or protected migratory/marine species including the Sooty Oystercatcher, Little Penguin, Wedge-tail Shearwater (*Ardenna pacificus*), Short-tailed Shearwater (*A. tenuirostris*) (NPWS, 2005).

Due to the close proximity of the Five Islands Nature Reserve and wide foraging ranges of the listed seabirds above, many have potential to overfly or swim through the study area. This is discussed in section 3.15.2.

No Aquatic Reserves or Marine Parks occur within the study area or the study locality.

3.15 Matters of National Environmental Significance

There are nine types of Matters of National Environmental Significance (MNES) listed under the EPBC Act of which actions that have, or are likely to have, a significant impact on would require approval from the Australian Government Minister for the Environment (Commonwealth Minister). Of the nine types of MNES, four are potentially relevant to the proposal:

- Listed threatened species and ecological communities
- Wetlands of international importance
- Migratory species
- Commonwealth marine areas.

Threatened species and ecological communities listed under the EPBC Act are considered as MNES and are discussed in sections 3.9 and 3.11. The location and/or relevance of migratory species, Commonwealth marine areas and wetland of international importance are discussed in the following sections.

3.15.1 Commonwealth marine areas

Commonwealth marine areas extends from three to 200 nautical miles from the coast of Australia. Thus, the study locality and the study area lies outside of any Commonwealth marine areas. The coastal waters to the north-east of the study area resides within the Temperate East Marine Region which covers 383,352 square kilometres and includes eight marine reserves. However, the study area does not reside within any Commonwealth marine reserves. The closest marine reserve is Hunter Commonwealth Marine Reserve, about 59 kilometres south of the study area.

3.15.2 Migratory species

Migratory species are those animals that migrate to Australia and its external territories, or pass through or over Australian waters during their annual migrations. Listed migratory species may include any native species identified in an international agreement approved by the Minister. All listed migratory species are MNES under the EPBC Act. An action will require approval if the action has, will have, or is likely to have, a significant impact on a listed migratory species.

The PMST indicated 35 bird species, two elasmobranchs, one reptile and four mammals have either been previously recorded or are predicted to occur within the study locality. An assessment of the likelihood of occurrence of all FM Act protected species, in accordance with the criteria set out in Table 2-1: Likelihood of occurrence criteria, was carried out to determine the potential for these species to occur within the study area (Appendix B - Habitat assessment table). A summary of the likelihood of occurrence assessment is provided in Table 3-5: Likelihood of occurrence summary of protected species.

Of the listed migratory species, the Wedge-tailed Shearwater (*Ardenna pacifica*) and Short-tailed Shearwater (*Ardenna tenuirostris*) were considered to have a moderate likelihood of occurrence. These species are known to breed at Five Islands Nature Reserve (NPWS, 2005) and may forage and fly over the study area. Human disturbance and boat traffic render the available foraging habitat as suboptimal, furthermore both species are highly

mobile; thus, impacts to these species from the proposal are considered unlikely and would not be considered further in this assessment.

Table 3-5: Likelihood of occurrence summary of protected species

Scientific Name	Common Name		EPBC Act*	Number of records (source)	Likelihood of occurrence
Birds					
Actitis hypoleucos	Common Sandpiper	-	M (B, C, J, R), Ma	(PMST) / 1 (BioNet)	Low.
Anous stolidus	Common Noddy	-	M (C, J), Ma	(PMST)	Low.
Apus pacificus	Fork-tailed Swift	-	M (C, J, R), Ma	(PMST) / 1 (BioNet)	Low.
Ardenna grisea	Sooty Shearwater	-	M (J), Ma	(PMST) / 3 (BioNet)	Low.
Ardenna pacifica	**Wedge-tailed Shearwater**	**-**	**M (C, J, R), Ma**	**(PMST) / 607 (BioNet)**	**Moderate.**
Ardenna tenuirostris	**Short-tailed Shearwater**	**-**	**M (C, J, R), Ma**	**(PMST) / 14 (BioNet)**	**Moderate.**
Arenaria interpres	Ruddy Turnstone	-	M (B, C, J, R), Ma	(PMST) / 21 (BioNet)	Low.
Calidris acuminata	Sharp-tailed Sandpiper	-	M (B, C, J, R), Ma	(PMST) / 6 (BioNet)	Low.
Calidris melanotos	Pectoral Sandpiper	-	M (B, J, R), Ma	(PMST)	Low.
Calonectris leucomelas	Streaked Shearwater	-	M (C, J, R), Ma	(PMST) / 1 (BioNet)	Low.
Charadrius bicinctus	Double-banded Plover	-	M (B), Ma	(PMST)	Low.
Chlidonias leucopterus	White-winged Tern	-	M, (C, J, R) Ma	1 (BioNet)	Low.
Cuculus optatus	Oriental Cuckoo		M (C, J, R)	(PMST)	Low.
Fregata ariel	Lesser Frigatebird	-	M (C, J, R), Ma	(PMST)	Low.
Fregata minor	Greater Frigatebird	-	M (C, J), Ma	(PMST)	Low.
Gallinago hardwickii	Latham's Snipe	-	M (B, J, R), Ma	(PMST) / 3 (BioNet)	Low.
Hydroprogne caspia	Caspian Tern	-	M (J), Ma	24 (BioNet)	Low.

Scientific Name	Common Name		EPBC Act*	Number of records (source)	Likelihood of occurrence
Limosa lapponica	Bar-tailed Godwit	-	M (B, C, J, R), Ma	(PMST) / 12 (BioNet)	Low.
Monarcha melanopsis	Black-faced Monarch	-	M (B), Ma	(PMST)	Low.
Motacilla flava	Yellow Wagtail	-	M (C, J, R), Ma	(PMST)	Low.
Myiagra cyanoleuca	Satin Flycatcher	-	M (B), Ma	(PMST)	Low.
Numenius phaeopus	Whimbrel	-	M (B, C, J, R), Ma	2 (BioNet)	Low.
Oceanites oceanicus	Wilson's Storm-Petrel	-	M (J), Ma	2 (BioNet)	Low.
Onychoprion anaethetus	Bridled Tern	-	M (C, J)	1 (BioNet)	Low.
Pandion haliaetus	Osprey	-	M (B), Ma	(PMST)	Low.
Pluvialis fulva	Pacific Golden Plover	-	M (B, C, J, R), Ma	1 (BioNet)	Low.
Pluvalis squatarola	Grey Plover	-	M (B, C, J, R)	5 (BioNet)	Low.
Rhipidura rufifrons	Rufous Fantail	-	M (B), Ma	(PMST)	Low.
Sterna hirundo	Common Tern	-	M (C, R, R), Ma	4 (BioNet)	Low.
Symposiachrus trivirgatus	Spectacled Monarch	-	M (B), Ma	(PMST)	Low.
Stercorarius parasiticus	Arctic Jaeger	-	M (C, J, R), Ma	2 (BioNet)	Low.
Stercorarius pomarinus	Pomarine Jaeger	-	M (C, J, R), Ma	4 (BioNet)	Low.
Thalasseus bergii	Greater Crested Tern	-	M (J), Ma	(PMST) / 87 (BioNet)	Low.
Tringa nebularia	Common Greenshank	-	M (B,C, J, R), Ma	(PMST) / 2 (BioNet)	Low.
Tringa stagnatilis	Marsh Sandpiper	-	M, Ma	1 (BioNet)	Low.
Elasmobranchs and reptiles					

Scientific Name	Common Name		EPBC Act*	Number of records (source)	Likelihood of occurrence
Carcharhinus longimanus	Oceanic Whitetip Shark	-	M	(PMST)	Low.
Lamna nasus	Porbeagle	-	M	(PMST)	Low.
Mobula birostris	Giant Manta Ray	-	M	(PMST)	Low.
Mammals					
Balaenoptera edeni	Bryde's Whale	-	M	(PMST)	Low.
Caperea marginata	Pygmy Right Whale	-	M	(PMST)	Low.
Lagenorhynchus obscurus	Dusky Dolphin	-	M	(PMST)	Low.
Orcinus orca	Killer Whale/Orca	-	M	(PMST)	Low.

**M = migratory (EPBC Act) (International agreements: B = Bonn; C = CAMBA; J = JAMBA; R = ROKAMBA); Ma = marine (EPBC Act)*

Moderate or high likelihood of occurrence species are in bold.

4 Impact assessment

This section assesses potential impacts to terrestrial and marine biodiversity in the study area as a result from the construction and operation of the proposal. The main components of the proposal are indicated in section 1.2, with potential to impact biodiversity and assessed here are summarised below:

Construction:

- Disturbance of the seabed from vessel traffic, anchoring and piling
- Movement and use of equipment, plant and vessels
- Installation and removal of structures in the harbour

Operation:

- Persistence of the new structures/features
- Vessel and pedestrian traffic.

This section details the extent and significance of impacts as a result of the proposal.

4.1 Construction impacts

4.1.1 Terrestrial vegetation

The proposal is predominantly waterside and would not require vegetation removal. The proposal would require the construction of a designated car park and temporary compound area, limited to the hardstand areas. Impacts of the proposal are considered negligible.

4.1.2 Marine vegetation and habitat

The proposal would not require large-scale disturbance of the seabed. The proposal would require the installation of four restraint piles in subtidal habitat in the harbour. All four piles would be drilled into soft unvegetated sediment (Type 3 KFH) via torqued head, resulting in a permanent loss of localised epifauna and infauna from the unvegetated soft sediment and temporary impact to barge anchor areas. The soft sediment habitats in the study area are characteristic of the majority of subtidal habitat within the harbour and community assemblages are generally ubiquitous and quick to recolonise following disturbance. Thus, the loss of these small areas would not be a substantial loss and anchor areas in soft sediment would quickly recolonise following the removal of anchors.

A small patch of low density Halophila sp. (Type 2 KFH) and macroalgae (Type 2 KFH) were identified within the study area, both of which are in proximity to the piling locations. There is potential for coarse and fine debris to be mobilised during piling and anchoring and propeller damage (on low tide). This can crush, damage and/or smother marine vegetation and habitat depending on the size of debris. Mobilisation of finer debris (ie sediments) can also result in the mobilisation of contamination known to persist in study area sediments. Depending on the volume and the size of fine debris, wave, tide and current actions, finer particles may not reside in the area for long and this may only be a temporary disturbance to marine vegetation and habitat.

Waterside construction activities would result in vessel and barge movements in and around the study area. This has potential to temporarily increase the frequency of vessel wash impact to scour soft sediment areas. Additionally, seagrass meadows and sessile fauna can be scoured from the seawall and epifauna, including scattered colonies of macroalgae on hard substratum, and infauna in soft sediment habitats can be removed/dislodged. As large and small vessels currently frequent the study area, the community assemblages are likely to be well-adapted to vessel wash and scour. Thus, impacts as a result of vessel and barge

movements are unlikely to substantially impact marine vegetation and associated assemblages in the study area.

4.1.3 Coastal fauna and mobile marine fauna

Proposal construction activities are unlikely to substantially impact mobile marine fauna occurring within the study area. Fish are highly mobile and temporary disturbance from the movement of vessels, piling would be minor, as similar and higher condition habitat are abundant and wide-ranging in the harbour and study locality. Disturbances from piling include noise and vibration and alterations to water quality. Tolerance to changes in noise, vibration and water quality may vary among species, but the response is generally similar (ie movement away from unfavourable conditions). Marine fauna in the harbour are likely to be exposed to an ambient level of noise and changes in water quality from existing marine activities and runoff. These species are also likely to recolonise the study area once conditions return to pre-construction levels.

Impacts on sessile and less mobile marine fauna (excluding threatened species) associated with rocky reef and soft sediments have been addressed in section 4.1.2.

An increase in vessel and barge activity during construction is associated with an increased risk of vessel strikes with marine mammals/reptiles and elasmobranchs. The proposal footprint is considered suboptimal habitat for most marine mammals and very few individuals, if any, would occur during construction. The increased risk of vessel strike, however, is proportional to the increase in vessel traffic for the proposal relative to overall vessel traffic. This proportional increase is considered to be very small. Given marine reptiles and marine mammals regularly breach the surface to breathe, the risk of vessel strike to these species could be managed by having observers monitoring potential encroachment of individuals. Vessel strike can also be mitigated by slow boat speeds that avoid collisions or result in minor harm from which fauna may recover.

Landside construction activities would also create noise and vibration in the study area and the responses of terrestrial fauna are likely to be similar to that of mobile marine fauna (ie move away from unfavourable conditions and return once disturbance is removed).

With the correct controls, proposal construction is unlikely to cause mortality to coastal or mobile marine fauna in the study area.

4.1.4 Threatened, migratory and protected species

Given the highly urbanised, coastal and exposed location of the study area, impacts to terrestrial flora and fauna are considered negligible. The proposal is unlikely to significantly impact threatened species and disturbances to potential habitat would largely be temporary.

Waterside activities have potential to impact potential habitat for the White's Seahorse. Potential habitat in the study area would be made available for the White's Seahorse following the completion of construction thus, proposal impacts to potential foraging habitat for the White's Seahorse are only temporary. Operational impacts of the pontoon and gangway would not shade available habitat for the White's Seahorse as light penetrating decking (30x30mm mesh) would be utilised. These are also very small proportions of available habitat in their distribution and the installation of new piles and structures would provide similar, if not the same habitat for these species during operation. Additional controls would be implemented to survey for White's Seahorse at the start of construction so that individuals in the area are not harmed (see Chapter 5). Based on this, the proposal is unlikely to significantly impact White's Seahorse.

4.1.5 Pests and diseases

Waterside proposal activities have potential to introduce marine pests, if controls are not implemented.

4.1.6 Commercial and recreational fishing

The proposal is unlikely to substantially impact populations of marine species important to recreational fishing as discussed in section 4.1.3 above.

4.1.7 Key threatening processes

Two Key Threatening Processes (KTPs) have potential to be triggered by the proposal. These are discussed below.

1. Introduction of Non-indigenous Fish and Marine Vegetation to the Coastal Waters of NSW (FM Act)

Threat abatement actions prioritised in the Priority Action Statement – Actions for the introduction of non-indigenous fish and marine vegetation to coastal waters of NSW (Fisheries Scientific Committee, 1994) surrounds community and stakeholder liaison and awareness, legislative development and implementation, eradication and control and research, monitoring and mapping. The proposal is unlikely to interfere with any of these threat abatement actions albeit the potential to introduce/facilitate the spread of non-indigenous fish and marine vegetation. However, vessels and equipment should be sourced from local areas and inspected (see Chapter 5) to avoid introducing non-indigenous fish and marine vegetation. Thus, proposal activities are unlikely to further exacerbate this KTP.

2. Installation and Operation of Instream Structures and Other Mechanisms That Alter Natural Flow Regimes of Rivers and Streams (FM Act)

The proposal would install four piles and a floating pontoon. These structures are not considered to interfere with fish passage nor likely to alter hydrodynamics in the broader harbour.

The identified threat abatement actions for this KTP include advice to consent authorities, community and stakeholder engagement, research and monitoring and habitat rehabilitation and protection. The proposal is unlikely to interfere with these actions with habitat rehabilitation proposed following proposal completion. Thus, the proposal is unlikely to further exacerbate or trigger this KTP.

4.2 Operational impacts

4.2.1 Marine vegetation and habitat

The gangway and pontoon components of the proposal would sit permanently on or above the water's surface and avoid impacts to the seabed. Light penetrating decking (30x30mm mesh) would be utilised for the pontoon and gangway to allow sufficient light to penetrate the substrate and allow seagrass and marine vegetation to grow.

The aim of the proposal is to develop Wollongong Harbour to accommodate for future projected population growth and increased tourism. Consequently, the harbour may result in increased vessel traffic and underwater turbulence. There is potential for unvegetated soft sediment habitat to be scoured from vessel motors while docking and departing the new pontoon. However, these habitats are quick to recover as discussed in section 4.1.2 above. Sediment mobilisation from vessels may affect nearby rocky reef and seagrass habitat, however, communities in the study area are likely to be well-adapted to turbidity and sedimentation from stormwater runoff and from existing vessel traffic (also see section 4.1.2).

The structures of the proposal are not expected to substantially alter coastal processes or hydrology of the study area or the wider harbour. The proposal would install four piles and a floating pontoon and gangway. These structures are not considered to interfere with fish passage nor likely to alter localised hydrodynamics and unlikely to produce substantial impacts to marine biodiversity.

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5 Avoid, minimise and mitigate impacts

Under the Transport for NSW *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (Roads and Traffic Authority (RTA), 2011) the management of biodiversity should aim to:

1. Avoid and minimise impacts first
2. Mitigate impacts where avoidance is not possible
3. Offset where residual impacts cannot be avoided.

Table 5-1: Mitigation measures details measures to avoid, minimise or mitigate proposal impacts. These should be included in the construction environmental management plan and any associated sub-plans prior to construction.

Table 5-1: Mitigation measures

Impact	Mitigation measures	Responsibility	Timing	Likely efficacy of mitigation	Residual impacts anticipated
All proposal impacts	Integrate the management of flora and fauna into the construction environmental management plan (either as a standalone flora and fauna management plan or a subplan). This is to include all terrestrial and marine flora and fauna and include but not be limited to such measures as: • Documenting and establishing site clearing limits and include on sensitive area plans • Establishing no go zones (including no anchoring zones in seagrass) and go slow zones (ie vessel speed restricted areas) and include on sensitive area plans • Pre-construction surveys, weed management and unexpected finds measures in line with the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA, 2011).	Contractor	Pre-construction	Effective	None.
Removal of marine vegetation and habitat	As part of the detailed design process, provide evidence of opportunities explored to promote colonisation of habitat-forming species. Examples include the installation of structures which provide habitat complexity (i.e. designs available as part of the Living Seawalls Project).	Transport for NSW and Contractor	Detailed design	Effective	Potential loss of habitat and disturbance to marine vegetation
Removal of marine vegetation and habitat	The piling activity shall mitigate the risk of sediment dispersal by applying industry best practice of minimising sediment disturbance during construction.	Contractor	Construction	Effective	

Impact	Mitigation measures	Responsibility	Timing	Likely efficacy of mitigation	Residual impacts anticipated
Removal of marine vegetation and habitat	No bed anchoring is to occur. Existing land-based anchor points are to be used.	Contractor	Construction	Effective	None
Aquatic impacts	Aquatic habitat will be protected in accordance with Guide 10: Aquatic habitats and riparian zones of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA, 2011) and Section 3.3.2 Standard precautions and mitigation measures of the *Policy and guidelines for fish habitat conservation and management Update 2013* (NSW DPI, 2013).	Contractor	Construction	Effective	Potential localised sediment mobilisation
Aquatic impacts	Work associated with positioning barges, drilling and pile driving will occur during calm conditions to prevent excessive scouring and other impacts. Conditions are to be assessed by the contractor, prior to any works being undertaken.	Contractor	Construction	Effective	None
Aquatic impacts	Prior to commencement of construction activities, a sediment control device (such as sediment boom and curtain) will be installed around the site to contain disturbed sediment from the water surface by allowing suspended sediments to settle back on the bottom of the seabed overtime. The silt boom and curtain will be installed in accordance with the manufacturers specification for installation. Installation will be undertaken during high tide periods from a boat as tides, currents, the weather and wind could impact the level of erosion and sedimentation. The device will be designed to rise and fall with the tide to prevent disturbance. Inspection of the device will be undertaken on a daily basis after ebbing tides, with additional inspection carried out	Contractor	Construction	Effective	Potential localised sediment mobilisation

Impact	Mitigation measures	Responsibility	Timing	Likely efficacy of mitigation	Residual impacts anticipated
	following storm events. Prior to removing the sediment control device, conditions within the curtain will be assessed visually and with a field instrument to verify that sediment has settled resulting in similar water turbidity to that outside the curtain.				
Aquatic impacts	A spill management plan will be developed as part of the CEMP and communicated to all staff working on site. Appropriate land and aquatic spill kits are to be maintained on site and on barges. Aquatic spill kits must be specific for working within the marine environment. The spill kit must be appropriately sized for the volume of potentially polluting liquids stored on site. All workers will be advised of the location of the spill kit and trained in its use.	Contractor	Pre-construction / Construction	Effective	None
Aquatic impacts	Piling to stop if marine mammals, reptiles or Little Penguins are observed within approximately 100 metres of the proposal area and only to recommence once they have moved beyond 100 metres of the study area or are not seen for at least 20 minutes.	Contractor	Construction	Effective	None
Injury and mortality of fauna	Fauna will be managed in accordance with Guide 9: Fauna handling of the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA, 2011).	Contractor	Construction	Effective	None
Invasion and spread of weeds, pests and diseases	Weed species will be managed in accordance with *Guide 6: Weed management of the Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA, 2011).	Contractor	Construction	Effective	None

Impact	Mitigation measures	Responsibility	Timing	Likely efficacy of mitigation	Residual impacts anticipated
Invasion and spread of weeds, pests and diseases	Waterside equipment and vessels to be sourced from local suppliers where possible. Equipment and vessels must be cleaned and inspected prior to entering the proposal area. If any marine pests are encountered during waterside construction activities, the area of infestation must be isolated/not disturbed and NSW DPI (Fisheries) notified promptly.	Contractor	Construction	Effective	None
Fish kill	NSW DPI (Fisheries) (1800 043 536) and the EPA (131 555) is to be notified immediately if any fish kills occur in the vicinity of the works. In such cases, all works other than emergency response procedures are to cease until the issue is rectified and approval is given by NSW DPI (Fisheries) and/or the EPA for the works to proceed.	Contractor	Construction	Effective	None

6 Offset strategy

The proposal will not clear any remnant native vegetation (or PCTs), therefore offsets are not required.

The proposal is expected to impact less than 0.01 hectares of marine vegetation on subtidal soft sediment as well as (Table 3-1). More than 0.01 hectares of submerged surface area would be available for recolonisation of marine vegetation and other habitat-forming species as part of the new piles, pontoon and gangway. No offsets are required as per the Transport for NSW *Guidelines for Biodiversity Offsets 2016* as there is no net loss of KFH.

7 Conclusion

The proposal forms part of the Wollongong Harbour Master Plan and is focused on improving user/vessel access to the central pier. This includes land and waterside activities for the construction of a fixed platform, gangway and pontoon

A biodiversity assessment was completed to describe the existing coastal and marine environment within the study area and to assess impacts to coastal and marine biodiversity as a result of the construction and operation of the proposal. The biodiversity assessment was informed by a review of existing information and data in the study area and the wider study locality, as well as a field survey of the study area.

The study area is located at Wollongong Harbour, between Flagstaff Hill Park and the Wollongong Breakwater Lighthouse. There was no remnant native vegetation in the study area as it is predominantly hardstand with a small portion of landscaped grass near the Wollongong Yacht Club building.

The marine portion of the study area consisted of a steep artificial sandstone seawall with large rubber tyres, subtidal low relief rocky reef with macroalgae, unvegetated soft sediment with debris and a small patch of Halophila sp. seagrass. No mangroves or saltmarsh occur in or next to the study area. The subtidal habitat in the study area forms potential habitat for one marine fauna.

Subtidal habitat in the study area forms potential habitat for one threatened marine species:

- White's Seahorse (*Hippocampus whitei*) listed as endangered under the FM Act and EPBC Act

The proposal is not expected to remove any vegetation (trees or shrubs) as the study area is largely hardstand. The risks of the spread/introduction of weeds and diseases and the potential for erosion and sediment mobilisation associated with construction activities would be managed during construction in accordance with the relevant Transport for NSW guidelines.

With respect to waterside impacts, four piles would be driven into subtidal soft sediment habitat, resulting in permanent loss of localised epifauna and infauna. However, this loss would be expected to recolonise following disturbance. The area is proportionally small compared to similar habitat in the study area and the wider harbour, and communities assemblages are generally ubiquitous. The presence of *Halophila* sp. may be seasonal in nature, the species is considered a pioneering species and would potentially recolonise the area following a disturbance. Due to this seasonality, an additional seagrass survey may be required to further define the extent of the *Halophila* sp.

Waterside construction activities have potential to temporarily disturb the marine environment. Waterside construction activities would also create noise and vibration in the study area and the responses of mobile marine fauna are likely to be similar to that of terrestrial fauna (i.e. move away from unfavourable conditions and return once disturbance is removed). Following the completion of the work, habitat would become available, with the additional piles creating habitat for sessile marine species.

During operation, the gangway and pontoon components would sit permanently on or above the water's surface and avoid impacts to the seabed. Light penetrating decking (30x30mm mesh) would be utilised for the pontoon and gangway to allow sufficient light to penetrate the substrate and allow seagrass and marine vegetation to grow, therefore impacts to seagrass and/or marine vegetation are considered negligible.

Section 205 of the FM Act states that a permit to 'harm' marine vegetation would be required. However, through consultation with NSW DPI (Fisheries) (21 February 2022), this is not required for the piling associated with the proposal.

Sediment mobilisation and vessel wash and scour were also identified as likely proposal impacts. However, the study area is likely frequently exposed to elevated levels of sediment associated with rainfall and sea conditions, and vessel traffic. Thus, with the appropriate controls, a slight, temporary increase in these impacts is not expected to substantially impact marine biodiversity. Impacts from the introduction/spread of marine pests would also be managed during construction.

The structures of the proposal are not expected to substantially alter coastal processes or hydrology of the study area or the wider harbour. These structures are not considered to interfere with fish passage nor likely to alter localised hydrodynamics and unlikely to produce substantial impacts to marine biodiversity. Considering the above, the proposal is unlikely to significantly impact coastal and marine biodiversity.

The proposal would not fragment or isolate threatened species populations or substantially impact any species' lifecycle, if present. Surveys for White's Seahorse prior to the commencement of construction activities would occur so that individuals in the area are not harmed. Species impact statements (SISs), entry into the Biodiversity Offsets Scheme or referrals are not required for the proposal.

Considering the above, the proposal is unlikely to significantly impact coastal and marine biodiversity.

8 References

Australian Museum, 2022. *Seahorses and pipefishes*.

BoM (2021a) *Climate data online*. Bellambi AWS. Bureau of Meteorology. Available online: http://www.bom.gov.au/climate/data/ Accessed 20 January 2022.

BoM (2022a) *Climate data online*. Bellambi AWS. Bureau of Meteorology. Available online: http://www.bom.gov.au/climate/data/ Accessed 20 January 2022.

BoM, 2022b. *Groundwater Dependent Ecosystem Atlas*. Accessed 20 January 2022.

Bowman, N & Stewart, R. (1974) *Wollongong 1:50,000 Geological Sheet 9029*, 1st edition. Geological Survey of New South Wales, Sydney.

Cardno (2007) *Revised Wollongong Harbour Coastal Processes and Hazard Study.* Prepared by Cardno (NSW/ACT) Pty Ltd on behalf of Wollongong City Council.

Coffey (2016) *Contamination Assessment Report DTIRIS 15/190 – Wollongong Harbour Central Pier.* Prepared by Coffey for NSW Department of Primary Industries.

Connell, S. & Gillanders, B. (2007). *Marine Ecology*. Melbourne, Victoria: Oxford University Press

DPI (2022) *Fisheries Data Portal*. Department of Primary Industries. Available online: https://webmap.industry.nsw.gov.au/Html5Viewer/index.html?viewer=Fisheries_Data_Portal Accessed January 2022.

DPE (2021) *State of the beaches 2020-2021: Illawarra region. Beachwatch*. Department of Planning, Industry and Environment.

Eyre, B. & Ferguson, A. (2005). *Benthic metabolism and nitrogen cycling in a subtropical east Australian estuary (Brunwick): temporal variability and controlling factors*. Limnology and Oceanography, Volume 50, pp. 81-96.

Fisheries Scientific Committee. (1994). *Introduction of Non-indigenous Fish and Marine vegetation to Coastal Waters Key Threatening Process - Recommendation*, s.l.: s.n.

Fisheries Scientific Committee. (2019). *White's seahorse: Hippocampus whitei - Final Determination*. s.l.:s.n.

Gadd, G. & Griffiths, A. (1977). *Microorganisms and heavy metal toxicity*. Microbial Ecology, Volume 4, pp. 303-317.

Harasti, D., Glasby, T. M. & Martin-Smith, K. M. (2010). *Striking a balance between retaining populations of protected seahorses and maintaining swimming nets*. *Aquatic Conservation: Marine and Freshwater Ecosystems*, Volume 20, pp. 159-166.

Harasti, D., Martin-Smith, K. & Gladstone, W. (2014). *Ontogenetic and sex-based differences in habitat preferences and site fidelity of the White's seahorse Hippocampus whitei*. *Journal of Fish Biology*, Volume 85, pp. 1413-1328.

Harasti, D., Martin-Smith, K. M. & Gladstone, W. (2012). *Population dynamics and life history of a geographically restricted seahorse, Hippocampus whitei*. *Journal of Fish Biology*, Volume 81, pp. 1297-1314.

Henry, G. & Lyle, J. (2003). *The National Recreational and Indigenous Fishing Survey*, s.l.: NSW DPI (Fisheries).

Kuiter, R. H. (2009). *Seahorses and their relatives*. s.l.:Seaford: Aquatic Photographics.

NPWS (2005) *Five Islands Nature Reserve Plan of Management*. NSW National parks and Wildlife Services, Department of Environment and Conservation (NSW).

NSW DPI. (2013). *Policy and Guidelines for Fish Conservation and Management, Wollongbar, NSW*: NSW DPI.

NSW DPI. (2018) *Fisheries Spatial Data Portal*. Estuarine Macrophytes.

NSW DPI. (2022a). *Key Fish Habitat maps*. Accessed 20 January 2022.

NSW DPI. (2022b). *Commercial Fishing: Our Fisheries*. Accessed 20 January 2022.

Pollard, D. & Pethebridge, R. (2002). *Report on Port Kembla Introduced Marine Pest Species Survey*, s.l.: Port Kembla Port Corporation.

PWA (2017) *Wollongong Harbour Remediation Project Review of Environmental Factors.* Public Works Advisory on behalf of Department of Industry – Lands.

Roads and Traffic Authority (RTA). (2011). *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects*, s.l.: Roads and Maritime.

9 Appendix A – Species recorded

Recorded flora

Family	Scientific name	Common name	Native/exotic	Priority weed
Asteraceae	*Erigeron bonariensis*	Hairy Fleabane	Exotic	N/A
Dictyotaceae	*Padina sp.*	Peacock's Tail	Native	N/A
Dryopteridaceae	*Cyrtomium falcatum*	House Holy-Fern	Exotic	N/A
Hydrocharitaceae	*Halophila* sp. (marine)	Paddle Weed	Native	N/A
Lessoniaceae	*Ecklonia radiata*	Kelp	Native	N/A
Urticaceae	*Parietaria judaicia*	Spreading Pellitory	Exotic	N/A

Recorded fauna

Family	Scientific name	Common name	Native/exotic
Laridae	*Chroicocephalus novaehollandiae*	Silver Gull	Native
Ostreidae	*Saccostrea glomerata*	Sydney Rock Oyster	Native

10 Appendix B - Habitat assessment table

Likelihood of occurrence criteria

Likelihood	Criteria
Recorded	The species was observed in the study area during the current survey.
High	It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (ie for breeding or important life cycle periods such as winter flowering resources), has been recorded recently (within 20 years) in the locality (five kilometres) and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Moderate	Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent (ie for breeding or important life cycle periods such as winter flowering resources) on habitat within the study area, or habitat is in a modified or degraded state. Includes cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded.
Low	It is unlikely that the species inhabits the study area and has not been recorded recently in the locality (five kilometres). It may be an occasional visitor, but habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent (ie for breeding or important life cycle periods such as winter flowering resources) on available habitat. Specific habitat is not present in the study area or the species are a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.
None	Suitable habitat is absent from the study area.

Threatened species habitat assessment table

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Amphibians						
Heleioporus australiacus	Giant Burrowing Frog	V	V	The Giant Burrowing Frog is distributed in south eastern NSW and VIC, and appears to exist as two distinct populations: a northern population largely confined to the sandstone geology of the Sydney Basin and extending as far south as Ulladulla, and a southern population occurring from north of Narooma through to Walhalla, VIC. Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. Spends more than 95% of its time in non-breeding habitat in areas up to 300 metres from breeding sites. Whilst in non-breeding habitat it burrows below the soil surface or in the leaf litter. Individual frogs occupy a series of burrow sites, some of which are used repeatedly. The home ranges of both sexes appear to be non-overlapping suggesting exclusivity of non-breeding habitat. Home ranges are approximately 0.04 ha in size.	(PMST) / 47 (BioNet)	None. No suitable habitat within the study area.
Litoria aurea	Green and Golden Bell Frog	E	V	Since 1990 there have been approximately 50 recorded locations in NSW, most of which are small, coastal, or near coastal populations. These locations occur over the species' former range, however they are widely separated and isolated. Large populations in NSW are located around the metropolitan areas of Sydney, Shoalhaven and mid north coast (one an island population). Ephemeral and permanent freshwater wetlands,	(PMST) / 464 (BioNet)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				ponds, dams with an open aspect and fringed by Typha spp. and other aquatics, free from predatory fish.		
Litoria littlejohni	Littlejohn's Tree Frog	V	V	Distribution includes the plateaus and eastern slopes of the Great Dividing Range from Watagan State Forest (90 km north of Sydney) south to Buchan in VIC. This species breeds in the upper reaches of permanent streams and in perched swamps. Non-breeding habitat is heath based forests and woodlands where it shelters under leaf litter and low vegetation, and hunts for invertebrate prey either in shrubs or on the ground.	(PMST)	None. No suitable habitat within the study area.
Mixophyes balbus	Stuttering Frog	E	V	Occur along the east coast of Australia from southern QLD to north-eastern VIC. Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Outside the breeding season adults live in deep leaf litter and thick understorey vegetation on the forest floor.	(PMST)	None. No suitable habitat within the study area.
Pseudophryne australis	Red-crowned Toadlet	V	-	It has restricted distribution from Pokolbin to Nowra and west to Mt VIC. Occurs in open forests and wet drainage lines below sandstone ridges that often have shale lenses or cappings in the Hawkesbury and Narrabeen Sandstones.	17 (BioNet)	None. No suitable habitat within the study area.
Flora						

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Acacia bynoeana	Bynoe's Wattle, Tiny Wattle	E	V	Found in central eastern NSW, from the Hunter District south to the Southern Highlands and west to the Blue Mountains. It has recently been found in the Colymea and Parma Creek areas west of Nowra. Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include Red Bloodwood (*Corymbia gummifera*), Scribbly Gum (*Eucalyptus haemastoma*), Drooping Red Gum (*E. parramattensis*), Old Man Banksia (*Banksia serrata*) and Small-leaved Apple (*Angophora bakeri*).	(PMST)	None. No suitable habitat within the study area.
Allocasuarina glareicola	-	E	E	Primarily restricted to the Richmond (NW Cumberland Plain) district, but with an outlier population found at Voyager Point, Liverpool. Grows in Castlereagh woodland on lateritic soil. Found in open woodland with Eucalyptus parramattensis, Eucalyptus fibrosa, Angophora bakeri, Eucalyptus sclerophylla and Melaleuca decora. Common associated understorey species include Melaleuca nodosa, Hakea dactyloides, Hakea sericea, Dillwynia tenuifolia, Micromyrtus minutiflora, Acacia elongata, Acacia brownei, Themeda australis and Xanthorrhoea minor.	(PMST)	None. No suitable habitat within the study area.
Caladenia tessellata	Thick-lipped Spider-orchid	E	V	Known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Populations in Kiama and Queanbeyan are presumed extinct. Generally found in grassy sclerophyll woodland on clay loam or sandy soils,	(PMST)	None. No suitable habitat within

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				though the population near Braidwood is in low woodland with stony soil.		the study area.
Cryptostylis hunteriana	Leafless Tongue-orchid	V	V	The Leafless Tongue Orchid has been recorded from as far north as Gibraltar Range National Park south into VIC around the coast as far as Orbost. The larger populations typically occur in woodland dominated by Scribbly Gum (*Eucalyptus sclerophylla*), Silvertop Ash (*E. sieberi*), Red Bloodwood (*Corymbia gummifera*) and Black Sheoak (*Allocasuarina littoralis*); appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid (*C. subulata*) and the Tartan Tongue Orchid (*C. erecta*).	(PMST)	None. No suitable habitat within the study area.
Cynanchum elegans	White-flowered Wax Plant	E	E	Occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree (*Leptospermum laevigatum*) – Coastal Banksia (*Banksia integrifolia* subsp. *integrifolia*) coastal scrub; Forest Red Gum (*Eucalyptus tereticornis*) aligned open forest and woodland; Spotted Gum (Corymbia maculata) aligned open forest and woodland; and Bracelet Honeymyrtle (*Melaleuca armillaris*) scrub to open scrub.	(PMST) / 43 (BioNet)	None. No suitable habitat within the study area.
Epacris purpurascens var. purpurascens	-	V	-	Recorded from Gosford in the north, to Narrabeen in the east, Silverdale in the west and Avon Dam vicinity in the South. Found in a range of habitat types, most of which have a strong shale soil influence.	3 (BioNet)	None. No suitable habitat within

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
						the study area.
Genoplesium baueri	Yellow Gnat-orchid	E	E	Recorded from locations between Nowra and Pittwater and may occur as far north as Port Stephens. About half the records were made before 1960 with most of the older records being from Sydney suburbs including Asquith, Cowan, Gladesville, Longueville and Wahroonga. No collections have been made from those sites in recent years. The species has been recorded at locations now likely to be within the several conservation reserves including Berowra Valley Regional Park, Royal National Park and Lane Cove National Park. May occur in the Woronora, O'Hares, Metropolitan and Warragamba Catchments. Found in sparse sclerophyll forest and moss gardens over sandstone	(PMST)	None. No suitable habitat within the study area.
Gossia acmenoides	*Gossia acmenoides* population in the Sydney Basin Bioregion south of the Georges River	EP	-	*Gossia acmenoides* grows in dry rainforest, as well as in subtropical rainforest, on the ranges and coastal plain of eastern Australia from the Illawarra (in the south) to QLD. The population of G. acmenoides in the Sydney Basin Bioregion south of the Georges River is found in the local government areas of Wollongong, Shellharbour and Kiama. There are currently about 30 sites where G. acmenoides is found, often as single individual plants or as a small group of up to four individuals. There are estimated to be less than 100 mature G. acmenoides plants in the population.	9 (BioNet)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Grevillea raybrownii	-	-	V	Generally occurs on ridgetops and, less often, slopes and benches of Hawkesbury Sandstone and Mittagong Formation. It occurs in Eucalyptus open forest and woodland with a shrubby understorey on sandy, gravelly loam soils derived from sandstone that are low in nutrients. All natural remnant sites occur within a habitat that is both characteristic and consistent between sites.	(PMST)	None. No suitable habitat within the study area.
Haloragis exalata subsp. exalata	Square Raspwort	V	V	Occurs in four widely scattered localities in eastern NSW. It is disjunctly distributed in the Central Coast, South Coast and North Western Slopes botanical subdivisions of NSW. Square Raspwort appears to require protected and shaded damp situations in riparian habitats. Flowering specimens in NSW are recorded from November to January.	(PMST)	None. No suitable habitat within the study area.
Melaleuca biconvexa	Biconvex Paperbark	V	V	Found only in NSW, with scattered and dispersed populations found in the Jervis Bay area in the south and the Gosford-Wyong area in the north. Generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.	(PMST)	None. No suitable habitat within the study area.
Melaleuca deanei	Deane's Melaleuca	V	V	Occurs in two distinct areas, in the Ku-ring-gai, Berowra, Holsworthy and Wedderburn areas, and there are also more isolated occurrences at Springwood, Wollemi National Park, Yalwal and the Central Coast areas. The species grows in heath on sandstone.	(PMST)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Persicaria elatior	Knotweed, Tall Knotweed	V	V	Tall Knotweed has been recorded in south-eastern NSW (Mt Dromedary (an old record), Moruya State Forest near Turlinjah, the Upper Avon River catchment north of Robertson, Bermagui, and Picton Lakes. In northern NSW it is known from Raymond Terrace (near Newcastle) and the Grafton area (Cherry Tree and Gibberagee State Forests). This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	(PMST)	None. No suitable habitat within the study area.
Persoonia acerosa	Needle Geebung	V	V	The Needle Geebung has been recorded only on the central coast and in the Blue Mountains, from Mt Tomah in the north to as far south as Hill Top where it is now believed to be extinct. Mainly in the Katoomba, Wentworth Falls, Springwood area. Occurs in dry sclerophyll forest, scrubby low-woodland and heath on low fertility soils.	(PMST)	None. No suitable habitat within the study area.
Persoonia hirsuta	Hairy Geebung	E	E	The Hairy Geebung has been recorded in the Sydney coastal area, the Blue Mountains area and the Southern Highlands. Found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone.	(PMST)	None. No suitable habitat within the study area.
Persoonia nutans	Nodding Geebung	E	E	Restricted to the Cumberland Plain in western Sydney, between Richmond in the north and Macquarie Fields in the south. Core distribution occurs within the Penrith, and to a lesser extent, Hawkesbury LGAs, with isolated and relatively small populations also occurring in the Liverpool,	(PMST)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				Campbelltown, Bankstown and Blacktown LGAs. Confined to aeolian and alluvial sediments and occurs in a range of sclerophyll forest and woodland vegetation communities, with the majority of individuals occurring within Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland.		
Pimelea spicata	Spiked Rice-flower	E	E	Broad distribution in western Sydney, occurring on the Cumberland Plain (Narellan, Marayong, Prospect Reservoir areas). Another smaller population is recorded in districts (Landsdowne to Shellharbour to northern Kiama) Illawarra. It grows on well-structured clay soils. On the inland Cumberland Plain sites it is associated with Grey Box and Ironbark. In the coastal Illawarra it occurs commonly in Coastal Banksia open woodland with a more well developed shrub and grass understorey.	(PMST)	None. No suitable habitat within the study area.
Posidonia australis	*Posidonia australis* in the Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie/*Posidonia australis* seagrass	EP (FM Act)	E	Only member of the Posidoniaceae family that occurs in NSW waters. Occurs in six estuaries within the Sydney and Central Coast regions. This species can grow in coarse sandy to fine silty sediments between the low tide line and approximately 10 m depth. It may also occur in deeper water if water clarity is good. Can occur as monospecific stands or in mixed stands with other species of seagrass.	(DPI)	Low. Not mapped within study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
	meadows of the Manning-Hawkesbury ecoregion					
Prasophyllum affine	Jervis Bay Leek Orchid	E	E	Jervis Bay Leek Orchid is currently known from three areas south-east of Nowra on South Coast. These are Kinghorne Point, Wowly Gully near the town of Callala Bay, and near the township of Vincentia. Grows on poorly drained clay soils that support low heathland and sedgeland communities. Plants retreat into subterranean tubers after fruiting, so are not visible above-ground.	(PMST)	None. No suitable habitat within the study area.
Pterostylis gibbosa	Illawarra Greenhood	E	E	Known from a small number of populations in the Hunter region (Milbrodale), the Illawarra region (Albion Park and Yallah) and the Shoalhaven region (near Nowra). It is apparently extinct in western Sydney which is the area where it was first collected (1803). All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage. In the Hunter region, the species grows in open woodland dominated by Narrow-leaved Ironbark (*Eucalyptus crebra),* Forest Red Gum (Eucalyptus tereticornis) and Black Cypress Pine (*Callitris endlicheri*).	(PMST)	None. No suitable habitat within the study area.
Pterostylis saxicola	Sydney Plains Greenhood	E	E	Restricted to western Sydney between Freemans Reach in the north and Picton in the south. There are very few known populations and they are all very small and isolated. Only one population	(PMST)	None. No suitable habitat within

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				occurs within a conservation reserve at Georges River National Park. Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. The vegetation communities above the shelves where it occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils.		the study area.
Pultenaea aristata	Prickly Bush-pea		V	Prickly Bush-pea is restricted to the Woronora Plateau, a small area between Helensburgh, south of Sydney, and Mt. Kiera above Wollongong. The species occurs in either dry sclerophyll woodland or wet heath on sandstone. Flowering has been recorded in winter and spring.	(PMST) / 55 (BioNet)	None. No suitable habitat within the study area.
Rhizanthella slateri	Eastern Underground Orchid	V	E	Occurs from south-east QLD to south-east NSW. In NSW, currently known from fewer than 10 locations, including near Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra. Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest.	(PMST)	None. No suitable habitat within the study area.
Rhodamnia rubescens	Scrub Turpentine	CE	-	Shrub or small tree to 25 metres high occurring in coastal districts north from Batemans Bay in NSW approximately 280 kilometres south of Sydney, to areas inland of Bundaberg in QLD. Populations typically occur in coastal regions and occasionally extend inland onto escarpments up to 600 metres asl with rainfall of 1,000-1,600 mm. Commonly	(PMST) / 16 (BioNet)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				occurs in all rainforest subforms except cool temperate rainforest.		
Rhodomyrtus psidioides	Native Guava	CE	CE	Occurs from Broken Bay, approximately 90 km north of Sydney, NSW, to Maryborough in QLD. Populations are typically restricted to coastal and sub-coastal areas of low elevation however the species does occur up to c. 120 km inland in the Hunter and Clarence River catchments and along the Border Ranges in NSW. Pioneer species found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest often near creeks and drainage lines. This species is characterised being extremely susceptible to infection by Myrtle Rust. Myrtle Rust affects all plant parts.	(PMST)	None. No suitable habitat within the study area.
Senna acclinis	Rainforest Cassia	E	-	Occurs in coastal districts and adjacent tablelands of NSW from the Illawarra in NSW to QLD. Grows on the margins of subtropical, littoral and dry rainforests. Often found as a gap phase shrub.	2 (BioNet)	None. No suitable habitat within the study area.
Solanum celatum	-	E	E	Restricted to an area from Wollongong to just south of Nowra, and west to Bungonia. Majority of records are prior to 1960 and the majority of populations are likely to have been lost to clearing. Grows in rainforest clearings, or in wet sclerophyll forests.	3 (BioNet)	None. No suitable habitat within the study area.
Syzygium paniculatum	Magenta Lilly Pilly	V	V	The Magenta Lilly Pilly is found only in NSW, in a narrow, linear coastal strip from Upper Lansdowne to Conjola State Forest. On the south	(PMST) / 3 (BioNet)	None.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.		No suitable habitat within the study area.
Thelymitra kangaloonica	Kangaloon Sun Orchid	CE	CE	Only known to occur on the southern tablelands of NSW in the Moss Vale / Kangaloon / Fitzroy Falls area at 550-700 m above sea level. It is known to occur at three swamps that are above the Kangaloon Aquifer. It is found in swamps in sedgelands over grey silty grey loam soils	(PMST)	None. No suitable habitat within the study area.
Thesium australe	Austral Toadflax, Toadflax	V	V	Found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in TAS and QLD and in eastern Asia. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (*Themeda australis*).	(PMST)	None. No suitable habitat within the study area.
Xerochrysum palustre	Swamp Everlasting	-	V	Swamp Everlasting is endemic to south-eastern Australia, where it is widely distributed from south-eastern NSW through VIC to north-eastern TAS. The Swamp Everlasting grows in wetlands including sedge-swamps and shallow freshwater marshes, often on heavy black clay soils.	(PMST)	None. No suitable habitat within the study area.
Zieria granulata	Illawarra Zieria	E	E	The species has a fragmented distribution on the volcanic lowlands around Kiama and	(PMST) / 1 (BioNet)	None.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				Shellharbour, in the Illawarra Region of the south coast of NSW. It is found from Albion Park in the north to Foxground in the south, mostly between Oak Flats and Toolijoa and has a range of 22 km. Plants have been recorded growing in highly disturbed environments including along roadsides and fencelines, amongst regrowth in cleared paddocks and in dense Lantana thickets. The preferred habitat is dry, rocky ridges and outcops with shallow volcanic soil but the species is sometimes also found on the moist slopes of the Illawarra escarpment		No suitable habitat within the study area.
Birds						
Anthochaera phrygia	Regent Honeyeater	CE	CE	Temperate woodlands and open forests of the inland slopes of south-east Australia. The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters usually nest in horizontal branches or forks in tall mature Eucalypts and Sheoaks.	(PMST) / 1 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.
Ardenna carneipes	Flesh-footed Shearwater	V	M (J, R), Ma	Ranges throughout the Pacific and Indian Oceans. There are two main breeding areas in the world: one in the South West Pacific includes Lord Howe Island and NZ; the other along the coast of WA. Nest on LHI on sandy soils from Ned's Beach to Clear Place, with smaller colonies below Transit Hill and at Old Settlement Beach.	(PMST) / 6 (BioNet)	Low. Recorded within the study locality. Has potential to fly through

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				Eggs are laid at the end of a burrow 1 - 2 metres in length.		the study area however, this species has a wide-ranging habitat and is highly mobile.
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	-	Dusky woodswallows are widespread in eastern, southern and south WA. The species occurs throughout most of NSW, but is sparsely scattered in, or largely absent from, much of the upper western region. Most breeding activity occurs on the western slopes of the Great Dividing Range. Primarily inhabit dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understorey of eucalypt saplings, acacias and other shrubs, and ground-cover of grasses or sedges and fallen woody debris.	1 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.
Botaurus poiciloptilus	Australasian Bittern	E	E	Occurs from south-east QLD to south-east SA, TAS and the south-west of WA. Occurs in terrestrial freshwater wetlands and, rarely, estuarine habitats.	(PMST)	Low. No records in the study locality. Preferred habitat not within the study area but it may fly through.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Calidris alba	Sanderling	V	M (B, C, J, R), Ma	A regular summer migrant from Siberia and other Arctic breeding grounds to most of the Australian coastline. It is uncommon to locally common, arriving from September and leaving by May (some may overwinter in Australia). Sanderlings occur along the NSW coast, with occasional inland sightings. Often found in coastal areas on low beaches of firm sand, near reefs and inlets, along tidal mudflats and bare open coastal lagoons; individuals are rarely recorded in near-coastal wetlands.	(PMST) / 3 (BioNet)	Low. Recorded within the study locality. May fly through and forage in study area however, study area habitat is widely distributed.
Calidris canutus	Red Knot	E	CE, M (B, C, J, R), Ma	Common in all the main suitable habitats around the coast of Australia. Mainly inhabit intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs.	(PMST) / 3 (BioNet)	Low. Recorded within the study locality. May fly through and forage in study area however, study area habitat is widely distributed.
Calidris ferruginea	Curlew Sandpiper	E	CE, M (B, C, J, R), Ma	The breeding range of the Curlew Sandpiper is mainly restricted to the Arctic of northern Siberia, including Yamal Peninsula east to Kolyuchiskaya Gulf, Chokotka Peninisula, and also New Siberian Island. Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such	(PMST) / 1 (BioNet)	Low. Recorded within the study locality. Preferred

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms.		habitat not within the study area but it may fly through.
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. Also occur in subalpine Snow Gum woodland and occasionally in temperate or regenerating forest. In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in box ironbark assemblages, or in dry forest in coastal areas. It requires tree hollows in which to breed.	45 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.
Calyptorhynchus lathami	Glossy-black Cockatoo	V	-	The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central QLD coast to East Gippsland in VIC, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. An isolated population exists on Kangaroo Island, SA. Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Black Sheoak (*Allocasuarina littoralis*) and Forest Sheoak (*A. torulosa*) are important foods. Inland populations feed on a wide range of sheoaks, including Drooping Sheoak, Allocasuarina diminuta and A. gymnathera. Belah (*Casuarina cristata*) is also utilised and may be a critical food	5 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				source for some populations. In the Riverina, birds are associated with hills and rocky rises supporting Drooping Sheoak, but also recorded in open woodlands dominated by Belah.		
Charadrius leschenaultii	Greater Sand Plover	V	V, M (B, C, J, R), Ma	The Greater Sand-plover breeds in central Asia from Armenia to Mongolia, moving further south for winter. In Australia the species is commonly recorded in parties of 10-20 on the west coast, with the far northwest being the stronghold of the population. The species is apparently rare on the east coast, usually found singly. In NSW, the species has been recorded between the northern rivers and the Illawarra, with most records coming from the Clarence and Richmond estuaries. Almost entirely restricted to coastal areas in NSW, occurring mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks. Roosts during high tide on sandy beaches and rocky shores; begin foraging activity on wet ground at low tide, usually away from the edge of the water; individuals may forage and roost with other waders.	(PMST)	Low. Preferred habitat not within the study area but it may fly through.
Circus assimilis	Spotted Harrier	V	-	The Spotted Harrier occurs throughout the Australian mainland, except in densly forested or wooded habitats of the coast, escarpment and ranges, and rarely in TAS. Individuals disperse widely in NSW and comprise a single population. Occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It	1 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.		study area but it may fly through.
Daphoenositta chrysoptera	Varied Stilleta	V	-	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west. The Varied Sittella's population size in NSW is uncertain but is believed to have undergone a moderate reduction over the past several decades. Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy.	1 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.
Dasyornis brachypterus	Eastern Bristlebird	E	E	The distribution of the Eastern Bristlebird has contracted to three disjunct areas of south-eastern Australia. There are three main populations: Northern - southern QLD/northern NSW, Central - Barren Ground Nature Reserve, Budderoo Nature Reserve, Woronora Plateau, Jervis Bay National Park, Booderee National Park and Beecroft Peninsula and Southern - Nadgee Nature Reserve and Croajingalong National Park in the vicinity of the NSW/VICn border. Habitat for central and southern populations is characterised by dense, low vegetation including heath and open woodland with a heathy understorey. In	(PMST) / 5 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				northern NSW the habitat occurs in open forest with dense tussocky grass understorey and sparse mid-storey near rainforest ecotone; all of these vegetation types are fire prone.		
Diomedea antipodensis	Antipodean Albatross	V	V, M (B), Ma	The Antipodean Albatross is endemic to NZ, however forages widely in open water in the south-west Pacific Ocean, Southern Ocean and the Tasman Sea, notably off the coast of NSW. It breeds on the NZ islands of Antipodes Island, Campbell Island, Pitt Island and the Auckland Islands. This subspecies nests in open patchy vegetation, such as among tussock grassland or shrubs on ridges, slopes and plateaus. On Antipodes Island, they nest in relatively uniform densities, but avoid areas of tall vegetation on steep coastal slopes, or amongst the tall ferns on poorly drained parts of the peaks near the island's centre.	(PMST) / 3 (BioNet)	Low. Recorded within the study locality. Has potential to fly through the study area however, this species has a wide-ranging habitat and is highly mobile.
Diomedea antipodensis gibsoni	Gibson's Albatross	V	V	In Australian territory, Gibson's Albatross has been recorded foraging between Coffs Harbour, NSW, and Wilson's Promontory, VIC. Gibson's Albatrosses are rarely observed in the Pacific Ocean or Indian Ocean. The only Australian record of this species is from a recapture off Wollongong, NSW, in September 1997. Gibson's Albatross breeds on Adams Island and Auckland Island, NZ. There are no breeding colonies of Gibson's Albatross in Australian territory. This albatross visits Australian waters while foraging and during the non-breeding season.	(PMST) / 4 (BioNet)	Low. Recorded within the study locality. Has potential to fly through the study area however, this species has a wide-ranging habitat and is highly mobile.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Diomedea epomophora	Southern Royal Albatross	-	E, M (B), Mi	During the non-breeding season, the Southern Royal Albatross has a wide and possibly circumpolar distribution, ranging north to about 35°S. The Southern Royal Albatross is moderately common throughout the year in offshore waters of southern Australia, mostly off southeastern NSW, VIC and TAS. Off SA, they are mostly seen May to September. It breeds on Campbell, Adams, Enderby and Auckland Islands, south of NZ. nests on flat or gently sloping ground on slopes, ridges, gullies and plateaux of large islands, and on the summits of islets. Depressions, gullies, lee slopes and vegetation provide shelter for its nests, but exposed sites are also needed nearby so that the Southern Royal Albatross can take off and land. Its nests are placed among vegetation that is sparse enough for easy access.	(PMST)	Low. Has potential to fly through the study area however, this species has a wide-ranging habitat and is highly mobile.
Diomedea exulans	Wandering Albatross	E	E, M (B), Ma	The Wandering Albatross breeds on Macquarie Island. Macquarie Island lies in the southwest Pacific Ocean, about half-way between NZ and Antarctica. A single breeding pair has also been recorded on Heard Island. The Territory of Heard Island and McDonald Islands are an Australian external territory and volcanic group of barren Antarctic islands, about two-thirds of the way from Madagascar to Antarctica. It feeds in Australian portions of the Southern Ocean. On breeding islands, the Wandering Albatross nests on coastal or inland ridges, slopes, plateaux and plains, often on marshy ground. Nests of the Wandering	(PMST) / 32 (BioNet)	Low. Recorded within the study locality. Has potential to fly through the study area however, this species has a wide-ranging habitat and is highly mobile.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				Albatross are sited on moss terraces, in dense tussocks, and often in loose aggregations on the west (windward) side of islands. It prefers open or patchy vegetation (tussocks, ferns or shrubs), and it requires nesting areas that are near exposed ridges or hillocks so that it can take off.		
Diomedea sanfordi	Northern Royal Albatross	E	E, M (B), Ma	The Northern Royal Albatross ranges widely over the Southern Ocean, with individuals seen in Australian waters off south-eastern Australia. It breeds on Chatham Island and Taiaroa Head on the South Island of NZ. Its habitat includes subantarctic, subtropical, and occasionally Antarctic waters. The Northern Royal Albatross nests on flat or gently sloping ground, on slopes, ridges, gullies and plateaux of large islands, and on the summits of islets.	(PMST)	Low. Has potential to fly through the study area however, this species has a wide-ranging habitat and is highly mobile.
Ephippiorhynchus asiaticus	Black-necked Stork	E	-	In Australia, Black-necked Storks are widespread in coastal and subcoastal northern and eastern Australia, as far south as central NSW (although vagrants may occur further south or inland, well away from breeding areas). In NSW, the species becomes increasingly uncommon south of the Clarence Valley, and rarely occurs south of Sydney. Since 1995, breeding has been recorded as far south as Buladelah. Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW for the Black-necked Stork. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries. Storks usually forage in water 5-30cm deep for vertebrate and	1 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				invertebrate prey. Eels regularly contribute the greatest biomass to their diet, but they feed on a wide variety of animals, including other fish, frogs and invertebrates (such as beetles, grasshoppers, crickets and crayfish). Black-necked Storks build large nests high in tall trees close to water. Trees usually provide clear observation of the surroundings and are at low elevation (reflecting the floodplain habitat).		
Falco hypoleucos	Grey Falcon	E	-	Sparsely distributed in NSW, chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range. Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast.	(PMST)	Low. Preferred habitat not within the study area but it may fly through.
Fregetta grallaria grallaria	White-bellied Storm-Petrel	V	V, Ma	A wide oceanic distribution in the south Pacific and Atlantic Oceans, ranging into tropical waters from various breeding grounds. The White-bellied Storm-Petrel (Tasman Sea) breeds on small offshore islets and rocks in the Lord Howe Island group, including Roach Island and Balls Pyramid. It nests in crevices between large volcanic rocks, and in burrows excavated in banks. Breeding colonies are often situated along dykes. In the non-breeding season, it reaches and forages over near-shore waters along the continental shelf of mainland Australia.	(PMST)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Glossopsitta pusilla	Little Lorikeet	V	-	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in apples (*Angophora* spp.), paperbarks (*Melaleuca* spp.) and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country (e.g. paddocks, roadside remnants) and urban trees also help sustain viable populations of the species.	16 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.
Grantiella picta	Painted Honeyeater	V	V	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, VIC and southern QLD. During the winter it is more likely to be found in the north of its distribution. Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus Amyema.	(PMST)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.
Haematopus fuliginosus	Sooty Oystercatcher	V	-	Sooty Oystercatchers are found around the entire Australian coast, including offshore islands, being most common in Bass Strait. Favours rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries. Forages on exposed rock or coral at low tide for foods such as limpets and mussels.	104 (BioNet)	Low. Recorded within the study locality. Known to breed at Five Islands Nature Reserve. Preferred

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
						habitat not within the study area but it may fly through.
Haematopus longirostris	Pied Oystercatcher	E	-	The species is distributed around the entire Australian coastline, although it is most common in coastal TAS and parts of VIC, such as Corner Inlet. In NSW the species is thinly scattered along the entire coast, with fewer than 200 breeding pairs estimated to occur in the State. Favours intertidal flats of inlets and bays, open beaches and sandbanks. Forages on exposed sand, mud and rock at low tide, for molluscs, worms, crabs and small fish. The chisel-like bill is used to pry open or break into shells of oysters and other shellfish. Nests mostly on coastal or estuarine beaches although occasionally they use saltmarsh or grassy areas. Nests are shallow scrapes in sand above the high tide mark, often amongst seaweed, shells and small stones.	4 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.
Haliaeetus leucogaster	White-bellied Sea Eagle	V	Ma	Distributed along the coastline (including offshore islands) of mainland Australia and TAS. Found in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. The habitats occupied by the sea-eagle are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, and the sea).	(PMST) / 43 (BioNet)	Moderate Recorded within the study locality. Fishing raptor that may forage within the study area or locality,

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
						albeit widespread.
Hieraaetus morphnoides	Little Eagle	V	-	The Little Eagle is found throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment. It occurs as a single population throughout NSW. Occupies open Eucalypt forest, woodland or open woodland. She-oak or Acacia woodlands and riparian woodlands of interior NSW are also used.	6 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.
Hirundapus caudacutus	White-throated Needletail	-	V, M (C, J, R), Ma	Widespread in eastern and south-eastern Australia. Almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground. They also commonly occur over heathland but less often over treeless areas, such as grassland or swamps.	(PMST) / 5 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.
Ixobrychus flavicollis	Black Bittern	V	-	The Black Bittern is found along the coastal plains within NSW, although individuals have rarely being recorded south of Sydney or inland. It inhabits terrestrial and estuarine wetlands such as flooded grasslands, forests, woodlands, rainforests and mangroves with permanent water and dense waterside vegetation. The Black	6 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				Bittern typically roosts on the ground or in trees during the day and forages at night on frogs, reptiles, fish and invertebrates. The breeding season extends from December to March. Nests are constructed of reeds and sticks in branches overhanging the water.		study area but it may fly through.
Lathamus discolor	Swift Parrot	E	CE, Ma	On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany (*Eucalyptus robusta),* Spotted Gum (*Corymbia maculata*), Red Bloodwood (*C. gummifera*), Red Ironbark (*E. sideroxylon*), and White Box (*E. albens*).	(PMST) / 19 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.
Limosa lapponica baueri	Bar-tailed Godwit (baueri)	-	V	The Bar-tailed Godwit is a migratory wader which undertakes the largest non-stop flight of any bird. The trans-Pacific route from its breeding grounds in the Arctic to its non-breeding grounds in the southern hemisphere covers over 11,000 km. It is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. Less frequently it occurs in salt lakes and brackish wetlands, sandy ocean beaches and rock platforms.	(PMST)	Low. May fly through and forage in study area however, study area habitat is widely distributed.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Limosa limosa	Black-tailed Godwit	V	M (B, J, R), Ma	A migratory wading bird that breeds in Mongolia and Eastern Siberia and flies to Australia for the southern summer, arriving in August and leaving in March. In NSW, it is most frequently found at Kooragang Island (Hunter River estuary). Occurs in sheltered bays, estuaries and lagoons with large intertidal mudflats and sand flats. Also found at inland mudflats, swamps.	1 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.
Lophoictinia isura	Square-tailed Kite	V	-	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by *E. longifolia*, *C. maculata*, *E. elata*, or *E. smithii*. Individuals appear to occupy large hunting ranges of more than 100 km^2. They require large living trees for breeding, particularly near water with surrounding woodland/forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs.	8 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.
Macronectes giganteus	Southern Giant-Petrel	E	E, M (B), Ma	The Southern Giant Petrel has a circumpolar pelagic range from Antarctica to approximately 20° S and is a common visitor off the coast of NSW. Over summer, the species nests in small colonies amongst open vegetation on Antarctic and subantarctic islands, including Macquarie and Heard Islands and in Australian Antarctic territory.	(PMST) / 4 BioNet)	Low. Recorded within the study locality. Has potential to fly through the study area however, this species has a

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
						wide-ranging habitat and is highly mobile.
Macronectes halli	Northern Giant Petrel	V	V, M (B), Ma	The Northern Giant-Petrel has a circumpolar pelagic distribution, usually between 40-64ºS in open oceans. Their range extends into subtropical waters (to 28ºS) in winter and early spring, and they are a common visitor in NSW waters, predominantly along the south-east coast during winter and autumn. Breeding in Australian territory is limited to Macquarie Island and occurs during spring and summer. Adults usually remain near the breeding colonies throughout the year (though some do travel widely) while immature birds make long and poorly known circumpolar and trans-oceanic movements. Hence most birds recorded in NSW coastal waters are immature birds. Northern Giant-Petrels seldom breed in colonies but rather as dispersed pairs, often amidst tussocks in dense vegetation and areas of broken terrain.	(PMST) / 2 (BioNet)	Low. Recorded within the study locality. Has potential to fly through the study area however, this species has a wide-ranging habitat and is highly mobile.
Melithreptus gularis gularis	Black-chinned Honeyeater	-	V	Extends south from central QLD, through NSW, VIC into south eastern SA, though it is very rare in the last state. In NSW it is widespread, with records from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark Eucalypts, especially Mugga Ironbark (*Eucalyptus sideroxylon*), White Box (*E. albens*), Inland Grey	1 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the study area but

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				Box (*E. microcarpa*), Yellow Box (*E. melliodora),* Blakely's Red Gum (*E. blakelyi)* and Forest Red Gum (*E. tereticornis*). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks, river sheoaks (nesting habitat) and teatrees.		it may fly through.
Neophema chrysogaster	Orange-bellied Parrot	CE	CE, Ma	The Orange-bellied Parrot breeds in the south-west of TAS and migrates in autumn to spend the winter on the mainland coast of south-eastern SA and southern VIC. There are occasional reports from NSW, with the most recent records from Shellharbour and Maroubra in May 2003. On the mainland, the Orange-bellied Parrot spends winter mostly within 3 km of the coast in sheltered coastal habitats including bays, lagoons, estuaries, coastal dunes and saltmarshes. The species also inhabits small islands and peninsulas and occasionally saltworks and golf courses. Birds forage in low samphire herbland or taller coastal shrubland.	(PMST)	Low. Preferred habitat not within the study area but it may fly through.
Ninox connivens	Barking Owl	-	V	Found throughout continental Australia except for the central arid regions. Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas.	3 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Ninox strenua	Powerful Owl	-	V	In NSW, it is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered records on the western slopes and plains suggesting occupancy prior to land clearing. Now at low densities throughout most of its eastern range, rare along the Murray River and former inland populations may never recover. The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine (*Syncarpia glomulifera*), Black Sheoak (*Allocasuarina littoralis*), Blackwood (*Acacia melanoxylon*), Rough-barked Apple (*Angophora floribunda*), Cherry Ballart (*Exocarpus cupressiformis*) and a number of Eucalypt species.	84 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.
Numenius madagascariensis	Eastern Curlew	-	CE, M (B, C, J, R), Ma	Within Australia, the Eastern Curlew has a primarily coastal distribution. The species is found in all states, particularly the north, east, and south-east regions including TAS. The Eastern Curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large	(PMST) / 2 (BioNet)	Low. Recorded within the study locality. Has potential to fly through the study area however, this

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				intertidal mudflats or sandflats, often with beds of seagrass.		species has a wide-ranging habitat and is highly mobile.
Onychoprion fuscata	Sooty Tern	V	Ma	The Sooty Tern is found over tropical and sub-tropical seas and on associated islands and cays around Northern Australia. In NSW only known to breed at Lord Howe Island. Occasionally seen along coastal NSW, especially after cyclones. Large flocks can be seen soaring, skimming and dipping but seldom plunging in off shore waters. Breeds in large colonies in sand or coral scrapes on offshore islands and cays including Lord Howe and Norfolk Islands.	2 (BioNet)	Low. Recorded within the study locality. Has potential to fly through the study area however, this species has a wide-ranging habitat and is highly mobile.
Oxyura australis	Blue-billed Duck	V	-	Endemic to south-eastern and south-WA. It is widespread in NSW, but most common in the southern Murray-Darling Basin area. Birds disperse during the breeding season to deep swamps up to 300 km away. It is generally only during summer or in drier years that they are seen in coastal areas. Prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge of dense cover. It will fly if disturbed, but	2 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				prefers to dive if approached. Partly migratory, with short-distance movements between breeding swamps and overwintering lakes with some long-distance dispersal to breed during spring and early summer. Usually nest solitarily in Cumbungi over deep water between September and February. They will also nest in trampled vegetation in Lignum, sedges or Spike-rushes, where a bowl-shaped nest is constructed. The most common clutch size is five or six. Males take no part in nest-building or incubation.		
Pachyptila turtur subantarctica	Fairy Prion (southern)	-	V	The southern subspecies (subantarctica) of the Fairy Prion was first recorded on Macquarie Island in 1956, with breeding confirmed in 1978. Breeding has also been recorded on two offshore rock stacks at Macquarie Island, one near Langdon Point, the other near Davis Point. A second sub-population was found on Bishop and Clerk Islands in 1993. The species as a whole has been recorded breeding on subantarctic and cool temperate islands. The southern subspecies of the Fairy Prion is a marine bird, found mostly in temperate and subantarctic seas. The species' oceanic distribution is poorly known. The Fairy Prion sometimes forages over continental shelves and the continental slope, but it can come close inshore in rough weather. It may also feed in deep coastal waters. Off Wollongong, NSW, 79% of Fairy Prions were seen in waters over the continental slope while 21% were counted over neritic water (water more than 200 m deep). Data from the south-eastern Australian Seabird Atlas	(PMST)	Low. Recorded within the study locality. Has potential to fly through the study area however, this species has a wide-ranging habitat and is highly mobile.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				confirm this pattern, with 83% (of 24 505 individuals) seen over the continental slope, 9% over continental shelf and only 8% over open ocean. The southern Fairy Prion is found flying over the ocean where sea surface temperatures are 8.6° to 20.2 °C.		
Pandion cristatus	Eastern Osprey	V	M (B), Ma	Total range of this species is from Esperance in WA to NSW and into VIC and TAS. In some states (VIC and TAS and southern NSW) the species is a rare vagrant. The only single historical breeding record in NSW is from the St. Georges Basin. Occurs in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. Mostly found in coastal areas but occasionally travel inland along major rivers.	3 (BioNet)	Moderate Recorded within the study locality. Fishing raptor that may forage within the study area or locality, albeit widespread.
Pezoporus wallicus wallicus	Ground Parrot (eastern)	V	-	The eastern subspecies (wallicus) inhabits south-eastern Australia from southern QLD through NSW to western VIC. It formerly occurred in SA, but was last recorded in 1945. In NSW populations have declined and contracted to islands of coastal or subcoastal heathland and sedgeland habitats. The Ground Parrot occurs in high rainfall coastal and near coastal low heathlands and sedgelands, generally below one metre in height and very dense (up to 90% projected foliage cover). These habitats provide a high abundance and diversity of food, adequate cover and suitable roosting and nesting	1 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				opportunities for the Ground Parrot, which spends most of its time on or near the ground.		
Phoebetria fusca	Sooty Albatross	V	V, M (B), Ma	The Sooty Albatross has sometimes been observed foraging in inshore waters in southern Australia. The Sooty Albatross is a rare, but probably regular migrant to Australia, mostly in the autumn-winter months, occurring north to south-east QLD, NSW, VIC, TAS and SA. The Sooty Albatross breeds on islands in the southern Indian and Atlantic Oceans, and forages south of 30° S, between southern NSW and Argentina.	(PMST)	Low. Has potential to fly through the study area however, this species has a wide-ranging habitat and is highly mobile.
Pterodroma leucoptera leucoptera	Gould's Petrel	V	E	Breeds on both Cabbage Tree Island, 1.4 km offshore from Port Stephens and on nearby Boondelbah island. The range and feeding areas of non-breeding petrels are unknown. The first arrival of Gould's petrel on cabbage tree Island occurs from mid to late September. Principal nesting habitat is located within two gullies which are characterised by steeply, sloping rock scree with a canopy of Cabbage Tree Palms. They nest predominantly in natural rock crevices among the rock scree and also in hollow fallen palm trunks, under mats of fallen palm fronds and in cavities among the buttresses of fig trees.	(PMST)	Low. Has potential to fly through the study area however, this species has a wide-ranging habitat and is highly mobile.
Pterodroma neglecta neglecta	Kermadec Petrel (western)	V	V	Ranges over subtropical and tropical waters of the South Pacific. Balls Pyramid (near Lord Howe Island) and Phillip Island (near Norfolk Island) are the only known breeding sites in Australian waters. Breeds on islands across the South Pacific. In Australia it breeds on Ball's Pyramid	(PMST)	Low. Has potential to fly through the study area however, this

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				and Phillip Island (near Norfolk Island). Nests in a crevice amongst rocks.		species has a wide-ranging habitat and is highly mobile.
Ptilinopus regina	Rose-crowned Fruit Dove	V	-	Coast and ranges of eastern NSW and QLD, from Newcastle to Cape York. Vagrants are occasionally found further south to VIC. Rose-crowned Fruit-doves occur mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful.	3 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.
Rostratula australis	Australian Painted Snipe	E	E, Ma	Most records are from the south east, particularly the Murray Darling Basin, with scattered records across northern Australia and historical records from around the Perth region in WA. Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds.	(PMST)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Sternula albifrons	Little Tern	E	M (B, C, J, R)	Migrates from eastern Asia, this species is found along the north, east and south-east Australian coasts. In NSW, it arrives from September to November, occurring mainly north of Sydney, with smaller numbers found south to VIC. It breeds in spring and summer along the entire coast from TAS to northern QLD. This species is almost exclusively coastal, preferring sheltered environments.	(PMST) / 3 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.
Sternula nereis nereis	Australian Fairy Tern	-	V	Within Australia, the Fairy Tern occurs along the coasts of VIC, TAS, SA and WA; occurring as far north as the Dampier Archipelago near Karratha. The subspecies has been known from NSW (NSW) in the past, but it is unknown if it persists there. The Fairy Tern (Australian) nests on sheltered sandy beaches, spits and banks above the high tide line and below vegetation. The subspecies has been found in embayments of a variety of habitats including offshore, estuarine or lacustrine (lake) islands, wetlands and mainland coastline. The bird roosts on beaches at night.	(PMST)	
Stictonetta naevosa	Freckled Duck	V	-	Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, lignum or teatree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds.	1 (BioNet)	Low. Recorded within the study locality. Preferred habitat not

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
						within the study area but it may fly through.
Thalassarche bulleri	Buller's Albatross	-	V, M (B), Ma	Buller's Albatross breed in NZ (Snares, Solander and Chatham Islands), but are regular visitors to Australian waters. They are frequently seen off the coast from Coffs Harbour, south to TAS and west to Eyre Peninsula. In Australia, Buller's Albatross are seen over inshore, offshore and pelagic waters. They appear to congregate over currents where water temperature exceeds 16 °C.	(PMST) / 1 (BioNet)	Low. Recorded within the study locality. Has potential to fly through the study area however, this species has a wide-ranging habitat and is highly mobile.
Thalassarche bulleri platei	Northern Buller's Albatross	-	V, M, Ma	The Pacific Albatross is a non-breeding visitor to Australian waters. Foraging birds are mostly limited to the Pacific Ocean and the Tasman Sea, although birds do reach the east coast of the Australian mainland. Occurrence within the Australian Fishing Zone is likely, however, the threat from longline injury is considered low. The Pacific Albatross is a marine, pelagic species. It occurs in subtropical and subantarctic waters of the South Pacific Ocean. Habitat preferences are poorly known. In NZ, the species has been observed in association with fishing boats close inshore and over waters of 180–360 m depth	(PMST)	Low. Has potential to fly through the study area however, this species has a wide-ranging habitat and is highly mobile.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				although it is not so strongly associated with fishing grounds as are other albatrosses.		
Thalassarche carteri	Indian Yellow-nosed Albatross		V, M (B), Ma	The Indian Yellow-nosed Albatross forages mostly in the southern Indian Ocean where it is particularly abundant off WA. In the Australasian region, the species occupies inshore and offshore waters, particularly where there are calm seas and light winds.	(PMST)	Low. Has potential to fly through the study area however, this species has a wide-ranging habitat and is highly mobile.
Thalassarche cauta	Shy Albatross	V	E, M (B), Ma	This species is circumpolar in distribution, occurring widely in the southern oceans. Islands off Australia and NZ provide breeding habitat. In Australian waters, the Shy Albatross occurs along the east coast from Stradbroke Island in QLD along the entire south coast of the continent to Carnarvon in WA. Although uncommon north of Sydney, the species is commonly recorded off southeast NSW, particularly between July and November, and has been recorded in Ben Boyd National Park. This pelagic or ocean-going species inhabits subantarctic and subtropical marine waters, spending the majority of its time at sea. Occasionally the species occurs in continental shelf waters, in bays and harbours. Known breeding locations include Albatross Island off TAS, Auckland Island, Bounty Island and The Snares, off NZ, where nesting colonies of 6-500 nests occur and may contain other	(PMST) / 8 (BioNet)	Low. Recorded within the study locality. Has potential to fly through the study area however, this species has a wide-ranging habitat and is highly mobile.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				species such as the Australian Gannet. Located on sheltered sides of islands, on cliffs and ledges, in crevices and slopes, nests are used annually and consist of a mound of mud, bones, plant matter and rocks.		
Thalassarche eremita	Chatham Albatross		E, M (B), Ma	Breeding for the Chatham Albatross is restricted to Pyramid Rock, Chatham Islands, off the coast of NZ. The principal foraging range for this species is in coastal waters off eastern and southern NZ, and TAS.	(PMST)	Low. Recorded within the study locality. Has potential to fly through the study area however, this species has a wide-ranging habitat and is highly mobile.
Thalassarche impavida	Campbell Albatross	-	E, M (B), Ma	Breeding for the Chatham Albatross is restricted to Pyramid Rock, Chatham Islands, off the coast of NZ. The principal foraging range for this species is in coastal waters off eastern and southern NZ, and TAS.	(PMST) / 3 (BioNet)	Low. Recorded within the study locality. Has potential to fly through the study area however, this species has a wide-ranging habitat and is highly mobile.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Thalassarche melanophris	Black-browed Albatross	V	V, M (B), Ma	The Black-browed Albatross has a circumpolar range over the southern oceans, and are seen off the southern Australian coast mainly during winter. This species migrates to waters off the continental shelf from approximately May to November and is regularly recorded off the NSW coast during this period. The species has also been recorded in Botany Bay National Park Inhabits antarctic, subantarctic, subtropical marine and coastal waters over upwellings and boundaries of currents. Can tolerate water temperatures between 0 ºC and 24 ºC. Spends most of its time at sea, breeding on small isolated islands.	(PMST) / 20 (BioNet)	Low. Recorded within the study locality. Has potential to fly through the study area however, this species has a wide-ranging habitat and is highly mobile.
Thalassarche salvini	Salvin's Albatross		V, M, Ma	Salvin's Albatross breeds on Bounty, Snares and Chatham Islands, south of NZ, as well as on Crozet Island in the Indian Ocean. The species forages over most of the southern Pacific Ocean, where it is particularly common in the Humboldt Current, off South America. There are small numbers in the Indian Ocean and sometimes in the South Atlantic Ocean. During the non-breeding season, the species occurs over continental shelves around continents. It occurs both inshore and offshore and enters harbours and bays. Salvin's Albatross is scarce in pelagic waters.	(PMST)	Low. Has potential to fly through the study area however, this species has a wide-ranging habitat and is highly mobile.
Thalassarche steadi	White-capped Albatross	-	V, M (B), Ma	Breeding colonies occur on islands south of NZ. The White-capped Albatross is a marine species and occurs in subantarctic and subtropical waters. The White-capped Albatross is probably common	(PMST)	Low. Has potential to fly through

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				off the coast of south-east Australia throughout the year.		the study area however, this species has a wide-ranging habitat and is highly mobile.
Thinornis cucullatus cucullatus	Eastern Hooded Plover	CE	V, Ma	The Hooded Plover is endemic to southern Australia and is nowadays found mainly along the coast from south of Jervis Bay, NSW, south through VIC and Tasmania to the western side of the Eyre Peninsula (SA). In south-eastern Australia Hooded Plovers prefer sandy ocean beaches, especially those that are broad and flat, with a wide wave-wash zone for feeding, much beachcast seaweed, and backed by sparsely vegetated sand-dunes for shelter and nesting. Occasionally Hooded Plovers are found on tidal bays and estuaries, rock platforms and rocky or sand-covered reefs near sandy beaches, and small beaches in lines of cliffs. They regularly use near-coastal saline and freshwater lakes and lagoons, often with saltmarsh.	(PMST) / 3 (BioNet)	Low. Recorded within the study locality. May fly through and forage in study area however, study area habitat is widely distributed.
Tyto novaehollandiae	Masked Owl	V	-	Extends from the coast where it is most abundant to the western plains. Overall records for this species fall within approximately 90% of NSW, excluding the most arid north-western corner. There is no seasonal variation in its distribution. Dry Eucalypt forests and woodland, typically prefers open forest with low shrub density. Requires old trees for roosting and nesting.	5 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the study area but

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
						it may fly through.
Tyto tenebricosa	Sooty Owl	V	-	Occupies the easternmost one-eighth of NSW, occurring on the coast, coastal escarpment and eastern tablelands. Territories are occupied permanently. Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist Eucalypt forests.	12 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.
Fish						
Bidyanus bidyanus	Silver Perch	V	CE	Once widespread and abundant throughout most of the Murray-Darling river system. They have now declined to low numbers or disappeared from most of their former range. Only one remaining secure and self-sustaining population occurs in NSW in the central Murray River downstream of Yarrawonga weir, as well as several anabranches and tributaries.	(PMST/DPI)	Low. Estuarine.
Epinephelus daemelii	Black Rockcod	E (FM Act)	V	In Australia, the distribution of black cod ranges from southern QLD through NSW to northern VIC. However, records from QLD and VIC are rare, and the NSW coastline forms the species' main range, both in Australia and internationally. Adults	(PMST/DPI)	Moderate. Potential habitat (ie rocky reef)

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				are usually found in saves, gutters and beneath bommies on rocky reefs from nearshore areas to at least 50 metres depth. Small juveniles are often recorded in coastal rock pools while larger juveniles are found around rocky shores in estuaries. The use of estuaries may be an important part of the ecology of juvenile black cod in NSW waters. The black cod is territorial and often have a high site fidelity.		within the study area.
Hippocampus whitei	White's Seahorse	E (FM Act)	E, Ma	Endemic temperate Australian species found only between Forster and Wollongong, NSW. White's seahorse inhabits shallow inshore areas in estuaries, harbours and bays, where it lives on rocky reefs, sponges, seagrass beds, and under piers and jetties to 25 m.	(PMST/DPI)	Moderate. Potential habitat (ie rocky reef and seagrass) within the study area, although wash and vessel traffic render suboptimal.
Maccullochella peelii	Murray Cod	-	V	Found extensively throughout the Murray-Darling Basin (the Basin) in south-eastern Australia. Its range throughout the Basin includes QLD, NSW (NSW), the Australian Capital Territory (ACT), VIC and SA. Utilizes a diverse range of habitats from clear rocky streams, such as those found in the upper western slopes of NSW, to slow-flowing, turbid rivers and billabongs.	(PMST)	Low. Estuarine.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Macquaria australasica	Macquarie Perch	E	E	The Murray-Darling form of the Macquarie Perch is still known to exist in waterways of VIC, NSW and the ACT. The eastern form is confined to the Hawkesbury-Nepean and Shoalhaven river systems including a number of Sydney's water supply reservoirs. The Macquarie Perch is a riverine, schooling species. It prefers clear water and deep, rocky holes with lots of cover. As well as aquatic vegetation, additional cover may comprise of large boulders, debris and overhanging banks.	(PMST/DPI)	Low. Estuarine.
Prototroctes maraena	Australian Grayling	E (FM Act)	V	The Australian grayling occurs in rivers and streams on the eastern and southern flanks of the Great Dividing Range but is diadromous. During the freshwater phase of the life cycle, this species inhabits lower altitude reaches of both large rivers and smaller streams spawning in the tidal freshwater reaches of rivers, presumably among a gravel streambed. Very little is known of the Australian grayling's specific habitat requirements during the estuarine or marine phase of the life cycle.	(PMST)	Low. Estuarine.
Elasmobranchs						
Carcharias taurus	Grey Nurse Shark (east coast population)	CE (FM Act)	CE	Grey Nurse Sharks are usually found in inshore coastal waters usually less than 40 metres in depth. This species congregates at a number of rocky reef sites with gravel or sand filled gutters, overhangs or caves known as 'aggregate sites' and key aggregate sites refer to those areas occupied by a larger number of grey nurse	(PMST/DPI)	Low. The study area does not constitute an aggregate site.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				sharks. Individuals spend most of their time within or in close proximity to aggregate sites but may undertake excursions of varying lengths of time away from site. In NSW, aggregations of grey nurse sharks (east coast population as listed under the EPBC Act) can be found at reefs off the following locations: Byron Bay, Brooms Head, Solitary Islands, South West Rocks, Laurieton, Forster, Seal Rocks, Port Stephens, Sydney, Bateman's Bay, Narooma and Montague Island. Relatively little is known about the migratory habits of Grey Nurse Sharks in Australian waters but tagged sharked have been recorded moving over 800 kilometres between sites in relatively short periods of time.		Individuals may swim through the study area at albeit not optimal habitat.
Carcharodon carcharias	White Shark	V (FM Act)	V, Mi	In Australia, White Sharks have been recorded from central QLD around the south coast to north-west WA, but may occur further north on both coasts. White Sharks are widely, but not evenly, distributed in Australian waters. This species can be found from close inshore around rocky reefs, surf beaches and shallow coastal bays to outer continental shelf and slope areas. The majority of recorded White Shark movements occur between the coast and 100 metres in depth but have been recorded to dive to depth of over 1,200 m. Individuals may travel long distances in a relatively short time, but can remain in the same areas for weeks to months. In NSW, the Stockton Beach/Hawks Nest area are identified as primary residency areas for juvenile White Sharks.	(PMST/DPI)	Low. Juveniles may venture into the study area albeit a very mobile species and the study area does not constitute optimal habitat.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Galeorhinus galeus	School Shark	-	CD	The School Shark is distributed world-wide in temperate waters. In Australia, they occur throughout the temperate coastal waters of southern Australia. The School Shark is most abundant in cold to temperate continental seas, from the surfline and very shallow water to well offshore	(PMST)	Low. Juveniles may venture into the study area albeit a very mobile species and the study area does not constitute optimal habitat.
Rhincodon typus	Whale Shark	-	V, M	In Australia, the Whale Shark is known from NSW, QLD, NT, WA and occasionally VIC and SA, but it is most commonly seen in waters off northern WA, NT and QLD. The Whale Shark is an oceanic and coastal, tropical to warm-temperate pelagic shark. It is often seen far offshore, but also comes close inshore and sometimes enters lagoons of coral atolls. The Whale Shark is generally encountered close to or at the surface, as single individuals or occasionally in schools or aggregations of up to hundreds of sharks. This species is generally found in areas where the surface temperature is 21–25 °C, preferably with cold water of 17 °C or less upwelling into it, and salinity of 34 to 34.5 parts per thousand.	(PMST)	Low. Individuals may swim through the study area at albeit not optimal habitat.
Sphyrna lewini	Scalloped Hammerhead	E	CD	The Scalloped hammerhead shark has a circumglobal distribution in tropical and warm	(PMST)	Low.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				temperate seas between 45° N to 34° S, but occurs more frequently at higher latitudes during the warmer months. Scalloped hammerhead sharks may be found throughout the seas around northern Australia as far south as Sydney, NSW (34° S) and Geographe Bay WA (33° S). They inhabit deep waters adjacent to continental shelves in water depth ranging from the surface to at least 275 m. Juveniles are found close to shore in nursery habitats. Juveniles often occur in large migratory schools while adults may be seen alone, in pairs or small schools.		Juveniles may venture into the study area albeit a very mobile species and the study area does not constitute optimal habitat.
Mammals						
Arctocephalus forsteri	NZ Fur Seal	V	Ma	Occurs in Australia and NZ. Reports of non-breeding animals along southern NSW coast particularly on Montague Island, but also at other isolated locations to north of Sydney. Prefers rocky parts of islands with jumbled terrain and boulders.	(PMST)	Low. Some foraging habitat present in the study area however, is highly disturbed and not suited as preferred foraging habitat.
Arctocephalus pusillus	Australian Fur Seal	V	Ma	Reported to breed at Seal Rocks, near Port Stephens and Montague Island in southern NSW. Haul outs are observed at isolated places along the NSW coast. Prefers rocky parts of islands with flat, open terrain. They occupy flatter areas than	(PMST) / 3 (BioNet)	Low. Some foraging habitat present in the

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				do NZ fur-seals where they occur together. The Australian fur-seal prefers to utilise oceanic waters of the continental shelf for foraging and generally does not dive deeper than 150 m.		study area however, is highly disturbed and not suited as preferred foraging habitat.
Balaenoptera borealis	Sei Whale	-	V, M (B)	Sei whales have been infrequently recorded in Australian waters. The similarity in appearance of sei whales and Bryde's whales (Balaenoptera edeni) has resulted in confusion about distributional limits and frequency of occurrence, particularly in warmer waters (>20 °C) where Bryde's whales are more common. Sei whales were thought to be the most common whales reported by whalers off Albany, WA while hunting sperm whales (Physeter macrocephalus), however, these may have been misidentified Bryde's whales. There are several reports of presumed sei whale sightings by fishermen around the shelf edge (50 km offshore) off the coast of NSW. The Australian Antarctic waters are important feeding grounds for sei whales, as are temperate, cool waters. Sightings of sei whales feeding in the Bonney Upwelling area indicate that this area is potentially also an important feeding ground. Breeding occurs in tropical and subtropical waters.	(PMST)	Low. Usually associated with open water, but may swim through the study area albeit boat traffic renders the study area suboptimal.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Balaenoptera musculus	Blue Whale	E	E, M (B)	Oceanic within Southern Hemisphere between 20° to 70° S including NSW waters. However, much of the Australian continental shelf and coastal waters have no particular significance to the whales and are only used for migration and opportunistic feeding. The only known areas of significance to the blye whale are feeding areas around tyhe southern continental shelf, notably Perth Canyon, in WA and the Bonney Upwelling and adjacent upwelling areas of SA and VIC. Preferring open seas rather than coastal waters. While breeding areas have not yet been identified, it is likely that they occur in tropical areas of high localised biological production, as, unlike the humpback whale (*Megaptera novaeangliae*) and southern right whale (*Eubalaena australis*), the blue whale has a thin blubber layer, which implies that they cannot fast during the winter season. This is supported by the occurrence of the blue whale in tropical upwelling areas in the eastern tropical Pacific Ocean, such as the Costa Rica Dome and the waters west of the Galapagos Islands. Wintering areas, where some blue whale sightings have been reported, include the Indonesian archipelago and the waters adjacent to the Solomon Islands and other island groups of the south-west Pacific (Paton & Gibbs 2003). Satellite tagging has confirmed that the pygmy blue whale feeds off the Perth Canyon and head north in March/April to potential breeding grounds in Indonesian waters by June.	(PMST)	Low. Usually associated with open water, but may swim through the study area albeit boat traffic renders the study area suboptimal.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Balaenoptera physalus	Fin Whale	-	V, M	Fin whales are widely distributed in both hemispheres between latitudes 20–75° S. This species is common in temperate waters, the Arctic Ocean and Southern Ocean. In the Southern Ocean/Subantarctic this species is often found in areas of complex and steep bathymetry, such as deep ravines, where fish and other prey are known to concentrate. Fin whales have been observed during aerial surveys in SAn waters between November and May. The Australian Antarctic waters are important feeding grounds for fin whales. Sightings of fin whales feeding in the Bonney Upwelling area indicate that this area is also a potentially important feeding ground. There are no known mating or calving areas in Australian waters.	(PMST)	Low. Usually associated with open water, but may swim through the study area albeit boat traffic renders the study area suboptimal.
Cercartetus nanus	Eastern Pygmy-possum	V	-	Found in a broad range of habitats from rainforest through to wet and dry sclerophyll forest and woodland to heath, but in most areas woodlands and heath appear to be preferred.	(PMST)	None. No suitable habitat within the study area.
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Forages over a broad range of open forest and woodland habitats, this species is a cave roosting bat which favours sandstone escarpment habitats for roosting, in the form of shallow overhangs, crevices and caves.	(PMST)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Dasyurus maculatus maculatus	Spot-tailed Quoll	V	E	Wet and dry sclerophyll forests and rainforests, and adjacent open agricultural areas. Generally associated with large expansive areas of habitat to sustain territory size. Requires hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites.	(PMST) / 2 (BioNet)	None. No suitable habitat within the study area.
Eubalaena australis	Southern Right Whale	E	E, M	This species occurs in temperate and subpolar waters of the Southern Hemisphere, with a circumpolar distribution between about 20° S and 55° S with some records further south to 63° S. The southern right whale migrates between summer feeding grounds in Antarctica and winter breeding grounds around the coasts of southern Australia, NZ, South Africa and South America. This species feed in the open oceans in summer and move inshore in winter for calving and mating with calving females usually remaining very close to the coast. The southern right whale is not believed to feed in Australian waters at all. The southern right whale is constrained in their ability to colonise unused areas of potentially suitable habitat due to a high degree of site fidelity (individuals returning to the same breeding site each year).	(PMST)	Low. Usually associated with open water, but may swim through the study area albeit boat traffic renders the study area suboptimal.
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings.	2 (BioNet)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)	E	E	This species prefers sandy soils with scrubby vegetation and/or areas with low ground cover that are burn from time to time. A mosaic of post fire vegetation is important for this species.	(PMST)	None. No suitable habitat within the study area.
Megaptera novaeangliae	Humpback Whale	V	V, M	Occurs in oceanic and coastal waters worldwide. The population of Australia's east coast migrates from summer, cold-water feeding grounds in Subantarctic waters to warm-water winter breeding grounds in the central Great Barrier Reef. They are regularly observed in NSW waters in June and July, on the northward migration and October and November, on the southward migration. As with the WAn population, the eastern Australian population also tend to migrate further offshore during their northward migration. Three major aggregation areas have been previously identified for the eastern Australian population in QLD around the southern end of the Great Barrier Reef, Hervey Bay and in the Gold Coast region. The southern end of the Great Barrier Reef is a suspected calving area. The breeding area for the eastern population of the humpback whale is presumed to be off the coast between central and northern QLD. Some feeding has been observed in Australia's coastal waters but this is thought to primarily be opportunistic and forms only a small portion of their nutritional requirements. Feeding has been observed close to shore off Eden, NSW, from late September until late November. Feeding behaviour has also	(PMST)	Low. Usually associated with open water, but may swim through the study area albeit boat traffic renders the study area suboptimal.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				been reported off Fraser Island, QLD. Feeding may also occur in northern waters of the Great Barrier Reef, as well as VIC, as sightings of humpback whales have been reported in these areas in summer months.		
Myotis macropus	Southern Myotis	V	-	Generally roost in groups close to water in caves, mine shafts, hollow-bearing trees, and storm water channels, buildings, under bridges and in dense foliage. Forages over streams and pools catching insects and small fish.	3 (BioNet)	Moderate. Recorded within the study locality. Minimal roosting habitat available and not expected to be impacted, but may forage and fly though the study area, albeit widespread.
Miniopterus australis	Little Bent-winged Bat	V	-	East coast and ranges of Australia from Cape York in QLD to Wollongong in NSW. Little Bentwing-bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats.	1 (BioNet)	Moderate. Recorded within the study locality. Minimal roosting habitat available and not expected

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
						to be impacted, but may forage and fly though the study area, albeit widespread.
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	-	Occurs on east and north west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other manmade structures.	4 (BioNet)	Moderate. Recorded within the study locality. Minimal roosting habitat available and not expected to be impacted, but may forage and fly though the study area, albeit widespread.
Petaurus australis	Yellow-bellied Glider	V	-	Found along the eastern coast to the western slopes of the Great Dividing Range, from southern QLD to VIC. Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north;	5 (BioNet)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				moist coastal gullies and creek flats to tall montane forests in the south. Feed primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein. Extract sap by incising (or biting into) the trunks and branches of favoured food trees, often leaving a distinctive 'V'-shaped scar.		
Petaurus norfolcensis	Squirrel Glider	V	-	The species is widely though sparsely distributed in eastern Australia, from northern QLD to western VIC. Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey.	4 (BioNet)	None. No suitable habitat within the study area.
Petauroides volans	Greater Glider	-	V	"The greater glider is restricted to eastern Australia, occurring from the Windsor Tableland in north QLD through to central VIC (Wombat State Forest), with an elevational range from sea level to 1200 m above sea level. An isolated inland subpopulation occurs in the Gregory Range west of Townsville, and another in the Einasleigh Uplands. The broad extent of occurrence is unlikely to have changed appreciably since European settlement. However, the area of occupancy has decreased substantially mostly due to land clearing. This area is probably continuing to decline due to further clearing, fragmentation impacts, fire and some forestry activities. Kearney et al. (2010)	(PMST)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				predicted a 'stark' and 'dire' decline ('almost complete loss') for the northern subspecies P. v. minor if there is a 3 °C temperature increase. An arboreal, nocturnal marsupial largely restricted to Eeucalypt forests and woodlands with a diet of eucalypt leaves and occassionally flowers. Found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows althought, distribution may be patchy, even in suitable habitat. Favours forests with a diversity of eucalypt species due to seasonal variation i its preferred tree species. Shelters in tree hollows during the day. Home ranges are typically 1-4 ha."		
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Range extends from south-east QLD to the Grampians in western VIC, roughly following the line of the Great Dividing Range. Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees.	(PMST)	None. No suitable habitat within the study area.
Phascolarctos cinereus	Koala (combined populations of QLD, NSW and the Australian	V	V	In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 Eucalypt species and 30 non-Eucalypt species, but in any one area will select preferred browse species.	(PMST) / 11 (BioNet)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
	Capital Territory)					
Potorous tridactylus tridactylus	Long-nosed Potoroo (SE Mainland)	V	V	The long-nosed potoroo is found on the south-eastern coast of Australia, from QLD to eastern VIC and TAS, including some of the Bass Strait islands. Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature. The fruit-bodies of hypogeous (underground-fruiting) fungi are a large component of the diet of the Long-nosed Potoroo. They also eat roots, tubers, insects and their larvae and other soft-bodied animals in the soil.	(PMST)	None. No suitable habitat within the study area.
Pseudomys novaehollandiae	New Holland Mouse	-	V	Distribution is fragmented across all eastern states of Australia, where it inhabits open heath lands, open woodlands with heath understorey and vegetated sand dunes.	(PMST)	None. No suitable habitat within the study area.
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Generally found within 200 km of the eastern coast of Australia, from Rockhampton in QLD to Adelaide in SA. In times of natural resource shortages, they may be found in unusual locations. Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food	(PMST)	None. No suitable habitat within the study area.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Individual camps may have tens of thousands of animals and are used for mating, and for giving birth and rearing young.		
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings.	1 (BioNet)	Low. Recorded within the study locality. Minimal roosting habitat, but may forage and fly though the study area, albeit widespread.
Reptiles						
Caretta caretta	Loggerhead Turtle	E	E, Mi, Ma	The Loggerhead Turtle has a worldwide distribution in coastal tropical and subtropical waters. In Australia, Loggerheads occur in coral reefs, bays and estuaries in tropical and warm temperate waters off the coast of QLD, NT, WA and NSW.	(PMST) / 1 (BioNet)	Low. Recorded within the study locality. May swim through the study area albeit boat traffic renders the study area as suboptimal.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Chelonia mydas	Green Turtle	V	V, Mi, Ma	Green Turtles occur in seaweed-rich coral reefs and coastal seagrass pastures in tropical and subtropical areas of Australia. Usually ocean-dwelling but also occurs in coastal waters on the north or central coast with some straying south of the central coast. Green Turtles spend their first five to ten years drifting on ocean currents. During this pelagic (ocean-going) phase, they are often found in association with driftlines and rafts of Sargassum (a floating marine plant that is also carried by currents). Once Green Turtles reach 30 to 40 cm curved carapace length, they settle in shallow benthic foraging habitats such as tropical tidal and sub-tidal coral and rocky reef habitat or inshore seagrass beds. The shallow foraging habitat of adults contains seagrass beds or algae mats on which Green Turtles mainly feed. In Australia there are seven separate genetic management units for the green turtle, and three of these occur in QLD. The entire Great Barrier Reef area is an important feeding area for turtles which nest locally, as well as for those which nest in other regions and countries.	(PMST) / 4 (BioNet)	Low. Recorded within the study locality. May swim through the study area albeit boat traffic renders the study area as suboptimal.
Dermochelys coriacea	Leatherback Turtle	E	E, Mi, Ma	Throughout the world's tropical and temperate seas and in all coastal waters of Australia. Most sightings are in temperate waters. Occurs in inshore and offshore marine waters. Rarely breeds in Australia, with the nearest regular nesting sites being the Solomon Islands and Malayan Archipelago. Occasional breeding	(PMST)	Low. May swim through the study area albeit boat traffic renders

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				records from NSW coast, including between Ballina and Lennox Head in northern NSW.		the study area as suboptimal.
Eretmochelys imbricata	Hawksbill Turtle	-	V, Mi, Ma	Major nesting of Hawksbill Turtles in Australia occurs at Varanus Island and Rosemary Island in WA, and in the northern Great Barrier Reef and Torres Strait, QLD. hawksbill turtles spend their first five to ten years drifting on ocean currents. Hawksbill Turtles spend their first five to ten years drifting on ocean currents. During this pelagic phase, they are often found in association with rafts of Sargassum sp. (floating marine algae that is also carried by currents). Once Hawksbill Turtles reach 30 to 40 cm curved carapace length, they settle and forage in tropical tidal and sub-tidal coral and rocky reef habitat. They primarily feed on sponges and algae. They have also been found, though less frequently, within seagrass habitats of coastal waters, as well as the deeper habitats of trawl fisheries. Hawksbill Turtles have been seen in temperate regions as far south as northern NSW.	(PMST) / 1 (BioNet)	Low. Recorded within the study locality. May swim through the study area albeit boat traffic renders the study area as suboptimal.
Hoplocephalus bungaroides	Broad-headed Snake	E	V	Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in hollows in large trees within 200 metres of escarpments in summer.	(PMST)	None. No suitable habitat within the study area.
Natator depressus	Flatback Turtle	-	V, Mi, Ma	The Flatback Turtle is only found in the tropical waters of northern Australia, Papua New Guinea and Irian Jaya and is one of only two species of sea turtle without a global distribution. Post-	(PMST)	Low. May swim through the

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				hatchling and juvenile Flatback Turtles do not have the wide dispersal phase in the oceanic environment like other sea turtles. Adults inhabit soft bottom habitat over the continental shelf of northern Australia, extending into Papua New Guinea and Irian Jaya although the extent of their range is not fully known. Hatchling to subadult Flatback Turtles lack a pelagic life stage and reside in the Australian continental shelf. Flatback Turtles require sandy beaches to nest. Sand temperatures between 25 °C and 33 °C are needed for successful incubation. Beaches free from light pollution are required to prevent disorientation, disturbance, and to allow nesting females to come ashore.		study area albeit boat traffic renders the study area as suboptimal.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence

** Distribution and habitat requirement information adapted from:*

Australian Government DAWE https://www.environment.gov.au/biodiversity/threatened/species.

NSW DPE-EES http://www.environment.nsw.gov.au/threatenedSpeciesApp/. and

NSW DPI (Fisheries) listed threatened species, populations and ecological communities https://www.dpi.nsw.gov.au/fishing/species-protection/what-current.

+ Data source includes

The NSW DPI (Fisheries) Threatened species lists https://www.dpi.nsw.gov.au/fishing/species-protection/what-current.

Number of records from the NSW DPE-EES Wildlife Atlas record data (Accessed January 2022) http://www.bionet.nsw.gov.au/. and

Australian Government DAWE PMST http://www.environment.gov.au/epbc/protected-matters-search-tool.

Key:

EP = endangered population

CE = critically endangered

E = endangered

V = vulnerable

M = migratory (EPBC Act only); International migratory agreements: B = Bonn, C = CAMBA, J = JAMBA, R = ROKAMBA

Ma = marine (EPBC Act only)

Migratory species habitat assessment table

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)[+]	Likelihood of occurrence
Birds						
Actitis hypoleucos	Common Sandpiper	-	M (B, C, J, R), Ma	Found along all coastlines of Australia and in many areas inland, the Common Sandpiper is widespread in small numbers. The species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats.	(PMST) / 1 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.
Anous stolidus	Common Noddy	-	M (C, J), Ma	Mainly occurs in ocean off the QLD coast. Breeds on or near islands, on rocky islets and stacks with precipitous cliffs, or on shoal or cays or coral or sand. This species feeds main on fish but are known to take squid, molluscs and aquatic insects in offshore areas.	(PMST)	Low. Recorded within the study locality. May fly through and forage in study area however, study area habitat is widely distributed.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Apus pacificus	Fork-tailed Swift	-	M (C, J, R), Ma	Recorded in all regions of NSW. The Fork-tailed Swift is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground and probably much higher.	(PMST) / 1 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.
Ardenna grisea	Sooty Shearwater	-	M (J), Ma	In Australia, the Sooty Shearwater breeds on islands off NSW (NSW) and TAS. The Sooty Shearwater forages in pelagic (open ocean) sub-tropical, sub-Antarctic and Antarctic waters. The Sooty Shearwater breeds mainly on subtropical and sub-Antarctic islands, as well as on the mainland of NZ. The Sooty Shearwater forages in pelagic (open ocean) sub-tropical, sub-Antarctic and Antarctic waters. The species migrates and forages in the North Pacific and Atlantic Oceans during the non-breeding season. Sooty Shearwaters may forage inshore occasionally, especially during rough weather.	(PMST) / 3 (BioNet)	Low. Recorded within the study locality. Has potential to fly through the study area however, this species has a wide-ranging habitat and is highly mobile.
Ardenna pacifica	Wedge-tailed Shearwater	-	M (C, J, R), Ma	The Wedge-tailed Shearwater breeds on the east and west coasts of Australia and on off-shore islands. The Wedge-tailed Shearwater is a pelagic, marine bird	(PMST) / 607 (BioNet)	Moderate. Recorded within the study locality.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				known from tropical and subtropical waters.		Known to breed at Five Islands Nature Reserve. May fly through and forage in study area.
Ardenna tenuirostris	Short-tailed Shearwater	-	M (C, J, R), Ma	In summer months, the Short-tailed Shearwater is the most common shearwater along the south and south-east coasts of Australia. The Short-tailed Shearwater is found in coastal waters.	(PMST) / 14 (BioNet)	Moderate. Recorded within the study locality. Known to breed at Five Islands Nature Reserve. Preferred habitat not within the study area but it may fly through.
Arenaria interpres	Ruddy Turnstone	-	M (B, C, J, R), Ma	Coastline and only occasionally inland. They are mainly found on exposed rocks or reefs, often with shallow pools, and on beaches.	(PMST) / 21 (BioNet)	Low. Recorded within the study locality. May fly through and forage in

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
						study area however, study area habitat is widely distributed.
Calidris acuminata	Sharp-tailed Sandpiper	-	M (B, C, J, R), Ma	The Sharp-tailed Sandpiper spends the non-breeding season in Australia with small numbers occurring regularly in NZ. Most of the population migrates to Australia, mostly to the south-east and are widespread in both inland and coastal locations and in both freshwater and saline habitats. Many inland records are of birds on passage. Prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation.	(PMST) / 6 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.
Calidris melanotos	Pectoral Sandpiper	-	M (B, J, R), Ma	In NSW, the Pectoral Sandpiper is widespread, but scattered. Records exist east of the Great Divide, from Casino and Ballina, south to Ulladulla. West of the Great Divide, the species is widespread in the Riverina and Lower Western regions. Prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands.	(PMST)	Low. Preferred habitat not within the study area but it may fly through.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Calonectris leucomelas	Streaked Shearwater	-	M (C, J, R), Ma	Found in the western Pacific, breeding on the coast and on offshore islands of Japan, Russia, and on islands off the coasts of China, North Korea and South Korea. This marine species can be found over both pelagic and inshore waters.	(PMST) / 1 (BioNet)	Low. Recorded within the study locality. Has potential to fly through the study area however, this species has a wide-ranging habitat and is highly mobile.
Charadrius bicinctus	Double-banded Plover	-	M (B), Ma	The Double-banded Plover can be found in both coastal and inland areas. The Double-banded Plover is found on littoral, estuarine and fresh or saline terrestrial wetlands and also saltmarsh, grasslands and pasture. It occurs on muddy, sandy, shingled or sometimes rocky beaches, bays and inlets, harbours and margins of fresh or saline terrestrial wetlands such as lakes, lagoons and swamps, shallow estuaries and rivers.	(PMST)	Low. May fly through and forage in study area however, study area habitat is widely distributed.
Chlidonias leucopterus	White-winged Tern	-	M, (C, J, R) Ma	The species is a non-breeding migrant to Australia, where it is widespread and common along south-western, northern and central-eastern coasts, with only scattered records of small numbers along	1 (BioNet)	Low. Recorded within the study locality.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				the coasts elsewhere in southern Australia. The White-winged Black Tern mainly forages aerially, over water or over muddy or sandy edges of wetlands; and also forages over land adjacent to wetlands, especially if inundated, including rice paddies and dry paddocks and grassland.		Preferred habitat not within the study area but it may fly through.
Cuculus optatus	Oriental Cuckoo		M (C, J, R)	Occurs from the coastal region of the NT to the south of NSW coast. This species is very secretive inhabiting forests, occurring in coniferous, deciduous and mixed forest.	(PMST)	Low. Preferred habitat not within the study area but it may fly through.
Fregata ariel	Lesser Frigatebird	-	M (C, J, R), Ma	Breeding populations are found in the tropical waters of Indian and Pacific Oceans, except in the east Pacific, and the South Atlantic on remote tropical and sub-tropical islands. Mainly feeds on fish but can snatch bird eggs and chicks as well as scavenge.	(PMST)	Low. Recorded within the study locality. Has potential to fly through the study area however, this species has a wide-ranging habitat and is highly mobile.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Fregata minor	Greater Frigatebird	-	M (C, J), Ma	Breeding populations found on small, remote tropical and sub-tropical islands of the Indian and Pacific Oceans and the South Atlantic. Kleptoparasitic behaviour leads to stealing fish and squid from other bird species as well as snatching small chicks	(PMST)	Low. Recorded within the study locality. Has potential to fly through the study area however, this species has a wide-ranging habitat and is highly mobile.
Gallinago hardwickii	Latham's Snipe	-	M (B, J, R), Ma	Recorded along the east coast of Australia from Cape York Peninsula through to south-eastern SA. Occurs in permanent and ephemeral wetlands up to 2000 metres above sea-level.	(PMST) / 3 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.
Hydroprogne caspia	Caspian Tern	-	M (J), Ma	Within Australia, the Caspian Tern has a widespread occurrence and can be found in both coastal and inland habitat. The	24 (BioNet)	Low. Recorded within the

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				Caspian Tern breeds on variable types of sites including low islands, cays, spits, banks, ridges, beaches of sand or shell, terrestrial wetlands and stony or rocky islets or banks. This species usually forages in open wetlands, including lakes and rivers.		study locality. May fly through and forage in study area however, study area habitat is widely distributed.
Limosa lapponica	Bar-tailed Godwit	-	M (B, C, J, R), Ma	The Bar-tailed Godwit has been recorded in the coastal areas of all Australian states. The Bar-tailed Godwit is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays.	(PMST) / 12 (BioNet)	Low. Recorded within the study locality. May fly through and forage in study area however, study area habitat is widely distributed.
Monarcha melanopsis	Black-faced Monarch	-	M (B), Ma	Widespread in eastern Australia. Mainly occurs in rainforest ecosystems, including semi-deciduous vine-thickets, complex notophyll vine-forest, tropical (mesophyll)	(PMST)	Low. Preferred habitat not within the

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				rainforest, subtropical (notophyll) rainforest, mesophyll (broadleaf) thicket/shrubland, warm temperate rainforest, dry (monsoon) rainforest and (occasionally) cool temperate rainforest.		study area but it may fly through.
Motacilla flava	Yellow Wagtail	-	M (C, J, R), Ma	Breeds in northern latitudes and travels south before the onset of winter. Occurs in a variety of damp or wet habitats with low vegetation. Outside of the breeding season, it is also found in cultivated areas.	(PMST)	Low. Preferred habitat not within the study area but it may fly through.
Myiagra cyanoleuca	Satin Flycatcher	-	M (B), Ma	Widespread in eastern Australia and vagrant to NZ. Inhabit heavily vegetated gullies in Eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests.	(PMST)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.
Numenius phaeopus	Whimbrel	-	M (B, C, J, R), Ma	The Whimbrel is a regular migrant to Australia and NZ, with a primarily coastal distribution. The Whimbrel is often found on the intertidal mudflats of sheltered	2 (BioNet)	Low. Recorded within the study locality.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				coasts. It is also found in harbours, lagoons, estuaries and river deltas, often those with mangroves, but also open, unvegetated mudflats.		May fly through and forage in study area however, study area habitat is widely distributed.
Oceanites oceanicus	Wilson's Storm-Petrel	-	M (J), Ma	The Wilson's Storm-Petrel is a pelagic (marine) species distributed throughout most of the world's oceans. Its distribution stretches north through the mid-latitudes of the Northern Hemisphere and south through the oceans surrounding Australia and the Australian Antarctic Territory. Wilson's Storm-Petrel spends much of its life at sea.	2 (BioNet)	Low. Recorded within the study locality. Has potential to fly through the study area however, this species has a wide-ranging habitat and is highly mobile.
Onychoprion anaethetus	Bridled Tern	-	M (C, J)	Worldwide, the Bridled Tern occupies tropical and subtropical waters and coastlines, with several apparently discrete populations, which are treated as subspecies. In Australia, Bridled Terns are widespread, breeding on offshore islands	1 (BioNet)	Low. Recorded within the study locality. Has potential to fly through

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				in western, northern and north-eastern Australia, extending from Cape Leeuwin in the south-west, around northern Australia to north-eastern and mid-eastern QLD, extending through the Great Barrier Reef and Coral Sea as far south as Lady Elliott Island. Bridled Terns occupy tropical and subtropical seas, breeding on islands, including vegetated coral cays, rocky continental islands and rock stacks. Bridled Terns breed on islands.		the study area however, this species has a wide-ranging habitat and is highly mobile.
Pandion haliaetus	Osprey	-	M (B), Ma	The Osprey occurs in Indonesia, Philippines, Palau Islands, New Guinea, Solomon Islands, New Caledonia and Australia. The breeding range of the Osprey extends around the northern coast of Australia (including many offshore islands) from Albany in WA to Lake Macquarie in NSW; with a second isolated breeding population on the coast of SA, extending from Head of Bight east to Cape Spencer and Kangaroo Island. The total range (breeding plus non-breeding) around the northern coast is more widespread, extending from Esperance in WA to NSW, where records become scarcer towards the south, and into VIC and TAS, where the species is a rare vagrant. Ospreys occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. They are mostly found in	(PMST)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				coastal areas but occasionally travel inland along major rivers, particularly in northern Australia		
Pluvialis fulva	Pacific Golden Plover	-	M (B, C, J, R), Ma	Most Pacific Golden Plovers occur along the east coast, and are especially widespread along the QLD and NSW coastlines. In non-breeding grounds in Australia this species usually inhabits coastal habitats, though it occasionally occurs around inland wetlands. Pacific Golden Plovers usually occur on beaches, mudflats and sandflats (sometimes in vegetation such as mangroves, low saltmarsh such as Sarcocornia, or beds of seagrass) in sheltered areas including harbours, estuaries and lagoons, and also in evaporation ponds in saltworks.	1 (BioNet)	Low. Recorded within the study locality. May fly through and forage in study area however, study area habitat is widely distributed.
Pluvalis squatarola	Grey Plover	-	M (B, C, J, R)	Non-breeding visitor to Australia, Grey Plovers usually forage on large areas of exposed mudflats and beaches of sheltered coastal shores such as inlets, estuaries and lagoons. They usually roost in sandy areas, such as on unvegetated sandbanks or sand-spits on sheltered beaches or other sheltered environments such as estuaries or lagoons.	5 (BioNet)	Low. Recorded within the study locality. May fly through and forage in study area however, study area habitat is

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
						widely distributed.
Rhipidura rufifrons	Rufous Fantail	-	M (B), Ma	Occurs in coastal and near coastal districts of northern and eastern Australia. In east and south-east Australia, the Rufous Fantail mainly inhabits wet sclerophyll forests, often in gullies dominated by Eucalypts such as Tallow-wood (*Eucalyptus microcorys*), Mountain Grey Gum (*E. cypellocarpa*), Narrow-leaved Peppermint (*E. radiata*), Mountain Ash (*E. regnans*), Alpine Ash (*E. delegatensis*), Blackbutt (*E. pilularis*) or Red Mahogany (*E. resinifera*); usually with a dense shrubby understorey often including ferns.	(PMST)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.
Sterna hirundo	Common Tern	-	M (C, R, R), Ma	The species is a non-breeding migrant to Australia, where it is widespread and common on the eastern coast south to eastern VIC, and common on parts of the northern coast, mainly east of Darwin. Common Terns are marine, pelagic and coastal. In Australia, they are recorded in all marine zones, but are commonly observed in near-coastal waters, both on ocean beaches, platforms and headlands and in sheltered waters, such as bays, harbours and estuaries with muddy, sandy or rocky shores. However, off Wollongong,	4 (BioNet)	Low. Recorded within the study locality. May fly through and forage in study area however, study area habitat is

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				NSW, Common Terns were recorded in all marine zones but generally recorded in offshore and pelagic waters, 11–55 km from shore.		widely distributed.
Symposiachrus trivirgatus	Spectacled Monarch	-	M (B), Ma	Occurs along the entire east coast of Australia. Breeds in dense scrub in gullies of coastal ranges.	(PMST)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.
Stercorarius parasiticus	Arctic Jaeger	-	M (C, J, R), Ma	Breeds on the northernmost coasts of Eurasia and North America and is a trans equatorial migrant. The Artic Jaeger is predominantly coastal and feeds mainly by kleptoparasitism.	2 (BioNet)	Low. Recorded within the study locality. Has potential to fly through the study area however, this species has a wide-ranging habitat and is highly mobile.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Stercorarius pomarinus	Pomarine Jaeger	-	M (C, J, R), Ma	Breeds in the far north of Eurasia and North America. This species is marine outside the breeding season, remaining somewhat coastal, especially in upwelling regions of the tropics and subtropics. It feeds primarily on lemmings while also feeding on young waders.	4 (BioNet)	Low. Recorded within the study locality. Has potential to fly through the study area however, this species has a wide-ranging habitat and is highly mobile.
Thalasseus bergii	Greater Crested Tern	-	M (J), Ma	There are few stretches of the Australian coastline where the Crested Tern cannot be seen — it has been known as both the Bass Straits Tern and the Torres Straits Tern. They breed in colonies on small offshore islands where their nests are so densely packed together that adjacent owners can touch each other's bills. Though the Crested Tern is usually a strictly coastal species, there are occasional records in the arid interior of Australia, where birds were possibly blown by passing tropical cyclones.	(PMST) / 87 (BioNet)	Low. Recorded within the study locality. Has potential to fly through the study area however, this species has a wide-ranging habitat and is highly mobile.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Tringa nebularia	Common Greenshank	-	M (B,C, J, R), Ma	The Common Greenshank does not breed in Australia, however, the species occurs in all types of wetlands and has the widest distribution of any shorebird in Australia.	(PMST) / 2 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.
Tringa stagnatilis	Marsh Sandpiper	-	M, Ma	The Marsh Sandpiper is found on coastal and inland wetlands throughout Australia. In WA they are mainly found around the coast. The Marsh Sandpiper lives in permanent or ephemeral wetlands of varying salinity, including swamps, lagoons, billabongs, saltpans, saltmarshes, estuaries, pools on inundated floodplains, and intertidal mudflats and also regularly at sewage farms and saltworks.	1 (BioNet)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.
Elasmobranchs and reptiles						
Carcharhinus longimanus	Oceanic Whitetip Shark	-	M	The Oceanic Whitetip Shark is widespread throughout tropical and subtropical pelagic waters of the world (30°N to 35°S). Within Australian waters, it is found in from Cape Leeuwin (WA) through parts of the NT,	(PMST)	Low. May swim through the study area

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				down the east coast of QLD and NSW to Sydney. It has not been recorded within the Gulf of Carpentaria or the Arafura Sea, preferring pelagic waters. A single specimen has been recorded in SA.		albeit boat traffic renders the study area as suboptimal.
Lamna nasus	Porbeagle	-	M	The Porbeagle is wide-ranging and inhabits temperate, subarctic and subantarctic waters of the North Atlantic and Southern Hemisphere. The Porbeagle primarily inhabits oceanic waters and areas around the edge of the continental shelf. They occasionally move into coastal waters, but these movements are temporary. The Porbeagle utilises a broad vertical range of the water column and is known to dive to depths exceeding 1300 m. The Porbeagle is thought to be reasonably flexible in the types of habitat used for foraging.	(PMST)	Low. May swim through the study area albeit boat traffic renders the study area as suboptimal.
Mobula birostris	Giant Manta Ray	-	M	The Giant Manta Ray occurs in tropical, sub-tropical and temperate waters of the Atlantic, Pacific and Indian Oceans. Commonly sighted along productive coastlines with regular upwelling, oceanic island groups and particularly offshore pinnacles and seamounts. Widespread, although relatively uncommon in Australian waters; also Cocos (Keeling) Islands and Christmas Island in the eastern Indian Ocean. Elsewhere the species is circumglobal, usually offshore,	(PMST)	Low. May swim through the study area albeit boat traffic renders the study area as suboptimal.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				often around oceanic islands, sometimes coastal, and most common in tropical waters. Giant Manta Rays aggregate around Ningaloo Reef during autumn and winter.		
Mammals						
Balaenoptera edeni	Bryde's Whale	-	M	Bryde's whales occur in temperate to tropical waters, both oceanic and inshore, bounded by latitudes 40° N and 40° S, or the 20 °C isotherm. Bryde's whales have been recorded from all Australian states except the NT, including one sighting each in VIC and NSW and 11 reported strandings in SA (7), NSW (2), VIC (1) and QLD (1). Bryde's whales are found year-round primarily in temperatures exceeding 16.3 °C. The coastal from of Bryde's whale appears to be limited to the 200 m depth isobar, moving along the coast in response to availability of suitable prey. The offshore form is found in deeper water (500 m to 1000 m). Dive times are relatively short, averaging 1.27 minutes but potentially lasting 9 minutes. This suggests that Bryde's whales use the upper layers of the ocean, and can therefore be considered pelagic.	(PMST)	Low. Usually associated with open water, but may swim through the study area albeit boat traffic renders the study area suboptimal.
Caperea marginata	Pygmy Right Whale	-	M	Records of pygmy right whales in Australian waters are distributed between 32° S and 47° S, but are not uniformly	(PMST)	Low. Usually associated

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				spread around the coast. The northern distribution of pygmy right whales may be limited on the west and east coasts of Australia by the warm, south-flowing Leeuwin and East Australian currents. Few or no records are available for NSW, eastern VIC, and the northern part of the Great Australian Bight, while WA has fewer records than comparative eastern Australian states. Concentrations of stranded animals have occurred at the entrance of the gulfs in SA and around TAS, but live sightings have predominated in the former region. The numerous strandings in TAS may be due to the proximity of the Subtropical Convergence, an apparently important feeding zone for pygmy right whales. Pygmy right whales have primarily been recorded in areas associated with upwellings and with high zooplankton abundance, particularly copepods and small euphausiids which constitute their main prey. There is some evidence to indicate that the area south of 41° S is important for weaned pygmy right whales, possibly because of the higher prey abundance in these waters.		with open water, but may swim through the study area albeit boat traffic renders the study area suboptimal.
Lagenorhynchus obscurus	Dusky Dolphin	-	M	In Australia, dusky dolphins are known from only 13 reports since 1828, with two sightings in the early 1980s. They occur across southern Australia from WA to TAS, with unconfirmed sightings south of	(PMST)	Low. May swim through the study area

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				continental Australia but confirmed sightings near Kangaroo Island, SA, and off TAS, and a recent stranding in the latter State. Given the lack of understanding of the species' distribution in Australian waters, no key localities have yet been identified. Dusky dolphins occur mostly in temperate and subantarctic waters. They are considered to primarily inhabit inshore waters but may also be pelagic at times.		albeit boat traffic renders the study area as suboptimal.
Orcinus orca	Killer Whale/Orca	-	M	In Australia, orcas are recorded from all states, with concentrations reported around TAS. Sightings are also frequent in SA and VIC. A sighting at Yirrkala in April 1999 provides evidence that they also occur in NTwaters. Orcas are frequently seen in the Antarctic south of 60° S and have been recorded from Heard and Macquarie Islands. Macquarie Island appears to be a key locality, with orcas regularly reported there. The preferred habitat of orcas includes oceanic, pelagic and neritic (relatively shallow waters over the continental shelf) regions, in both warm and cold waters. They may be more common in cold, deep waters, but off Australia, orcas are most often seen along the continental slope and on the shelf, particularly near seal colonies. Orcas have regularly been observed within the	(PMST)	Low. Usually associated with open water, but may swim through the study area albeit boat traffic renders the study area suboptimal.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				Australian territorial waters along the ice edge in summer.		

** Distribution and habitat requirement information adapted from:*

Australian Government DAWE https://www.environment.gov.au/biodiversity/threatened/species.

NSW DPE-EES http://www.environment.nsw.gov.au/threatenedSpeciesApp/. and

NSW DPI (Fisheries) listed threatened species, populations and ecological communities https://www.dpi.nsw.gov.au/fishing/species-protection/what-current.

+ Data source includes

The NSW DPI (Fisheries) Threatened species lists https://www.dpi.nsw.gov.au/fishing/species-protection/what-current.

Number of records from the NSW DPE-EES Wildlife Atlas record data (Accessed January 2022) http://www.bionet.nsw.gov.au/. and

Australian Government DAWE PMST http://www.environment.gov.au/epbc/protected-matters-search-tool.

Key:

M = migratory (EPBC Act only); International migratory agreements: B = Bonn, C = CAMBA, J = JAMBA, R = ROKAMBA

Ma = marine (EPBC Act only)

Protected species habitat assessment table

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Birds						
Bubulcus ibis	Cattle Egret	-	Ma	The Cattle Egret was originally native to Africa, south-west Europe, and Asia. Originally the bird's Asian distribution was from Pakistan, south to Sri Lanka, north to the Himalayas and east to Korea, Japan, and the Philippines. Two major distributions have been located; from north-east WA to the Top End of the NT and around south-east Australia. The Cattle Egret occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands. It has occasionally been seen in arid and semi-arid regions however this is extremely rare.	(PMST)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.
Charadrius ruficapillus	Red-capped Plover	-	Ma	The Red-capped Plover is widespread throughout Australia. Found in wetlands, especially in arid areas, and prefers saline and brackish waters.	(PMST)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.
Chroicocephalus novaehollandiae	Silver Gull	-	Ma	Found throughout Australia, NZ and New Caledonia. In virtually any watered habitat and is rarely seen far from land.	(PMST)	High.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
						Observed within the study area.
Eudyptula minor	Little Penguin	-	Ma	Occurs in Australia and NZ. They generally breed from south of Port Stephens in NSW along the coast through VIC, SA, TAS and as far as Fremantle in WA. A range of nest sites are utilised by the penguins at Manly including under rocks on the foreshore, under seaside houses and structures, such as stairs, in wood piles and under overhanging vegetation including lantana and under coral tree roots.	(PMST)	Moderate. Known to breed at Five Islands Nature Reserve. May swim through the study area albeit boat traffic renders the study area suboptimal.
Merops ornatus	Rainbow Bee-eater	-	Ma	The Rainbow Bee-eater is widely distributed throughout Australia and eastern Indonesia. The Rainbow Bee-eater is distributed across much of mainland Australia, and occurs on several near-shore islands. The Rainbow Bee-eater occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation.	(PMST)	Low. Recorded within the study locality. Preferred habitat not within the study area but it may fly through.
Neophema chrysostoma	Blue-winged Parrot	-	Ma	The main populations of Blue-winged Parrots are in TAS and VIC, particularly in southern VIC and the midlands and eastern areas of TAS. Sparser populations are found in western NSW and eastern SA, extending to south-west	(PMST)	Low. Recorded within the study locality. Preferred habitat

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				QLD and occasionally into the NT. The Blue-winged Parrot inhabits a range of habitats from coastal, sub-coastal and inland areas, right through to semi-arid zones. Throughout their range they favour grasslands and grassy woodlands. They are often found near wetlands both near the coast and in semi-arid zones.		not within the study area but it may fly through.
Pachyptila turtur	Fairy Prion	-	Ma	The Fairy Prion is found throughout oceans and coastal areas in the Southern Hemisphere. This marine species apparently occurs mainly offshore, but may move inshore during stormy weather. Its diet is comprised mostly of crustaceans (especially krill), but occasionally includes some fish and squid.	(PMST)	Low. Recorded within the study locality. Has potential to fly through the study area however, this species has a wide-ranging habitat and is highly mobile.
Pelagodroma marina	White-faced Storm-Petrel	-	Ma	The White-faced Storm-petrel breeds on remote islands in the south Atlantic, such as Tristan da Cunha (St Helena to UK) and also on the coast Australia and NZ. There are north Atlantic colonies on the Cape Verde Islands, Canary Islands, Spain and Savage Islands, Portugal. Outside the breeding season birds from the Atlantic have been seen off the east coast of North America and South	(PMST)	Low. Recorded within the study locality. Has potential to fly through the study area however, this species has a wide-ranging

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				America, and off the western coast of Central Africa. Breeds from Australia and NZ range as far as the northern Indian Ocean and the north-west coast of South America.		habitat and is highly mobile.
Stercorarius skua	Great Skua	-	Ma	This species breeds in Iceland, Norway, Svalbard (to Norway), the Faroe Islands (to Denmark), the Scottish islands and a few on mainland Scotland. It is a migratory species, normally wintering off the Atlantic coast of France and the Iberian Peninsulas, but juveniles can reach as far as Cape Verde, the coast of Brazil, areas of the Caribbean and small numbers also winter on the Grand Banks of Newfoundland (Canada). This marine species avoids land during migration and winter, aggregating in winter in areas where it can scavenge from fisheries. It has a hugely varied diet owing to be being a highly opportunistic feeder. Individuals regularly show individual specialisations in diet and feeding with some colony-specific learning. Breeding begins in May, and it is loosely colonial but highly territorial, breeding on islands on flat ground with some vegetation cover, usually avoiding human contact. Most birds breed within 1 km of their birth place.	(PMST)	Low. Recorded within the study locality. Has potential to fly through the study area however, this species has a wide-ranging habitat and is highly mobile.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Fish and Sygnathids						
Acentronura tentaculata	Shortpouch Pygmy Pipehorse	P (FM Act)	Ma	This species is found on tropical inshore reefs. It also occurs in temperate waters associated with shallow sandflats in protected and somewhat silty coastal areas among sparse low plant growth and in algae on rocks. This species inhabits waters of 7-40 m in depth. Pipefishes feed on small living crustaceans.	(PMST)	Moderate. Potential habitat within the study area, albeit widespread in the study locality.
Anampses elegans	Elegant wrasse	P (FM Act)	-	Elegant Wrasse are a widespread but uncommon species found on coral reef and rocky reef habitats at depths from 2 to 35 m. The distribution of elegant wrasse extends from southern QLD to Montague Island on the NSW south coast, particularly around inshore islands. The species is also found at Lord Howe Island, especially in the shallow lagoon habitat, and at nearby Elizabeth and Middleton Reefs, and they have also been recorded from Norfolk Island, the Kermadec Islands, NZ and Easter Island. Elegant wrasse are a subtropical, warm-temperate species that are active during the day.	(DPI)	Moderate. Potential habitat within the study area, albeit widespread in the study locality.
Festucalex cinctus	Girdled Pipefish	P (FM Act)	Ma	Endemic to tropical and temperate waters of the NT, QLD and NSW. Usually inhabits sheltered coastal bays and estuaries, on patches of rubble, sand or in areas of sparse seagrass, algal and	(PMST)	Moderate. Potential habitat within the study area, albeit

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				sponge growth. Most specimens were dredged or trawled in depths of 8-31 m but divers collected some specimens over rubble bottoms in depths of 12 m. In Sydney Harbour it is most common in depths of 10-20 m.		widespread in the study locality.
Filicampus tigris	Tiger Pipefish	P (FM Act)	Ma	The Tiger Pipefish is relatively common in subtropical waters of Australia's east and west coasts. A relic population also occurs in the warmer waters of Spencer Gulf, WA. Inhabits areas near channels in inshore sheltered bays and estuaries with sandy or muddy bottoms, or along seagrass bed edges at 2-30 m. Feeds on aggregations of mysid shrimps in sheltered bays adjacent to tidal channels.	(PMST)	Low. Preferred habitat not within the study area.
Heraldia nocturna	Upside-down Pipefish	P (FM Act)	Ma	Endemic to temperate waters of southern and south-eastern Australia, from about Hastings, NSW, southwards to VIC, to Port Davey on the west coast of Tasmania, westwards through SA to Geographe Bay, WA. Upside-down Pipefish inhabit sheltered inshore rocky reefs in harbours, bays and coves where they are found under ledges, in holes, crevices and small caves at 2-30 m.	(PMST)	Moderate. Potential habitat within the study area, albeit widespread in the study locality.
Hippichthys penicillus	Beady Pipefish	P (FM Act)	Ma	Widespread in the tropical Indo-west-central Pacific, from the Red Sea and East Africa across the Indian Ocean to	(PMST)	Low.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				north-eastern Australia, north to Taiwan, Japan, Micronesia and east to Samoa and Tonga. This species usually inhabits brackish waters in mangrove estuaries, tidal creeks and sometimes in freshwater reaches in the lower parts of rivers and streams.		Preferred habitat not within the study area.
Hippocampus abdominalis	Big-belly Seahorse	P (FM Act)	Ma	Known from temperate waters of NZ and southern Australia, where it occurs from about South West Rocks, NSW, southwards to the northern Great Australian Bight, WA, and south to the Derwent Estuary, TAS. Big-belly seahorses live in a range of habitats from low rocky reefs in shallow estuaries, to deep tidal channels and deeper coastal reefs to 100m. They cling to seagrasses, sponges, macroalgae such as kelp holdfasts and other structures on reefs.	(PMST)	Moderate. Potential habitat within the study area, albeit widespread in the study locality.
Histiogamphelus briggsii	Crested Pipefish	P (FM Act)	Ma	Endemic to temperate waters of south-eastern Australia, from NSW, south to VIC and TAS, and westwards to Gulf St Vincent. Crested Pipefish inhabit inshore sandy areas, singly or in small aggregations, often amongst detached seaweed or along the margins of Posidonia seagrass beds and in open sandy areas at 3–20 m; most common in Bass Strait.	(PMST)	Moderate. Potential habitat within the study area, albeit widespread in the study locality.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Lissocampus runa	Javelin Pipefish	P (FM Act)	Ma	Endemic to temperate waters of southern and eastern Australia; known from southern QLD, southwards to TAS, and across to about Rottnest Island, south-WA. Usually inhabits tidepools and sheltered bays, usually in seagrass and algal beds, and rocky and shelly rubble substrates to about 20 m.	(PMST)	Moderate. Potential habitat within the study area, albeit widespread in the study locality.
Maroubra perserrata	Sawtooth Pipefish	P (FM Act)	Ma	Endemic to temperate southern Australian waters from southern QLD to Rottnest Island, WA. The Sawtooth Pipefish inhabits coastal rocky reefs at 3-25m, sheltering beneath ledges and in caves during day.	(PMST)	Moderate. Potential habitat within the study area, albeit widespread in the study locality.
Notiocampus ruber	Red Pipefish	P (FM Act)	Ma	Endemic to temperate waters of southern and south-eastern Australia from Sydney Harbour, NSW, south and west to Flinders Island in Bass Strait, TAS, VIC, WA and the Recherche Archipelago, WA; usually inhabits rocky reefs, often in crevices, in association with sponges and encrusting and filamentous red algae at 5–20 m.	(PMST)	Moderate. Potential habitat within the study area, albeit widespread in the study locality.
Odontaspis ferox	Herbsts nurse shark	P (FM Act)	-	Herbsts Nurse Sharks are a rarely encountered species that looks very similar to the grey nurse shark. Grey nurse sharks are found in shallower inshore waters, while Herbsts nurse	(DPI)	Low. May swim through the study area albeit boat traffic

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				sharks are generally found at depths of 150–600 m off the NSW coast. The species has a wide but irregular distribution throughout the warm temperate and tropical waters of the Atlantic, Indian and Pacific oceans, and the Mediterranean Sea. In Australasia, they have been recorded off NSW, eastern VIC, north-WA, NZ and the Kermadec Islands. Herbsts nurse sharks usually live in relatively deep water on insular and continental shelves and upper slopes, and around seamounts. They have been caught off NSW in depths up to 850 m, and there are also records of the species from open waters of the Indian Ocean.		renders the study area as suboptimal.
Paraplesiops bleekeri	Eastern blue devil	P (FM Act)	-	Eastern Blue Devil are a shy, secretive fish found in caves, crevices and under ledges on inshore reefs and estuaries. Eastern blue devil fish are distributed from southern QLD to Montague Island on the NSW south coast. They can be found in waters between 3-30 m and are generally solitary occupying caves, crevices or under ledges.	(DPI)	Moderate. Potential habitat within the study area, albeit widespread in the study locality.
Phyllopteryx taeniolatus	Common Seadragon	P (FM Act)	Ma	Endemic to temperate coastal waters of southern Australia, from about Newcastle (NSW) south to Actaeon Island (TAS) and across southern Australia to about Geraldton (WA). Common seadragons	(PMST)	Moderate. Potential habitat within the study area, albeit

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				inhabit shallow estuaries to deeper offshore reefs, living seagrass beds and on rocky reefs covered in macroalgae, especially kelp beds, in depths of 1-50 m. Individuals usually remain within a broad home range.		widespread in the study locality.
Solegnathus spinosissimus	Spiny Pipehorse	P (FM Act)	Ma	Known from temperate waters of Australia and NZ. In Australian waters, Spiny pipehorses have been recorded from off Caloundra, southern QLD, to southern TAS, throughout Bass Strait to south of Cape Otway, VIC. In the southern part of their range, Spiny pipehorses inhabit relatively shallow waters. Specimens have been collected from muddy, silty, shelly and rubble substrates, and rocky reefs, and may be washed ashore after storms. Spiny Pipehorses use their prehensile tails to cling to macroalgae and sessile invertebrates on the substrate.	(PMST)	Moderate. Potential habitat within the study area, albeit widespread in the study locality.
Solenostomus cyanopterus	Robust Ghostpipefish	P (FM Act)	Ma	Widespread in the tropical Indo-west Pacific, from East Africa and the Red Sea, eastwards to Fiji and southern Japan, and south to Australia. Known in Australian waters from the Shark Bay region, WA, around the tropical north and southwards to at least Sydney Harbour, NSW. Robust Ghost Pipefish live in protected coastal and lagoon reefs, deeper coastal reefs and deep, clear	(PMST)	Moderate. Potential habitat within the study area, albeit widespread in the study locality..

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				estuaries with seagrass or macro-algae in 15-25m.		
Solenostomus paradoxus	Ornate Ghostpipefish	P (FM Act)	Ma	Widespread in tropical and warm-temperate regions of the Indo-west Pacific, from East Africa, eastwards to Fiji and Tonga, north to southern Japan, south to Australia and New Caledonia. Ornate Ghost Pipefish inhabit protected coastal, lagoon and outer reef areas with drop-offs or rock faces, in depths of 3-35 m. They often associate with Crinoids (featherstars), Gorgonians and black corals. Although usually solitary, they may be seen in pairs, or even in small groups.	(PMST)	Moderate. Potential habitat within the study area, albeit widespread in the study locality.
Stigmatopora argus	Spotted Pipefish	P (FM Act)	Ma	Found from the Hawkesbury River, NSW to Shark Bay, WA (WA) in temperate waters. Usually among vegetation in bays and estuaries, but sometimes offshore among floating Sargassum.	(PMST)	Moderate. Potential habitat within the study area, albeit widespread in the study locality..
Stigmatopora nigra	Widebody Pipefish	P (FM Act)	Ma	Known from temperate waters of southern Australia and NZ. The Widebody Pipefish occurs from about Fraser Island in southern QLD to north of Perth (WA), and around TAS. It is common in sheltered seagrass and algal beds from intertidal depths to 35 m.	(PMST)	Moderate. Potential habitat within the study area, albeit widespread in the study locality.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
Syngnathoides biaculeatus	Double-end Pipehorse	P (FM Act)	Ma	In Australian waters, known from Geraldton to Shark Bay, and north to Ashmore and Cartier Reefs, WA, and from the Timor Sea, the NT, eastwards to QLD and south to Batemans Bay (NSW). Inhabits shallow, protected waters of bays, lagoons and estuaries including mangrove areas, in association with seagrass beds and macroalgae in depths at 0-10 m. Juveniles sometimes found clinging to floating algae and plant debris including Sargassum rafts.	(PMST)	Moderate. Potential habitat within the study area, albeit widespread in the study locality.
Trachyrhamphus bicoarctatus	Bentstick Pipefish	P (FM Act)	Ma	Widespread in the tropical Indo-west Pacific. Bentstick Pipefish are known in Australian waters from the central coast of WA, northwards throughout the waters of the NT and QLD to central NSW. They live in sheltered coastal lagoon and reef areas on sandy and rubble habitats amongst seagrasses and macroalgae at 1– 30 m.	(PMST)	Moderate. Potential habitat within the study area, albeit widespread in the study locality.
Urocampus carinirostris	Hairy Pipefish	P (FM Act)	Ma	In Australia, known from the Shoalwater Bay region (QLD) to northern TAS, VIC, and to the Ceduna region of WA, and in south-WA where it reaches the Perth region. Rare in WA. Inhabits the lower reaches of rivers, sheltered estuaries and shallow reefs in seagrass and algal beds a 0-6 m. One of the most common estuarine pipefishes in	(PMST)	Moderate. Potential habitat within the study area, albeit widespread in the study locality.

Scientific Name	Common Name	BC Act/FM Act	EPBC Act	Habitat requirements*	Number of records (source)+	Likelihood of occurrence
				eastern Australia, occurring year-round in seagrass beds in Western Port (VIC), and abundant in seagrass beds in Moreton Bay (QLD).		
Vanacampus margaritifer	Mother-of-pearl Pipefish	P (FM Act)	Ma	Endemic to sub-tropical and temperate Australia, from North Stradbroke island, QLD, southwards to Jurien Bay, WA, absent from TAS. Inhabits shallow estuarine and coastal waters in seagrass beds), macroalgae (*Ecklonia* spp. and other brown algae), rocky reef, boulder, rubble, sandy and muddy habitats between 2–15 m.	(PMST)	Moderate. Potential habitat within the study area, albeit widespread in the study locality.

** Distribution and habitat requirement information adapted from:*

Australian Government DAWE https://www.environment.gov.au/biodiversity/threatened/species.

NSW DPE-EES http://www.environment.nsw.gov.au/threatenedSpeciesApp/. and

NSW DPI (Fisheries) listed threatened species, populations and ecological communities https://www.dpi.nsw.gov.au/fishing/species-protection/what-current.

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Australian Government DAWE PMST http://www.environment.gov.au/epbc/protected-matters-search-tool.

Key:

Ma = marine (EPBC Act only)

P = protected (FM Act)

11 Appendix C – Assessments of significance

Preamble

The Assessments of Significance (AoSs) have been completed by Jake Ludlow (BSc) ecologist for Cardno, for the White's Seahorse listed under the FM Act and the EPBC Act that was identified as having a moderate to high potential to occur within the study area due to the presence of nearby records and/or the presence of suitable habitat. These species were identified in section 3.11 and include:

- White's Seahorse (*Hippocampus whitei*) listed as endangered under the FM Act

No threatened ecological communities (TECs) occur within or next to the study area thus, no AoSs are required for this proposal.

Under the BC Act a five-part test of significance is applied to determine whether an activity is likely to have a significant impact on listed threatened species, ecological communities, or their habitats, or will be carried out in a declared area of outstanding biodiversity value. The test of significance is set out in section 7.3 of the BC Act.

Part 7A of the FM Act lists threatened species, populations and ecological communities and key threatening processes (KTPs) for species, populations and ecological communities in NSW waters. Section 220ZZ of the FM Act outlines significant impact considerations to threatened species, populations and ecological communities listed under the FM Act. Under the FM Act, a '7-part test' is carried out to assess the likelihood of significant impact upon threat-listed species, populations or ecological communities listed under the FM Act. The document *Threatened Species Assessment Guidelines: The Assessment of Significance* (NSW DPI, 2008) outlines a set of guidelines to help proponents of a development or activity with interpreting and applying the factors of assessment in the seven-part test. The guidance provided by the NSW DPI (Threatened Species Assessment Guidelines: The Assessment of Significance, 2008) has been used here in preparing the seven-part test.

For the species listing under the EPBC Act, a significance assessment has been completed in accordance with the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DoE, 2013). Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment that is affected, and upon the intensity, duration, magnitude and geographic extent of the impacts (DoE, 2013). Importantly, for a 'significant impact' to be 'likely', it is not necessary for a significant impact to have a greater than 50 per cent chance of happening. it is sufficient if a significant impact on the environment is a real or not remote chance or possibility (DoE, 2013).

Species listed under the FM Act and the EPBC Act have been assessed using the corresponding assessment guidelines separately. Species with similar life stage/habitat requirements (ie cave-roosting microbats) have been assessed together.

White's Seahorse (*Hippocampus whitei*) – endangered (FM Act)

The following questions test whether a proposed development or activity is likely to significantly affect White's Seahorse:

1. In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

White's Seahorse has limited geographical distribution in Australia and is endemic to nine estuaries, coastal lakes and embayments from Wallis Lake in the north to Lake Illawarra in the south, along approximately 300 kilometre of the NSW coast (Harasti, et al., 2014). White's seahorse is known to occur at depths of between one and 15 metres and can be found in a wide range of habitat types (both natural and artificial). Natural habitat for White's Seahorse in estuaries includes marine vegetation (ie seagrass, macroalgae on rocky reef and mangroves) as well as sponges and corals (Australian Museum, 2020; Harasti, et al., 2014; Kuiter, 2009). In Sydney, they are often found associated with artificial structures, particularly protective swimming net enclosures and jetty pylons. Their use of artificial habitats appears to be most common in areas where natural habitat (such as seagrass, sponges and soft corals) has been lost (Fisheries Scientific Committee, 2019). The species is found to prefer habitats with dense epibiotic growth and avoids areas devoid of growth, possibly in relation to the greater availability of shelter and prey in these areas (Harasti, et al., 2010). Densities in artificial habitats such as swimming nets can be as much as one per square metre, but estimates in natural habitat have been around an order of magnitude less (Harasti, Martin-Smith, & Gladstone, Population dynamics and life history of a geographically restricted seahorse, Hippocampus whitei, 2012).

Data collected on breeding pairs found that White's Seahorse displays life-long monogamy, with three pairs observed remaining bonded over three consecutive breeding years (Harasti, et al., 2012). The breeding season for White's Seahorse extends between from about October to April (Australian Museum, 2020).

The study area is considered to provide suitable habitat for White's Seahorse within subtidal low relief rocky reef, macroalgae and seagrass (less than 0.01 hectares combined). As per NSW DPI Fisheries advice on 21 February 2021 a targeted survey and relocation of seahorses is not required due to negligible impacts from the proposal.

2. In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

3. In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

    (a) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

    (b) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

Not applicable.

4. In relation to the habitat of a threatened species, population or ecological community:

    (a) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

(b) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

(c) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the threatened species, population or ecological community in the locality

As indicated in (1), White's Seahorse are generally associated with seagrass meadows which are present in the study area. No known populations are known to occur in the study area. It is also likely that the frequent exposure to vessel wash and currents may render habitat in the study area suboptimal.
The proposal would utilise light penetrating decking (30x30mm mesh) which would not shade seagrass or marine vegetation. The vegetation within the study area considered suboptimal for this species due to the low density of shoots and the exposure to vessel wash and currents. These are considered small proportions of potential habitat for the species in the study area and the wider harbour and these impacts would not remove these areas from the species occupancy (ie the species is still able to transit or disperse through soft sediment areas). Furthermore, the new piles and pontoon to be installed would form potential habitat, covering similar surface areas as those removed, once habitat-forming species have colonised. Thus, although the proposal may alter habitat important for the long-term survival of the species, additional habitat would be installed and not fragment or isolate potential habitat for the species in the harbour.

5. Whether the proposed development or activity is likely to have an adverse effect on any critical habitat (either directly or indirectly)

Critical habitat refers to those areas listed in the Register of Critical Habitat kept by NSW DPI (Fisheries). This question is not applicable, as no critical habitat has been listed for White's Seahorse.

6. Whether the proposed development or activity is consistent with a recovery plan or threat abatement plan

There is no recovery plan or threat abatement plan (TAP) for this species. It was, however, in the opinion of the Fisheries Scientific Committee that White's Seahorse is eligible to be listed nationally as endangered under the Common Assessment Method (Fisheries Scientific Committee, 2019).

In the interim, the Scientific Committee has recommended management actions for White's Seahorse, including:

- Collate and synthesise data collected to quantify the significance of high and moderate risk threat interactions with *H. whitei* (medium priority)
- Reduce the impact of public and private boat moorings that impact on *H. whitei* habitats (high priority)
- Councils to maintain best practice management of protective swimming nets by using the suggested NSW DPI seahorse friendly cleaning methods (high Priority)
- Consider information on *H. whitei* distribution, abundance and habitat preferences during development and review of Marine Park Zoning Plans (medium priority)
- Negotiate with relevant authorities to encourage the identification, assessment and modification of natural resource management plans and policies to minimise impacts on *H. whitei* habitats (medium priority)
- Continue to monitor the distribution and abundance of *H. whitei* at important sites (Port Stephens and Sydney Harbour) to inform population status and to assist in determining the effectiveness of recovery actions (high priority)

- Develop and trial artificial habitats to promote recovery of *H. whitei* populations (high priority).
- Implement research using eDNA to investigate the occurrence of *H. whitei* in estuaries and embayments across its range (high priority)
- Implement genetics research to investigate population structure of *H. whitei* across its entire range (NSW and Qld) (medium priority)
- Encourage the reporting of sightings of seahorses along the east coast of Australia to iSeahorse and iNaturalist (medium priority).

The proposal is unlikely to interfere with any of the above recommendations. Targeted surveys during pre-construction to capture and relocate individuals could be completed in consultation with NSW DPI (Fisheries) to align with some of the above management recommendations (see Chapter 5).

7. Whether the proposed development constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

A KTP is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community.

The KTP of *Installation and operation of instream structures and other mechanisms that alter natural flow regimes of rivers and streams* (FM Act) is of relevance given instream structures would be placed in or adjacent to White's Seahorse habitat. This KTP is discussed in section 4.1.7. These structures are unlikely to substantially alter nearshore natural tidal flow and therefore would not be exacerbated by the proposal to significantly impact White's Seahorse.

Conclusion

White's Seahorse are known to occur in the harbour and the study area provides potential habitat for the species in existing wharf structures and seagrass meadows. Additional habitat would be installed and not fragment or isolate potential habitat for the species in the study area. Furthermore, this area of seagrass loss is considered suboptimal for this species due to the low density of shoots and exposure to vessel wash and currents. As per NSW DPI Fisheries advice on 21 February 2021 a targeted survey and relocation of seahorses is not required due to negligible impacts from the proposal. Thus, the proposal is unlikely to have a significant impact on White's Seahorse. Therefore, a SIS is not required

Significant impact assessment (EPBC Act)

White's Seahorse (*Hippocampus whitei*) – endangered (EPBC Act)

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

a. lead to a long-term decrease in the size of an important population of a species

White's Seahorse has limited geographical distribution in Australia and is endemic to nine estuaries, coastal lakes and embayments from Wallis Lake in the north to Lake Illawarra in the south, along approximately 300 kilometre of the NSW coast (Harasti, Martin-Smith, & Gladstone, Ontogenetic and sex-based differences in habitat preferences and site fidelity of the White's seahorse Hippocampus whitei, 2014). White's seahorse is known to occur at depths of between one and 15 metres and can be found in a wide range of habitat types (both natural and artificial). Natural habitat for White's Seahorse in estuaries includes marine vegetation (ie seagrass, macroalgae on rocky reef and mangroves) as well as sponges and corals (Australian Museum, 2020; Harasti, et al., 2014; Kuiter, 2009). The species is found to prefer habitats with dense epibiotic growth and avoids areas devoid of growth, possibly in relation to the greater availability of shelter and prey in these areas (Harasti, et al., 2010). Densities in artificial habitats such as swimming nets can be as much as one per square

metre, but estimates in natural habitat have been around an order of magnitude less (Harasti, et al., 2012).

Data collected on breeding pairs found that White's Seahorse displays life-long monogamy, with three pairs observed remaining bonded over three consecutive breeding years (Harasti, et al., 2012). The breeding season for White's Seahorse extends between October to April (Australian Museum, 2020).

The study area is considered to provide suitable habitat for White's Seahorse within subtidal low relief rocky reef, macroalgae and seagrass (approximately 0.1 hectares). As per NSW DPI Fisheries advice on 21 February 2021 a targeted survey and relocation of seahorses is not required due to negligible impacts from the proposal.

b. reduce the area of occupancy of an important population

As indicated in (a), White's Seahorse has potential to reside in subtidal low relief rocky reef, macroalgae and seagrass

It is also likely that the frequent exposure to vessel wash and currents may render habitat in the study area suboptimal. The habitat is considered suboptimal due to the low density of shoots and exposure to vessel wash and currents. These are considered small proportions of potential habitat for the species in the study area and the wider harbour and shading of subtidal rocky reef habitat is unlikely to remove these areas from use by the species. The new piles to be installed would form potential habitat once habitat-forming species have colonised. Thus, the proposal is unlikely to reduce the area of occupancy of the White's Seahorse.

c. fragment an existing important population into two or more populations

As indicated in (a) and (b), the White's Seahorse habitat occurs in nearshore areas. This species exhibits high site fidelity and does not have a pelagic juvenile stage. Young are known to either disperse short distances from or simply settle at the birth site. High abundances if any, of this species are not known to occur in the study area. However, the proposal is not expected to install any structures or alter operations such that potential dispersal corridors along the foreshore would become fragmented or isolated. Thus, the proposal is unlikely to fragment an existing population of White's Seahorse if present, in the harbour into two or more populations.

d. adversely affect habitat critical to the survival of a species

Habitat critical to the survival of a species refers to areas that are necessary for activities such as:

- Foraging, breeding, roosting, or dispersal
- For the long-term maintenance of the species including the maintenance of other species essential to the survival of the species, such as pollinators
- To maintain genetic diversity and long-term evolutionary development
- For the reintroduction of populations or recovery of the species.

See (a) and (b). The proposal has potential to alter suboptimal habitat for the species. However

However, some of the lost habitat would be reinstated (in a similar area than that lost) and the remaining habitat would be altered but still be available and considered a potential area of occupancy. Thus, the proposal is unlikely to adversely affect habitat critical to the survival of the White's Seahorse.

e. disrupt the breeding cycle of an important population

Research found that White's Seahorse displays life-long monogamy, with three pairs observed remaining bonded over three consecutive breeding years (Harasti, et al., 2012).

Thus, the loss of any individuals would disrupt the breeding cycle of White's Seahorse. No individuals are expected to be lost as a result of the proposal (see (a)). Any individuals occurring within the study area would be relocated prior to construction by a qualified marine ecologist using researched methods to avoid disruption to their lifecycle. Habitat would be selected by a marine ecologist and individuals would only be relocated to nearby, like-for-like habitat (as per advice from NSW DPI (Fisheries)). Hence, the proposal is unlikely to disrupt the breeding cycle of a population.

f. modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

See (b) and (c). The proposal is unlikely to modify, destroy, remove or isolate or decrease the availability of quality of habitat to the extent that the White's Seahorse is likely to decline.

g. result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

Use of equipment and movement of vessels and barges have potential to act as vectors for introduced species. However, there are no known invasive species that could be introduced that could directly cause White's Seahorse to decline. Invasive species that would alter White's Seahorse habitat could be introduced via the aforementioned vectors however, proposal controls would be in place to avoid introducing or spreading invasive species. Thus, the proposal is unlikely to introduce or spread invasive species that are harmful to White's Seahorse.

h. introduce disease that may cause the species to decline

As per (g).

i. interfere substantially with the recovery of the species

There is currently no recovery plan or recommendations for a recovery plan for the White's Seahorse. When this species was initially nominated for listing under the EPBC Act, the Fisheries Scientific Committee had recommended management actions for the White's Seahorse, including:

- Collate and synthesise data collected to quantify the significance of high and moderate risk threat interactions with *H. whitei* (medium priority)
- Reduce the impact of public and private boat moorings that impact on *H. whitei* habitats (high priority)
- Councils to maintain best practice management of protective swimming nets by using the suggested NSW DPI seahorse friendly cleaning methods (high Priority)
- Consider information on *H. whitei* distribution, abundance and habitat preferences during development and review of Marine Park Zoning Plans (medium priority)
- Negotiate with relevant authorities to encourage the identification, assessment and modification of natural resource management plans and policies to minimise impacts on *H. whitei* habitats (medium priority)
- Continue to monitor the distribution and abundance of *H. whitei* at important sites (Port Stephens and Sydney Harbour) to inform population status and to assist in determining the effectiveness of recovery actions (high priority)
- Develop and trial artificial habitats to promote recovery of *H. whitei* populations (high priority).
- Implement research using eDNA to investigate the occurrence of *H. whitei* in estuaries and embayments across its range (high priority)
- Implement genetics research to investigate population structure of *H. whitei* across its entire range (NSW and Qld) (medium priority)

- Encourage the reporting of sightings of seahorses along the east coast of Australia to iSeahorse and iNaturalist (medium priority).

The proposal would not interfere with any of the above recommendations. Targeted surveys during pre-construction to capture and relocate the species could be completed in consultation with NSW DPI (Fisheries) to align with some of the above management recommendations.

Conclusion

The study area possesses suboptimal habitat for the species and it is not known to disperse (either as adults or juveniles) great distances from the birth sites. Potential habitat in the study area occurs as subtidal low relief rocky reef, macroalgae and seagrass. As per NSW DPI Fisheries advice on 21 February 2021 a targeted survey and relocation of seahorses is not required due to negligible impacts from the proposal. The proposal is unlikely to fragment the population of White's Seahorse in the study area, disrupt the breeding cycle of the species, introduce or spread invasive species or disease that may adversely impact the species or interfere with any recovery objectives. Thus, the proposal is unlikely to significantly impact White's Seahorse and a referral is not required.

Appendix D

Statement of heritage impact

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WOLLONGONG HARBOUR
WOLLONGONG
NEW SOUTH WALES

STATEMENT OF HERITAGE IMPACT

DRAFT REPORT

CARDNO

12 January 2022

DOCUMENT INFORMATION

Project:	Wollongong Harbour
Services required:	Statement of Heritage Impact
Client:	Cardno
Prepared by:	Nicole Monk, Stephanie Moore
Project number:	21152

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EXECUTIVE SUMMARY

Austral Archaeology (Austral) has been commissioned by Cardno, on behalf of Transport for NSW (the Proponent) to undertake a Statement of Heritage Impact (SOHI) for the proposed Wollongong Harbour Public Pontoon, Wollongong, New South Wales (NSW). The proposed development consists of upgrading the mooring and loading/unloading areas within the Belmore Basin at Wollongong Harbour. This report will form part of a Review of Environmental Factors (REF) being prepared by Cardno on behalf of Transport for NSW under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EPA Act).

The study area consists of Lot 1, DP739591 (Figure 1.1 and Figure 1.2). The study area is located within Wollongong Central Business District (CBD) and is within the Wollongong Local Government Area (LGA). The study area is listed under Schedule 5 of the Wollongong LEP as: "Stone Steps" (LEP No. 6364) and "Harbour Steps" (LEP No. 6418).

The purpose of this SOHI is to assess the potential impact from the development on the significance of any built, landscape and archaeological values that may be present within or in the vicinity of the study area. The report will provide suitable management recommendations should impacts to identified historic heritage values be anticipated.

This SOHI report evaluates the European (Historic) heritage within the study area and does not include Aboriginal cultural heritage or recommendations regarding Aboriginal cultural heritage.

IDENTIFIED HERITAGE VALUES

It is concluded that there are varying degrees of historical heritage values potential and sensitivity within the study area owing to its use as a functioning harbour. Historic heritage values of interest relate to 2 different phases of occupation:

- Phase 1: Wollongong Harbour –1849 - 1850
- Phase 2: Construction of Belmore Basin 1850 - 1900

These remains are likely to be associated with the use of the harbour for the transportation of cedar and coal.

HISTORIC BACKGROUND

During the early years of the colony, the study area was an important port for the transportation of supplies around the Illawarra. During the 1830s, works to protect and increase the capabilities of the harbour resulted in the development of a basin, stairs, a quay and piers around and within the study area.

Following the increased production of coal in the late 19th century, the study area underwent further maintenance works, including the deepening of the harbour, and the construction of Belmore Basin in 1865.

The start of the 20th century saw the harbour and study area move from coal and cedar transportation to recreation and fishing activities. The the study area now contains 44 berths, predominantly used by commercial fishing vessels and tour operators.

PROPOSED WORKS

The proposal is to construct a new Public Pontoon at the Belmore Basin marina of Wollongong Harbour. The key features of the proposal would include:

- Installation of a 25 metre by five metre steel and aluminium pontoon, with a fixed ramp and four steel piles, near the end of the central pier to provide safer access for trawlers, charter vessels, yachts and other recreational craft
- Installation of a new 5 metre by 5 metre fixed platform and 20 metre by 1.8 metre aluminium gangway to access the new pontoon
- Orientation of the new pontoon in line with the prevailing wave direction, which will assist to provide the lowest motions, to enhance user safety and comfort

- Installation of two restraint piles on either end of the pontoon to minimise impacts from vessels
- Introduction of designated temporary parking area for pick up/drop off and loading/unloading activities.

STATEMENT OF SIGNIFICANCE

The statement of significance is quoted from the State Heritage Inventory for the Wollongong Harbour Precinct, although only parts relevant to the study area are below:

> *Wollongong Harbour Precinct is of State significance because it displays the infrastructure on which the first southern port outside Sydney was founded and developed at Wollongong. It also provides evidence of the measures taken to defend that important southern outpost of the colony.*
>
> *The Precinct includes fabric deriving from each stage of its development from the substantially intact 19th century convict-built harbour together with modifications made as it developed from a commercial harbour to its present function as a fishing and tourist port.*
>
> *The harbour was the first port in the Illawarra and is the oldest and most intact extant block walled harbour in NSW. It comprises the Belmore Basin (the block walled harbour); the 1869 rubble mound breakwater; mooring rings, other related appurtenances and remnants of facilities left as the harbour developed.*
>
> *Also included in the Precinct is the 1872 Breakwater lighthouse, one of the early lighthouses of NSW and one of only two wrought iron lighthouses in NSW - the other being at Ulladulla and built to the same design by the same engineer, Joseph Mather of Sydney.*
>
> *The harbour is associated with two of the most important Colonial engineers; Belmore Basin was constructed under George Barney, Commanding Royal Engineer and Colonial Engineer, and the outer harbour under Edward Orpen Moriarty, first Engineer-in-Chief, Harbours & Rivers of the Public Works Department, whose work included the Breakwater lighthouse;*
>
> *The Harbour was essential to the development of Wollongong and was the focus of Wollongong's commercial, administrative, judicial and social activities from the early 19th century until well into the 20th century.*

As such, the Wollongong Harbour within the study area is considered to meet the Heritage Significance Criteria (a), (b), (c), (e) and (f) at the State level.

CONCLUSIONS

This report has concluded that the proposed works will have a negligible impact on known heritage values within and surrounding the study area. The works will allow safe continuation of commercial and recreational use of Wollongong Harbour and Belmore Basin.

RECOMMENDATIONS

The following recommendations have been developed to mitigate harm resulting from unexpected finds that may occur during construction.

1. If historical archaeological relics not assessed or anticipated by this report are found during the works, all works in the immediate vicinity are to cease immediately and the Heritage NSW be notified in accordance with the conditions of the Section 60 permit. A qualified archaeologist is to be contacted to assess the situation and consult with the Heritage NSW regarding the most appropriate course of action.
2. If Aboriginal archaeological material or deposits are encountered during earthworks, all works affecting that material or deposits must cease immediately to allow an archaeologist to make an assessment of the find. The archaeologist may need to consult with Heritage NSW and the relevant Aboriginal stakeholders regarding the find. Section 89A of the *National Parks & Wildlife Act 1974* requires that Heritage NSW must be notified of any Aboriginal objects discovered within a reasonable time.
3. Should the actual development be altered significantly from the proposed concept design, then a reassessment of the heritage/archaeological impact may be required. This includes any impacts not explicitly stated in Section 1.3 or the REF.

4. A copy of this assessment should be lodged by the proponent in the local history section of the local library, and in the library maintained by Heritage NSW.

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1. INTRODUCTION

Austral Archaeology (Austral) has been commissioned by Cardno on behalf of Transport for NSW (the Proponent) to undertake a Statement of Heritage Impact (SOHI) for the proposed Wollongong Harbour Public Pontoon, Wollongong, New South Wales (NSW). This report will form part of a Review of Environmental Factors (REF) being prepared by Cardno on behalf of Transport for NSW under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The study area consists of Lot 1, DP739591. The study area is located within Wollongong Central Business District (CBD) and is within the Wollongong Local Government Area (LGA).

The location of the study area is shown in Figure 1.1, Figure 1.2 and Figure 1.3.

1.1 METHODOLOGY

The methodology supporting this report involved a period of research to locate additional background material and to prepare a synthesis of the historical research to reflect better and understand the historical context of the study area.

The report is underpinned by the philosophy of the International Council on Monuments and Sites (ICOMOS) and the *Burra Charter: Australia ICOMOS Charter for Places of Cultural Significance, 2013* (Burra Charter), the practices and guidelines of the Heritage NSW and the requirements of the *Wollongong Local Environmental Plan 2009* (Wollongong LEP) and *Wollongong Development Control Plan 2009* (Wollongong DCP).

1.2 ASSESSMENT OBJECTIVES

The purpose of this SOHI is to assess the potential impact from the development on the significance of any heritage values that may be present within or in the vicinity of the study area. The report will provide suitable management recommendations should impacts to heritage values be anticipated.

The objectives of this report are to:

- Identify any potential historical heritage and archaeological values within or in the vicinity of the study area;
- Produce an archaeological predictive model and sensitivity map to guide any management decisions regarding the study area;
- Make a statement of significance regarding any historical heritage values that may be impacted by the proposed development;
- Assess the impact of the proposed works on any identified heritage values; and
- Make appropriate management and mitigation recommendations.

1.3 PROPOSED WORKS

Transport for NSW proposed to construct a new Public Pontoon at Belmore Basin, as part of the Wollongong Harbour Master Plan. The proposal will improve access to the central pier and marine vessels for users. The key features of the proposal would include:

- Installation of a 25 metre by five metre steel and aluminium pontoon, with a fixed ramp and four steel piles, near the end of the central pier to provide safer access for trawlers, charter vessels, yachts and other recreational craft
- Installation of a new 5 metre by 5 metre fixed platform and 20 metre by 1.8 metre aluminium gangway to access the new pontoon
- Orientation of the new pontoon in line with the prevailing wave direction, which will assist to provide the lowest motions, to enhance user safety and comfort
- Installation of two restraint piles on either end of the pontoon to minimise impacts from vessels

- Introduction of designated temporary parking area for pick up/drop off and loading/unloading activities.

The main design features of the proposal are:

- Pontoon
    - The Public Pontoon would consist of a pontoon that is a rectangular steel and aluminium floating structure 25 metres long and five metres wide.
    - The pontoon will be used for boarding of trawlers, charter vessels, yachts and other recreational craft. The pontoon will be orientated parallel to the existing shoreline and in line with the prevailing wave direction. This alignment will minimise vessel motion and enhance user safety and comfort. The pontoon would be supported by a fixed platform and four steel restraint piles.
    - A total of four steel restraint piles will be installed to minimise wear and prolong the life of the pontoon. These restraint piles will be installed in pairs on the northern and southern ends of the pontoon.
- Gangway and fixed platform
    - The Public Pontoon would also include access to the pontoon via a 20 metre long and 1.8 metre wide aluminium gangway attached to a 5 metre by 5 metre fixed platform. The fixed platform will be connected to the shoreline approximately 15 metres south east of the heritage listed harbour steps.
- Temporary parking area
    - An approximately 15 metre by 6 metre area on the existing shore will be designated for temporary parking. Line markings and signage would be erected for the temporary parking area. The temporary parking area will be used for the pick up and drop off of users of the pontoon and the loading and unloading of equipment.

The proposal would be constructed over a duration of up to 3 months, starting in late 2022.

Further details of the proposed works methodology can be found in the REF.

1.4 PROJECT TEAM AND ACKNOWLEDGEMENTS

The project team has been led by Stephanie Moore (Senior Archaeologist, Austral) who has managed the project and provided input into the assessment approach and management recommendations. The assessment was authored by Nicole Monk (Archaeologist, Austral). Alexander Beben (Director, Austral) reviewed the draft report for quality assurance and technical adequacy.

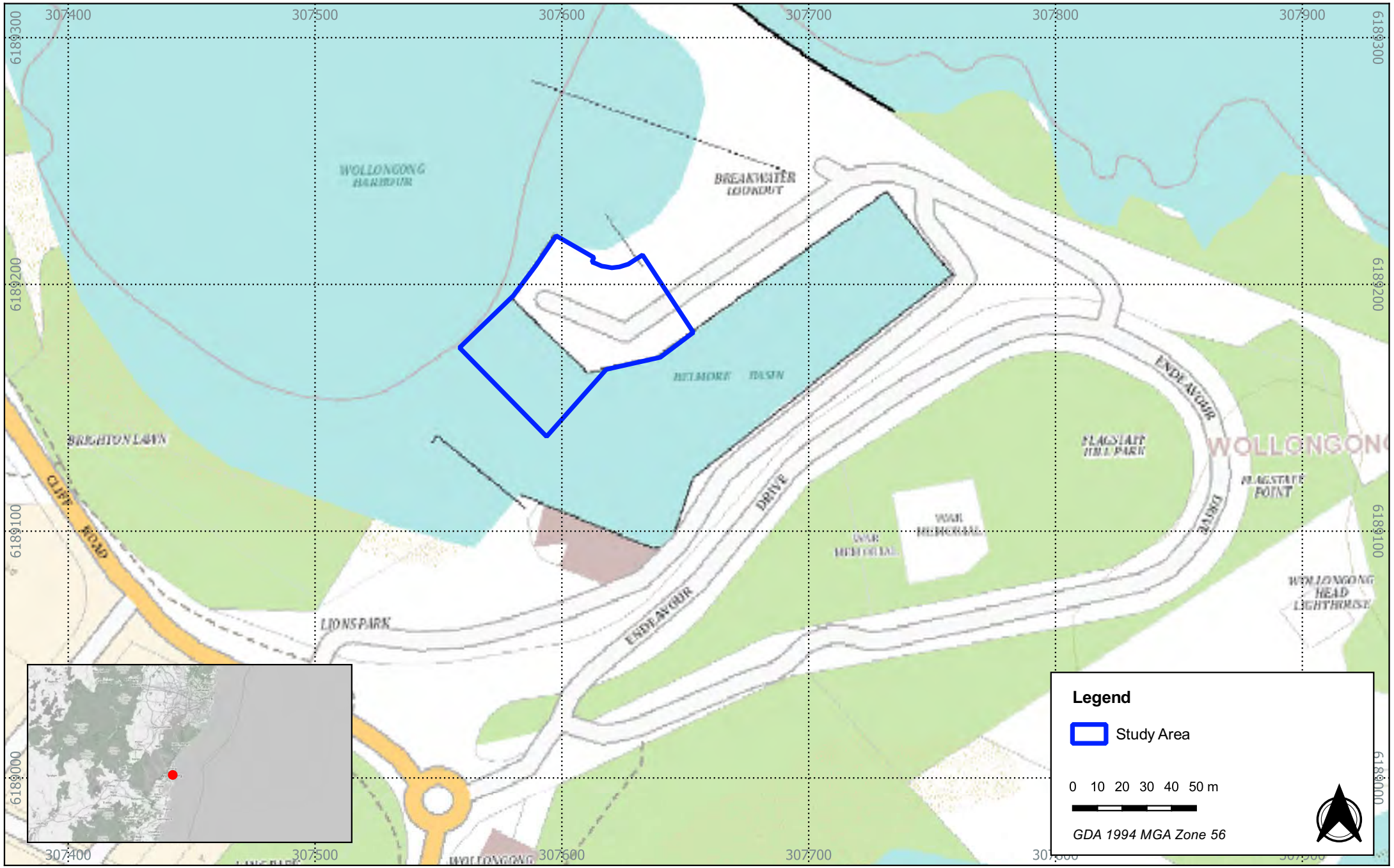

Figure 1.1 - Location of the study area

21152 - Endeavour Drive Wollongong - SOHI

Source: OSM, OSM Monochrome

Drawn by: ARH Date: 2022-01-07

AUSTRAL ARCHAEOLOGY

Figure 1.2 - Detailed aerial showing the study area

21152 - Endeavour Drive Wollongong - SOHI

Source: NSW LPI Aerial, OSM Monochrome

Drawn by: ARH Date: 2022-01-07

AUSTRAL ARCHAEOLOGY

Figure 1.3 Cadastral boundaries within and surrounding the study area

21152 - Endeavour Drive Wollongong - SOHI

Source: NSW LPI Aerial

Drawn by: ARH Date: 2022-01-07

AUSTRAL ARCHAEOLOGY

1.5 LIMITATIONS OF THE REPORT

This assessment includes an assessment of archaeological values to support the REF being prepared by Cardno. The report must be read in conjunction with the REF as it refers to supporting documentation not included within this report. It does not include an assessment of Aboriginal cultural heritage that may be present within the study area.

The results, assessments and judgements contained in this report are constrained by the standard limitations of historical research and by the unpredictability inherent in archaeological zoning from the desktop. Whilst every effort has been made to gain insight to the historical values of the study area, Austral cannot be held accountable for errors or omissions arising from such constraining factors.

1.6 ABBREVIATIONS

The following are common abbreviations that are used within this report:

AHC	Australian Heritage Council / Australian Heritage Commission (former)
Austral	Austral Archaeology Pty Ltd
Burra Charter	Burra Charter: Australia ICOMOS Charter for Places of Cultural Significance 2013
CBD	Central Business District
CHL	Commonwealth Heritage List
DCP	Development Control Plan
DPC	Department of Premier and Cabinet
EP&A Act	Environmental Planning and Assessment Act 1979
EPBC Act	Environmental Protection and Biodiversity Act 1999
EPI	Environmental Planning Instrument
Heritage Act	NSW Heritage Act 1977
ICOMOS	International Council on Monuments and Sites
IHO	Interim Heritage Order
LEP	Local Environmental Plan
LGA	Local Government Area
NHL	National Heritage List
NPW Act	National Parks and Wildlife Act 1974
NSW	New South Wales
REF	Review of Environmental Factors
RNE	Register of the National Estate
s170	Section 170 Heritage Register
SHI	State Heritage Inventory
SHR	State Heritage Register
SOHI	Statement of Heritage Impact
Study Area	Wollongong Harbour
TfNSW / the Proponent	Transport for New South Wales
Wollongong DCP	Wollongong Development Control Plan 2009
Wollongong LEP	Wollongong Local Environmental Plan 2009

Refer also to the document Heritage Terms and Abbreviations, published by the Heritage Office and available on the website: http://www.environment.nsw.gov.au/heritage/index.htm.

2. STATUTORY CONTEXT

The following section summarises the relevant statutory context, including heritage listings, acts, and environmental planning instruments which are relevant to the study area and its cultural heritage.

2.1 ENVIRONMENTAL PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) established the Australian Heritage Council (formerly the Australian Heritage Commission) and provides for the protection of cultural heritage at a national level, and for items owned or managed by the Commonwealth. The EPBC Act has established two heritage registers:

- National Heritage List (NHL): for items assessed as being of national cultural significance.
- Commonwealth Heritage List (CHL): for significant items owned or managed by Commonwealth Government agencies;

A referral under the EPBC Act that is approved by the Australian Heritage Council is required for works to an item registered on either of these lists to ensure that the item's significance is not impacted upon.

No part of the study area appears on either the CHL or NHL.

The Australian Heritage Council is also responsible for keeping the Register of the National Estate (RNE). In 2007, the RNE was frozen and no further sites were added to it. The RNE was superseded by the CHL and NHL lists. The RNE is now retained as an archive of information about more than 13,000 places throughout Australia.

The study area is listed on the RNE as "Wollongong Harbour (part) Endeavour Dr, Wollongong, NSW Australia" (Place ID. 1537).

2.2 NSW HERITAGE ACT 1977

The Heritage Council is the approval authority under the Heritage Act for works to an item on the State Heritage Register (SHR). Section 57(1) of the Heritage Act identifies the need for Heritage Council approval if the work involves the following tasks:

- Demolishing the building or work;
- Damaging or despoiling the place, precinct or land, or any part of the place, precinct or land;
- Moving, damaging or destroying the relic or moveable object;
- Excavating any land for the purpose of exposing or moving the relic;
- Carrying out any development in relation to the land on which the building, work or relic is situated, the land that comprises the place, or land within the precinct;
- Altering the building, work, relic or moveable object;
- Displaying any notice or advertisement on the place, building, work, relic, moveable object or land, or in the precinct; and
- Damaging or destroy any tree or other vegetation on or remove any tree or other vegetation from the place, precinct or land.

Demolition of an SHR item (in whole) is prohibited under the Heritage Act, unless the item constitutes a danger to its occupants or the public. A component of an SHR item may only be demolished if it does not contribute to the significance of the item.

Section 57(1) of the Heritage Act also applies to archaeological remains (such as relics) within an SHR site, and excavation can only proceed subject to approval of a Section 60 application by Heritage NSW.

The study area is listed on the SHR as "Wollongong Harbour Precinct" (Place ID. 01823).

HERITAGE AND CONSERVATION REGISTER (SECTION 170 REGISTER)

Under Section 170 of the Heritage Act, government instrumentalities must keep a Heritage and Conservation Register (a Section 170 Register) which contains items under the control or ownership of the agency, and which are, or could, be listed as heritage items (of State or local significance). Road reserves within the study area are owned by Transport for NSW.

No part of the study area appears on any Section 170 Heritage and Conservation registers.

2.3 ENVIRONMENTAL PLANNING INSTRUMENTS

An Environmental Planning Instrument (EPI) is made under the EPA Act. An EPI can be a Development Control Plan (DCP), Local Environmental Plan (LEP) or a State Environmental Planning Policy.

WOLLONGONG LOCAL ENVIRONMENTAL PLAN 2009

The current LEP for the study area is the Wollongong LEP. Part 5.10 of the Wollongong LEP deals with heritage conservation, and subsections (2) and (3) determine whether development consent needs to be granted by Wollongong Council before any activities occurring which may impact cultural heritage. Heritage items are listed under Schedule 5, Part 1 of the Wollongong LEP.

The study area is listed on Schedule 5 of the Wollongong LEP as:

- **"Harbour Steps" (LEP No. 6418)**
- **North Beach Precinct and Belmore Basin Heritage Conservation Area (part).**

The SHI online portal maps an additional item "Harbour Steps" (LEP No. 6419) within the study area. A search of Schedule 5 of the LEP indicates that item 6419 is not listed on the schedule. Investigation into the SHI mapping indicates that item 6418 has been mapped in the wrong location, while 6419, which is not listed on Schedule 5 of the LEP, is in the correct location of the harbour steps. The mapping produced in this report reflects the correct numbering and location of the item "Harbour Steps" (LEP No. 6418) and is not a faithful reproduction of the SHI mapping.

The study area is also within close vicinity to several listed heritage items:

- **"Stone Steps" (LEP No. 6364)**
- **"Breakwater Lighthouse" (LEP No. 5906)**
- **"Crane Pedestal" (LEP No.6399)**
- **"Site of Coke Works, including remains of coke oven" (LEP No. 6406)**

WOLLONGONG DEVELOPMENT CONTROL PLAN 2009

The applicable DCP for the study area is the Wollongong DCP. Part E of the Wollongong DCP outlines design controls to be implemented when dealing with heritage items in general. Section 19.2 details requirements for managing post-European archaeological sites. Section 14.2 details the controls for developments in the vicinity of a heritage site and Section 20.3.2 provides controls for the North Beach Precinct and Belmore Basin Heritage Conservation Area:

- *1. North Beach Precinct and Belmore Basin Heritage Conservation Area is subject to the findings and recommendations contained in the 1997 Conservation Study, prepared by Meredith Hutton on behalf of Council.*
- *2. Any proposal affecting any heritage item or building or structure within the area identified as 'North Beach Precinct' on the State Heritage Register will require the lodgement of an Integrated Development Application under Section 91 of the Environmental Planning and Assessment Act 1979 since the concurrence approval is required from the NSW Heritage Council pursuant to Section 60 of the Heritage Act*

1977. Alternatively, a separate approval application may be made to the NSW Heritage Office of the Department of Planning under Section 60 of the Heritage Act 1979, prior to the lodgement of a Development Application with Council. Any such application must be supported by a Conservation Management Plan which takes into account the findings and recommendations of the 1997 Conservation Study.

- *3. Any proposal affecting any heritage item or building / structure within the remainder of the heritage conservation area will require the lodgement of a Development Application and should be supported by a Conservation Management Plan which takes into account the findings and recommendations of the 1997 Conservation Study.*
- *It is recommended that any prospective applicant should liaise with Council's Strategic Project Officer (Heritage) at an early stage to discuss Council's requirements in respect to a proposal within the North Beach Precinct and Belmore Basin Heritage Conservation Area and the relationship with the 1997 Conservation Study.*

2.4 SUMMARY OF HERITAGE LISTINGS

Table 2.1 lists the relevant statutory and non-statutory registers, listings and orders, and identifies those in which any part of the site is listed. The location of heritage items in relation to the study area are outlined in Figure 2.1.

Table 2.1 Summary of heritage register listings for the subject study area

Register/Listing	Inclusion	Statutory implications
NHL	No	None
CHL	No	None
RNE	Yes	None
SHR	Yes	Yes
Wollongong LEP	Yes	Yes
Wollongong DCP	Yes	Yes

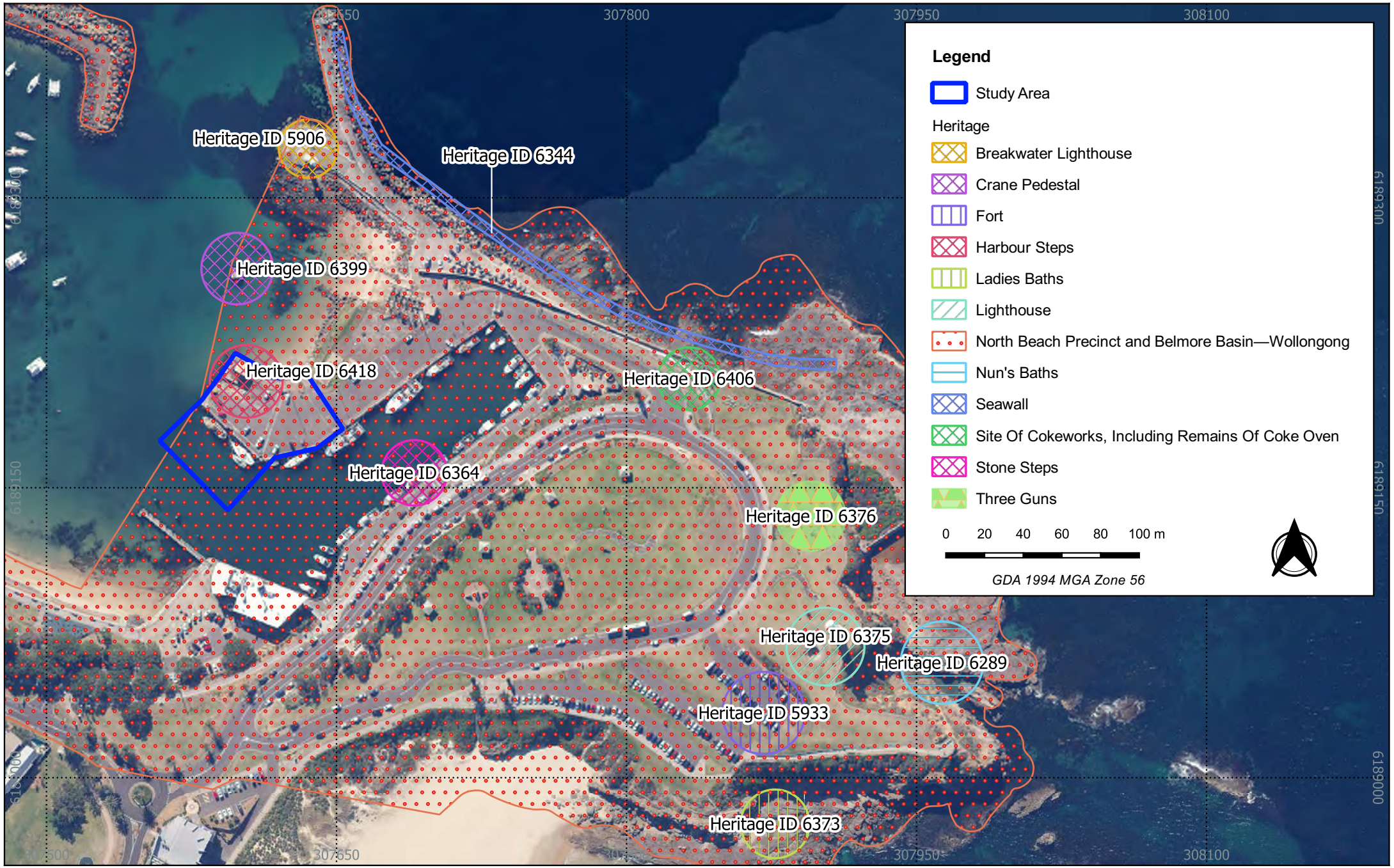

Figure 2.1 Heritage items in relation to the study area

21152 - Endeavour Drive Wollongong - SOHI

Source: NSW LPI Aerial, State Heritage Inventory *Drawn by: ARH Date: 2022-01-07*

AUSTRAL ARCHAEOLOGY

3. HISTORICAL CONTEXT

The following historical background is designed to contextualise a site-specific history which will aid in the understanding of the heritage values of the study area. This work will provide a useful and concise summary of the history of the study area.

3.1 HISTORY OF THE WOLLONGONG AREA

3.1.1 EARLY DEVELOPMENT – 1770 TO 1892

The charting and exploration of the Illawarra by Europeans began in 1770 when Lieutenant James Cook sailed the Endeavour along the coast. The land from Port Kembla to Corrimal was drawn by the ship's artist Sidney Parkinson and landmarks named included the Port Kembla headland ('Red Point') and Mount Kembla ('Hat Hill'). In 1796, George Bass and Matthew Flinders landed near Tom Thumb Lagoon, named after their small boat, and explored Lake Illawarra and areas to the west, documenting the first recorded contact with Aboriginal people in Illawarra. At this time, Flinders' recorded the areas as being called 'Alowrie' with Macquarie later describing the area as '*five islands, but called by the Natives Illawarra*' (Jervis 1942, p.244) Flinders' journal refers to whites living with Aboriginal people encountered there, and it has been suggested these were escaped convicts (McDonald 1979, Organ 1990).

In 1797, the ship 'Sydney Cove' was wrecked in the Bass Strait and survivors made their way along the coast, largely on foot, passing through the Illawarra and making camp at Coalcliff, where a coal seam was discovered and utilised for a camp fire. Upon reaching Sydney the survivors reported the discovery as well as a supposed attack by 'savage natives' near Red Point (McDonald 1979). The discovery of coal led to its investigation by George Bass on a further expedition along the coast in a whaleboat. Bass landed at Kiama and also explored the Shoalhaven River area, making observations on the richness of the land (Osborne 2000, p.20).

As European settlement extended further from the colony, explorers attempted to identify new fruitful pastures and beneficial resources in other areas. One of these explorers was Joe Shephard, an employee of Dr Charles Throsby, who not only identified good pastures but also a way to travel from Bong Bong Road through to the Illawarra (Lindsay 1994, p.14). Prior to this, the only way that stock had been able to access this area was by boat, which had begun in 1803. Following Wild's report, the opportunity to farm the Illawarra area became popular and many individuals requested farming permits from Governor King (Lindsay 1994, p.14).

In 1810, authorities under Governor Macquarie decided to extend the boundaries of the colony, with the Illawarra providing opportunities to farmers and cedar getters (Organ & Speechley 1997, p.10). Five years later, in 1815, Throsby established the first settlement in the Illawarra, and, with the assistance of Wild and Aboriginal guides, cut a cattle track from Appin via Bulli in the same year. The track was in use until 1844 when Captain Westmacott found another route up Bulli Mountain in approximately the same vicinity as the modern-day pass. Throsby established a small cattle station behind South Beach in Wollongong, where an area was cleared for a cattle yard and a stockman's hut was built for Joe Wild who remained as Throsby's overseer and was also made Constable of the district of Five Islands in 1815 (Osborne 2000, p.1). The following year, Surveyor-General John Oxley was sent to the Illawarra region to prepare plans for the Crown in preparation for the granting of the rich lands discovered there; Oxley himself became the second person to establish cattle in the area (Dowd 1977, p.72).

In the same year that Oxley was sent to the Illawarra, the first of the promised land grants were allocated to a group of individuals who had been using land in the area under the free occupation permits (Lindsay 1994, p.14). The group of individuals who were allocated the initial grants included David Allen, Robert Jenkins, Richard Brooks, George Johnston and Andrew Allan (Lindsay 1994, p.17). Four years later, in 1821, additional grants were allocated to Thomas Davey, D'Arcy Wentworth, James Milham, John Horsley, William Wentworth and Samuel Terry (Lindsay 1994, p.19).

Early employment in the district was primarily timber getting and land clearing for farming. According to the 1828 Census, 42% of those in work were employed in agriculture. By the 1830s,

a few farms had been established in the Illawarra. Surplus produce was taken to the bay at Wollongong and shipped to Sydney in small vessels (Lindsay 1994, p.63, Humphreys 2005, p.33).

In 1849, James Shoobert opened the first coal mine in the Illawarra at Mount Keira. From this point on, coal mining began to develop as the major primary industry of the northern Illawarra. The developing coal industry had a major impact on the trade at Wollongong Harbour. The increase in trade that the coal industry brought to the harbour was a major incentive for improvements that commenced in 1861 (Lindsay 1994, p.78).

In 1887, a railway line was constructed from Wollongong to Scarborough, before it was extended to Kiama and then Sydney in 1888 (Mitchell 1993, p.95). Within 3 years, in 1892, the line was duplicated (Jackson 2012, p.23).

3.2 HISTORICAL SKETCH OF THE STUDY AREA

The following section seeks to document the known development history of the site.

3.2.1 PHASE 0 – PRE-1830

As early as 1803, European settlers had ventured into the Illawarra with boats travelling with stock and supplies to and from Sydney as a result of the mountainous topography (Lindsay 1994, p.14). By 1812, cedar cutting had become an important industry in the colony with some cedar cutters travelling further into the regions of the Illawarra in their search for wood (Lindsay 1994, p.12). At this time, the study area, then a 'poorly sheltered sandy beach', was used as the main landing port for small vessels (Johnson 1992, p.8, Gardiner-Garden 1975, p.10).

In 1815, a drought resulted in Throsby and his party exploring the region following rumours of greener pastures in the 'Five Islands', returning to Throsby's Glenfield home before cutting a cattle track down Appin via Bulli (McDonald 1966, p.27, Gardiner-Garden 1975, p.8, Lindsay 1994, p.14). Upon returning to the Illawarra, Throsby constructed a hut near South Beach, in present-day Wollongong, with his stockmen residing in another hut close to the junction of Smith and Harbour streets (AMAC 2013, p.13). As reports of the farming opportunities spread, Governor Macquarie opened up the Illawarra for settlement with the first land grants allocated in 1816 (Gardiner-Garden 1975, p.10).

During the 1820s, the Wollongong area quickly developed, particularly around the Harbour, with the establishment of military barracks. In 1826, the 40th Regiment, under Captain Bishop, was stationed around the study area, resided in tents, whilst protecting the beach from attacks from the local Aboriginal people and bushrangers (Johnson 1992, p.8, AMAC 2013, p.15).

3.2.2 PHASE 1 – WOLLONGONG HARBOUR: 1830 TO 1849

Colony Surveyor General Major Thomas Mitchell surveyed the Wollongong region in 1834 and within the year, the town of Wollongong was proclaimed by Governor Bourke (Heritage NSW 2018). The following year, 1835, Mitchell proposed that the harbour's garrison be provisioned to protect smaller boats and that convict labour be used to reduce expenses (Heritage NSW 2018). Two years later, Governor Bourke approved works for the harbour, and from 1837 to 1846, 300 convicts, overseen by guards, undertook excavation work under the Commanding Royal Engineer and Colonial Engineer, George Barney [Figure 3.1] (Mitchell 1993, p.96).

The plans proposed by Barney included a stone pier with a slipway for the Pilot boat, measuring 100 feet (30 metres) long, by 35 feet (10 metres) wide. The slipway was 8 feet (2.5 metres) deep at low tide or 14 feet deep at high tide (4 metres). During construction it was identified that additional works would be required and the basin was increased to 300 feet (91 metres) long and 150 feet (46 metres) wide (Heritage NSW 2018, Boleyn & Boleyn 1999, p.3).

Figure 3.1 Wollongong Pier and stone work in relation to the study area

21152 - Endeavour Drive Wollongong - SOHI

Source: NSW State Archives

Drawn by: ARH Date: 2022-01-07

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The first stone was laid by the superintendent and stonemason, Mr Cremlin, on 23 May 1839 (Hutton 1997, p.9). The works were often arduous and reports were often made regarding the excavation conditions:

> *The excavation of the basin through solid and intensely hard rock was most laborious, nor was the damming against such a force and constant pressure of water an easy matter. 'twas no schoolboy work; nor was the laying of the foundation of the pier, nor adjusting the facings with cut stone by means of the diving bell a light or unlaborious task (The Sydney Morning Herald,* 16 December 1841 quoted in Boleyn & Boleyn 1999, p.3).

During the development of the harbour, the larger blocks of stone excavated from the study area were deposited on the pier and the remaining spoil was used to create a marine road that extended from the head of the bay and formed part of the road from the town to the dock [Figure 3.2] (Boleyn & Boleyn 1999, p.3). In addition, an area located toward Pier Head was widened, and partially filled, to include a Pilot's slipway and stone steps, to access the outer harbour (with the steps still present in the study area).

By the time that the works were completed in 1842, the Harbour included a quay, central pier and a curved dressed stone vertical sea wall basin, with lime mortar joints, and was known as the third port into NSW, with the other 2 ports at Sydney and Newcastle (Heritage NSW 2018, Gardiner-Garden 1975, p.5).

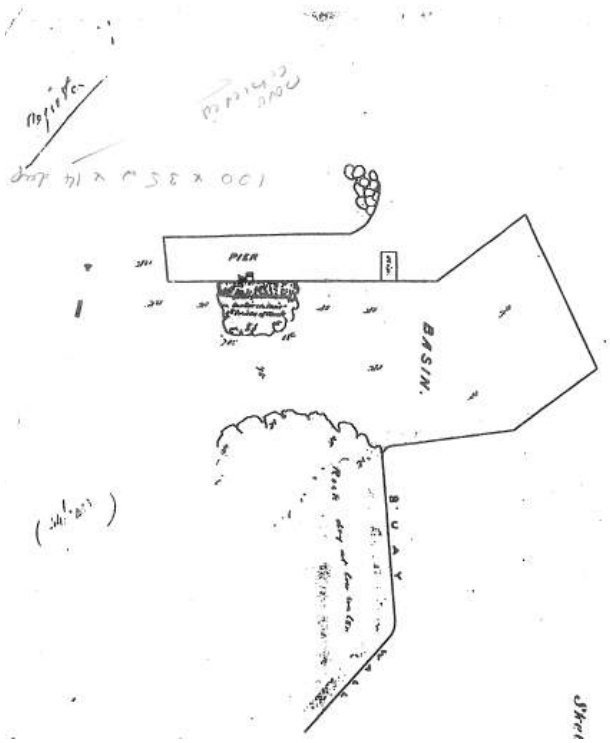

Figure 3.2 1844 Sketch of the Wollongong Basin showing the portion of rocks which required removing (Source: Boleyn & Boleyn 1999, p.6)

3.2.3 PHASE 2 – CONSTRUCTION OF BELMORE BASIN: 1850 TO 1900

Ongoing maintenance for the study area continued over the next 18 years, with additions including moorings affixed to the Wollongong Harbour in 1855, however following the introduction of coal processing in the area, there was increased pressure on the harbour. As a result, additional works were requested by residents and workers (Hutton 1997, p.11, Boleyn & Boleyn 1999, p.10).

In 1858, the Governor-General Sir William Dension and Mr E O Moriarty, the Engineer in Chief of Harbours and Rivers visited the study area, following a petition by the local people who requested an upgrade to the facilities (Boleyn & Boleyn 1999, p.10). During this visit, the depth of water in the study area was around 9 feet (3 meters) but the coffer dam had not been completely removed,

which resulted in some areas not being as deep. Combined with the mooring chains located across the harbour mouth and the anchorage, the area was deemed unsafe (Boleyn & Boleyn 1999, p.10).

By 1859, plans for the extension and deepening of the Harbour were approved, with works beginning in 1861 [Figure 3.3 and Figure 3.4] (Boleyn & Boleyn 1999, p.10). It was soon apparent that these works would need to be adjusted and additional works would be required, with the Harbour increased from 300 feet (91 metres) deep to 455 feet (138 metres) deep (Boleyn & Boleyn 1999, p.10). Other works were also necessary and by 1868, when works were completed, 3 high level staiths (which were able to load 3,000 tons of coal per day to ships), vertical stone sea-walls, (made from imported quartz sandstone and lithic sandstone) and a high coursed stone wall were also constructed. The boardwalk was extended towards the lighthouse and beach to the study area's sandstone wall (Heritage NSW 2018, Boleyn & Boleyn 1999, p.10).

During the updating of the harbour, the workers had gone on strike in 1861 and the harbour works had been at a standstill in 1863, but by 1865 the Belmore Basin (within the study area) had been constructed (Hutton 1997, p.13) On 6 October 1868, the Harbour was officially opened (*The Tasmanian Times*, 6 October 1868, pg 3).

At the same time as the construction of the wider harbour, in 1863, the Mount Pleasant Coal Company had developed a horse tramway, which consisted of 2 inclines, running from Mount Pleasant Colliery to Wollongong and then to Belmore Basin in 1879 (Singleton 1984, p.7, Hutton 1997, p.14, Boleyn & Boleyn 1999, p.23).

In 1880, increasing traffic to the Port resulted in the construction of a Tee Jetty and crane operated steam winch with a vertical boiler (Boleyn & Boleyn 1999, p.23). Although the jetty has since been demolished, the concrete base from the crane remains in the harbour, although not within the study area (Boleyn & Boleyn 1999, p.23). To protect the railway line adjacent to the study area, a 12 foot (3.6 metres) masonry sea wall was also erected near the breakwater to the cliff, however, this is also outside the study area (Boleyn & Boleyn 1999, p.23).

In the late 19th century, the Wollongong Harbour was 'imperfectly protected' and was only viable for small-sized vessels, resulting in the advocation of a harbour at Wollongong that would be suitable for larger vessels (Coode & Wollongong Trust 1895, p.1). Ideas were presented by Coode & Wollongong Trust (1895) to develop the harbour so that 2 arms would shelter the harbour from the weather (Coode & Wollongong Trust 1895, p.5). Changes were also recommended as the coke production increased with 2 mines producing 1,000 tons of coal a day and by 1897 the study area had numerous coke producing structures and appurtenances crowding the foreshore with sidings located to the south-east of the study area [Figure 3.5 and] (Rogers 1988, p.15, Boleyn & Boleyn 1999, p.23).

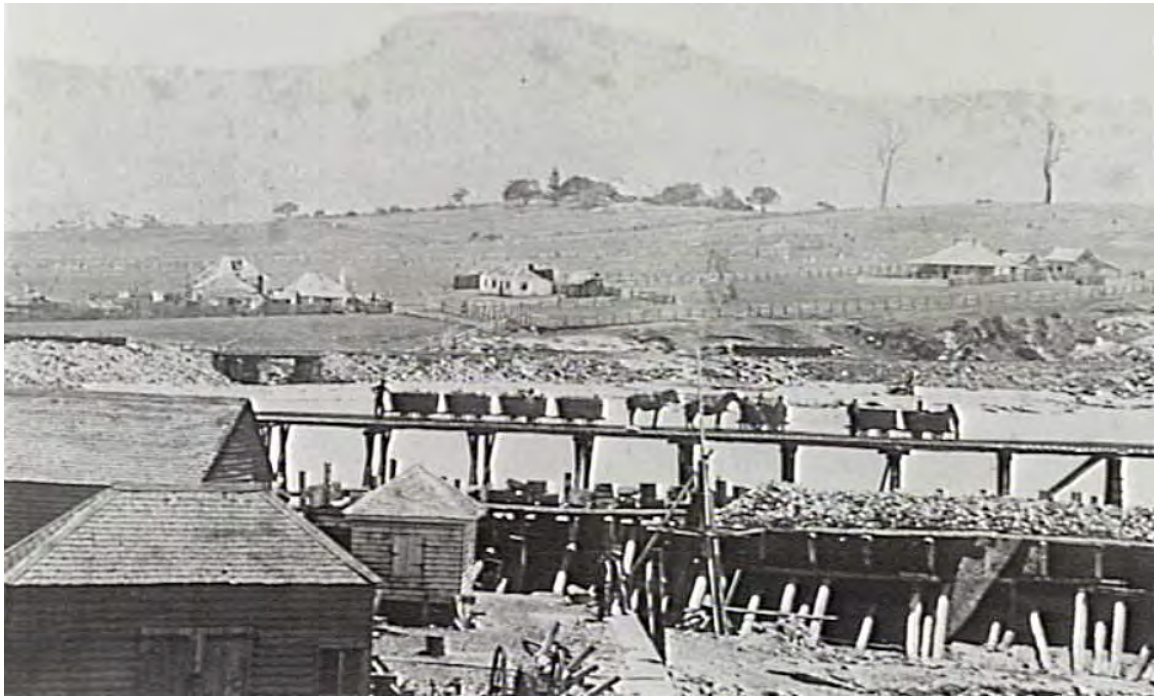

Figure 3.3 **Construction of Belmore Basin, looking west and showing temporary levee (Source: Boleyn & Boleyn 1999, p.13)**

Figure 3.4 **Wollongong Basin [c.1860 to 1880] (Source: State Archives and Records Authority of New South Wales, ID: 1l4E7bX1)**

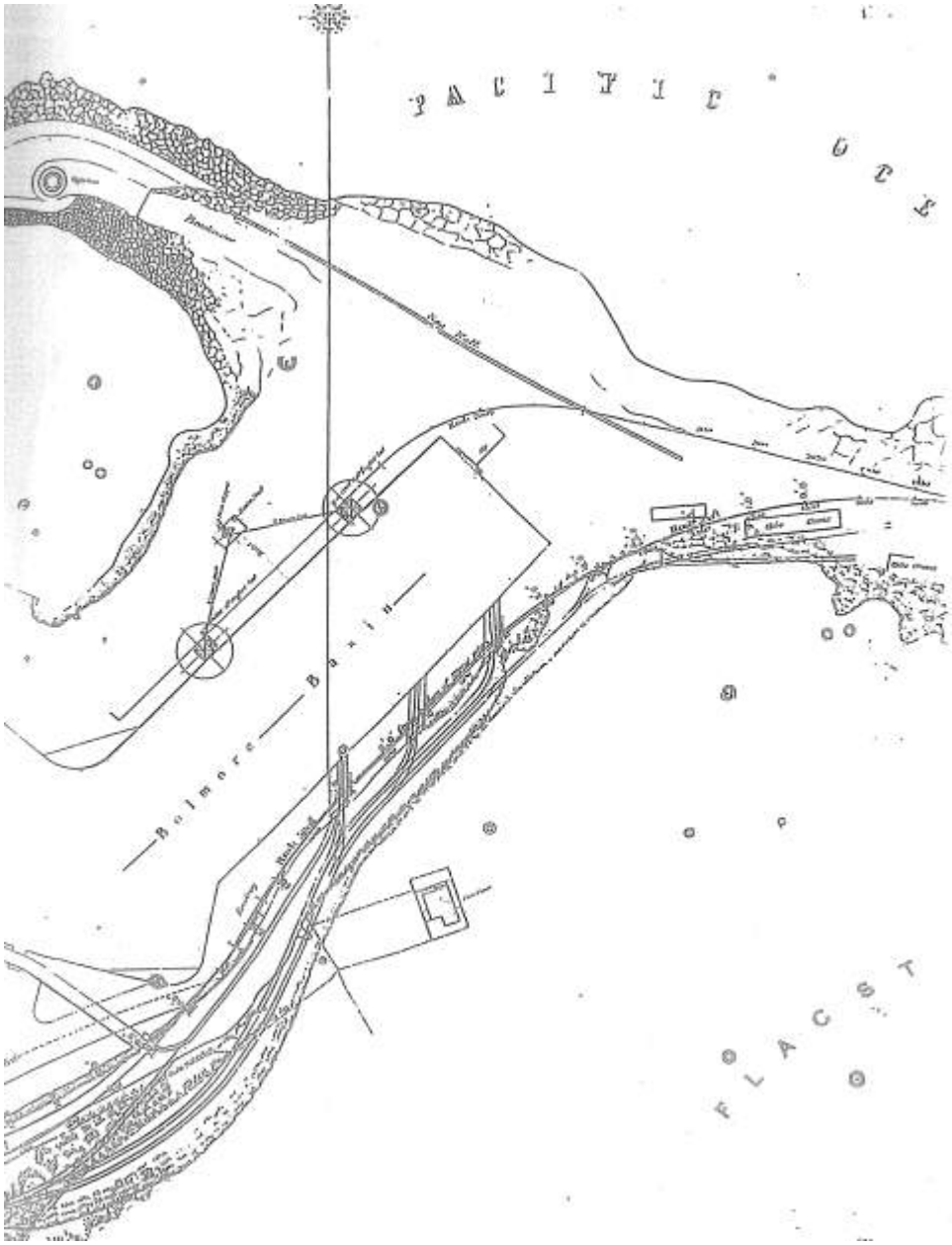

Figure 3.5 **c.1881 survey for additional sidings for coal (Source: Boleyn & Boleyn 1999, p.17)**

Figure 3.6 1891 Plan of Town of Wollongong in relation to the study area

21152 - Endeavour Drive Wollongong - SOHI

Source: NSW State Archives *Drawn by: ARH Date: 2022-01-07*

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3.2.4 PHASE 3 – MAINTENANCE OF BELMORE BASIN: 1900 TO PRESENT

From the early 20th century the study area and its usage as a passenger and coal port declined, as the popularity of Belmore Basin increased as a fishing port (Johnson 1992, p.46). In 1927, the Australian Iron and Steel Pty Ltd company discontinued shipments of coal from Belmore Basin, finding alternative railway facilities (Singleton 1984, p.17). Many of the earlier buildings were demolished and standing structures were repurposed for fishing and recreational activities before they too were demolished in the 1980s and roads were updated around the study area (Coode & Wollongong Trust 1895, p.46). In 1987, Belmore Basin was appropriated for the 1987 Harbour improvement purposes (Government Gazette of New South Wales. 21 August 1987, pg 4703).

In 2009, a report on the Wollongong Harbour was provided for the redevelopment of the harbour and foreshore. This report specified that the study area consisted of both commercial and recreational vessels but that some of the facilities were not suitable for tourism and commercial activities as they restricted vessel maneuvering and that there were also stormwater management issues (Wollongong Harbour Consultative Committee 2009, p.13). This report also determined that the historic sandstone walls and fixtures were not to be impacted during any of proposed works. (Wollongong Harbour Consultative Committee 2009, p.13).

The current harbour usage has 44 berths for trawler vessels, charter fishing vessels, recreational yacht club and multi-user/casual berths. The surrounding land currently consists of a fisherman's cooperative, general and trailer parking, game fishing gantry, pilot landing (historical and disused), yacht club building, a boat ramp, a substation, public space, slip way and slip way operational area, and a work compound.

3.3 CHRONOLOGY OF THE STUDY AREA

Based on the historical background presented, it is possible to summarise the chronology of the study area. This is presented in Table 3.1.

Table 3.1 Summary of chronological events relating to the study area

Phase	Summary	Date range
0	Before Throsby's employee Joe Shephard explored the Illawarra, the only means of travelling to the Illawarra with large numbers of stock was via the sea. In 1810 Governor Macquarie extended the boundaries of the colony which provided opportunities to cedar getters and farmers. In 1815, Throsby established the first settlement in the Illawarra and resided on a cattle station behind South Beach in Wollongong. At this time the study area was a 'sandy beach' and would have been used for small boats.	Pre 1830
1	During the 1830s Major Thomas Mitchell surveyed the town of Wollongong and in 1835 proposed that the harbour, including the study area, be garrisoned to protect smaller boats, with the use of convict labour. In 1837 works that increased the depth, width and length of the harbour began and concluded in 1846.	1830-1870
2	The establishment of coal facilities in the harbour resulted in increased pressure on the harbour and residents petitioned for further works. In 1858 the Governor-General and the Engineer in Chief of Harbours and Rivers visited the Wollongong area in response to the petition and by 1859 plans were submitted for the harbour and the construction of the study area into Belmore Basin. In 1861, works began on the harbour and by 1865 Belmore Basin had been engineered. During the last 25 years of the 19th century, a railway line was constructed next to the study area and other works surrounding the study area included the construction of a Tee Jetty and the erection of 2 sea walls.	1850-1900
3	From the 20th century, the study area adapted to change, moving away from a passenger and coal port to a fishing and recreational area. Many of the structures and features surrounding the study area were repurposed or demolished and updated roads were constructed around the study area. The study area currently consists of 44 berths for trawler and charter fishing vessels, recreational yacht clubs and multi-user/casual berths. The surrounding land currently consists of a fisherman's cooperative, general and trailer parking, game fishing gantry, pilot landing (historical and disused), yacht club building, a boat ramp, a substation, public space, slip way and slip way operational area and a work compound.	1900-Present

4. SITE INSPECTION

The site inspection was conducted by Stephanie Moore (Senior Archaeologist, Austral) on 18 November 2021. The inspection consisted of a pedestrian survey of the harbour infrastructure surrounding Belmore Basin, with focus on listed heritage items in proximity and any materials which may be of heritage value.

Pedestrian survey commenced on the south side of Belmore Basin, near the fisherman's co-operative. Overall photographs of the study area were taken from the south and east, showing the current situation (Figure 4.1 and Figure 4.2).

The southern side of the basin is a one way road, with the direction of travel headed south, which allows access to the fisherman's co-operative and provides some parking. Adjacent to this roadway, is the heritage item "Stone Steps" (LEP No. 6364). The stone steps connect the lower roadway adjacent to the basin with Endeavour Drive, which is significantly higher than the basin. The steps are constructed of sandstone and are heavily weathered (Figure 4.3). The steps have been fenced off and are no longer used for pedestrian access. Inspection was undertaken here to determine the potential for visual impacts to the heritage item as a result of the proposal. No visual impacts to this heritage item will result from the proposed works.

The northern side of the basin features a carpark and access road, which terminates at the Yacht Club. The Yacht Club consists of a small, double storey rendered building, containing a café and offices. Immediately to the east of the Yacht Club is heritage item "Harbour Steps" (LEP No. 6418). The steps descend from the northern edge of the basin to an adjacent beach (Figure 4.4). The steps are constructed of sandstone and appear heavily weathered. Although access has not been restricted, the steps are not suitable for regular use. The steps are on the opposite side of the pier from the proposed works and will not be physically impacted by the proposal, and no visual impact is anticipated.

Figure 4.1 North-east facing photograph of study area.

Figure 4.2 View west across the study area.

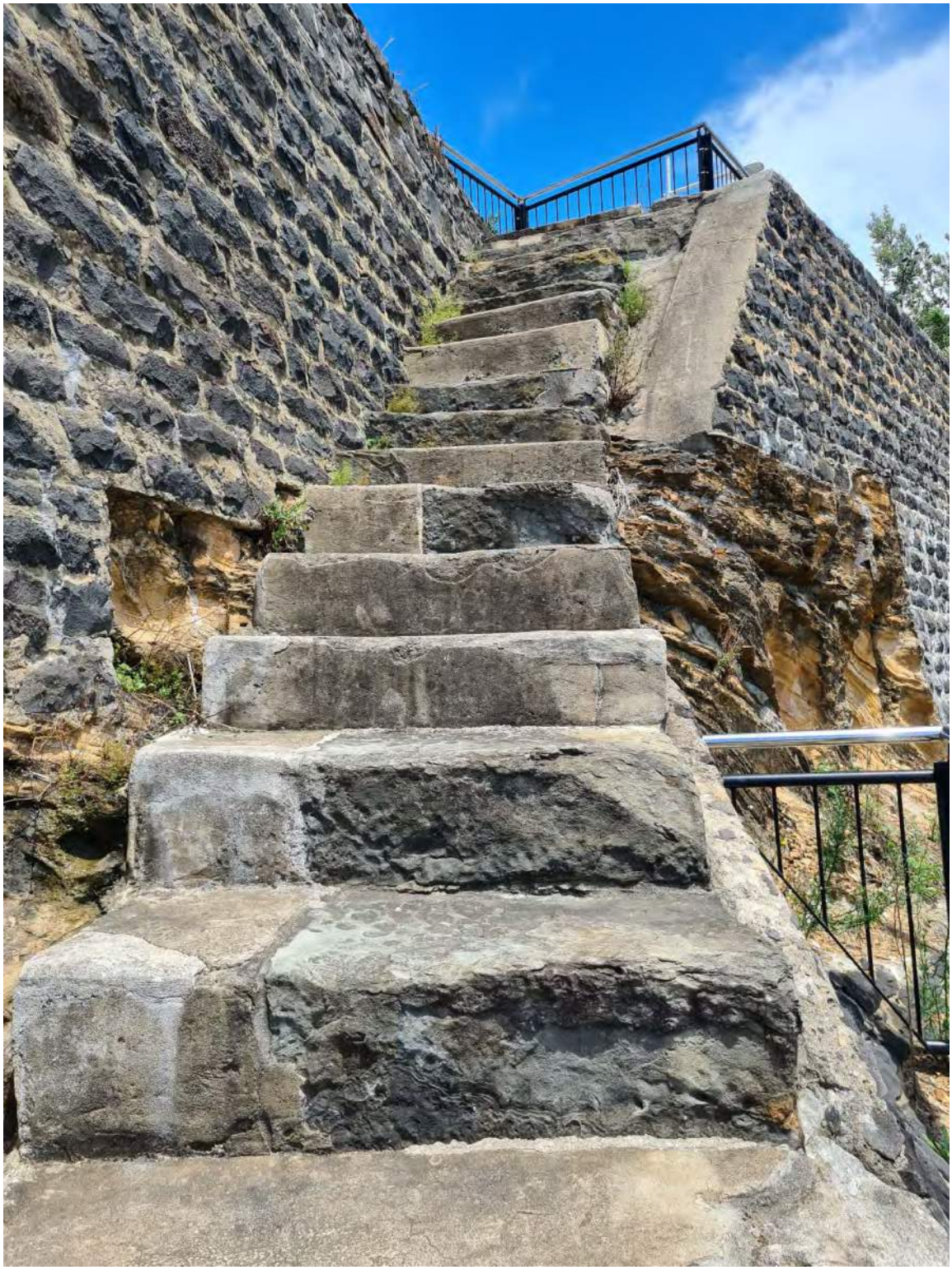

Figure 4.3 "Stone Steps" (Item ID 6364), located east of the study area.

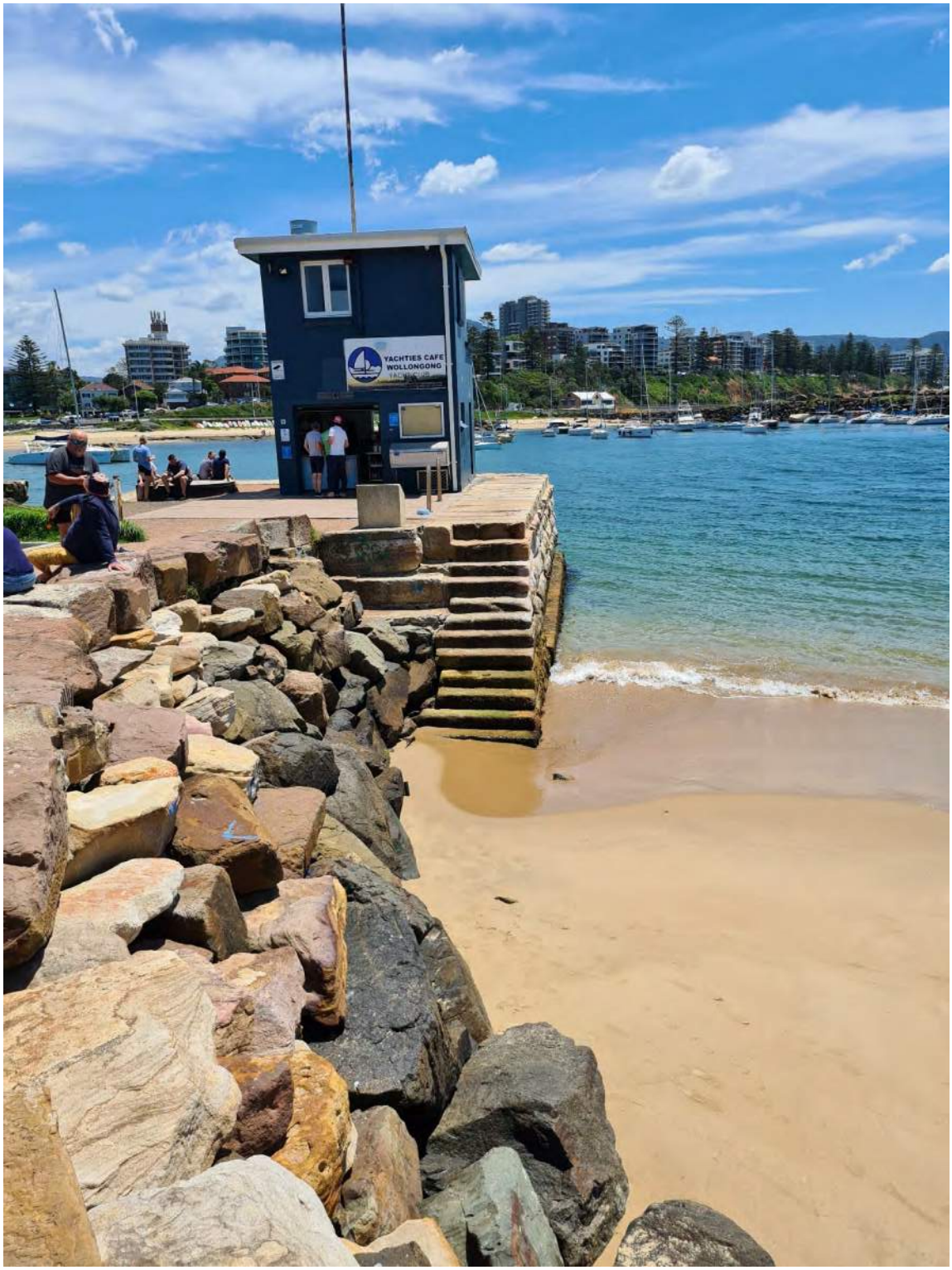

Figure 4.4 View west of the Yacht Club and 'Harbour Steps' (Item ID 6418)

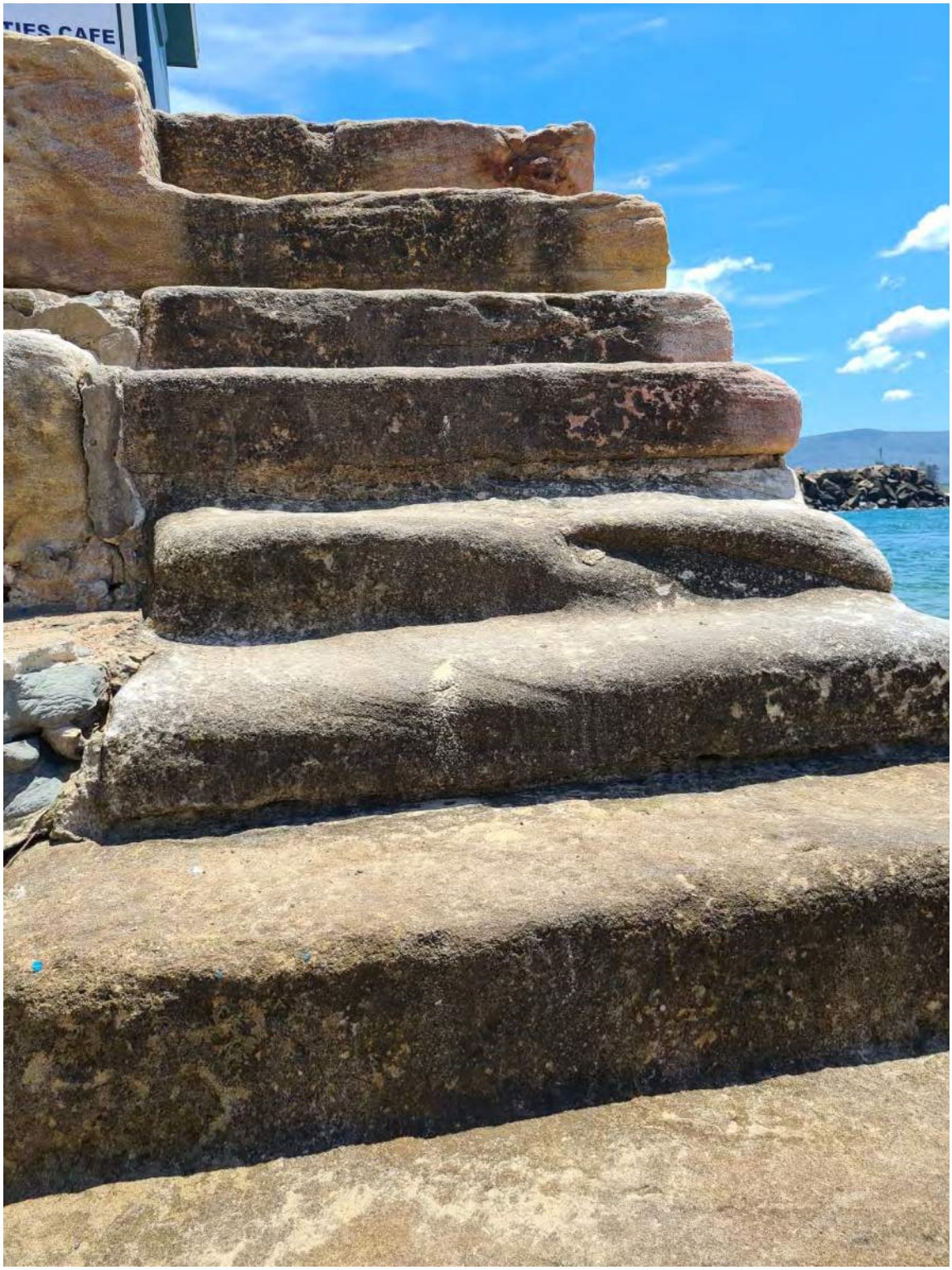

Figure 4.5 Condition of “Harbour Steps” (Item ID 6418)

5. HISTORICAL LAND USE MAPPING

5.1 HISTORICAL LAND USE

The earliest known European use of the study area was around 1803 when early settlers in the Illawarra region transported stock up the coast and used the study area as a harbour. Within 10 years, the production of cedar cutting had increased and between the stock and the cedar transportation, the study area, a 'poorly sheltered sandy beach', was a popular location.

During the 1830s the town of Wollongong was established and large scale convict works occurred for the redevelopment of the Wollongong Harbour. During this time, the study area and Harbour were subject to works that included the widening of the mouth and deepening of the harbour.

Following the completion of the works on the study area and Wollongong Harbour, it was soon determined that further works would be required and so in the 1860s, the Belmore Basin was constructed within the study area.

Although the study area had additional works over the next century (Figure 5.1, Figure 5.2, and Figure 5.3), the turn of the century saw the transformation from being a shipping supply area to a commercial and recreational berthing area.

5.2 DEGREE OF HISTORICAL DISTURBANCE AND IMPACTS

The initial construction of the Belmore Basin within the study area was undertaken by convicts, and although the ongoing maintenance of the harbour would have removed some of the in situ historical archaeology, there is still evidence of historical use, including stone steps surrounding the study area. In addition, the Basin was constructed from convict labour and there is the potential that evidence of their workmanship, including markings, are present within the study area.

It is therefore assessed that the study area has **low** potential to uncover subsurface historical deposits.

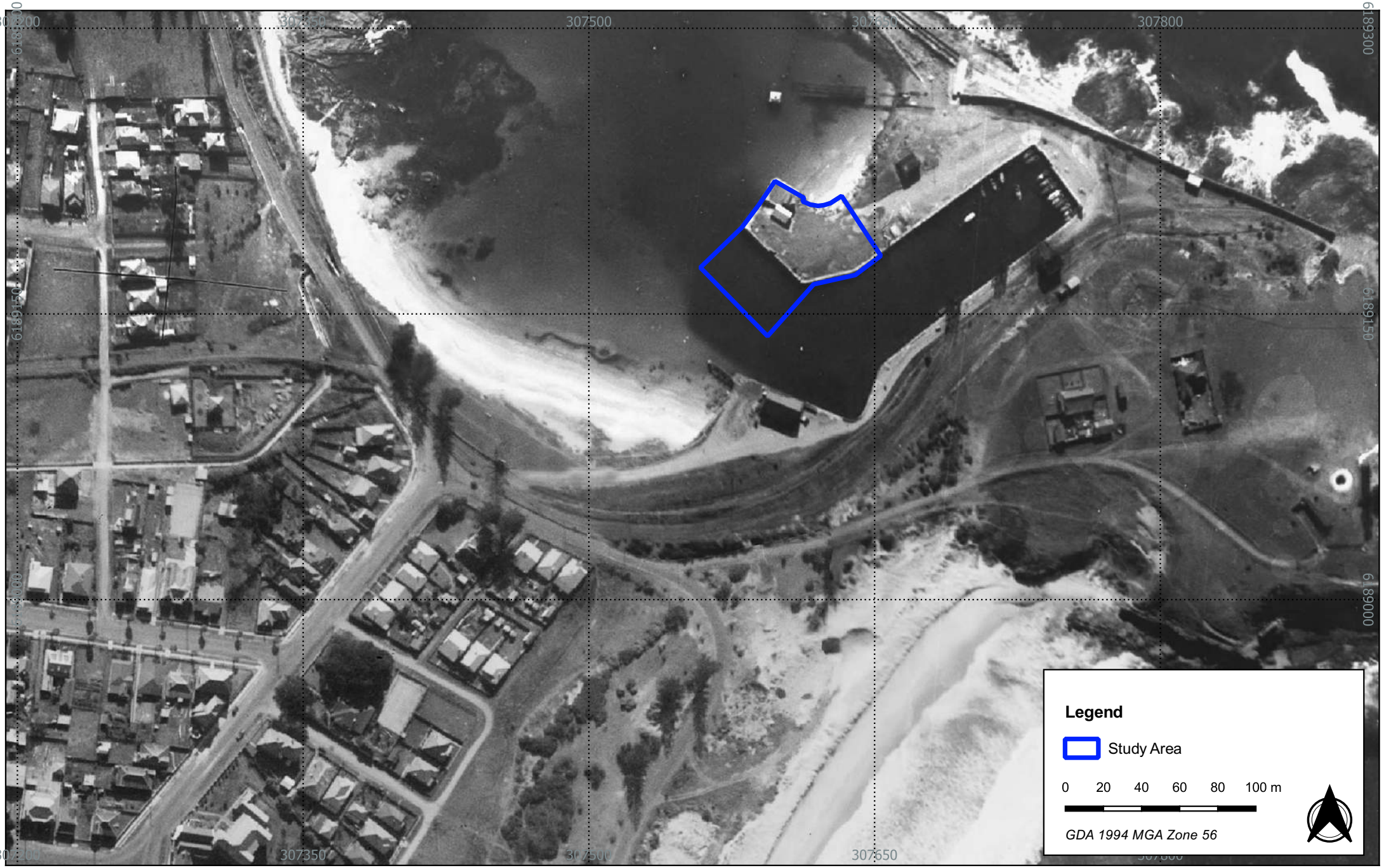

Figure 5.1 1938 Aerial of the study area

21152 - Endeavour Drive Wollongong - SOHI

Source: NSW Spatial services

Drawn by: ARH Date: 2022-01-07

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Figure 5.2 1977 Aerial of the study area

21152 - Endeavour Drive Wollongong - SOHI

Source: NSW Spatial services

Drawn by: ARH Date: 2022-01-07

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Figure 5.3 1993 Aerial of the study area

21152 - Endeavour Drive Wollongong - SOHI

Source: NSW Spatial services

Drawn by: ARH Date: 2022-01-07

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6. ASSESSMENT OF SIGNIFICANCE

An assessment of cultural significance seeks to establish the importance that a place has to the community. The concept of cultural significance is intrinsically tied to the fabric of the place, its history, setting and its relationship to other items in its surrounds and the response it evokes from the community.

The assessment of cultural significance with respect to archaeological sites can present difficulties because the nature and extent of the "relics" are often indeterminate and value judgements therefore need to be made based on potential attributes. The element of judgement can be greatly reduced by historical or other research, as has been completed for the current study. Archaeological deposits and features provide important evidence of the history and settlement of New South Wales. These heritage items may include deposits containing material culture (artefacts) that can be analysed to yield information regarding early urban development that is unavailable from other sources. Archaeological investigations can reveal much about technology, industry, past economic and social conditions and people's lives.

Sites that contain these elements therefore have scientific value that may be of considerable significance when analysed in association with documentary evidence. It is through this potential to reveal information about the past use of a place that archaeological sites have heritage significance.

6.1 BASIS FOR ASSESSMENT

The Burra Charter of Australia ICOMOS was formulated in 1979 (revised 1999 and 2013) (Australia ICOMOS 2013), based largely on the Venice Charter (for International Heritage) of 1966. The Burra Charter is the standard adopted by most heritage practitioners in Australia. The Charter divides significance into four categories for the purpose of assessment. They are: Aesthetic, Historical, Scientific/Technical, and Social significance.

The Heritage Council of NSW has established a set of seven criteria to be used in assessing cultural heritage significance in NSW, and specific guidelines have been produced to assist archaeologists in assessing significance for subsurface deposits (Heritage Council of New South Wales 2009; NSW Heritage Office 2001). The Heritage Council's criteria incorporate those of the Burra Charter, but are expanded to include rarity, representative value, and associative value.

In order to determine the significance of a historical site, the Heritage Council have determined that the following seven criteria are to be considered (NSW Heritage Office 2001):

- **Criterion (a):** an item is important in the course, or pattern, of NSW's cultural or natural history (or the local area);
- **Criterion (b):** an item has strong or special association with the life or works of a person, or group of persons, of importance in NSW's cultural or natural history (or the local area);
- **Criterion (c):** an item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area);
- **Criterion (d):** an item has strong or special association with a particular community or cultural group in NSW for social, cultural or spiritual reasons (or the local area);
- **Criterion (e):** an item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the local area);
- **Criterion (f):** an item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the local area); and
- **Criterion (g):** an item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places or cultural or natural environments (or the local area).

These criteria were designed for use on known or built heritage items, where above ground heritage is both tangible and easily identified. Due to the nature of archaeology being that it is invisible until disturbed, the presence and attributes of archaeological material must be assumed based on the recorded levels of disturbance, known site history and the creation of predictive statements. Ultimately, the actual presence of archaeological material can only ever be framed in terms of the potential for it to be present. The following assessment therefore deals with the built and archaeological potential within the study area in a consolidated manner.

6.2 LEVELS OF SIGNIFICANCE

The Heritage Act allows for the protection of heritage items of State or local significance. The levels of significance can be defined as:

- Items of State significance are of special interest in a State context. They form an irreplaceable part of the environmental heritage of NSW and must have some connection of association to the State.
- Items of local significance are of special interest to the LGA. They important to the local community and often form an important part of the local identity. Collectively, such items reflect the cultural or natural history of the given area.

6.3 SIGNIFICANCE ASSESSMENT

The following section addresses the significance of the potential archaeological resource in accordance with the criteria adopted in the Heritage Council's significance guidelines for archaeological deposits (Heritage Council of New South Wales 2009, pp.11–13) The assessment presented in Table 6.1 has been drawn from the SHI listing for “Wollongong Harbour Precinct” (Place ID. 01823).

Table 6.1 Signficance assessment

Criterion	Assessment
(a) an item is important in the course, or pattern, of NSW’s cultural or natural history (or the local area);	The study area is historically linked with the development of the Wollongong precinct and its ongoing role in transporting supplies from the 1830 colonial period until the present day. During the 1820s, the study area was a shipping point for Wollongong and the southernmost outpost for the colony of NSW. From 1829, the study area provided anchorage for supply boats and military forces garrisoned there. The study area contains part of a rare and intact example of a convict-built, block walled harbour that was constructed between 1837 and 1844, making it the oldest block walled harbour in NSW. The construction of the Belmore Basin in the study area and the additions of coal loading apparatus, rail lines and coke ovens adjacent to the study area demonstrates the role of the study area in the development of Wollongong and the Illawarra's coal and agricultural industries. The study area has had a changing role that has adapted from an importation transportation area to a commercial and recreational area which is evident in the fabric of the precinct.
(b) an item has strong or special association with the life or works of a person, or group of persons, of importance in NSW’s cultural or natural history (or the local area);	The study area has historic significance as it is enhanced by its association with important individuals including the first Colonial Engineer, Captain George Barney, who was responsible for the design and construction of the original harbour, central pier and basin wall; Department of Public Works Engineer in Chief, Harbours and River Navigation Edward Orpen Moriatry who designed and oversaw the construction of Belmore Basin; and a 300 convict labour force, who built the Belmore Basin.
(c) an item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area);	The study area contains a portion of the Belmore Basin, which is a block wall harbour, that has mostly remained in its 19th century configuration. The study area shows the evolution of a 19th century harbour that has successfully adapted to changes, including altering cargo and associated handling technologies. The extensive and unified use of sandstone block walls incised into the natural bedrock demonstrates a traditional construction technique and together with the timber bollards and iron

	mooring fixtures and fittings demonstrate a cohesive, substantially intact, distinctive mid 19th century harbour landscape which has become rare in NSW.
(d) an item has strong or special association with a particular community or cultural group in NSW for social, cultural or spiritual reasons (or the local area);	The study area does not have any strong or special associations with a particular community or group in NSW.
(e) an item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the local area);	The Wollongong Harbour is of State heritage significance for its research potential in providing an insight into the operation of a Colonial and early 20th Century shipping port and the infrastructure required to support a burgeoning produce and coal industries.
(f) an item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the local area); and	The study area is representative of a harbour that has been continuously used as a port for over 180 years. It is one of very few coastal harbours with its historic 19th century infrastructure and fittings such as timber bollard and fender piles, cast iron and wrought iron mooring fixtures, the Pilots slip rails and eyelets and the crane pedestal, still in situ. The study area has mostly maintained the configuration and scale of a coastal 19th century trading port that has been utilised from the early Colony period and that has adapted to change over time from a shipping resource centre for cedar and coal within the Illawarraicular coal.
(g) an item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places or cultural or natural environments (or the local area).	The study area does not demonstrate the principal characteristics of a class of NSW's cultural or natural places or natural environments.

The relevant themes which may be applied solely to the archaeological remains within the study area are listed below in Table 6.2.

Table 6.2 Historical Themes

Australian Theme	NSW Theme	Local Themes
Working	Migration	Unknown
Tracing the evolution of a continent's special environments	Exploration	Other open space
Tracing the evolution of a continent's special environments	Exploration	Modification of terrain
Tracing the evolution of a continent's special environments	Exploration	Introduce cultural planting
Tracing the evolution of a continent's special environments	Exploration	Cultural: Natural landscapes valued by humans
Tracing the evolution of a continent's special environments	Exploration	Cultural: Coasts and coastal features supporting human activities
Tracing the evolution of a continent's special environments	Exploration	Changing the environment
Peopling the continent	Death	Working for the Crown
Peopling the continent	Death	Demonstrating convicts' experience and activities

Australian Theme	NSW Theme	Local Themes
Peopling the continent	Death	Convict labour
Peopling the continent	Death	Convict barracks
Peopling the continent	Death	Administrating the convict system
Peopling the continent	Aboriginal post-convict	Dharawal Nation- contact sites
Governing	Education	Building Peace time healing and understanding between cultures
Developing local, regional and national economies	Utilities	Unknown
Developing local, regional and national economies	Events	Significant Places How are significant places marked in the landscape by, or for, different groups developing local, regional and national economies
Developing local, regional and national economies	Events	Developing local, regional and national economies
Developing local, regional and national economies	Cultural sites	Unknown
Developing local, regional and national economies	Convict	Trading along the NSW coast
Developing local, regional and national economies	Aboriginal pre-contact	Wharf and shipping history
Developing local, regional and national economies	Aboriginal pre-contact	Unknown
Developing local, regional and national economies	Aboriginal pre-contact	Maritime navigation and regulation
Developing local, regional and national economies	Aboriginal pre-contact	Maintaining maritime transport routes
Developing local, regional and national economies	Aboriginal pre-contact	Lighthouse
Developing local, regional and national economies	Aboriginal pre-contact	Building and maintaining jetties, wharves and docks
Building settlements, towns and cities	Welfare	Subdivision of urban estates
Building settlements, towns and cities	Welfare	Role of Transport in Settlement
Building settlements, towns and cities	Welfare	Planning relationships between key structures and town plans
Building settlements, towns and cities	Welfare	Outlying settlements
Building settlements, towns and cities	Welfare	Developing towns in response to topography
Building settlements, towns and cities	Welfare	Developing suburbia
Building settlements, towns and cities	Welfare	Developing private towns
Building settlements, towns and cities	Welfare	Developing ports

Australian Theme	NSW Theme	Local Themes
Building settlements, towns and cities	Welfare	Creating landmark structures and places in regional settings
Building settlements, towns and cities	Welfare	20th century Suburban Developments
Building settlements, towns and cities	Welfare	19th century Infrastructure
Building settlements, towns and cities	Mining	Surveying by John Oxley
Building settlements, towns and cities	Mining	Sea Wall
Building settlements, towns and cities	Mining	Resuming private lands for public purposes
Building settlements, towns and cities	Mining	Early Farming (Cattle grazing)
Building settlements, towns and cities	Mining	Changing land uses – from rural to tourist
Building settlements, towns and cities	Mining	Administrating and alienating Crown lands
Building settlements, towns and cities	Agriculture	Building settlements, towns and cities
Building settlements, towns and cities	Agriculture	Adapted heritage buildings or structures
Building settlements, towns and cities	Agriculture	Accommodating convicts

6.4 STATEMENT OF SIGNIFICANCE

The statement of significance is quoted from the State Heritage Inventory for the Wollongong Harbour Precinct, although only parts relevant to the study area are below:

> *Wollongong Harbour Precinct is of State significance because it displays the infrastructure on which the first southern port outside Sydney was founded and developed at Wollongong. It also provides evidence of the measures taken to defend that important southern outpost of the colony.*
>
> *The Precinct includes fabric deriving from each stage of its development from the substantially intact 19th century convict-built harbour together with modifications made as it developed from a commercial harbour to its present function as a fishing and tourist port.*
>
> *The harbour was the first port in the Illawarra and is the oldest and most intact extant block walled harbour in NSW. It comprises the Belmore Basin (the block walled harbour); the 1869 rubble mound breakwater; mooring rings, other related appurtenances and remnants of facilities left as the harbour developed.*
>
> *Also included in the Precinct is the 1872 Breakwater lighthouse, one of the early lighthouses of NSW and one of only two wrought iron lighthouses in NSW - the other being at Ulladulla and built to the same design by the same engineer, Joseph Mather of Sydney.*
>
> *The harbour is associated with two of the most important Colonial engineers; Belmore Basin was constructed under George Barney, Commanding Royal Engineer and Colonial Engineer, and the outer harbour under Edward Orpen Moriarty, first Engineer-in-Chief, Harbours & Rivers of the Public Works Department, whose work included the Breakwater lighthouse;*
>
> *The Harbour was essential to the development of Wollongong and was the focus of Wollongong's commercial, administrative, judicial and social activities from the early 19th century until well into the 20th century.*

As such, the Wollongong Harbour within the study area is considered to meet the Heritage Significance Criteria (a), (b), (c), (e) and (f) at the State level.

7. STATEMENT OF HERITAGE IMPACT

The purpose of this section is to present a comprehensive assessment of the impacts to the identified archaeological values associated with the study area from the proposed works.

6.5 PROPOSED WORKS

The proposed upgrade works to the study area in the Wollongong Harbour will include updating infrastructure and will include the installation of a Public Pontoon and temporary parking area (APPENDIX A). These works will include:

- Installation of a 25 metre by five metre steel and aluminium pontoon, with a fixed ramp and four steel piles, near the end of the central pier to provide safer access for trawlers, charter vessels, yachts and other recreational craft
- Installation of a new 5 metre by 5 metre fixed platform and 20 metre by 1.8 metre aluminium gangway to access the new pontoon
- Orientation of the new pontoon in line with the prevailing wave direction, which will assist to provide the lowest motions, to enhance user safety and comfort
- Installation of two restraint piles on either end of the pontoon to minimise impacts from vessels
- Introduction of designated temporary parking area for pick up/drop off and loading/unloading activities.

6.6 ASSESSED IMPACTS

It has been assessed that prior to the start of the proposed works, that the stability of the heritage walls will be confirmed. Any fixings into the heritage walls should be of suitable materials and limited in their surface impacts. No physical impacts on the heritage item “Harbour Steps” (LEP No. 6418) or the North Beach Precinct and Belmore Basin Heritage Conservation Area will result from the project works. The heritage item “Stone Steps” (LEP No. 6364), which is in proximity to the proposed works, will not be subject to physical or visual impacts. It is assessed that the installation of fencing around the construction site will have a negligible temporary visual impact on the site and surrounding heritage during construction works only.

The construction of the pontoon will have a visual impact on views to Belmore Basin, although this impact is considered to be negligible, as the pontoon allows a continuous use of the harbour for commercial and recreational activities.

6.7 CONSIDERATION OF HERITAGE VALUES IN THE DESIGN PROCESS

The following questions are taken from the Heritage NSW guidelines to preparing statements of heritage impact (Heritage Office and Department of Urban Affairs & Planning 1996).

WHAT ASPECTS OF THE PROPOSAL RESPECT OR ENHANCE THE HERITAGE SIGNIFICANCE OF THE STUDY AREA?

The proposal will not directly enhance the heritage values of the item “Harbour Steps” (LEP No. 6418) and “Stone Steps” (LEP No. 6364), or the North Beach Precinct and Belmore Basin Heritage Conservation Area.It is noted, however, that the history of the study area as a functioning harbour will continue to thrive through the infrastructure works around the Belmore Basin. The proposed works will have a positive impact on Wollongong Harbour through its ongoing use for both commercial and recreational activities.

WHAT ASPECTS OF THE PROPOSAL COULD HAVE A DETRIMENTAL EFFECT ON THE HERITAGE SIGNIFICANCE OF THE STUDY AREA?

The works are not considered to have any adverse impact on the heritage significance of the “Harbour Steps” (LEP No. 6418) and “Stone Steps” (LEP No. 6364), or the North Beach Precinct and Belmore Basin Heritage Conservation Area.

HAVE MORE SYMPATHETIC OPTIONS BEEN CONSIDERED AND DISCOUNTED?

It is not considered that any alterations to design are required to avoid impact to known heritage values, additional options were considered in the initial planning of the project.

8. CONCLUSIONS AND RECOMMENDATIONS

7.1 CONCLUSIONS

This report has concluded that the proposed works will have a negligible impact on known heritage values within and surrounding the study area. The works will allow safe continuation of commercial and recreational use of Wollongong Harbour and Belmore Basin.

7.2 RECOMMENDATIONS

The following recommendations have been developed to mitigate harm resulting from unexpected finds that may occur during construction.

1. If historical archaeological relics not assessed or anticipated by this report are found during the works, all works in the immediate vicinity are to cease immediately and the Heritage NSW be notified in accordance with the conditions of the Section 60 permit. A qualified archaeologist is to be contacted to assess the situation and consult with Heritage NSW regarding the most appropriate course of action.
2. If Aboriginal archaeological material or deposits are encountered during earthworks, all works affecting that material or deposits must cease immediately to allow an archaeologist to make an assessment of the find. The archaeologist may need to consult with Heritage NSW and the relevant Aboriginal stakeholders regarding the find. Section 89A of the *National Parks & Wildlife Act 1974* requires that Heritage NSW must be notified of any Aboriginal objects discovered within a reasonable time.
3. Should the actual development be altered significantly from the proposed concept design, then a reassessment of the heritage/archaeological impact may be required. This includes any impacts not explicitly stated in Section 1.3 or the REF.
4. A copy of this assessment should be lodged by the proponent in the local history section of the local library, and in the library maintained by Heirtage NSW.

9. REFERENCES

AMAC 2013, *7 Harbour Street, Wollongong, NSW. Report for Craig Osborne*.

Australia ICOMOS 2013, *The Burra Charter: the Australia ICOMOS Charter for Places of Cultural Significance*, Australia ICOMOS, Burwood, VIC.

Boleyn, D & Boleyn, S 1999, 'Nomination for Historic Engineering Marker, Wollongong Harbour, Wollongong'.

Coode, J & Wollongong Trust 1895, *Report on Wollongong Harbour*.

Dowd, BT 1977, *The First Five Land Grantees and their Grants in the Illawarra*, Illawarra Historical Society, Wollongong.

Gardiner-Garden, C 1975, 'Port of Wollongong'.

Heritage Council of New South Wales 2009, *Assessing significances for historical archaeological sites and 'relics'*, Heritage Branch, NSW Dept. of Planning, Parramatta, N.S.W., viewed 30 January 2019, <http://www.heritage.nsw.gov.au/03_index.htm>.

Heritage NSW 2018, 'Wollongong Harbour Precinct'.

Heritage Office and Department of Urban Affairs & Planning 1996, 'Statements of Heritage Impact', <https://www.environment.nsw.gov.au/resources/heritagebranch/heritage/hmstatementsofhi.pdf>.

Humphreys, AL 2005, *Shellharbour City Council Heritage Study: Thematic History*, Shellharbour City Council, Shellharbour.

Hutton, M 1997, *Conservation Study for Belmore Basin Conservation Area, Wollongong, NSW*, Report Prepared for Wollongong City Council.

Jackson, G 2012, *The Road to Illawarra: Part 3*, University of Sydney, Sydney.

Jervis, J 1942, 'Illawarra: A Century of History', *Journal of the Royal Australian Historical Society*, vol. XXVIII, pp. 65–107; 129–56; 193–248; 273–302; 353-374.

Johnson, AW 1992, *Wollongong Harbour: Assessment of Archaeological Remains*, Prepared for Public Works Department.

Lindsay, B 1994, *Early Land Settlement in Illawarra (1804-1861)*, M Organ & A Doyle (eds.), Illawarra Historical Publications.

McDonald, WG 1966, *Earliest Illawarra by its explorers and pioneers*, Illawarra Historical Society, Wollongong.

McDonald, WG 1979, *The Oldest Road*, Illawarra Historical Publications, Wollongong.

Mitchell, WH 1993, 'The Discovery and Growth of Greater Wollongong'.

NSW Heritage Office 2001, 'Assessing heritage significance', viewed 1 May 2016, <http://www.environment.nsw.gov.au/resources/heritagebranch/heritage/listings/assessingheritagesignificance.pdf>.

Organ, M 1990, *A Documentary History of the Illawarra and South Coast Aborigines 1770-1850*, Aboriginal Education Unit, Wollongong University, Wollongong.

Organ, M & Speechley, C 1997, *Illawarra Aborigines - An Introductory History*, University of Wollongong, Wollongong, NSW.

Osborne, F 2000, 'The Parkinson family', *Illawarra Historical Society Bulletin*, , no. March/April, p. 6.

Rogers, B 1988, 'The Coke Works on Flagstaff Point, Wollongong, 1875-1890', *Australian Journal of Historical Archaeology*, vol. 6, pp. 12–19.

Singleton, C 1984, *Railway History in Illawarra, New South Wales*, Illawarra Historical Society, Wollongong.

Wollongong Harbour Consultative Committee 2009, *Wollongong Harbour Redevelopment: Wollongong Harbour Consultative Committee. Report to Minister Kelly*.

APPENDIX A – PROPOSED WORKS DESIGN

Appendix E

Aboriginal Heritage Information Management System Results

AHIMS Web Services (AWS)
Search Result

Your Ref/PO Number : WH

Client Service ID : 639269

Belinda Crichton

Level 9, The Forum, 203 Pacific Highway
St Leonards New South Wales 2756

Attention: Belinda Crichton

Email: belinda.crichton@cardno.com.au

Date: 17 November 2021

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lot : 1, DP:DP739591, Section : - with a Buffer of 200 meters, conducted by Belinda Crichton on 17 November 2021.

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.

A search of Heritage NSW AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

4	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (https://www.legislation.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Heritage NSW upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Heritage NSW and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date. Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

Level 6, 10 Valentine Ave, Parramatta 2150
Locked Bag 5020 Parramatta NSW 2124
Tel: (02) 9585 6345

ABN 34 945 244 274
Email: ahims@environment.nsw.gov.au
Web: www.heritage.nsw.gov.au

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 8202206601

Client Service ID : 640233

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
52-3-0757	WOLLONGONG HARBOUR;	AGD	56	307300	6188870	Open site	Valid	Shell : -, Artefact : -	Midden	102212
	Contact	**Recorders**	Kerry Navin					**Permits**		
58-4-0688	Brighton Lawn Park 1(same as 52-2-1783)	AGD	56	307350	6188880	Open site	Valid	Shell : -, Artefact : -	Midden	
	Contact	**Recorders**	Mr.Peter Kuskie					**Permits**		
52-2-1783	Brighton Lawn Park 1;	AGD	56	307350	6188880	Open site	Valid	Shell : -, Artefact : -	Midden	102212
	Contact	**Recorders**	Mr.Peter Kuskie					**Permits**	1059	
52-2-1686	belmore basin;	AGD	56	307300	6188870	Open site	Valid	Shell : -, Artefact : -	Midden	2476,102212
	Contact	**Recorders**	Kerry Navin					**Permits**	458	

**** Site Status**

Valid - The site has been recorded and accepted onto the system as valid

Destroyed - The site has been completely impacted or harmed usually as consequence of permit activity but sometimes also after natural events. There is nothing left of the site on the ground but proponents should proceed with caution.

Partially Destroyed - The site has been only partially impacted or harmed usually as consequence of permit activity but sometimes also after natural events. There might be parts or sections of the original site still present on the ground

Not a site - The site has been originally entered and accepted onto AHIMS as a valid site but after further investigations it was decided it is NOT an aboriginal site. Impact of this type of site does not require permit but Heritage NSW should be notified

Report generated by AHIMS Web Service on 19/11/2021 for Cassy Baxter for the following area at Lot : 1, DP:DP739591, Section : null with a Buffer of 200 meters.. Number of Aboriginal sites and Aboriginal objects found is 4

27I 07 I 2021

Jessica Don
Engineering Cadet - Southern Region
Safety, Environment and Regulation
Transport for NSW

Dear Jessica,

Preliminary assessment results for the Wollongong Harbour Upgrade; Stage 1 of the Procedure for Aboriginal cultural heritage consultation and investigation (the procedure).

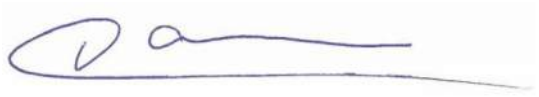
The project, as indicated in the Procedure for Aboriginal cultural heritage consultation and the AHIMS search was assessed as being unlikely to have an impact on Aboriginal cultural heritage.

If the scope of your project changes, you must contact me and your regional environmental staff to reassess any potential impacts on Aboriginal cultural heritage.

For further assistance in this matter and do not hesitate to contact me on 0447498847.

Yours Sincerely

Tabatha Cann
Aboriginal Cultural Heritage Officer



27 / 07 / 2021

Transport NSW

Level 6, 90 Crown Street Wollongong NSW 2500
T 04474988471 E tabatha.r.cann@transport.nsw.gov.au

Appendix F

Traffic and Parking Impact Assessment

Our Ref: 8202206601:HC
Contact: Hayden Calvey

5 July 2022

Stantec Australia Pty Ltd
ABN 17 007 820 322

Level 9 - The Forum
203 Pacific Highway
St Leonards NSW 2065
PO Box 19

Phone +61 2 9496 7700
Fax +61 2 9439 5170

www.cardno.com
www.stantec.com

TfNSW Maritime Infrastructure Delivery Office
33 James Craig Road
Rozelle NSW 2039

Attention: Gareth Doran

Dear Gareth,

WOLLONGONG HARBOUR - TRAFFIC AND PARKING IMPACT STATEMENT

Cardno now Stantec (Stantec) has been engaged by Transport for NSW's Maritime Infrastructure Delivery Office (MIDO) to provide a Traffic and Parking Impact Statement to address the traffic, parking and pedestrian impacts of the proposed new pontoon and re-opening of the slipway at Wollongong Harbour.

All traffic and parking requirements will be sourced and referenced from Australian Standards (AS2890), Austroads Guide to Traffic Management Part 12, Transport for NSW (TfNSW) Guidelines and the Wollongong Development Control Plan (DCP) 2009.

1.1 PROPOSED DEVELOPMENT

Site Location

Wollongong Harbour is located 1km north-east of the Wollongong Central Business District (CBD) and approximately a one and a half hour drive south of Sydney. The central pier of Wollongong Harbour (the Site) is located in the Wollongong Council Local Government Area (LGA) and can be accessed from Endeavour Drive off Cliff Road and Marine Drive.

Figure 1-1 Site Location

Within Wollongong Harbour, Belmore Basin is bounded by the central and southern piers. Belmore Basin serves as a marina for trawlers, charter vessels, yachts and other recreational craft. The use of non-motorised craft such as kayaks, paddleboards and sailing boats are popular recreational activities within the harbour.

Wollongong Harbour currently only supports private marine vessels and recreational craft. There are no existing public, water-based transport options (i.e. ferries).

Belmore Basin currently has 44 wet berths which are allocated to various marine vessel users. A plan of these wet berths is shown in **Figure 1-2**.

Figure 1-2 Existing Wollongong Harbour Berth Plan (AECOM, 2019)

Project Description

The Proposal is to construct a new public pontoon and short-term parking area at the Belmore Basin Marina of Wollongong Harbour.

As shown in **Figure 1-3**, the key features of the Proposal would include:

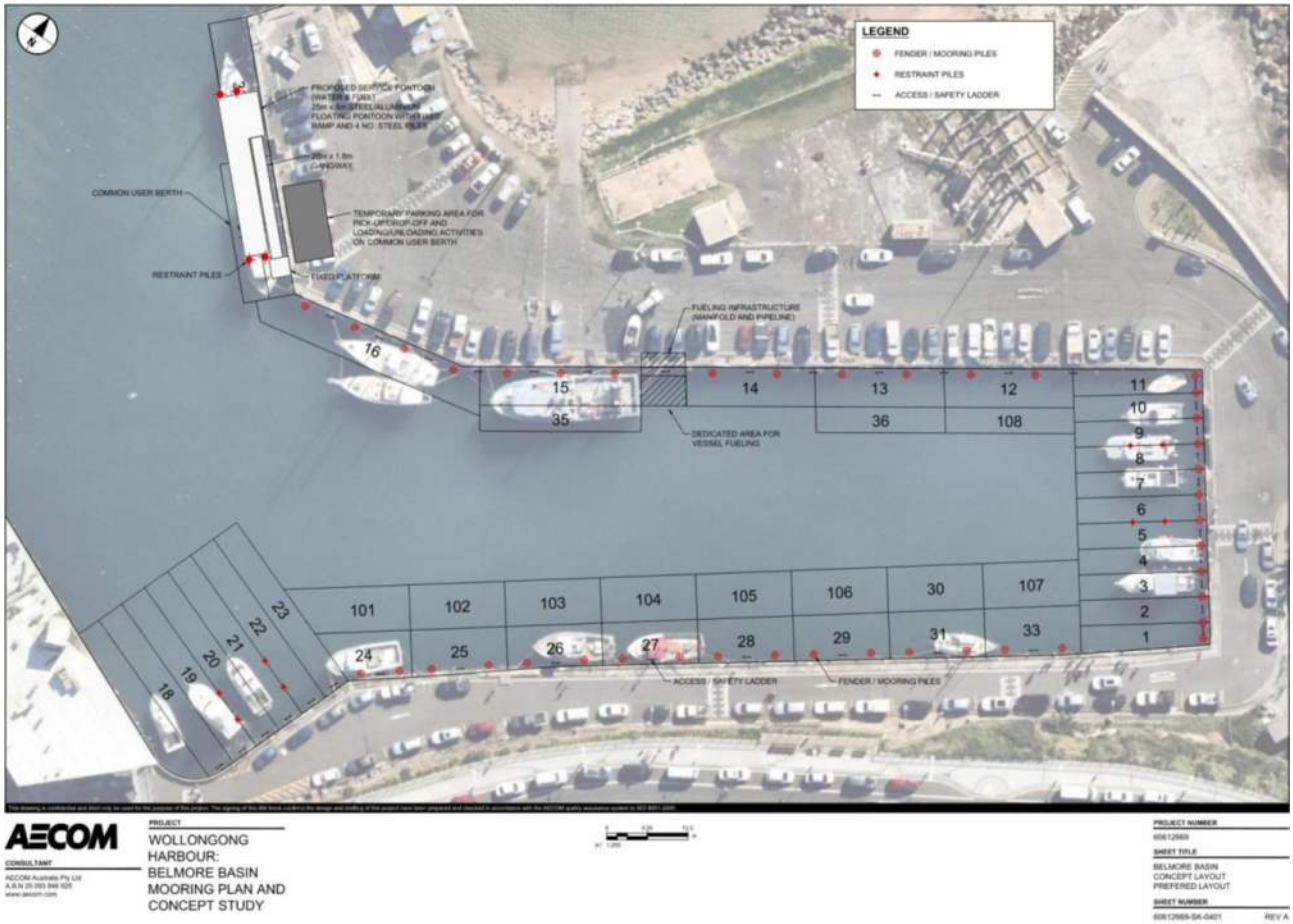
- Installation of a 25 metre by five metre pontoon, with a fixed ramp and four restraint piles, near the end of the central pier to provide safer access for trawlers, charter vessels, yachts and other recreational craft
- Installation of a new five metre by five metre fixed platform and 20 metre by 1.8 metre gangway to access the new pontoon
- Orientation of the new pontoon in line with the prevailing wave direction, which will assist to provide the lowest motions, to enhance user safety and comfort
- Installation of two restraint piles on either end of the pontoon to minimise impacts from vessels
- Introduction of designated short-term parking area for pick up/drop off and loading/unloading activities.

To cater for the new pontoon, three (3) of the marina's existing wet berths will be removed (wet berth numbers 17, 32 and 34 of **Figure 1-2**). The current public boat ramp on the northern side of the central pier will continue to be used as a launching point for the marine vessels, with the pontoon to be used as the boarding point for vessels.

From the Wollongong Harbour Master Plan Report (TfNSW, 2020), some of the proposed water-based recreation uses include kayak hire, whale watching tours, eco tours, fishing charters, other active recreation-based water activities and water sports. Many of these recreation uses currently exist and operate from the

harbour. The Proposal will improve accessibility to watercraft and recreational uses within the harbour however is unlikely to materialise in greater demand (given the existing boat ramp and southern pier remain unchanged). However, in the event that increased commercial operations did occur (i.e. seasonal whale watching tours, kayak hire providers or other tourist attractions) it is anticipated that demand will increase on the existing land-based infrastructure such as parking.

Figure 1-3 Refined Preferred Option (AECOM, 2019)

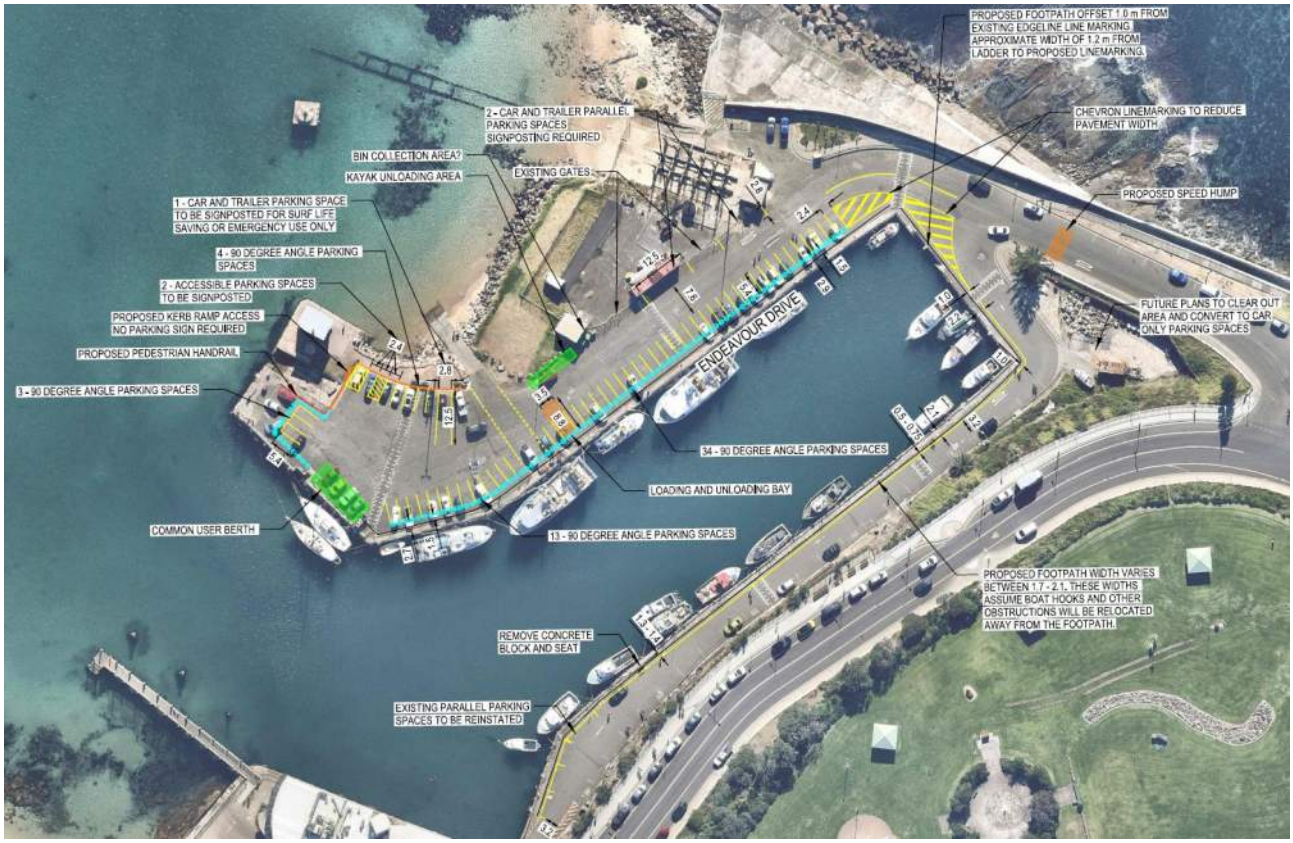


Separate to the Proposal, TfNSW are also proposing to undertake a linemarking project at the Site to delineate the parking spaces and improve pedestrian walkways. This is aimed to improve the overall safety and efficiency of traffic, parking and pedestrians in this location.

As per the current preferred linemarking plan (**Figure 1-4**), the project will assist in creating and delineating the following areas:

- A total of 59 parking spaces at the Site (57x 90-degree angled spaces and 2x parallel spaces):
  - 54x unrestricted spaces (5.4m x 2.4m)
  - 3x long vehicle spaces (12.5m x 2.8m) for cars with trailers (two general spaces and one for surf lifesaving purposes); and
  - 2x accessible parking spaces (with adjacent shared spaces with bollards).
- A loading bay (8.8m x 3.5m), suitable for vehicles up to a Medium Rigid Vehicle
- A short-stay parking zone near the boat ramp, designed for kayak users to load and unload
- A short-stay parking zone near the proposed pontoon, designed for pick-up and drop-off purposes and loading / unloading
- A pedestrian footpath along the water's edge, varying in width between 1.7m – 2.1m.

Figure 1-4 Parking Improvements Plan - Option 3A (TfNSW, 2021)



1.2 EXISTING CONDITIONS

Road Network

TfNSW, in partnership with local government, have established an administrative framework of State, Regional and Local Road categories to help manage the extensive network of roads. State Roads are managed and financed by TfNSW, while Regional / Local Roads are managed and financed by Councils.

The key road network surround the Site consists of:

- Endeavour Drive
- Cliff Road
- Unnamed access road leading to the central pier; and
- Unnamed access road leading to the southern pier / Brighton Lawn Reserve.

Endeavour Drive

Endeavour Drive is a local road under the care and maintenance of the local Council. The road forms a circular loop around Flagstaff Point headland, with access off the roundabout at Cliff Road / Marine Drive. Endeavour Drive has a single lane of travel in each direction and is signposted as a 40km/h High Pedestrian Activity Area (HPAA).

The road width is approximately 12m wide and caters for on-street parallel parking on both sides of the road in most sections. The headland area is signposted No Parking 10pm – 5am, with the outer side of the Endeavour Drive also restricted to 4 Hour Parking between 8.30am – 6pm Monday to Friday.

Cliff Road

Cliff Road is a local collector road under the care and maintenance of the local Council. The road runs parallel to the beach front and connects onto the state road, Corrimal Street. Cliff Road has a single lane of travel in each direction and is signposted as a 40km/h HPAA.

The road width is approximately between 9-10m between Harbour Street and Marine Drive, with limited on-street parking available in this section of Cliff Road.

There is a No Right Turn implemented for westbound vehicles attempting to turn into Brighton Lawn Reserve, presumably due to the narrow road width not allowing westbound drivers to pass another vehicle waiting to turn right.

Unnamed Access Road (central pier)

The unnamed access road running along the northern side of Belmore Basin from Endeavour Road to the end of the central pier is privately owned (on Lot 102 DP747592) and not maintained by the local Council. The road is two-way and signposted as a 10km/h Shared Zone.

The road width varies greatly between 9.5m – 17m, with a combination of parallel and 90-degree angled on-street parking. Parking on this road is also signposted as No Parking 10pm – 5am.

Unnamed Access Road (southern pier)

The unnamed access road running along the eastern and southern sides of Belmore Basin towards Brighton Lawn Reserve is privately owned (on Lot 102 DP747592) and not maintained by the local Council. The road is one-way southbound and signposted as a 10km/h Shared Zone.

The road width varies between 6.5m – 10m, with marked on-street parallel parking bays generally available on one side of the road. Parking on this road is also signposted as No Parking 10pm – 5am.

Parking

The Site generally consists of unmarked parking spaces around the central pier of Wollongong Harbour (north of Belmore Basin). The existing parking capacity at the Site is approximately 65-75 spaces, with most vehicles parking at 90 degrees to the waterfront.

Once this capacity within the Site is reached, there are multiple other parking options within a short walking distance to the proposed pontoon. There is a combined total of 234 parking spaces shared with other land uses around the headland including cafes / restaurants, recreational parkland, beaches and tourist attractions (e.g. the two lighthouses).

A summary of the parking around the Flagstaff Point headland is shown in **Table 1-1**.

Figure 1-5 Parking Areas at Flagstaff Point

Table 1-1 Parking Supply at Flagstaff Point Headland

Parking	Location	Marked / Unmarked Spaces	Type of Parking	Parking Spaces
On-street	Unnamed Access Road (central pier) – in Subject Site	Unmarked	90-degree	65-75
	Unnamed Access Road (central pier) – outside Subject Site	Marked	Parallel	15
	Unnamed Access Road (southern pier)	Marked	Parallel	25
	Endeavour Drive	Unmarked	Parallel	95
Off-street	Flagstaff Hill eastern car park	Marked	90-degree	36
	Flagstaff Hill central car park	Marked	90-degree	26
	Flagstaff Hill western car park	Marked	90-degree	37

Public Transport

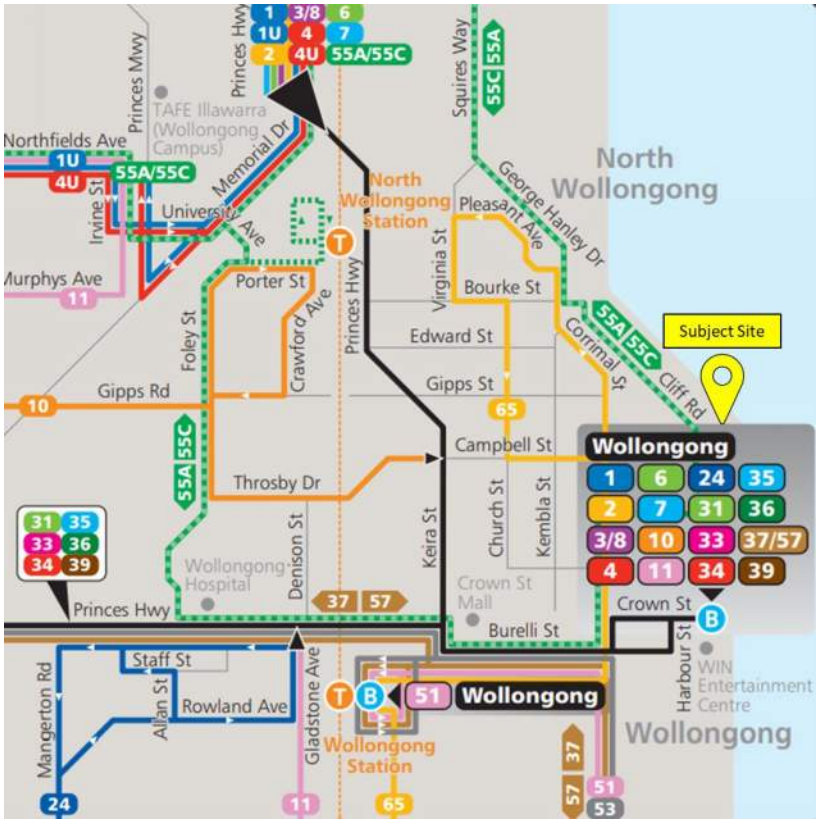
Bus

The closest bus stops to the Site are located on the western side of Cliff Road (ID: 2500336) and southern side of Market Street (ID: 2500205), which are approximately a 650-700m walk (9 minutes) away from the proposed pontoon's location.

The bus stop on Cliff Road services northbound buses on Route 55A towards Fairy Meadow, running every 20 minutes on weekends.

The bus stop on Market Street services westbound buses on Route 55C towards Wollongong and Gwynneville, running every 20 minutes on weekends.

Figure 1-6 Bus Services in Wollongong



Train

The closest train station to the Site (Wollongong Station) is approximately 2.5km away on foot, which is roughly a 32-minute walk. For this reason, it is unlikely that any users of the Site would catch a train to travel to and from the Site.

Active Transport

Pedestrians

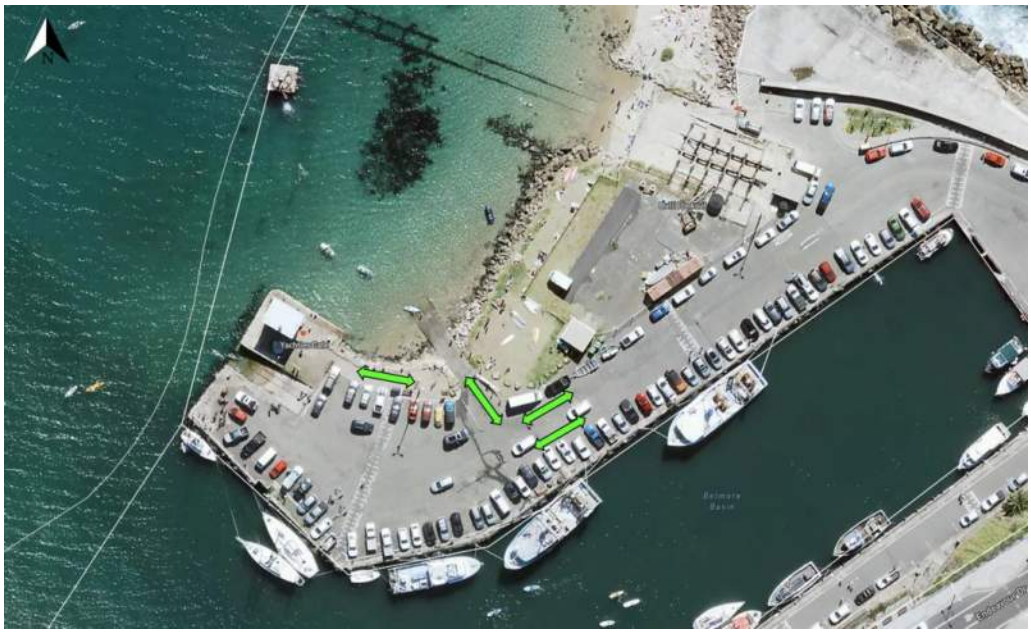
Provision of safe pedestrian walkways and crossing infrastructure around the Site is generally considered as poor. There are no defined routes or crossing points for pedestrians, and there is a lack of wayfinding signage to safely guide pedestrians to points of interest around the Site (for example, to the boat ramp or café).

There is a solid white line which provides a buffer between parked vehicles and the water's edge, and this buffer could potentially be used as a pedestrian path. However, many parked vehicles encroach into this buffer which make the buffer an undesirable walking route. The walking route is also disjointed with many water access ladders and other obstructions making the route unsafe for pedestrians.

With no defined walkways or crossings, pedestrians are likely to walk along the roadway next to moving vehicles as depicted in **Figure 1-8**.

Figure 1-7 Potential Pedestrian Walking Route along water edge

Figure 1-8 Assumed Existing Pedestrian Desire Lines

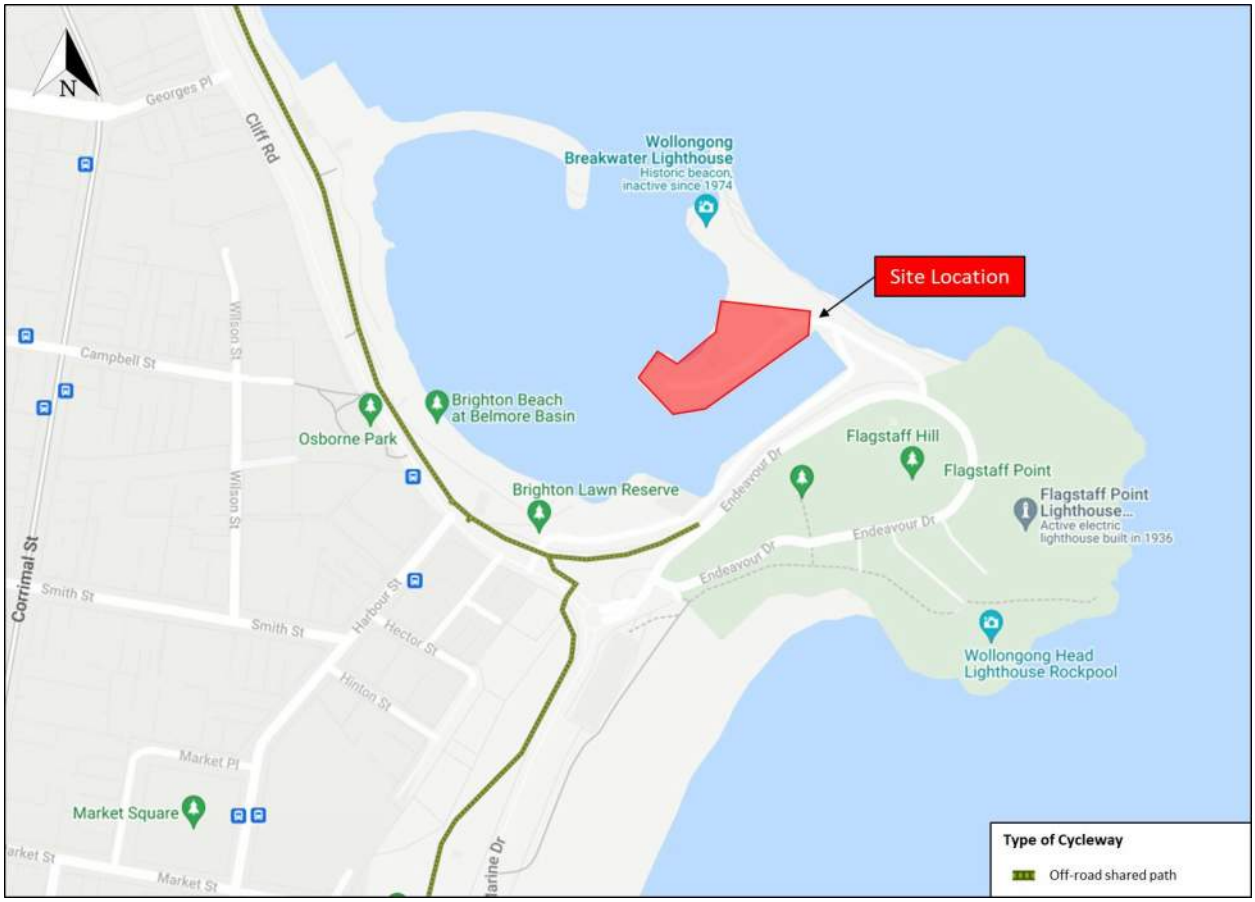


Cyclists

There is an existing off-road shared path measuring approximately 2.2m – 2.5m in width which travels along the western side of Marine Drive, crosses Cliff Road at the refuge island just west of the roundabout at Endeavour Drive / Marine Drive, and then continues west along the northern side of Cliff Road.

There are no cycle routes or cycling infrastructure around the Site itself.

Figure 1-9 Off-Road Cycle Route



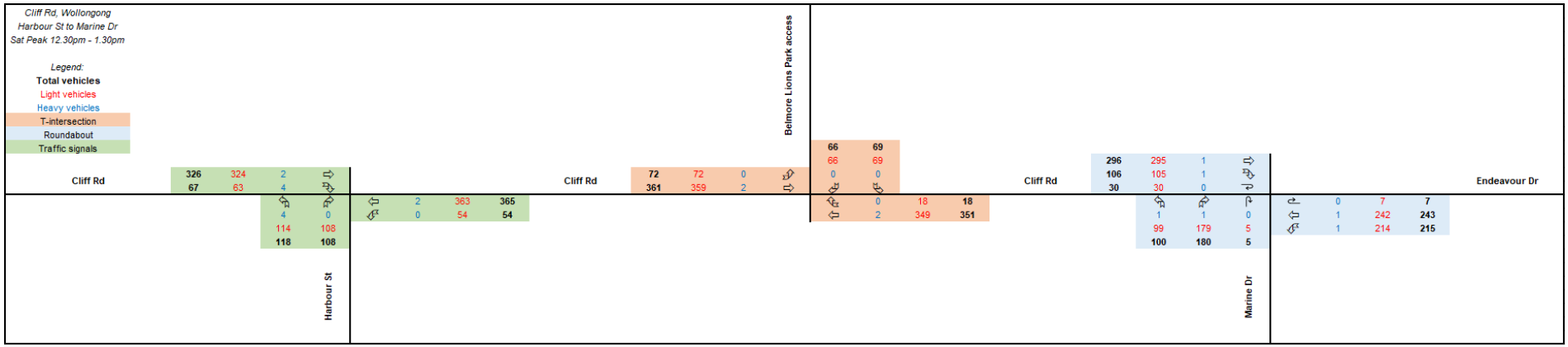
Traffic Surveys

Three classified intersection counts (CIC) were undertaken at the intersections of Cliff Road / Harbour Street, Cliff Road / Belmore Lions Park Access and Cliff Road / Marine Drive / Endeavour Drive on Saturday 14 May 2022 and Sunday 15 May 2022 between 9.00am – 3.00pm. The peak hour was anticipated to occur on a weekend within this time period.

The vehicles and transport modes that were counted were classified as either light vehicles, heavy vehicles (including buses) or pedestrians.

Traffic volumes were generally found to be higher on Saturday compared to Sunday, and the combined peak hour between all three intersections was 12.30pm – 1.30pm on Saturday. A summary of the turning movements at each intersection during the Saturday peak is shown in **Figure 1-10**.

Figure 1-10 Existing Saturday Peak Traffic Volumes



Road Safety

TfNSW provides details of all recorded accidents in NSW within the latest 5-year reporting period (2016 – 2020) on the NSW Centre for Road Safety website. The accident history on Endeavour Drive and the unnamed Wollongong Harbour access roads has been analysed, with a summary of the crash details provided below.

Table 1-2 Accident History (2016 – 2020)

Location	Year	Crash ID	Degree of Crash	RUM Code	Description	Vehicles
Endeavour Dr at Endeavour Dr	2019	1197798	Moderate Injury	21	Right through	Car / motorcycle
Endeavour Dr, 100m west of Harbour access road	2020	1244134	Non-casualty	44	Parking vehicles	Unknown / car
Unnamed road, 200m north of Cliff Road	2016	1093982	Serious Injury	9	Pedestrian other	Car / pedestrian

The pedestrian accident in 2016 is of particular relevance to this project, which occurred on the one-way unnamed access road, on the southern side of Belmore Basin. A vehicle / pedestrian accident suggests that the pedestrian may have been walking on the road due to the lack of a safe pedestrian walkway. It is envisaged that the improved signage and line marking plan will go about reducing the number of pedestrian and vehicle conflicts around the harbour.

1.3 PARKING ANALYSIS

Numerical Parking Requirement

A review of Australian Standard AS3962:2020 (Marina Design), TfNSW's Guide to Traffic Generating Developments, NSW Boat Ramp Facility Guideline (RMS, 2015) and Chapter E3 of the Wollongong DCP has been undertaken to determine the recommended number of parking spaces required for the land uses involved at the Site.

For public boat ramps at marinas in urban environments, AS3962 recommends that 20-30 parking spaces per ramp lane are required. If the public boat ramp also has a vessel holding structure such as a mooring pontoon or jetty, this recommendation is increased to 30-40 parking spaces per ramp lane. It is noted that the NSW Boat Ramp Facility Guideline refers to a now superseded version of AS3962, which is updated to 2020.

The TfNSW Guide provides the following recommended parking rates at marinas:

- 0.6 spaces per wet berth
- 0.2 spaces per dry storage berth
- 0.2 spaces per swing mooring; and
- 0.5 spaces per marina employee.

The Guide also notes that parking demand at marinas is quite dependant on the season (more parking demand during summer), the types of berth / mooring (i.e. wet or dry) and the types of boats (larger boats demand additional parking spaces).

The Site also has a small café / kiosk, which is primarily considered ancillary to the aforementioned land uses. For the purpose of a conservative assessment, Wollongong DCP's parking rate for a 'kiosk' of 1 parking space per 25m^2 GFA will also be applied to the numerical parking recommendation. The DCP does not provide any car parking rates for marinas and/or boat ramps.

The resulting numerical parking recommendation based on review of these reference documents is shown below in **Table 1-3**.

It is relevant to note that boat users can board and alight watercraft from the southern pier, which would be considered a "vessel holding structure", and thus require a higher parking demand than what is shown for

existing conditions in **Table 1-3**. However, as a conservative assumption, this existing operation at the southern pier has not been considered.

Table 1-3 Comparison between Existing and Proposed Parking Space Requirement

	Existing			Proposed		
Land Use	Parking Rate	Units	Parking Space Requirement	Parking Rate	Units	Parking Space Requirement
Boat Ramp & Pontoon	20-30 spaces / ramp lane	1 ramp lane	20-30	30-40 spaces / ramp lane	1 ramp lane	30-40
Marina Wet Berths	0.6 spaces / wet berth	44 wet berths	27	0.6 spaces / wet berth	41 wet berths	25
Kiosk	1 space / 25m^2 GFA	39m^2	2	1 space / 25m^2 GFA	39m^2	2
		Total =	**49-59**		**Total =**	**57-67**

Overall, the proposed changes consisting of the installation of a mooring pontoon at the central pier and removal of 3 wet berths results in an additional parking requirement of 8 spaces for the Site. With 59 parking spaces proposed, the proposed number of spaces is within the recommended range of parking spaces (57 – 67).

The upper limit recommendation of 67 parking spaces is anticipated to be met only on days of peak usage throughout the year, likely to be in summer. During these times, there is an ample amount of alternate parking within a short walking distance as outlined in **Table 1-1**.

Parking for Different Users

The Belmore Basin Marina is expected to be used by a number of different users. The following types of parking spaces / areas have been included in the design plan for TfNSW's linemarking project at the Site.

- Two public long vehicle spaces for cars with trailers. It is recommended that these parking spaces be signposted as 'No Parking – Vehicles with Trailers Excepted'.
- One long vehicle space for surf lifesaving purposes. It is recommended that this parking space be signposted as 'No Parking – Surf Lifesaver Vehicles Excepted'.
- Two accessible parking spaces for disability parking permit holders. Table D3.5 of the Building Code of Australia (BCA) provides guidance of accessible parking requirements, where a rate of 1 space for every 50 parking spaces or part thereof is generally considered acceptable. For the Proposal, the supply of 2 accessible parking space is considered as acceptable.
- One loading and unloading bay for delivery / service trucks. It is recommended that this parking space be signposted as a 'Loading Zone'.
- One short-stay parking zone near the boat ramp and one near the proposed pontoon. It is recommended that these parking zones be signposted as '10 Minute Parking (5am-10pm)'.

1.4 TRAFFIC ANALYSIS

Traffic Generation

The TfNSW Guide provides the following recommended daily vehicle trip rate at marinas:

- 2.7 daily trips per fixed berth + 1.4 daily trips per swing mooring.

Table 1-4 Comparison between Existing and Proposed Traffic Generation

	Existing			Proposed		
Land Use	Trip Generation Rate	Units	Daily Trip Generation	Trip Generation Rate	Units	Daily Trip Generation
Marina	2.7 trips / fixed berth	44 wet berths	119 veh/day	2.7 trips / fixed berth	41 wet berths	111 veh/day
		Total =	**119 veh/day**		**Total =**	**111 veh/day**

As **Table 1-4** shows, traffic generation at a marina is calculated based on the number of fixed berths. With a decrease in the number of berths, it follows that there is less traffic generated by the marina, according to the TfNSW Guide.

The Guide also notes that there are large seasonal variations in marina usage, with peak traffic generation occurring on summer weekends.

Assuming that the peak hour accounts for 10% of the daily trip generation, and by rounding up to the nearest whole number (as per the DCP parking guidelines), this results in a peak hour traffic generation of 12 vehicles / hour (e.g. 6 vehicles travelling to the Site, 6 vehicles leaving the Site).

Despite these theoretical traffic generation rates, it is anticipated that traffic generation may slightly increase due to the appeal and attractiveness of a new pontoon. The re-opening of the slipway may also slightly increase traffic generation. It is assumed that the slipway will be a commercial operation, likely to consist of no more than 3-5 staff at any one time.

For the purpose of a conservative traffic assessment, this analysis will assume a traffic generation rate based on the number of additional parking spaces, with the 8 additional spaces creating 8 additional vehicle movements in the peak hour.

A rate of 8 additional vehicle movements in the peak hour increases the current traffic generation rate from 12 veh/h to 20 veh/h (assumed to be 10 inbound vehicles and 10 outbound vehicles).

Trip Distribution

Based on the proportion of traffic movements found from the traffic surveys during the weekend peak (**0**), the following trip distribution splits have been assumed for inbound and outbound vehicles:

Inbound

- Cliff Road (North-West): 45%.
- Marine Drive (South): 40%.
- Harbour Street (South-West): 15%.

Outbound

- Cliff Road (North-West): 50%.
- Marine Drive (South): 45%.
- Harbour Street (South-West): 5%.

Trip Assignment

For the 8 additional vehicles generated by the Proposal, their origins / destinations have been assigned as per **Table 1-5**, assuming 4 inbound vehicles and 4 outbound vehicles are generated.

Table 1-5 Trip Assignment

	Inbound			Outbound		
Road	Direction Travelling	Trip Distribution	Vehicles in Peak Hour	Direction Travelling	Trip Distribution	Vehicles in Peak Hour
Cliff Road	South-East	45%	2	North-West	50%	2
Marine Drive	North	40%	2	South	45%	2
Harbour Street	North-East	15%	0	South-West	5%	0
		Total =	**4 veh/h**		**Total =**	**4 veh/h**

Intersection Performance

The intersection performance criteria are based on the TfNSW Traffic Modelling Guidelines (2013). The capacity of a road network can be largely determined by the capacity of the controlling intersections. The key indicator of intersection performance Level of Service (LOS) is delay, where results are placed on a continuum from 'A' to 'F' as shown in **Table 1-6**.

The SIDRA movement summaries are presented in Appendix A.

Table 1-6 Level of Service Criteria

Level of Service	Average Delay per Vehicle (s)	Traffic signals / roundabout	Give Way / Stop signs
A	<14	Good operation	Good operation
B	15 to 28	Good with acceptable delays & spare capacity	Acceptable delays & spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity & accident study required
E	57 to 70	At capacity; at signals, incidents will cause excessive delays	At capacity, requires other control mode
F	>70	Unsatisfactory and requires additional capacity	Unsatisfactory and requires additional capacity

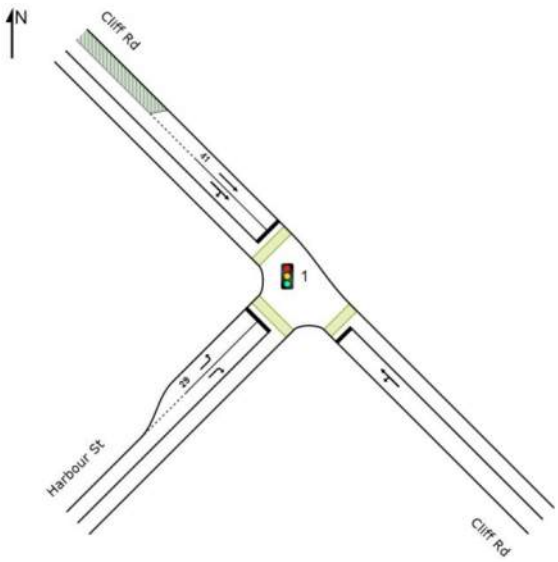
Source: TfNSW Traffic Modelling Guidelines (2013)

TfNSW guidelines state that for traffic signals, the average movement delay and corresponding LoS over all movements should be determined and reported. For roundabouts and priority control intersections, LOS assessment should be reported based on the worst performing movement of the intersection.

Cliff Road / Harbour Street

An aerial picture and layout of the Cliff Road / Harbour Street intersection as modelled in SIDRA is shown below in **Table 1-7**.

Table 1-7 Layout of Cliff Road / Harbour Street

Aerial	SIDRA Model
	

The intersection performance results are summarised below in **Table 1-8**.

Table 1-8 2022 Intersection Performance of Cliff Road / Harbour Street

Scenario	Intersection Leg	Degree of Saturation, DoS	95th Percentile Queue (m)	Average Delay (s)	Level of Service, LoS
Weekend Peak (12.30pm – 1.30pm)					
Existing Conditions (base)	Cliff Road (South East)	41.3%	32.1	9.6	A
	Cliff Road (North West)	42.8%	27.0	10.4	A
	Harbour Street (South West)	31.6%	14.0	26.6	B
	Overall	**42.8%**	**32.1**	**13.6**	**A**
With Proposed Works	Cliff Road (South East)	41.5%	32.3	9.6	A
	Cliff Road (North West)	43.0%	27.2	10.4	A
	Harbour Street (South West)	31.6%	14.0	26.6	B
	Overall	**43.0%**	**32.3**	**13.6**	**A**

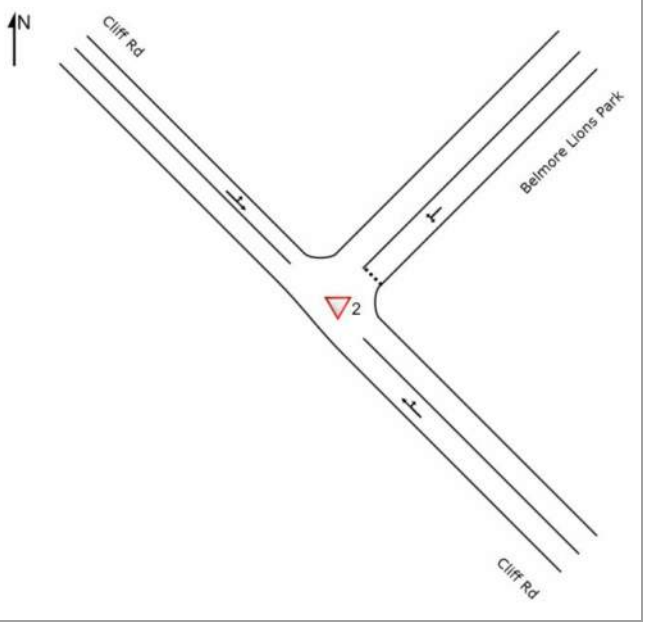
The intersection performance results presented above demonstrate the following:

- The Cliff Road legs of the intersection currently perform well at LOS A in the weekend peak period.
- After the proposed works are completed, the intersection will continue to perform at the existing LOS in the weekend peak period, with no increases to the average delay time on each intersection leg.
- No mitigation measures are required based on the LOS being retained in the weekend peak period.

Cliff Road / Belmore Lions Park access

An aerial picture and layout of the Cliff Road / Belmore Lions Park access intersection as modelled in SIDRA is shown below in **Table 1-9**.

Table 1-9 Layout of Cliff Road / Belmore Lions Park access

Aerial	SIDRA Model
	

The intersection performance results are summarised below in **Table 1-10**.

Table 1-10 2022 Intersection Performance of Cliff Road / Belmore Lions Park access

Scenario	Turning Movement	Degree of Saturation, DoS	95th Percentile Queue (m)	Average Delay (s)	Level of Service, LoS
Weekend Peak (12.30pm – 1.30pm)					
Existing Conditions (base)	Right turn into Cliff Road	39.5%	5.7	17.9	B
With Proposed Works	Right turn into Cliff Road	39.7%	5.8	18.1	B

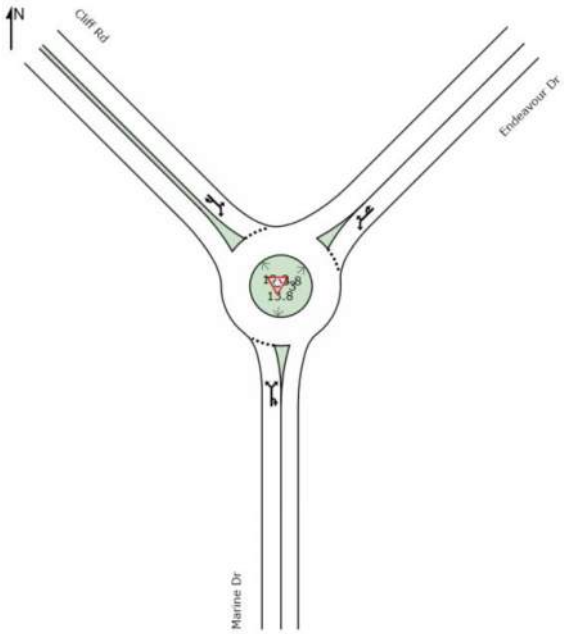
The intersection performance results presented above demonstrate the following:

- The intersection currently performs well at LOS B in the weekend peak period.
- After the proposed works are completed, the intersection will continue to perform at the existing LOS in the weekend peak period, with only a minor increase to the average delay time on the worst performing leg.
- No mitigation measures are required based on the LOS being retained in the weekend peak period.

Cliff Road / Endeavour Road / Marine Drive

An aerial picture and layout of the Cliff Road / Endeavour Road / Marine Drive intersection as modelled in SIDRA is shown below in **Table 1-11**.

Table 1-11 Layout of Cliff Road / Endeavour Road / Marine Drive

Aerial	SIDRA Model
	

The intersection performance results are summarised below in **Table 1-12**.

Table 1-12 2022 Intersection Performance of Cliff Road / Endeavour Road / Marine Drive

Scenario	Turning Movement	Degree of Saturation, DoS	95th Percentile Queue (m)	Average Delay (s)	Level of Service, LoS
Weekend Peak (12.30pm – 1.30pm)					
Existing Conditions (base)	U-turn from Marine Drive	29.1%	4.9	8.6	A
With Proposed Works	U-turn from Marine Drive	29.3%	4.9	8.6	A

The intersection performance results presented above demonstrate the following:

- The intersection currently performs well at LOS A in the weekend peak period.
- After the proposed works are completed, the intersection will continue to perform at the existing LOS in the weekend peak period, with no increase to the average delay time on the worst performing leg.
- No mitigation measures are required based on the LOS being retained in the weekend peak period.

1.5 OPERATIONAL AND SAFETY IMPACTS

Parking

The installation of a mooring pontoon and re-opening of the slipway is expected to have a place a slighter greater burden on the demand for parking at the Site.

Formalising the parking with TfNSW's linemarking project is estimated to reduce the parking supply from approximately 65 – 75 spaces down to 59 spaces. This is due to the creation of two short-stay drop-off / pick-up 'zones', shared areas to complement the accessible parking spaces, and signage to deter drivers from parking in front of the access gates to the former slipway maintenance yard.

With higher demand (especially in summer) and a lower supply, parking can be expected to extend into nearby streets and carparks across the Flagstaff Hill Park area. With roughly 234 parking spaces within easy walking distance to the Site, the parking impacts should be able to be contained within the general Flagstaff Hill precinct.

In terms of safety, the loading bay and one of the proposed long vehicle parking bays on the linemarking plan both protrude into the moving traffic area near the boat ramp. If vehicles park in these spaces, they are potential hazards to drivers who do not expect the road width to suddenly narrow without any warning signs or linemarking. Vehicles that park in these spaces also do not have any physical protection or barriers, and are at risk of being clipped, struck or damaged by a moving vehicle.

Active Transport

Pedestrian safety is a key focus of TfNSW's linemarking project, with a wider and more defined walkway for pedestrians to be created around the water's edge of Belmore Basin. The path will stretch from the kiosk at the tip of the central pier to the cafes and restaurants situated on the southern pier. The footpath width will vary between 1.3m – 2.1m, with the assumption that boat hooks and other obstructions (e.g. concrete blocks) will be relocated away off the footpath.

The parking spaces on the central pier adjacent to the northern edge of Belmore Basin are proposed to have wheel stops installed. Wheel stops will prevent vehicles from encroaching into the pedestrian area when parking, further enhancing safety for pedestrians using the new path.

Some shortfalls have been identified with the new path:

> It is noted that the existing condition of the footpath pavement around the water's edge is poor, with variations in height between the asphalt and concrete posing potential trip hazards to pedestrians.

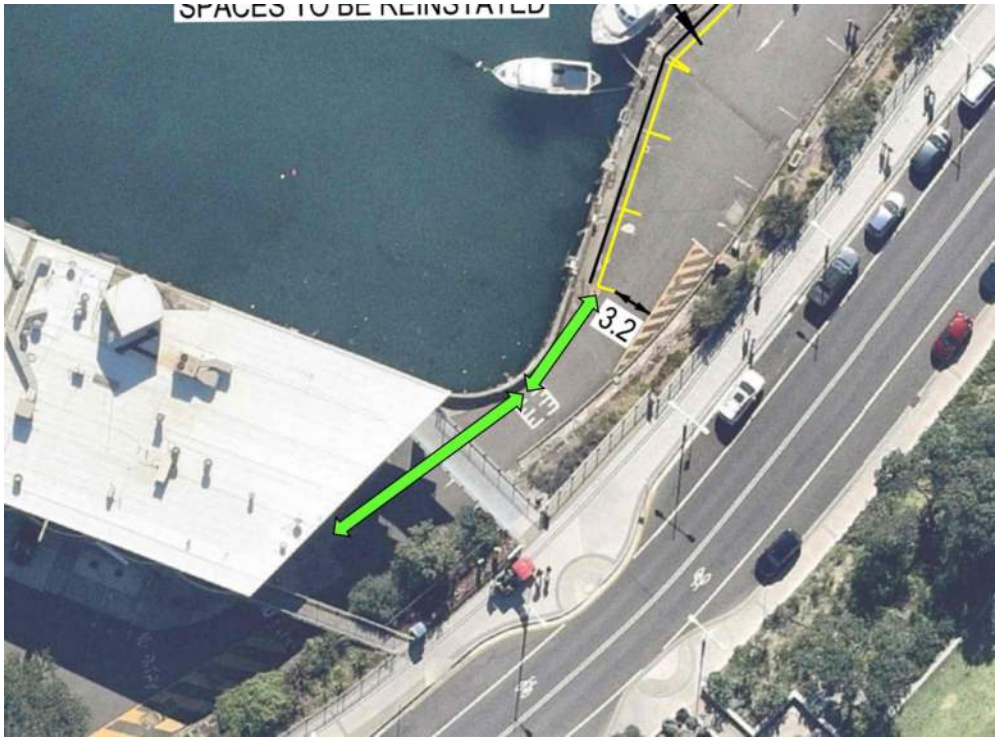
Figure 1-11 Existing Path Condition around Belmore Basin

> There is a lack of wayfinding signage and/or identification (through signs or linemarking) which would allow pedestrians to recognise the path as a safe path for pedestrian use.

> The proposed 'Common User Berth' for vehicles intercepts the pedestrian desire line, which introduces the likelihood for more pedestrian / vehicle conflicts. A continuous pedestrian path separated away from vehicle movements should ideally be maintained to enhance pedestrian safety.

> At the southern end of the path, the path leads pedestrians directly into the moving traffic lane just east of the pedestrian fly-over bridge. This is a safety hazard for pedestrians, with the path ideally continuing to the west under the pedestrian fly-over bridge and connecting up to the footpath around the café and restaurant area.

Figure 1-12 Lack of Path Continuity



> There is no footpath connection between the kiosk on the central pier and the proposed kerb ramp in the car park. This may raise accessibility issues for users of the accessible parking spaces.

Cycling around Wollongong Harbour has already been raised as a safety concern from the consultation conducted by TfNSW. The following theme was raised in the Wollongong Harbour Master Plan Report (TfNSW, 2020):

"Shared use of space between pedestrians and cyclists along the harbour pathways was a clear access and safety concern. Almost all conversations favoured that the space be prioritised for pedestrians. The speeds at which cyclists travel through the harbour's thoroughfares were considered a danger to user groups — particularly children and the elderly walking or playing in and around the space."

The Proposal is not anticipated to change any existing cyclist movements or behaviours around the harbour.

Water Users

Water users of non-motorised craft such as kayakers and paddleboarders will have the benefit of a new pontoon from which they can safely get in and out of their vessels. The additional launching point will also assist in spacing out the demand, creating less congestion around the existing boat ramp.

The creation of two short-stay parking zones will add to the appeal and safety around the Site, with water users able to directly load and unload their water vessels from their vehicles within close proximity to either launching point. This reduces the likelihood of illegal parking around the launching points (areas of high pedestrian activity) to load and unload, and removes the need for water users to carry their vessels through the car park to reach the launching points (thereby reducing the potential for pedestrian / vehicle accidents in the car park).

1.6 CONCLUSION

The key findings of this Traffic and Parking Impact Statement for the proposed new pontoon and re-opening of the slipway at Wollongong Harbour are:

> The existing parking capacity at the Site is approximately 65-75 spaces, however there are a further 234 parking spaces around Flagstaff Point headland which can accommodate any overflow parking.

> The Proposal will result in an additional parking requirement of 8 spaces. The 59 parking spaces proposed on the plan is within the recommended parking supply range of 57 – 67 spaces.

- There is a lack of any safe pedestrian paths around the Site with no defined routes or crossing points for pedestrians.
- A wider and more defined walkway for pedestrians will be created around the water's edge of Belmore Basin (with a varying width between 1.3m – 2.1m). However, the proposed path still lacks connectivity, continuity, wayfinding and an even pavement surface.
- The existing peak hour traffic generation rate of the Site is estimated to be 12 veh/h. It is conservatively assumed that the additional parking requirement for 8 spaces will create 8 additional vehicle movements in the peak hour, therefore increasing the traffic generation up to 20 veh/h.
- 4 additional inbound vehicle and 4 outbound vehicles in the peak hour have been shown to have no impact on the external intersection's existing Levels of Service. Cliff Road / Harbour Street and Cliff Road / Endeavour Road / Marine Drive will continue to operate at LOS A, and Cliff Road / Belmore Lions Park access will continue to operate at LOS B.

Yours sincerely,

Hayden Calvey
Traffic Engineering Team Leader
for Cardno
Direct Line: +61 2 9024 7093
Email: hayden.calvey@cardno.com.au

APPENDIX A

SIDRA Outputs

MOVEMENT SUMMARY

Site: 1 [Cliff Rd / Harbour St - 2022 Base (Site Folder: General)]

Network: N101 [Cliff Rd - 2022 Base (Network Folder: General)]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 60 seconds (Site User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
SouthEast: Cliff Rd														
21	L2	57	0.0	57	0.0	* 0.413	12.6	LOS A	4.6	32.1	0.63	0.59	0.63	39.0
22	T1	384	0.5	384	0.5	0.413	9.2	LOS A	4.6	32.1	0.63	0.59	0.63	33.7
Approach		441	0.5	441	0.5	0.413	9.6	LOS A	4.6	32.1	0.63	0.59	0.63	34.3
NorthWest: Cliff Rd														
28	T1	343	0.6	343	0.6	* 0.428	9.7	LOS A	3.8	27.0	0.64	0.57	0.64	32.8
29	R2	71	6.0	71	6.0	0.428	14.0	LOS A	3.8	27.0	0.68	0.62	0.68	38.5
Approach		414	1.5	414	1.5	0.428	10.4	LOS A	3.8	27.0	0.64	0.57	0.64	34.2
SouthWest: Harbour St														
30	L2	124	3.4	124	3.4	0.316	26.7	LOS B	1.9	14.0	0.88	0.76	0.88	33.7
32	R2	114	0.0	114	0.0	0.287	26.5	LOS B	1.8	12.4	0.88	0.76	0.88	29.0
Approach		238	1.8	238	1.8	0.316	26.6	LOS B	1.9	14.0	0.88	0.76	0.88	32.1
All Vehicles		1093	1.2	1093	1.2	0.428	13.6	LOS A	4.6	32.1	0.69	0.62	0.69	33.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Effective Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
SouthEast: Cliff Rd											
P5	Full	86	24.4	LOS C	0.1	0.1	0.90	0.90	198.6	209.0	1.05
NorthWest: Cliff Rd											
P7	Full	114	24.4	LOS C	0.2	0.2	0.90	0.90	200.1	210.8	1.05
SouthWest: Harbour St											
P8	Full	26	24.3	LOS C	0.0	0.0	0.90	0.90	200.5	211.4	1.05
All Pedestrians		226	24.4	LOS C	0.2	0.2	0.90	0.90	199.5	210.2	1.05

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

Site: 1 [Cliff Rd / Harbour St - 2022 Base (Site Folder: General)]

Network: N101 [Cliff Rd - 2022 Base (Network Folder: General)]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 60 seconds (Site User-Given Cycle Time)

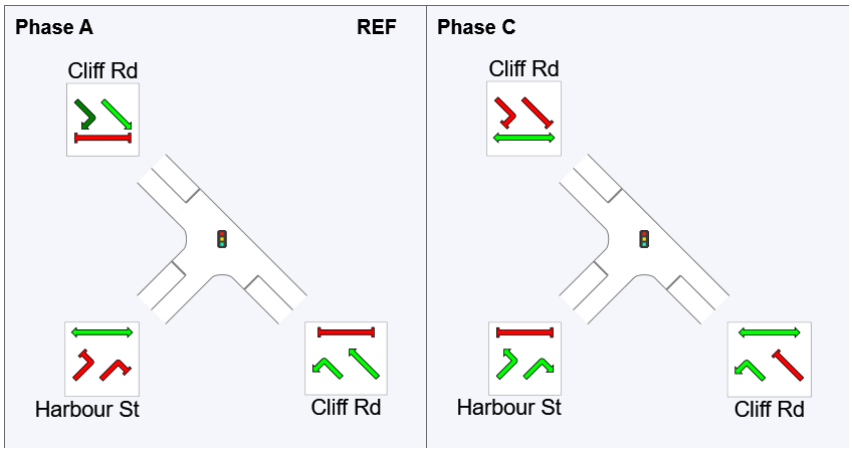
Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Downstream lane blockage effects included in determining phase times
Phase Sequence: Leading Right Turn
Reference Phase: Phase A
Input Phase Sequence: A, B*, C
Output Phase Sequence: A, C
(* Variable Phase)

Phase Timing Summary

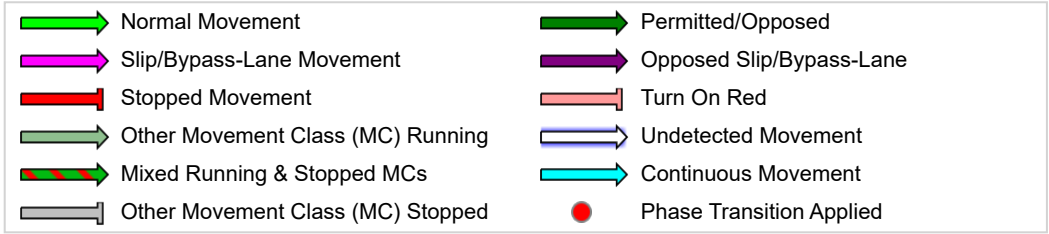
Phase	A	C
Phase Change Time (sec)	0	38
Green Time (sec)	32	16
Phase Time (sec)	38	22
Phase Split	63%	37%

See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase



MOVEMENT SUMMARY

Site: 1 [Cliff Rd / Harbour St - 2022 With Proposed Works (Site Folder: General)]

Network: N101 [Cliff Rd - 2022 With Proposed Works (Network Folder: General)]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 60 seconds (Site User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
SouthEast: Cliff Rd														
21	L2	57	0.0	57	0.0	* 0.415	12.6	LOS A	4.6	32.3	0.64	0.59	0.64	39.0
22	T1	386	0.5	386	0.5	0.415	9.2	LOS A	4.6	32.3	0.64	0.59	0.64	33.7
Approach		443	0.5	443	0.5	0.415	9.6	LOS A	4.6	32.3	0.64	0.59	0.64	34.3
NorthWest: Cliff Rd														
28	T1	345	0.6	345	0.6	* 0.430	9.7	LOS A	3.8	27.2	0.64	0.57	0.64	32.7
29	R2	71	6.0	71	6.0	0.430	14.0	LOS A	3.8	27.2	0.68	0.62	0.68	38.5
Approach		416	1.5	416	1.5	0.430	10.4	LOS A	3.8	27.2	0.64	0.58	0.64	34.2
SouthWest: Harbour St														
30	L2	124	3.4	124	3.4	0.316	26.7	LOS B	1.9	14.0	0.88	0.76	0.88	33.7
32	R2	114	0.0	114	0.0	0.287	26.5	LOS B	1.8	12.4	0.88	0.76	0.88	29.0
Approach		238	1.8	238	1.8	0.316	26.6	LOS B	1.9	14.0	0.88	0.76	0.88	32.1
All Vehicles		1097	1.2	1097	1.2	0.430	13.6	LOS A	4.6	32.3	0.69	0.62	0.69	33.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Effective Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
SouthEast: Cliff Rd											
P5	Full	86	24.4	LOS C	0.1	0.1	0.90	0.90	198.6	209.0	1.05
NorthWest: Cliff Rd											
P7	Full	114	24.4	LOS C	0.2	0.2	0.90	0.90	200.1	210.8	1.05
SouthWest: Harbour St											
P8	Full	26	24.3	LOS C	0.0	0.0	0.90	0.90	200.5	211.4	1.05
All Pedestrians		226	24.4	LOS C	0.2	0.2	0.90	0.90	199.5	210.2	1.05

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

Site: 1 [Cliff Rd / Harbour St - 2022 With Proposed Works (Site Folder: General)]

Network: N101 [Cliff Rd - 2022 With Proposed Works (Network Folder: General)]

New Site
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 60 seconds (Site User-Given Cycle Time)

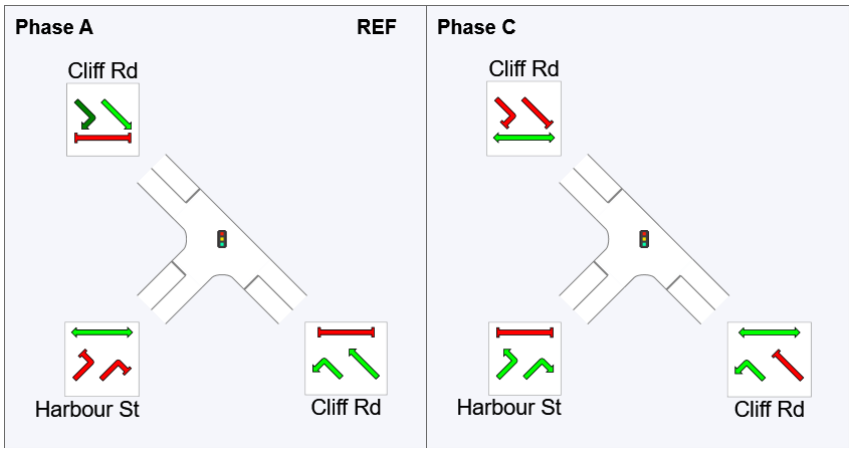
Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Downstream lane blockage effects included in determining phase times
Phase Sequence: Leading Right Turn
Reference Phase: Phase A
Input Phase Sequence: A, B*, C
Output Phase Sequence: A, C
(* Variable Phase)

Phase Timing Summary

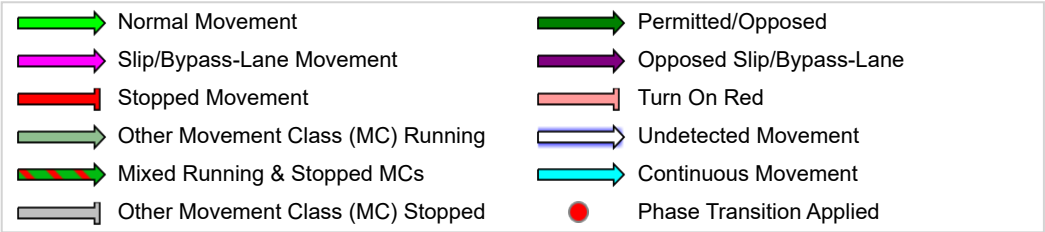
Phase	A	C
Phase Change Time (sec)	0	38
Green Time (sec)	32	16
Phase Time (sec)	38	22
Phase Split	63%	37%

See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase



MOVEMENT SUMMARY

Site: 2 [Cliff Rd / Belmore Lions Park - 2022 Base (Site Folder: General)]

Network: N101 [Cliff Rd - 2022 Base (Network Folder: General)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
SouthEast: Cliff Rd														
22	T1	369	0.6	369	0.6	0.188	2.2	LOS A	0.0	0.0	0.00	0.39	0.00	27.9
23	R2	19	0.0	19	0.0	0.188	7.0	LOS A	0.0	0.0	0.00	0.39	0.00	37.4
Approach		388	0.5	388	0.5	0.188	2.5	NA	0.0	0.0	0.00	0.39	0.00	30.3
NorthEast: Belmore Lions Park														
24	L2	73	0.0	73	0.0	0.395	6.3	LOS A	0.8	5.7	0.67	0.86	0.90	9.4
26	R2	69	0.0	69	0.0	0.395	17.9	LOS B	0.8	5.7	0.67	0.86	0.90	9.4
Approach		142	0.0	142	0.0	0.395	12.0	LOS A	0.8	5.7	0.67	0.86	0.90	9.4
NorthWest: Cliff Rd														
27	L2	76	0.0	76	0.0	0.239	7.2	LOS A	0.0	0.0	0.00	0.47	0.00	37.1
28	T1	380	0.6	380	0.6	0.239	2.2	LOS A	0.0	0.0	0.00	0.47	0.00	27.2
Approach		456	0.5	456	0.5	0.239	3.1	NA	0.0	0.0	0.00	0.47	0.00	32.5
All Vehicles		986	0.4	986	0.4	0.395	4.1	NA	0.8	5.7	0.10	0.49	0.13	16.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 2 [Cliff Rd / Belmore Lions Park - 2022 With Proposed Works (Site Folder: General)]

Network: N101 [Cliff Rd - 2022 With Proposed Works (Network Folder: General)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
SouthEast: Cliff Rd														
22	T1	372	0.6	372	0.6	0.189	2.2	LOS A	0.0	0.0	0.00	0.39	0.00	27.9
23	R2	19	0.0	19	0.0	0.189	7.0	LOS A	0.0	0.0	0.00	0.39	0.00	37.4
Approach		391	0.5	391	0.5	0.189	2.5	NA	0.0	0.0	0.00	0.39	0.00	30.3
NorthEast: Belmore Lions Park														
24	L2	73	0.0	73	0.0	0.397	6.4	LOS A	0.8	5.8	0.67	0.87	0.91	9.4
26	R2	69	0.0	69	0.0	0.397	18.1	LOS B	0.8	5.8	0.67	0.87	0.91	9.4
Approach		142	0.0	142	0.0	0.397	12.1	LOS A	0.8	5.8	0.67	0.87	0.91	9.4
NorthWest: Cliff Rd														
27	L2	76	0.0	76	0.0	0.240	7.2	LOS A	0.0	0.0	0.00	0.47	0.00	37.1
28	T1	382	0.6	382	0.6	0.240	2.2	LOS A	0.0	0.0	0.00	0.47	0.00	27.2
Approach		458	0.5	458	0.5	0.240	3.1	NA	0.0	0.0	0.00	0.47	0.00	32.5
All Vehicles		991	0.4	991	0.4	0.397	4.1	NA	0.8	5.8	0.10	0.49	0.13	16.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 3 [Cliff Rd / Endeavour Dr / Marine Dr - 2022 Base (Site Folder: General)]

Network: N101 [Cliff Rd - 2022 Base (Network Folder: General)]

New Site
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Marine Dr														
1a	L1	105	1.0	105	1.0	0.291	3.4	LOS A	0.7	4.9	0.52	0.60	0.52	35.7
3a	R1	189	0.6	189	0.6	0.291	6.5	LOS A	0.7	4.9	0.52	0.60	0.52	38.3
3u	U	5	0.0	5	0.0	0.291	8.6	LOS A	0.7	4.9	0.52	0.60	0.52	39.1
Approach		300	0.7	300	0.7	0.291	5.5	LOS A	0.7	4.9	0.52	0.60	0.52	37.7
NorthEast: Endeavour Dr														
24a	L1	226	0.5	226	0.5	0.393	2.5	LOS A	1.0	7.2	0.40	0.51	0.40	38.4
26	R2	256	0.4	256	0.4	0.393	6.3	LOS A	1.0	7.2	0.40	0.51	0.40	36.0
26u	U	7	0.0	7	0.0	0.393	7.7	LOS A	1.0	7.2	0.40	0.51	0.40	39.3
Approach		489	0.4	489	0.4	0.393	4.6	LOS A	1.0	7.2	0.40	0.51	0.40	37.5
NorthWest: Cliff Rd														
27	L2	312	0.3	312	0.3	0.389	3.3	LOS A	1.0	7.0	0.46	0.54	0.46	36.7
29a	R1	112	0.9	112	0.9	0.389	5.9	LOS A	1.0	7.0	0.46	0.54	0.46	37.7
29u	U	32	0.0	32	0.0	0.389	8.0	LOS A	1.0	7.0	0.46	0.54	0.46	22.4
Approach		455	0.5	455	0.5	0.389	4.3	LOS A	1.0	7.0	0.46	0.54	0.46	36.8
All Vehicles		1244	0.5	1244	0.5	0.393	4.7	LOS A	1.0	7.2	0.45	0.55	0.45	37.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 3 [Cliff Rd / Endeavour Dr / Marine Dr - 2022 With Proposed Works (Site Folder: General)]

Network: N101 [Cliff Rd - 2022 With Proposed Works (Network Folder: General)]

New Site
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Marine Dr														
1a	L1	105	1.0	105	1.0	0.293	3.4	LOS A	0.7	4.9	0.52	0.61	0.52	35.6
3a	R1	192	0.5	192	0.5	0.293	6.6	LOS A	0.7	4.9	0.52	0.61	0.52	38.3
3u	U	5	0.0	5	0.0	0.293	8.6	LOS A	0.7	4.9	0.52	0.61	0.52	39.1
Approach		302	0.7	302	0.7	0.293	5.5	LOS A	0.7	4.9	0.52	0.61	0.52	37.7
NorthEast: Endeavour Dr														
24a	L1	228	0.5	228	0.5	0.396	2.5	LOS A	1.0	7.3	0.40	0.51	0.40	38.4
26	R2	258	0.4	258	0.4	0.396	6.3	LOS A	1.0	7.3	0.40	0.51	0.40	36.0
26u	U	7	0.0	7	0.0	0.396	7.7	LOS A	1.0	7.3	0.40	0.51	0.40	39.3
Approach		494	0.4	494	0.4	0.396	4.6	LOS A	1.0	7.3	0.40	0.51	0.40	37.5
NorthWest: Cliff Rd														
27	L2	314	0.3	314	0.3	0.392	3.3	LOS A	1.0	7.0	0.46	0.54	0.46	36.7
29a	R1	112	0.9	112	0.9	0.392	5.9	LOS A	1.0	7.0	0.46	0.54	0.46	37.6
29u	U	32	0.0	32	0.0	0.392	8.0	LOS A	1.0	7.0	0.46	0.54	0.46	22.4
Approach		457	0.5	457	0.5	0.392	4.3	LOS A	1.0	7.0	0.46	0.54	0.46	36.8
All Vehicles		1253	0.5	1253	0.5	0.396	4.7	LOS A	1.0	7.3	0.45	0.55	0.45	37.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.