



The new Sydney Fish Market

Marine Ecology Assessment – Stage 1 (Concept & Demolition) and Stage 2 (Main Works)

Prepared for
UrbanGrowth NSW Development Corporation

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Contents

Executive summary	6
1 Introduction and overview	7
1.1 Background.....	7
1.2 Site and context.....	7
1.3 Approval strategy.....	7
1.4 Summary of the development.....	8
1.4.1 Concept development application	8
1.4.2 Main Works development application.....	9
1.5 Purpose of this report	10
1.6 Marine ecology	10
2 Legislative context	11
2.1 Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	11
2.2 NSW Environmental Planning and Assessment Act 1979 (EP&A Act).....	11
2.3 NSW Biodiversity Conservation Act 2016 (BC Act).....	11
2.4 NSW Fisheries Management Act 1994 (FM Act)	11
2.5 Sydney Regional Environmental Plan (SREP, Sydney Harbour Catchment) 2005	12
2.6 NSW Coastal Management Act 2016 (CM Act)	12
3 Methods	13
3.1 Desktop assessment	13
3.2 Field survey	13
4 Aquatic habitats and ecology	14
4.1 Previous aquatic habitat mapping	14
4.2 Aquatic habitats at Blackwattle Bay	16
4.3 Presence or likelihood of threatened and protected species and populations.....	21
4.3.1 Fish, sharks and marine vegetation	22
4.3.2 Other listed or protected species.....	23
5 Impact assessment and mitigation	24
5.1 Assessment of demolition and construction impact	24
5.2 Assessment of operational impact.....	26
5.3 Fisheries Management Act habitat protection and permit requirements.....	27
5.4 Matters of National Environmental Significance (MNES).....	31
5.5 Sydney Regional Environmental Plan (SREP, Sydney Harbour Catchment) 2005	31
5.6 Recommended mitigation measures.....	33

5.7	Habitat opportunities (increase biodiversity value).....	34
6	Conclusion	36
7	References	37
	Appendix A: Threatened species likelihood of occurrence and impact	38
	Appendix B: Key fish habitat types	43
	Appendix C: Habitat opportunities	44
	Appendix C: Sediment Reprofiling	48

List of figures

Figure 1: Sydney Harbour - Foreshores and Waterways Area Development Control Plan: Ecological Communities and Landscape Characters (map sheet 8).....	14
Figure 2: Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005: Wetlands Protection Area (map sheet 4).....	15
Figure 3: DPI Fisheries mapping of estuarine macrophytes (Creese et al 2009)	15
Figure 4: Field survey of key fish habitat (KFH) July 2017	17
Figure 5: Proposed footprint and shading impact	18
Figure 6: Manmade structures in Blackwattle Bay	19
Figure 7: Subtidal sand	21
Figure 8: Intertidal and subtidal rock rubble	21
Figure 9: Example habitat opportunity areas on the new Sydney Fish Market (Image taken from SSD-DA Package: Stage 1 Concept Proposal – 3XN)	47

List of tables

Table 1: Impact to key fish habitat (KFH)	30
Table 2: Matters of National Environmental Significance from database search	31

Abbreviations

Abbreviation	Description
BC Act	NSW <i>Biodiversity Conservation Act 2016</i>
CM Act	NSW <i>Coastal Management Act 2016</i>
CEMP	Construction Environmental Management Plan
DPI	NSW Department of Primary Industries
ELA	Eco Logical Australia Pty Ltd
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
FM Act	NSW <i>Fisheries Management Act 1994</i>
KFH	Key fish habitat

Executive summary

Eco Logical Australia (ELA) has been commissioned by UrbanGrowth NSW Development Corporation (UrbanGrowth NSW) to undertake a Marine Ecology Assessment for the proposed new Sydney Fish Market within Blackwattle Bay.

The project is a State Significant Development for which Secretary's Environmental Assessment Requirements (SEARs) have been issued. The SEARs relevant to this report are as follows:

10. Biodiversity

- Provide a Marine Ecology Report to identify and determine the impacts to aquatic ecology, including from vessel use during demolition and early works, pile removal, hydrodynamic changes to water circulation and sediment movement, reduced water quality and dredging.
- Outline the mitigation measures to avoid, reduce, mitigate and offset these impacts, and provide recommendations to increase the aquatic biodiversity value of the urban waterway.
- Include consideration for the relevant policies and guidelines, including the *Policy and Guidelines for Fish Habitat Conservation and Management (2013)*, *DPI Fisheries Threatened Species Assessment Guidelines*, *NSW Biodiversity Offsets Policy for Major Projects – Aquatic Biodiversity Factsheet* and *About Fish Friendly Marine Infrastructure*.

The aim of this marine assessment is to understand the biota and habitat occurring in the subject site (defined as the development footprint of the new Sydney Fish Market) and surrounding study area (defined as the extent of Blackwattle Bay including the adjoining seawall, **Figure 4**). With this understanding, we determined if any impact would occur to threatened species, communities or populations as a result of the proposed project. We also determined if any environmental offsets are required in accordance with the DPI Fisheries Policy and Guidelines for Fish Habitat Conservation and Management (update 2013).

A desktop search using online databases was used to identify threatened aquatic species, populations or communities near the study area. A field survey using a boat-mounted underwater camera was completed to map the 'key fish habitat' within Blackwattle Bay and determine if any threatened aquatic species, populations or communities were present or could potentially use the area and be impacted by the works.

We conclude there would be no direct or indirect impacts to threatened aquatic species, populations or ecological communities or their habitat as a result of the project. Direct and indirect impact through piling and shading would occur on unvegetated substrate (minimally sensitive key fish habitat). New hard surfaces from piles, pontoons and vertical walls may supplement habitat loss due to the new structure, but there would still be an overall net loss of key fish habitat (type 3). The use of habitat enhancing features would also increase and improve habitat and help offset the loss of type 3 habitat. Three small mangrove seedlings would be harmed equating to the loss of less than 1 m² of type 2 key fish habitat.

Recommended mitigation measures to reduce the impact of the project are outlined in this report, such as habitat enhancement, and complement the Construction Environmental Management Plan in addressing pollution, contamination and unnecessary disturbance during construction.

1 Introduction and overview

1.1 Background

Sydney Fish Market is the largest of its kind in the Southern Hemisphere and among the three largest seafood markets in terms of variety in the world. The market sources product both nationally and internationally and trades approximately 14,500 tonnes of seafood annually with up to one hundred sustainable seafood species traded every day and approximately 500 species traded annually. The site attracts over 3 million visits each year.

In November 2016 the NSW Premier announced a new Sydney Fish Market would be built at the head of Blackwattle Bay, adjacent to the existing fish market. In June 2017 the Premier of NSW announced the appointment of Danish architects 3XN to lead the design team that includes Sydney firms BVN and Aspect Studios. They have been working with key stakeholders, including UrbanGrowth NSW and Sydney Fish Market Pty Ltd (SFM), to develop the design for the new fish market. As announced by the NSW Premier, works are planned to commence in 2019.

1.2 Site and context

The site is located at the head of Blackwattle Bay between the Pyrmont Peninsula and the foreshore of Glebe, situated less than 2 km west of Sydney's CBD and is partially within the City of Sydney Local Government Area.

The land to which the development application relates comprises Lots 3 - 5 in DP 1064339, part of Lot 107 in DP 1076596 and part of Lot 1 in DP 835794. Works to connect to the existing waterfront promenade to the west of the site are located on Lot 3 in DP 1018801. The development footprint is irregular in shape and has an area of approximately 36,800 m². The site is partly on land above mean high water mark and partly on water below mean high water mark.

The site has a frontage to Bridge Road to the south and Blackwattle Bay to the north. Pyrmont Bridge Road is an arterial road that links to the Anzac Bridge to the north-west of the site. Sydney Secondary College Blackwattle Bay Campus is immediately south-west of the site and the existing Fish Market immediately north-east. Located directly opposite the site to the south is Wentworth Park, separated by Bridge Road.

Located approximately 400 m walking distance from the site are the Fish Market, Wentworth Park, and Glebe Light Rail stops which are serviced by the Dulwich Hill Line which is a 23 stop, 12.8 km route running from Dulwich Hill to Central station via Pyrmont.

The site contains one heritage item being the heritage stormwater culvert. The site is also near a number of heritage items.

The site's current uses include a concrete batching plant at the western end and concrete hardstand and wharf area at the eastern end, which is currently vacant. The site includes wharves and land-based structures. Part of the site is the water of Blackwattle Bay. Works will be undertaken on Bridge Road and its intersections with Wattle Street and Wentworth Park Road.

1.3 Approval strategy

Pursuant to the provisions of the *Environmental Planning and Assessment Act 1979* and *State Environmental Planning Policy (State and Regional Development) 2011* ("SEPP SRD") the new Sydney

Fish Market development is State Significant Development and the Minister for Planning is the consent authority.

To deliver the new fish market, the following applications will be lodged:

1. A concept development application seeking approval for concept proposals for the new fish market. This is to meet the requirements for a master plan contained in clause 40 of *Sydney Regional Environmental Plan No 26—City West* (SREP26). This concept development application will also set out details of the first stage of the development is the demolition of land and water-based structures on the site including removal of marine piles and any resulting repairs to the existing seawall.
2. A development application for the construction of the new fish market.
3. An application to amend the planning controls applying to the site to enable the proposed development to be a permissible use on all of the site. This is to be achieved by an amendment to SREP26.

These applications are lodged concurrently.

1.4 Summary of the development

The proposal is to build a new Sydney Fish Market with a contemporary urban design, provide unique experiences for visitors and world-class auction and wholesale facilities. The new facility will be set within an improved public domain including the creation of a waterfront promenade with improved access to Blackwattle Bay and links to surrounding areas and to public transport.

The development will expand and improve the functions of the existing Fish Market in a new setting designed to achieve design excellence, functional performance and environmental sustainability.

The new Sydney Fish Market will include retail and food and beverage premises, wholesale facilities and auction rooms, offices and commercial space, Sydney Seafood Schools, back-of-house facilities and car, truck and coach parking spaces. The new facility is to include a new foreshore promenade and wharves. The new Sydney Fish Market will be purpose built and will be supported by a state of the art back-of-house plant and recycling/waste management facilities.

1.4.1 Concept development application

The Concept development application seeks approval for:

1. the use of the site for the fish market including waterfront commercial and tourist facilities and ancillary uses and the distribution of uses
2. a gross floor area of up to 30,000 m² contained within a defined building envelop
3. waterfront structures such as wharves
4. concepts for improvements to the public domain including promenades, access to Blackwattle Bay and landscaping
5. pedestrian cycle and road access and circulation principles
6. principles for infrastructure provision and waste management.

This concept development application will also set out details of the first stage of the development is the demolition of land and water-based structures on the site including removal of marine piles and any resulting repairs to the existing seawall, and related services relocations.

1.4.2 Main Works development application

The Main Works development application seeks approval for:

1. the construction of a new Sydney Fish Market including land and water-based structures
2. the use of the site for the fish market including waterfront commercial and tourist facilities and ancillary uses and the distribution of uses
3. a gross floor area (GFA) of approximately 26,000 m² as calculated according to the definition of GFA under SREP 26 (approximately 25,600 m² as calculated according to the definition of GFA under the Standard Instrument)
4. public domain works including promenades access to Blackwattle Bay and landscaping
5. pedestrian, cycle and road access, and circulation
6. infrastructure provision and waste management
7. associated works as required.

The proposed uses comprise:

Below Ground Level

- Parking for service and delivery, and private vehicles up to approximately 417 vehicles
- Plant and storage
- Waste management facilities and
- End of journey facilities.

Ground Level - Outside of Building Envelope

- Up to three operational wharves for fishing fleet servicing and product unloading/loading, multi-purpose wharf space, private-operated ferry stop, recreational vehicles and the like
- Vehicular access driveways
- Publicly accessible promenade.

Ground Level - Within Building Envelope

- Wholesale services space including product storage and processing
- Auction floor and associated refrigeration and handling space
- Loading dock including time-limited delivery and service vehicle parking area
- Waste management facilities
- Office space including buyers room
- Staff amenities, plant and storage.

Upper Ground Level (L1)

- Retail premises including fresh food retail, food and drink premises including harbourside dining
- External/shared dining space
- Ancillary back of house space and staff amenities
- Circulation areas.

Upper Level 2 (Mezzanine)

- Catering space
- The Sydney Seafood School

- Tenant and subtenant office space
- Plant and storage space.

1.5 Purpose of this report

The purpose of this report is to address the SEARs:

- 10. Biodiversity
 - Provide a Marine Ecology Report to identify and determine the impacts to aquatic ecology, including from vessel use during demolition and early works, pile removal, hydrodynamic changes to water circulation and sediment movement, reduced water quality and dredging.
 - Outline the mitigation measures to avoid, reduce, mitigate and offset these impacts, and provide recommendations to increase the aquatic biodiversity value of the urban waterway.
 - Provide a Biodiversity Development Assessment Report (BDAR) prepared in accordance with the Biodiversity Assessment Method to assess the impacts of the proposed development on biodiversity.
 - Include consideration for the relevant policies and guidelines, including the *Policy and Guidelines for Fish Habitat Conservation and Management (2013)*, *DPI Fisheries Threatened Species Assessment Guidelines*, *NSW Biodiversity Offsets Policy for Major Projects – Aquatic Biodiversity Factsheet* and *About Fish Friendly Marine Infrastructure*.

The point above regarding a BDAR is addressed in a separate report by ELA that assesses terrestrial ecology.

1.6 Marine ecology

The aim of this Marine Ecology Assessment is to increase knowledge of the biota and habitats that occur in the study area (all of Blackwattle Bay) and within the subject site (the proposed extent of the new Sydney Fish Market). To achieve this, the following tasks were undertaken:

- Desktop review of existing literature and local data to confirm the presence of known and likely species and habitats in the study area (the extent of Blackwattle Bay including the adjoining seawall, **Figure 4**)
- Aquatic survey during optimum conditions (calm seas with high water clarity)
- Mapping, photography and identification of aquatic vegetation and key fish habitat (eg macroalgae, seagrasses, mangroves and saltmarsh)
- Assessment of the density and condition of aquatic vegetation and key fish habitat, including verification of any threatened or protected species, populations or ecological communities, pest species or presence of 'critical habitat' that may occur locally
- Provide recommendations to avoid, reduce and offset any impacts, increase the habitat value and assist management of construction and operational outcomes.

The following policies and guidelines have been considered:

- Policy and Guidelines for Fish Habitat Conservation and Management (2013 update, Fairfull 2013)
- DPI Fisheries Threatened Species Assessment Guidelines
- NSW Biodiversity Offsets Policy for Major Projects – Aquatic Biodiversity Factsheet
- About Fish Friendly Marine Infrastructure Guidelines
- Guiding Principles for Marine Foreshore Developments.

2 Legislative context

2.1 Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

Under the EPBC Act, the Commonwealth Environment Minister needs to approve any development that is likely to have a significant impact on Matters of National Environmental Significance (MNES). Should such an impact, as defined in the EPBC Act Policy Statement 1.1 – Significant Impact Guidelines (DEWHA 2009) be likely, the proposal should be referred to the Commonwealth to determine if it is a Controlled Action that requires approval of the Commonwealth.

2.2 NSW Environmental Planning and Assessment Act 1979 (EP&A Act)

All developments in NSW are assessed in accordance with the provisions of the EP&A Act and the EP&A Regulation. The EP&A Act provides a system for environmental planning and assessment, including approvals and environmental impact assessment requirements for proposed developments. Implementation of the EP&A Act is the responsibility of the Minister for Planning, statutory authorities and local councils.

Under s.78A (8) of the EP&A Act and schedule 2 of the Environmental Planning and Assessment Regulation 2000, the project is State Significant Development (SSD 8925) and the Minister for Planning is the consenting authority. This report addresses the Secretary's Environmental Assessment Requirements (SEARs) Application Number SSD 8925, under Specific Matter 10 - Biodiversity:

- Provide a Marine Ecology Report to identify and determine the impacts to aquatic ecology, including from vessel use during demolition and early works, pile removal, hydrodynamic changes to water circulation and sediment movement, reduced water quality and dredging.
- Outline the mitigation measures to avoid, reduce, mitigate and offset these impacts, and provide recommendations to increase the aquatic biodiversity value of the urban waterway.
- Include consideration of the relevant policies and guidelines, including the Policy and Guidelines for Fish Habitat Conservation and Management (2013), DPI Fisheries Threatened Species Assessment Guidelines, NSW Biodiversity Offsets Policy for Major Projects – Aquatic Biodiversity Factsheet and About Fish Friendly Marine Infrastructure.

2.3 NSW Biodiversity Conservation Act 2016 (BC Act)

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. This report focusses exclusively on the marine environment: please refer to the Biodiversity Development Assessment Report (ELA 2018), for further information on terrestrial ecology.

2.4 NSW Fisheries Management Act 1994 (FM Act)

The FM Act is the principal piece of legislation protecting aquatic habitat in NSW. The act aims to conserve fish stocks, key fish habitat, aquatic vegetation, and threatened species, populations and communities. Threatened aquatic species, populations and communities are listed under Schedules 4, 4A and 5 of the FM Act, while key threatening processes are listed under Schedule 6. Permits under Part 7 of the FM Act

to harm marine vegetation, obstruct fish passage, dredge or reclaim land do not apply to State Significant Developments, however, the offset policy applies to ensure there is 'no net loss' of key fish habitat (KFH) in NSW.

DPI Fisheries has identified the area within Blackwattle Bay and around the new Sydney Fish Market development as KFH. The development would only harm <1 m² of marine vegetation but would shade unvegetated substrate, reprofile shallow sediment beneath the structure, involve modifications to the seawall and temporarily obstruct fish passage during construction. There would be a 'net loss' of KFH (type 3), therefore, environmental compensation may be required.

There are unlikely to be any threatened species, populations or communities listed under the FM Act that depend on the site for habitat. Therefore, these would not be impacted as a result of the works and an assessment of significance is not required.

2.5 Sydney Regional Environmental Plan (SREP, Sydney Harbour Catchment) 2005

The proposal is located within the Sydney Harbour Catchment and is subject to the SREP (Sydney Harbour Catchment) 2005, in particular, Clause 21: biodiversity, ecology and environment protection. Water-based recreation and entertainment facilities which have a direct structural connection to the foreshore are currently prohibited in this W1 zone. S89E(3) of the EP&A Act provides that development consent may be granted to State Significant Development despite the development being partly prohibited by an environmental planning instrument. Notwithstanding this provision, an amendment is sought to the planning controls applying to the site to ensure the proposed development is wholly permissible. This amendment has been concurrently lodged with this EIS.

2.6 NSW Coastal Management Act 2016 (CM Act)

The CM Act came into effect 3 April 2018, replacing the *Coastal Protection Act 1979*. The objective of this Act is to manage the coastal environment of NSW in a manner consistent with the principles of ecologically sustainable development for the social, cultural and economic well-being of the people of the State. Part 2 of the CM Act identifies objectives related to four coastal management areas of the 'coastal zone':

- Coastal wetlands and littoral rainforests area
- Coastal vulnerability area
- Coastal environment area
- Coastal use area.

Under the State Environmental Planning Policy (Coastal Management) 2018 (Coastal Management SEPP), the area of the proposed works is mapped as 'coastal environment area'. However, under clause 13 (3) of the Coastal Management SEPP, the development objectives for the coastal environment area do not apply to the Foreshores and Waterway Areas within the SREP. Therefore, the Coastal Management SEPP is not applicable to this project.

3 Methods

3.1 Desktop assessment

Online database searches were used to confirm the presence of recorded species in the region prior to the field survey. This was then used to infer what is likely to be present in the study area. The desktop search covered Port Jackson (Sydney Harbour including tidal areas of Parramatta River and Lane Cove River) plus a 10 km buffer. The desktop search grid was about 50 x 30 km using the coordinates:

- Latitude: -33.6974792526866, Longitude: 150.915584274089
- Latitude: -33.6974792526866, Longitude: 151.474105513707
- Latitude: -33.9762150862402, Longitude: 151.474105513707
- Latitude: -33.9762150862402, Longitude: 150.915584274089

Only species known to use estuarine/marine water or intertidal foreshores were considered in this aquatic assessment. Databases accessed include:

- EPBC Act – Protected Matters Search Tool
- BC Act – Threatened Species Search Tool (BioNet)
- FM Act – Listed protected and threatened species and populations, including species profiles, ‘Primefact’ publications and expected distribution maps (Riches et al 2016)
- Online Zoological Collections of Australian Museums (OZCAM) – individual species searches to determine the likelihood of occurrence of threatened species.

3.2 Field survey

A survey was undertaken on 24 – 25 July 2017 to inspect the aquatic habitat of Blackwattle Bay. The survey area included benthic and intertidal habitat within the entire bay. Weather conditions were calm and water clarity was good. Underwater visibility was approximately four meters.

The survey was undertaken by lowering a video camera to the seafloor and around foreshore structures. A triple camera setup (Sea-View, Go-Pro and Kaiser Baas brands) angled down and front allowed for live streaming of habitat features to an on-board monitor (colour/infrared). We were unable to survey directly beneath fixed structures and moored vessels. The shallow intertidal area and foreshore were photographed from the water and on foot where boat access was limited. Habitat types were mapped using a spatial application on a tablet to ensure all habitat types were surveyed adequately. High-definition footage and photographs were also viewed later to confirm habitat extent and condition. ArcMap Version 10.2 was used to merge data into a final map for spatial analysis.

4 Aquatic habitats and ecology

4.1 Previous aquatic habitat mapping

Map 8 of the ‘Sydney Harbour - Foreshores and Waterways Area Development Control Plan 2005: Ecological Communities and Landscape Characters’, identifies the study area as ‘Mixed Rocky Intertidal and Rock Platform’, ‘Water’ and ‘Grassland’ (**Figure 1**).

Sheet 4 of the ‘Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005: Wetlands Protection Area’, shows that there are no Wetland Protection Areas within or near the site, therefore Clause 61 of the SREP is not triggered. (**Figure 2**).

The State-wide mapping of estuarine macrophytes (mangroves, saltmarsh and seagrass) by DPI Fisheries have not mapped mangrove communities within Blackwattle Bay. The nearest patch of mangroves in Rozelle Bay is outside the study area. There are no records of the threatened *Posidonia* seagrass population within the bay (Creese et al 2009, **Figure 3**).

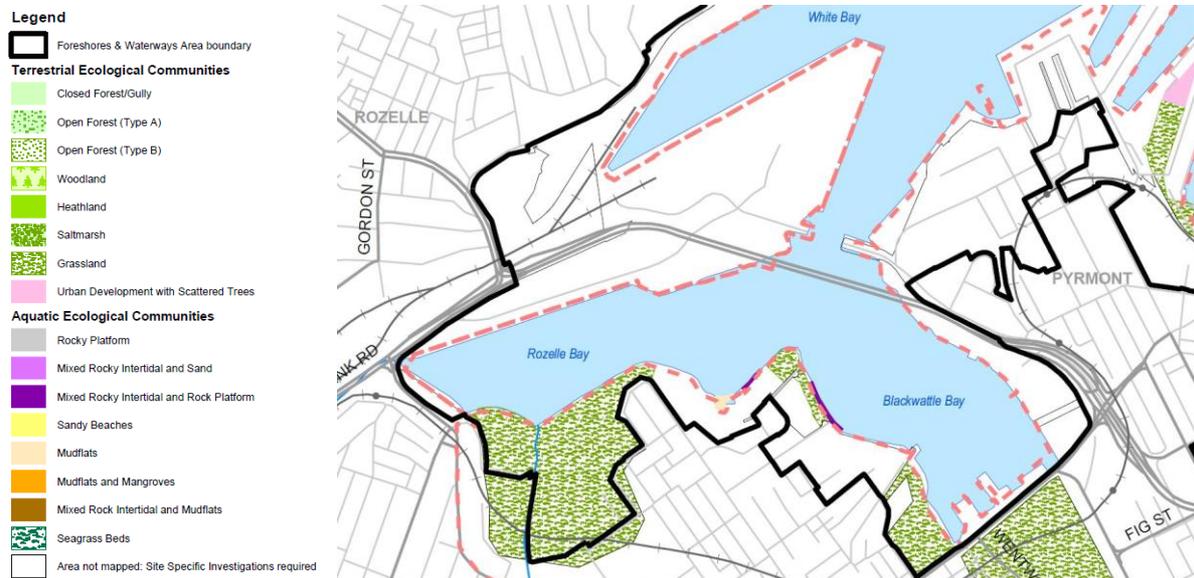


Figure 1: Sydney Harbour - Foreshores and Waterways Area Development Control Plan: Ecological Communities and Landscape Characters (map sheet 8)

Source: <http://www.planning.nsw.gov.au/Policy-and-Legislation/Environment-and-Heritage/Sharing-Sydney-Harbour>

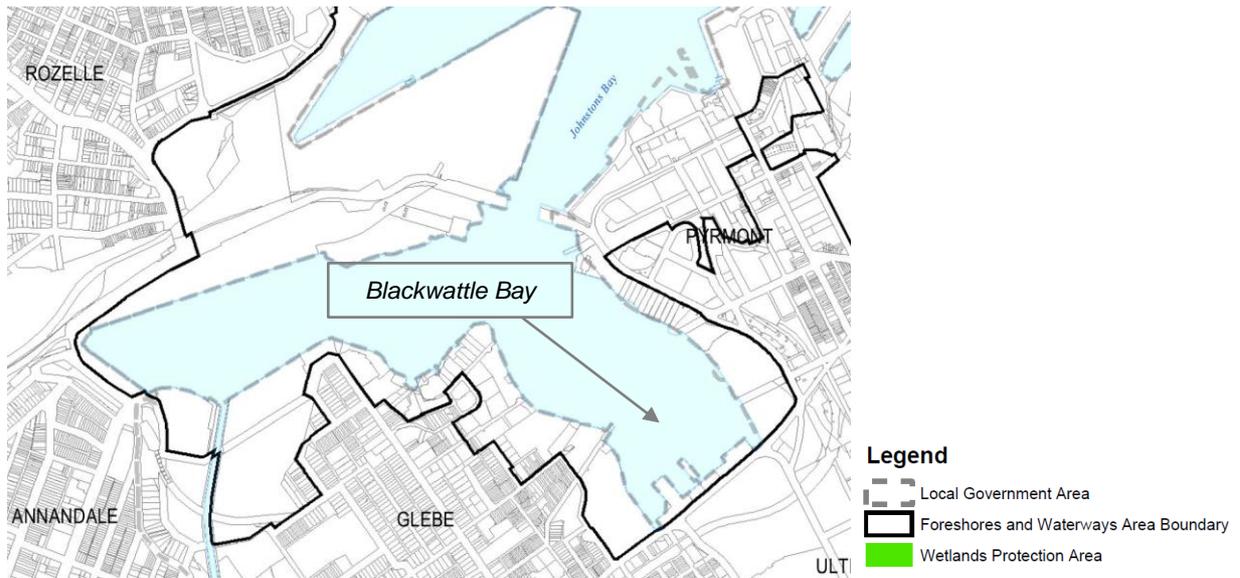


Figure 2: Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005: Wetlands Protection Area (map sheet 4)

Source: <http://www.planning.nsw.gov.au/Policy-and-Legislation/Environment-and-Heritage/Sharing-Sydney-Harbour>



Figure 3: DPI Fisheries mapping of estuarine macrophytes (Creese et al 2009)

Source: <http://www.dpi.nsw.gov.au/content/research/areas/aquatic-ecosystems/estuarine-habitats-maps>.

4.2 Aquatic habitats at Blackwattle Bay

Recent surveys of Blackwattle Bay (Bugnot et al 2016) found the aquatic habitat and biodiversity to be comparable, if not slightly worse, than other bays within Sydney Harbour (Rozelle, White and Johnstons Bay, Gore and Iron Cove). The subtidal sediment had high metal concentrations, with Annelids (worms) as the predominate infauna species. These are indicative of a disturbed environment. A low biodiversity and number of fish were observed within the Bays Precinct, potentially due to the lack of habitat complexity.

ELA documented the aquatic habitat in the study area, which had been modified by a vertical seawall, wharf structure, pontoons, piles and disturbance by regular boat traffic. These are similar habitat conditions described by Bugnot et al (2016). The following distinct zones were mapped during the field survey (**Figure 4** and **Figure 5**):

- **Manmade structures (Figure 6)** – The foreshore habitat was highly modified by industrial buildings, a footpath and seawall. The seawall creates a barrier between the intertidal zone and foreshore, constraining the deposition of sediment and establishment of marine/riparian vegetation. The industrial area was built out over the bay, supported by thousands of piles. These piles were covered in encrusting organisms, turfing algae, bryozoans, barnacles, oysters and mussels.
- **Subtidal sand (Figure 7)** – The subtidal zone was characterised by coarse sediment, covered with a variety of features including shell fragments, woody debris, rubbish and scattered rocky rubble. Moderate to dense bioturbation was evident throughout the site. No seagrass was observed.
- **Intertidal rock rubble (Figure 8)** – The intertidal zone was characterised by rock rubble extending from the base of the seawall was intertidal rock rubble that was covered with sessile organisms including, oysters, barnacles and algae.
- **Macroalgae (Figure 8)** – The subtidal zone also featured *Sargassum linearifolium* attached on rock rubble. Densities varied throughout Blackwattle Bay, with the majority of the macroalgae found along the western boundary of the study area.

DPI Fisheries identify three types of key fish habitat (KFH) in their Policy and Guidelines for Fish Habitat Conservation and Management (Fairfull 2013, **Appendix B**). KFH types occurring in the study area are mapped on **Figure 4**, comprising:

- Type 1 (highly sensitive KFH) – no type 1 KFH habitat was observed within the study area
- Type 2 (moderately sensitive KFH) – represented onsite by the various densities of *Sargassum linearifolium* (brown macroalgae) and three mangrove seedlings on an intertidal rock bench
- Type 3 (minimally sensitive KFH) – represented onsite by the subtidal substrate and intertidal seawall.

No threatened species, populations or communities were observed in the subject site or study area, or are expected to use the subject site (see **Section 4.3** and likelihood of occurrence assessment in **Appendix A**). Seahorses and their relatives (syngnathiformes) were not observed during the field survey. They may occur in the macroalgae along the western shoreline but are unlikely near the piles as there was very little macroalgae in this location. Management for these species is not required during construction, as the proposed footprint would not impact macroalgae, and Construction Environmental Management Plan (CEMP) mitigation measures would prevent unintended impacts.

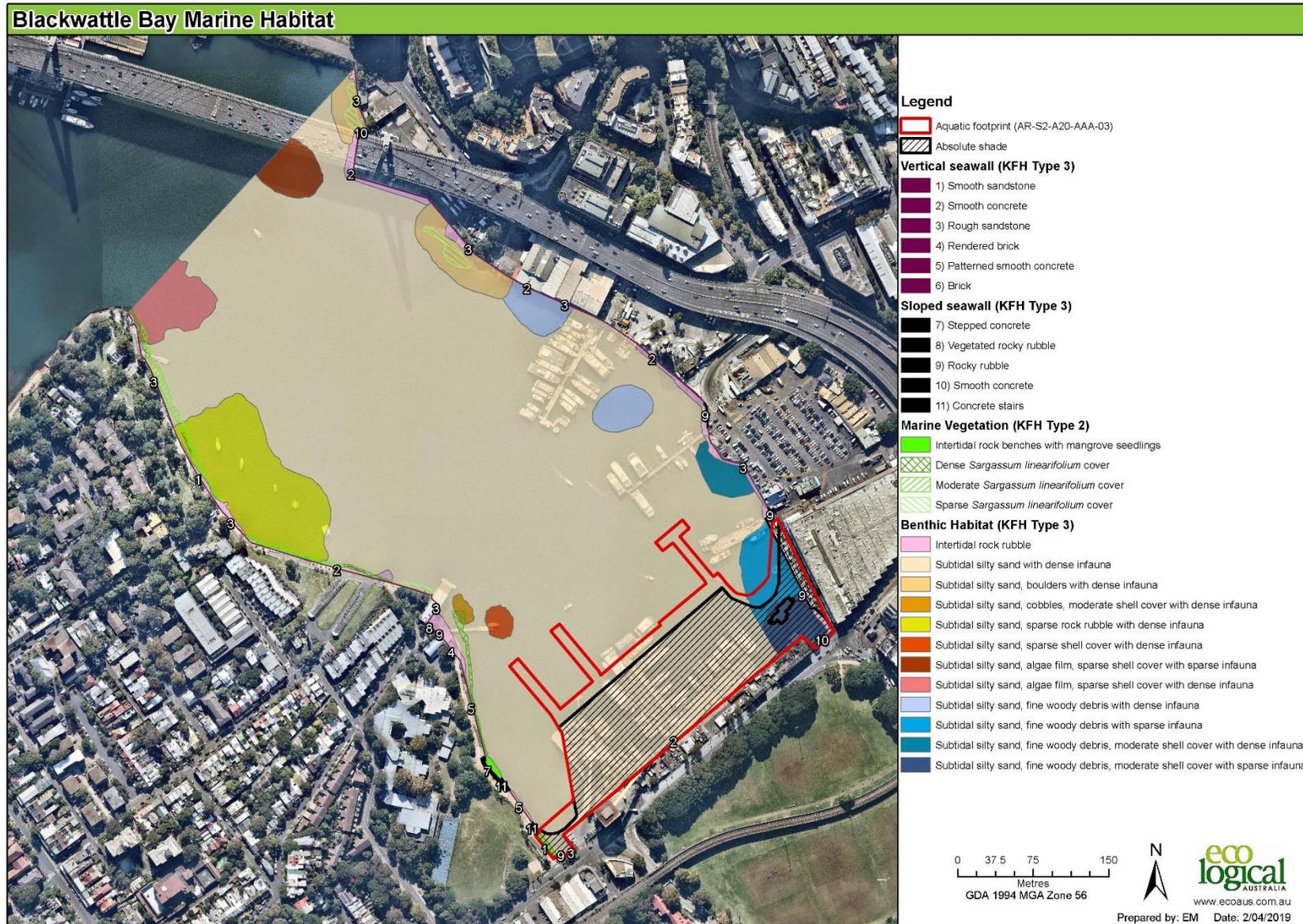


Figure 4: Field survey of key fish habitat (KFH) July 2017

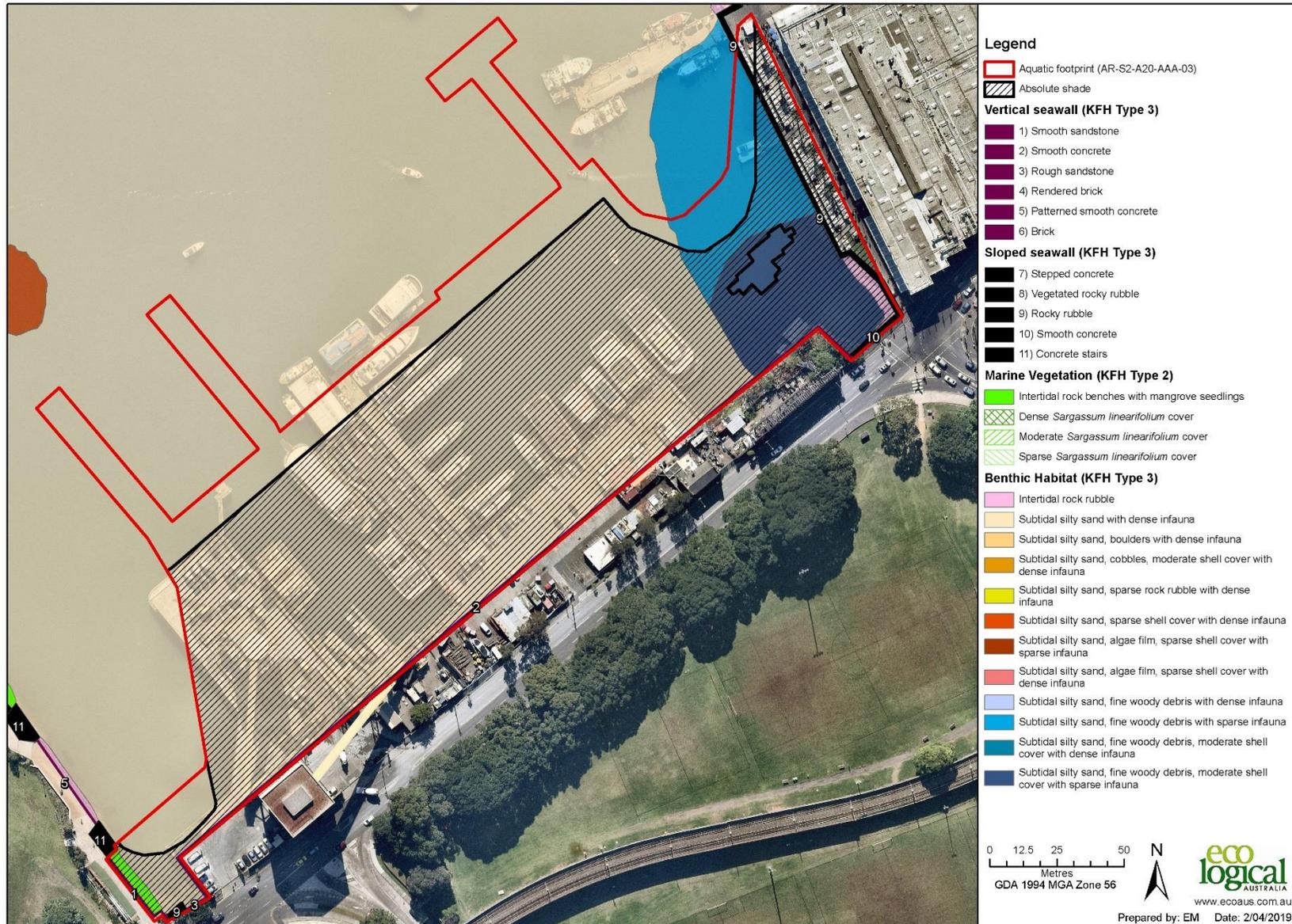


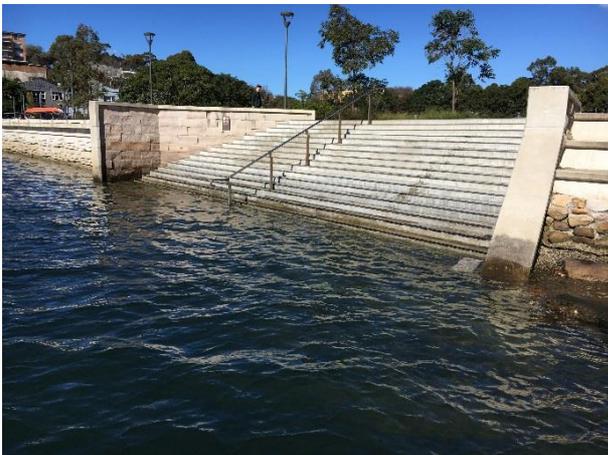
Figure 5: Proposed footprint and shading impact



Pontoon and gangway extending from fish markets



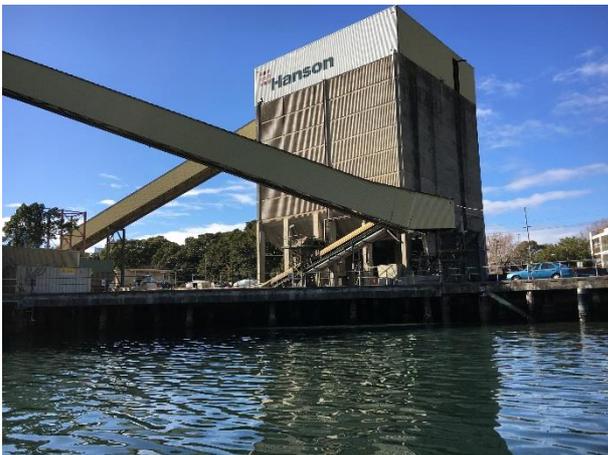
Sydney Fish Market



Stepped concrete stairs with intertidal toe



Intertidal rock bench with mangrove seedlings



*Concrete batch plant on foreshore
(removal of the batch plant not assessed in this report)*



Industry built on wharf

Figure 6: Manmade structures in Blackwattle Bay



Barnacles and encrusting algae on piles



Stormwater outlet with oyster growth

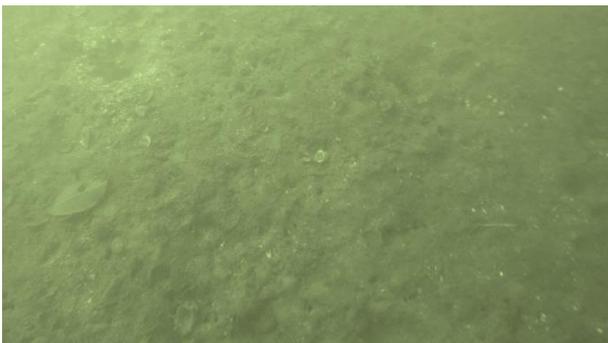


Encrusting organisms on pontoon (subtidal)



Oysters on rough seawall (intertidal)

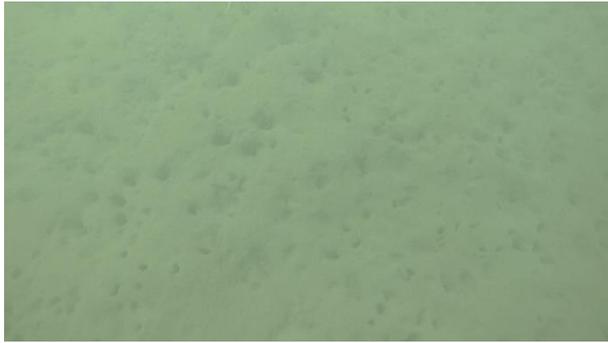
Figure 6: Manmade structures continued



Shell fragments and fine algae crust on subtidal sand



Fine woody debris and leaf litter on subtidal sand



Dense bioturbation from infauna



Fine algae crust with dense infauna

Figure 7: Subtidal sand



Rock rubble with Sargassum linifolium



Algae encrusted rock rubble

Figure 8: Intertidal and subtidal rock rubble

4.3 Presence or likelihood of threatened and protected species and populations

Threatened species, populations or communities listed under the FM Act, BC Act and EPBC Act that are known or expected to occur in the region are listed in **Appendix A**. Within the study area, the only habitat capable of supporting threatened species was the macroalgae growing predominately along the western seawall of the bay. The closest macroalgae patch to the subject site was approximately 100 m to the west of the subject site. Syngnathiformes occur in the harbour and are known to use similar habitats. No

seahorses or other Syngnathiformes were observed during the field survey, and are unlikely to use the structures within the proposed area of works as habitat. No other threatened species, populations or communities were observed on site although it is possible that some species may pass through the area, given the connectivity to Sydney Harbour and coastal habitats. It is unlikely that they would rely on the site for habitat or survival.

4.3.1 Fish, sharks and marine vegetation

Protected fauna listed under the FM Act were assessed for their likelihood of occurrence. Listed marine or estuarine species include one shark, six fishes and the taxonomic order of Syngnathiformes (seahorses, seadragons, pipefish, pipehorses, ghostpipefish and seamoths). The species assessed included:

- The Herbst's nurse shark, which only occurs in deep water (150-600 m) and would not be present in the study area.
- Listed fishes known to occur around offshore rocky reefs, which do not occur in the study area.
- Estuary cod occurs in a range of habitats, from turbid shallow estuarine waters (juveniles) to the base of drop-offs and deeper water (adults). Sydney is the southern extent of estuary cod, with no records in Blackwattle Bay, or the harbour.
- Syngnathiformes occur in the harbour and are known to use a variety of habitats, such as macroalgae, wharf/jetty piles, seagrass beds and unvegetated shallows. These habitats occur within the site. The wharves/jetty piles within the proposed area of works would not be suitable habitat as they have no macroalgae growing on them. Seahorses are more likely to use macroalgae along the western boundary, which would not be impacted. As of Note. *Hippocampus whitei* (White's Seahorse) is proposed for listing as endangered under the FM Act has been addressed below.

Hippocampus whitei (White's Seahorse) is unlikely to occur in the study area, therefore, an assessment of significant in accordance with Section 220ZZ of the FM Act is not required.

Threatened fish are unlikely to occur in the study area because there is no suitable habitat. The species identified in the desktop assessment as possibly occurring within the search grid either require freshwater, rocky reefs, caves, rocky overhangs. None of these habitat features occurs within Blackwattle Bay. Deep water occurs within Blackwattle Bay, but not near the subject site. Species that utilise deep water would be deterred by frequent boat traffic and are more likely in coastal waters.

Threatened sharks and rays may enter the area while exploring or chasing prey. If they do enter the area, a lack of habitat and frequent boat traffic makes it unlikely they would stay for extended periods.

The threatened seagrass population of *Posidonia australis* occurs in the harbour, and is known to grow on subtidal sand up to 10 m deep, however, there are no records of *Posidonia* upstream of Darling Point. *Posidonia australis* was not observed and is not likely within the study area.

Marine vegetation is protected under the FM Act and includes saltmarsh, seagrasses, mangroves and macroalgae (seaweeds). No seagrass was observed within the study area. Seagrass requires soft sediment with good light penetration which was present within the study area. However, no seagrass was observed or has been mapped in the area by DPI Fisheries. Mangrove trees can occur in protected bays and tidal waterways with soft intertidal sediment. Three small mangrove trees have grown in an artificial intertidal shelf in the southwest corner of the site. These would be removed as part of the demolition works. Combined, these mangrove seedlings equal less than 1 m² of habitat. The threatened ecological community, coastal saltmarsh, was not observed within the study area. The intertidal zone, where

saltmarsh is found, is steep and artificial (seawall), so no plants have established. Macroalgae occurs in the harbour along rocky fringes and deeper hard substrate reefs. *Sargassum linearifolium* was observed within the study area in shallow water, attached to intertidal and subtidal rubble and the fringing hard substrate. These plants are outside the subject site, and if CEMP mitigation measures are followed would be unaffected by the works.

4.3.2 Other listed or protected species

Threatened aquatic mammals (whales, dolphins, and seals) are known to occur in the harbour and/or along the coast. Large mammals are unlikely to use habitat this close to shore. Dugongs require seagrass beds for foraging, which do not occur on site. Furthermore, there are no records of dugongs within Sydney Harbour. Seals have been sighted near Birchgrove Point, but there is no record of them in Blackwattle Bay. Whales have been recorded in the Harbour, but not west of the Sydney Harbour Bridge. It is unlikely they would venture through the narrow entrance to Blackwattle Bay. Other marine mammals may explore this area but are unlikely to stay for prolonged periods as there is no breeding or foraging habitat. The narrow channel to enter Blackwattle Bay and frequent use of the area by boats would also be a deterrent.

Threatened aquatic reptiles (turtles) are more common along coastal waters than in the harbour. They may explore the greater area but would not depend on the site for feeding habitat or nesting as there is no seagrass.

Threatened shore, wetland, migratory, and pelagic birds use intertidal zones to forage, but are unlikely to occur in the study area, as the intertidal zones are steep and artificial (seawall). They also avoid areas with concentrated human activities. Aerial foragers may follow a coastal route, fly over open water or hunt over decomposing wrack. Given the large scale of more suitable habitat nearby, the works are not expected to affect their migration or food resources.

5 Impact assessment and mitigation

5.1 Assessment of demolition and construction impact

As per the CEMP dated August 2018 (Thelem 2018) the stage one works would include the demolition of water-based structures include removal of the marine piles. The following structures are proposed to be demolished:

- A wharf structure comprising a reinforced concrete deck supported by 250 x 250 mm hardwood girders
- A finger jetty
- A concrete jetty
- Piles supporting the existing wharves and jetty structures
- Concrete batching facilities including concrete and steel-clad silos and hoppers (to be removed as part of a separate DA)
- The former Jones Coal Loader
- All other associated land and water-based structures.

Following stage one works (demolition), a cofferdam would be installed around the site for stage two works (construction). This cofferdam would have a gap for barge access during the initial installation of foundations piles. The gap would be sealed off for construction of the superstructure. More detailed demolition methodology is not yet available, therefore, ELA has based this assessment on the CEMP.

Once the existing structures have been demolished, minor sediment reprofiling would occur within the coffer dam area. This is to allow sufficient depth to construct the superstructure supported on piles. Currently, sediment deposits have built up in small mounds close to the seawall. The works require about 500 m³ of sediment to be excavated and spread over adjacent substrate (of the same habitat type) within the coffer dam area (**Appendix D**). The likely construction methodology would be the use of a long-armed excavator mounted on a barge, scraping the material along the sea bed.

Three impact types are likely to occur during wharf demolition and construction:

- Underwater noise generation and disturbance during pile removal and installation
- Benthic disturbance from demolition/construction vessels and sediment reprofiling
- Changes to water quality, circulation and sedimentation.

Pile removal and installation

Based on the current wharf structure, ELA has estimated there is approximately one pile per 4 m² supporting the current wooden/concrete wharf structure and one pile per 25 m² supporting the pontoons. All of these piles (estimated at 1914) would be removed. Each pile has an approximate diameter of 0.61 m², and wetted heights between 3 m and 5 m. Therefore, 14,675 m² of type 3 fish habitat would be removed.

Approximately 244 new piles would be installed. ELA has estimated that 200 of these piles would be enclosed by the submerged concrete basement wall and have no light exposure. These piles would, therefore, provide no additional habitat due to absolute shading. Approximately 44 piles would be placed outside of this enclosed space, and with an approximate diameter of 0.61 m² and wetted height between 5 m and 6 m would create 464 m² of new type 3 fish habitat. Piling would not have a direct or indirect impact on marine vegetation.

Any potential sediment pluming that occurs during pile removal and installation would be contained by a silt curtain as prescribed in the CEMP. As the piling is through bedrock and predominantly coarse sands and would be performed during calm conditions, drill cuttings and suspended sediments are likely to settle locally in a similar habitat type. Finer sediments could disperse further, depending on tidal dynamics, but would be contained within a silt curtain surrounding the works.

The site is classed as having a 'high probability' of acid sulphate soil (ASS) within the benthic sediments. These soils can cause harm to marine flora and fauna if disturbed, exposed to oxygen and then resubmerged (eg piling in an intertidal area during low tide which exposes the soil, which is then covered again at high tide). Fine-scale sediment plumes, which may release the acid sulphate, would be contained within the construction site by a silt curtain in stage one and a cofferdam with a silt curtain covering the access gap during stage two. The silt curtain should not be removed until the risk of sediment contamination is negligible. **Section 5.6** discusses relevant measures to mitigate the harm to marine flora and fauna. If neutralising substances are used, as per section 5.3.2 of the Acid Sulphate Soil Management Plan (JBS&G), the environmental risk (eg contamination of surrounding water) associated with the compounds used needs to be assessed.

Underwater noise from hammering piles has the potential to cause disturbance or physical impact to marine fauna in the area. Fish in the vicinity would be affected by excessive underwater noise. Impacts range from mortality to interruption of communication, depending on species anatomy (eg fish with swim bladders closer to the ear are more sensitive to acoustic impact than species with swim bladders further from the ear). Due to the shallow depth, fish would not be able to escape under the silt curtain. Estimates on the number or type of fish are not part of this impact assessment.

Demolition/construction vessel impact

There would be little direct or indirect impact caused by construction vessels if best practice environmental management procedures are in place and effective. Best practice management procedures are discussed further in **Section 5.6**.

Scouring of benthic sediments, either from propeller operation, dragging anchor or mooring chain, or water movement from shallow barge operation could cause bed sediment particles to become entrained in the water, increasing turbidity. The increased sediment load would reduce light penetration through the water column, and sediment particles may settle on aquatic plants or benthic infauna burrows. If mitigation measures are followed, then it is unlikely that large volumes of sediment would be moved and damage to aquatic plants would not occur. Damage to infauna burrows would be temporary and insignificant.

Chemical or material spills from machinery, propeller scouring in shallow water and mooring impacts from barges are potential impacts which would increase with unfavourable swell and weather conditions. Chemical spills, although unlikely, may also occur when refuelling of boats or if there is a hydraulic fluid leak. Spilt chemicals have the potential to kill or impair fauna within the area and disperse in the water.

Vessels may also be a vector for movement of marine pests, especially if construction vessels are not from the local area. For example, machinery and boats used on other sites where the noxious alga *Caulerpa taxifolia* was present could introduce the weed if hygiene procedures aren't followed. To ensure that this doesn't happen, barges moving from areas where *Caulerpa* is present should be inspected before entering the site. If *Caulerpa* becomes established around the fish market, then commercial and recreational vessels using the area have the potential to become vectors and spread the weed throughout Sydney Harbour and other estuaries.

During sediment reprofiling, there would be a direct loss of benthic infauna and smothering of adjacent similar habitat. Given the area is currently heavily shaded by the existing wharf, the species occupying the sediment would likely be those tolerant of disturbed areas. Species would recolonise the area over time, resulting in only a minor and temporary impact to the benthic infauna, and foraging resources in the area. Indirect impact may arise if bed sediment particles become entrained in the water, increasing turbidity and potentially releasing contaminants, if present. Best practise construction methods, such as a silt curtain and water quality monitoring (turbidity), would reduce this risk and the potential impact would be minor.

Changes to water quality, circulation and sedimentation

The submerged wall surrounding the basement would be constructed to allow tidal inundation beneath the structure and around enclosed piles. The existing area in the subject site has a magnitude of piles that have historically influenced the local tidal dynamics. Given the existing and proposed character of the stub of this bay, it is unlikely the new development would markedly affect the tidal prism or local hydrology. No dredging of the approach channel would occur and the site would continue to be frequented by boats, maintaining the current conditions.

It is unlikely there would be significant change to marine water quality during construction if CEMP measures are followed, eg placing sediment barriers downslope of works and spoil stockpiles (Thelem 2018). However, the results of the MUSIC modelling in the Flooding and Water Quality Assessment (FWQA) (Cardno 2018) indicated that Water Sensitive Urban Design (WSUD) strategies are anticipated to create an overall improvement in water quality. Rainwater harvesting, gross pollutant traps and bioretention basins are proposed to be adapted and would reduce the stormwater runoff and pollution by over 71%. If these WSUD strategies are not in place then an increase in pollution including total suspended solids, total nitrogen, total phosphorus and gross pollutants is expected. An increase may have a negative effect on the surrounding marine ecology. For example, eutrophication (an increase of nitrogen and phosphorus) can result in algal blooms, loss of marine vegetation and a reduction in available oxygen (Mayer-Pinto et al 2015). Also, increase in total suspended solids can reduce primary productivity by reducing light availability.

There are identified hazardous materials on-site including lead-based paint, which are addressed in the Hazardous Materials Management Plan (JBS&G 2018). These are primarily land-based hazards. The removal works procedures outlined in that plan should be followed to mitigate the spread of these substances into the marine environment. If the relevant procedures are followed, there are no anticipated changes to water quality as a result of these materials.

5.2 Assessment of operational impact

Three impact types are likely to occur during operation of the fish markets:

- Boat traffic using the facility
- Shading impact on benthic habitat
- Creation of new aquatic habitat.

Boat traffic impact

The impacts which could occur to marine habitats during operation are typically associated with boat wash, disturbance of sediments, and an increase in pollutants and litter. Given the location and existing high-intensity use of the area, the following impacts are considered minor:

- Boat wash would not impact the foreshore, which is stabilised by a seawall.
- Pollutants expelled from boats would be the same as the existing conditions. Commercial fishing vessels, ferries and recreational vessels all frequent the area regularly. Frequency is not expected to increase significantly.

Shading impact

Absolute and partial shading from the proposed works may have an indirect impact on benthic habitat. There is currently approximately 8190 m² of seafloor shaded by the wharf and pontoons. The new works would shade an additional 23,735 m² of the unvegetated sandy substrate. Of this, 18,034 m² would be absolute shading caused by the elevated superstructure and submerged boundary wall. No light is expected to reach beneath the superstructure, leading to the loss of type 3 KFH.

There would be 5701 m² of partial shading over unvegetated sediment. This is made up of the areas fringing the basement wall that would receive some light penetration throughout the day. This partial shading impact may be reduced through the use of meshed or clear material along wharves, pontoons, steps and decks (addressed in **Section 5.7**). Organisms on piles (barnacles) and subtidal sediment (infauna) would not be significantly impacted by partial shading as they do not need large amounts of light and already exist in shaded areas onsite.

Creation of new aquatic habitat

Once installed, 44 of the piles would create new areas of vertical hard substrate. Piles, if possible, should be textured to increase their surface area and attractiveness as habitat. This provides areas for the attachment of sessile marine organisms and structural habitat for small fish (likely type 3 KFH). Exposure to partial sunlight allows for macroalgae to potentially establish. The number of piles to be removed equates to 14,675 m² of type 3 KFH, which is greater than the number of piles to be installed in light-accessible areas (based on 44 of the 244 new piles creating habitat). The wetted underside of new structures (pontoons), new piles and wetted areas of the outer basement wall would create 2930 m² of hard substrate (type 3 KFH). Therefore, the project would create a net loss of key fish habitat on site.

5.3 Fisheries Management Act habitat protection and permit requirements

DPI Fisheries' Policy and Guidelines for Fish Habitat Conservation and Management (Fairfull 2013) outline requirements for assessing the impact of waterfront development to ensure the sustainable management, and 'no net loss', of key fish habitats in NSW. Part 7 of the FM Act addresses the protection of aquatic habitats and work that requires a permit. Part 7 permits do not apply to State Significant Developments, but the offset policy does apply to ensure there is 'no net loss' of key fish habitat. A net loss of type 3 key fish habitat is expected, therefore, offsetting through environmental compensation or habitat compensation may be required.

Threatened species, populations or communities

No threatened species, populations or communities listed under the FM Act are likely to occur in the study area or be directly or indirectly harmed by the proposed work (see **Section 4.3** and **Appendix A**). As such, an assessment of significance is not required.

Protected vegetation

Protected vegetation occurs in the study area in the form *Sargassum linearifolium* (macroalgae), which is located outside the subject site and potential construction zone. Three mangrove seedlings are located

on the edge of the footprint. These seedlings would be removed as part of the demolition process. Combined, they equate to less than 1 m² of KFH.

Protected fauna

Protected fauna are unlikely to occur in the area of proposed works and would not be impacted (see **Section 4.3** for detail). Syngnathiformes (seahorses and their relatives) were not observed during the field survey but may use the macroalgae along the western boundary as habitat. They are unlikely to use structures within the subject site as there is no macroalgae growing, and better habitat elsewhere in the study area.

Critical habitat

There is only one registered critical habitat NSW. The study area does not have habitat that is critical to any threatened species and is not within or near the critical habitats for Grey Nurse Shark (Part 7A of the FM Act), so would have no impact on the species.

Commercial Fisheries and Aquaculture

There are no aquaculture leases within Blackwattle Bay, or within Sydney Harbour. Commercial fishing has not been permitted in Sydney Harbour since 2006, therefore, the proposed works would not impact commercial fishing or aquaculture. Access to the fish market, by commercial fishing vessels, would not be impacted. The proposed works would maintain access for vessels to the existing markets during the construction phase.

Key threatening processes

Key threatening processes have the potential to adversely affect threatened species, populations or ecological communities, or could cause species, populations or ecological communities that are not threatened to become threatened. Processes (Part 7A of the FM Act) relevant to an aquatic impact assessment, but would not occur during the development of the new Sydney Fish Market include:

- current shark meshing program in NSW waters
- hook and line fishing in areas important for the survival of threatened fish species
- human-caused climate change
- instream structures and other mechanisms that alter natural flow
- introduction of non-indigenous fish and marine vegetation to the coastal waters of NSW
- the introduction of fish to fresh waters within a river catchment outside their natural range
- the removal of large woody debris from NSW rivers and streams
- the degradation of native riparian vegetation along NSW watercourses.

No net loss of key fish habitat

Significant environmental impacts (direct and indirect) are to be offset by environmental compensation. Compensation to offset fisheries resource or habitat loss is considered only after it is demonstrated that the proposed loss is unavoidable, in the best interests of the community in general and is in accordance with the FM Act, Regulations and Fisheries policies and guidelines. Habitat replacement (as a compensation measure) needs to account for both direct and indirect impacts from the development to ensure that there is 'no net loss' of key fish habitats.

Calculation of habitat lost versus gained is itemised in **Table 1**. Sediment reprofiling is not calculated here because it is unclear how far the smothering of benthic habitat would extend (estimated 500 m³ of sediment to be spread). Removal of the existing piles and pontoons would result in the loss of approximately 16,105 m² of wetted surface area and a gain of 1064 m² of newly exposed subtidal sand. However, the construction would result in absolute shading (no light availability) of 18,034 m² of unvegetated substrate (excluding area shaded by existing structures), plus partial shading of 5701 m² of this habitat. The calculation of absolute shading is based on the aquatic area proposed to be enclosed by a semi-submerged wall. Partial shading is based on the area seaward of the wall, which would receive some light penetration throughout the day. There would be a gain of hard substrate through the installation of exposed piles and pontoon structures of 2930 m². Therefore, there would be a total loss of type 3 KFH, due to the absolute shading of subtidal sand.

Table 1: Impact to key fish habitat (KFH)

Aquatic habitat (KFH type)	Available in study area (m ²)	Impact type	Loss (m ²)	Gain (m ²)
Existing piles (wetted surface area) (type 3)	14,675	All piles removed	14,675	-
New piles (exposed to partial sunlight) (type 3)	-	44 gained	-	464
New piles (no sunlight exposure) (no KFH)		200 gained	-	-
Existing pontoons (wetted surface area) (type 3)	1430	4 removed	1430	-
New pontoons (wetted surface area) (type 3)	-	1 gained	-	1063
Intertidal seawall (type 3)	2750	Absolute shading	818	-
Basement wall (type 3)	-	1 gained	-	1403
Unvegetated subtidal habitat (type 3)	234,726	Partial shading	5701**	1064*
		Absolute shading	18,034**	-
		Sediment reprofiling	About 500 m ³ reshaped on same habitat	
Macroalgae (type 2)	2674	No impact	-	-
Intertidal flats with mangrove (type 2)	240	3 mangrove seedlings removed	1	-
Total	256,496		40,659	3994

* area previously shaded that would be exposed

**excludes existing shaded areas that would remain shaded

5.4 Matters of National Environmental Significance (MNES)

The following MNES (**Table 2**) were returned from the database search for a 5 km radius around coordinates -33.8733, 151.19241. No MNES would be impacted by the proposed works.

Table 2: Matters of National Environmental Significance from database search

Matter of NES	Count	Comment	Impact Assessment
World Heritage Properties	6	Not near site - terrestrial	No impact
National Heritage Places	6	Not near site - terrestrial	No impact
Wetlands of International Importance	1	Not near site (Towra Point Nature Reserve)	No impact
Great Barrier Reef Marine Park	None		No impact
Commonwealth Marine Areas	None		No impact
Listed Threatened Ecological Communities	5	See likelihood of occurrence in Appendix A for estuarine communities. None on site.	No impact
Listed Threatened Species	74	See likelihood of occurrence in Appendix A for estuarine species (terrestrial species excluded).	No impact
Listed Migratory Species	60	See likelihood of occurrence in Appendix A for estuarine migratory species (terrestrial species excluded).	No impact

5.5 Sydney Regional Environmental Plan (SREP, Sydney Harbour Catchment) 2005

Clause 21 of the SREP provides nine matters to be taken into consideration in relation to biodiversity, ecology and environment protection:

21(a) Development should have a neutral or beneficial effect on the quality of water entering the waterways.

During construction, potential impact to water quality would be controlled by implementation of a Construction Environmental Management Plan (CEMP). The operational use would not be hugely different from the current use, so the works are not expected to alter the quality of the water.

There is a risk that ASSs would be disturbed during the construction, which would directly harm marine flora and fauna within the study area. The CEMP will directly address this and provide further mitigation measures on how to reduce this impact.

21(b) Development should protect and enhance terrestrial and aquatic species, populations and ecological communities and, in particular, should avoid physical damage and shading of aquatic vegetation (such as seagrass, saltmarsh and algal and mangrove communities).

No communities of seagrass, saltmarsh or macroalgae would be directly or indirectly harmed by the proposed works. Three small mangrove seedlings in the southwestern corner of the subject site would be harmed by the works. Combined, these seedlings equal <1 m² of habitat.

21(c) Development should promote ecological connectivity between neighbouring areas of aquatic vegetation (such as seagrass, saltmarsh and algal and mangrove communities).

The proposal would not disconnect any aquatic vegetation patches and would not inhibit the movement of plant propagules through the water body or along the substrate.

21(d) Development should avoid indirect impacts on aquatic vegetation (such as changes to flow, current and wave action and changes to water quality) as a result of increased access.

The proposed piles would influence the localised hydrology by creating back-eddies, however, this would not increase as there are already a large number of closely spaced piles in the site. The site is subject to high boat frequency and tidal movement already, so it is unlikely that there would be a significant change in hydrology.

21(e) Development should protect and reinstate natural intertidal foreshore areas, natural landforms and native vegetation.

The proposal would not affect natural foreshore areas, as they do not exist. The proposal has the potential to reinstate foreshore areas by creating additional sloped surfaces and habitat availability. **Section 5.7** has additional information on habitat opportunities which may be included in the final works.

21(f) Development should retain, rehabilitate and restore riparian land.

The proposal would not interfere with any riparian vegetation or riparian land.

21(g) Development on land adjoining wetlands should maintain and enhance the ecological integrity of the wetlands and, where possible, should provide a vegetative buffer to protect the wetlands.

The proposal is not on, or adjoining wetlands identified on the Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005 – Wetland Protection Map.

21(h) The cumulative environmental impact of development.

The foreshore and aquatic habitat are highly modified by a footpath, extensive seawall, wharf/pontoon structures and commercial and recreational boat traffic. There would be an increase in partial shading of unvegetated substrate, which would be offset by the creation of hard substrate (piles). Increased signage and bins would reduce rubbish entering the water. The use of transparent materials and/or meshed decking (recommended in **Section 5.7**) may have a positive impact, by increasing light availability to the subtidal sand currently shaded. Overall, the proposed works, although they have not been finalised yet, are not expected to increase environmental impact above the current conditions.

21(i) Whether sediments in the waterway adjacent to the development are contaminated, and what means will minimise their disturbance.

The site is located in an area classed as having a 'high probability' of ASSs within the bottom sediments of the bay. The long-standing use of the bay as an industrial environment may have also had an impact on soils. Disturbance to the soil would arise from removing and drilling the piles in intertidal zones at low tide. Fine-scale sediment plumes, which may release the acid sulphate, would be avoided by working at high tide. The silt curtain should not be removed until the risk of sediment contamination is negligible. The CEMP has directly addressed ASS management.

5.6 Recommended mitigation measures

Although the work would not directly or indirectly harm marine vegetation (besides three small mangrove seedlings), the following mitigation measures are recommended to minimise the risk of impact during construction and operation. These are adapted from guidelines issued by DPI Fisheries for instream and foreshore work with additional measures recommended in response to potential water quality impacts. These mitigation measures are in addition to the Construction Environmental Management Plan (CEMP) developed by Theme (August 2018) and at a minimum include:

- machinery and engine maintenance schedule to reduce oil/fuel leakage
 - low impact barge positioning to prevent propeller scouring and thrust wash onto shallow habitats
 - minimise footprint and establish no-go zones in sensitive habitats
 - biological hygiene (eg prevent spread of noxious species on and off the site)
 - aquatic fauna management (see below)
 - other measures listed below.
- Establish no-go zones to avoid damage to nearby habitats (eg macroalgae in **Figure 4**). No-go zones should be marked on a map and displayed inside the construction barge and office. All staff responsible for maneuvering the barge should check the map before selecting a new position. A brief pre-construction survey should be undertaken to confirm the extent of sensitive habitat types (no-go zones) present, eg the extent of macroalgae to the west of the subject site.
 - Work positioning barges, drilling and pile driving should occur during calm conditions.
 - No anchors or mooring blocks/lines should be placed on the intertidal rock habitat. All lines should be suspended off the seafloor to minimise drag across benthic communities.
 - Use a floating boom with silt curtain to contain sediment plumes during sediment reprofiling, pile removal, drilling and pile hammering. As the site is large, the silt curtain should encompass the area where work is being undertaken, rather than encompassing the entire site. The silt curtain should not be removed until the risk of sedimentation is negligible. The silt curtain should be placed across the gap in cofferdam or around piling activities until it is closed after piling.
 - All waste material should be disposed of on land, stored away from stormwater drains and not reused in the construction.
 - Syngnathids (seahorses and their relatives) were not observed during the field survey and are unlikely to use the construction area. Pre-construction surveys are not required.
 - The noxious marine alga *Caulerpa taxifolia* was not observed in the study area. Care should be taken not to introduce this species to the area by using contaminated vessels and machinery. For example, a drill head or anchor used at another site with *Caulerpa* should be thoroughly cleaned of plant propagules and sediment before being used at another location. Fragments of *Caulerpa* can remain viable for up to three days out of the water. Best hygiene practices are outlined in the NSW Control Plan for the Noxious Marine Alga *Caulerpa taxifolia* (NSW I&I 2009).

- Although large marine mammals are not expected to occur, gentle start-up hammering is recommended to allow undetected aquatic fauna to leave the area and avoid hearing damage. Work should be stopped if large fauna is observed nearby.
- Avoid piling or minor excavation works in intertidal zones at low tide, to reduce the risk of exposing ASSs. A silt-curtain should be used to contain sediment plumes. Refer to the Acid Sulphate Soil Management Plan developed by JBS&G for further mitigation measures.
- Submersible pump heads should be covered in a filter to prevent fauna being sucked into the pump. Pumps must also be of a suitable size and capacity with a slow enough velocity to allow fish to escape during any dewatering process.
- Develop an aquatic biodiversity management plan (ABMP). This should be developed by a suitably qualified aquatic ecologist during the detailed design phase of the project and address the on-going management of the aquatic biodiversity in Blackwattle Bay.
- Monitor water quality at the frequencies recommended in the FWQA. If trigger values are exceeded then works should cease, and water treated prior to works continuing.

5.7 Habitat opportunities (increase biodiversity value)

This section identifies habitat improvement opportunities presented by construction of the new fish markets. It is recommended that an ABMP be prepared during the detailed design phase of the building. Examples of habitat enhancement ideas are provided in **Appendix C**. The Plan should have monitoring for a period of five years to determine the extent to which the habitat enhancement has been successful – and therefore provide lessons for future harbour infrastructure.

Seawalls – The current seawall is a mix of vertical and sloped concrete and sandstone surfaces. Naturally, the intertidal zone is a slow transition from subtidal to terrestrial consisting of microhabitats which support flora (macroalgae) and fauna (sponges and molluscs). These species provide food for higher order species including crustaceans and fish. The seawall steepens this transition, reducing the habitat complexity in this area. Where the vertical seawall would be retained, its habitat complexity can be increased by adding artificial habitat features including pots, crevices or panels. This adds texture, water retaining features and crevices which allows flora and fauna to establish. As additional structures on the seawall may create shade, it is important not to shade any existing vegetation and position pot plants in areas of least sensitivity to disturbance (type 3 KFH). A trial study in Blackwattle Bay retrofitted complex ridged tiles and flowerpots to mono-textured seawalls to increase surface area and introduce microhabitats (Strain et al 2017). An increase in settlement was recorded on the textured tiles. There was an 80% increase in biodiversity of the seawall, with the use of flowerpots. Starfish, fish and sponges were some of the fauna using the pots as habitat. Although these features were retrofitted, it is suggested that water-retaining features are better to be incorporated into a seawall or pile at the planning stage. A seawall, at McMahons Point, Sydney Harbour is an example of this. The sandstone seawall was purposely built to include pools for structural habitat and features rock boulders at its toe for additional transitioning habitat.

Where the seawall would be replaced, creating a sloping transition from the water to the land would increase the surface area that is tidally inundated. Rock revetments provide large tidal surface areas and trap water during the low tide to create microhabitats. The inclusion of flat areas within the rock revetment can create additional habitat and allow the accumulation of sediment and establishment of natural vegetation (mangroves and saltmarsh). There are current examples of this onsite, with three mangrove

seedlings growing in an artificial area located in front of the vertical seawall. Materials including coir or timber logs can be used as a barrier to wash while the mangrove seedlings establish. These logs would decompose slowly, and offer additional habitat and nutrient cycling in the process. A naturally vegetated shoreline has benefits to the aquatic environment including supplying food and habitat for fish and trapping contaminants/nutrients/gross pollution from the land before they enter the water.

Wharves, piles and pontoons – Pontoons can create habitat by creating texture in the intertidal and subtidal zones. Complex panels fitted to the wetted side of the pontoon would increase habitat complexity and provide a greater surface area for flora and fauna to colonise. Installing textured piles, as opposed to piles with smooth surfaces, would also increase habitat availability. Wharves are preferable to pontoons, as the use of a solid structure means that light penetrating materials can be used. Mesh decking, Perspex or glass can all be used to reducing shading on the benthic habitat below. Increased light allows for the establishment of vegetation, eg macroalgae, which are primary producers and an important food source for secondary produces, eg invertebrates. This habitat opportunity also allows pedestrians of these structures to observe the aquatic biodiversity below the structure. Increasing the height of the structure above the water also maximises light availability under the structure. Artificial hanging structures, similar in shape to milk crates, can be hung below wharves or pontoons at varying depths to create another habitat opportunity.

Subtidal sand – Subtidal sand can be enhanced by installing features such as artificial reefs. Artificial structures are designed to deflect currents and create nutrient upwellings around them. This, in turn, attracts fish. The hard structures also allow for encrusting organisms to establish. The reef structure must be made of environmentally friendly material, and free of all noxious substances that may leech into the water. They must not become navigational hazards.

Planting of native macroalgae on rubble amongst subtidal sand that is less than 2 m deep would also improve that habitat on site. Transplanting habitat-forming species such as *Ecklonia radiata*, that is native to the region, has previously been successful within Sydney Harbour.

These habitat opportunities aim to emulate the natural environment, creating habitats for native species and providing natural dissipation of wash and waves. An increase in colonisation of native species reduces the resources and opportunity for invasive species to establish. See **Appendix C** for examples of where these habitat opportunities can be incorporated into the new Sydney Fish Market design.

6 Conclusion

There is not likely to be a direct or indirect impact on threatened aquatic species, populations, ecological communities or their habitats. Therefore, the proposed footprint does not trigger a Species Impact Statement (SIS) or Referral. Impacts on marine vegetation are not likely if no-go zones are established in a CEMP and followed.

Regarding DPI Fisheries Policy and Guidelines for Fish Habitat Conservation and Management (2013 update), there is expected to be a total loss of 40,658 m² of type 3 KFH, <1 m² of type 2 KFH (three mangrove seedlings) and a total gain of 3994 m² hard substrate (type 3 KFH). Therefore, there would be a 'net loss' of KFH in the subject site. However, this habitat has a low biodiversity value, and does not support threatened species, populations or ecological communities.

Habitat opportunities should be considered and implemented as part of the new Sydney Fish Market to increase the habitat complexity and biodiversity within Blackwattle Bay. These would be best incorporated during the design phase, with retro-fitted structural habitat being less desirable.

7 References

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Appendix A: Threatened species likelihood of occurrence and impact

If a species has suitable habitat present on site **AND** is likely to use this habitat **AND** the species or its habitat would be directly or indirectly impacted, **THEN** an Assessment of Significance is required. Such species, if any, are highlighted in the table below. This list excludes terrestrial species that do not use estuarine/marine water or tidal foreshores.

Type	Species name	Common name	BC/FM Act Status	EPBC Status	Use of site	Is an impact assessment required?
Fish	<i>Epinephelus daemeli</i>	Black Rockcod	V	V	No suitable habitat present, eg rock overhangs, crevices or caves	No
	<i>Hippocampus whitei</i>	White's Seahorse	E – proposed		Nearby habitat present but would not be impacted	No
	<i>Macquaria australasica</i>	Macquarie Perch	E1	E	No records in catchment	No
	<i>Prototroctes maraena</i>	Australian Grayling	E	V		No
Shark	<i>Carcharias taurus</i>	Grey Nurse Shark	E4A	CE	Unlikely close to shore	No
	<i>Carcharodon carcharias</i>	Great White Shark	V	V		No
	<i>Lamna nasus</i>	Porbeagle, Mackerel Shark		Bonn		No
	<i>Rhincodon typus</i>	Whale Shark		V,Bonn		No
Ray	<i>Manta alfredi</i>	Reef Manta Ray		Bonn	May opportunistically pass through but would be deterred during construction	No
	<i>Manta birostris</i>	Giant Manta Ray		Bonn		No
	<i>Pristis zijsron</i>	Green Sawfish	E4	V	Presumed extinct in NSW	No
Turtle	<i>Caretta caretta</i>	Loggerhead Turtle	E1	E	Unlikely, may briefly explore area	No
	<i>Chelonia mydas</i>	Green Turtle	V	V		No
	<i>Dermochelys coriacea</i>	Leatherback Turtle	E1	E		No
	<i>Eretmochelys imbricata</i>	Hawksbill Turtle		V,Bonn		No
	<i>Natator depressus</i>	Flatback Turtle		V,Bonn		No
Whale	<i>Balaenoptera bonaerensis</i>	Antarctic Minke Whale		Bonn	Unlikely to enter site through narrow channel into Blackwattle Bay.	No
	<i>Balaenoptera edeni</i>	Bryde's Whale		Bonn		No
	<i>Balaenoptera musculus</i>	Blue Whale	E1	E		No
	<i>Caperea marginata</i>	Pygmy Right Whale		Bonn		No
	<i>Eubalaena australis</i>	Southern Right Whale	E1	E		No

Type	Species name	Common name	BC/FM Act Status	EPBC Status	Use of site	Is an impact assessment required?
	<i>Megaptera novaeangliae</i>	Humpback Whale	V	V		No
	<i>Physeter macrocephalus</i>	Sperm Whale	V			No
Dolphin	<i>Lagenorhynchus obscurus</i>	Dusky Dolphin		Bonn	Unlikely to enter site through narrow channel into Blackwattle Bay.	No
	<i>Orcinus orca</i>	Killer Whale, Orca		Bonn		No
	<i>Sousa chinensis</i>	Indo-Pacific Humpback Dolphin		Bonn		No
Marine mammal	<i>Dugong dugon</i>	Dugong	E1	Bonn	Unlikely, no seagrass	No
Seal	<i>Arctocephalus forsteri</i>	New Zealand Fur-seal	V		Unlikely, may briefly explore area	No
	<i>Arctocephalus pusillus doriferus</i>	Australian Fur-seal	V			No
Frog	<i>Litoria aurea</i>	Green and Golden Bell Frog	E1	V	No habitat	No
Bird	<i>Actitis hypoleucos</i>	Common Sandpiper		C,J,K	Some species only occur offshore. Site is exposed to human activity, which would be avoided by these species. Larger, better habitat in region. These birds are unlikely to use the area of proposed works.	No
	<i>Anseranas semipalmata</i>	Magpie Goose	V			No
	<i>Apus pacificus</i>	Fork-tailed Swift		C,J,K		No
	<i>Arenaria interpres</i>	Ruddy Turnstone		C,J,K		No
	<i>Botaurus poiciloptilus</i>	Australasian Bittern	E1	E		No
	<i>Calidris acuminata</i>	Sharp-tailed Sandpiper		C,J,K		No
	<i>Calidris alba</i>	Sanderling	V	C,J,K		No
	<i>Calidris canutus</i>	Red Knot		C,J,K		No
	<i>Calidris ferruginea</i>	Curlew Sandpiper	E1	CE,C,J,K		No
	<i>Calidris melanotos</i>	Pectoral Sandpiper		J,K		No
	<i>Calidris ruficollis</i>	Red-necked Stint		C,J,K		No
	<i>Calidris subminuta</i>	Long-toed Stint		C,J,K		No
	<i>Calidris tenuirostris</i>	Great Knot	V	C,J,K		No
	<i>Calonectris leucomelas</i>	Streaked Shearwater		C,J,K		No
	<i>Charadrius bicinctus</i>	Double-banded Plover		Bonn		No
	<i>Charadrius leschenaultii</i>	Greater Sand-plover	V	C,J,K		No
	<i>Charadrius mongolus</i>	Lesser Sand-plover	V	C,J,K		No
<i>Charadrius veredus</i>	Oriental Plover		J,K	No		
	<i>Diomedea antipodensis</i>	Antipodean Albatross	V	V	No	

Type	Species name	Common name	BC/FM Act Status	EPBC Status	Use of site	Is an impact assessment required?
	<i>Diomedea dabbenena</i>	Tristan Albatross		Bonn		No
	<i>Diomedea exulans</i>	Wandering Albatross	E1	V,J		No
	<i>Diomedea gibsoni</i>	Gibson's Albatross	V	V		No
	<i>Diomedea sanfordi</i>	Northern Royal Albatross		E,Bonn		No
	<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	E1			No
	<i>Epthianura albifrons</i>	White-fronted Chat	E2,V			No
	<i>Esacus magnirostris</i>	Beach Stone-curlew	E4A			No
	<i>Eudyptula minor</i>	Little Penguin in the Manly Point Area	E2			No
	<i>Fregetta grallaria grallaria</i>	White-bellied Storm-Petrel		V		No
	<i>Gallinago hardwickii</i>	Latham's Snipe		C,J,K		No
	<i>Gallinago megala</i>	Swinhoe's Snipe		Bonn,C		No
	<i>Gallinago stenura</i>	Pin-tailed Snipe		Bonn,C		No
	<i>Gygis alba</i>	White Tern	V			No
	<i>Haematopus fuliginosus</i>	Sooty Oystercatcher	V			No
	<i>Haematopus longirostris</i>	Pied Oystercatcher	E1			No
	<i>Heteroscelus brevipes</i>	Grey-tailed Tattler		J		No
	<i>Heteroscelus incanus</i>	Wandering Tattler		J		No
	<i>Hirundapus caudacutus</i>	White-throated Needletail		C,J,K		No
	<i>Ixobrychus flavicollis</i>	Black Bittern	V			No
	<i>Limicola falcinellus</i>	Broad-billed Sandpiper	V	C,J,K		No
	<i>Limosa lapponica</i>	Bar-tailed Godwit		C,J,K		No
	<i>Limosa limosa</i>	Black-tailed Godwit	V	C,J,K		No
	<i>Macronectes giganteus</i>	Southern Giant Petrel	E1	E		No
	<i>Macronectes halli</i>	Northern Giant-Petrel	V	V		No
	<i>Monarcha melanopsis</i>	Black-faced Monarch		Bonn		No
	<i>Monarcha trivirgatus</i>	Spectacled Monarch		Bonn		No
	<i>Numenius madagascariensis</i>	Eastern Curlew		CE,C,J,K		No
	<i>Numenius minutus</i>	Little Curlew		C,J,K		No

Type	Species name	Common name	BC/FM Act Status	EPBC Status	Use of site	Is an impact assessment required?
	<i>Numenius phaeopus</i>	Whimbrel		C,J,K		No
	<i>Onychoprion fuscata</i>	Sooty Tern	V			No
	<i>Pachyptila turtur subantarctica</i>	Fairy Prion (southern)		V		No
	<i>Pandion cristatus</i>	Eastern Osprey	V			No
	<i>Pandion haliaetus</i>	Eastern Osprey		Bonn		No
	<i>Philomachus pugnax</i>	Ruff		C,J,K		No
	<i>Phoebastria fusca</i>	Sooty Albatross	V	V		No
	<i>Pluvialis fulva</i>	Pacific Golden Plover		C,J,K		No
	<i>Pluvialis squatarola</i>	Grey Plover		C,J,K		No
	<i>Pterodroma leucoptera leucoptera</i>	Gould's Petrel	V	E		No
	<i>Pterodroma neglecta neglecta</i>	Kermadec Petrel	V	V		No
	<i>Pterodroma solandri</i>	Providence Petrel	V	J		No
	<i>Puffinus carneipes</i>	Flesh-footed Shearwater		J,K		No
	<i>Rostratula australis</i>	Australian Painted Snipe	E1	E		No
	<i>Sternula albifrons</i>	Little Tern	E1	Bonn,C,J,K		No
	<i>Sternula nereis nereis</i>	Australian Fairy Tern		V		No
	<i>Thalassarche bulleri</i>	Buller's Albatross		V,Bonn		No
	<i>Thalassarche cauta</i>	Shy Albatross	V	V		No
	<i>Thalassarche cauta steadi</i>	White-capped Albatross		V		No
	<i>Thalassarche eremita</i>	Chatham Albatross		E,Bonn		No
	<i>Thalassarche impavida</i>	Campbell Albatross		E,Bonn		No
	<i>Thalassarche melanophris</i>	Black-browed Albatross	V	V		No
	<i>Thalassarche salvini</i>	Salvin's Albatross		V,Bonn		No
	<i>Tringa nebularia</i>	Common Greenshank		C,J,K		No
	<i>Tringa stagnatilis</i>	Marsh Sandpiper		C,J,K		No
	<i>Xenus cinereus</i>	Terek Sandpiper	V	C,J,K		No
Seagrass	Posidonia australis - Port Hacking, Botany Bay, Sydney Harbour, Pittwater, Brisbane Waters and Lake Macquarie populations	Posidonia australis	E2		No plants observed	No

Type	Species name	Common name	BC/FM Act Status	EPBC Status	Use of site	Is an impact assessment required?
	Posidonia australis seagrass meadows of the Manning-Hawkesbury ecoregion	Posidonia australis		E		No
Saltmarsh	Subtropical and Temperate Coastal Saltmarsh	Coastal Saltmarsh	E1	V	No plants observed or available habitat	No
	<i>Wilsonia backhousei</i>	Narrow-leafed Wilsonia	V		No plants observed	No

BC Act: E1 = Endangered, E2 = Endangered Population, E4 = Extinct, E4A = Critically Endangered, V = Vulnerable

FM Act: E1 = Endangered, E2 = Endangered Population, E4 = Extinct, E4A = Critically Endangered, V = Vulnerable

EPBC Act: Bonn = Listed migratory species under Bonn Convention, CD = Conservation Dependent, CE = Critically Endangered, E = Endangered, V = Vulnerable, X = Extinct

Appendix B: Key fish habitat types

NSW key fish habitat types and associated sensitivity classification (from Fairfull 2013).

<p>TYPE 1 - Highly sensitive key fish habitat:</p> <ul style="list-style-type: none"> ▪ <i>Posidonia australis</i> (strapweed) ▪ <i>Zostera</i>, <i>Heterozostera</i>, <i>Halophila</i> and <i>Ruppia</i> species of seagrass beds >5m² in area ▪ Coastal saltmarsh >5m² in area ▪ Coral communities ▪ Coastal lakes and lagoons that have a natural opening and closing regime (i.e. are not permanently open or artificially opened or are subject to one off unauthorised openings) ▪ Marine park, an aquatic reserve or intertidal protected area ▪ SEPP 14 coastal wetlands, wetlands recognised under international agreements (e.g. Ramsar, JAMBA, CAMBA, ROKAMBA wetlands), wetlands listed in the Directory of Important Wetlands of Australia² ▪ Freshwater habitats that contain in-stream gravel beds, rocks greater than 500 mm in two dimensions, snags greater than 300 mm in diameter or 3 metres in length, or native aquatic plants ▪ Any known or expected protected or threatened species habitat or area of declared 'critical habitat' under the FM Act ▪ Mound springs 	<p>TYPE 2 – Moderately sensitive key fish habitat:</p> <ul style="list-style-type: none"> ▪ <i>Zostera</i>, <i>Heterozostera</i>, <i>Halophila</i> and <i>Ruppia</i> species of seagrass beds <5m² in area ▪ Mangroves ▪ Coastal saltmarsh <5m² in area ▪ Marine macroalgae such as <i>Ecklonia</i> and <i>Sargassum</i> species ▪ Estuarine and marine rocky reefs ▪ Coastal lakes and lagoons that are permanently open or subject to artificial opening via agreed management arrangements (e.g. managed in line with an entrance management plan) ▪ Aquatic habitat within 100 m of a marine park, an aquatic reserve or intertidal protected area ▪ Stable intertidal sand/mud flats, coastal and estuarine sandy beaches with large populations of in-fauna ▪ Freshwater habitats and brackish wetlands, lakes and lagoons other than those defined in TYPE 1 ▪ Weir pools and dams up to full supply level where the weir or dam is across a natural waterway <hr/> <p>TYPE 3 – Minimally sensitive key fish habitat may include:</p> <ul style="list-style-type: none"> ▪ Unstable or unvegetated sand or mud substrate, coastal and estuarine sandy beaches with minimal or no in-fauna ▪ Coastal and freshwater habitats not included in TYPES 1 or 2 ▪ Ephemeral aquatic habitat not supporting native aquatic or wetland vegetation
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Appendix C: Habitat opportunities

Area of new Fish Market (Figure 9 shows corresponding numbers)	Indicative area of the new Sydney Fish Market (pictures taken from Concept Proposal)	Habitat improvement opportunity	Example habitat improvement
1. Subtidal sand (1-2 m depth)		<p>Plant/transplant native macroalgae (eg <i>Ecklonia radata</i>, <i>Horomisa banksia</i> or <i>Sargassum linearifolium</i>) using transplant mats in sandy subtidal zones</p>	
2. Subtidal sand (>2 m depth)		<p>Deploy hard structures (oyster reefs) onto soft sediment to create an artificial reef. Need to consider other uses of the waterway (boat thoroughfare).</p>	

<p>3. Vertical smooth wall</p>		<p>Textured tiles, or features including crevices to increase habitat complexity. These are best incorporated in the design stage but can be retrofitted.</p>	
<p>4. Suspended slab</p>		<p>Hanging structures can suspend from slab to create additional habitat. These can act as fish aggregation devices.</p>	
<p>5. Sloped stepped surfaces</p>		<p>Design should consider ways to allow light to penetrate, eg integrated glass panels or metal grills</p>	

<p>6. Piles</p>		<p>Improvements could include water-retaining features in the intertidal zone eg flowerpots</p>	
<p>7. Wharf</p>		<p>Design should consider ways to allow light to penetrate, eg integrated glass panels or metal grills</p>	

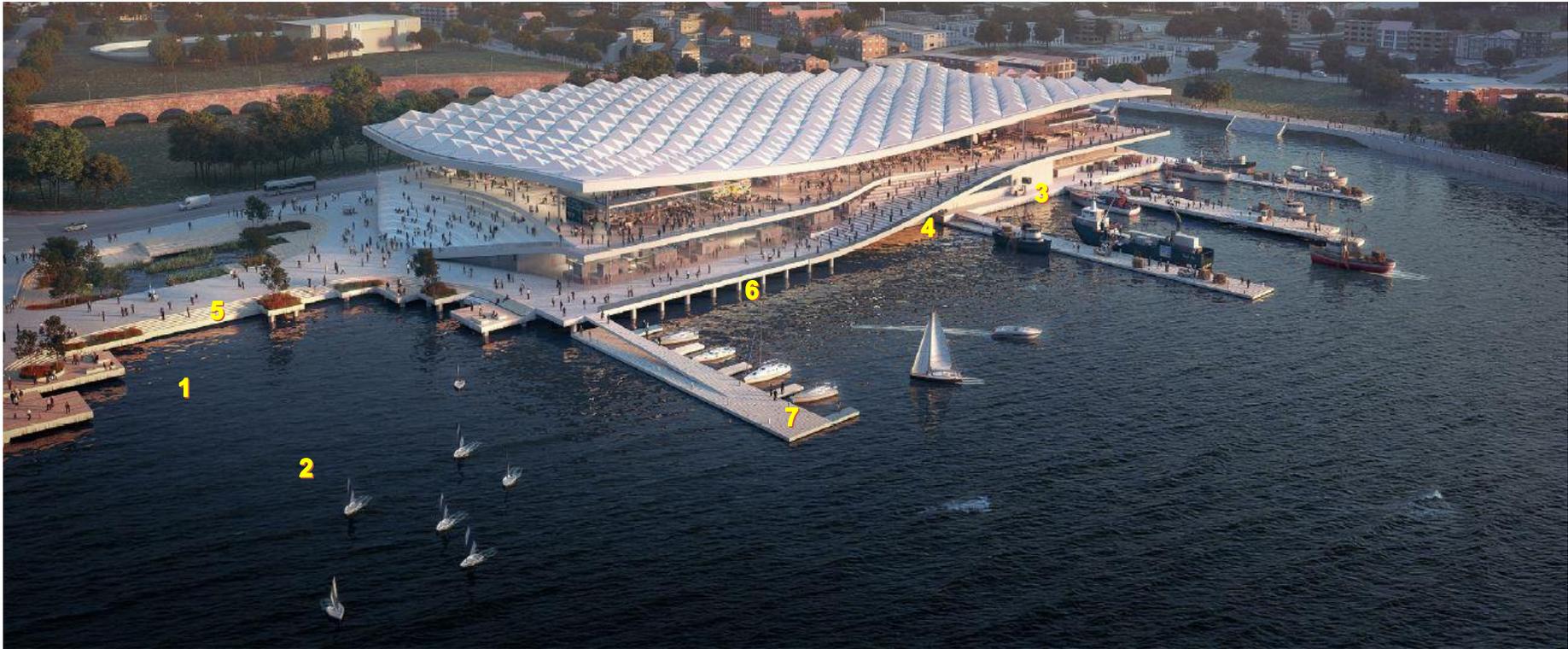
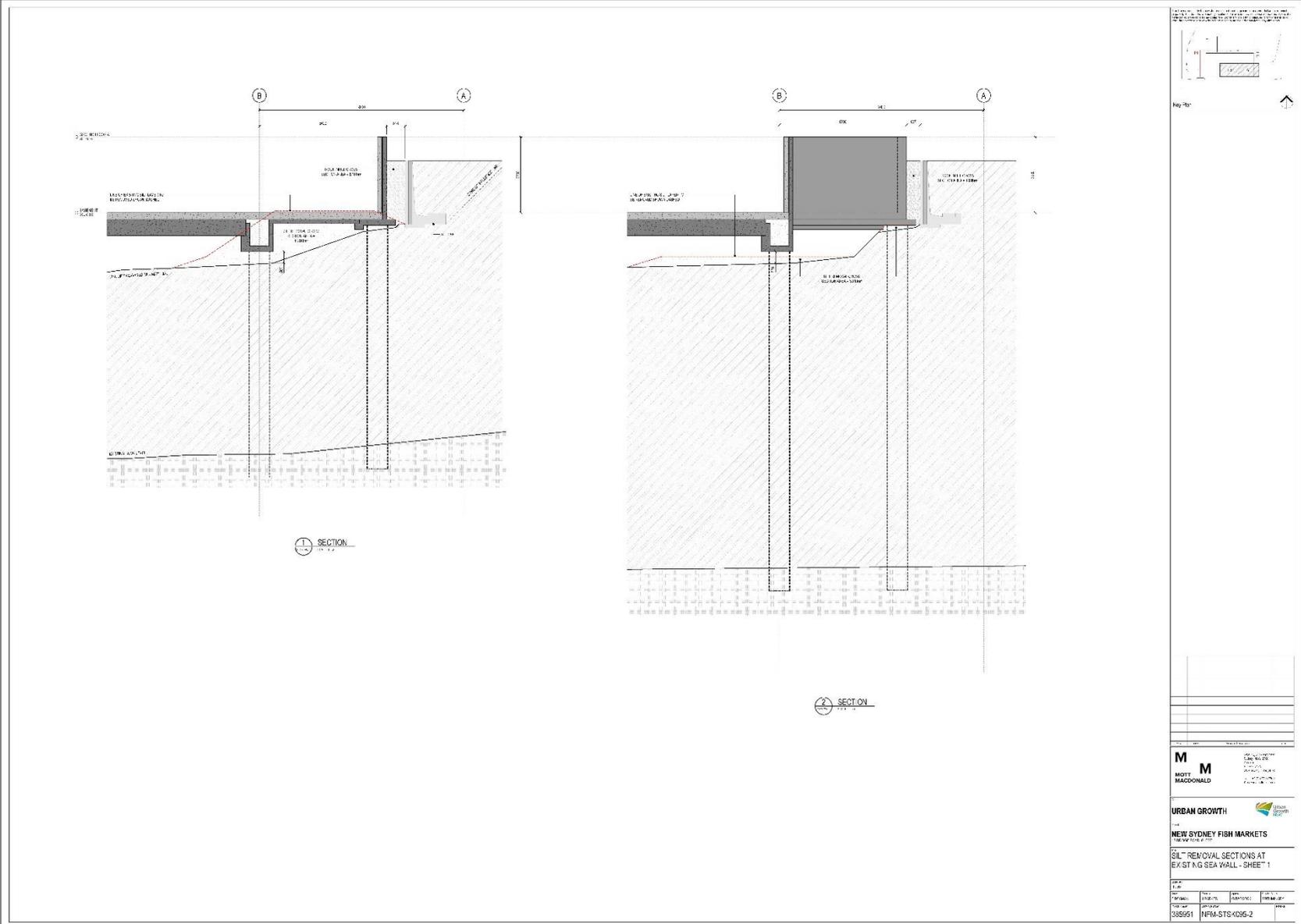
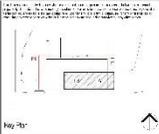
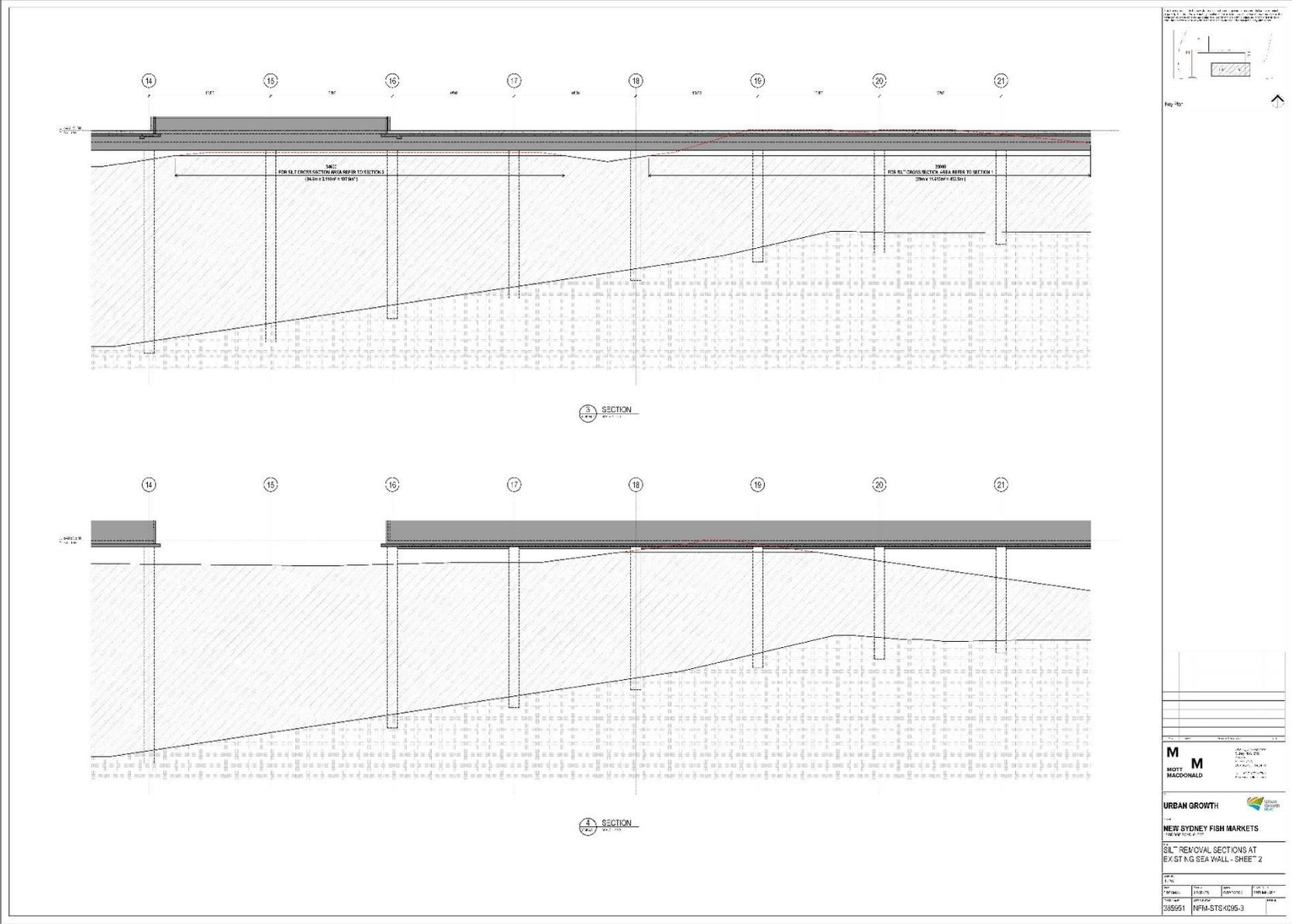


Figure 9: Example habitat opportunity areas on the new Sydney Fish Market (Image taken from SSD-DA Package: Stage 1 Concept Proposal – 3XN)

Appendix C: Sediment Reprofiling



URBAN GROWTH THE NEW SYDNEY FISH MARKETS		
SIL™ REMOVAL SECTIONS AT EXISTING SEA WALL - SHEET 1		
DATE: 11/11/11 DRAWN BY: J. SMITH CHECKED BY: J. SMITH PROJECT NO: 335951	NO: 2 DATE: 11/11/11 PROJECT NO: NFM-ST5-035-2	SHEET NO: 1 TOTAL SHEETS: 1



Key Plan

3 SECTION

4 SECTION

M M		MOTT MACDONALD	
URBAN GROWTH		URBAN GROWTH	
NEW SYDNEY FISH MARKETS			
SILT REMOVAL SECTIONS AT EXISTING SEA WALL - SHEET 2			
DATE:	NO.:	REV.:	BY:
12/01/2011	001	001	ECOLOGICAL
PROJECT:	PROJECT:	PROJECT:	PROJECT:
335951	NFM-ST3-035-3		

eco
logical
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