GatewaySA Program – Berth 6 Extension Crown Development Application

Prepared for Flinders Port Holdings Pty Ltd
February 2025

GatewaySA Program – Berth 6 Extension

Crown Development Application

Prepared for Flinders Port Holdings Pty Ltd

February 2025

GatewaySA Program – Berth 6 Extension

Crown Development Application

Flinders Port Holdings Pty Ltd

E240841 RP3

February 2025

Version	Date	Prepared by	Reviewed by	Comments
1	29 January 2025	A. Eadie S. Longhurst	P. Gibbons	Draft
2	30 January 2025	P. Gibbons	L. Kolokas (FPH)	Final Draft
3	20 February 2025	S. Longhurst	P. Gibbons	Final

Approved by

Paul Gibbons
Director
20 February 2025

Level 4 74 Pirie Street
Adelaide SA 5000
ABN: 28 141 736 558

This report has been prepared in accordance with the brief provided by Flinders Port Holdings Pty Ltd and, in its preparation, EMM has relied upon the information collected at the times and under the conditions specified in this report. All findings, conclusions or recommendations contained in this report are based on those aforementioned circumstances. The contents of this report are private and confidential. This report is only for Flinders Port Holdings Pty Ltd's use in accordance with its agreement with EMM and is not to be relied on by or made available to any other party without EMM's prior written consent. Except as permitted by the Copyright Act 1968 (Cth) and only to the extent incapable of exclusion, any other use (including use or reproduction of this report for resale or other commercial purposes) is prohibited without EMM's prior written consent. Except where expressly agreed to by EMM in writing, and to the extent permitted by law, EMM will have no liability (and assumes no duty of care) to any person in relation to this document, other than to Flinders Port Holdings Pty Ltd (and subject to the terms of EMM's agreement with Flinders Port Holdings Pty Ltd).

© EMM Consulting Pty Ltd, Level 10, 201 Pacific Highway, St Leonards NSW 2065. 2025.
ABN: 28 141 736 558

Executive Summary

This Crown Development Application (Crown DA) has been prepared by EMM Consulting Pty Limited (EMM) on behalf of Flinders Port Holdings Pty Ltd (FPH) for the proposed Berth 6 Extension (the project) as part of the GatewaySA Program at the Flinders Adelaide Container Terminal (FACT), Outer Harbor in the Port of Adelaide, South Australia (SA).

The proposed Berth 6 Extension forms part of a larger upgrade to the existing container storage operations at the FACT, which is required to ensure that the infrastructure and capabilities continue to meet the current and future requirements at the FACT for PFH's port users, supply chain and ultimately the SA economy.

The proposed project comprises:

- extension of Berth 6 to a length of approximately 135 metres (m) in length and 28 m in width
- land reclamation of 20 m strip directly behind wharf extension to provide wharf access
- new mooring dolphin located 20 to 30 m west from the edge of the proposed Berth 6 extension, connected to Berth 6 via a suspended walkway
- piling construction with options under consideration including driven piles, sheet piles or king piles
- dredging of the area adjacent to Berth 6 in the shipping channel to achieve a channel design depth of 14.2 m composite depth (mCD). This involves:
  - dredging footprint approximately 550 square metres (m^2) with a sediment volume of approximately 900 cubic metres (m^3)
  - proposed disposal of dredge spoil to existing Pelican Point Dredge Pond located approximately 1 kilometre (km) from the dredge location. However, if the extension of Berth 6 involves a sheet pile wharf, the spoil may be used as a low level backfill behind the sheet pile, or potentially incorporated into land reclamation works for alternate design options
  - the dredging methodology to be confirmed following detailed design
- pavement surface upgrade to the area adjacent to Berth 6 Extension
- ancillary works, including but not limited to civil engineering for surface water management.

The Department for Transport and Infrastructure (DIT) provided Crown Sponsorship to FPH for the GatewaySA Program and proposed Berth 6 Extension pursuant to Section 131 (Development assessment – Crown development) under the *Planning, Development and Infrastructure Act 2016* (PDI Act).

The investigations and analysis for this Crown DA have been informed by a number of technical assessments prepared in accordance with relevant guidelines and assessment criteria. Technical assessments include benthic survey, marine ecology, coastal processes, construction management of dredging and piling, stormwater, water quality, and noise with the findings concluding that the project would not adversely impact on surrounding land uses, sensitive receptors or the local marine and terrestrial environment. These reports are included as appendices to this Crown DA.

A construction environmental management framework has also been outlined in this Crown DA to provide guidance to FPH and its contractors on mitigation measures to be implemented during construction to minimise potential impacts on the environment, surrounding landowners and the community. As the environmental risks associated with the project are considered to be low, mitigation measures will remain largely consistent with

FPH's existing Construction Environmental Management Plan (CEMP). Additional documents that are proposed to be developed by FPH and its contractor to support construction include a Water Quality Management Plan, Dredge Management Plan and Traffic Management Plan.

In preparing this Crown DA, the proponent has carried out stakeholder engagement with the Port Adelaide-Enfield Council, relevant SA government agencies, adjacent landholders and the local community. Relevant issues and opportunities associated with the project have been identified and addressed.

The proposed development is considered appropriate for the land use, is adequately sited, designed and separated from sensitive receptors to minimise potential impacts, is deemed to satisfy the provisions of the Planning and Design Code under the PDI Act and when considered on its merits warrants the granting of planning consent.

TABLE OF CONTENTS

Appendices

Tables

Figures

Plates

1 Introduction

This Crown Development Application (Crown DA) has been prepared by EMM Consulting Pty Limited (EMM) on behalf of Flinders Port Holdings Pty Ltd (FPH) for the proposed Berth 6 Expansion (the project) as part of the GatewaySA Program at the Flinders Adelaide Container Terminal (FACT), Outer Harbor in the Port of Adelaide, South Australia (SA) (Figure 1.1).

1.1 Overview

The current FACT operations include transhipping of containerised commodities including fertilisers, scrap metal, steel, textiles, forestry products, soda, ash, grain and mineral ore. The project site includes the following components:

- Berth 6 and 7 located adjacent to the Port River in the northern part of the site.
- Ship-to-Shore (STS) cranes for loading and un-loading ships along the shipping berth.
- Container storage area set back from the shipping berth.
- Warehouse located adjacent to Coghlan Road and the rail infrastructure on the eastern part of the site.
- Office and amenity area situated in the central part of the site, including a septic tank system.
- Radioactive container storage area.
- Empty containers storage area in the southern part of the site.
- Other minor buildings used for maintenance and general storage.
- Unsealed land in the central part of the site (known as Lot 9) currently used as a laydown area and soil stockpiling.
- Vegetation mound located along the southern boundary.

The existing site layout is shown in Figure 1.2.

1.2 GatewaySA Program

FPH propose to expand its existing container storage operations at the FACT located in Outer Harbor (referred to by FPH's as the GatewaySA Program) in the Port of Adelaide, SA.

The FACT is a world class facility able to facilitate Panamax and Post-Panamax class vessels with shipping services that connect SA to destinations in most of the world's continents, including north, south and west Asia, the Indian sub-continent, Europe and North America.

Commodities transhipped from the FACT include fertilisers, scrap metal, steel, textiles, forestry products, soda, ash, grain and mineral ore with the volume of containerised trade projected to grow significantly over the next 20 years.

Three key project activities associated with FPH's GatewaySA Program require development approval under the *Planning, Development and Infrastructure Act 2016* (PDI Act) which include:

1. Extension to Berth 6 (the purpose of this report).
2. Lot 9 development (subject to a separate approval).

3. Relocation of site access and installing a new automated gate from Coghlan Road (subject to a separate approval).

FPH are proposing to complete the construction works for all three development activities using a successional approach. The purpose of this is to reduce the potential impacts (e.g. to traffic or noise) associated with multiple construction works occurring at the same time.

1.3 Berth 6 Extension

FPH propose an extension of the existing berth wharf infrastructure to cater for current and forecast shipping trends (i.e. larger vessels).

The proposed project comprises:

- extension of Berth 6 to a length of approximately 135 metres (m) in length and 28 m in width
- land reclamation of 20 m strip directly behind wharf extension to provide wharf access
- new mooring dolphin located 20 to 30 m west from the edge of the proposed Berth 6 extension, connected to Berth 6 via a suspended walkway
- piling construction with options under consideration including driven piles, sheet piles or king piles
- dredging of the area adjacent to Berth 6 in the shipping channel to achieve a channel design depth of 14.2 m composite depth (mCD). This involves:
    - dredging footprint approximately 550 square metres (m^2) with a sediment volume of approximately 900 cubic metres (m^3)
    - proposed disposal of dredge spoil to existing Pelican Point Dredge Pond located approximately 1 kilometre (km) from the dredge location. However, if the extension of Berth 6 involves a sheet pile wharf, the spoil may be used as a low level backfill behind the sheet pile, or potentially incorporated into land reclamation works for alternate design options
    - the dredging methodology to be confirmed following detailed design
- pavement surface upgrade to the area adjacent to Berth 6 extension
- ancillary works, including but not limited to civil engineering for surface water management.

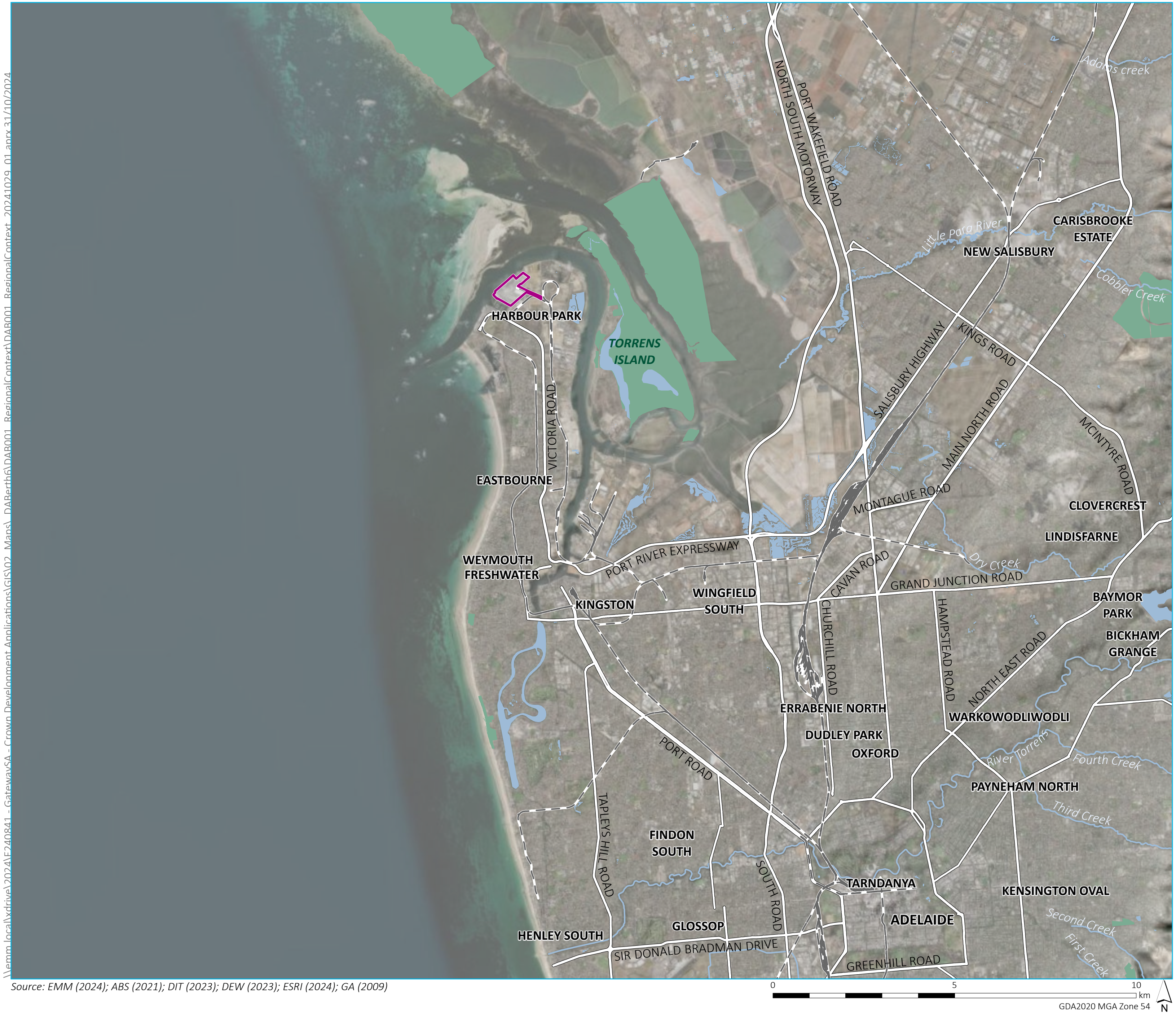
The conceptual site layout is shown on Figure 1.2.

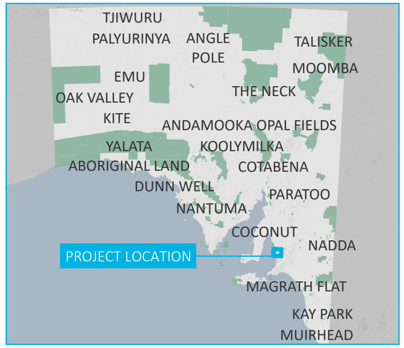
1.4 Section 131 (Development assessment – Crown development)

The Department for Transport and Infrastructure (DIT) provided Crown Sponsorship to FPH on 6 November 2024 for the GatewaySA Program pursuant to section 131 (Development assessment – Crown development) of the PDI Act with the nature of activities for the proposed Berth 6 Extension, namely the wharf extension and dredging activities, deemed 'development' (Appendix A).

Section 131 of the PDI Act allows for State Agencies to sponsor and lodge a Crown Development Application (Crown DA) on behalf of a private sector developer for the purposes of 'essential infrastructure'. Crown Development is commonly used to facilitate electricity, transport networks or facilities and public infrastructure in SA.

Essential Infrastructure is defined in Part 1(3)(c) of the PDI Act and includes infrastructure for transport networks or facilities (including ports, wharfs and freight-handling facilities). DIT considered that the nature of activities deemed ‘development’ for the GatewaySA Program could be considered essential infrastructure associated with wharf development and freight handling facilities (i.e. berth extension, container storage and movement).





KEY

Gateway SA program area

Existing environment

Rail line

Major road

Named watercourse

Waterbody

Conservation and national park

Regional context

Flinders Ports Holding Gateway SA Program
Berth 6 Upgrade Development Application
Figure 1.1

EMM creating opportunities

Source: EMM (2024); ABS (2021); DIT (2023); DEW (2023); ESRI (2024); GA (2009)

\\emm.local\vdrive\2024\E240841 - GatewaySA - Crown Development Applications\GIS\02_Maps_DABerth6\DAB001_RegionalContext\DAB001_RegionalContext_20241029_01.aprx 31/10/2024

KEY

- Project area
- Existing Berth 6
- Dredging of berth pocket
- Proposed berth 6 extension
- Proposed heavy duty pavement area
- Proposed light duty pavement area
- Proposed breakwall

Existing environment

- Rail line

INSET KEY

- Major road
- Minor road

Source: EMM (2024); DIT (2023); DEW (2023); Metromap (2024)

0 250 500 m

GDA2020 MGA Zone 54

\\emm.local\xdrive\2024\E240841 - GatewaySA - Crown Development Applications\GIS\02_Maps_DABerth6\DAB002_SiteLocality\DAB002_SiteLocality_20241218_04.aprx 18/12/2024

Site locality

Flinders Ports Holding Gateway SA Program
Berth 6 Upgrade Development Application
Figure 1.2

EMM
creating opportunities

2 The applicant

2.1.1 Flinders Port Holdings

FPH is a privately-owned port operator in SA, handling most of the state's imports and exports. Established in 2001, FPH acquired a 99-year land lease and licence from the SA Government to operate seven ports across the state.

FPH provides direct employment for over 750 people and indirectly supports 6,000 jobs in SA, with an annual turnover of more than $300 million. FPH facilitates over $25 billion in international trade annually and are the key platform for South Australian two-way trade in goods.

2.1.2 Applicant details

FPH's applicant details are provided in Table 2.1.

Table 2.1 Applicant details

Applicant	
Applicant details	Josh Smith GatewaySA – Program Director Flinders Port Holdings 296 St Vincent Street Port Adelaide, SA 5015
Registered ABN/CAN	ABN 46 117 687 313
Registered address	296 St Vincent Street Port Adelaide South Australia 5015 Australia
Telephone number	0427 183 110
Email	Josh.Smith@fphgroup.com.au
Company details	FPH is a privately-owned port operator in SA, handling most of the state's imports and exports. Established in 2001, FPH acquired a 99-year land lease and licence from the SA Government to operate seven ports across the state.

3 Description of the proposed development

3.1 Development site

The project site is located at 7 Coghlan Road, Outer Harbor, on the northern tip of the Lefevre Peninsula, approximately 22 km north of the Adelaide Central Business District.

The project site is predominantly comprised of land which has been reclaimed from the natural intertidal mangrove and samphire flats which originally formed this part of the Lefevre Peninsula. The adjacent Port River, which forms the sea entrance to the Port of Adelaide, has been utilised as a shipping channel since European settlement and is utilised by FPH vessels, tourist vessels, commercial fishers, recreational boaters and anglers and kayakers.

The Port River is tidal, and at Outer Harbor has been subject to regular dredging programs to maintain channel depth and width which allows larger container vessels, cruise ships, fuel tankers and other commercial shipping to be accommodated. As well as providing access to the Inner Harbour shipping channel and berths.

3.2 Berth 6 site area

Berth 6 is one of the two berths at FACT and is approximately 300 m in length. Total combined length of the two berths at the container terminal (Berth 6 and Berth 7) is 650 m. The existing area includes a cargo shed, maintenance and administration buildings, a paved area for the loading and unloading of shipping containers and quay cranes to support the loading and unloading of ships.

The proposed development will include:

- an extension of Berth 6 to a length of approximately 135 m in length and 28 m in width, comprising land reclamation, new mooring dolphin and piling construction with options under consideration including driven piles, sheet piles or king piles
- dredging of the area adjacent to Berth 6 in the shipping channel to achieve a channel design depth of 14.2 m composite depth (mCD). This involves:
    - dredging footprint approximately 550 m^2 with a sediment volume of approximately 900 m^3
- a pavement surface upgrade to the area adjacent to Berth 6 Extension and ancillary works.

A conceptual plan is provided in Figure 3.1 and Appendix B.

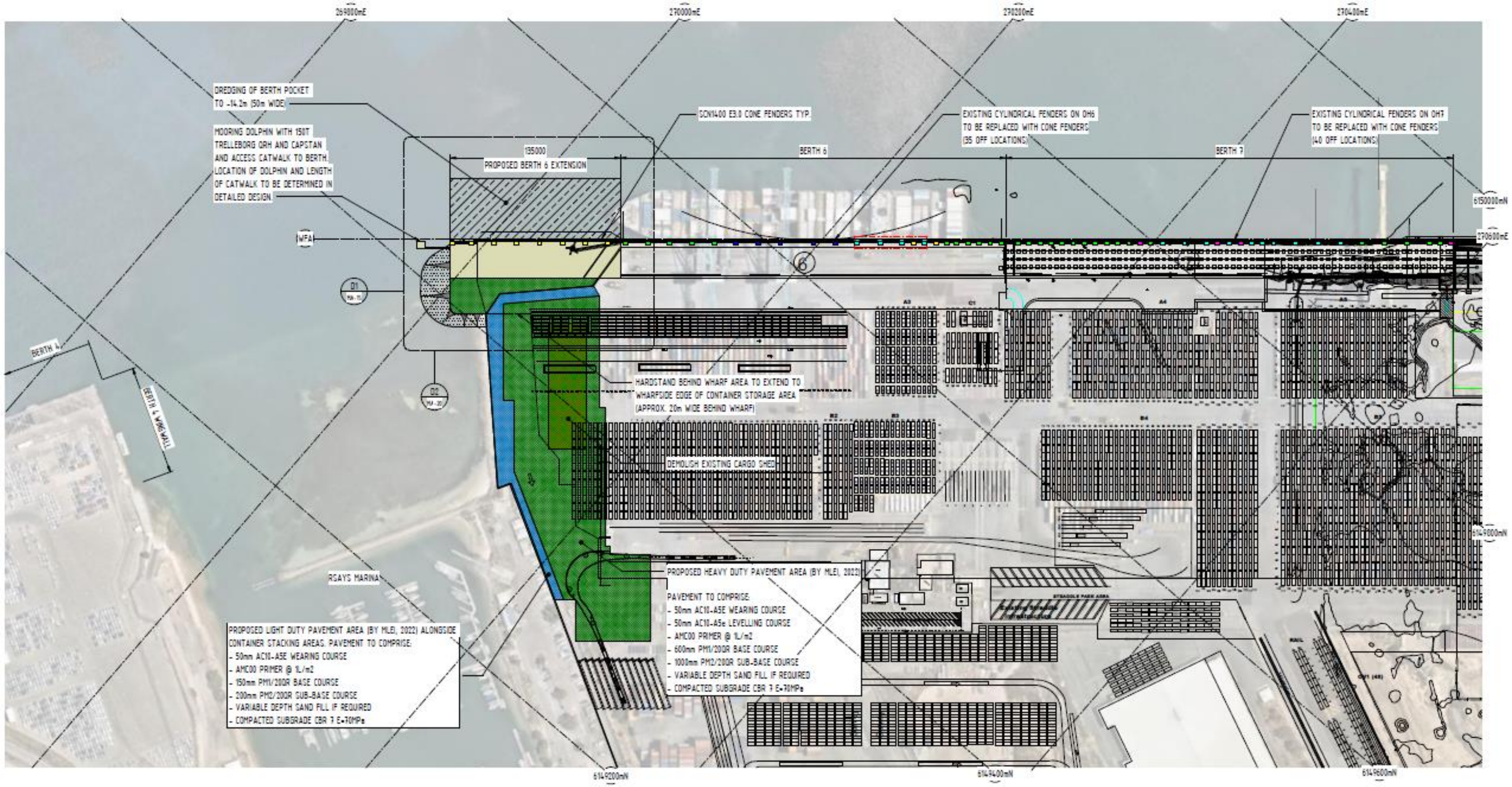


Figure 3.1 Berth 6 upgrade conceptual site plan

3.3 Land tenure

Berth 6 is located on Parcel ID D73109L1, Title Reference CT6126/861 (Appendix C).

FPH has a 99-year Crown Lands Lease (CL 10434595) for part of the site with any new development on Crown land requiring approval under the *Harbors and Navigation Act 1993*. Land tenure for the Berth 6 Extension Crown DA is being reviewed by FPH in consultation with the Department for Infrastructure and Transport (DIT), including any lease boundary amendments, secondary permitting and Native Title requirements (if applicable).

4 Statutory and strategic context

4.1 Introduction

This chapter provides an assessment of the project against relevant State Government Strategic Plans and Planning and Design Code policy provisions under the *Planning, Development and Infrastructure Act 2016* (PDI Act) and Planning, Development and Infrastructure (General) Regulations 2017 (Planning Regulations).

4.2 Strategic alignment

A number of State Government strategic plans and policy documents are of relevance in providing context and justification for the project. These are summarised in Sections 4.2.1 and 4.2.2 below.

4.2.1 30-Year Plan for Greater Adelaide

The 30-Year Plan for Greater Adelaide (the 30-Year Plan) was released by the then Department of Planning, Transport and Infrastructure (now Department for Infrastructure and Transport [DIT]) in 2017, which describes the plan to sustainably grow Adelaide to ensure it maintains and improves liveability, increases competitiveness and drives sustainability and resilience to climate change.

The following key themes are identified as critical to the state's future:

- Support economic development by unlocking investment.
  - Promote certainty to undertake development while at the same time providing scope for innovation.
  - Ensure there are suitable land supplies for the retail, commercial and industrial sectors.
  - Provide sufficient strategic employment land options with direct access to major freight routes to support activities that require separation from housing and other sensitive land uses.
- Maximise the efficient use of infrastructure.
  - Coordinate and link strategic infrastructure across Greater Adelaide to ensure it meets the needs of a growing population with a changing demographic profile and supports a more productive economy.
  - Protect major economic infrastructure such as airports, ports and intermodals from encroachment by incompatible development and facilitate further economic activity in these locations.

The 30-Year Plan recognises the important role that sea-ports play in supporting South Australia's economic growth. Both agriculture and mining industries are expected to continue to grow over the next few decades, resulting in a significant increase in both exports and imports and reliance on ports.

FPH is the leading privately-owned port operator in South Australia, handling the vast majority of the state's trade imports and exports. The FACT is one of the five key capital city container ports operating around Australia and is the only operating container terminal in South Australia, handling all of the state's international container freight volume. The GatewaySA Program ensures that the infrastructure and capabilities continue to meet the current and future requirements of its port users, the supply chain and ultimately the South Australian economy.

To service FPH’s current and future requirements, the proposed development has been designed to both cater for current and forecast shipping trends. The development would allow for the ability to service an increased number of vessels, with an ability to service two Super Post Panamax vessels simultaneously. The proposed development would also support economic growth and development by creating a number of jobs during its construction and development.

4.2.2 20-Year State Infrastructure Strategy

The *20-Year State Infrastructure Strategy* (20-Year Strategy) released by Infrastructure SA in May 2020 sets the priorities and direction for infrastructure investment in South Australia. The role of the 20-Year Strategy is to identify the key needs and challenges and provide priorities to guide government policy and investment in infrastructure to achieve efficient outcomes and support economic growth.

The following strategic objectives underpin the 20-Year Strategy:

- Sustained economic and jobs growth.
- Planned population growth.
- Connected and productive regions.
- A vibrant, global Adelaide.
- Enviable liveability.

The 20-Year Strategy acknowledges the importance of having efficient freight operations, and in particular shipping activities, to ensure that South Australia is set up to fulfill its growth potential. The Port of Adelaide is South Australia’s largest port, and Outer Harbour houses the states only container terminal. The strategy also directly acknowledges the continued strategic investments made by FPH to ensure its facilities are set up to manage future forecast growth.

The 20-Year Strategy principles of greatest relevance to the project are identified in Table 4.1.

Table 4.1 20-Year Strategy key guiding principles of relevance to Lot 9 development

Relevant Principle	Project contribution
Optimise current assets before building new	The GatewaySA Program aims to optimise the existing FACT to meet current and future requirements of its port users. In particular, Berth 6 is an existing asset and the proposed development aims to increase vessel servicing capabilities and windows, and to service two Super Post Panamax vessels simultaneously.
Prioritise infrastructure that contributes to economic and jobs growth	The GatewaySA Program would provide a significant contribution to the state economy through direct capital expenditure and job opportunities. The development costs for the GatewaySA Program are expected to be in the order of $338 million with approximately 100 full-time equivalent (FTE) employees being required over the course of the proposed development. The Berth 6 Extension is expected to have a capital cost of approx. $120 million and require approximately 30-50 FTE employees during construction. Additionally, by increasing the freight handling capacity of the facility, the GatewaySA program would indirectly generate employment in related supply-chain industries.

4.3 Legislative context

4.3.1 PDI Act

In March 2021 the planning system was reformed with the introduction of the Planning and Design Code and e-Planning system, under pinned by PDI Act and Planning Regulations.

The Planning and Design Code provides one set of consistent planning rules for the state, by consolidating 72 previous Council development plans.

Section 131 of the PDI Act allows for State Agencies to sponsor and lodge a Crown Development Application (Crown DA) on behalf of a private sector developer for the purposes of 'essential infrastructure'. Crown Development is commonly used to facilitate electricity, transport networks or facilities and public infrastructure in SA.

Essential Infrastructure is defined in Part 1(3)(c) of the PDI Act and includes infrastructure for transport networks or facilities (including ports, wharfs and freight-handling facilities). FPH has obtained Crown sponsorship from DIT for the proposed Berth 6 expansion as it was seen to be essential infrastructure associated with wharf development and freight handling facilities.

The approval process for the project will involve the preparation and submission of a Crown DA (this document) under the Planning and Design Code to assess potential impacts on the surrounding area pursuant to the PDI Act.

i Current zoning

FACT is located on land zoned Strategic Employment within the Local Government Area of the Port Adelaide Enfield Council.

The Planning and Design Code under the PDI Act envisages:

> a range of industrial, logistical, warehousing, storage, research and training land uses together with compatible business activities generating wealth and employment for the state" and "create new and enhanced existing business clusters.

A summary of the key planning controls applying to the project site, as derived from the Planning and Design Code, are provided in Table 4.2.

Table 4.2 Key planning controls applying to the project

Planning control	Strategic Employment Zoned land
Property zoning	Strategic Employment Zone
	DO1 – A range of industrial, logistical, warehousing, storage, research and training land uses together with compatible business activities generating wealth and employment for the state. DO2 – Employment-generating uses are arranged to: • Support the efficient movement of goods and materials on land in the vicinity of major transport infrastructure such as ports and intermodal freight facilities. • Maintain access to waterfront areas for uses that benefit from direct water access including harbour facilities, port related industry and warehousing, ship building and related support industries. • Create new and enhance existing business clusters. • Support opportunities for the convenient co-location of rural related industries and allied businesses that may detract from scenic rural landscapes. • Be compatible with its location and setting to manage adverse impacts on the amenity of land in adjacent zones. ***Planning assessment*** *Zoning envisages the nature and scale of the proposed GatewaySA Program. The Strategic Employment Zone envisages development of the nature and scale proposed. The GatewaySA Program facilitate the efficient use of FACT land and represents significant investment to upgrade the existing freight-handling facility in a planned and orderly manner.*
Property subzone	Ports
Desired outcome	DO1 – A range of port related activities that support the ongoing strategic and economic state significance of the area for the handling of export and import commodities. ***Planning assessment*** *The GatewaySA Program is consistent with the desired outcome of the site's zoning. It involves the use of suitably zoned land for the purpose of an industry which is located and designed to minimise potential impacts on surrounding land uses and meet relevant environmental and amenity criteria.*
Land use and intensity	PO 1.1 – Development primarily for a range of port related activities. PO 1.2 – Waterfront land developed for activities dependent on a direct frontage to the water, including port functions involving waterborne vessels and/or the movement of products or items from the water to the land (or vice versa). ***Planning assessment*** *The proposed GatewaySA Program is compatible with the scale, function and character of the existing site and surrounding area which comprises the existing land use surrounded by predominantly commercial and industrial activities. The proposed developments (i.e. Berth 6 extension, Lot 9 development, etc) would be designed and constructed to minimise potential impacts on surrounding land uses and meet relevant environmental and amenity criteria*
Landscaping	PO 2.1 – Development adjoining the waterfront landscaped to: a) Screen storage areas otherwise open to public view. b) Enhance the appearance of the development and the waterfront. c) Provide amenity for employees on site.

Planning control	Strategic Employment Zoned land
General Development Policies	**Interface between Land Uses** DO 1 – Development is located and designed to mitigate adverse effects on or from neighbouring and proximate land uses. **Site Contamination** DO 1 – Ensure land is suitable for the proposed use in circumstances where it is, or may have been, subject to site contamination. **Transport, Access and Parking** DO 1 – A comprehensive, integrated and connected transport system that is safe, sustainable, efficient, convenient and accessible to all users. ***Planning assessment*** *The GatewaySA Program is located in an area where freight-handling facilities are envisaged, with associated infrastructure and development work located away from sensitive receptors, as far as practicable.*
Planning overlays	
Coastal Areas	DO 1 - The natural coastal environment (including environmentally important features such as mangroves, wetlands, saltmarsh, sand dunes, cliff tops, native vegetation, wildlife habitat, shore and estuarine areas) is conserved and enhanced. ***Preliminary planning assessment*** *The potential loss of seagrass habitat associated with the Berth 6 extension is not foreseen to have a significant impact on any listed threatened species, migratory species and marine megafauna.* DO 2 - Provision is made for natural coastal processes; and recognition is given to current and future coastal hazards including sea level rise, flooding, erosion and dune drift to avoid the need, now and in the future, for public expenditure on protection of the environment and development. ***Preliminary planning assessment*** *The GatewaySA Program proposes to retain existing site levels to match with existing to maintain and ensure operation of freight-handling operating plant and equipment within engineering tolerances. Any proposed critical or vulnerable infrastructure (e.g. electrical switchrooms, buildings, etc) would be raised above flood levels.*
Defence Aviation Area	DO 1 – Management of potential impacts of buildings on the operational and safety requirements of Defence Aviation Areas. ***Planning assessment*** *No Defence Aviation Areas locate within proximity to the GatewaySA Program.*
Hazards (Flooding – General)	DO 1 – Impacts on people, property, infrastructure and the environment from general flood risk are minimised through the appropriate siting and design of development. ***Planning assessment*** *The GatewaySA Program proposes to retain existing site levels in order to match with existing to maintain and ensure operation of freight-handling operating plant and equipment within engineering tolerances. Any proposed critical or vulnerable infrastructure (e.g. electrical switchrooms, buildings, etc) would be raised above flood levels.*
Prescribed Wells Area	DO 1 – Sustainable water use in prescribed wells areas. ***Planning assessment*** *Not Applicable*
Regulated and Significant Tree	DO 1 – Conservation of regulated and significant trees to provide aesthetic and environmental benefits and mitigate tree loss. ***Planning assessment*** *There are no regulated or significant trees in the proposed Berth 6 development.*

Planning control	Strategic Employment Zoned land
Other planning considerations	
Adelaide Dolphin Sanctuary	Development would minimise harm to habitat, and the functioning of ecosystems that support the dolphin population. Development is considered unlikely to result in the disruption of critical dolphin behaviours such as breeding, feeding, resting and movement. Stormwater runoff would continue to be monitored to ensure it is disposed of in a manner that avoids pollution or other detrimental impacts to the Adelaide Dolphin Sanctuary.
Coastal protection	Development would not unreasonably affect the marine and onshore coastal environment by pollution, erosion, damage or depletion of physical or biological resources; interference with natural coastal processes; or the introduction of and spread of marine pests and diseases or any other means. Development would be designed so that wastewater is disposed of in a manner that avoids pollution or other detrimental impacts on the marine and onshore environment of coastal areas. Development would be designed to ensure stormwater runoff is disposed of in a manner that avoids pollution or other detrimental impacts on the marine and onshore environment of coastal areas.
Stormwater management	Development incorporates stormwater management to effectively manage within the existing system to manage flood risk and avoid pollution.
Hazards (Acid Sulfate Soils)	Development is considered unlikely to disturbance potential or actual acid sulfate soils and/or the release of acid drainage. Development would involve excavation and would be managed to avoid any change to the water table.

4.3.2 Environment Protection Act 1993

The *Environment Protection Act 1993* (EP Act) prescribes general environmental duty of care requirements for all proposed activities (i.e. protection of the environment from environmental harm). Under Section 36 of the EP Act an environmental authorisation/licence is required before undertaking certain prescribed activities of environmental significance listed in Schedule 1 associated with:

- noise
- air quality
- water quality discharge
- dredging.

Discussion with EPA has indicated that the proposed dredging activities will not require a new authorisation and can be included in the existing dredging maintenance licence (with appropriate management and monitoring provisions) which is in the process of being renewed.

4.3.3 Native Vegetation Act 1993

The *Native Vegetation Act 1991* (NV Act) regulates the clearance, and provides for the management of, native vegetation throughout South Australia. It also ensures that areas of high conservation value are protected, and that minor vegetation clearance is subject to a thorough assessment process.

Under the NV Act, the clearance of native vegetation requires the consent of the Native Vegetation Council (NVC), which is advised by the Native Vegetation Management Unit of the Department for Environment and Water (DEW). The clearance of native vegetation is required to be offset by an environmental gain, referred to as a Significant Environmental Benefit (SEB). The SEB offset recognises that the clearance of native vegetation will result in habitat and/or biodiversity loss and provides a mechanism to minimise that loss by managing, restoring or revegetating areas of native vegetation or making a payment to the NVC which is paid into the Native Vegetation Fund.

Extension to Berth 6 requires the removal of seagrass native vegetation with an assessment undertaken in accordance with the NV Act outlined in Section 8.1.

4.3.4 Fisheries Management Act 2007

The *Fisheries Management Act 2017* is administered by the Biosecurity SA division of PIRSA to manage risks to South Australia posed by animal and plant pests and diseases, including noxious and pest marine species and the Pacific Oyster Mortality Syndrome (POMS). The *Fisheries Management Act 2017* also provides for the management of fisheries and aquatic reserves and protection of aquatic habitats, mammals and resources.

There are two species of Caulerpa in the Port River, with Caulerpa taxifolia declared noxious under the Act and *Caulerpa cylindracea* declared exotic listed under the Act.

There is currently a ban on the removal of bivalves from the Port River (PIRSA 2022) under the Fisheries Management (General) Regulations 2017, including removal by dredging and removal of rock revetment with attached bivalves.

The deposit of exotic species, including the reuse of rock revetment with attached Pacific oysters, is prohibited under the *Fisheries Management Act 2007*. These activities (i.e. removal of bivalves or deposit of rocks with Pacific oyster) would require a Determination and a Ministerial permit under the *Fisheries Management Act 2007*, if applicable (refer Section 8.1).

4.3.5 Coast Protection Act 1972

The *Coast Protection Act 1972* provides for the conservation and protection of the beaches and coast of South Australia and is administered by the Department for Environment and Water (DEW). The Act establishes the Coast Protection Board, which manages the beaches and coast using management plans and provides funds for protection works and undertakes said works. The Coast Protection Board is a key referral agency under the PDI Act that assesses proposed developments which interact with the coastal environment.

4.3.6 Adelaide Dolphin Sanctuary Act 2005

The *Adelaide Dolphin Sanctuary Act 2005* provides for the establishment and management of a sanctuary to protect the dolphin population of the Port River estuary and Barker Inlet and its natural habitat.

The proposed minor dredging works for the Berth 6 Extension will take place in the Port River within the Adelaide Dolphin Sanctuary and would be managed pursuant to FPH's EPA Licence 51153 and in accordance with a Dredge Management Plan and Dredge Spoil Management Plan (refer Section 8.1).

4.3.7 Landscape South Australia Act 2019

The *Landscape South Australia Act 2019* is the key framework for managing the state's land, water, pest plants and animals, and biodiversity across the state.

Prescribed water resources are managed to ensure water use and management is sustainable. They are managed by the issuing of water licences that provide a water access entitlement to the holder of the licence. Activities that require a licence vary depending on the water resources prescribed within a region.

The project does not propose to impact any prescribed water resources. Dredging and piling may impact coastal waters (refer Section 8.4).

4.3.8 Aboriginal Heritage Act 1988

The *Aboriginal Heritage Act 1988* (AH Act) provides protection for all Aboriginal sites, objects and remains in South Australia including registered, recorded, reported, or undiscovered heritage. An Aboriginal site is defined by the Act as being an area of land:

- that is of significance according to Aboriginal tradition; or
- that is of significance to Aboriginal archaeology, anthropology or history.

It is an offence under Section 23 of the AH Act to collect, damage or destroy Aboriginal sites, objects or remains without the written authorisation of the Minister for Aboriginal Affairs.

An Aboriginal cultural heritage (desktop) assessment of the GatewaySA Program has been undertaken by FPH in accordance with the *Aboriginal Heritage Act 1988* (Section 6.5). This included:

- review of Aboriginal Affairs and Reconciliation (AAR) database and any relevant past cultural heritage studies in the area
- a cultural assessment to investigate whether there are any living cultural knowledge holders who may have cultural knowledge relevant to the assessment of cultural values or cultural landscapes of the project site
- development of measures to avoid, reduce and mitigate potential impacts.

The proposed development is unlikely to impact Aboriginal archaeological sites given:

- there are no AGD-AAR listed sites within and adjacent to the proposed Berth 6 expansion area
- there are no landforms commonly associated with increased archaeological potential present within the project area
- the majority of the area has been heavily disturbed through historical filling and use as a port facility use.

4.3.9 Native Title Act (Cth) 1993

The *Native Title Act 1993* (NT Act) recognises and protects native title, being the rights and interests in land and waters that Aboriginal and Torres Strait Islanders have under their traditional laws and customs.

Under the NT Act, native title is extinguished by various tenures, including freehold land and gazetted public roads. FPH has undertaken due diligence for matters related to Aboriginal cultural heritage under both State and Commonwealth legislation.

Due to the nature and level of previous disturbance of the Port River, the potential for Aboriginal archaeological values in the area (both in the Port River and on land) is considered limited.

4.3.10 Historical heritage

i Historic Shipwrecks Act 1981

All shipwrecks older than 75 years are protected in South Australia under the *Historic Shipwrecks Act 1981* and the *Historic Shipwrecks Regulations 2017*. The Act prohibits the damaging, destroying, interfering with, removing or disposing of an historic shipwreck or relic without a permit.

An assessment of potential historical heritage was completed through a search of the following databases:

- The Australian Heritage Database – for world heritage places, national heritage places and commonwealth heritage places.
- The South Australian Heritage Places Database – for places of state and local heritage significance.
- The results of this assessment are provided in Section 6.4.

4.3.11 Road Traffic Act 1961

The *Road Traffic Act 1961* (RT Act) details traffic control devices, road closing provisions, vehicle standards and heavy vehicle requirements.

A Traffic Management Plan (TMP) is planned to be developed to manage the temporary impacts of construction traffic on the road network and within the site.

The TMP would need to be approved prior to the commencement of construction. Traffic management is discussed further in Section 8.7.

4.3.12 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) aims to protect matters of national environmental significance (MNES) including:

- world heritage areas
- National Heritage places
- wetlands of international importance (listed under the Ramsar Convention)
- listed threatened species and ecological communities
- listed migratory species (protected under international agreements)
- Commonwealth marine areas
- Great Barrier Reef Marine Park
- nuclear actions (including uranium mines)
- water resources (that relate to coal seam gas development and large coal mining development).

The Act also protects the environment when actions are taken:

- on Commonwealth land or impact upon Commonwealth land
- by an Australian Government agency anywhere in the world
- that impact Commonwealth heritage places overseas.

The Berth 6 development works is unlikely to have a significant impact on MNES. A review of the Protected Matters Search Tool (PMST) results and proposed activities has been undertaken to determine if referral under the EPBC Act would be required (refer to Section 8.2).

4.3.13 Secondary approvals, permits and licenses

Aspects of the project will trigger secondary permitting, approvals and licencing requirements, including (but not limited to) the:

- approval to clear native vegetation under the NV Act
- removal of bivalves or deposit of rocks with Pacific oyster under the *Fisheries Management Act 2007.*

5 Economic effects of development

5.1 Economic impact

FPH is the leading privately-owned port operator in South Australia, handling the vast majority of the state's trade imports and exports. Through these operations, FPH facilitates over $22 billion in international trade annually and represent the key platform for providing access for South Australian two-way goods trade.

FPH's Vision is to be South Australia's supply chain partner, bringing the state's businesses closer to each other and to the world. FPH seeks to achieve this by offering integrated solutions, which leverage all our assets, operations and people. This approach reduces complexity, cost, and friction for our customers at each stage of the supply chain through to the port.

The contribution of a port extends beyond the businesses and employees that are directly employed or interact with the port of a regular basis. As ports facilitate domestic and international trade this links them to almost every sector in the economy. A recent report commissioned by Ports Australia ("2024 State of Trade – Inaugural Economic Impact Study") identified that the South Australian ports industry facilitates over 20 million tonnes of trade, supports over 24,000 jobs and contributes over $4.5 billion to national Gross State Product.

The most critical precinct and infrastructure operated by FPH for South Australia is the container terminal. The use of shipping containers has grown exponentially to become one of the foremost methods for which trade is moved through a supply chain. The Flinders Adelaide Container Terminal (FACT) is one of the five key capital city container ports operating around Australia and is the only operating container terminal in South Australia – therefore handling all of the state's international container freight volume.

FACT is South Australia's only waterside container terminal. With direct connections to key road and rail networks, FACT provides local and interstate producers and consumers with access to global trade markets – such as consumer products, manufacturing products, specialised equipment, as well as raw, agricultural and scrap materials. In addition to employing near half of FPH's workforce, FACT and the containerised freight activity it facilitates also supports a large number of jobs in South Australia's road and rail transport sectors.

Since 2001, FPH have championed the development of South Australia's port infrastructure. The GatewaySA Program continues this ongoing investment and ensures that the infrastructure and capabilities continue to meet the requirements of our port users, the supply chain and ultimately South Australian importers and exporters.

The GatewaySA Program ensures that the port and container terminal infrastructure, equipment and the associated technology responds to its current and future requirements and ensures that the port continues to play its critical role in supporting international container trade. Only by responding to these market and environmental changes (i.e. receipt of larger container vessels) can FACT and the port continue to play this role and ensure that the economic benefit, GSP contribution and employment that it supports are protected.

In addition, the GatewaySA Program will create a number of jobs during its construction and development (refer Section 5.4).

5.2 Economic opportunities

The GatewaySA Program which includes expansion of Berth 6 will allow for FPH to respond to growth opportunities required for the FACT to meet forecast future shipping demands.

Specifically, development will enable FPH to:

- increase vessel servicing capabilities and windows, meaning the port can support larger vessels and more of them

- cater for current and forecast shipping trends, with an ability to service two Super Post Panamax vessels simultaneously
- attract new business to SA
- create sustainable terminal operations
- create safer operation
- effective use of land
- enable future commercial opportunities.

5.3 Expected project development costs

Expected Berth 6 development costs are in the order of $150 million with a breakdown of the estimated capital provided in Table 5.1.

Table 5.1 Estimated GatewaySA Program CAPEX

CAPEX	$ Estimate (Totals)	$ (Essential Infrastructure)
Extension to Berth 6	$120m	$120m
Remediation works for Berth 6 wharf	$30m	-

5.4 Employment opportunities

The project is estimated to provide the following employment during construction:

- Extension to Berth 6: approximately 30–50 full-time equivalent (FTE).

The expansion of Berth 6 proposes no change in operational FTE and is intended to improve efficiency of the FACT into the future.

5.5 Project alternatives

5.5.1 Design

FPH is considering three options for the foundations of Berth 6:

- driven piles
- sheet piles, or
- king piles.

5.5.2 Not proceeding

If project does not proceed, the following benefits would be forgone:

- 30–50 FTE.
- Increase vessel servicing capabilities and windows, meaning the port can support larger vessels and more of them.

- Cater for current and forecast shipping trends, with an ability to service two Super Post Panamax vessels simultaneously.
- Attract new business to SA.
- Create sustainable terminal operations.
- Effective use of land.
- Enable future commercial opportunities.

The Berth 6 Extension is strongly aligned with current market conditions and revenue opportunities at the FACT. An extension of the existing berth wharf infrastructure will enable FPH to cater for current and forecast shipping trends (i.e. larger vessels) to capitalise on existing demand and generate significant local economic benefits.

6 Existing environment

6.1 Background

6.1.1 Historic land use and development

Prior to the European colonisation of SA in 1836, the Port River was a shallow and narrow tidal creek winding between mangrove swamps. Known by the local Kaurna people as Yerta Bulti, the Port River and estuary region was a continuous ecological system in terms of freshwater flow from the hills, across the plains and to the sea via the River Torrens. The mangroves and intertidal mud flats that dominated the Port River provided the local Kaurna people with river mussels, oysters, periwinkles, river crawfish, crabs, and various fish species (Malone & Telfer 2012).

The project site was granted to the predecessors of FPH between 1923 and 1976. A small portion of the site adjacent to Victoria Road was leased out to a number of individuals in the 1920s. The aerial photographs indicated that the site remained undeveloped until the 1960s, when reclamation of the land began.

By 1979, construction of the majority of the infrastructure which currently exists in this area had been completed. This included the berth, the original rail line, some of the administration buildings and the surrounding bitumen area. The site was expanded in 1982, including extensions to the bitumen sealed area and the wharf. By 1997, a new rail corridor had been constructed. Today, Port Adelaide is the primary port in South Australia.

The FACT, as South Australia's international gateway is a critical freight hub and port infrastructure of State-wide importance and directly linked to the trade logistical capabilities of South Australia, and subsequently to the economic health of the state.

6.1.2 Locality context

Outer Harbor is essentially an industrial suburb that is within the City of Port Adelaide Enfield and includes the headland of Pelican Point. It is bounded to the east by Osborne, the southwest by North Haven and in every other direction by the Port River.

The Outer Harbor area accommodates a range of industries including port-related activities, bulk handling and storage of minerals, agricultural and petroleum products, transport and warehousing, defence, electricity generation and manufacturing.

6.1.3 Landform and topography

The project site is predominantly comprised of land which has been reclaimed from the natural intertidal mangrove and samphire flats which originally formed this part of the Lefevre Peninsula. The subject land is largely flat with minimal vegetation. The site is bounded by chain-link fencing, with asphalt paved areas and FACT infrastructure contained within.

6.2 Ecology

6.2.1 Conservation parks and reserves

Several conservation parks and reserves occur within 5 km of project site, including:

- Adelaide International Bird Sanctuary National Park (Winaityinaityi Pangkara) approximately 4 km east
- Torrens Island Conservation Park and Mutton Cove Conservation Reserve located approximately 3 km and 2 km east respectively

- Barker Inlet – St Kilda Aquatic Reserve and the St Kilda – Chapman Creek Aquatic Reserve located 3 km east and 3.5 km northeast respectively.

The Berth 6 extension is not considered to have any impact on the above conservation parks.

The Port River and wider coastal area is located within the area established for the Adelaide Dolphin Sanctuary under the *Adelaide Dolphin Sanctuary Act 2005*. An assessment of potential impacts is included in Section 8.1.

6.2.2 Terrestrial ecology

As the FPH site has been an operational container terminal since the early 20th century, terrestrial ecology is limited and is a highly modified environment with no or minimal vegetation and fauna present.

There is no terrestrial vegetation or fauna noted at the Berth 6 development area (refer Section 8.1).

6.2.3 Marine ecology

The benthic habitat within the adjacent Port River is highly modified (given the nature of the Port River as a shipping channel). Intertidal seagrass on the mudflat represents a very small fraction of available intertidal seagrass in the Port River.

The adjacent Port River area comprises a mudflat with intertidal seagrass that extends out into a highly modified shipping channel of largely silty/sandy bottom interspersed with sparse small patches of native seagrass (*Zostera* sp.) interspersed with shell fragments and bivalves (razor clams).

6.3 Geology and hydrogeology

6.3.1 Geology

The Adelaide 1:50,000 geological map indicates the project site is underlain by the Quaternary St Kilda Formation, described as light grey shelly sand and silt. This has been amended by the placement of fill material dredged from the Port Adelaide River and hydraulically placed on land.

The following subsurface geological profile is indicated by investigations of the project site:

- Fill to depth of 0 to 5 m of variable consistency and composition, overlying.
- St Kilda Formation typically 5 to 10 m thick comprising unconsolidated and compressible marine sediments, including loose silts and sands, and commonly with organic clay, seaweed, or peat towards the top of the formation, overlying.
- Glanville Formation typically less than 3 to 4 m thick comprising loose to dense sands, with distinct cemented calcrete horizons, overlying.
- Hindmarsh Clay extending to 70 m depth or more comprising very stiff and hard high plasticity clay.

6.3.2 Hydrogeology

Site investigations at the site indicate site water levels (SWLs) varying from 0.243 to 0.388 mAHD. Groundwater levels are subject to seasonal and tidal variations and flow is north-west towards the coast.

The beneficial uses of the groundwater is protection of marine aquatic ecosystems and recreational contact at its point of discharge.

6.4 Historic heritage

A desktop historic heritage assessment of the site was undertaken with the objective to assess the historic heritage context of the project area and to determine the risk of project-related impacts to historical heritage items.

All historic heritage and archaeological features, whether listed or not, are protected and must be managed in line with the requirements of the *Heritage Places Act 1993* (HPA), EPBC Act 1999, Shipwrecks Act, and the PDI Act.

The following registers, databases and documents were reviewed via desktop assessment:

- The Australian Heritage Database – for world heritage places, national heritage places and commonwealth heritage places.
- The South Australian Heritage Places Database – for places of state and local heritage significance.

The Berth 6 project area is not expected to impact existing shipwreck sites and the risk of encountering and impacting the remains of undocumented built heritage and archaeological features of heritage significance is low given:

- there are no Commonwealth or state heritage sites within the Berth 6 project area
- two registered shipwrecks are located within 1 km of the project site. However, they are both more than 500 m from the Berth 6 extension area and unlikely to be impacted
- there are no heritage places from the SA Heritage Register and Local Heritage Places and Contributory Items from Planning and Design Code within the FACT or Berth 6 extension area
- the closest heritage place is the locally protected Outer Harbor Railway Station (ID Code H0401429) approximately 1 km south. The closest state heritage place is the Former Outer Harbor Pilot Station (ID Code H0400016) approximately 1.1 km southwest of the site
- the proposed works will not impact the Former Outer Harbor Pilot Station.

Although there are no state heritage sites are listed within the Berth 6 project area, FPH will implement the following measures:

- Implementation of an unexpected finds procedure. If any potentially significant, heritage items are found, work should be stopped and the finds immediately reported to Heritage SA.
- Site induction to outline the unexpected finds procedure.

The historic heritage assessment identified that there are no Commonwealth or state heritage sites within the current project area. The project is unlikely to impact on any historical heritage sites.

6.5 Aboriginal heritage

The Kaurna People are the first nations Aboriginal community who are custodians for the land in which the Project Site is situated. Native Title was awarded to the Kaurna people in March of 2019 from the Government of South Australia.

Due to the nature and level of previous disturbance of the Port River, the potential for Aboriginal archaeological values in the area (both in the Port River and on land) is considered limited.

The proposed development is unlikely to impact Aboriginal archaeological sites:

- There are no AGD-AAR listed sites within and adjacent to the proposed Berth 6 expansion area.
- There are no landforms commonly associated with increased archaeological potential present within the project area.
- The majority of the area has been heavily disturbed through historical filling and use as a port facility use.

Although there are no Aboriginal heritage sites listed within the project area, FPH will implement the following measures:

- Implementation of an unexpected finds procedure. If any potentially significant, heritage items are found, work should be stopped and Ministerial authorisation under section 23 of the AHA will be required.
- Site induction to outline the unexpected finds procedure.

7 Stakeholder engagement

7.1 Stakeholder management

The aims of effective stakeholder management are to:

- ensure all parties potentially affected by the project are informed of the project's scope, timing, potential impacts and benefits
- in collaboration with stakeholders, ensure potential issues are identified early on and appropriate mitigation strategies are developed
- ensure effective consultation with stakeholders to inform and endorse scope and direction
- position FPH as a 'good neighbour' that acknowledges and responds to stakeholder needs
- communicate decisions and provide progress updates.

7.2 Stakeholder identification

Stakeholders include any person, company or group that may influence or be impacted by the planning, operations or outcomes of the project.

Stakeholders can be internal or external to FPH, local, regional, state, federal or international level, be directly or indirectly impacted by, have an interest in, or influence a decision or issue associated with the project.

Key stakeholders include:

- Kaurna People, Registered Native Title Body Corporate
- local communities
- local government entities
- local business community and industry bodies
- government authorities and boards with local interests
- environmental interest groups
- FPH employees and contractors.

As the project progresses, new stakeholders may be identified, and stakeholder records kept by FPH would continue to be updated.

7.3 Community engagement

7.3.1 Community engagement approach

FPH will use a variety of communications methods to consult, record and respond to the community on the project to ensure the community are informed and can provide feedback during the preparation of the Crown development applications.

The engagement methods may include:

- GatewaySA Program website
- information sheets
- dedicated email address and telephone line
- public advertisement via newspaper
- community information sessions.

7.4 Regulator engagement

7.4.1 Commonwealth Government engagement

Engagement will be undertaken with the Department of Climate Change, Energy, the Environment and Water (DCCEEW) with the purpose of these meetings to discuss the project, development approval process, environmental studies to be commissioned and to identify and mitigate any critical issues that will need to be addressed up front in the EPBC Referral (if required).

7.4.2 State Government engagement

Preliminary engagement has been undertaken with a number of key State government agencies with the purpose of these meetings to discuss the project, development approval process, environmental studies to be commissioned and to identify and mitigate any critical issues that will need to be addressed up front in the Development Applications.

The table below provides an overview of the key stakeholders that have been consulted on the project and their comments/feedback to date.

Table 7.1 State Government engagement

Agency	Preliminary comments / feedback
Department for Infrastructure and Transport (DIT) – Rail and Marine [Email correspondence: Maria Kollar (DIT)]	Berth 6 Extension initial email enquiry to determine land tenure for lease boundary amendment, any secondary permitting and Native Title requirements (if applicable)
Coast Protection Board (CPB) – 9 September 2024 [Attendees: David Osborn (CPB), Mark Polzer (CPB – Shipwrecks)]	Berth 6 Extension development application should be adequately supported by benthic survey and assessment of coastal processes and shipwrecks. Assessment of the potential flooding / climate change risk.
Department for Environment and Water (DEW) – 9 September 2024 [Attendees: Kym Pryde (DEW – Director Planning & Assessment), Michael Queale (DEW – Heritage Branch), Darryl Cowan (DEW - Marine Parks), De-Anne Smith (DEW- Assessment), Gayle Grieger (DEW – NV Branch),)]	Development applications should quantify and assess potential flood hazard / climate change risk and impacts to marine environment and vegetation in accordance with requirements under the *Native Vegetation Act 1993* (NV Act).
Environment Protection Authority (EPA) – 10 September 2024 [Attendees: Stephen Both (Planning & Assessment), Dennis Linard (Air Quality), Matt Nelson (Marine), Mark Hassam (Marine)]	Berth 6 Extension development applications should adequately quantify and assess the nature and scale of dredging, sediment quality, noise, stormwater management and associated licencing in the marine environment pursuant to requirements under the *Environment Protection Act 1993* (EPA Act).

7.5 Local Government engagement

FPH has undertaken preliminary engagement with the Port Adelaide Enfield Council (Russell Fink, Head of Planning and Major Projects Group) on 16 April 2024.

Key comments raised by Port Adelaide Enfield Council which have been addressed in the DA and appendices include:

- stormwater management, water quality treatment and flooding (refer Section 8.6, Appendix L)
- civil design plans (refer Appendix B).

Preliminary comments on the Crown Sponsorship Application were provided by Council to DEM on 28 October 2024. FPH will continue to consult with Council on the GatewaySA Program as the Crown development applications are prepared.

7.6 Royal South Australian Yacht Squadron (RSAYS)

FPH has undertaken preliminary engagement with the Royal South Australia Yacht Squadron (Hayley Hunt, General Manager) on 20 August 2024 in relation to the GatewaySA Program to date and will continue to consult with this adjacent landholder as the Crown development applications are prepared.

7.7 Transport Companies

FPH has made contact with 6 major transport carriers and presented the scope and purpose of the GatewaySA program of works (September to October 2024). The feedback was well received by the local companies and the GatewaySA team has committed to providing updates as the Program progresses.

8 Environmental assessment

A number of technical assessments have been undertaken as part of this DA to identify any potential impacts associated with the proposed Berth 6 Extension and suitable controls that would be required to prevent any adverse impacts on surrounding land uses, sensitive receptors or the local marine and terrestrial environments. These technical assessments include benthic survey, marine ecology, coastal processes, construction management of dredging and piling, stormwater, water quality and noise.

Based on the initial design of the wharf upgrade, FPH commissioned marine assessments in support of an EPBC self-assessment and state DA approval. Since that time, the design of the Berth 6 extension has been amended and the footprint of the proposed development has decreased substantially. EMM were engaged to review the adequacy of the existing marine studies to determine their suitability for assessing potential marine impacts for the revised footprint. The review was completed by a specialist marine ecologist and a supporting memorandum has been prepared and is included in Appendix D. The review concluded that the existing marine assessments are adequate to inform both this DA and the preparation of various management plans required for the project.

These assessments are discussed further in the remainder of Section 8 below.

8.1 Ecology

A number of ecological assessments have been undertaken in accordance with relevant guidelines and assessment criteria in support of the proposed Berth 6 Extension. These technical assessments were required to demonstrate that the project would not adversely impact on surrounding land uses, sensitive receptors or local marine and terrestrial environment, and include:

- Native Vegetation Assessment – Native Vegetation Clearance Outer Harbor Berth 6 Extension (Dredging and land reclamation) Data Report, 3 June 2024 (J. Diversity Pty Ltd) (Appendix E).

- Marine Fauna Survey - Outer Harbour Berth 6 – Benthic survey report, 31 May 2024 (J. Diversity Pty Ltd) (Appendix F).

A summary of the results of these assessments are provided in the remainder of Section 8.1 below.

i Terrestrial ecology

Terrestrial ecology is limited, as the FPH site has been an operational container terminal since the early 20th century and is a highly modified environment with no or minimal vegetation and fauna present.

There is no terrestrial vegetation or fauna noted within the Berth 6 development area.

ii Marine ecology

a Vegetation

The benthic habitat within the adjacent Port River is highly modified (given the nature of the Port River as a shipping channel). Intertidal seagrass on the mudflat represents a very small fraction of available intertidal seagrass in the Port River.

The adjacent Port River area comprises a mudflat with intertidal seagrass that extends out into a highly modified shipping channel of largely silty/sandy bottom interspersed with sparse small patches of native seagrass (Zostera sp.) interspersed with shell fragments and bivalves (razor clams).

No seagrass was recorded by J Diversity Pty Ltd (2024) within the proposed dredge location for Berth 6 (refer to Appendix E). Very sparse subtidal seagrass occurs in some areas within the footprint of the new berth (seaward of the rock revetment) and will be beneath the wharf (if piled) or within areas reclaimed (if sheet piled). Areas of dense intertidal/shallow subtidal seagrass were mapped on the mudflats south of the wharf, with a total seagrass area of approximately 0.9 hectares.

Less than 10% (<0.1 hectares) of the dense intertidal/shallow subtidal seagrass will be directly impacted by the Berth 6 Extension (Figure 8.1). However, there is the potential for seagrass to be indirectly impacted through turbidity impacts and/or sedimentation associated with the dredging and piling.

b Fauna

During a recent survey undertaken by J Diversity Pty Ltd (2024b) Pacific oysters (*Magallana gigas*) (on the rock revetment), razor clams (*Pinna bicolor*) and a hammer oyster (*Malleus meridianus*) were recorded within the proposed Berth 6 reclamation area and several bivalves, including queen scallop (*Equichlamys bifrons*), native oyster (*Ostrea angasi*) and hammer oyster, were recorded in the proposed dredging area (Appendix F).

There is currently a ban on the removal of bivalves from the Port River (PIRSA 2022) under the Fisheries Management (General) Regulations 2017, including removal by dredging and removal of rock revetment with attached bivalves.

The deposit of exotic species, including the reuse of rock revetment with attached Pacific oysters, is prohibited under the *Fisheries Management Act* 2007. The removal of bivalves or deposit of rocks with Pacific oyster would require a Determination and a Ministerial permit under the *Fisheries Management Act 2007*. As this may occur during the dredging process, FPH would seek a Ministerial permit prior to the commencement of dredging operations.

POMS is more prevalent when water temperatures are above ~16°C.

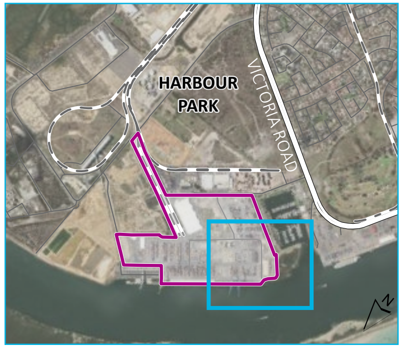
Controls and management measures for minimising the risk of spreading Pacific Oyster Mortality Syndrome (POMS) beyond the Port River during the minor dredging for the Berth 6 extension to appropriately managed during construction and operations are indicated below.

c Avifauna

Based on the likely extent of impacts associated with the proposed development, four EPBC threatened birds were assessed as possibly occurring within the vicinity of Berth 6. However, none of these species were considered dependent on habitat within the site.

Five migratory bird species, plus one overfly species, were assessed as possibly occurring within the vicinity of Berth 6. However, it was considered that the Proposed Development Area would not provide important habitat for any of these migratory species.

\\emm.local\xdrive\2024\E240841 - GatewaySA - Crown Development Applications\GIS\02 Maps\ DABerth6\DAB003 SeagrassDistribution\DAB003 SeagrassDistribution 20241218 04.aprx 18/12/2024



KEY

- Project area
- Existing Berth 6
- Benthic survey area
- Dredging of berth pocket
- Proposed berth 6 extension
- Proposed heavy duty pavement area
- Proposed light duty pavement area
- Proposed breakwall

Native vegetation association

- Dense intertidal/shallow subtidal *Zostera*
- Very sparse subtidal *Zostera*

Existing environment

- Rail line
- Minor road

Source: EMM (2024); DIT (2023); DEW (2023); Metromap (2024)

0 100 200 m

GDA2020 MGA Zone 54

Seagrass distribution

Flinders Ports Holding Gateway SA Program
Berth 6 Upgrade Development Application
Figure 8.1

EMM creating opportunities

d Marine megafauna

Dolphins

The Port River estuary lies within the Adelaide Dolphin Sanctuary (ADS) under the *Adelaide Dolphin Sanctuary Act 2005* with the entire Port River estuary utilised by dolphins, including:

- a resident population of approximately 30 Indo-Pacific bottlenose dolphins (*Tursiops aduncus*)
- an estimated 400 transient dolphins including short-beaked common dolphin (*Delphinus delphis*) and the common bottlenose dolphin (*Tursiops truncatus*) (DEWNR 2007).

Other

Marine megafauna species, including whales, sea lions, fur seals and turtles, have occasionally been recorded in the upper Gulf St Vincent and the Port River Estuary.

Two threatened marine mammals (southern right whales [*Eubalaena australis*] and Australian sea-lion [*Neophoca cinerea*], one threatened shark species (white shark [*Carcharodon carcharias*]) and three threatened species of turtle (loggerhead [*Caretta caretta*], green [*Chelonia midas*], and leatherback [*Dermochelys coriacea*]) were also listed in the Protected Matters Search Tool (PMST) as having the potential to occur in the project area. None of these species are resident in the Port River and individuals would only occur near the project area as transient visitors, if at all.

There were two sightings of southern right whales within the western end of the offshore shipping channel (outside the breakwaters) during the Outer Harbor Channel Widening Project in 2019.

8.1.2 Marine vegetation and fauna assessment methodology

The assessment comprised searches of the PMST and Atlas of Living Australia (ALA) databases (the latter incorporating the Biological Databases of South Australia (BDBSA) records) within a 5 km radius of the proposed clearance area.

In addition, targeted field surveys of benthic habitats were undertaken, including:

- surface supplied breathing apparatus (SSBA) surveys along transect lines and video recording
- snorkel surveys - from fixed points within the south-western study area at which the water was sufficiently shallow to see the seafloor from the vessel
- drone surveys using a DJI Mavic Air 2 Drone - the images were processed using the OpenDroneMap (ODM) software to construct a georeferenced orthomosaic of the images
- intertidal survey along the base of the rock revetment north-west from RSAYS, spanning 160 m, during low tide.

Details of the survey are included in Appendix E.

8.1.3 Management and mitigation measures

FPH primary management measure is to avoid impacts to seagrass and marine species wherever possible (refer to Section 8.8 for assessment of noise impacts).

i Seagrass

A Data Report in accordance with Regulation 34(1)(b) under the Native Vegetation Regulations 2017 was prepared by J. Diversity Pty Ltd (Appendix F) for clearance of seagrass.

A synthesis of the seagrass mapped identified two associations:

- Dense intertidal/shallow subtidal *Zostera*. It is possible that it includes two different *Zostera* species, but for the purpose of the SEB calculations the intertidal and shallow subtidal sections have similar attributes.
- Very sparse subtidal *Zostera*.

Figure 8.1 indicates the distribution of these seagrass areas.

a Mitigation hierarchy

When exercising its power or making a decision under Division 5 of the Native Vegetation Regulations 2017, the NVC must have regard to the mitigation hierarchy.

The following outlines assessment under the Hierarchy:

- Avoidance – outline measures taken to avoid clearance of native vegetation.
  - The dredge footprint avoids seagrass. The land reclamation necessary to construct the wharf extension cannot avoid clearance of small areas of predominantly sparse seagrass.
- Minimisation – if clearance cannot be avoided, outline measures taken to minimise the extent, duration and intensity of impacts of the clearance on biodiversity to the fullest possible extent (whether the impact is direct, indirect or cumulative).
  - Only the minimum area required for the wharf extension will be reclaimed. The total area of known high value seagrass beds (intertidal) that will be directly impacted by the proposed reclaim has been reduced through the latest wharf design from approximately 0.9 hectares to less than 0.1 hectares, representing less than 10% of the total intertidal seagrass mapped.
  - Subtidal seagrass, within the footprint of the new berth, is described as 'sparse' or 'very sparse' which is 'functionally equivalent, in an ecological sense, to bare silt' (J. Diversity, 2024a). The berth design minimises direct impacts on areas of sparse seagrass.
  - Measures to be considered to avoid indirect impacts on seagrasses include construction outside of warmer months when seagrass is building carbohydrate reserves and flowering (Short et al. 2017), and potential use of silt curtains.
  - Dredging during winter months may also overlap with periods of naturally elevated turbidity due to storms, such that turbidity associated with dredging is less likely to have an impact.

- Rehabilitation or restoration – outline measures taken to rehabilitate ecosystems that have been degraded, and to restore ecosystems that have been degraded, or destroyed by the impact of clearance that cannot be avoided or further minimized, such as allowing for the re-establishment of the vegetation.
  - There is no option to rehabilitate the area, as it will be maintained as a berth and channel for ongoing use.
- Offset – any adverse impact on native vegetation that cannot be avoided or further minimized should be offset by the achievement of a significant environmental benefit that outweighs that impact.
  - The clearance will be offset by a payment into the Native Vegetation Fund, unless the possibility arises of a suitable offset associated with support of seagrass restoration in the Port River.

b Significant Environmental Benefit

The following table provides calculation of the estimated significant environmental benefit (SEB). The SEB will require approval from the NVC under Division 5 of the Native Vegetation Regulations 2017. The NVC must be satisfied that as a result of the loss of vegetation from the clearance that an SEB will result in a positive impact on the environment that is over and above the negative impact of the clearance. The total SEB payment to the Native Vegetation Fund has been calculated to be $30,888.97 (excluding GST).

Clearance Area(s) Summary table

Block	Site	Species diversity score	Threatened Ecological community Score	Threatened plant score	Threatened fauna score	UBS	Area (ha)	Total Biodiversity score	Loss factor	Loadings	Reductions	SEB Points required	SEB payment	Admin Fee
1	1	7	1	0	0.1	35.46	0.50	17.73	1			18.62	27,787.79	1528.33
1	2	7	1	0	0	8.65	0.11	0.95	1			1.00	1490.85	82.00
						Total	**0.61**	**18.68**				**19.62**	**$29,278.64**	**$1610.33**

Totals summary table

	Total Biodiversity score	Total SEB points required	SEB Payment	Admin Fee	Total Payment
Application	18.68	19.62	**$29,278.64**	**$1610.33**	**$30,888.97**

Plate 8.1 SEB calculation

ii Biosecurity - *Caulerpa taxifolia*

Caulerpa taxifolia is a specific invasive species of marine algae. Surveys of *Caulerpa taxifolia* undertaken in 2015 and 2016 (Wiltshire & Deveney 2017) found a sparse (<5%) cover of this species at Berth 6 in 2015, and up to 75% cover adjacent to the mud flat north of Royal South Australian Yacht Squadron (RSAYS) in both years (Figure 8.2).

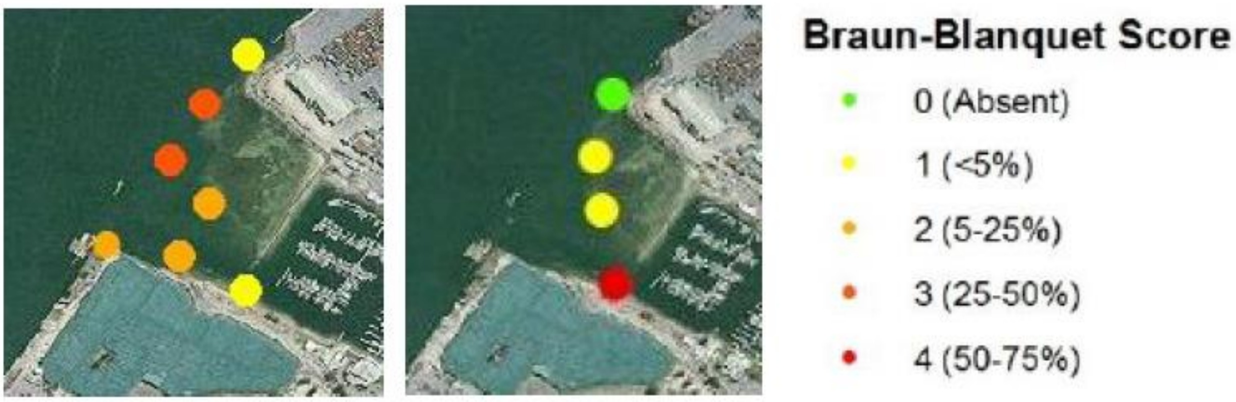


Figure 8.2 Percentage cover of *Caulerpa taxifolia* (Source: Wiltshire & Deveney 2017)

However, the Berth 6 survey undertaken in May 2024 (J. Diversity 2024a) did not encounter *Caulerpa taxifolia* nor the similar invasive species *Caulerpa cylindracea.*

FPH will adhere to all requirements of biosecurity including a specific action to ensure *Caulerpa* is managed appropriately and as detailed in the Biosecurity Management Plan (Appendix G).

iii Dolphins

a Introduction

The Department of Planning, Transport and Infrastructure (DPTI) has prepared an Underwater Piling Noise Guidelines document that apply to any proposed piling operation within SA waters, and which provide a current accepted best-practice approach to assessing and managing underwater noise.

Dolphins produce mainly high-frequency sound, using a combination of ‘clicks’ for echolocation and vocalisation and ‘whistles’ for communication between individuals.

b Potential risks

The key potential risks and impacts to dolphins could occur during piling and dredging activities due to:

- piling and dredging noise
- collisions with the dredge and attending vessels.

Potential adverse effects, in ascending level of impact and noise exposure, are broadly:

- auditory masking (noise levels that cause important biological sounds to be obscured), this has generally short-term impacts
- avoidance behaviour (animals become stressed and move away from the noise source), short-term impacts with animals moving back when the noise subsides

- temporary hearing damage, due to fatigue/exhaustion of the auditory system from persistent noise. Hearing ability recovers over a timeframe of hours or days once the animals move away from the noise or the noise subsides

- permanent hearing damage, due to cell death of the auditory system (either physical damage to the hearing structures or nerve damage to the auditory nerve). This has similar impacts to temporary hearing damage, but the impacts can be permanent rather than short term

- physical trauma/injury due to collision with vessels which can lead to injury or death.

c Management and mitigation

Pling works will be performed in accordance with the DPTI Underwater Piling Noise Guidelines (2012) and conditions of approval issued for this Crown DA. Typically management measures will include:

- provision of trained marine mammal observers who will be present during all piling and dredging activity

- ‘soft start’ procedures to encourage marine mammals to leave the area before the noise increases

- shut down procedures if marine mammals are observed within proximity of the piling activity.

FPH are required to report any wildlife incidents to the EPA and DEW immediately and investigate and rectify the cause.

The dredge plant would maintain low speeds at all times during the works and strict protocols to avoid marine mammals in accordance with the Dredge Management Plan.

Additional information is included in Section 8.8 which details potential noise impacts.

8.1.4 Conclusion

The potential loss of small areas of seagrass habitat associated with the Berth 6 extension is not foreseen to have a significant impact on any threatened species or migratory species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or the *Native Vegetation Act 1993* (SA) (JBS&G 2024).

Adoption of appropriate management during piling and dredging will minimise potential impacts on dolphins.

8.2 EPBC self-assessment

FPH engaged JBS&G to complete an EPBC Act self-assessment for the proposed Berth 6 precinct upgrade project based on a review of existing ecological databases and recent fieldwork completed on behalf of FPH (Appendix H). The assessment was undertaken in accordance with DCEEW Guidelines.

The self-assessment concluded that the proposed Berth 6 extension is not likely to have a significant impact on any matters of national environmental significance (MNES). As such, referral of the proposed Berth 6 extension under the EPBC Act is not required.

Key findings leading to this conclusion are summarised below for those MNES relevant to the proposed Berth 6 extension.

i Threatened Ecological Communities

The proposed Berth 6 extension area is entirely developed. Listed threatened ecological communities do not occur within the proposed Berth 6 extension area. The Subtropical and Temperate Coastal Saltmarsh Threatened Ecological Community (TEC) is predicted to occur within the Mutton Cove Conservation Reserve and the Torrens Island Conservation Park, 2 km and 3 km from the proposed Berth 6 extension area on the other side of Lefevre peninsula, respectively.

The Subtropical and Temperate Coastal Saltmarsh Threatened Ecological Community is listed as 'Vulnerable' and therefore does not constitute a MNES for the purposes of Part 3 of the EPBC Act.

ii Threatened and Migratory Species

The proposed Berth 6 extension area is small and does not provide suitable habitat for threatened or migratory species.

No threatened or migratory species were considered dependent on habitat at the site of the proposed Berth 6 extension area.

iii Seagrass

The mudflat surveyed during the on-ground benthic survey comprised sparse subtidal and medium density intertidal seagrass which could be impacted during reclamation (i.e. seagrass loss through clearance) and possible indirect impacts from increased turbidity and sedimentation during dredging.

A risk assessment and management plan will be prepared for review and agreement with Biosecurity SA to ensure appropriate actions are identified, agreed and implanted to reduce the risk of any biosecurity incidents.

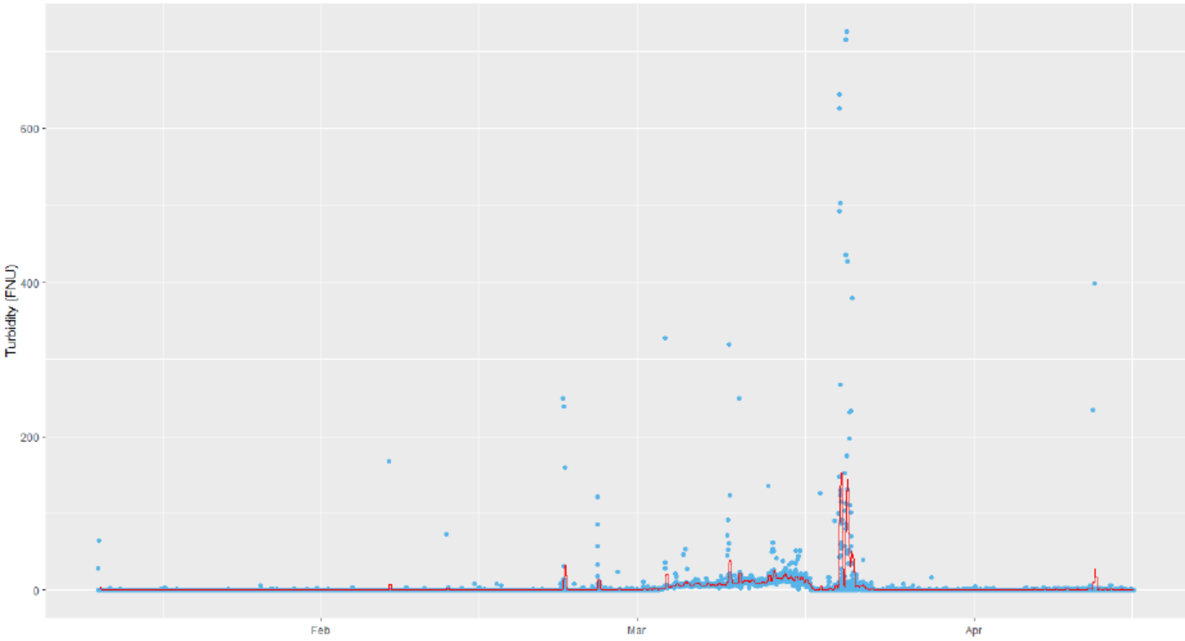
8.3 Marine water quality

8.3.1 Existing environment

FPH have measured turbidity in various locations of the Port River to gather baseline data.

A water quality probe was installed next to the Port Adelaide Passenger Terminal (Tide Hut), approximately 1 km west of Berth 6, in January 2024. The Sonde measures turbidity in Formazin Nephelometric units (FNU). Data has so far been continuous since the day of installation (JBS&G 2024b).

Turbidity data for the period 11 January to 15 April 2024 (Figure 8.3) showed a mean value of 3.2 FNU (± 21.59 FNU) with occasional peaks exceeding 100 FNU and with a median value of 0.00 FNU. A simple moving average for a 6-hour window period (see red line on Figure 8.3), with several peaks greater than 20 FTU, and on occasions, persisting at elevated turbidity levels (i.e. >50 FTU) for more than 1 day (JBS&G 2024a).



Source: JBS&G 2024b

Figure 8.3 Water turbidity from 11 January 2024 to 15 April 2024 (red line indicates simple moving average)

Turbidity baseline data has been used to determine appropriate management and mitigation measures for construction activities associated with the Berth 6 extension.

Water quality monitoring in the Port River estuary has been undertaken by the South Australian Environment Protection Authority (EPA) between 1995 and 2008. Nine sites were studied as part of this monitoring program, with Site 3 the closest site to the proposed dredging location, approximately 500 m north-east to the existing Berth 6. Water samples are collected annually and analysed for a suite of physical, chemical and biological properties (JBS&G 2024a).

8.3.2 Potential impacts

Potential impacts on water quality could occur during dredging activities and include:

- increased turbidity and sedimentation
- creation of anoxic conditions
- release of hazardous substances.

Issues related to turbidity and sedimentation are discussed in Sections 8.4 and 8.5.

The resuspension of sediments has the potential to result in an increase in nutrients in the water column, which can lead to increased phytoplankton biomass and subsequent oxygen depletion. Oxygen deletion can negatively impact marine flora and fauna occurring within the vicinity of the project.

Disturbance of sediment during dredging activities may release potential hazardous substances into the water column, including pollutants related to human activities such as heavy metals, and naturally occurring minerals associated with Acid Sulphate Soil (ASS). Previous chemical analyses of sediment samples from the PDL showed that levels of pollutants of concern were below human health and ecological levels and National Water Quality Management Strategy guidelines (Golder 2020). Chemical analyses suggest there is sufficient neutralising capacity in the sediment, and treatment or management of ASS is likely not needed (Golder 2020).

8.3.3 Mitigation and management

A Water Quality Monitoring Program (WQMP) Framework to support the proposed dredging activities at Berth 6 has been prepared by JBS&G (Appendix I).

This WQMP was prepared in accordance with:

- Environment Protection Act 1993 (EP Act)
- Environment Protection (Water Quality) Policy 2015 (Water Quality EPP)
- National Water Quality Management Strategy (NWQMS)
- Australian and New Zealand Guidelines for Fresh and Marine Quality (ANZG 2000, 2018)
- South Australian Environmental Protection Authority Dredge guideline (EPA 2020)
- National Assessment Guidelines for Dredging (Commonwealth of Australia 2009).

Objectives were developed to:

- understand existing water quality and natural variability at the PDL
- ensure compliance with existing legislation and regulations
- prevent any environmental harm resulting from proposed dredging activities.

Turbidity will be the key parameter measured to identify potential risk to the environment during project activities. Turbidity provides a proxy for suspended sediments within the water column and will be measured via light scatter in units FNU.

Visual extent of plume would also be measured in conjunction with other parameters including:

- dissolved oxygen (DO)
- pH
- water temperature, if dredging outside of winter.

Other parameters to record daily include:

- wind speed and direction
- tide stage (Ebb, Flood, High, Low)
- cloud cover (%).

8.3.4 Conclusions

The proposed management and monitoring during dredging operations will mitigate potential impacts to marine water quality and marine receptors.

8.4 Coastal processes

8.4.1 Potential impacts

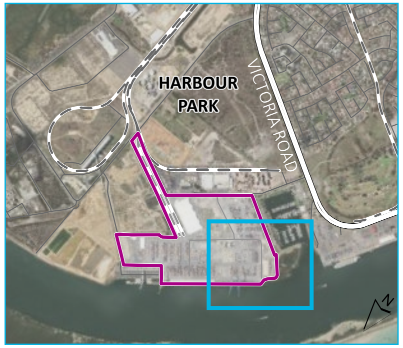
BMT was engaged by FPH to undertake an assessment of coastal processes due to concerns that development of Berth 6 could alter local water circulation and impact the rates of flushing, sedimentation and seagrass wrack accumulation within the RSAYS marina located south-west of the proposed development (Appendix J).

8.4.2 Methodology

The coastal process assessment utilised BMT's existing three-dimensional hydrodynamic model of the Port River which was previously been used to support Flinders Ports Outer Harbor Channel Widening project in 2018/19. The model was refined in the area of Berth 6 and used to simulate both base and developed case for Berth 6 and the reclamation areas.

In addition, the assessment included a review of:

- aerial photography
  - Nearmap and Google Earth
- bathymetry data
  - data from Hydro Survey (Flinders Ports) covering the full shipping channel and the RSAYS Marina, and in the vicinity of Berth 6
  - LiDAR topography data from the Elvis - Elevation and Depth - Foundation Spatial Data service (https://elevation.fsdf.org.au/)
  - National Intertidal DEM (https://knowledge.dea.ga.gov.au/data/product/dea-intertidal/?tab=overview)
  - electronic chart data.



KEY

Project area

Location of assessment

Existing Berth 6

Proposed berth 6 extension

Proposed breakwall

Option 1 - Reclamation area

Option 2 - Reclamation area

Existing environment

Rail line

Minor road

Location of assessment

Flinders Ports Holding Gateway SA Program
Berth 6 Upgrade Development Application
Figure 8.4

EMM creating opportunities

Source: EMM (2024); DIT (2023); DEW (2023); Metromap (2024)

0 100 200 m

GDA2020 MGA Zone 54

\\emm.local\xdrive\2024\E240841 - GatewaySA - Crown Development Applications\GIS\02_Maps_DABerth6\DAB004_LocationOfAssessment\DAB004_LocationOfAssessment_20241030_03.aprx 31/10/2024

8.4.3 Conclusions

The analysis indicated the following:

- The aerial photography data indicated that there has been little change in the appearance of the sand/mud flat that will be partially covered by the proposed extension of the wharf. The water level in the photographs varies, but the extent of exposure of the sand/mud flat appears to be consistent over the last 20 years.

- The available photography also indicates the occasional presence of seagrass wrack near the entrance to the RSAYS Marina.

- The bathymetric data did not reveal any trend in the morphological evolution of the seabed in the vicinity of the Berth 6 expansion footprint.

- The modelling results indicate that there will be very little change to the flow patterns and water velocity and no change to water levels in the vicinity of the proposed upgrade.

- There will be minimal change to the 95th percentile (near-peak) bed shear stress distribution, so minimal change to sediment transport rates and erosion/deposition is expected near the reclamation area.

- The flushing capacity and water quality in the marina will not be significantly changed.

- There will be little change in seagrass wrack accumulation rates or sediment transport expected due to the Berth 6 extension.

8.5 Sediment modelling

A qualitative assessment of the need for additional sediment modelling was undertaken by EMM (Appendix D).

8.5.1 Methodology

The qualitative assessment included reviews of:

- the BMT report

- FPH's existing EPA maintenance dredging permit (No. 51153)

- JBS&G Dredge Management Framework

- EPA Dredge Guideline (2020).

8.5.2 EPA Dredge Guideline

The EPA Dredge Guideline (2020) (Guideline) provides guidance to dredging proponents and licensees in meeting their general environmental duty under section 25 of the *Environment Protection Act 1993*, by demonstrating that all reasonable and practicable measures have been undertaken to minimise the potential for environmental harm.

Section 5.1 of the Guideline indicates that EPA "expect that all dredge contractors consider best available technology economically achievable (BAT) when planning their dredge campaign and do everything reasonable and practicable to ensure that environmental harm is minimised" including "Using modelling or already acquired data to identify the fate and extent of turbidity plumes generated during dredging, and spoil dewatering and placement."

Section 5.3 of the Guideline provides "'guidance on the level of information required by EPA to undertake an assessment". In Section 5.3.2 (Water quality) the Guideline indicates "hydrodynamic modelling and sediment deposition modelling to predict the fate and degree of turbidity plumes" is required if "Spoil contains a portion of fine sediments (approximately more than 1% clays/silts) AND/OR Dredge spoil volume is greater than 100,000 m^3 and duration of dredge campaign is greater than 8 weeks".

8.5.3 Mitigation and management measures

The management and mitigation measures for dredging and piling activities are summarised in Section 8.8 and further in Appendix K.

8.5.4 Conclusions

The EMM review indicated that the BMT report is acceptable for determining the potential issues of sedimentation, seagrass wrack accumulation, flow patterns and water velocity, change to water levels and flushing and water quality.

Berth 6 sediment is described as comprising 47.5% silt + 10.5% clay (Golder 2020) which is greater than the EPA Dredge Guideline requirement to undertake sediment modelling. However as indicated previously, the dredging volume and the proposed dredging will occur over a short period of time, within FPH existing maintenance dredging permit, and it is concluded that plume modelling is not required. This approach has been supported by the EPA via correspondence provided on 23 October 2024.

8.6 Stormwater and flooding

A stormwater assessment was undertaken by Tonkin with the results summarised below and the assessment report included in Appendix L.

8.6.1 Existing environment

The surrounding area is largely developed land with an established independent stormwater network. Each network currently has its own outfall for each berth (Berth 6, Berth 7 and Berth 8). The existing Berth 6 network currently accepts and conveys stormwater runoff from Coghlan Road at an estimated rate of approximately 1.5 m^3/s. The Berth 7 network is independent of other drainage networks across the site and is unlikely to have significant capacity available for stormwater without significant upgrades. Figure 8.5 indicates the drainage network across the FACT site.

The Berth 6 extension area is currently undeveloped and adjacent to an existing cargo shed building and has a catchment area of approximately 4,230 m^2. The existing cargo shed building is understood to drain via its own 375 mm outfall pipe independent of the large trunk outfalls indicated above.

A review of the sites existing topography and drainage catchments suggests that the proposed Berth 6 extension may discharged via the Cargo Shed's outfall pipe or a new outfall. A determination of the preferred approach will be part of detailed design.

Source: EMM (2024); DIT (2023); DEW (2023); Metromap (2024)

0 100 200 m
GDA2020 MGA Zone 54

KEY

- Project area
- Existing stormwater drainage

Indicative project area stormwater network

- Stormwater drainage
- Stormwater runoff

Existing environment

- Rail line
- Minor road

Existing site drainage

Flinders Ports Holding Gateway SA Program
Berth 6 Upgrade Development Application
Figure 8.5

EMM
creating opportunities

\\emm.local\xdrive\2024\E240841 - GatewaySA - Crown Development Applications\GIS\02_Maps_DABerth6\DAB005_ExistingSiteDrainage\DAB005_ExistingSiteDrainage_20241030_02.aprx 31/10/2024

8.6.2 Assessment methodology

A Drainage, Runoff, Agriculture, Irrigation, Nutrients and Soil (DRAINS) model was developed to assess the capacity of the proposed underground drainage network at the FACT.

The DRAINS model included relevant upstream and downstream systems and the relevant contributing catchments. This model was used to assess the ability for the proposed development to drain via the existing Berth 6 network and outfall. This assessment also considered a 0.2 Expected Years (EY) storm event with all conclusions based upon this design event.

In accordance with Council requirements, the DRAINS model used a downstream boundary constraint of 1.25 mAHD for the 1% Average Exceedance Probability (AEP) major storm and 2.5 mAHD for the 0.2 EY minor storm.

An Input-Output Linearisation and Catchment-Liner (IL-CL) hydrological model was used with the DRAINS model with the following parameters:

- Impervious Area Initial Loss (mm) = 1 mm
- Impervious Area Continuing Loss (mm/hr) = 0 mm/hr
- Pervious Area Initial Loss (mm) = 29 mm
- Pervious Area Continuing Loss (mm/hr) = 4 mm/hr

A combination of lumped and discrete catchment areas were used in the stormwater assessment. Catchments were considered to be 100% impervious with time of concentrations between 5 to 11 minutes dependent on catchment size.

8.6.3 Potential impacts

The following potential impacts could occur as a result of the proposed redevelopment:

- Flooding impacts to the site and/or neighbouring private properties.
- Release of stormwater to the receiving environment that does not meet relevant water quality standards.

8.6.4 Management and mitigation measures

The key findings of the stormwater assessment completed by Tonkin are summarised below and explained in more detail in Appendix L.

- Based on the local catchment analysis, there was no identified adverse impacts to external parties or external infrastructure as a consequence of the proposed development as use of an outfall independent of any external upstream catchments is proposed.
- Utilising the existing local stormwater drainage outfall will result in some localised ponding at surface level in a major storm event. However the presence of localised ponding or flooding within their site is acceptable to FPH.

Notwithstanding, management and mitigation measures would be implemented to reduce the risk of potential impacts associated with stormwater. These management and mitigation measures are discussed below.

i Water quality

Water quality treatment devices would continue to be used to ensure the following reduction objectives are met at outfall locations:

- 90% gross pollutants (greater than 50 mm)
- 80% total suspended solids (TSS)
- 60% total phosphorus (TP)
- 45% total nitrogen (TN)
- Demonstrated reduction of hydrocarbons (oils and greases)

To minimise potential impacts to the marine environment at the Berth 6 outfall a new water quality treatment device would be provided prior to discharge. The exact device would be determined during the detailed design process; however, would likely be a Gross Pollutant Trap (GPT) device, such as an Atlan Vortceptor with a StormSack or similar unit to meet the design objectives.

A MUSIC model was developed to assess the treatment train efficiency of the proposed 4000 Series Ecoceptor and StormSack combination. Pollutant loads from the South Australian MUSIC Guidelines were used to assess the treatment train effectiveness. The resultant treatment train effectiveness exceeded Council's Objectives (refer to Appendix L).

To prevent sea water entering the tertiary treatment device, a tidal flap gate will be installed in network prior to outfall into the Port Adelaide River to prevent backflow into water quality treatment devices in a 0.2 EY Scenario.

Additional mitigation measures would include:

- divert surface water away from construction zones and bare soil
- silt socks/choir logs placed at stormwater entry pits
- ballast rock used to reduce sediment transported in drainage lines
- ensure drainage lines are free from sediment and pollutants
- containment through bunding/encapsulation
- stablised site access/exits to reduce drag out
- street sweeper to remove debris from roads and stormwater drainage on regular basis.

8.6.5 Conclusion

As discussed above, the project would not result in any significant risks in terms of stormwater management or potential water quality impacts at the drainage outlet to Port Adelaide River.

8.7 Traffic

8.7.1 Existing environment

The site is accessed via gated/security entrance off the sealed Coghlan Road and sealed on site roads. FPH operates three gate entrances:

All authorised vehicles and trucks must enter and exit the site through the following gates:

- Gate 1 – entry and exit for Light Vehicles to FACT.
- Gate 2 – entry and exit for Heavy Vehicles to FACT or Empty Container Park.
- Gate 3 – entry and exit for Light Vehicles to Empty Container Park / FACT Training Centre.

8.7.2 Potential impacts

Potential impacts due to construction of Berth 6 include:

- temporary increase in the numbers of vehicles along the road network surrounding the site and within the site during construction due to the following:
  - Precast deliveries: Beginning in September 2025 and finishing in June 2026 and would involve approximately one additional semi-trailer each day. This would result in a minor increase on existing traffic volumes of approximately 0.2% over a 10-month period.
  - Concrete deliveries: Beginning in October 2025 and concluding in October 2026 and would involve approximately one additional agitator truck each day. This would result in a minor increase on existing traffic volumes of approximately 0.2% over a 10-month period.
  - Quarry material deliveries: Beginning in August 2025 and finishing in April 2026 and would involve approximately nine additional trucks each day. This would result in a minor increase on existing traffic volumes of approximately 2% over a 12-month period.
  - Miscellaneous deliveries: Beginning in August 2025 and finishing in April 2026 and would involve approximately one additional semi-trailer each day. This would result in a minor increase on existing traffic volumes of approximately 0.2% over a 12-month period.
  - Pile deliveries: It is assumed that all piles will arrive via sea freight through the port, minimising potential road traffic impacts.
- increase in safety issues due to new plant and equipment for piling operations.

Existing operations at the FACT would remain unchanged and continue to run at 550 vehicles per day. Whilst the proposed Berth 6 extension would allow larger vessels to be serviced, there is no anticipated increase to overall shipping or traffic numbers due to the wharf extension. The extended wharf will allow more efficient management of the existing fleet of vessels visiting the terminal and ability to facilitate existing forecasted organic growth. Further, as discussed in Section 1.2 FPH are proposing to complete the construction works for all three development activities (i.e. Berth 6 Extension, Lot 9 redevelopment and Relocation of the site access) using a successional approach to reduce potential impacts to traffic during construction.

The Berth 6 Extension is also aligned with current market conditions and revenue opportunities at the FACT. An extension of the existing berth wharf infrastructure will enable FPH to cater for current and forecast shipping trends (i.e. larger vessels) to capitalise on existing demand and generate significant local economic benefits.

No changes to site access arrangements are proposed as part of the Berth 6 Extension. Any changes would form part of the separate Relocation of Site Access and New Gate Crown Development Application (i.e. third key project activity).

Overall the potential impact to traffic on Coghlan Road is expected to be minor, with a temporary increase of up to 2% over a 10 to 12-month period for the construction phase only, with no change to existing operations. This change is not expected to significantly or adversely affect the function or safety of the local road network.

8.7.3 Management and mitigation

FPH has developed a Traffic Management Plan for the site (Appendix M). The plan ensures that traffic movements onto and around the site are undertaken to ensure the risks to the safety of personnel in vehicles or as pedestrians are minimised.

Upon entering visitors, contractors and truck drivers must stop and report to the security hut. Truck drivers and contractors entering FACT must complete an online induction prior to gaining access. External stakeholder and site visitors to be accompanied by a site escort whilst on site. Truck drivers once parked in designated loading/ unloading bay.

Speed limits are restricted to 25 km/hour generally around the site and 10 km/hour in shared traffic movement areas. Signage is used around the site to minimise safety issues (Plate 8.2).

Plate 8.2 Typical traffic management signage

Communication protocols are used to minimise the risks to equipment and personnel, including:

- Vehicle Booking System (VBS) in place to control when trucks arrive on site to minimise long queues.
- FACT website for live truck turnaround times for external truck companies to check and plan their arrival times to avoid busy periods.
- hand signals are used for communication between truck drivers and straddle operators. Signage is placed on each truck lane to remind truck drivers of correct hand signals.
- traffic lights on Coghlan Road to indicate to truck drivers when they can proceed to enter FACT. Signage to indicate which truck lane to use.
- traffic lights for entry to road train lanes for trucks, and straddles.
- the Terminal is equipped with a radio communication system to assist in operations and provide radio contact between the control functions and the operators on the Terminal.

To minimise the risk of visibility during nighttime operations FPH has in place adequate lighting throughout the FACT site. In addition, all vehicles and mobile plant must ensure that they have fully operational and effective head lights, taillights, and flashing warning beacons (where applicable) which are turned on when visibility is poor.

Wherever feasible FPH requires that vehicles must avoid the need for vehicles to reverse as this is a major cause of fatal incidents.

Pedestrians are required to use designated walkways where marked and must be fully aware of the locations of plant and equipment in their vicinity and get the operators attention if seeking to move into the construction area or area of influence of the plant and equipment.

Additionally, existing access and egress points would continue to be used by traffic as part of the proposed construction works to further limit any potential impacts on Coghlan Road.

8.7.4 Conclusion

The project will result in a minor increase in total numbers of vehicles along the road network surrounding the site during construction of Berth 6. The operational stage is not expected to result in an increase in site traffic. Further, the project is not expected to significantly or adversely affect the function or safety of the local road network.

On this basis, a separate traffic assessment is considered not required for the Berth 6 project. The proposed management and mitigation measures outlined above and in the Traffic Management Plan will ensure the safety of vehicles, plant and equipment and personnel on the site.

8.8 Noise & vibration

A noise impact assessment was undertaken by Resonate for the proposed Berth 6 upgrade (Appendix N). The objective was to assess the baseline noise and to determine the risk of potential terrestrial and underwater project-related noise and vibration impacts during construction (piling and dredging activities).

8.8.1 Existing environment

The key sources of noise are associated with shipping, container loading and un-loading from ships, container transfer across the FACT and truck movements in and out of FACT during construction.

Ambient noise monitoring was undertaken at the site and it is considered to be consistent with that of a port facility and industrial site, including the existing FACT, other adjacent industrial/transport land uses, nearby road traffic and from natural sources such as birds and wind-induced noise.

The closest noise sensitive receivers are located approximately 450 m to the south of the site along Victoria Road, within the suburb of North Haven. The nearest residences face away from the subject site, with backyards, sheds and boundary fences separating the dwellings from the Key Freight Route of Victoria Road.

The ocean is filled with sound that is generated by a variety of natural sources, such as rain, breaking waves, marine life, and man-made sources, such as shipping and sonar activity. The underwater baseline noise conditions in the marine area consist mainly of snapping shrimp noise and vessels passing by the site.

8.8.2 Potential impacts

i Noise

The operation of dredging equipment and associated machinery (e.g. generators, pumps, trucks, anchors) has the potential to cause off-site impacts when occurring near residents, businesses and frequently used areas.

The following potential receptors could be impacted by noise from piling and dredging works:

- RSAYS users (some of which may temporarily reside in their boats).
- Dolphins located around the Port River estuary and Barker Inlet.
- Significant marine fauna and including fish and marine mammals.

- Residential area approximately 450 m to the south of the site along Victoria Road, within the suburb of North Haven, located in a General Neighbourhood zone.

- More distant residential dwellings situated approximately 1 km to the south of the site, located in a Waterfront Neighbourhood zone.

ii Vibration

The key sources of vibration would be associated with both vibratory and impact piling during the construction process for Berth 6. Piling has the potential to impact both human comfort and heritage structures, with the following sensitive receptors identified:

- The nearest residential premises is approximately 500 m from the proposed works, therefore potential impacts are expected to be low.

- The nearest heritage structure to the proposed works is the shipwreck *Corsair*, which is located approximately 1 km to the northeast of the proposed Berth 6 extension.

8.8.3 Assessment methodology

The assessment completed by Resonate included the following:

- Identify relevant construction activities, in particular, wharf construction and dredging requirements.

- Determine relevant State/Federal legislation and assessment criteria, including DIT's Underwater Piling and Dredging Noise Guidelines (2022).

- Predict underwater noise impacts from piling and dredging activities.

- Predict vibration impacts from piling activities.

- Identify preliminary mitigation and risk management measures.

Further information about the assessment method is provided in Appendix N.

i Operational noise assessment

Noise modelling was undertaken using two noise propagation algorithms to represent different meteorological conditions as follows:

- The ISO 9613-2:1996 algorithm, predicts sound pressure levels under meteorological conditions favourable to propagation from noise sources. These conditions are for downwind propagation, or, equivalently, propagation under a well-developed moderate ground-based temperature inversion, such as that which commonly occurs at night.

- Conservation of Clean Air and Water in Europe (CONCAWE) algorithm, using CONCAWE meteorological category 6 to represents weather conditions that are the most conducive to noise propagation (the worst case situation with the highest predicted noise levels).

ii Construction noise assessment

Construction activities are proposed to be undertaken within standard hours (i.e. 7 am to 7 pm, Monday to Saturday) and are therefore not subject to quantitative noise limits under the *Local Nuisance and Litter Control Act 2016* (LNLC Act). Therefore, noise modelling was not completed for this step and discussion on general mitigation measures if provided in Section 8.8.4.

iii Construction vibration assessment

Vibratory sheet piling vibration predictions have been undertaken utilising the approach described by Attwell et al. 1992, which uses an empirically derived quadratic regression model. The modelling assumptions are provided below:

- Sheet pile = AZ 24-700 (Z section profile, sectional area (cm^2) mass per m (kg/m))
- Pile length = 14 m
- Vibratory driver = 1,000 kN centrifugal force, 250 kW hydraulic power
- Driving frequency = 27 Hz

iv Marine fauna assessment

Underwater noise modelling has been undertaken in dBSea software using both a spherical and cylindrical model (S+CS model) for low frequencies (31.5 to 80 Hz) and a ray tracing model for high frequencies (100 to 16 kHz). The adopted crossover point between the two models is 80 Hz. Calculations have been undertaken in one-third octave bands.

Bathymetry data has been obtained from the GEBCO 2024 global ocean and land terrain model. GEBCO operates under the joint auspices of the International Hydrographic Organization (IHO) and the Intergovernmental Oceanographic Commission (IOC) (of UNESCO).

8.8.4 Results of assessment

i Operational noise assessment

Operational noise levels have been predicted for all noise-sensitive receptors in the vicinity of the Berth 6 development. The predicted noise levels are shown in Table 8.1 below.

Table 8.1 Predicted noise levels at selected locations

Location	Predicted noise level, L_{eq} dB(A)								Relevant criteria, L_{eq} dB(A)	
	E1	E2	E3	E4	P1	P2	P3	P4	Day	Night
1 South Australia One Dr	44	39	41	37	44	39	41	37	52	45
4 Comorin Ct	45	39	43	36	45	39	43	36	52	45
34 Oronsay Dr	47	42	44	39	47	42	44	39	52	45
50 Aurelia Dr	39	37	37	34	39	37	37	34	52	45
Royal South Australian Yacht Squadron	53	49	51	47	54	51	52	48	70	60

Predicted noise levels comply with the daytime and nighttime objective criteria of 45 dB(A) at all locations with the exception of at 34 Oronsay Dr (and other locations along Oronsay Dr and Himalaya Drive) where night time criteria are exceeded by up to 2 dB(A) during peak operation under worst-case meteorological conditions. However, it should be noted that background noise levels due to road traffic on Victoria Road are generally high in this location.

The proposed project is also not predicated to result in a noticeable increase in overall FACT noise emissions at this location, compared to existing operations. Operational noise levels are predicted to comply with the relevant daytime and nighttime criteria at all locations under all other operating scenarios.

ii Construction noise assessment

As mentioned above, construction activities which are undertaken within standard hours (i.e. 7 am to 7 pm Monday to Saturday) are not subject to quantitative noise limits under the LNLC Act or EP Act. However, reasonable and practicable measures should be taken to minimise noise resulting from the activity and to minimise its impact.

iii Construction vibration assessment

A summary of the predicted impact piling vibration levels (mm/s PPV) associated with the proposed works are provided in Table 8.2 below.

Table 8.2 Predicted vibration levels (mm/s PPV) in accordance with Attwell et al. 1992 – impact piling

Distance (m)	Best fit, mm/s PPV	Half standard deviation, mm/s PPV	One standard deviation, mm/s PPV
10	11.9	19.9	33.2
20	7.3	12.1	20.3
50	3.3	5.4	9.1
100	1.6	2.6	4.4
200	0.7	1.1	2.0

The vibration targets for human comfort are unlikely to be exceeded at residential premises given the distance from the works, being at least 500 m from the proposed works. We note that the maximum baseline vibration levels resulting from road traffic on Victoria Road are generally above the adopted criteria.

The nearest heritage structure to the proposed works is the shipwreck Corsair which is located approximately 1 km to the northeast of the proposed Berth 6 extension. Based on the predicted vibrational levels outlined in Table 8.2 above, it can be concluded that potential vibration impacts on heritage structures are not expected.

Similarly to construction noise, the mitigation and management of vibration generated from construction activities will be included in a Construction Noise and Vibration Management Plan (CNVMP) developed by the contractor responsible for managing the construction works. The CNVMP will consider the potential impact of vibration on human comfort to any occupied building as well as any damage to nearby structures and heritage assets.

iv Marine fauna noise assessment

Based on the results of various modelling scenarios for the different types of marine fauna, the following were identified:

- In relation to impact piling (i.e. impulsive noise source), the results indicate that the effect on fish, sharks and turtles relates to the length of exposure time, which also relates to the mobility of the animals in the area during piling activities. The greatest impact potential is on fish with swim bladders given their increased hearing sensitivity.

- A temporary hearing threshold shift could also occur for fish (both with/without swim bladders) within approximately 75 m of initial piling commencement, depending upon the direction of travel and behavioural response to the noise to move away from the noise. For an assumed 1-hour equivalent of continuous piling noise over a 24-hour period, fish remaining within an area of approximately 1,300 m from the impulsive piling noise, may incur temporary hearing threshold shift.

- The results indicate that the effect on marine mammals relates to the length of exposure time, which also relates to the mobility of the animals relative to the distance from each noise source. In general terms, the greatest impact potential is on low frequency cetaceans and phocid carnivores, given their increased hearing sensitivity at low frequencies.

8.8.5 Management and mitigation measures

i Operational noise and vibration

The proposed project is also not predicated to result in a noticeable increase in overall FACT noise emissions at this location, compared to existing operations. Operational noise levels are predicted to comply with the relevant daytime and nighttime criteria at all locations under all other operating scenarios

The following additional measures would be considered for the project:

- Strategic design of future FACT site layout to place container stacks to the south of the site (i.e. in between noise sources and sensitive receiver locations where they may provide incidental 'shielding' of noise emissions from trucks and other sources.

- Selection of quieter equipment items, where possible. This may include selection of plant that does not exhibit any tonality or other special characteristics which may otherwise make the noise more noticeable or annoying to residential receivers.

ii Construction noise and vibration

A Construction Noise and Vibration Management Plan (CNVMP) will be developed by the contractor responsible for managing the construction works. The CNVMP will specifically address any noisy works that may be undertaken outside of the hours identified above. Appendix N summarises the general noise mitigation measures that could be considered in the CNVMP.

iii Marine noise

From the impact assessment undertaken, mitigation and management measures are considered necessary for impact sheet piling in particular and to a lesser extent dredging and vibratory piling. In relation to impact piling however, it is expected that most of the piling would be undertaken using vibro-driving, and impact piling only required if very stiff soils are encountered. Mitigation and/or management measures are not required for vessel movements.

The following mitigation and management options will be considered during the proposed construction:

- Mitigation options could involve piling in low tide or dry conditions, soft start procedures, avoiding whale migration season and developing bubble curtains.
- Development of safety zones such as an *Observation Zone* and *Shut-down Zone* if piling is wet or >1 m of water.
- Development of potential effect zones for fishes and marine turtles to inform project risk evaluation process and identification of reasonable and practicable noise mitigation measures where required.
- Development of preliminary safety zones to minimise the potential for temporary hearing impacts.
- Marine fauna observers to be present for the duration of related works.

8.8.6 Conclusion

Resonate has undertaken an environmental noise and vibration impact assessment for the proposed Berth 6 upgrade. The assessment has considered both the construction and operation of the facility.

Based on this assessment the planned construction and operation of the Project will be able to meet its environmental obligations as required by national and state legislation including the Planning & Design Code and Noise Policy. This will be achieved through the implementation of recommended mitigation and management measures outlined in this report. These measures may be refined and reviewed as the design progresses.

8.9 Geotechnical and soil

8.9.1 Existing marine sediment quality

An environmental assessment of sediments within the vicinity of Berth 6 were generally characterised as being dark grey, silty sandy clay and muddy sand with shell inclusions and plant roots (Golder Associates 2020).

Sediments within the depth range of 0 to 0.2 m comprised on average 41.5% sand, 47.5% silt, 10.5% clay and 0.5% gravel.

Chemical analyses of samples to depths of 0.3 m showed that total trace metals, hydrocarbons and polycyclic aromatic hydrocarbons were all below the Waste Fill criteria, the adopted human health and ecological screening guidelines, the Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand (ANZECC & ARMCANZ) water quality guidelines' Sediment Screening Levels, and the National Assessment Guidelines for Dredging (NAGD) Sediment Screening Levels.

Tributylin (TBT) was below NAGD and ANZECC & ARMCANZ guidelines (no waste disposal criteria for TBT) (JBS&G 2024b).

One sediment sample was tested for the chemical suite contained in the broad SA EPA Waste Screen. All chemical concentrations were below the limit of recording (LOR), with LORs below ANZECC and NAGD Sediment Screening Levels (JBS&G 2024b).

8.9.2 Geotechnical characteristics

WGA conducted a geotechnical Gap Assessment for Berth 6 which involved a review of previous geotechnical investigations for Berth 6 and Berth 7 (Appendix O).

The review considered there is sufficient information to derive inferred geotechnical parameters suitable for design of:

- driven and CFA pile design
- sheet pile wall design.

The typical soil profile and preliminary recommended design parameters are included in Plate 8.3 and Plate 8.4

TYPICAL DEPTH (mCD) [1]	UNIT	c_u [2] (kPa)	ϕ' [2] (°)	E_u' [2] (MPa)	ν_u [2]	f_s [3] (kPa)	f_b [4] (kPa)	P_y [5] (kPa)
Surface to -1.0	Unit 1: Fill (mainly granular)	Neglect for the purposed of pile design						
-1.0 to -3.50	Unit 2: St Kilda Formation (SM)	-	30	8	0.3	10	Not suitable	150 to 400 [7]
-3.50 to -6.0	Unit 3: Pooraka Formation (assume cohesive, CL)	40	-	10	0.5	20		400
-6.0 to -9.0	Unit 4a: Glanville Formation (GP/SP/SC)	-	33	35	0.3	30		800
-9.0 to -12.5	Unit 4b: Glanville Formation (CH/SC)	80	-	20	0.5	40		720
-12.5 to -21.0	Unit 5a: Hindmarsh Clay (CH)	200	-	90	0.4	90 to 100	2400 [6]	1800
Beyond -21.0	Unit 5a: Hindmarsh Clay (CVst)	250	-	100	0.4	125	4140	2000

Notes:

1. Typical depths across the site. Refer to borehole logs for further information.
2. c_u – undrained shear strength, ϕ' – drained internal angle of friction, E_u' – undrained Young's modulus for vertical loading; ν_u – undrained Poisson's ratio.
3. f_s – average skin friction.
4. f_b – ultimate end bearing capacity.
5. P_y: limiting ultimate pile-soil pressure for lateral loading.
6. Assumes piles are founded in clay of hard consistency (minimum undrained shear strength of 200 kPa). A higher end bearing resistance may be appropriate where piles are founded deeper than 20 m, subject to further geotechnical investigations.
7. During strong earthquake motion, the lateral resistance of the St Kilda Formation soils would be greatly reduced.

Plate 8.3 Geotechnical design parameters for static analysis of CFA or driven piles (for existing ground conditions)

TYPICAL DEPTH (mCD) (1)	UNIT	γ (2) (kN/m³)	c_u (2) (kPa)	c' (2) (kPa)	ϕ' (2) (°)	E_h' (2) (MPa)	v' (3)	K_a (3)	K_p (3)	K_0 (3)
Surface to -1.0	Unit 1: Existing Fill (mainly granular) (4)	19.5	0	0	32	10	0.25	0.31	3.2	0.65
-1.0 to - 3.50	Unit 2: St Kilda Formation (SM)	16	0	0	30	4	0.35	0.33	3.0	0.5
-3.50 to - 6.0	Unit 3: Pooraka Formation (CL) Sandy refers to medium dense sand in BH1 below 8.5 m	17	400 (sand y)	20 (sand y)	28 (33 sandy)	6	0.35	0.36	2.6	0.6
-6.0 to -9.0	Unit 4a: Glanville Formation (GP/SP/SC)	18	0	0	33	25	0.3	0.30	3.4	0.46
-9.0 to - 12.5	Unit 4b: Glanville Formation (CH/SC)	19	80	5	28	15	0.35	0.36	2.8	0.75
Beyond - 21.0	Unit 5: Hindmarsh Clay (CH)	20.5	200	20	27	60	0.3	0.38	2.7	1.5

Notes:

1. Typical depths across the site. Refer to borehole logs for further information. Depth has been converted to CD as approximate.
2. γ – bulk unit weight; c_u – undrained cohesion; c' – drained cohesion; ϕ' – drained internal angle of friction; E_h' – drained horizontal modulus; v' – drained Poisson's ratio.
3. K_a – coefficient of active lateral earth pressure; K_p – coefficient of passive lateral earth pressure; K_0 – coefficient of lateral earth pressure at rest.

   K_a and K_p assume no wall friction/adhesion and ground surface slope of 0°. No partial strength reduction factors have been applied.

   WGA cannot warrant the engineering performance of the fill. The design parameters presented are based on a pragmatic engineering assessment of the fill materials observed and are expected to be slightly conservative. The fill at depth is expected to be weaker than the fill in the upper 2 m.

Plate 8.4 Geotechnical design parameters for sheet pile wall design

8.9.3 Recommendations

WGA recommended that a Geophysical Investigation and minimum of two boreholes are carried out for the project. The intent of the geophysical investigation is to determine variability of strata conditions throughout the wharf extent. Further to this, the magnetic survey would assess for likely below seabed buried obstructions

The suggested investigation include:

- seismic reflection to a minimum depth of 20m below seabed. Extent as shown in the area in blue
- seismic refraction on four sections to a minimum depth of 20 m below seabed. Two of these are to extend on land to overlap potential borehole locations. Locations as shown in pink
- seabed levels survey over the extent of the geophysical investigation area
- side Scan Sonar/Magnetic Survey to investigate for below seabed obstructions.

Two potential options are being considered:

- over water along the front of wharf alignment
- deeper boreholes carried out on land just behind the rock revetement. The geophysical investigation could then overlap these boreholes to assist in calibration of the geophysical results.

FPH is considering the above options which are likely to be a requirements of a design/construct tender package.

8.10 General environmental considerations

8.10.1 Air quality - dust

It is unlikely that there will be significant dust generation during activities for extension of Berth 6. Dust will be managed in accordance with FPH Dust Management Plan which have been successfully used at the FACT during existing operations and previous site upgrades.

8.10.2 Visual amenity

The proposed expansion of Berth 6 is expected to have limited visual impact on sensitive receptors during construction due to pile driving equipment and equipment used for minor dredging.

During operation ships using Berth 6 will be more visible to the adjacent marina due to the berth having been extended by 135 m. This is not considered to be a significant impact as ship movements are a regular occurrence locally.

The overall visual impact of the site on the surrounding area (and potentially sensitive receptors) is considered low.

8.10.3 Cumulative impacts

A search of the Plan SA 'Current Notified Application Map Viewer[1]' website on 6 June 2024 indicated that no current notified development applications exist within the Port Adelaide Enfield Council.

Similarly, the Plan SA 'State developments' website[2] on 6 June 2024 indicated that there are currently no major developments on public notification with potential to result in cumulative impacts with the Wolseley development. It is therefore assumed that the project will not result in any cumulative impacts.

1 https://dpti.geohub.sa.gov.au/portal/apps/webappviewer/index.html?id=195687acee1c4829bd9b9e14fa6bea41

2 https://plan.sa.gov.au/have_your_say/notified_developments/state_developments

8.11 Construction environmental management plan

FHP have an established Environmental Management System (EMS) in place for the FACT to manage and control potential environmental risks.

For the purpose of the Crown DA, a Construction Environmental Management Plan(s) (CEMP) would be implemented during construction and is anticipated to include (but not limited to):

- Noise and vibration – construction hours Monday to Saturday (i.e. 7 am to 7 pm), unless out of hours works approved; plant, vehicles and construction equipment would be properly maintained to reduce the potential of excessive noise emissions and comply with regulatory requirements; work generating high vibration levels would be scheduled during less sensitive time periods and monitored.

- Traffic and transport – The TMP addresses traffic and safety arrangements during construction; parking of vehicles; vehicle and machinery movements during construction to be restricted to designated areas; traffic movements to be monitored if any community complaints/concerns are received.

- Dust – to prevent or minimise wind-blown dust; dust generating activities will be avoided or minimised during dry and windy conditions. Berth 6 activities unlikely to result in significant if any dust impacts.

- Water quality – Water Quality Management Plan during piling and dredging activities during construction will be implemented in accordance with dredging and piling management plan in accordance with the existing EPA licence.

- Waste – all waste will be recycled/disposed at an EPA licensed facility, where required.

- Heritage – implementation of site induction and unexpected finds procedure for Aboriginal Heritage and Non-Aboriginal Heritage. If any potentially significant, Aboriginal cultural heritage items are found, work should be stopped and Ministerial authorisation under section 23 of the AHA will be required.

- Stakeholders – a mechanism for receiving and responding to any complaints to be put in place for the duration of the construction phase.

The CEMP is included as Appendix P to this report.

9 Conclusion

The FACT is a world class facility able to facilitate Panamax and Post-Panamax class vessels with shipping services that connect SA to destinations in most of the world's continents, including north, south and west Asia, the Indian sub-continent, Europe and North America. FPH propose to expand its existing container storage and transfer operations at the FACT located in Outer Harbor (referred to by FPH as the GatewaySA Program) in the Port of Adelaide, SA.

The proposed development site is situated with the Strategic Employment Zone within the Local Government Area of the City of Port Adelaide Enfield. The existing zoning envisages the nature and scale of the proposed Lot 9 Redevelopment to facilitate the efficient use of FACT land and upgrade of the existing freight-handling facility in a planned and orderly manner.

The investigations and analysis for this Crown DA have been informed by a number of technical assessments prepared in accordance with relevant guidelines and assessment criteria. Technical assessments include ecology, stormwater, marine water, sediment modelling, noise with the findings concluding that the project would not adversely impact on surrounding land uses, sensitive receptors or the local environment. These reports are included as appendices to this Crown DA.

A construction environmental management framework has also been outlined in this development application to provide guidance to FPH and its contractors on mitigation measures to be implemented during construction to minimise impacts on the environment, surrounding landowners and the community.

In preparing this Crown DA, the proponent has carried out stakeholder engagement with the Port Adelaide-Enfield Council, relevant SA government agencies, adjacent landholders and the local community. Relevant issues and opportunities associated with the project have been identified and addressed.

The proposed development is considered appropriate for the existing site, is adequately sited, designed and separated from sensitive receptors to minimise potential impacts, is deemed to satisfy the provisions of the Planning and Design Code and when considered on its merits warrants the granting of planning consent.

References

BMT (2024*) Port Adelaide Berth 6 Extension - Coastal Processes Assessment*, Report prepared for JPH by BMT Commercial Australia Pty Ltd, 10 June 2024

DPTI (2017) *The 30-Year Plan for Greater Adelaide 2017 Update*, report prepared by the then Department of Planning, Transport and Infrastructure, 2017.

EPA (2020) *Dredge Guideline*. South Australian Environmental Protection Authority. August 2020.

Golder (2020) Flinders Ports Berth 6 Dredging Seagrass Survey, Sediment Sampling and Characterisation. Report prepared by Golder Associates for Flinders Port Holdings.

ISA (2020) *20-Year State Infrastructure Strategy*, report prepared by InfrastructureSA, 2020.

JBS&G (2024a) *Berth 6 Upgrades – Water Quality Management Plan*, Report prepared for FPH by JBS&G Australia Pty Ltd, 13 May 2024

JBS&G (2024b) *Dredge Management Plan Framework*, Report prepared for FPH by JBS&G Australia Pty Ltd, 13 May 2024

JBS&G (2024c) *Berth 6 Precinct upgrade – EPBC Self-assessment*, Report prepared for FPH by JBS&G Australia Pty Ltd, 3 June 2024

JBS&G (2024d) Gap analysis of available data/ reports and plans to support the Berth 6 Precinct Upgrade Development Application, Report prepared for FPH by JBS&G Australia Pty Ltd, 3 June 2024

J. Diversity (2024a) *Outer Harbour Berth 6 - Benthic survey report*, Report prepared for FPH by J. Diversity Pty Ltd, 31 May 2024

J. Diversity (2024b) Outer Harbor Berth 6 Precinct Upgrade Pacific Oyster Mortality Syndrome (POMS) Management Plan, Report prepared for FPH by J. Diversity Pty Ltd, 3 June 2024

J. Diversity (2024c) Native Vegetation Clearance Outer Harbor Berth 6 Extension (Dredging and land reclamation) Data Report, Report prepared for FPH by J. Diversity Pty Ltd, 3 June 2024

Malone & Telfer (2012), *Kaurna Meyunna Cultural Mapping, A People's Living Cultural Landscape*. City of Charles Sturt. Available online at: Yerta-Bulti-Port-River-and-Estuary-region.pdf

Appendix A
DIT Crown sponsorship letter

EMM
creating opportunities

Government of South Australia
Department for Infrastructure and Transport

OFFICE OF THE CHIEF EXECUTIVE

83 Pirie Street
Adelaide SA 5000
Kaurna Country

GPO Box 1533
Adelaide SA 5001
DX 171

dit.sa.gov.au

ABN 92 366 288 135

Build. Move. Connect.

In reply please quote #22287478
Enquiries to dit.officeofthechiefexecutive@sa.gov.au

Mr Josh Smith
Project Director, GatewaySA Program
Flinders Ports Holdings Pty Ltd
296 St Vincent Street
Port Adelaide SA 5015

Email: Josh.Smith@fphgroup.com.au

Dear Mr Smith

RE: Section 131 Sponsorship Request – Flinders Ports Upgrade and Expansion Works at Flinders Adelaide Container Terminal, Outer Harbor

I refer to your request dated 4 October 2024, seeking sponsorship under section 131 of the *Planning, Development and Infrastructure Act 2016* (the Act), for proposed upgrade and expansion works at Flinders Adelaide Container Terminal at Outer Harbor.

Given that the proposed works meet the definition of essential infrastructure, as outlined in section 3(1) of the Act, I am pleased to confirm the Department for Infrastructure and Transport's support and specific endorsement pursuant to section 131(2)(c) of the Act, for these works as detailed in the attached:

- *GatewaySA Program – scope of works and plans for Crown Sponsorship.*

The State of South Australia makes no commitment to provide any funding for this project. It is the responsibility of Flinders Ports Holdings to obtain all other statutory approvals, licences and permits from relevant authorities and to fund the project.

All costs of the development application, lodgement with State Planning Commission and any subsequent action are the responsibility of Flinders Ports Holdings Pty Ltd. No representations or warranties are given in relation to the outcome of the development application or the time it takes to secure a planning outcome.

A development application (or all development applications, if project activities are separately staged) must be lodged with the State Planning Commission on or prior to 13 November 2025. If this is not achieved by that time, my support under section 131(2)(c) of the Act will lapse.

Please contact Ms Felicity Greaves, Senior Project Officer, Case Management Services on telephone number (08) 7133 2199 when your office is able to submit all documentation for development approval.

Yours sincerely

Jon Whelan
Chief Executive

6 November 2024

Enc: - GatewaySA Program – scope of works and plans for Crown Sponsorship

Government of South Australia
Department for Infrastructure and Transport

GatewaySA Program – scope of works and plans for Crown Sponsorship

Scope of Works

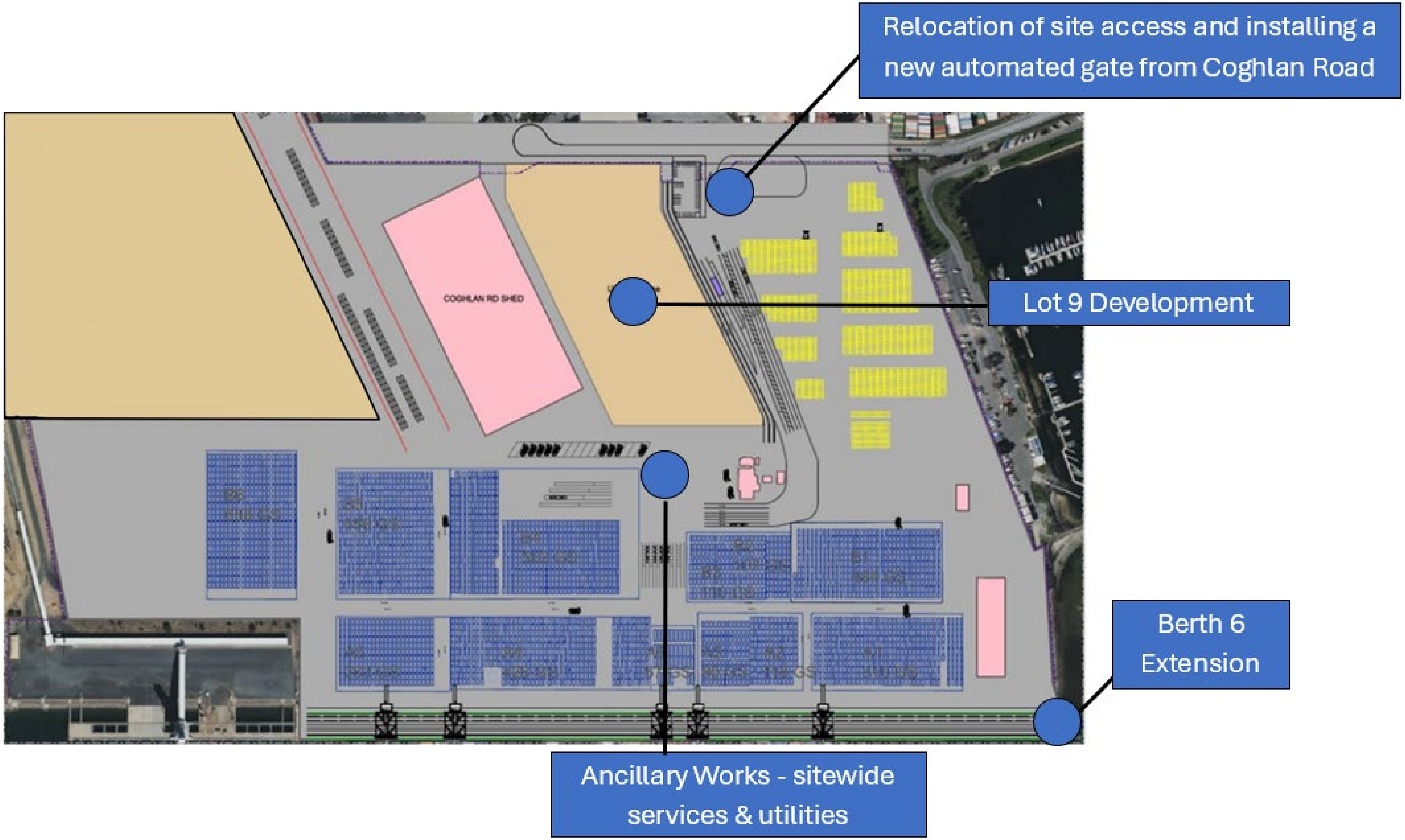
GatewaySA Program – Project activities

GatewaySA Program – Project Activities	Classified as 'Development' under the PDI Act?
1. Additional mobile quay cranes	**TBC – FPH considers this to be 'business as usual' but if deemed development would be incorporated in the Berth 6 Crown DA.**
2. Extension to Berth 6	**Yes**
3. Remediation works for Berth 6 wharf	No
4. Development of Lot 9	**Yes**
5. Relocation of site access and installing a new automated gate from Coghlan Road	**Yes**
6. Redevelopment of the empty container depot area	No
7. Ancillary works – including sitewide services and utilities	**TBC – subject to excavation and filling of land quantities exceeding 9 m^3 'development' threshold.**
8. Upgrading the terminal operating system (TOS) (i.e. IT systems)	No
9. Auto rubber tyres gantry crane (Auto RTG)	No

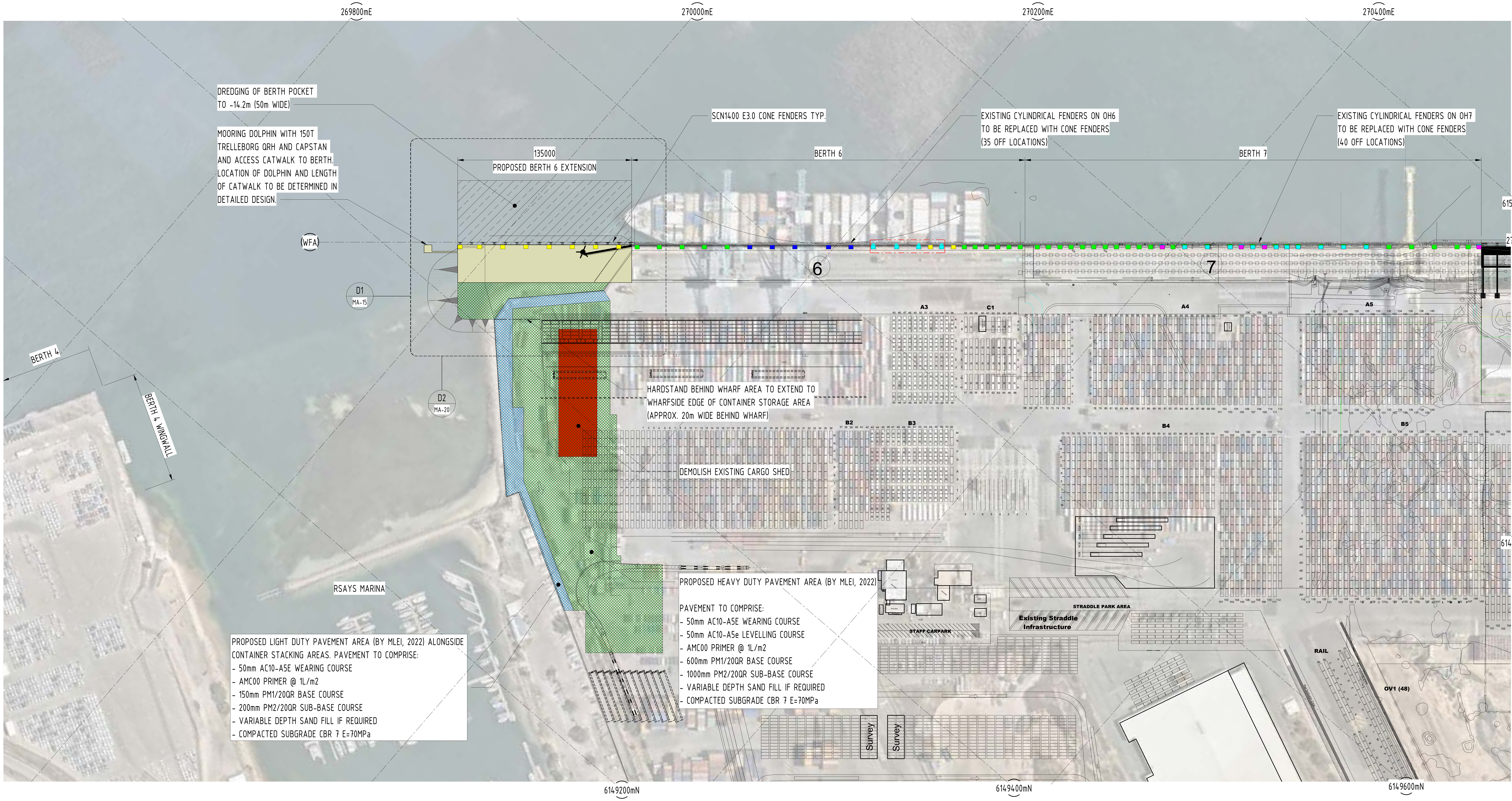
The additional mobile quay cranes are consistent with FPH's existing mobile quay cranes at Berth 6 and Berth 7 and operate by moving along the dock surface. If deemed development this activity would be incorporated in the Crown DA for Berth 6.

Project Activity	Nature of development
Extension to Berth 6	**Section 131 Crown DA** • The extension of existing berth wharf infrastructure to cater for current and forecast shipping trends (i.e. larger vessels). • The extension of Berth 6 includes: – An extension of Berth 6 to a length of approximately 135 metres (m) in length and 28 m in width. – Land reclamation of 20 m strip directly behind wharf extension to provide wharf access. – A new mooring dolphin located 20–30 m west from the edge of the proposed Berth 6 extension, connected to Berth 6 via a suspended walkway. – Piling construction with options under consideration including driving piles, sheetpiles or king piles. • Dredging of the area adjacent to Berth 6 in the shipping channel to achieve a channel design depth of 14.2 m composite depth (mCD). This involves: – Dredging footprint approximately 550 square metres (m^2) with a sediment volume of approximately 900 m^3. – Proposed disposal of dredge spoil to existing Pelican Point Dredge Pond located approximately 1 kilometre (km) from the dredge location. However, if the extension of Berth 6 involves a sheet pile wharf, the spoil may be used as a low level backfill behind the sheet pile, or potentially incorporated into land reclamation works for alternate design options. – The dredging methodology to be confirmed following detailed design. • Pavement surface upgrade to the area adjacent to Berth 6 extension. • Additional mobile quay cranes (if deemed 'development). A conceptual plan is included as Appendix A.
Development of Lot 9	**Section 131 Crown DA** • The pavement surfacing of land at Lot 9 (approximately 4.2 hectares (ha)) to enable the area to be trafficked by equipment applying up to a 90 tonne axle load and used to store a combination of empty and loaded shipping containers as required. • Ancillary works, including (but not limited to) bulk earthwork, soil and stockpile management during construction and civil engineering for surface water management. A conceptual drainage plan is included as Appendix B.
Relocation of site access and installation of a new automated gate from Coghlan Road	**Section 131 Crown DA** • Relocation of the existing site access and installation of a new automated gate from Coghlan Road. • Pavement surface upgrades. • Changes to the site access will allow for safer operation, efficient access and egress, internal traffic management and queuing of heavy vehicles to minimise impacts to other road users.
Ancillary works (subject to excavation and filling of land quantities)	**Section 131 Crown DA** • Relocation and reinstatement of existing assets and services to facilitate upgrades, including sitewide services, sewerage and utilities. This includes: – Decommissioning existing services (low voltage and high voltage electrical, data, communication, security, light towers, sewer and stormwater). – Construction of new services (low voltage and high voltage electrical, data, communication, security, light towers, sewer and stormwater). – Extension of existing fire services. – Excavation of existing pavement material and disposal off site (re-use where appropriate). • Construction of new pavement and bitumen surface.

Plans



Crown sponsored activities - site layout



GENERAL ARRANGEMENT

SCALE 1 : 1500

BOLLARD LEGEND

- NO BOLLARD POSSIBLE
- UPGRADED 150t DOUBLE BITT BOLLARDS (NOT PART OF BERTH 6 EXTENSION SCOPE)
- EXISTING 80t KIDNEY BOLLARDS
- EXISTING 80t KIDNEY BOLLARDS TO BE UPGRADED (PART OF BERTH 6 EXTENSION SCOPE)
- NEW 150t DOUBLE BITT BOLLARDS (PART OF BERTH 6 EXTENSION SCOPE)

- PROPOSED HEAVY DUTY PAVEMENT AREA (BY MLEI, 2022)
- PROPOSED LIGHT DUTY PAVEMENT AREA (BY MLEI, 2022)
- DEMOLISHED AREA
- PROPOSED BERTH 6 EXTENSION / MOORING DOLPHIN
- PROPOSED CONTAINER STORAGE AREA

When sheet printed full size, the scale bar is 1:1 (100mm).

0 50 100mm

R G B

THIS DRAWING INCLUDES COLOURED INFORMATION

COPIES OF THIS DRAWING MUST BE PRODUCED IN COLOUR

CONCEPT ISSUE

NOT FOR CONSTRUCTION

REV.	DATE	DESCRIPTION	DRAFT.	ENG.	CHKD.
A	08.05.24	DRAFT ISSUE	ES	MCD	MCD
B	13.08.24	CONCEPT ISSUE	ES	MCD	DBM
C	24.09.24	CONCEPT ISSUE	ES	MCD	DBM

WGA

GatewaySA - BERTH 6 EXTENSION

FLINDERS PORTS
OUTER HARBOR, SA

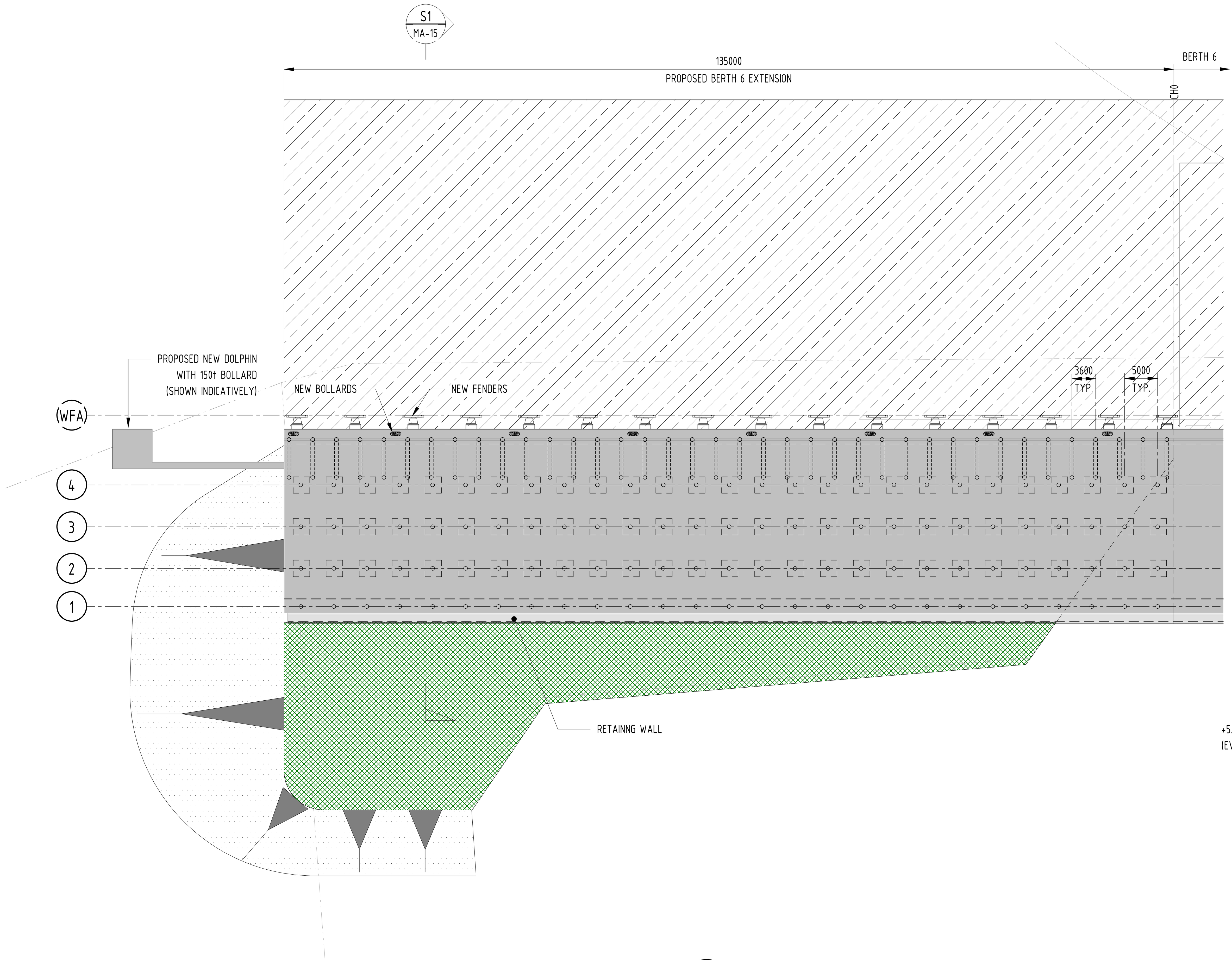
GENERAL ARRANGEMENT

A1

DOCUMENT NUMBER
Job Number　Sheet No.　Rev.

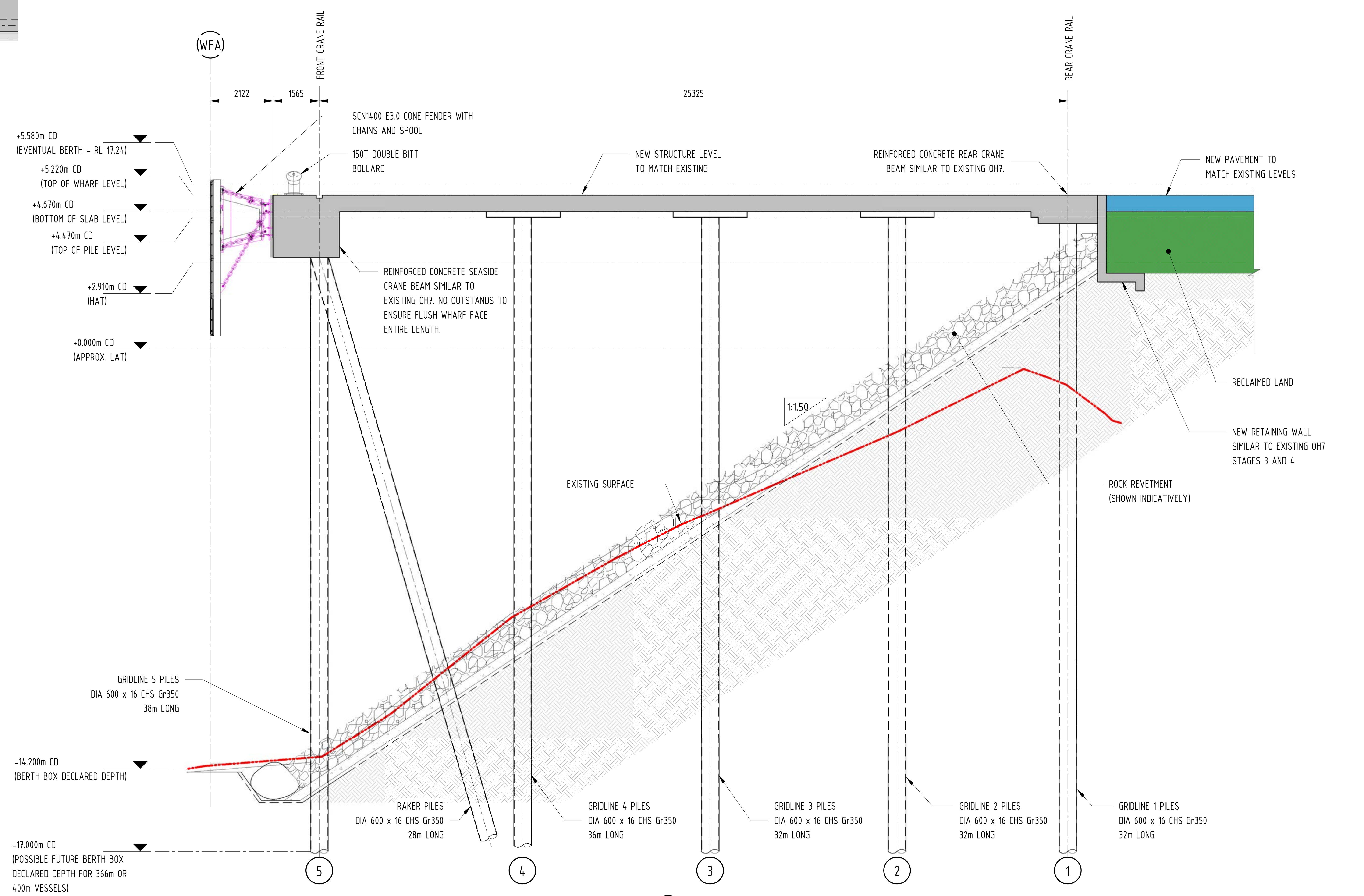
Design MCD　Drawn ES　WGA221572-24-DR-MA-05　C

C:\Users\ESanjari\Documents\WGA221572-24-MD-MA-R23_Berth 6 Extension_ESanjari.rvt
24/09/2024 1:38:14 PM



DETAIL D1 MA-05
SCALE 1 : 500

SUSPENDED DECK OPTION - PLAN VIEW



SECTION S1 MA-15
SCALE 1 : 100

SUSPENDED DECK OPTION - TYPICAL CROSS SECTION

C:\Users\ESanjari\Documents\WGA221572-24-MD-MA-R23_Berth 6 Extension_ESanjari.rvt
24/09/2024 1:38:15 PM

When sheet printed full size, the scale bar is 1:1 (100mm).
0 50 100mm

R G B
THIS DRAWING INCLUDES COLOURED INFORMATION
COPIES OF THIS DRAWING MUST BE PRODUCED IN COLOUR

CONCEPT ISSUE
NOT FOR CONSTRUCTION

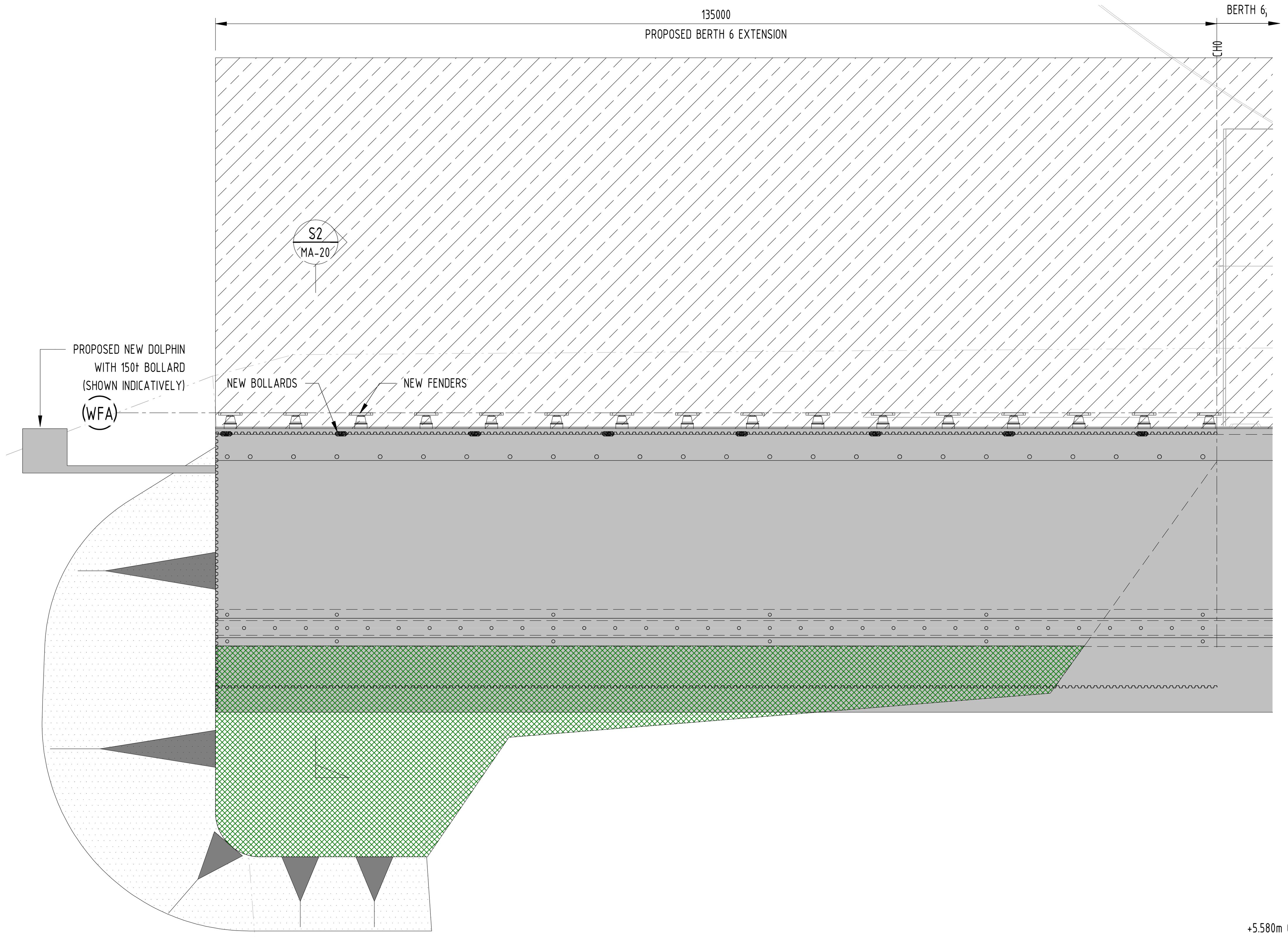
REV.	DATE	DESCRIPTION	DRAFT.	ENG.	CHKD.
A	08.05.24	DRAFT ISSUE	ES	MCD	MCD
B	13.08.24	CONCEPT ISSUE	ES	MCD	DBM
C	24.09.24	CONCEPT ISSUE	ES	MCD	DBM

WGA

GatewaySA - BERTH 6 EXTENSION
FLINDERS PORTS
OUTER HARBOR, SA
SUSPENDED DECK OPTION

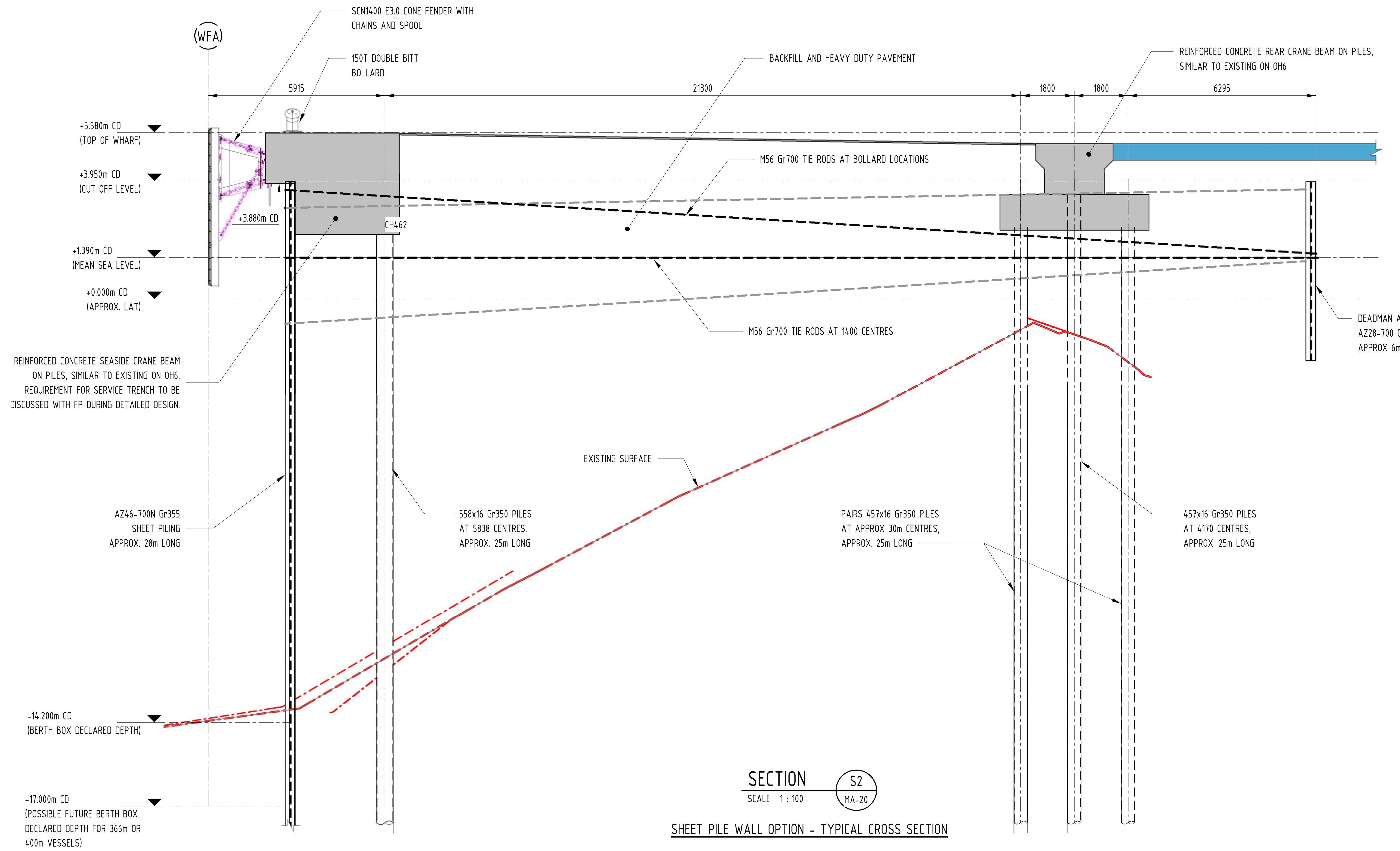
A1
DOCUMENT NUMBER
Job Number Sheet No. Rev.
Design MCD
Drawn ES
WGA221572-24-DR-MA-15 C

©



DETAIL D2 MA-05
SCALE 1 : 500

SHEET PILE WALL OPTION - PLAN VIEW



SECTION S2 MA-20
SCALE 1 : 100

SHEET PILE WALL OPTION - TYPICAL CROSS SECTION

C:\Users\ESanjari\Documents\WGA221572-24-MD-MA-R23_Berth 6 Extension_ESanjari.rvt
24/09/2024 1:38:20 PM

When sheet printed full size, the scale bar is 1:1 (100mm).
0 50 100mm

R G B
THIS DRAWING INCLUDES COLOURED INFORMATION
COPIES OF THIS DRAWING MUST BE PRODUCED IN COLOUR

CONCEPT ISSUE
NOT FOR CONSTRUCTION

REV.	DATE	DESCRIPTION	DRAFT.	ENG.	CHKD.
A	08.05.24	DRAFT ISSUE	ES	MCD	MCD
B	13.08.24	CONCEPT ISSUE	ES	MCD	DBM
C	24.09.24	CONCEPT ISSUE	ES	MCD	DBM

WGA

GatewaySA - BERTH 6 EXTENSION
FLINDERS PORTS
OUTER HARBOR, SA

SHEET PILE WALL OPTION

©

A1
DOCUMENT NUMBER
Job Number Sheet No. Rev.
Design MCD Drawn ES WGA221572-24-DR-MA-20 C

LEGEND

- PROPOSED STORMWATER
- EXISTING STORMWATER
- EXISTING ELECTRICAL (NOT IN SERVICE)
- EXISTING WATER
- EXISTING NBN
- EXISTING HV ELECTRICAL
- EXISTING HV ELECTRICAL OVERHEAD
- EXTENT OF STORMWATER CATCHMENT
- EXISTING STORMWATER PIT
- PROPOSED STORMWATER PIT
- EXISTING MAJOR CONTOUR (0.50m INTERVAL)
- EXISTING MINOR CONTOUR (0.1m INTERVAL)
- DESIGN MAJOR CONTOUR (0.50m INTERVAL)
- DESIGN MINOR CONTOUR (0.05m INTERVAL)

NOTE:

1. WHERE STORMWATER PITS ARE NOMINATED FOR DEMOLITION AND REPLACEMENT, EXISTING STORMWATER PIPE CONNECTIONS SHALL BE MAINTAINED INTO THE NEW PIT
2. WHERE CLASHES BETWEEN STORMWATER INFRASTRUCTURE AND OTHER SERVICES OCCUR, THE STORMWATER NETWORK TAKES PRECEDENCE AND RELOCATION OF THE CLASHING SERVICE SHALL BE UNDERTAKEN BY THE CONTRACTOR.
3. THE CONTRACTOR SHALL CONFIRM ALL CONNECTION INVERT LEVELS AND IDENTIFY ANY DISCREPANCIES TO THE DESIGNER PRIOR TO THE ORDERING OF ANY STORMWATER INFRASTRUCTURE.

THIS DRAWING IS TO BE VIEWED IN COLOUR AS SOME FEATURES / SYMBOLS ARE DIFFERENTIATED BY COLOUR. DRAWING NOT TO BE RELIED ON IF PRINTED IN GREYSCALE.

0 2.5 5 10 15
1 : 250m (A1) - 1 : 500m (A3)
100mm ON ORIGINAL DRAWING - DO NOT SCALE DRAWING

SHEET SIZE
A1

COORDS: GDA2020 MGA ZONE 54
DATUM: ALL LEVELS TO A.H.D.
SCALE: 1:500
SURVEYED:
SURVEY DATE:27.03.2024
APPROVED / PROJECT LEADER

REV	AMENDMENT / REASON FOR ISSUE	DATE	DES.	DWN.
A	50% DESIGN	18.07.24	IH	IH

PUBLIC AND PRIVATE UTILITIES:
THE SERVICES SHOWN ARE DERIVED FROM PLANS OBTAINED FROM THE PROVIDED SURVEY FILE. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO CONFIRM THE PRESENCE, LOCATION AND LEVEL OF ALL EXISTING SERVICES BEFORE EXCAVATION WORK COMMENCES.

tonkin
tonkin.com.au

NOT FOR CONSTRUCTION

Flinders Port Holdings

GATEWAY SA TERMINAL TRANSFORMATION
LOT 9 DETAIL DESIGN
DRAINAGE LAYOUT PLAN

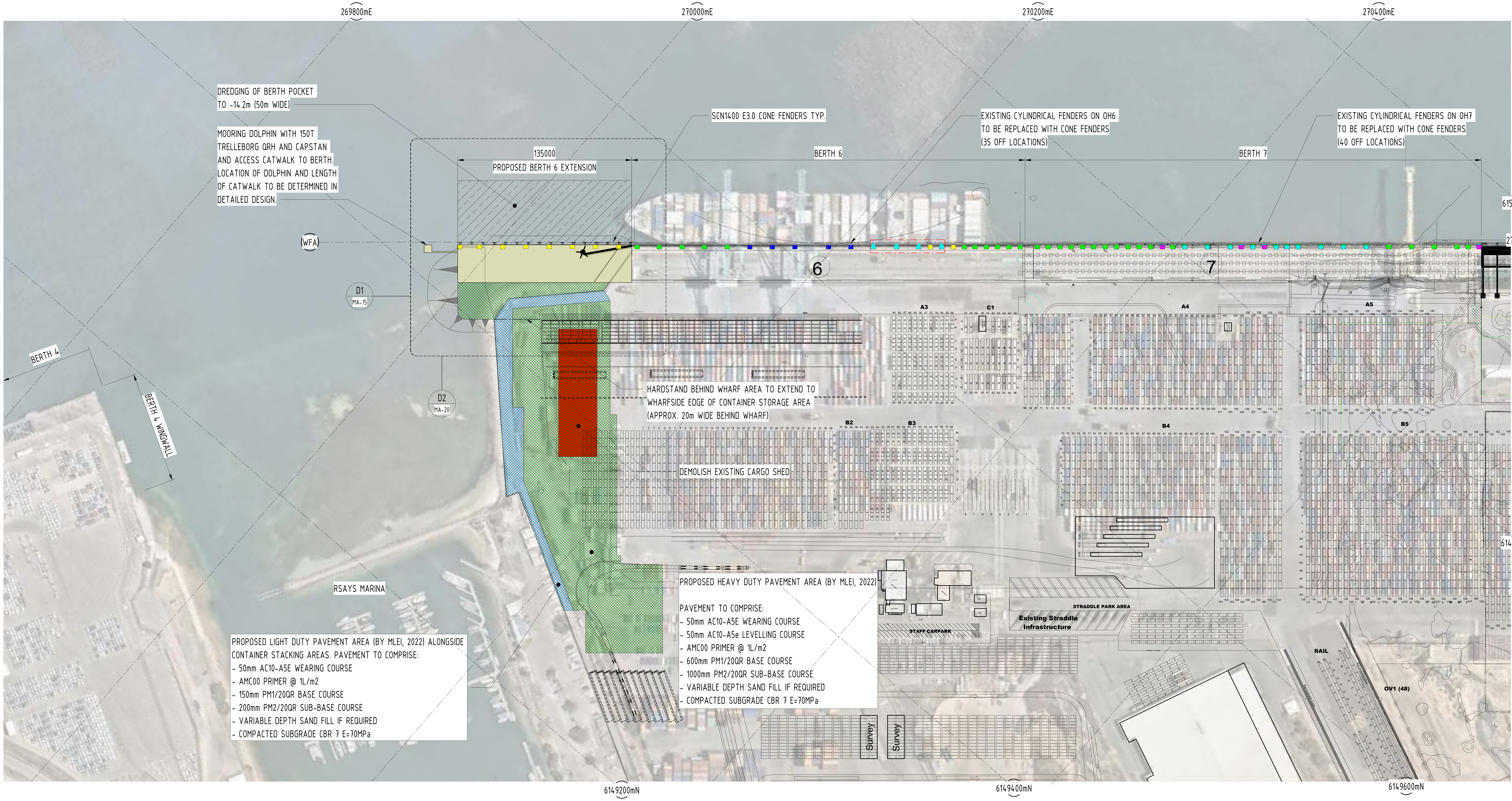
FILENAME: 241265-DW300.DWG

PROJECT NUMBER	DRAWING NUMBER	REVISION
241265	300	A

© TONKIN CONSULTING

Appendix B

Conceptual site plan



GENERAL ARRANGEMENT

SCALE 1 : 1500

BOLLARD LEGEND

- NO BOLLARD POSSIBLE
- UPGRADED 150t DOUBLE BITT BOLLARDS (NOT PART OF BERTH 6 EXTENSION SCOPE)
- EXISTING 80t KIDNEY BOLLARDS
- EXISTING 80t KIDNEY BOLLARDS TO BE UPGRADED (PART OF BERTH 6 EXTENSION SCOPE)
- NEW 150t DOUBLE BITT BOLLARDS (PART OF BERTH 6 EXTENSION SCOPE)

- PROPOSED HEAVY DUTY PAVEMENT AREA (BY MLEI, 2022)
- PROPOSED LIGHT DUTY PAVEMENT AREA (BY MLEI, 2022)
- DEMOLISHED AREA
- PROPOSED BERTH 6 EXTENSION / MOORING DOLPHIN
- PROPOSED CONTAINER STORAGE AREA

C:\Users\ESanjari\Documents\WGA221572-24-MD-MA-R23_Berth 6 Extension_ESanjari.rvt
24/09/2024 1:38:14 PM

When sheet printed full size, the scale bar is 1:1 (100mm).
0 50 100mm

R G B THIS DRAWING INCLUDES COLOURED INFORMATION
COPIES OF THIS DRAWING MUST BE PRODUCED IN COLOUR

CONCEPT ISSUE
NOT FOR CONSTRUCTION

REV.	DATE	DESCRIPTION	DRAFT.	ENG.	CHKD.
A	08.05.24	DRAFT ISSUE	ES	MCD	MCD
B	13.08.24	CONCEPT ISSUE	ES	MCD	DBM
C	24.09.24	CONCEPT ISSUE	ES	MCD	DBM

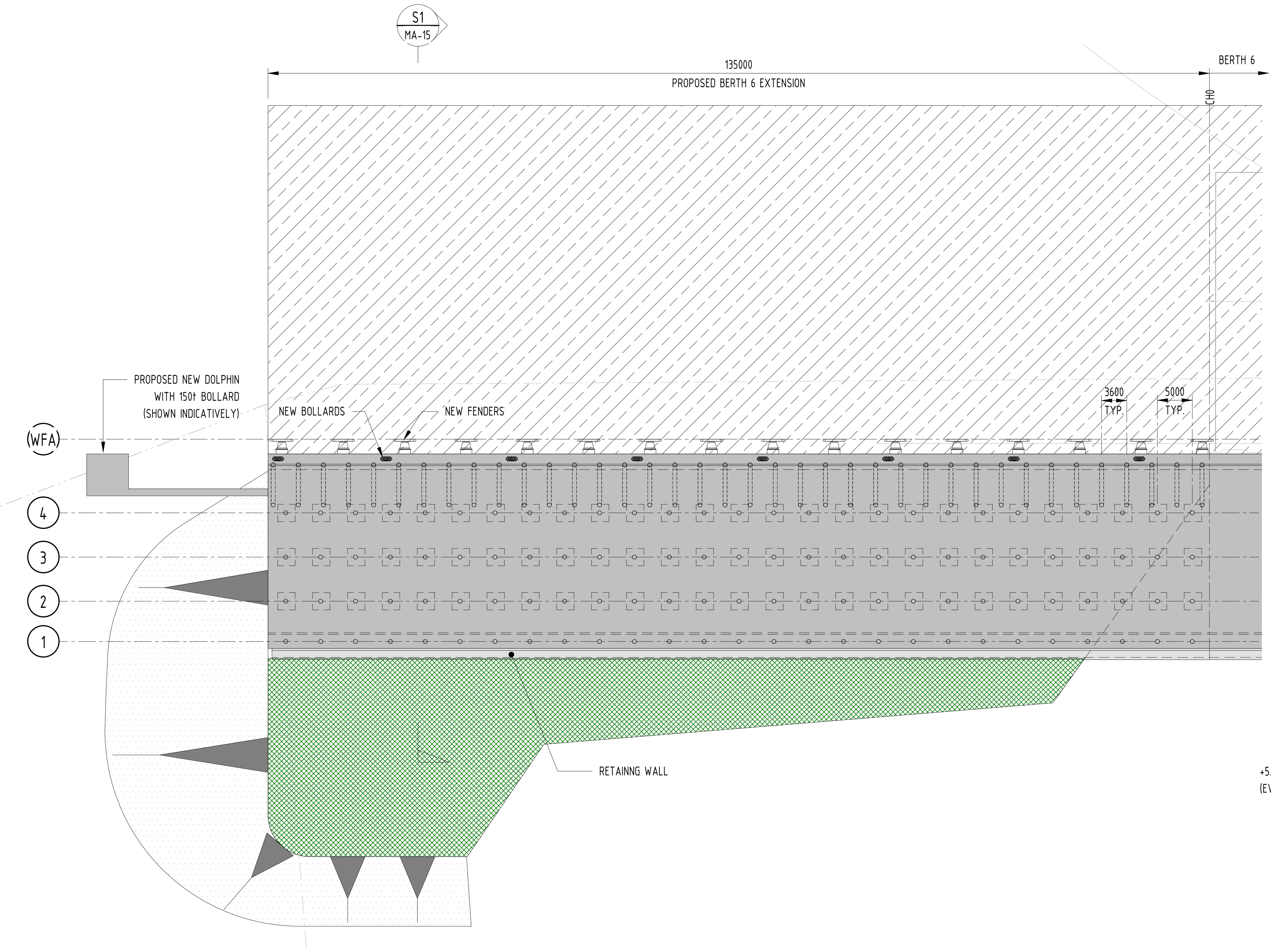
WGA

GatewaySA - BERTH 6 EXTENSION
FLINDERS PORTS
OUTER HARBOR, SA

GENERAL ARRANGEMENT

A1 | DOCUMENT NUMBER | Job Number | Sheet No. | Rev.
Design MCD | Drawn ES | WGA221572-24-DR-MA-05 | C

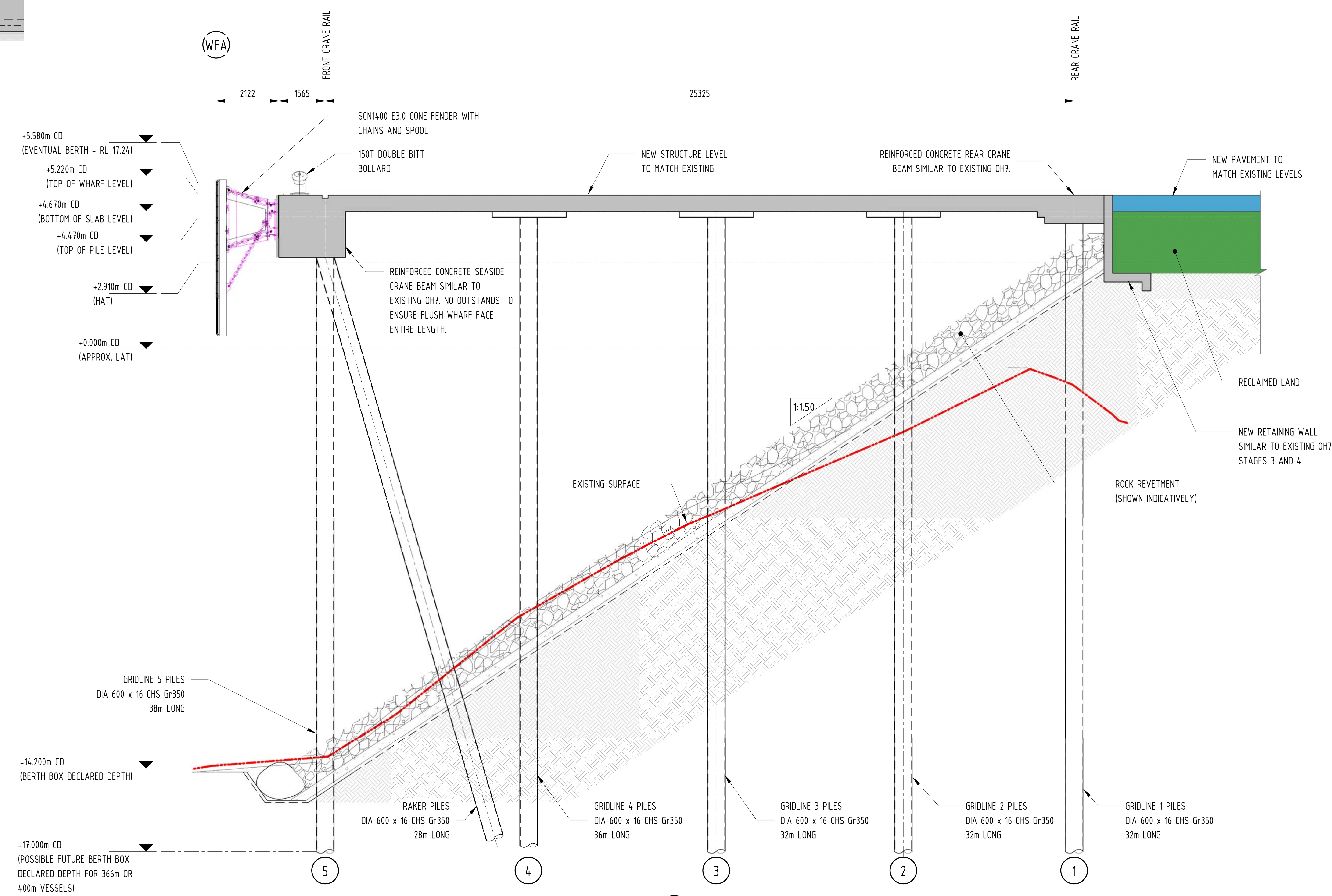
©



DETAIL D1

SCALE 1 : 500 MA-05

SUSPENDED DECK OPTION - PLAN VIEW



SECTION S1

SCALE 1 : 100 MA-15

SUSPENDED DECK OPTION - TYPICAL CROSS SECTION

C:\Users\ESanjari\Documents\WGA221572-24-MD-MA-R23_Berth 6 Extension_ESanjari.rvt
24/09/2024 1:38:15 PM

When sheet printed full size, the scale bar is 1:1 (100mm).
0 50 100mm

R G B
THIS DRAWING INCLUDES COLOURED INFORMATION
COPIES OF THIS DRAWING MUST BE PRODUCED IN COLOUR

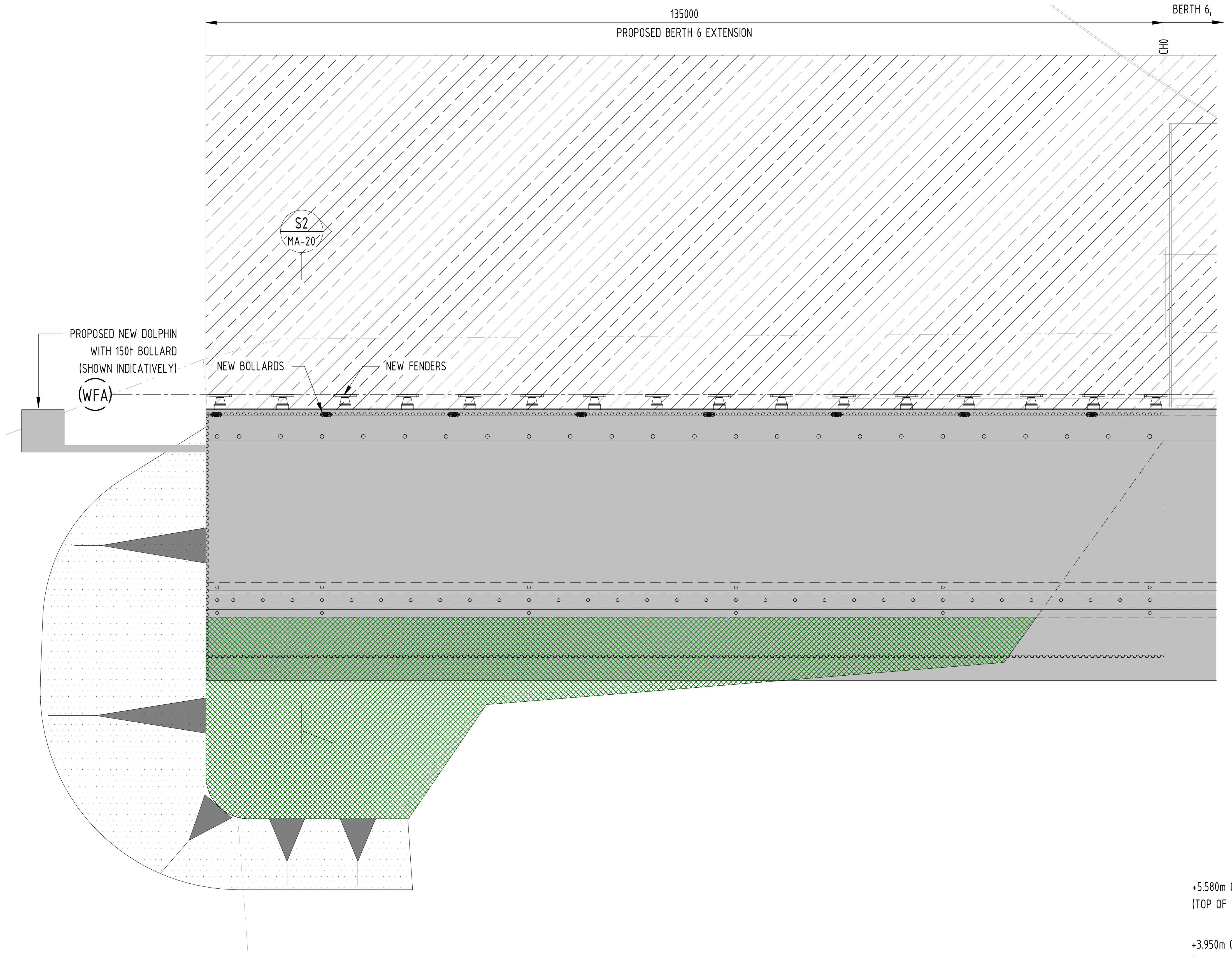
CONCEPT ISSUE
NOT FOR CONSTRUCTION

REV.	DATE	DESCRIPTION	DRAFT.	ENG.	CHKD.
A	08.05.24	DRAFT ISSUE	ES	MCD	MCD
B	13.08.24	CONCEPT ISSUE	ES	MCD	DBM
C	24.09.24	CONCEPT ISSUE	ES	MCD	DBM

WGA

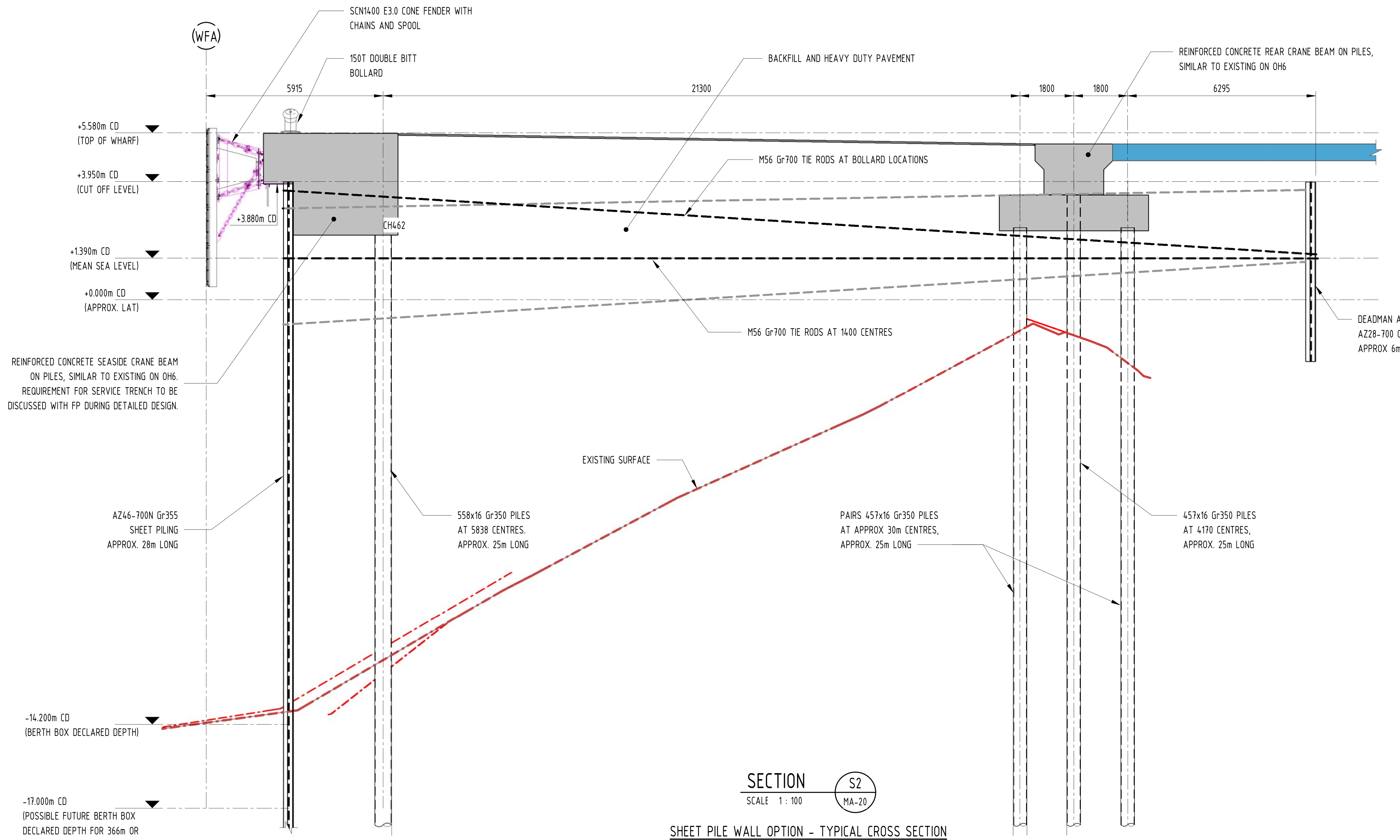
GatewaySA - BERTH 6 EXTENSION
FLINDERS PORTS
OUTER HARBOR, SA
SUSPENDED DECK OPTION

A1
DOCUMENT NUMBER
Job Number
Sheet No.
Rev.
Design MCD
Drawn ES
WGA221572-24-DR-MA-15 C



DETAIL D2 MA-05
SCALE 1 : 500

SHEET PILE WALL OPTION - PLAN VIEW



SECTION S2 MA-20
SCALE 1 : 100

SHEET PILE WALL OPTION - TYPICAL CROSS SECTION

C:\Users\ESanjari\Documents\WGA221572-24-MD-MA-R23_Berth 6 Extension_ESanjari.rvt
24/09/2024 1:38:20 PM

When sheet printed full size, the scale bar is 1:1 (100mm).
0 50 100mm

R G B
THIS DRAWING INCLUDES COLOURED INFORMATION
COPIES OF THIS DRAWING MUST BE PRODUCED IN COLOUR

CONCEPT ISSUE
NOT FOR CONSTRUCTION

REV.	DATE	DESCRIPTION	DRAFT.	ENG.	CHKD.
A	08.05.24	DRAFT ISSUE	ES	MCD	MCD
B	13.08.24	CONCEPT ISSUE	ES	MCD	DBM
C	24.09.24	CONCEPT ISSUE	ES	MCD	DBM

WGA

GatewaySA - BERTH 6 EXTENSION
FLINDERS PORTS
OUTER HARBOR, SA
SHEET PILE WALL OPTION

©

A1
DOCUMENT NUMBER
Job Number / Sheet No. / Rev.
Design MCD
Drawn ES
WGA221572-24-DR-MA-20 C

Appendix C
Parcel ID and title reference

REAL PROPERTY ACT, 1886

South Australia

The Registrar-General certifies that this Title Register Search displays the records maintained in the Register Book and other notations at the time of searching.

REGISTRAR - GENERAL SOUTH AUSTRALIA

Certificate of Title - Volume 6126 Folio 861

Parent Title(s)	CT 6105/395				
Creating Dealing(s)	DDA 12041316				
Title Issued	12/12/2013	**Edition**	6	**Edition Issued**	26/06/2020

Estate Type

FEE SIMPLE

Registered Proprietor

MINISTER FOR TRANSPORT, INFRASTRUCTURE AND LOCAL GOVERNMENT
OF ADELAIDE SA 5000

Description of Land

ALLOTMENT 1 DEPOSITED PLAN 73109
IN THE AREA NAMED OUTER HARBOR
OUT OF HUNDREDS (ADELAIDE) AND HUNDRED OF PORT ADELAIDE

Easements

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED K ON DP 73109 FOR DRAINAGE PURPOSES (RTC 10630220)

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED S.U AND V ON FP 53642 FOR DRAINAGE PURPOSES (TG 11839983)

SUBJECT TO EASEMENT(S) OVER THE LAND MARKED S.U AND V ON FP 53642 FOR DRAINAGE PURPOSES (TG 11839985)

TOGETHER WITH THE EASEMENT(S) OVER ALLOTMENT 11 IN DP 73109 (RTC 8934763)

TOGETHER WITH FREE AND UNRESTRICTED RIGHT(S) OF WAY OVER ALLOTMENT 11 IN DP 73109

TOGETHER WITH EASEMENT(S) OVER THE LAND MARKED T AND W ON FP 53642 FOR DRAINAGE PURPOSES (TG 11839984)

TOGETHER WITH RIGHT(S) OF WAY OVER THE LAND MARKED Q ON DP 73109 (TG 9209629)

TOGETHER WITH FREE AND UNRESTRICTED RIGHT(S) OF WAY OVER THE LAND MARKED D AND H ON DP 73109

Schedule of Dealings

Dealing Number	Description
10434595	LEASE TO FLINDERS PORTS PTY. LTD. (ACN: 097 377 172) COMMENCING ON 02/11/2001 AND EXPIRING ON 02/11/2100 AT 02:00 AM
11839986	UNDERLEASE OF PORTION OF LAND IN LEASE 10434595 TO VITERRA OPERATIONS LTD. COMMENCING ON 1/1/2009 AND EXPIRING ON 31/10/2100 (AREA A IN FP 54727)
12142654L	CAVEAT BY WESTPAC BANKING CORPORATION OVER LEASE 10434595

Copyright: www.landservices.com.au/copyright | Privacy: www.landservices.com.au/privacy | Terms of Use: www.landservices.com.au/sailis-terms-of-use

Notations

Dealings Affecting Title NIL

Priority Notices NIL

Notations on Plan NIL

Registrar-General's Notes

APPROVED FILED PLAN FOR LEASE PURPOSES FX54727
APPROVED FX53885

Administrative Interests NIL

Copyright: www.landservices.com.au/copyright | Privacy: www.landservices.com.au/privacy | Terms of Use: www.landservices.com.au/sailis-terms-of-use

Certificate of Title

Title Reference:	CT 6126/861
Status:	CURRENT
Parent Title(s):	CT 6105/395
Dealing(s) Creating Title:	DDA 12041316
Title Issued:	12/12/2013
Edition:	6

Dealings

Lodgement Date	Completion Date	Dealing Number	Dealing Type	Dealing Status	Details
24/06/2020	26/06/2020	13322577	VESTING (GLOBAL PROPRIETORSHIP UPDATE)	REGISTERED	MINISTER FOR TRANSPORT, INFRASTRUCTURE AND LOCAL GOVERNMENT
10/08/2016	10/08/2016	12580211	TITLE REPAIR - ENDORSEMENT	REGISTERED	FLINDERS PORTS PTY. LTD. (ACN: 097 377 172) 10434595
19/02/2016*	23/02/2016	12322795	EXTENSION OF LEASE	REGISTERED	10434595
22/09/2015	28/09/2015	12400278	TITLE REPAIR - ENDORSEMENT	REGISTERED	FLINDERS PORTS PTY. LTD. (ACN: 097 377 172) 10434595
21/08/2015	07/09/2015	12383774	TITLE REPAIR - ENDORSEMENT	REGISTERED	10434595
22/10/2014	22/10/2014	12214936	AMENDMENT TO ENDORSEMENT DETAILS	REGISTERED	12142654L
06/06/2014	09/10/2014	12142654L	CAVEAT (SUBSIDIARY INTEREST)	REGISTERED	WESTPAC BANKING CORPORATION 10434595
06/06/2014	09/10/2014	12142650	DISCHARGE OF MORTGAGE	REGISTERED	10434620
26/10/2012	11/01/2013	11839986	UNDER LEASE	REGISTERED	VITERRA OPERATIONS LTD. (ACN: 007 556 256) 10434595
05/04/2006	21/09/2006	10434620	MORTGAGE OF LEASE	REGISTERED	COMMONWEALTH BANK OF AUSTRALIA 10434595
05/04/2006	21/09/2006	10434595	LEASE	REGISTERED	FLINDERS PORTS PTY. LTD. (ACN: 097 377 172)

Copyright: www.landservices.com.au/copyright | Privacy: www.landservices.com.au/privacy | Terms of Use: www.landservices.com.au/sailis-terms-of-use

Appendix D

Adequacy review of marine assessments undertaken to date

EMM
creating opportunities

Level 3 175 Scott Street
Newcastle NSW 2300
ABN: 28 141 736 558

02 4907 4800

www.emmconsulting.com.au

Memorandum

16 December 2024

To: Josh Smith
GatewaySA – Program Director
Flinders Port Holdings
296 St Vincent Street
Port Adelaide, SA 5015

From: Paul Goldsworthy, Technical Lead – Environmental Risk (Marine Ecology)

Subject: Proposed Berth 6 Extension - Adequacy of existing marine assessments

1 Purpose

EMM Consulting Pty Limited (EMM) has been engaged to support Flinders Ports Holdings Pty Ltd (FPH) proposed Berth 6 Extension Development Application (DA), pursuant to Section 131 Development assessment – Crown development of the *Planning, Development and Infrastructure Act 2016*.

This Technical Memorandum has been prepared to review the adequacy of various marine studies completed by FPH to support the DA, particularly in relation to assessing potential impacts to the marine environment in relation to:

- construction management
- dredging (minor) and land reclamation
- water quality
- acoustic noise and marine mammals
- native vegetation (seagrass) clearance
- pacific oyster mortality syndrome (POMS).

2 Background

FPH propose to expand its existing container storage operations at the Flinders Adelaide Container Terminal (FACT) located in Outer Harbor (referred to by FPH as the GatewaySA Program) in the Port of Adelaide, South Australia (SA).

As part of GatewaySA Program, FPH is proposing an extension to the Berth 6 Wharf to facilitate improved dockside servicing of larger cargo vessels at the FACT. The FACT is a world class facility able to facilitate Panamax and Post-Panamax class vessels with shipping services that connect SA to destinations in most of the world's continents.

To meet forecast shipping demand from larger vessels, FPH proposes to upgrade its existing FACT operations, including extending the existing Berth 6 wharf by approximately 135 metres (m). The berth extension will overcome current limitations of FACT's existing berth line due to the inability to simultaneously accommodate two of the larger container vessels.

The design of the proposed Berth 6 upgrade has evolved from a formerly proposed extended length of 179 m and reclamation of approximately 1.6 hectares (ha) of marine habitat to the currently proposed 135 m extended length and 0.3 ha reclamation (i.e. substantially smaller).

Based on the former design of the wharf upgrade, FPH commissioned marine assessments in support of an EPBC self-assessment and the state DA approval. EMM was engaged to review the adequacy of those marine assessment reports with respect to the latest design of the Berth 6 upgrade, and to identify any gaps that would need additional assessment to support the project approval process.

3 Existing marine assessments

Various technical reports have been submitted to FPH on aspects of the marine environment relative to the former design for the Berth 6 upgrade including the following (ordered by date):

- *Berth 6 Upgrades – Water Quality Management Plan*, 13 May 2024 (JBS&G Australia Pty Ltd)
- *Dredge Management Plan Framework*, 13 May 2024 (JBS&G Australia Pty Ltd)
- *Outer Harbour Berth 6 – Benthic survey report*, 31 May 2024 (J. Diversity Pty Ltd)
- *Outer Harbor Berth 6 Precinct Upgrade Pacific Oyster Mortality Syndrome (POMS) Management Plan*, 3 June 2024 (J. Diversity Pty Ltd)
- *Native Vegetation Clearance Outer Harbor Berth 6 Extension (Dredging and land reclamation) Data Report*, 3 June 2024 (J. Diversity Pty Ltd)
- *Berth 6 Precinct upgrade – EPBC Self-assessment*, 3 June 2024 (JBS&G Australia Pty Ltd)
- *Gap analysis of available data/reports and plans to support the Berth 6 Precinct Upgrade Development Application*, 3 June 2024 (JBS&G Australia Pty Ltd)
- *Port Adelaide Berth 6 Extension - Coastal Processes Assessment*, 10 June 2024 (BMT Commercial Australia Pty Ltd).

These reports were reviewed by EMM to assess their adequacy in providing relevant and necessary information to inform the project approval process for the revised berth design, and to identify any critical gaps that may affect the approval.

3.1 Berth 6 Upgrades – Water Quality Management Plan (JBS&G 2024a)

JBS&G (2024a) proposed a Water Quality Management Plan (WQMP) framework that focuses on monitoring water quality before, during and after the proposed dredging of the extended berth pocket for the former Berth 6 design. JBS&G defines a proposed dredging location (PDL) that 'represents an area of 690 m^2, and with a corresponding volume of approximately 550 m^3 of spoil' (p.1). The dredged material (spoil) will be disposed of on land at FPH's nearby dredge ponds at Pelican Point.

EMM notes the following based on a review of the WQMP framework:

- The proposed dredging area and spoil volumes are largely unchanged for the latest berth design, since the required berth pocket will be almost the same size.
- The description of the receiving environment (Section 3) is sufficient to define the location of proposed dredging activities relative to the known benthic habitat. The report's Figure 3-2 shows the distribution of seagrass (*Zostera* sp.) relative to the PDL and the proposed reclamation area.
- The review of existing water quality in the Port River (Section 4) provides an overview of historical surface water quality at EPA Monitoring Site 3 (approximately 500 m north-east of Berth 6) between 1995 and 2008. Additional water quality data are discussed for sites further from Berth 6, as measured by Golder (2021). Continuous turbidity data are being collected by FPH from a sonde installed in January 2024.
- The proposed collection of continuous turbidity data for 12 months is appropriate and useful as a baseline against which monitoring data collected during dredging can be compared.

EMM considers that the proposed WQMP framework, including the use of turbidity monitoring, is suitable for monitoring the effects of dredging associated with the revised Berth 6 upgrade.

3.2 Dredge Management Plan Framework (JBS&G 2024b)

JBS&G prepared a Dredge Management Plan Framework (DMP Framework) to support the DA for the proposed extension of Berth 6 (JBS&G 2024b). The DMP Framework refers to 'capital dredging' that is required to enlarge the berth pocket to align with the longer berth.

EMM understands that FPH has 'in-principle' agreement from Environment Protection Authority (EPA) that the required dredging would fit within their existing maintenance dredging permit and will not require a capital dredging permit.

JBS&G defines a proposed dredging location (PDL) that 'represents an area of 690 m^2, and with a corresponding volume of approximately 550 m^3 of spoil'. The revised Berth 6 Extension proposes the same location (albeit the wharf extension length is shorter), 550 m^2 of dredging and 900 m^3 dredging volume. Further, the EPA has confirmed in writing that the low volume (~900 m^3) could be undertaken under the existing licence.

The DMP Framework refers to existing knowledge of sediment quality (Golder 2020) and benthic habitats (J. Diversity 2024a).

The DMP framework describes environmental management measures for potential environmental impacts from the proposed dredging activities based on the EPA's Dredge Guideline (2020). The management framework separately discusses the different key elements of importance as listed (p.9). The elements considered to be most critical for the minor dredging volumes being proposed are discussed briefly below.

3.2.1 Water quality

Water quality is discussed with respect to turbidity and impacts on seagrass. Noting that the latest design significantly reduces the proposed area of reclaimed seabed (0.3 ha), the DMP Framework is considered adequate to consider and mitigate potential risks to seagrass.

The assessment includes reference to 'results of plume modelling' to assess increased turbidity levels at areas of seagrass adjacent to the dredging footprint and to inform the potential need to implement additional controls.

The previously discussed Water Quality Management Plan (JBS&G 2024a) is included as Appendix A.

3.2.2 Sediment quality

The management framework for sediment quality is based on the results from Golder (2020), which concluded that trace metals concentrations were below Waste Fill criteria, human health and ecological screening guidelines, Australia New Zealand Guideline (ANZG) and National Assessment Guidelines for Dredging (NAGD) sediment screening levels.

FPH have also confirmed with the EPA that these 2020 sediment quality data could be used for the project if the 'dredge depth and volume had not changed'.

3.2.3 Interactions with marine mammals

Consideration of potential impacts and risks to marine mammals is warranted due to the dredging location being within the Adelaide Dolphin Sanctuary.

Risks to dolphins from dredging are considered low, and the proposed controls around vessel speeds, marine fauna observers, soft starts and imposing caution zones and pause zones are appropriate to minimise risks.

3.2.4 Management of POMS

Pacific Oyster Mortality Syndrome (POMS) is a specific risk for the proposed dredging due to it being endemic within the Port River since 2018. The primary risk is to commercial oyster farms from the spread of the POMS virus.

The risk from the proposed dredging is considered low given that spoil will be disposed on land. Notwithstanding this, a POMS Management Plan (Appendix B) has been prepared to provide the Department of Primary Industries, Resources and Regions, South Australia (PIRSA) confidence that the risks are being appropriately addressed.

3.2.5 Noise

The proposed controls to reduce the impacts and risks from noise, primarily underwater noise, are appropriate and typical for dredging activities. Noise from piling (indicated as higher risk than from dredging) is discussed here as well although it is not typically included in a DMP despite the use of similar controls, such as soft starts, observers and caution/pause zones.

Overall, JBS&G's proposed DMP Framework is considered appropriate for the proposed dredging at Berth 6 and addresses the typical risks associated with small scale dredging. EMM note that specific management plans will need to be developed as a DA condition of consent once the dredging methodology is finalised by FPH and the contractor.

3.3 Outer Harbour Berth 6 - Benthic survey report (J. Diversity, 2024a)

J. Diversity (2024a) reports benthic survey results for areas potentially impacted by proposed dredging and land reclamation, plus a 'reasonable' buffer into the shipping channel (double the width of the dredging footprint) and 'south far enough to capture the entirety of the shallow/intertidal mud flat' between Berth 3 and the Royal South Australian Yacht Squadron (RSAYS).

The purpose of the survey was to 'map benthic habitats, particularly seagrass, and characterise and quantity the fauna, with a focus on bivalves, pest species and species of conservation significance'.

Seagrass was reported in areas adjacent to the originally proposed dredging footprint but the substrate within the footprint was predominantly silt/sand. Isolated individuals of razor clam (*Pinna bicolor*) occur in deeper water in and adjacent to the shipping channel, and several bivalves, including queen scallop (*Equichlamys bifrons*), native oyster (*Ostrea angasi*) and hammer oyster (*Malleus meridianus*) were recorded where the dredging is proposed.

Seagrass was recorded within the footprint of the previous berth extension, comprising predominantly sparse subtidal *Zostera* and a narrow margin of medium *Zostera* along the base of the existing rock revetment. J. Diversity states that the very sparse *Zostera* are 'likely to be functionally equivalent, in an ecological sense, to bare silt' (p.22).

The current (shorter) berth extension will overlay a small area of intertidal seagrass, estimated to be less than 0.1 ha – compared to 0.5 ha within the formerly proposed reclamation area (p.13). With the revised berth design, more than 0.8 ha (90%) of the known dense intertidal/shallow subtidal seagrass would be outside the footprint and unaffected by direct impacts.

Pacific oysters (*Magellana gigas*) were dominant on the rocks at the base of the rock revetment and razor clams were common across the intertidal mudflat, around the river-facing edges of the mudflat and in the shallow water adjacent to the northern rock revetment. A few other mollusc species occur amongst the rocks of the revetment.

Neither of the introduced 'pest' macroalgae species – *Caulerpa cylindracea* or *Caulerpa taxifolia* – were recorded anywhere during the assessment.

With the revised smaller footprint of the Berth 6 extension and associated berth pocket, the direct impacts to seagrass will be on a much smaller scale compared to the former design and not considered to be significant impact on local habitats. Areas of sediment with razor clams occur within the dredging and berth footprint but it is unlikely that the wider population would be impacted.

The benthic assessment, therefore, appropriately covers areas likely to be impacted by the proposed works and indicates that the dredging campaign is unlikely to result in any significant loss of benthic habitat. On this basis, the J. Diversity (2024a) management measures are considered appropriate for the revised berth design.

3.4 Outer Harbor Berth 6 Precinct Upgrade Pacific Oyster Mortality Syndrome (POMS) Management Plan (J. Diversity 2024b)

(POMS is a specific issue for the Port River due to the virus being classified as endemic in 2018 and the subsequent introduction of strict management protocols to prevent its spread to commercial oyster farms beyond the river. The management requirements have implications for the movement of sediment and bivalves, including in dredge spoil, and the management of plumes and drainage water (from land-based spoil disposal areas).

J. Diversity (2024b) provide an assessment of risk from POMS and propose management actions to minimise the risk of spreading POMS outside of the project area. According to the report, 'although the Pacific oyster can be found attached to hard substrates, rocks, debris and shells from the lower intertidal zone to depths of 40 m, it is generally found only in the intertidal zone within the Port River.' The species was recorded during the survey of the rock revetment at Berth 6.

The current ban on the removal of bivalves from the Port River (PIRSA 2022) under the Fisheries Management (General) Regulations 2017, includes removal by dredging and removal of rock revetment with attached bivalves. These activities (removal of bivalves or deposit of rocks with Pacific oyster) would require a Determination and a Ministerial permit under the *Fisheries Management Act* 2007.

POMS may spread through carrier organisms, including larvae (Pacific oysters or other bivalves), by water or sediment contaminated by the virus or by translocation on vessels or equipment.

Removal and reuse of the rock revetment as new rock armour has the potential to spread POMS if rocks with attached bivalves are placed back into the intertidal zone, however, any reuse of rocks within the Project would presumably be at Berth 6 (as new revetment or backfill) and effectively would not move rocks very far from their source.

Dredged material is likely to include bivalves, and the spoil would be disposed on land in the Pelican Point Dredge Ponds, which would minimise the risk of POMS transmission. If sheet piles are used in the wharf construction, the dredged material would be used as back fill behind the sheet piles and would therefore be isolated from the river and minimise the risk of POMS transmission.

POMS transmission is lower in cooler water and therefore dredging could be scheduled for winter when the water temperatures will help to minimise the risk of POMS transmission.

The controls outlined in the POMS management plan are considered adequate to minimise the risk of POMS transmission from dredging activities. If all controls are implemented, the overall risk of POMS transmission for the dredging campaign is considered to be low.

3.5 Native Vegetation Clearance Outer Harbor Berth 6 Extension (Dredging and land reclamation) Data Report (J. Diversity 2024c)

This report presents relevant information on direct clearance of seagrass for the Project due to the dredging and land reclamation, as covered under the Native Vegetation Regulations 2017. This assessment is based on the former (larger) berth design, involving a significantly larger area of reclamation than proposed in the latest design.

The contents of this report are relevant to the new design except that the proposed seagrass impact area is smaller, and comprises 0.11 ha of 'very sparse *Zostera*' and 0.1 hectares of 'dense intertidal/shallow subtidal *Zostera*. Consequently, the proposed payment of $29,278.64 (excl GST) plus an admin fee of $1,610.33 into the Native Vegetation Fund is no longer valid, and a smaller total payment of around $7,500 (excl GST) is more likely. The exact payment amount will need to be confirmed.

3.6 Berth 6 Precinct upgrade – EPBC Self-assessment (JBS&G 2024c)

The EPBC Self-assessment prepared by JBS&G (2024c) concludes that an EPBC referral is not required due to the absence of significant impacts on matters of national environmental significance (MNES). There were no MNES of concern within the Project area or within the 5 km assessment buffer.

The EPBC Self-assessment is considered relevant to and adequately addresses the revised (and smaller) dredging footprint.

3.7 Gap analysis of available data/reports and plans to support the Berth 6 Precinct Upgrade Development Application (JBS&G 2024d)

JBS&G (2024d) reviewed the existing data, reports and plans provided by FPH in May 2024 with the purpose of 'identifying any gaps for further studies and/or assessments.' The information that was reviewed pertained to the proposed Berth 6 Upgrade as well as other projects in the Port River, such as the Inner Harbour Maintenance Dredging and the Outer Harbour Channel Widening Project (OWCHP).

The review of Berth 6 Upgrade documents identified the following:

- Native vegetation clearance – due to the likely loss of seagrass within the footprint of Berth 6 (but not the within the dredging footprint), as discussed above, the total estimated loss of seagrass needs to be updated in accordance with the revised design, with a smaller footprint and smaller area of seagrass directly impacted. The estimated fee payable into the Native Vegetation Fund will be smaller than indicated by J. Diversity and needs to be recalculated to be commensurate with the likely loss of seagrass.

- POMS management – acknowledgement of the current ban on the removal of bivalves from the Port River (PIRSA 2022) under the Fisheries Management (General) Regulations 2017, including removal by dredging and removal of rock revetment with attached bivalves. The proposed activities (removal of bivalves and/or deposit of rocks with Pacific oyster) would require a Determination and a Ministerial permit under the *Fisheries Management Act* 2007. The POMS Management Plan was developed (see review above).

  Minutes of meetings with PIRSA (21 March 2024) indicate:

  - ideally avoid undertaking dredging in water >16–17 °C
  - physical cleaning of vessels – slip vessel, physically remove biofouling, disinfect with detergent and/or hot water followed by air drying
  - spoil disposal on land is best practice; dewatering into river would require additional mitigation measures
  - permit to remove bivalves is required under the *Fisheries Management Act* 2007
  - changes to the *Biosecurity Act* may be in effect for this project
  - *Caulerpa* biosecurity risk must also be addressed
  - POM Management Plan is normally a condition of the DA, and has been appended to the DA; the plan must also consider water temperature and timing of dredging
  - testing for POMS in bivalves in spoil is required if dewatering of dredge ponds into the river.

- EPBC Self-assessment – an EPBC referral was submitted for the OHCWP, and the proposed activity was deemed to be 'not a controlled action if undertaken in a particular manner'. An EPBC Self-assessment was prepared for the Berth 6 Upgrade (see review above) and a referral under the EPBC Act was deemed 'not to be required'.

JBS&G subsequently prepared a Dredge Management Plan (DMP) framework (2024b) and a Water Quality Monitoring Program (WQMP) framework (2024a) – see reviews above.

3.8 Port Adelaide Berth 6 Extension - Coastal Processes Assessment (BMT 2024)

BMT undertook an assessment of the potential effect of the new berth design on coastal processes, such as the characteristics of water flow and circulation patterns and their effects on the accumulation of wrack and sediment deposition within the local area.

BMT concluded that there would be no significant changes to water flow velocities and sedimentation (erosion/deposition) outside the RSAYC marina and no significant change in flushing (circulation) within the marina, or wrack accumulation within and outside the marina.

Those results are based on the former (larger) berth development design so the current (smaller) design with piles or sheets is likely to be even less of an impact and no additional modelling is considered necessary.

3.8.1 FPH Maintenance Dredging Permit (51153)

EMM note that FPH's existing maintenance dredging permit (No. 51153) does not specifically require plume modelling, however the licence does state:

- Condition 2.8 MAINTENANCE DREDGE MANAGEMENT PLAN (S – 290) The Licensee must:

  2.8.1 where a maintenance dredging campaign employs a dredging or dewatering methodology, or dredge spoil disposal location (the Dredging Scheme) which varies from the Dredging Scheme approved in a development approval associated with previous dredging works at the same location, the licensee must submit to the EPA, at least 20 business days prior to the commencement of the maintenance dredging campaign, a Maintenance Dredge Management Plan (MDMP).

  The EPA will assess the Maintenance Dredge Management Plan against the EPA Dredge Guideline 2020

- Condition 3.2 TURBIDITY MANAGEMENT (S – 291) The Licensee must:

  3.2.1 take all reasonable and practicable measures to prevent or minimise environmental harm that may be caused by turbidity resulting from dredging and dewatering (works); and

  3.2.2 ensure that where a water quality management plan has been implemented, provide all water quality monitoring data (including raw turbidity data documented in the approved spreadsheet template) to the EPA upon request, or at completion of the works.

In this regard the DA should outline relevant content from JBS&G's Dredge Management Framework to indicate how dredging activities are proposed to be managed in accordance with the EPA's Dredge Guideline (2020) and in particular to satisfy the following key requirements:

- The 'EPA expect that all dredge contractors consider best available technology economically achievable (BAT) when planning their dredge campaign and do everything reasonable and practicable to ensure that environmental harm is minimised' including 'Using modelling or <u>already acquired data</u> to identify the fate and extent of turbidity plumes generated during dredging, and spoil dewatering and placement.' (Section 5.1, p.35)

- Section 5.3 (Information Checklist) of the Dredge Guideline (2020) provides 'guidance on the level of information required by EPA to undertake an assessment'. Under 5.3.2 (Water quality) 'hydrodynamic modelling and sediment deposition modelling to predict the fate and degree of turbidity plumes' **is required if** 'Spoil contains a portion of fine sediments (~ more than 1% clays/silts) AND/OR Dredge spoil volume is greater than 100,000 m^3 and duration of dredge campaign is greater than 8 weeks.'

  It is noted that the Berth 6 sediment is described as 47.5% silt + 10.5% clay (Golder 2020) but the dredging volumes and duration are small.

4 Adequacy review conclusions

EMM's review of the available environmental documentation prepared in support of the proposed Berth 6 Upgrade indicates that the supporting information is adequate to inform the DA and the subsequent preparation of management plans for the Project.

The latest design has a smaller footprint and therefore is likely to have less of an impact on marine aspects than the former design, and therefore the supporting information adequately covers the current design elements.

The following considerations are of note:

- Dredging of the enlarged berth pocket will remove a relatively small volume (approximately 900 m^3 dredging volume) of essentially uncontaminated sediment from subtidal areas of the Port River.

- Dredge spoil disposed on land in the Pelican Point Dredge Ponds (if the wharf is piled construction) or reused as backfill (if the wharf construction involves sheet piles or king piles) will contain an unknown number of bivalves which triggers the need for a permit under the *Fisheries Management Act* 2007 due to the risk of POMS transmission. Testing of bivalves may be required to assess the POMS risk associated with dewatering of spoil if tailwater is to be discharged into the Port River:

    - PIRSA recommends undertaking dredging during cooler months due to a lower risk of POMS transmission.

    - Management of Biosecurity risks associated with Project vessels is requested by PIRSA, with respect to minimising the spread of POMS and pest species.

    - Include measures to manage risks of translocating marine pests, specifically macroalgae (*Caulerpa* spp.) and European fan worms (*Sabella spallanzanii*) during dredging.

    - The removal of rocks from the existing revetment and reuse in new revetments or as low-level backfill in reclaim areas may trigger a permit under the *Fisheries Management Act* 2007 due to POM transmission risks.

- No sediment plume modelling has been undertaken given the small volumes of material to be dredged, the short dredging period and the agreement from EPA that dredging can be undertaken under FPH's existing maintenance dredging permit. The EPA have also supported the proposed approach that sediment plume modelling would not be required.

- Based on the revised Berth 6 design, the significantly smaller area of seagrass clearance requires recalculation as does the payment amount to the Native Vegetation Fund.

- The EPBC Self-assessment conclusion that there is no requirement to submit a referral under the EPBC Act is valid based on the absence of significant impacts to matter of national environmental significance (MNES) under the EPBC Act.

- No additional coastal processes modelling is considered necessary for the new Berth 6 design due to the smaller footprint.

- Management plans will need to be developed as a DA condition of consent to address dredging methodology once finalised and ongoing turbidity and water quality monitoring in the Port River (i.e. triggers for monitoring during the Project).

Yours sincerely,

Paul Goldsworthy
Associate, Technical Lead - Environmental Risk

pgoldsworthy@emmconsulting.com.au

References

BMT (2024) *Port Adelaide Berth 6 Extension - Coastal Processes Assessment*, Report prepared for JPH by BMT Commercial Australia Pty Ltd, 10 June 2024

EPA (2020) *Dredge Guideline*. South Australian Environmental Protection Authority. August 2020.

Golder (2020) *Flinders Ports Berth 6 Dredging Seagrass Survey, Sediment Sampling and Characterisation*. Report prepared by Golder Associates for Flinders Port Holdings.

JBS&G (2024a) *Berth 6 Upgrades – Water Quality Management Plan*, Report prepared for FPH by JBS&G Australia Pty Ltd, 13 May 2024

JBS&G (2024b) *Dredge Management Plan Framework*, Report prepared for FPH by JBS&G Australia Pty Ltd, 13 May 2024

JBS&G (2024c) *Berth 6 Precinct upgrade – EPBC Self-assessment*, Report prepared for FPH by JBS&G Australia Pty Ltd, 3 June 2024

JBS&G (2024d) *Gap analysis of available data/ reports and plans to support the Berth 6 Precinct Upgrade Development Application*, Report prepared for FPH by JBS&G Australia Pty Ltd, 3 June 2024

J. Diversity (2024a) *Outer Harbour Berth 6 - Benthic survey report*, Report prepared for FPH by J. Diversity Pty Ltd, 31 May 2024

J. Diversity (2024b) *Outer Harbor Berth 6 Precinct Upgrade Pacific Oyster Mortality Syndrome (POMS) Management Plan*, Report prepared for FPH by J. Diversity Pty Ltd, 3 June 2024

J. Diversity (2024c) *Native Vegetation Clearance Outer Harbor Berth 6 Extension (Dredging and land reclamation) Data Report*, Report prepared for FPH by J. Diversity Pty Ltd, 3 June 2024

Appendix A

JBS&G Water Quality Management Plan

EMM
creating opportunities

Berth 6 Upgrades – Water Quality Management Plan

Flinders Port Holdings

Report

JBS&G 66422 | 159,382

13 May 2024

We acknowledge the Traditional Custodians of Country throughout Australia and their connections to land, sea and community.

We pay respect to Elders past and present and in the spirit of reconciliation, we commit to working together for our shared future.

Caring for Country The Journey of JBS&G
Artist: Patrick Caruso, Eastern Arrernte

Table of Contents

List of Tables

List of Figures

Abbreviations

Term	Definition
µS	micro-Siemens
ANZG	Australian and New Zealand Guidelines for Fresh and Marine Quality
ASS	Acid Sulphate Soil
DMP	Dredge Management Plan
DO	Dissolved Oxygen
EPA	Environment Protection Authority
EP Act	*Environment Protection Act 1993*
FACT	Flinders Adelaide Container Terminal
FNU	Formazin Nephelometric Unit
FPH	Flinders Port Holdings
NTU	Nephelometric Turbidity Unit
NWQMS	National Water Quality Management Strategy
PDL	Proposed Dredging Location
The Project	Proposed Berth 6 Precinct upgrade
Water Quality EPP	Environment Protection (Water Quality) Policy 2015
WQMP	Water Quality Monitoring Plan

1. Introduction

Flinders Port Holdings (FPH) are proposing to undertake capital dredging as part of upgrade works to their Berth 6 Precinct ('Berth 6 Precinct upgrade' or 'the Project" herein). Berth 6 is part of the Flinders Adelaide Container Terminal (FACT) owned by FPH and located in Outer Harbor in the Port of Adelaide.

The proposed upgrade works include an extension of Berth 6 to a length of 179 m and width 27.89 m width to accommodate for the forecast higher vessel sizes and volumes over the coming decades.

As part of the Berth 6 extension work, dredging is required. The Proposed Dredging Location (PDL) represents an area of 690 m^2, and with a corresponding volume of approximately 550 m^3 of spoil. Spoil is proposed to be disposed of on land at dredge ponds located approximately 800 m from the PDL. Dredging methodology is to be confirmed following detailed design but would likely involve a cutter suction dredger.

Construction works would be undertaken over a nominal period of approximately 12 months with the dredging component to occur over a 2-4-week period, subject to constraints associated with weather, tides and Port traffic.

2. Purpose and scope

This Water Quality Monitoring Plan (WQMP) Framework has been prepared to support the development application for the Berth 6 Precinct upgrade works. This WQMP Framework should be read together with the Dredge Management Plan (DMP) Framework.

2.1 Monitoring Objectives

The WQMP Framework details the proposed water quality monitoring program that will be implemented by FPH before, during and after the proposed dredging activities in order to:

- understand existing water quality and natural variability at the PDL
- ensure compliance with existing legislation and regulations; and
- prevent any environmental harm resulting from proposed dredging activities.

This WQMP was prepared in accordance with:

- *Environment Protection Act 1993* (EP Act)
- Environment Protection (Water Quality) Policy 2015 (Water Quality EPP)
- National Water Quality Management Strategy (NWQMS)
- Australian and New Zealand Guidelines for Fresh and Marine Quality (ANZG) (2000, 2018)
- South Australian Environmental Protection Authority Dredge guideline (EPA, 2020); and
- National Assessment Guidelines for Dredging (Commonwealth of Australia, 2009).

3. Receiving Environment

3.1 Location of dredging activities

3.1.1 General location of the FACT

The FACT is located in the Port of Adelaide at Outer Harbor, on the northern tip of the Lefevre Peninsula, approximately 22 km north of Adelaide (Figure 3-1). The area accommodates a range of industries including port-related activities, bulk handling and storage of minerals, agricultural and petroleum products, transport and warehousing, electricity generation and manufacturing.

The FACT itself is predominantly comprised of land which has been reclaimed from the natural intertidal mangrove and samphire flats which originally formed this part of the Lefevre Peninsula. The adjacent Port River, which forms the sea entrance to the Port of Adelaide, has been utilised as a shipping channel since European settlement and is also utilised by FPH vessels (e.g. tugboats), tourist vessels, commercial fishers, recreational boaters and anglers and kayakers. The Port River is tidal, and at Outer Harbor has been subject to regular dredging programs to maintain channel depth and width which allows larger container and cruise ships to be accommodated.

3.1.2 Proposed Dredging Location

The PDL is a 690 m^2 area adjacent to the existing Berth 6 (Figure 3-2). The benthic habitat within the PDL is highly modified, reflecting the nature of the Port River as a shipping channel. The benthic habitat within the PDL and in the area adjacent to the PDL comprises of sandy silt clays interspersed with shell fragments and bivalves (predominantly the Razor clam *Pinna bicolor,* and sparse Hammer oyster *Malleus meridianus*, Queen scallop *Equichlamys bifrons*, Spiny scallop *Scaeochlamys livida* and Mud cockle *Katelysia sp*.) (J Diversity 2024). The are several sparse patches of seagrass (*Zostera*) within 300 m of the PDL (Figure 3-2).

3.1.3 Spoil Disposal Location

Spoil will be disposed of at the Pelican Point dredge ponds located approximately 800 m northeast of the PDL (Figure 3-1). These ponds have previously been used by FHP for their maintenance dredging projects. Spoil from the proposed dredging activities will be settled out in a series of dredge ponds and the return water directed back to the Port River. Water remaining in the dredge ponds at the end of the dredging activities will be left to evaporate.

Timing for dewatering is to be confirmed following detailed design.

Figure 3-1: General location of the Flinders Adelaide Terminal Container and location of Berth 6

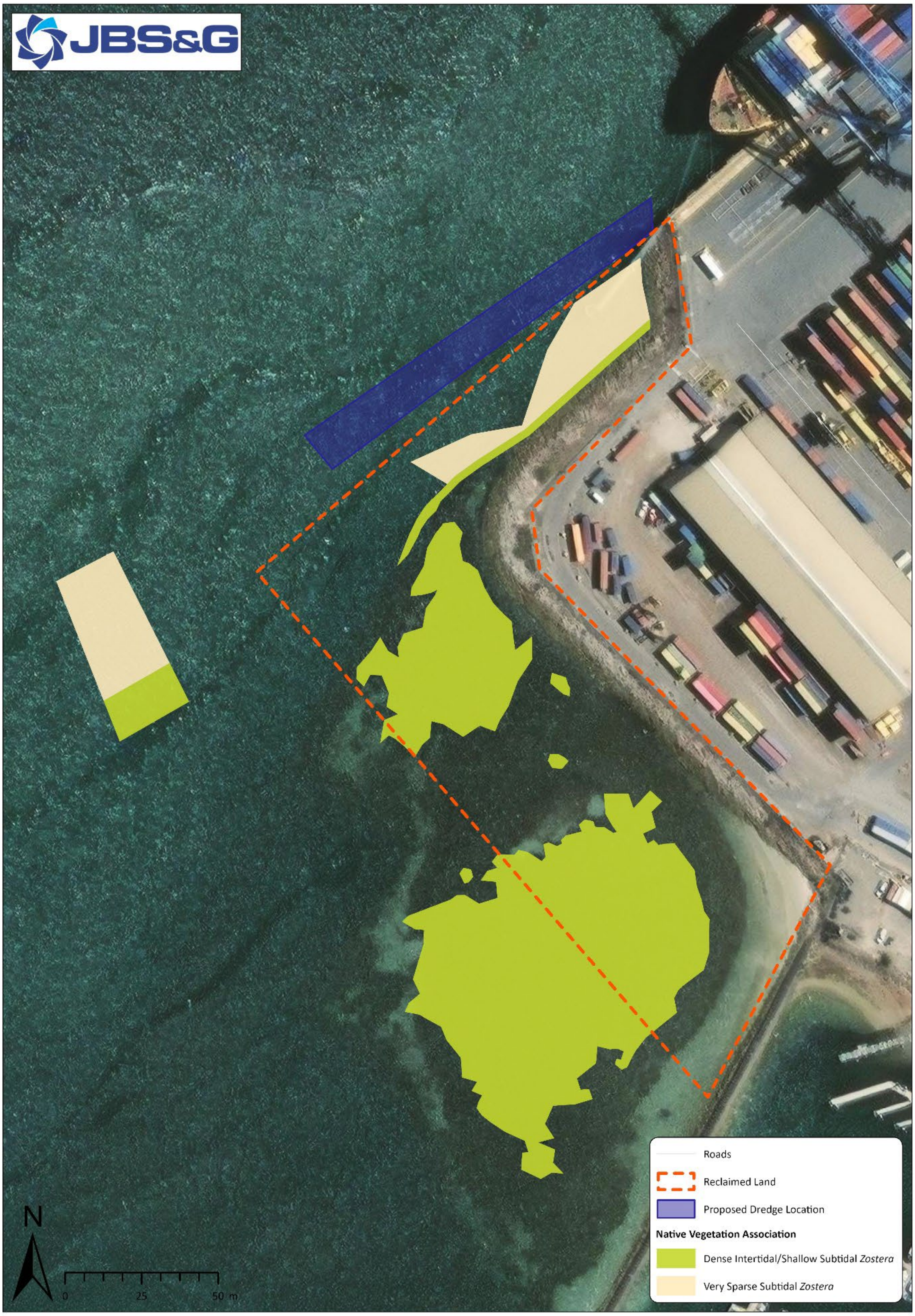


Figure 3-2: Proposed Location of Dredging

4. Review of existing data in the Port River

Water quality monitoring in the Port River estuary has been undertaken by the South Australian Environment Protection Authority (EPA) between 1995 and 2008. Nine sites were studied as part of this monitoring program, with Site 3 the closest site to the PDL, approximately 500 m northeast to the existing Berth 6 (Figure 3-1). Water samples were collected annually over the thirteen years, and analysed for a suite of physical, chemical and biological properties (see Table 4-1).

This reviewed data from EPA is publicly available[1] and / or described in reports prepared by the EPA (EPA 2002; EPA 2005; EPA 2008).

Table 4-1: Water quality parameters at Site 3 between 1995 and 2008

Parameter	Mean	Standard deviation	Median	Number of samples	ANZG guidelines value (2018) for slightly disturbed marine system[2]
Physical parameters					
Turbidity (NTU)	2.53	3.17	1.68	131	0.5-10
Conductivity* (salinity) (µS)	55,080	5,810	55,300	54	[3]
Temperature* (°C)	18.0	4.4	17.0	24	[3]
Chemical parameters					
Metal concentrations (total)					
Cadmium (mg/L)	0.004	0.002	0.005	135	0.0055
Copper (mg/L)	**0.010**	0.012	0.01	134	0.0013
Lead (mg/L)	**0.005**	0.004	0.005	135	0.004
Mercury (mg/L)	0.003	0.001	0.003	132	0.00004
Nickel (mg/L)	0.005	0.004	0.005	32	0.07
Total aluminium* (mg/L)	**0.074**	0.124	0.046	53	0.055
Total Zinc (mg/L)	**0.039**	0.040	0.03	135	0.008
Nutrient concentrations					
Ammonia-N (mg/L)	**0.162**	0.125	0.125	135	0.05
Oxidised N (mg/L)	**0.083**	0.075	0.061	115	0.05
Total N (mg/L)	0.485	0.286	0.445	115	1.0
Total phosphorus (mg/L)	0.045	0.054	0.035	135	0.1
Biological parameters					
Chlorophyll a (µg/L)	**3.211**	4.117	2.135	134	1, 5[4]

* Date collected during the period 1995 – 2000 (EPA, 2002).
NTU = Nephelometric Turbidity Unit; µS = micro-Siemens; N = Nitrogen
Bold indicates exceedance of guideline value.

[1] See http://report.epa.sa.gov.au/files/11377_port_3.csv
[2] Unless specified otherwise, values correspond to the default ANZG guidelines values for slightly disturbed marine system in South Australia. A 95% level of species protection was considered for metal concentrations.
[3] No guideline values; however default trigger values for marine ecosystems for thermal or saline impacts below or above ambient are given for the 20th and 80th percentiles respectively of the ambient temperature / salinity distribution (ANZG, 2018).
[4] For an estuarine system.

Analysis of the EPA's water quality monitoring data showed water turbidity in the Outer Harbor between 1995 and 2008 remained within the ANZG guidelines range for a slightly to moderately disturbed marine system. Metal levels in the Outer Harbor were variable, with cadmium, copper and nickel being within the ANZG guidelines range for a 95% level of species protection in slightly disturbed ecosystems. Lead, mercury, aluminium and zinc concentrations exceeded guideline values during that period.

Chlorophyll-a is used as a measure of the concentration of phytoplankton in the water column and is commonly used as an indicator of water quality. Chlorophyll-a concentration in the Outer Harbor was above ANZG guidelines value for slightly disturbed marine system, but below ANZG guidelines value for slightly disturbed estuarine system. This is consistent with the estuarine nature of the Outer Harbor. Average concentrations of Total Nitrogen and Total Phosphorous were below the ANZG default guideline values.

Additional water quality data available from Inner Harbour (sampled between February and March 2021) was also reviewed (Golder, 2021). While conditions in the Inner Harbour differ from the Outer Harbor due to lower level of flushing, it is useful to review this data to understand potential changes in metal concentrations in Port River over time.

Golder (2021) monitored water quality at two locations; the North Arm Beach site and the Birkenhead Beach site, which correspond to EPA's monitoring site 1 and 9, respectively. Table 4-2 compares results from the EPA data set (EPA, 2002) covering the period 1995 to 2000, with the Golder (2021) study. Overall, metals were generally of similar scale between the two data sets at North Arm, with the exception of cadmium being an order of magnitude lower in the 2021 study. All metals concentrations were lower, by approximately an order of magnitude, at the Birkenhead Beach site for the 2021 study. While there were exceedances of the ANZG guideline values even in the latter study for some metals and sites, the results indicate at least for the sites studied, that there has been no decline in water quality (in regard to metals) over the past few decades.

As part of the Golder (2021) study, pH was also measured, which ranged between 7.9 and 8.1. These pH values are within the expected range of estuarine / marine waters (Golder, 2021) and aligns with ANZG guidelines for slightly disturbed ecosystem (for both estuaries and marine).

Table 4-2: Average heavy metal concentrations in the Inner Harbour (EPA 2002; Golder 2021)

Metal	Site 1 / North Arm Beach site		Site 9 / Birkenhead Beach site		ANZG guidelines value (2018) for slightly disturbed marine system[5]
	EPA, 2002	Golder, 2021	EPA, 2002	Golder, 2021	
Copper (mg/L)	**0.012**	**0.020**	**0.014**	0.003	0.0013
Lead (mg/L)	**0.010**	**0.019**	**0.010**	0.004	0.0044
Mercury (mg/L)	0.00037	0.0002	0.00037	<0.0001	0.0004
Zinc (mg/L)	**0.051**	**0.058**	**0.04**	**0.023**	0.008
Cadmium (mg/L)	0.0020	<0.0002	0.0020	<0.0002	0.0055

Bold indicates exceedance of guideline value.

[5] Default ANZG guidelines values for slightly disturbed marine system in South Australia. A 95% level of species protection was considered for metal concentrations.

5. Potential Impacts and Relevant Indicators

Potential impacts from dredging activities for the Project are described below.

5.1 Increased Turbidity and sedimentation

A temporary increase in turbidity and resulting sedimentation is expected during dredging operations. An increase in turbidity and subsequent sedimentation can lead to a reduction in light levels for marine biota and temporary 'smothering' of benthic flora and fauna. In particular, there is the potential to indirectly impact seagrass through increased turbidity, resulting in lower light levels, and sedimentation, potentially leading to seagrass loss.

Seagrass species present in the Port River build their energy reserves and increase growth rates in spring and summer and are less active in autumn and winter when waters are cooler and light availability is lower.

To minimise turbidity impacts on marine biota, dredging would aim to be undertaken during the cooler months, as far as practicable.

Key parameters to be used as an indicator of elevated fine sediment levels in the water column will include:

- Water Turbidity; and
- Visible Plume Extent

Other parameters may include Total suspended solids.

5.2 Creation of anoxic conditions

The resuspension of sediments has the potential to result in an increase in nutrients in the water column, which can lead to increased phytoplankton biomass and subsequent oxygen depletion. Oxygen deletion can negatively impact marine flora and fauna occurring within the vicinity of the project.

Dissolved oxygen (DO) will be the key performance indicator of increased anoxic conditions in the water column.

5.3 Release of hazardous substances

Disturbance of sediment during dredging activities may release potential hazardous substances into the water column, including pollutants related to human activities such as heavy metals, and naturally occurring contaminants such as Acid Sulphate Soil (ASS).

Previous chemical analyses of sediment samples from the PDL showed that levels of pollutants of concern were below human health and ecological levels and National Water Quality Management Strategy guidelines (Golder, 2020). Therefore, monitoring of pollutant levels in the water is not considered to be needed as part of this WQMP.

Disturbance of ASS can lead to the acidification of waters, which in turn may impact flora and fauna within the dredge footprint. Potential ASS have previously been identified within the PDL, however, chemical analyses suggest there is sufficient neutralising capacity in the sediment and treatment or management of ASS is likely not needed (Golder, 2020).

Water pH will be the key parameters to be used as an indicator of acid release in the water column.

6. Water Quality monitoring methodology

Below describes the water quality methodology to be implemented for the project.

6.1 Baseline data

FPH have commenced measuring turbidity in various locations of the Port River.

A water quality probe (Xylem YSI EXO3 Multiparameter Sonde (‘Sonde’ herein)) was installed next to the Port Adelaide Terminal (Tide Hut), approximately 1 km west of Berth 6 (Figure 6-1) in January 2024. The Sonde measures turbidity in Formazin Nephelometric units (FNU). Data has so far been continuous since the day of installation.

Turbidity data is shown below for the period 11 January to 15 April 2024 is shown on (Figure 6-2). Negative values were converted to 0 as per manufacturer’s instructions. For the displayed period, turbidity showed a mean value of 3.2 FNU (± 21.59 FNU) with occasional peaks exceeding 100 FNU and with a median value of 0.00 FNU. A simple moving average for a 6-hour window period was calculated (see red line on (Figure 6-2), with several peaks greater than 20 FTU, and on occasions, persisting at elevated turbidity levels (i.e. > 50 FTU) for more than 1 day.

Baseline data will continue to be collected for a period of 12 months at this location. Turbidity baseline data will be used together with sediment plume modelling results to determine, in consultation with EPA, appropriate ALARM and HOLD triggers (see Section 6.7).

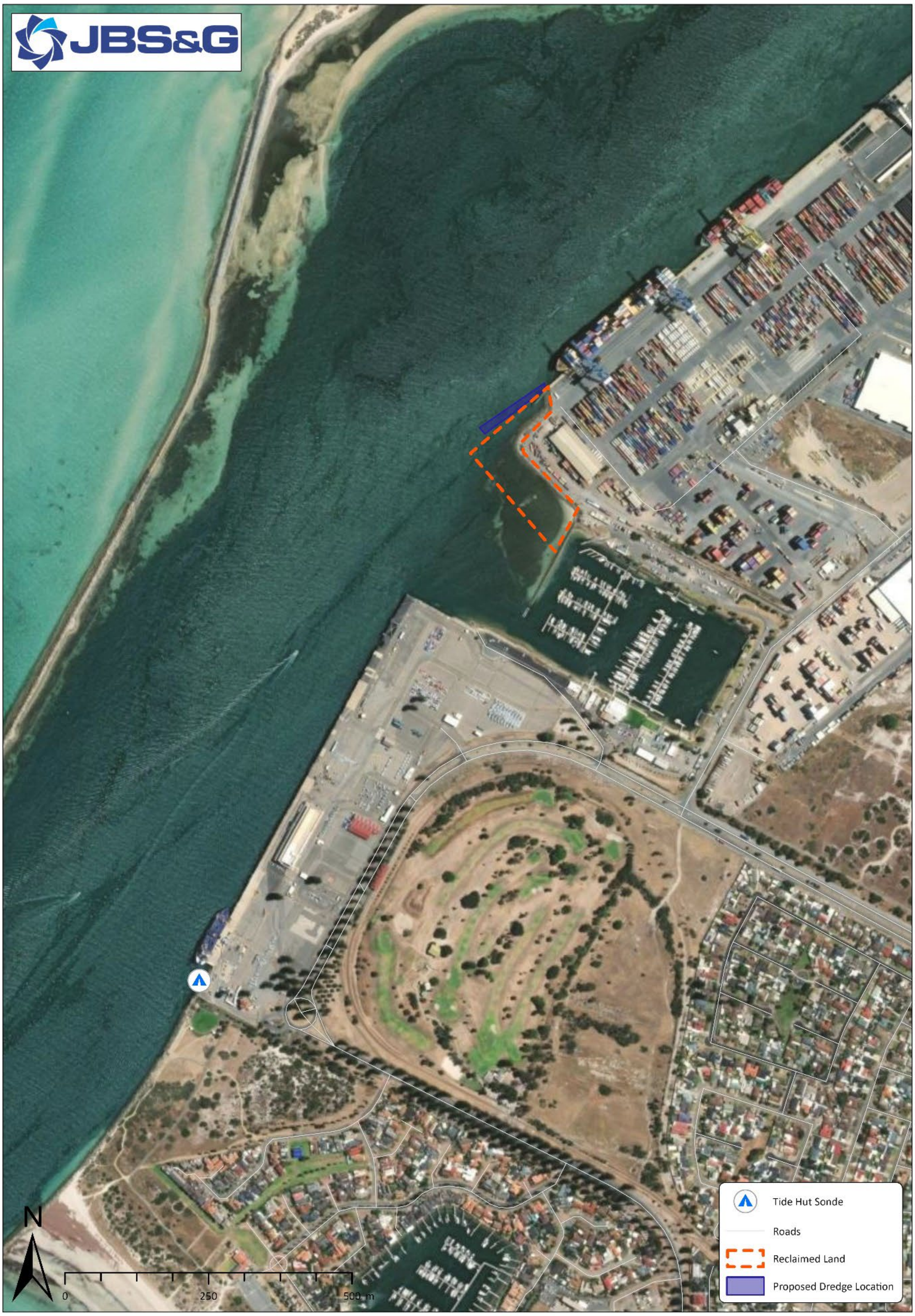


Figure 6-1: Location of the Sonde for measuring turbidity

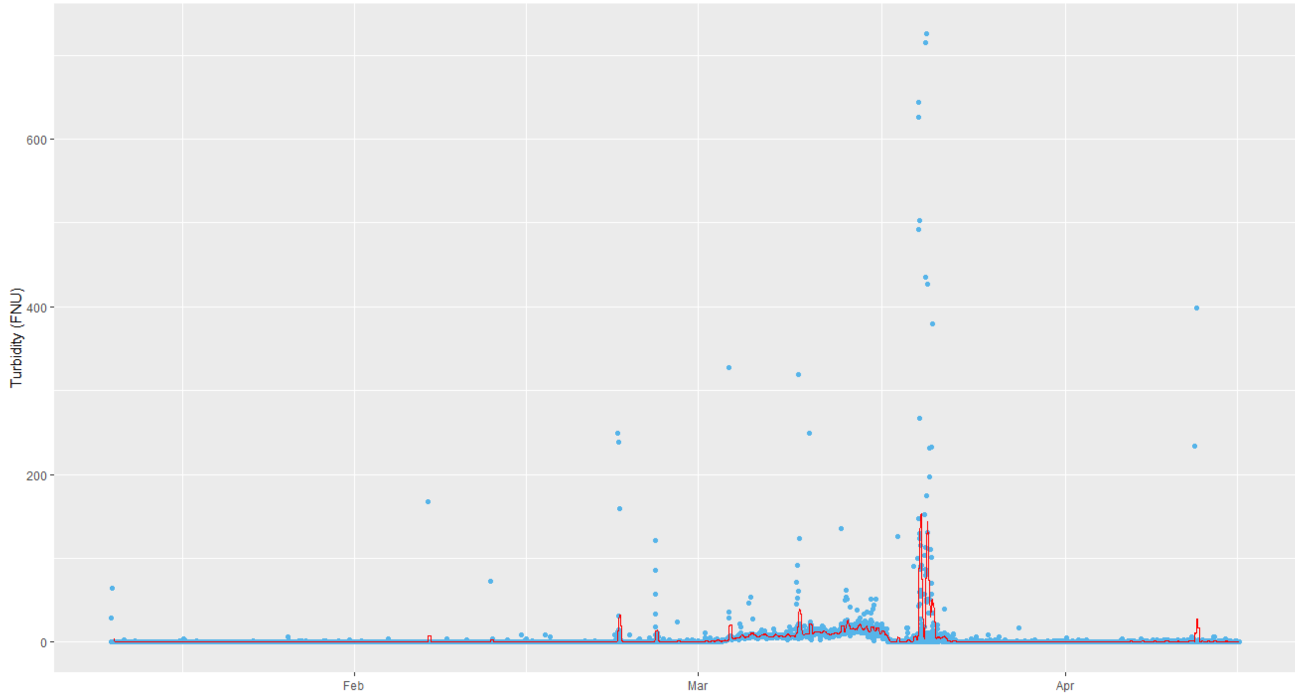


Figure 6-2: Water turbidity at Tide Hut from 11 January 2024 to 15 April 2024. Red line indicates simple moving average.

6.2 Monitoring sites

Sediment plume modelling is currently being undertaken for the project.

Sediment plume modelling results will inform the monitoring site(s) based on the three zones of impacts; Zone of High Impact, Zone of Moderate Impact, and Zone of Influence as defined by the EPA's Dredge guidelines (EPA, 2020). The zones of impact will also inform management triggers.

Discussions with EPA will confirm monitoring site(s) based on the sediment plume modelling and understanding of nearest sensitive receivers. At least one site will be located either within the zone of moderate impact or Zone of Influence, and one (control) site outside of the Zone of influence.

Monitoring will also be undertaken adjacent to the dredge pond to including:

- full perimeter inspection of the pond to check for structural integrity
- check discharge pipe flow, consistency, and colour
- check pond level and turbidity; and
- check return water is clear.

6.3 Parameters to be measured

Turbidity will be the key parameter measured to identify potential risk to the environment during project activities.

Turbidity provides a proxy for suspended sediments within the water column and will be measured via light scatter in units FNU.

Visual extent of plume would also be measured in conjunction with other parameters including:

- DO
- pH; and
- water temperature, if dredging outside of winter.

Other parameters to record daily include:

- Wind speed and direction
- Tide (Ebb, Flood, High, Low); and
- Cloud cover (%).

6.4 Monitoring equipment

Sonde loggers will be deployed at monitoring sites to record turbidity. Data will be logged every 15 minutes and telemetrically downloaded. Assessment of real-time turbidity data will allow for the detection of water quality exceedances (triggers to be determined – see Section 6.7), and response where necessary.

A water quality sensor would also be used to record other parameters including DO, pH and water temperature.

Details for discreet water sampling and analysis (if required) would be provided in the in the final water quality monitoring plan.

6.5 Equipment calibration

Instruments will be calibrated regularly according to manufacturer's specifications, with calibration details recorded.

Instruments will be used by qualified/ or trained operators.

6.6 Monitoring frequency

As detailed above, the water quality monitoring program for the proposed dredging activities will comprise baseline monitoring prior to dredging commencing (see Section 6.1), and during dredging.

The dredge pond would also be checked several times per day following spoil disposal, during dredging activities.

6.7 Triggers, management and contingency

As described in Section 6.3, turbidity would be the key parameter to signify potential risk of impact from dredging. Additional parameters including DO and PH will also be used.

In line with guidance from the EPA Dredge Guidelines (2020), adaptive management will be implemented for the Project. The adaptive management approach includes a set of management strategies to minimise and control potential impacts of dredging and disposal activities on sensitive receptors.

ALARM and HOLD Triggers will be selected to inform when impacts from dredging are likely to occur, or have already occurred. ALARM triggers forewarn the approach of HOLD Trigger and minimise non-compliance and resulting potential for environmental harm. Management measures will include, but not be limited to slow works, modifying dredge location and/or suspension of activities until better weather conditions prevail.

HOLD triggers represent the limit of acceptable impacts beyond which they may impose significant impact on the environment, and would include stop works until thresholds fall below the trigger value.

ALARM and HOLD trigger thresholds would be determined based on sediment plume modelling, baseline data and understanding of nearest sensitive receivers in consultation with EPA.

An example of a decision flow sheet for turbidity, adapted from EPA (2020) is shown in Figure 6-3. A detailed decision flow sheet would be updated in the final water qulaity monitoring plan following consultation with EPA.

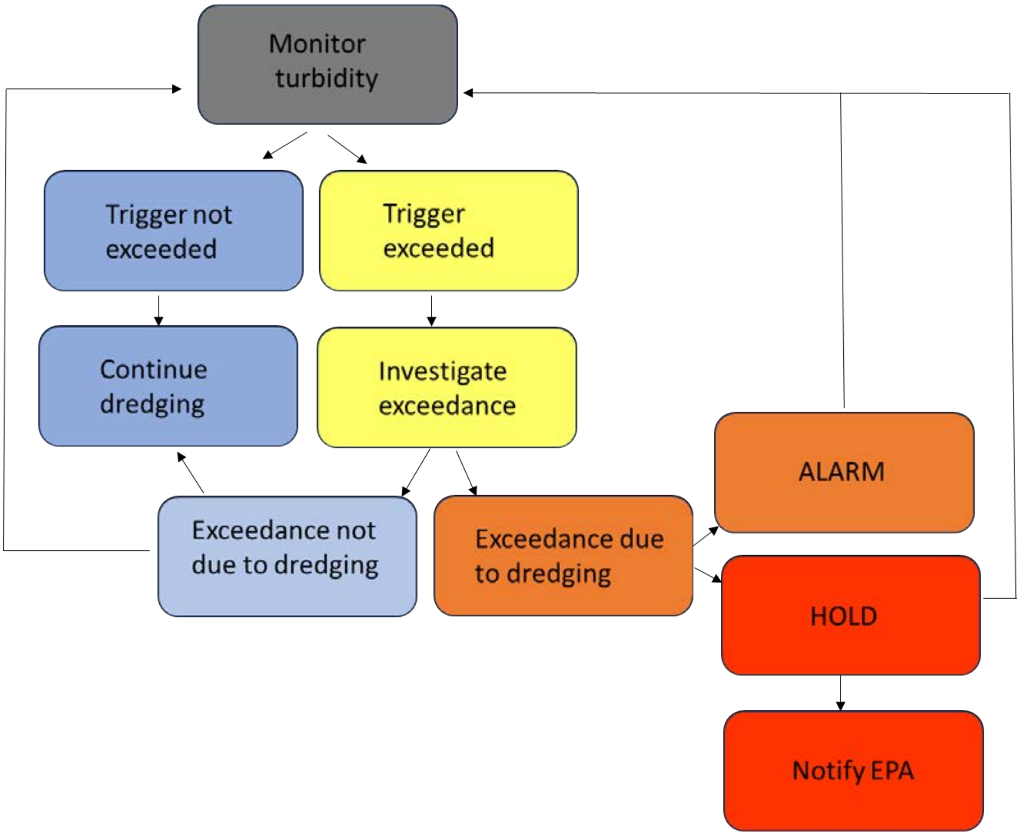


Figure 6-3: Decision flow sheet for turbidity (adapted from EPA 2020)

7. Reporting

A water quality monitoring report would be provided to EPA. The report would contain:

- All raw data collected
- A summary of the data in an acceptable format that may be used for reporting purposes; and
- Any exceedances of trigger values and mitigation measures/contingency measures implemented.

8. Limitations

Scope of services

This report ("the report") has been prepared by JBS&G in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and JBS&G. In some circumstances, a range of factors such as time, budget, access and/or site disturbance constraints may have limited the scope of services. This report is strictly limited to the matters stated in it and is not to be read as extending, by implication, to any other matter in connection with the matters addressed in it.

Reliance on data

In preparing the report, JBS&G has relied upon data and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise expressly stated in the report, JBS&G has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. JBS&G has also not attempted to determine whether any material matter has been omitted from the data. JBS&G will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to JBS&G. The making of any assumption does not imply that JBS&G has made any enquiry to verify the correctness of that assumption.

The report is based on conditions encountered and information received at the time of preparation of this report or the time that site investigations were carried out. JBS&G disclaims responsibility for any changes that may have occurred after this time. This report and any legal issues arising from it are governed by and construed in accordance with the law as at the date of this report.

Environmental conclusions

Within the limitations imposed by the scope of services, the preparation of this report has been undertaken and performed in a professional manner, in accordance with generally accepted environmental consulting practices. No other warranty, whether express or implied, is made, including to any third parties, and no liability will be accepted for use or interpretation of this report by any third party.

The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose.

JBS&G accepts no liability for use or interpretation by any person or body other than the client who commissioned the works. This report should not be reproduced without prior approval by the client, or amended in any way without prior approval by JBS&G or reproduced other than in full, including all attachments as originally provided to the client by JBS&G.

9. References

Commonwealth of Australia (2009). National Assessment Guidelines for Dredging, Canberra. Retrieved from https://www.dcceew.gov.au/sites/default/files/documents/guidelines09.pdf

EPA (2002). Ambient Water Quality Monitoring: Port River Estuary, September 1995 – August 2000: Environment Protection Authority South Australia. Adelaide, South Australia. May 2002.

EPA (2005). Port Waterways Water Quality Improvement Plan – Stage 1: Environment Protection Authority South Australia. Adelaide, South Australia. July 2005.

EPA (2008). Port Waterways Water Quality Improvement Plan: Environment Protection Authority South Australia. Adelaide, South Australia. May 2008.

EPA (2020). Dredge guidelines. Retrieve from https://www.epa.sa.gov.au/files/14712_dredge_guideline_2020.pdf

Flinders Port Holdings (2024). Case Study: Moving towards Smart Port status at Flinders Adelaide Container Terminal (FACT). Retrieved from https://www.flindersportholdings.com.au/wp-content/uploads/2024/01/CASE-STUDY_FACT_Smart-Port-Status_FINAL2024.pdf

Golder associates Pty Ltd (2020). Flinders Ports Berth 6 Dredging. Seagrass Survey, Sediment Sampling and Characterisation.

Golder associates Pty Ltd (2021). Flinders Ports - Inner Harbor Surface Water Sampling and Characterisation.

J Diversity Pty Ltd (2024). Outer Harbor Berth 6 Benthic survey report. Report for Flinders Ports Holdings.

© JBS&G
This document is and shall remain the property of JBS&G. The document may only be used for the purposes for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited

Document Distribution

Rev No.	Copies	Recipient	Date
0	Electonic	Flinders Ports Holding	13/05/2024

Document Status

Rev No.	Author	Reviewer	Approved for Issue		
		Name	Name	Signature	Date
A	Morgane Mallaird	Nicole Patten			
B	Morgane Mallaird	Nicole Patten			
C	Morgane Mallaird/ Nicole Patten	David Lenel	David Lenel		10/05/2024

www.jbsg.com.au

JBS&G

Adelaide
Kaurna Country | 100 Hutt St,
Adelaide, SA 5000
T: 08 8431 7113

Brisbane
Turrbal/Yuggera Country | Level 37,
123 Eagle Street, Brisbane, QLD 4000
T: 07 3211 5350

Bunbury
Wardandi Country | 177 Spencer
Street Bunbury, WA 6230
T: 08 9792 4797

Canberra
Ngunnawal Country | Level 1, The Realm
18 National Circuit Barton, ACT 2600
T: 02 6198 3278

Darwin
Larrakia Country | Suite G1, Level 1,
48-50 Smith Street, Darwin NT 0800
T: 08 8943 0600

Hobart
Muwununa/Nuenon Country | Level 6,
111 Macquarie Street Hobart, TAS 7000
T: 03 6108 9054

Melbourne
Wurundjeri Country | Level 19,
31 Queen Street, Melbourne VIC 3000
T: 03 9642 0599

Newcastle
Awabakal/Worimi Country | 61 / 63
Parry Street Newcastle West, NSW 2302
T: 02 8245 0300

Perth
Whadjuk Country | Allendale Square,
Level 9, 77 St Georges Terrace, WA 6000
T: 08 9380 3100

Sydney
Gadigal Country | Level 1,
50 Margaret Street, Sydney, NSW 2000
T: 02 8245 0300

Wollongong
Dharawal Country | Suite 1A, 280 - 286
Keira Street, Wollongong, NSW 2500
T: 02 4225 2647

Appendix B

POMS Management Plan

creating opportunities

Outer Harbor Berth 6 Precinct Upgrade Pacific Oyster Mortality Syndrome (POMS) Management Plan

Prepared for Flinders Port Holdings

J Diversity Pty Ltd

Rev 1
3 June 2024

Cover photo: Pacific oysters on rock revetment between Berth 6 and Royal South Australian Yacht Squadron. Taken by J. Brook, March 2024.

Disclaimer

The findings and opinions expressed in this publication are those of the author and do not necessarily reflect those of JBS&G or Flinders Port Holdings. While reasonable efforts have been made to ensure the contents of this report are factually correct, the author does not accept responsibility for the accuracy and completeness of the contents. The author does not accept liability for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on, the contents of this report.

Revision history

Rev	**Date**	**Comment**	**Author**	**Reviewed/ approved**
A	10/04/2024	Initial Draft	J. Brook	N. Patten
0	02/05/2024	Addressed review comments. Approved for release to client	J. Brook	N. Patten
1	03/06/2024	Updated to include rock revetment reuse	J. Brook	N. Patten

Table of Contents

Table of Figures

1 Introduction

Flinders Port Holdings are proposing an upgrade to Berth 6 and its supporting services within the Flinders Adelaide Container Terminal (FACT) in Outer Harbor, Port of Adelaide ('Berth 6 precent upgrade' or 'the project' herein). The Berth 6 precinct upgrade comprises an extension of Berth 6 to the south-west of the existing berth to a length of 179 m. The works for the project would include dredging and land reclamation in the areas shown in Figure 1. Removal (and reuse where appropriate for the works) of the rock revetment is also proposed.

During a recent survey in March 2024, Pacific oysters *Magallana gigas* (on the rock revetment), razor clams *Pinna bicolor* and a hammer oyster *Malleus meridianus* were recorded in the proposed reclamation area and several bivalves including queen scallop *Equichlamys bifrons*, native oyster *Ostrea angasi* and hammer oyster were recorded in the proposed dredging area (J Diversity 2024).

This Pacific Oyster Mortality Syndrome (POMS) Management Plan has been developed in response to those findings.

Figure 1. Areas of proposed dredging and land reclamation

2 Background

The Pacific Oyster Mortality Syndrome (POMS) is a disease which affects Pacific oyster *Magellana*[1] *gigas* and is caused by a virus called OsHV-1 microvariant (OsHV). There are no human health or food safety concerns, but it causes rapid death and high mortality rates in farmed Pacific oysters (up to 100% within days of being detected) and can spread quickly if introduced. The virus is not known to affect other oyster species but they can be contaminated with the virus (PIRSA 2020). Mussels have been found to be infected despite not dying, and other marine invertebrates could function as possible carriers, reservoirs or even alternative hosts of these oyster pathogens (O'Reilly et al. 2017, Bookelaar 2018).

POMS was detected (for the first time in South Australia) in feral oysters in the Port River in late February 2018 and is now endemic (PIRSA undated). Mortality of 50–90% of feral Pacific oysters was reported, but the survivors can act as carriers of the disease (Evans et al. 2017, cited by BMT WBM 2019). POMS remains inactive during cooler months, but ongoing detection of outbreaks are expected when seawater temperatures rise above 17°C for extended periods (PIRSA undated b). This is consistent with the findings by De Kantzow et al. (2016) that mortality from OsHV at temperatures of 26, 22, 18 and 14°C resulted in mortalities of 84, 77, 23 and zero per cent, respectively. POMS is generally spread through movement of live oysters, bivalve products or equipment that has been in contact with infected animals (PIRSA 2020). It is currently contained within the Port River estuary. The nearest commercial growing area is approximately 60 km away (PIRSA 2020).

Eradication of feral Pacific oysters and the virus is not considered to be achievable in the Port River estuary (PIRSA undated). PIRSA undertook a program to reduce feral oyster populations in the Port River, promoted vessel cleaning and equipment decontamination and banned the removal of bivalves, including oysters, mussels, cockles and razor clams, from the Port River (PIRSA 2020).

Although Pacific oyster can be found attached to hard substrates, rocks, debris and shells from the lower intertidal zone to depths of 40 m (Herbert et al. 2016), it is generally found only in the intertidal zone within the Port River (S. Owen, marine biologist/commercial diver, pers. comm., July 2020), and was recorded during the survey of the rock revetment within the proposed reclamation area for the for the Berth 6 Precinct upgrade.

3 Management context

3.1 Legislative framework

There is currently a ban on the removal of bivalves from the Port River (PIRSA 2022) under the *Fisheries Management (General) Regulations 2017*, including removal by dredging and removal of rock revetment with attached bivalves.

The deposit of exotic species, including the reuse of rock revetment with attached Pacific oysters, is prohibited under the Fisheries Management Act 2007.

These activities (removal of bivalves or deposit of rocks with Pacific oyster) would require a Determination and a Ministerial permit under the *Fisheries Management Act 2007.*

[1] Formerly known as *Crassostrea gigas* and is thus referred to in numerous documents relevant to POMS.

A new Biosecurity Act for South Australia is currently being developed which would merge several existing pieces of biosecurity legislation into one, to strengthen protection of the state's economy, terrestrial and aquatic environments and communities from the impacts of pests, diseases and other biosecurity matters (PIRSA 2023). Certain provisions for aquatic pests in the *Fisheries Management Act 2007* would also shift to the new legislation (PIRSA 2023). The Biosecurity Bill is expected to progress through the parliamentary process this year. This new Biosecurity Act may include aspects related to POMS.

3.2 Previous local dredging projects

The Outer Harbor Channel Widening Project (OHCWP), completed in 2021, dredged approximately 770,000 m^3 from the Port River near Outer Harbor and transferred it to a dredged material placement area (DMPA) in central Gulf St Vincent. A POMS Management Plan was developed for that project, and management measures were prescribed in the Dredge Management Plan (DMP) (Boskalis 2019). Similarly, the Venice Energy Project was approved to dredge 1.8 million m^3 from the Port River near Outer Harbor and transport it to the same DMPA. A DMP Framework developed for the Venice project included measures for managing POMS (Venice Energy 2021). Because ocean disposal was intrinsic in both of these projects, there was considerable emphasis on the removal and disposal to land of bivalves, and bivalve testing and monitoring, prior to dredging and transfer to the DMPA.

3.3 Potential vectors

POMS may spread through:

- carrier organisms, including larvae (Pacific oysters or other bivalves);
- by water or sediment contaminated by the virus or by
- translocation on vessels or equipment.

Vessels act as a vector by transporting carriers fouling their hulls, or via ballast water, but equipment in general can transport the virus on its surfaces.

4 Project activities with risk to POMS

The key activity which poses a risk to the spread of POMS is dredging.

For the project, dredging of the area adjacent to Berth 6 in the shipping channel is required to achieve channel design depth of 14.2 m CD. This involves dredging approximately 690 m^2 of sediment with a sediment volume of approximately 550 m^3.

Dredging methodology is to be confirmed following detailed design but would likely involve a cutter suction dredger.

The proposed location for disposal of dredge spoil is to existing Pelican Point Dredge Pond located approximately 1 km from the dredge location. However if the extension of Berth 6 involves a sheet pile wharf, spoil may be used as low level backfill behind the sheet pile.

Removal and reuse of the rock revetment as new rock armour also has the potential to spread POMS if rocks with attached bivalves are placed back into the intertidal zone.

5 Management measures

Controls and management measures for minimising the risk of spreading POMS beyond the Port River during dredging are outlined below and include potential timing constraints, disposal of spoil to land, vessel cleaning and a vessel navigation plan (Sections 5.1 to 5.5). Management measures for rock revetment removal and potential reuse are outlined in section 5.6.

5.1 Timing

The proposed dredging is to occur in 2025 but the exact timing within that year is yet to be confirmed. However, because of the lower transmission of POMS in water temperatures typical of winter compared with temperatures typical of summer, dredging activities would be undertaken, where practicable, during the window of cooler water temperatures, i.e. May through September inclusive, when water temperature would be below 16°C (Figure 2).

The duration of the dredging activity is also not known but based on the volume of material to be dredged (and with assumed cutter suction dredging methodology), is likely to be of the order of two weeks.

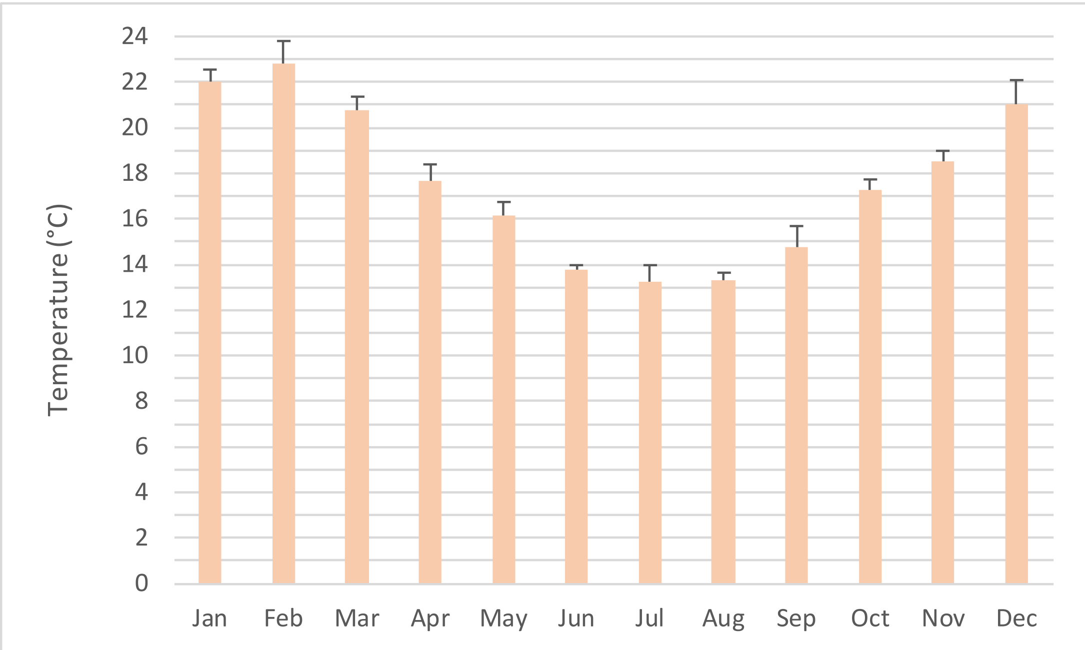


Figure 2. Mean monthly water temperatures from Outer Harbor during 1998–2008. Error bars show standard error of mean. Source: EPA, unpublished data.

5.2 Dredge spoil disposal

As described in Section 4, dredge spoil will be disposed of on land, to a series of ponds to settle out fines prior to returning water back to the Port River. These dredge ponds are located approximately 1km from the location of Berth 6 where dredging is proposed. Accumulated sediments (and bivalves) will be excavated out of the settlement areas for drainage and to increase the capacity of the pond. Discharged sediments (and bivalves) will remain within the footprint of the dredge ponds.

In the event of sheet pile wharf construction, dredge spoil may also be used in the same location as the existing Berth 6, as low level backfill for the Berth 6 extension.

5.3 Vessel inspection and cleaning

Vessel inspections and cleaning requirements for biofouling management would be outlined in the contractor's Dredge Management Plan and would be guided by:

- *Australian biofouling management requirements* (DAFF 2023).
- *National biofouling management guidelines for non-trading vessels* (Australian Government 2009)
- *Code of practice for vessel and facility management (marine and inland waters)* (EPA 2019)
- PIRSA.

The Australian biofouling management requirements (ABFMR) set out vessel operator obligations for the management of biofouling when operating vessels under biosecurity control within Australian territorial seas to comply with the *Biosecurity Act 2015.*

Operators of all commercial vessels subject to biosecurity control must provide information relating to biofouling management through the mandatory pre-arrival report. This information is reported through the department's Maritime and Aircraft Reporting System (MARS) and ideally includes one of the three management practice below:

- Implementation of an effective biofouling management plan
- Hull and niche areas cleaned of all biofouling within 30 days prior to arriving in Australian territory, or
- Implementation of an alternative biofouling management method pre-approved by the department.

This information would be used by the Australian and/or State Government to inform any vessel interventions including further vessel cleaning prior to undertaking dredging activities, and/or following dredging activities.

5.4 Navigation Plan

The project is located is more than 50 km away from the nearest oyster growing area.

A navigational plan to ensure that any vessel associated with the project does not navigate within 10 km of a commercial oyster growing area in South Australian waters would be implemented.

The navigational plan would document a route that avoided commercial oysters growing areas by at least 10 km. Oyster growing areas in Gulf St Vincent include Port Vincent, Stansbury, Coobowie Bay, American River and Western Cove; all more than 50 km from the project location. Sites further west include Port Lincoln, Coffin Bay, Streaky Bay, Smoky Bay and Ceduna (Figure 3).

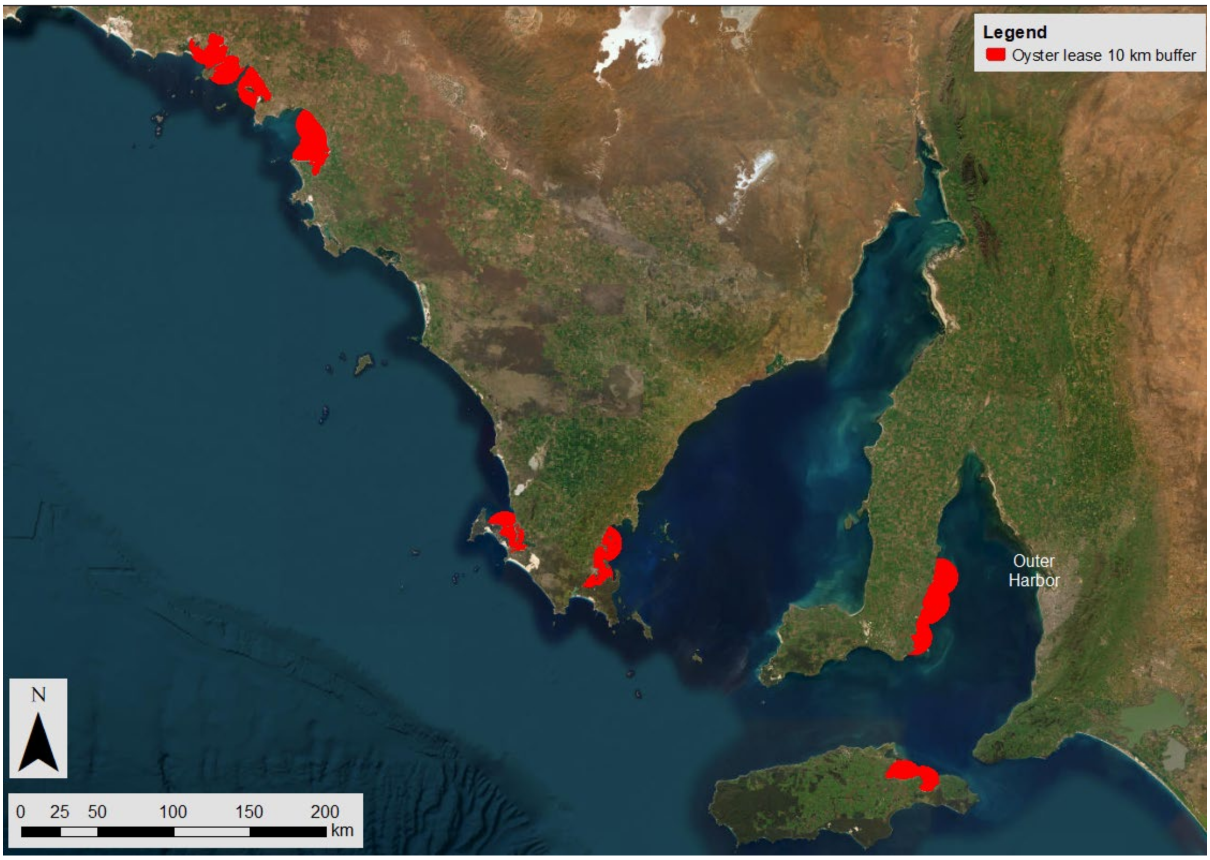


Figure 3. Ten kilometre buffers around oyster growing areas in South Australia.

5.5 Ballast water

Ballast water management would be documented in the contractors Dredge Management Plan.

Ballast water would be managed in accordance with the International Maritime Organization (IMO) Ballast Water Management Convention (IMO 2004) and by the applicable standard (exchange or preferably treatment) in accordance with the Australian Ballast Water Management Requirements, Version 8 (DAWE 2020).

5.6 Rock revetment

Land based works to remove the existing rock revetment would be documented in a construction environmental management plan. It is proposed that rocks may be reused onsite for the reinstatement of a new rock revetment wall, and/or for low level backfill to new pavement.

A Determination and Ministerial Permit under the *Fisheries Management Act 2007* would be sought prior to works involving rock revetment with bivalves present.

6 References

Australian Government (2009), *National Biofouling Management Guidelines for Non-Trading Vessels*, National System for the Prevention and Management of Marine Pest Incursions.

BMT WBM (2019), *Adelaide Outer Harbor Channel Widening Project: POMS Management Plan*.

Bookelaar, B. (2018). Understanding and minimizing the impacts of host pathogen- environment interactions in the Pacific oyster Crassostrea gigas. PhD Thesis, University College Cork.

Boskalis (2019), *Dredge Management Plan*. Outer Harbor Channel Widening Project.

DAWE (2020), *Australian Ballast Water Management Requirements Version 8*. Department of Agriculture, Water and the Environment.

DAFF (2023), *Australian biofouling management requirements version 2*, Department of Agriculture, Fisheries and Forestry, Canberra.

de Kantzow, Hick P, Becker JA and Whittington RJ (2016). Effect of water temperature on mortality of Pacific oysters *Crassostrea gigas* associated with microvariant ostreid herpesvirus 1 (OsHV-1 microvariant). *Aquaculture Environment Interactions*, 8: 419–428.

EPA (2019), *Code of practice for vessel and facility management (marine and inland waters)*, Environment Protection Authority, South Australian Government.

Herbert, RJH, Humphreys, J, Davies, CJ *et al.* (2016). Ecological impacts of non-native Pacific oysters (*Crassostrea gigas*) and management measures for protected areas in Europe. *Biodiversity Conservation* 25, 2835–2865.

IMO (2004). *International Convention for the Control and Management of Ships' Ballast Water and Sediments*. International Maritime Organisation.

J Diversity (2024), *Outer Harbor Berth 6 Benthic survey report.* Report prepared for Flinders Port Holdings by J Diversity Pty Ltd.

O' Reilly AJ, Laide C, Maloy A, Hutton S, Bookelaar B, O' Sullivan K, Lynch SA, Culloty SC. (2017). The role of the mussel *Mytilus spp.* in the transmission of ostreid herpesvirus-1 microVar. Parasitology. DOI: 10.1017/S0031182017002244

PIRSA (undated), *Frequently asked questions: Port River POMS outbreak*. Primary Industries and Regions South Australia.

PIRSA (2020), *Pacific Oyster Mortality Syndrome (POMS),* https://www.pir.sa.gov.au/aquaculture/aquatic_animal_health/pacific_oyster_mortality_syndrome.

PIRSA (2022), *Bivalve shellfish – Port River system,* https://pir.sa.gov.au/recreational_fishing/rules/fishing_closures/closure_areas/species_closures/bivalve_shellfish_port_river_system

PIRSA (2023). Draft Biosecurity Bill Overview. Developing a new Biosecurity Act for South Australia. Department of Primary Industries and Regions (PIRSA), Government of South Australia.

Venice Energy (2021), *Outer Harbor LNG Project Dredge Management Plan Framework*. Prepared by Venice Energy Pty Ltd and JBS&G Australia Pty Ltd.

Appendix E

Seagrass clearance report

EMM
creating opportunities

Native Vegetation Clearance

Outer Harbor Berth 6 Extension

(Dredging and land reclamation)

Data Report

Clearance under the *Native Vegetation Regulations 2017*

3/06/2024

Prepared by James Brook

Table of contents

1. Application information

Application Details

Applicant:	Flinders Port Holdings		
Key contact:	Name and contact details		
Landowner:	*If the applicant is not the landowner, written permission must be provided*		
Site Address:	7 Coghlan Rd, Outer Harbor		
Local Government Area:	City of Port Adelaide and Enfield	Hundred:	Port Adelaide
Title ID:	CT 6126/861	Parcel ID	D73109A1

Summary of proposed clearance

Purpose of clearance	Clearance required for the extension of Berth 6 in order to accommodate increasing vessel numbers and vessels of larger size.
Native Vegetation Regulation	Regulation 12, 34 Infrastructure.
Description of the vegetation under application	Dense intertidal or shallow subtidal *Zostera* on mudflat or near shoreline, and very sparse subtidal *Zostera* in modified river environment.
Total proposed clearance - area (ha) and number of trees	Approximately 0.61 ha, noting that this includes 0.11 ha of very sparse *Zostera* (isolated tufts) which are likely to be functionally equivalent to bare sand.
Level of clearance	Level 3
Overlay (Planning and Design Code)	Native Vegetation Overlay or State Significant Native Vegetation Overlay (for applications associated with a development application only)
Map of proposed clearance area: Refer Figure 1	
Mitigation hierarchy	The proposed dredge footprint avoids seagrass. The proposed reclamation area is the minimum area necessary to achieve the wharf expansion. A number of measures will be considered to avoid indirect impacts on seagrass, including construction outside of the warmer months (to minimise potential impact on seagrass carbohydrate storage), and the possible use of silt curtains. There is no option to rehabilitate the area, as it will be maintained as a berth and channel for ongoing use. The clearance will be offset by a payment into the Native Vegetation Fund.
SEB Offset proposal	Payment of $30,888.97 into the Native Vegetation Fund

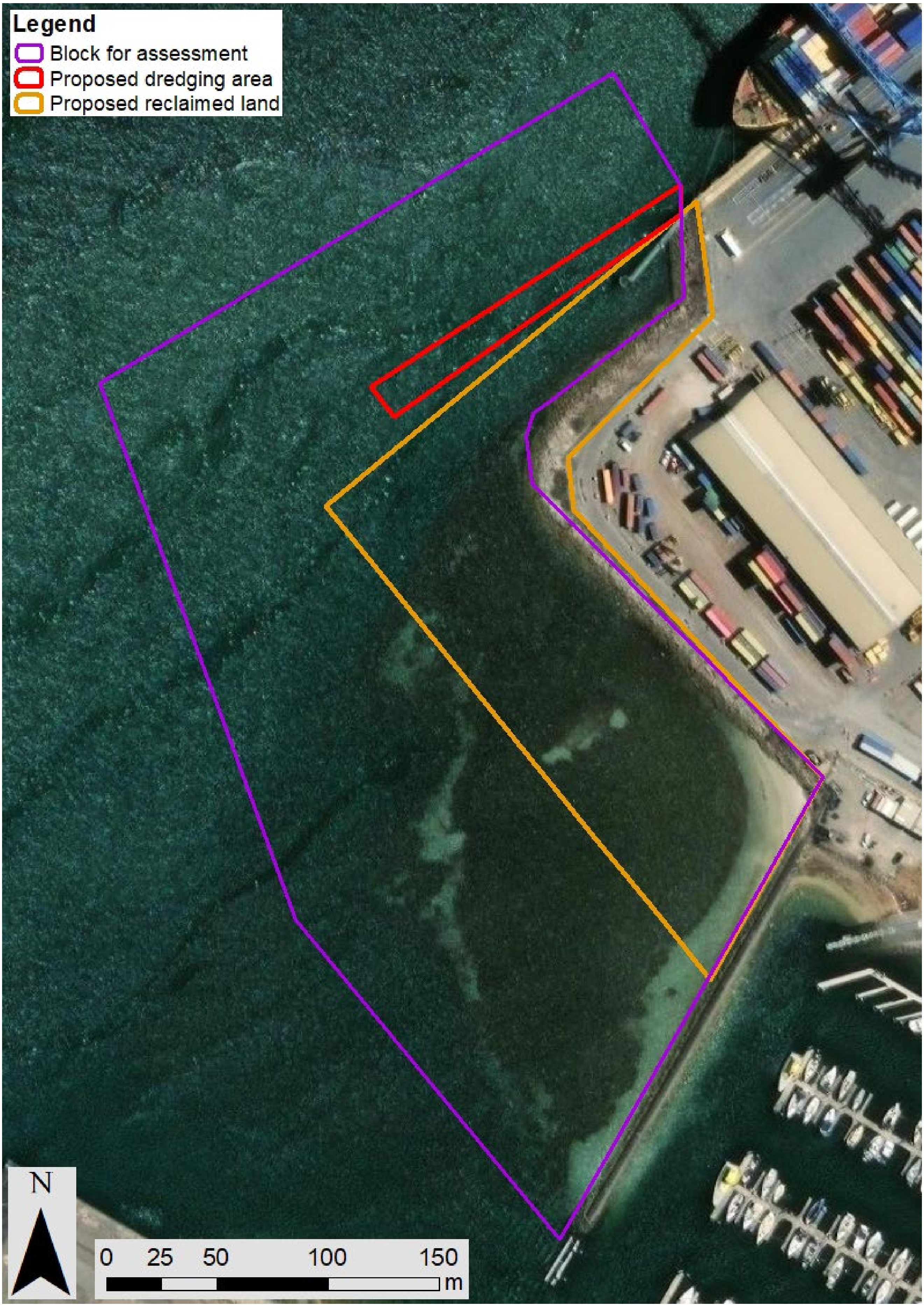


Figure 1. Proposed clearance areas within block defined for assessment.

2. Purpose of clearance

2.1 Description

Clearance approval is required to allow dredging and land reclamation activities to support a westwards extension of Berth 6 by 179 m in order to accommodate the increasing number of vessels and vessels of larger size accessing Berth 6.

Approximately 550 m^3 of material would be dredged from the Port River for disposal on land. Dredging is expected to take place in 2025 and take up to 2 weeks.

This application covers direct clearance of seagrass for the Project as a result of the dredging and land reclamation activities. Refer to Section 4.3 for discussion of the potential for indirect impacts.

This draft Data Report has been prepared to support the Development Application for the Project. Formal clearance approval under the Native Vegetation Act would be sought subsequent to development approval.

2.2 Background

The proposed clearance is near the existing Berth 6 at Outer Harbor in the Port River, near the Royal South Australian Yacht Squadron (RSAYS). The current channel and wharf area adjacent to the site have been formed by historic dredging and land reclamation activities and ongoing maintenance dredging. There is a mudflat between Berth 6 and the RSAYS, part of which would be reclaimed for the proposed wharf extension.

The Port River in this area is primarily used as a shipping channel but is also used by recreational, commercial fishing and tourist vessels.

There have been several other completed or approved dredging projects in the Port River in recent years (see table below). Areas within the Port River are periodically dredged to maintain the shipping channel and support port operations.

Project	Proponent	DA number	Location	Volume (m^3)	Status
Outer Harbor Channel Widening Project	Flinders Ports	010/V048/17	Outer Harbor	~800,000 m^3 for Port River component (Boskalis 2019)	Completed
Outer Harbor LPG Project	Venice Energy	040/V136/20	Pelican Point	1.8 million	Approved
Project LPG	Origin Energy	010/V008/18	Quarantine Station	70,000	Approved

Also of relevance to the proposed clearance is an understanding of the seagrass in the region, particularly species of the family *Zosteraceae*. Seagrass has been mapped on the northern bank of the Port River between the northern breakwater and the quarantine station, by NRS (2004, Figure 2), DEH (2008, Figure 3), BMT WBM (2017, Figure 4), Milne & Milne (2020, Figure 5). Mapping of intertidal *Zostera* from the Quarantine Station southwards to the AGL Power Station was reported by Tanner et al. (2021, Figure 6),

Although there are a few discrepancies between the various studies, and many of them do not differentiate between intertidal and subtidal seagrass, it is clear that there are at least several hundred hectares of subtidal and/or intertidal *Zostera* between the northern breakwater and the Torrens Island Power Station. Much of this is on the northern bank, where it is typically dense (Milne & Milne 2020).

At least two species of *Zostera*, including *Z. nigricaulis* and *Z. muelleri*, are present in the Port River. Typically, the former would be found in subtidal habitat and the latter in intertidal habitat (Hirst et al. 2017, Ball et al. 2010), but it should be noted that *Z. muelleri* has been recorded elsewhere to depths of 4 m (Jones et al. 2008).

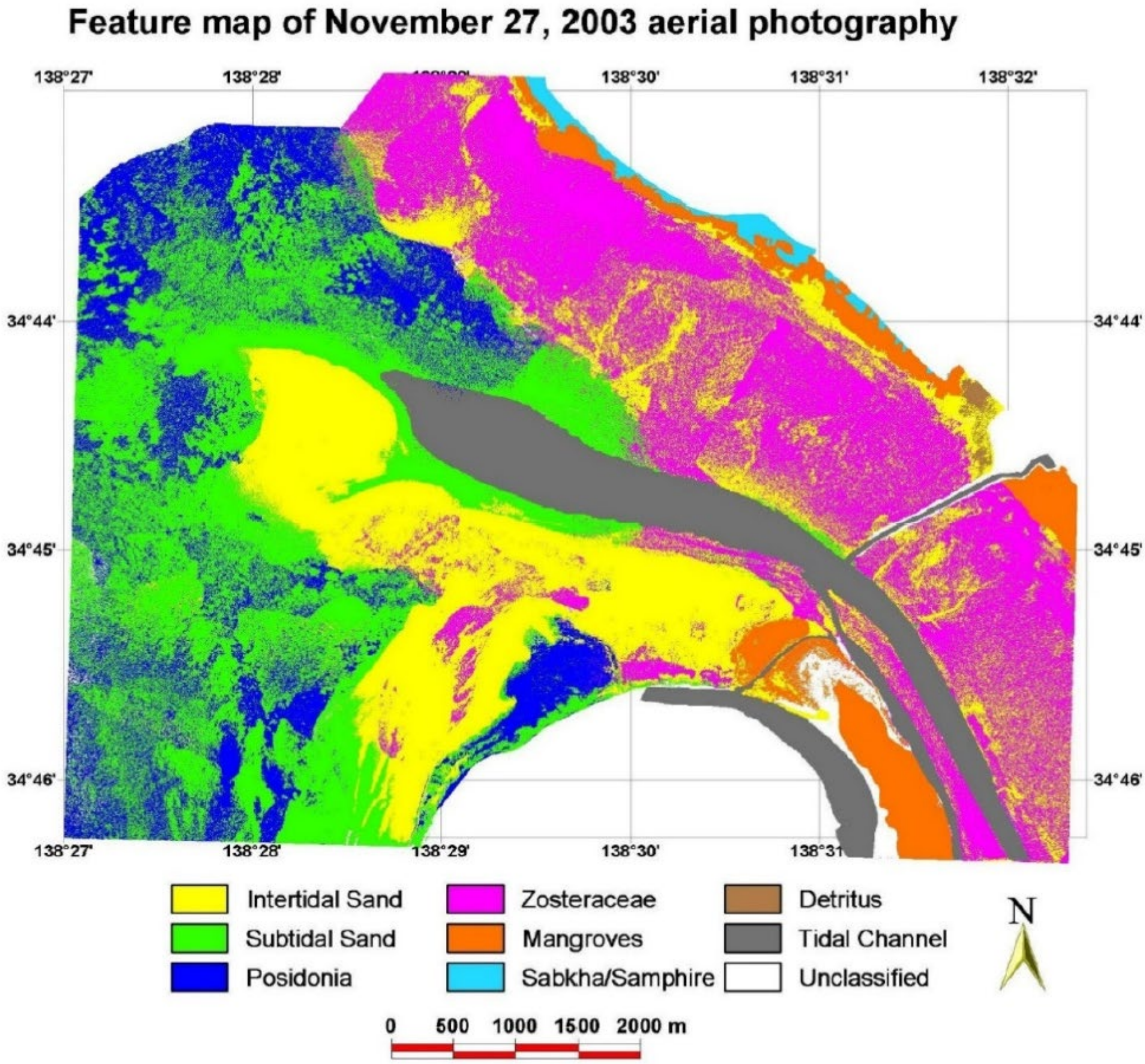


Figure 2. Habitat mapping by NRS (2004)

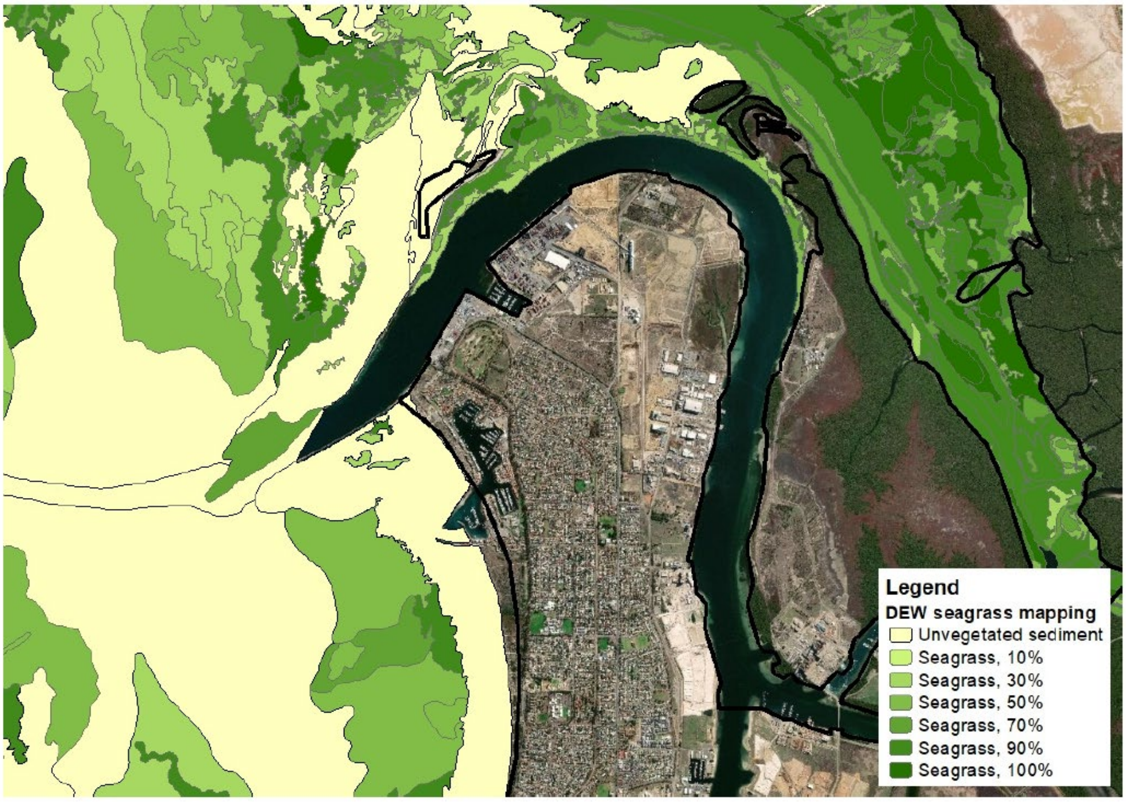


Figure 3. Habitat mapping by DEH (2008). Source: DEW 2021.

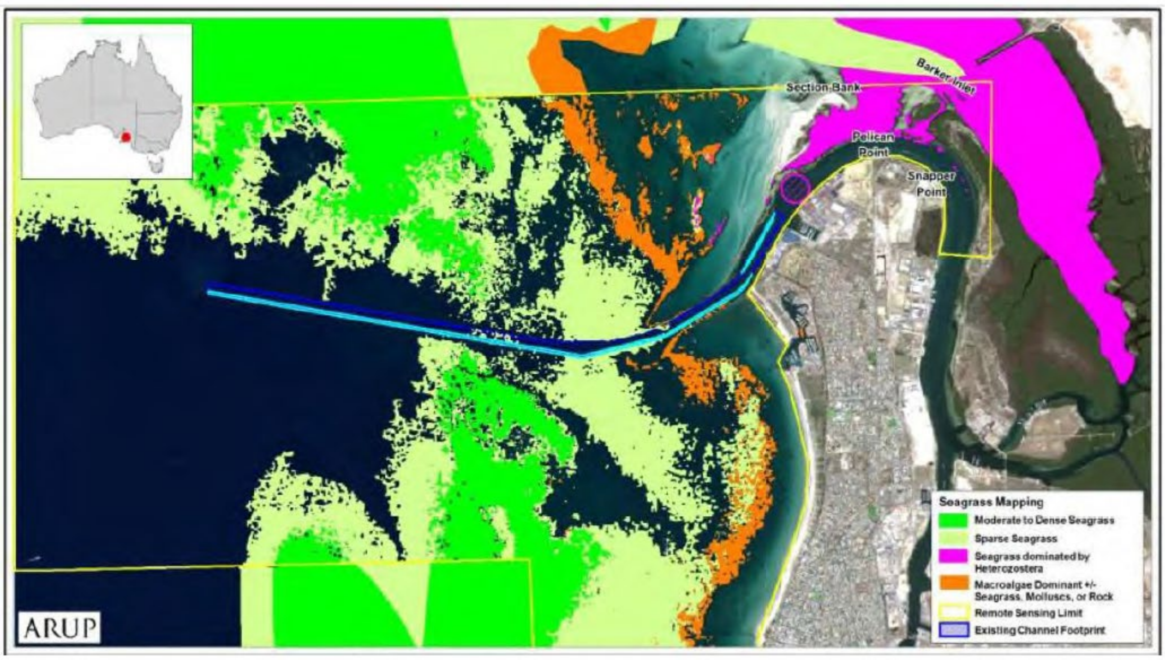


Figure 4 Habitat mapping by BMT WBM (2017).

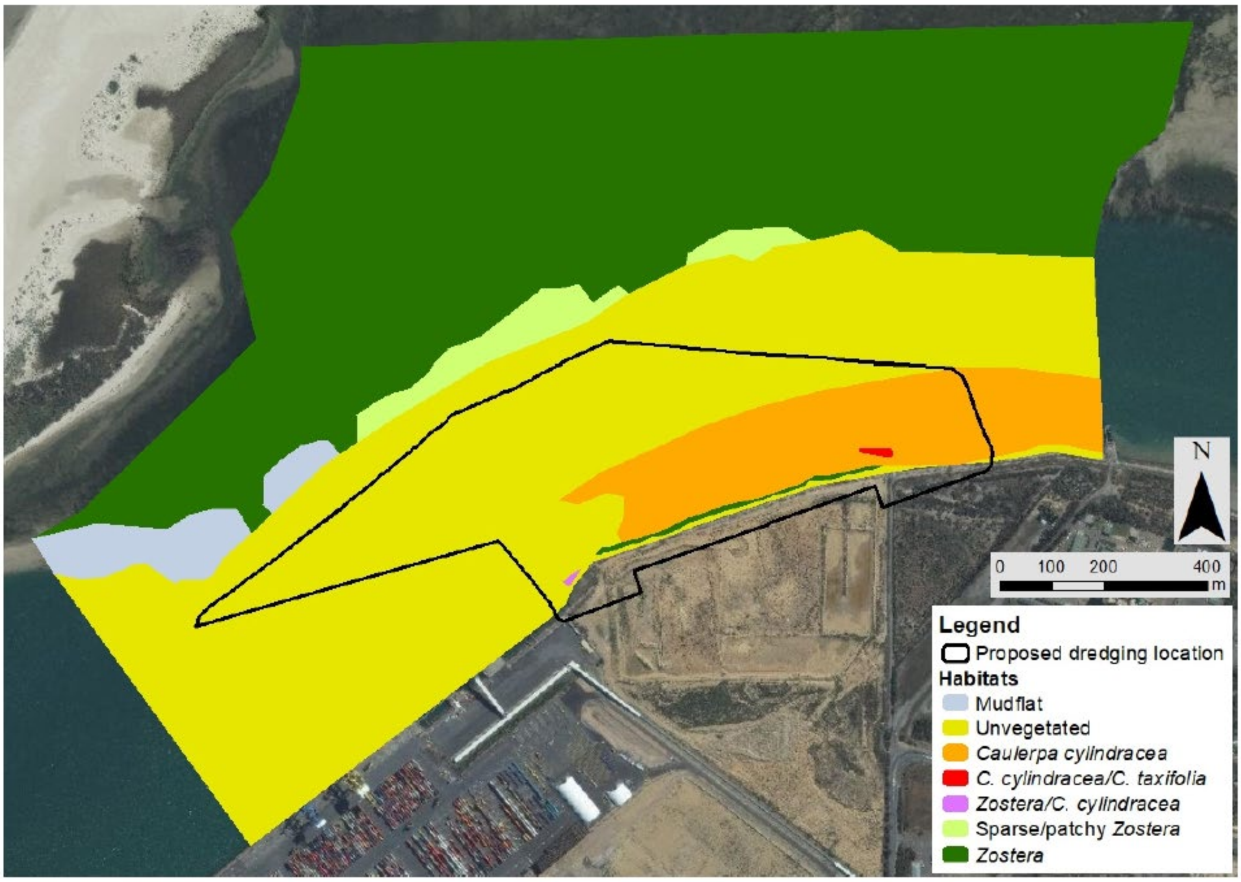


Figure 5. Habitat mapping near Pelican Point. Source: Milne & Milne (2020).

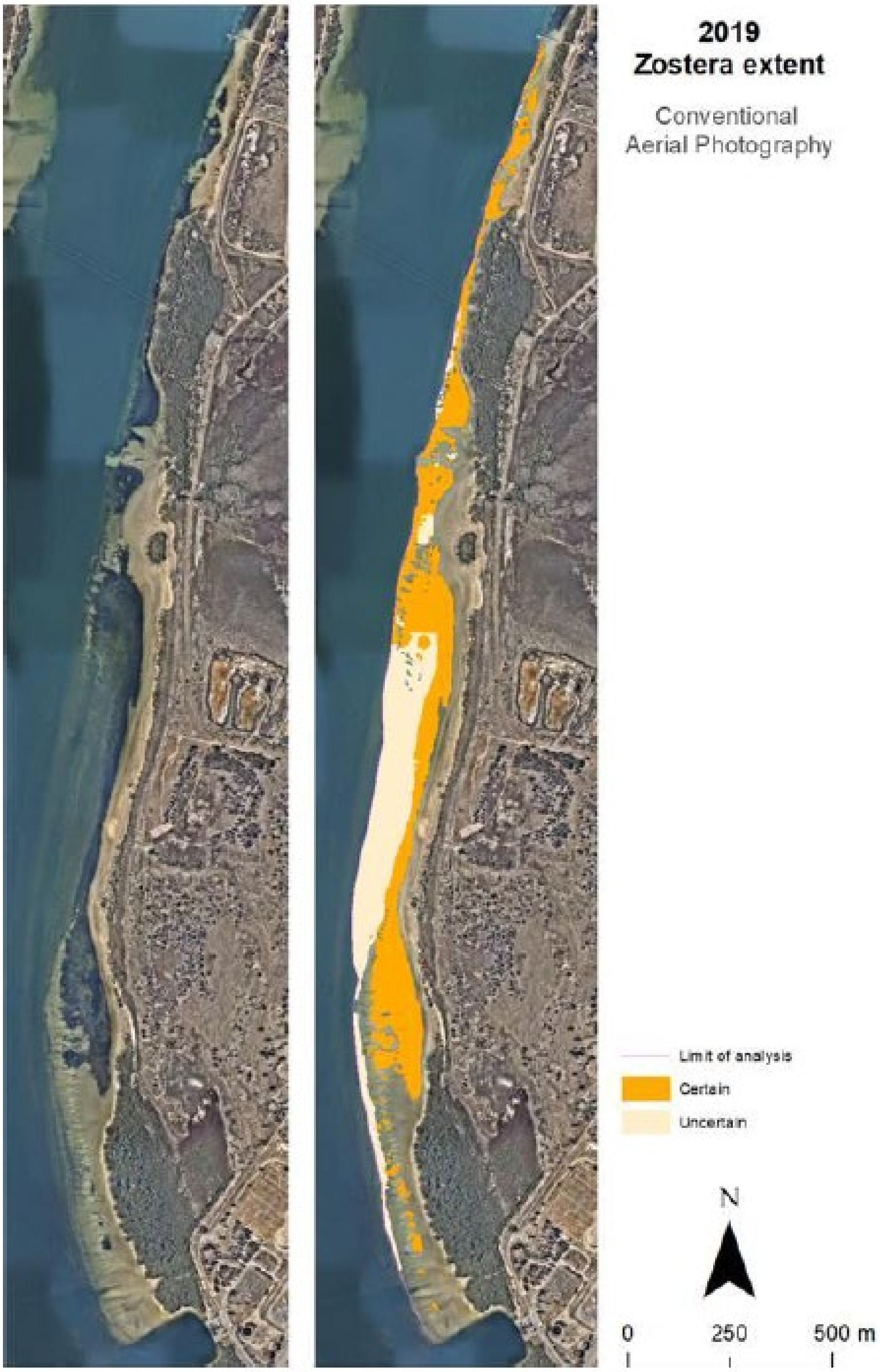


Figure 6. Intertidal Zostera mapped on Torrens Island south of the Quarantine Station. Source: Tanner et al. (2021)

2.3 General location map

Refer Figure 1

2.4 Details of the proposal

The layout of the proposed wharf extension is shown in Figure 7

Details of the land reclamation process, including the methodology, volume and type of materials, duration and whether it will be a staged operation, will not be known for 9–12 months, but in general terms it will be a wet/dry civil earthworks works operation.

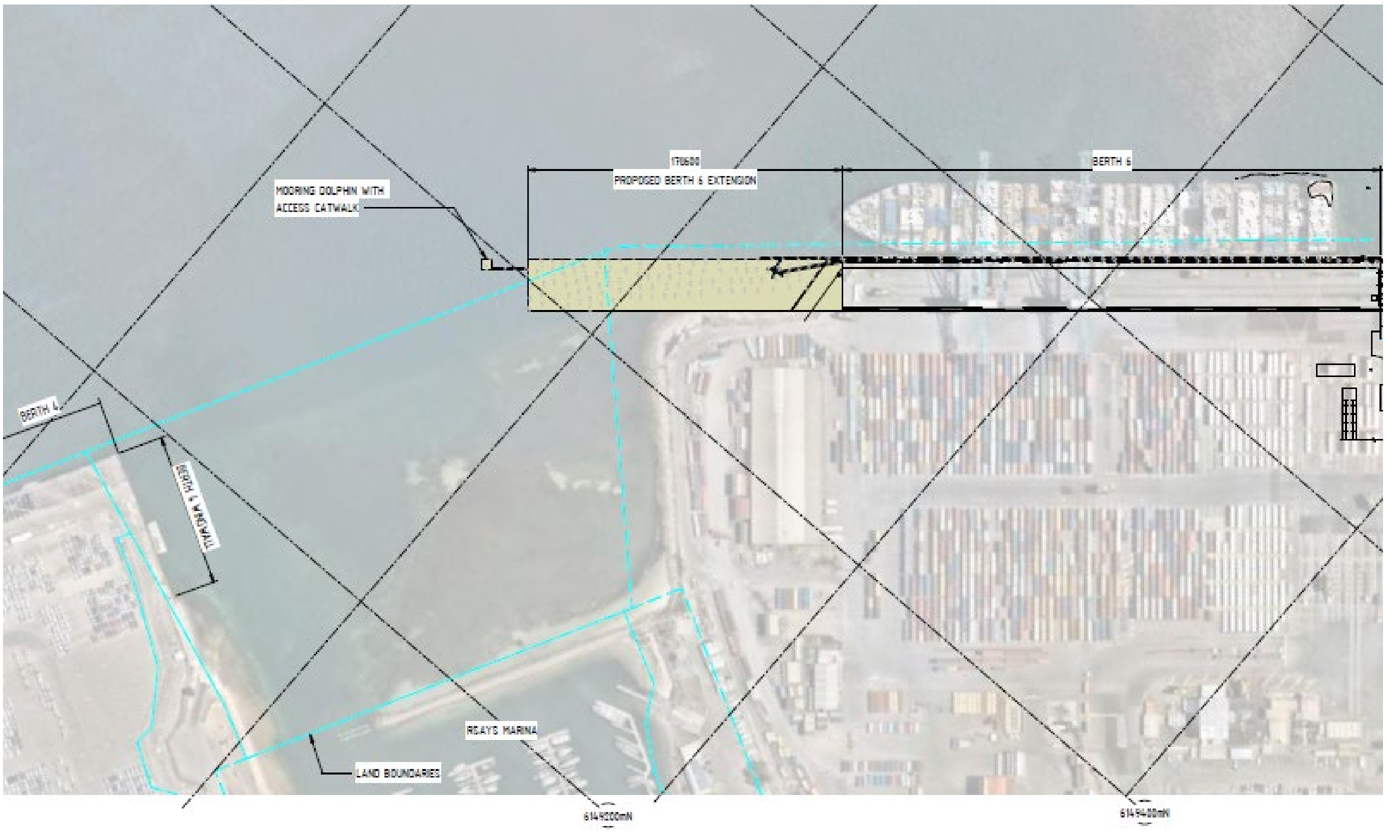


Figure 7. Drawing of proposed wharf extension.

2.5 Approvals <u>required</u> *or* <u>obtained</u>

A Development application is currently being prepared under the *Planning, Development and Infrastructure Act 2016* and the NVC assessment is part of that process.

2.6 Native Vegetation Regulation

Pursuant to Regulation 12, the proposed clearance should be assessed in accordance with Regulation 34(1)(b), as the purpose of the clearance is incidental to the expansion of infrastructure associated with a development application.

2.7 Development Application information (if applicable)

Zone: Strategic Employment

Sub Zone: Ports

Overlay: Native Vegetation

3. Method

3.1 Flora assessment

A field survey was undertaken using several different survey methods to address safety and practicality requirements.

- The northern area west of the existing Berth 6 required diving using surface supplied breathing apparatus (SSBA) as best safety practice in a busy port area and deeper water (to approximately 15 m depth).
- The mudflat between Berth 6 and RSAYS was too shallow to survey using scuba or snorkel during most tides and was surveyed at the lowest tide using a drone.

SSBA surveys were undertaken on 7–8 and 25 March 2024 (with the gap caused by ship berthing schedules). Transect lines were set by deploying a weighted rope from the vessel between GPS marks, or by using a 50 m tape deployed by the diver. Diving was undertaken by the author or other commercial divers with marine science qualifications and training, and video was captured from a head-mounted camera. Discretionary still photos were also taken using the same camera. The location of the transect lines is provided in Figure 8.

The drone survey was undertaken on 8 March 2024, at 12:30 pm, which was close to low tide. Images were captured using a DJI Mavic Air 2 Drone, which has a horizontal hovering accuracy of 1.5 m. The camera has a field of view of 84° and captured images of 4000 x 3000 pixels, i.e. an aspect ratio of 4:3. The drone was flown at 80 m, providing for images covering approximately 115 x 86 m. The grid spacing was such to provide for an overlap of 50% in each dimension (Figure 9).

The images were processed using the OpenDroneMap (ODM) software to construct a georeferenced orthomosaic of the images. Some ground truthing of seagrass distribution was undertaken by visual inspection on the northern side and by snorkel on the south-western side.

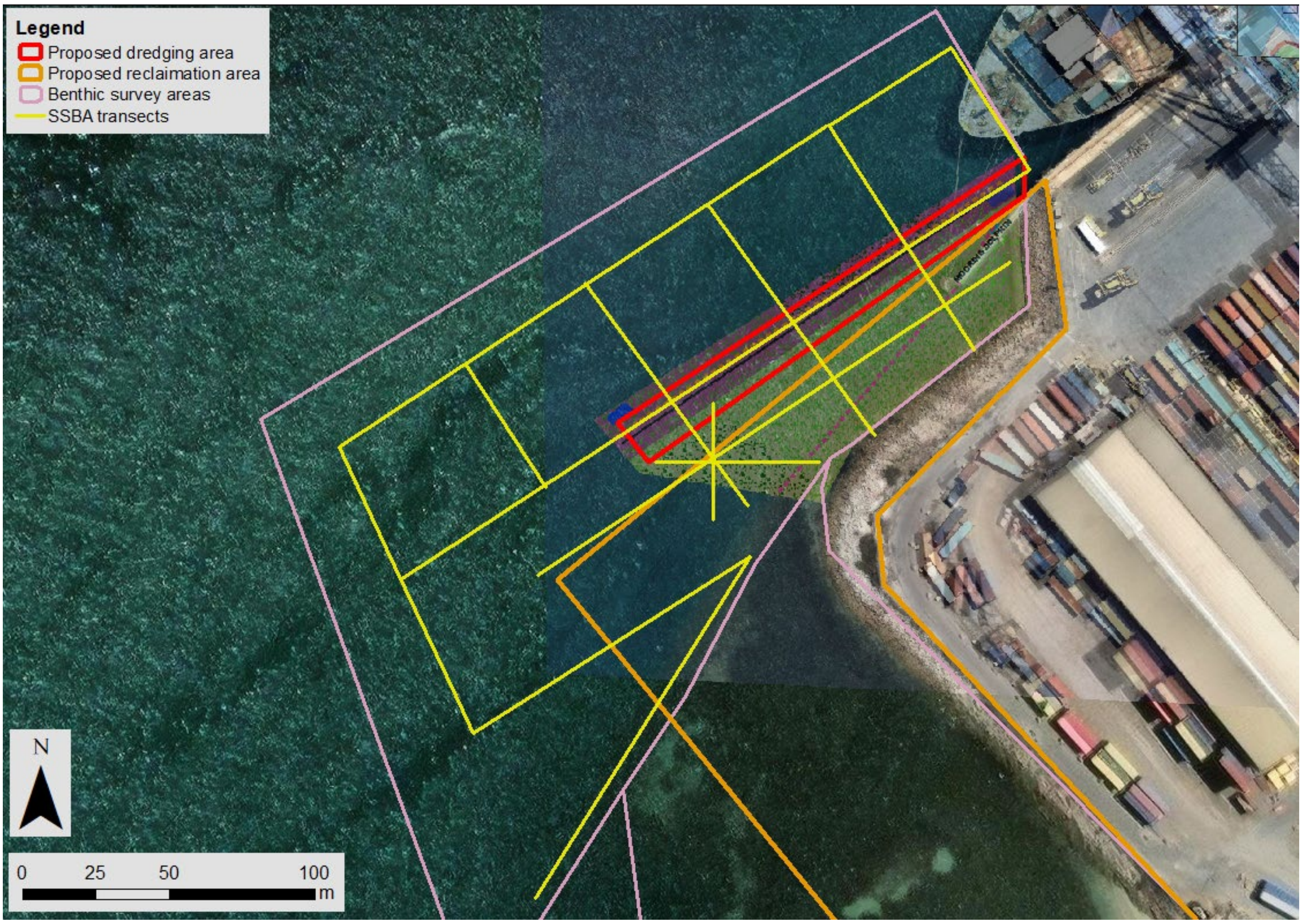


Figure 8. Layout of transects undertaken using surface supplied breathing apparatus (SSBA)

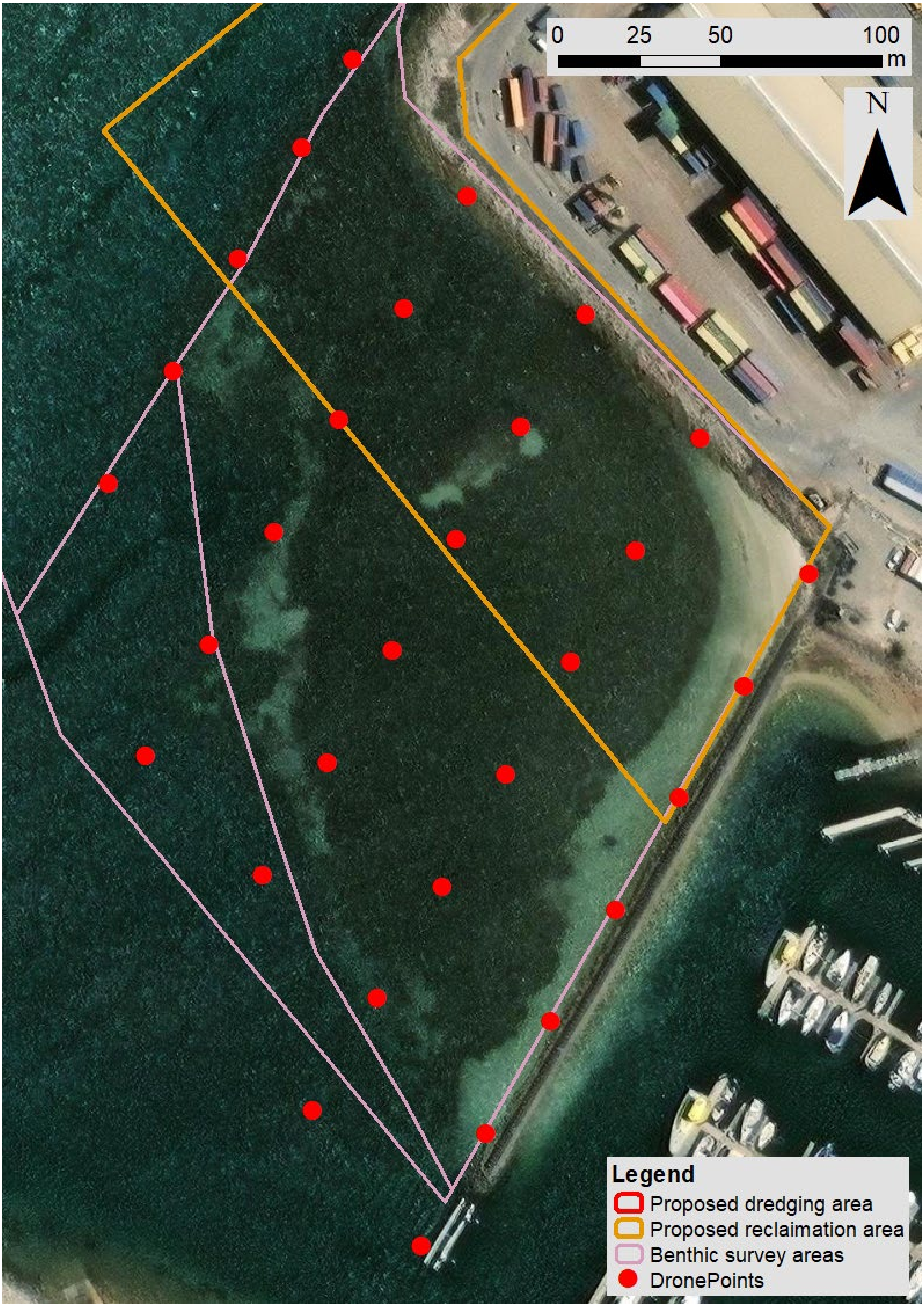


Figure 9. Locations of drone photopoints

3.2 Fauna assessment

Database searches were undertaken using the Protected Matters Search Tool and Atlas of Living Australia, of an area within 5 km of the proposed clearance area.

4. Assessment Outcomes

4.1 Vegetation Assessment

General description of the vegetation, the site and matters of significance

The SSBA transects were situated mostly over silt with a cover of sparse to moderate density seagrass wrack. In some areas with depths 2–13 m, very sparse *Zostera* was recorded, with isolated small tufts or even stems with a single leaf (Figure 10). On some transects only a single tuft was observed, including at point A, in the proposed dredging area, and at Point B, where the single tuft was at the end of the east-to-west transect, but coincided with sparse seagrass recorded over a longer section of the nearby north-to-south transect (Figure 10). In the former case, the single, isolated tuft was excluded from mapping (see below).

Intertidal seagrass identified from the drone images is shown in Figure 11. The locations of the identified seagrass were consistent with observations by snorkel and visual inspection from the shore,

A synthesis of the seagrass mapped using the above methods is provided in Figure 12, with two associations identified:

- Dense intertidal/shallow subtidal *Zostera*. It is possible that it includes two different *Zostera* species, but for the purpose of the SEB calculations the intertidal and shallow subtidal sections have similar attributes.
- Very sparse subtidal *Zostera*.

Figure 10. Seagrass identified from SSBA transects.

Figure 11. Seagrass identified from drone images.

Figure 12. Map of seagrass associations identified from SSBA and drone surveys.

Details of the vegetation associations proposed to be impacted

Vegetation Association	1. Dense intertidal/shallow subtidal *Zostera*				
(see also cover photo) 					
General description	Dense (>75% cover) *Zostera nigricaulis*, in intertidal mudflat or in shallow subtidal water north of the north-facing rock revetment west of Berth 6.				
Threatened species or community	No threatened flora, or community. Threatened fauna likely or possible to use the cleared area include a number of shorebirds, including migratory shorebirds, listed as Rare under the NP&W Act or threatened under the NP&W Act or EPBC Act (see Section 4.2 for details).				
Landscape context score	1.03	Vegetation Condition Score	31.45	Conservation significance score	1.1
Unit biodiversity Score	35.46	Area (ha)	0.50	Total biodiversity Score	17.73

<table>
<tr><td>Vegetation Association</td><td colspan="5">2. Very sparse Zostera nigricaulis</td></tr>
<tr><td colspan="6">
</td></tr>
<tr><td>General description</td><td colspan="5">Very sparse traces (single blades or tufts) of black-stemmed eelgrass Zostera nigricaulis, with distances between tufts of 1–5 m. This habitat is probably functionally similar to bare silt.</td></tr>
<tr><td>Threatened species or community</td><td colspan="5">No threatened flora, fauna or community</td></tr>
<tr><td>Landscape context score</td><td>1.03</td><td>Vegetation Condition Score</td><td>8.44</td><td>Conservation significance score</td><td>1.0</td></tr>
<tr><td>Unit biodiversity Score</td><td>8.65</td><td>Area (ha)</td><td>0.11</td><td>Total biodiversity Score</td><td>0.95</td></tr>
</table>

Site map showing areas of proposed impact

Refer Figure 12.

Photo log

Photos are shown above.

4.2 Threatened Species assessment

Searches of the PMST and ALA databases (the latter incorporating BDBSA records) within a 5 km radius of the proposed clearance returned a number of species listed as Endangered, Vulnerable or Rare under the NP&W Act or Critically Endangered, Endangered or Vulnerable under the EPBC Act, including four turtles, ten marine mammals, one shark, 23 seabirds and 22 shorebirds.

Many of these species were predicted by the PMST and have no ALA records within the search area. The listed rare and threatened species with ALA or other records from within 5 km of the proposed clearance since 1995, or for which the PMST returned "Species or species habitat known to occur in the area", are listed in the table below.

The clearance area does not provide important habitat for any of these species. The white shark is a wide-ranging pelagic feeder but its most important habitats are seal breeding colonies, of which the nearest is The Pages island group, more than 110 km south of the clearance area. The turtles have no known breeding habitat in southern Australia. The dense *Zostera* association is too shallow to be used by sharks, turtles and whales. The southern right whale is a wide-ranging mobile filter-feeding species whose use of the water columns does not rely on the presence of seagrass. Seabirds, including White-bellied Sea-eagles and Osprey may overfly and dive into the water column of the cleared area but the scale of the proposed clearance would not impact this activity.

Seagrass provides habitat or ecosystem services for some life stages of the prey of many of the threatened species, particularly shorebirds, but there is an abundance of dense seagrass on the northern and eastern banks of the Port River, including intertidal seagrass, and the proposed clearance would be unlikely to impact food availability in the Port River. There is also substantial intertidal seagrass in Barker Inlet and St Kilda. The cleared area is not within any nationally or internationally recognised important areas for the species listed below as likely or possibly using the cleared area.

It should also be noted that the seagrass within the "Very sparse *Zostera*" association is so sparse that the habitat is likely to be functionally more similar to bare substrate than to a typical seagrass meadow. Notably, the lowest score for the "Bare Ground" criterion within the Marine Assessment Scoresheet is achieved with a cover of 49% (51% bare ground). The association has a seagrass cover of a fraction of a percent. It is also noted that habitats classified by DEH (2008) as "bare substrate" can have up to 10% cover.

Taking into account all of the above, it is concluded that use of the proposed clearance area by threatened species is negligible or insignificant, and only the shorebirds considered likely or possibly to use the proposed cleared habitat have been added to the Marine Assessment Scoresheet, pending endorsement from the Native Vegetation Branch.

Species recorded within 5km of the development application area since 1995, or for which the vegetation is considered to provide suitable habitat. Information on habitat preferences is from the Species Profile and Threats Database (DCCEEW 2023) unless otherwise specified.

Species (common name)	NP&W Act	EPBC Act	Data source	Date of last record	Species known habitat preferences*	Likelihood of use for habitat – Comments
Sharks						
Carcharodon carcharias (White shark)		VU	5		Wide ranging species, with most frequent observations around seal breeding colonies. No ALA records in search area.	Unlikely (no records, unsuitable shallow habitat).
Turtles						
Chelonia mydas (Green turtle)	V	VU	2	2018	Key breeding and foraging habitat is in tropical Australia. Three ALA records in search area.	Unlikely (unsuitable shallow habitat)
Dermochelys coriacea (Leatherback turtle)	V	EN	2	1996	Pelagic feeder with no known breeding habitat in Australia. One ALA record in search area.	Unlikely (unsuitable shallow habitat)
*Lepidochelys olivacea (*Olive Ridley turtle)		EN	2	2012	Normally inhabits northern Australia. Two ALA records in search area.	Unlikely (unsuitable shallow habitat)
Marine mammals						
Arctocephalus tropicalis (Subantarctic Fur-seal)	E	EN	2	2005	Breeds and hauls out mainly on Macquarie Island, but individuals range widely and occasionally reach mainland Australia. One ALA record in search area near Taperoo Beach.	Unlikely (unsuitable shallow habitat)
Balaenoptera musculus (Blue whale)	E	EN	2	1989	Migrate between polar and tropical waters and have a number of aggregations worldwide but are globally rare. Nearest blue whale aggregation area is Robe in south-eastern South Australia. Outside aggregation areas coast is used only for migration and opportunistic feeding. Four ALA records in search area.	Unlikely (unsuitable shallow habitat)
Eubalaena australis (Southern right whale)	V	EN	2	2010	Circumpolar distribution in the Southern Hemisphere with coastal calving/nursery grounds in latitudes of 16–52°S occupied during late autumn to early spring and feeding in latitudes of 32–65° (DSEWPaC 2012). Six ALA records in search area.	Unlikely (unsuitable shallow habitat)

Species (common name)	NP&W Act	EPBC Act	Data source	Date of last record	Species known habitat preferences*	Likelihood of use for habitat – Comments
Kogia sima (Dwarf sperm whale)	R		2	1958	Occurs in all oceans apart from polar or sub-polar seas. One ALA record in search area.	Unlikely (no records in past 40 years, unsuitable shallow habitat)
Megaptera novaeangliae (Humpback whale)	V		2	2019	Global distribution is fragmented. In Australia, migration occurs between Antarctic feeding grounds and calving areas in northern Western Australia and Queensland. Seven ALA records in search area.	Unlikely (unsuitable shallow habitat)
Neophoca cinerea (Australian sea lion)	V	EN	2	2024	Temperate water species ranging from western Victoria to Western Australia. Twelve ALA records in search area.	Unlikely (unsuitable shallow habitat, no records of haulout on mudflat)
Physeter macrocephalus (Sperm whale)	R		2	-Inf	Occurs in deep waters in all oceans including all Australian states (possibly in fragmented populations), with concentrations near the continental shelf edge, including south-west of Kangaroo Island. One ALA record in search area.	Unlikely (unsuitable shallow habitat)
Seabirds						
Ardenna carneipes (Flesh-footed Shearwater)	R		2	1988	A trans-equatorial migrant, and a locally common visitor to waters of the continental shelf and continental slope off southern Australia. Spends most of life (except nesting) in flight, fishing from ocean. One ALA record in search area.	Unlikely (unsuitable shallow habitat)
Cereopsis novaehollandiae (Cape Barren Goose)	R		2	2020	Resident in south-eastern Australia (to Eyre Peninsula) and south-western Australia. Nearest important areas are Kangaroo Island and the Sir Joseph Banks Group in Spencer Gulf. Breeds and feeds on land (BirdLife Australia 2023). Seven ALA records in search area, near Largs Beach.	Unlikely (unsuitable habitat)

Species (common name)	NP&W Act	EPBC Act	Data source	Date of last record	Species known habitat preferences*	Likelihood of use for habitat – Comments
Haematopus fuliginosus fuliginosus (Sooty Oystercatcher)	R		2	2024	Endemic to Australia and is widespread in coastal eastern, southern and western Australia, usually within 50 m of the coast. Prefers rocky shores but also inhabits beach and tidal flats. Breeds on offshore islands and isolated rocky headlands (BirdLife Australia 2023). Two hundred and thirty ALA records in search area, including three on or near the mudflat north of RSAYS.	Likely (suitable habitat and records near block)
Haematopus longirostris (Pied Oystercatcher)	R		2	2023	Found in coastal areas throughout the Australian continent except for areas of unbroken sea cliffs such as the Great Australian Bight (BirdLife Australia 2023). Two hundred and seven ALA records in search area, including three on or near the mudflat north of RSAYS.	Likely (suitable habitat and records in or near block)
Haliaeetus leucogaster (White-bellied Sea Eagle)	E		2	2022	Distribution includes South-east Asia and the coastline (including offshore islands) of mainland Australia and Tasmania but restricted in south-central and south-western Australia. Fourteen ALA records in search area.	Unlikely (unsuitable habitat)
Larus dominicanus dominicanus (Kelp Gull)	R		2	1987	Circumglobal in the southern hemisphere. Established in Australia since the 1940s and are now common in many parts of the south-east and south-west coasts, and especially in Tasmania (Birdlife Australia 2023). Six ALA records in search area.	Unlikely (unsuitable habitat)
Macronectes giganteus (Southern Giant Petrel)	V	EN	2	1983	Widespread throughout the Southern Ocean and breed on six subantarctic and Antarctic islands in Australian territory. Three ALA records in search area.	Unlikely (unsuitable habitat)
Pachyptila turtur subantarctica (Fairy Prion (southern))		VU	5		Breeds on subantarctic islands but wide-ranging along southern Australian coastline. No ALA records in search area.	Unlikely (unsuitable habitat)

Species (common name)	NP&W Act	EPBC Act	Data source	Date of last record	Species known habitat preferences*	Likelihood of use for habitat – Comments
Pandion haliaetus cristatus (Eastern Osprey)	E		2	2023	Widespread around the Australian coastline. Breeds between June and February (DEW 2022). Five ALA records in search area.	Unlikely (unsuitable habitat)
Sternula nereis nereis (Australian Fairy Tern)	E	VU	2	2021	Widespread through temperate Australian coasts. Fifteen ALA records in search area.	Unlikely (unsuitable habitat)
Thalassarche carteri (Indian Yellow-nosed Albatross)	E	VU	2	1994	Breeds in South Africa and on French Antarctic islands. Forages mostly in the southern Indian Ocean including Western Australia. One ALA record in search area.	Unlikely (unsuitable habitat)
Thalassarche cauta (Shy Albatross)	V	EN	2	2020	Breeds in Tasmania but uses southern Australian coastline. One ALA record in search area.	Unlikely (unsuitable habitat)
Thalassarche steadi (White-capped Albatross)		VU	5		Breeds in New Zealand but considered common across southern Australia. No ALA records in search area.	Unlikely (no record, unsuitable habitats)
Shorebirds						
Actitis hypoleucos (Common Sandpiper)	R		2	2024	Breeds in Europe and Asia. Areas of national importance for the species are primarily in the north of Australia. Known to use coastal habitats, including sandy beaches and rocks. Twenty-seven ALA records in search area, including one on the mudflat north of RSAYS.	Likely (suitable habitat and records in or near block)
Arenaria interpres (Ruddy Turnstone)	R		2	2021	Breeds in Northern America and Eurasia, and forages around the Australian coastline. Five ALA records in search area.	Possible (suitable habitat and records in broader search area)
Calidris alba (Sanderling)	R		2	2019	Range includes large areas of the Australian coastline. One ALA record in search area near St Kilda.	Possible (suitable habitat and records in broader search area)
Calidris canutus (Red Knot)	E	EN	2	2016	Range includes large areas of the Australian coastline. Twelve ALA records in search area.	Possible (suitable habitat and records in broader search area)
Calidris ferruginea (Curlew Sandpiper)	E	CR	2	2021	Range includes large areas of the Australian coastline and inland areas. Thirty-nine ALA records in search area.	Possible (suitable habitat and records in broader search area)

Species (common name)	NP&W Act	EPBC Act	Data source	Date of last record	Species known habitat preferences*	Likelihood of use for habitat – Comments
Calidris melanotos (Pectoral Sandpiper)	R		2	1998	Broad distribution across Australia but in South Australia is generally found to the east of Spencer Gulf. Three ALA records in search area.	Possible (suitable habitat and records in broader search area)
Calidris subminuta (Long-toed Stint)	R		5		Breeds in Siberia. Inhabits terrestrial wetlands in Australia during summer. No ALA records in search area.	Unlikely (no records)
Calidris tenuirostris (Great Knot)	E	CR	2	2011	Recorded around the entirety of the Australian coast with greatest numbers and all recognised sites of significance in northern Australia. Ten ALA records in search area.	Possible (suitable habitat and records in broader search area)
Charadrius leschenaultii (Greater Sand Plover)	R	VU	2	1988	Breeds in central Asia and the Middle East. During winter migration, occurs in coastal areas in all Australian states, with greatest numbers in northern Australia. There are no internationally important sites in South Australia. One ALA record in search area.	Possible (suitable habitat and records in broader search area)
Charadrius mongolus (Lesser Sand Plover)	E	EN	5		Breeds in central and north-eastern Asia. Widespread in coastal regions, and has been recorded in all states, but mainly occurs in internationally and nationally important sites in northern and eastern Australia. No ALA records in search area.	Unlikely (no records)
Cladorhynchus leucocephalus (Banded stilt)	V		2	2023	Endemic to Australia, found mainly in large, open, shallow saline and hypersaline waters of inland and southern Australia (Birdlife Australia 2023). One hundred and sixty ALA records in search area.	Possible (suitable habitat and records in broader search area)
Limosa lapponica baueri (Western Alaskan Bar-tailed Godwit)	R	VU	5		Range includes large areas of the Australian coastline and inland areas. No ALA records in search area.	Unlikely (no records)

Species (common name)	NP&W Act	EPBC Act	Data source	Date of last record	Species known habitat preferences*	Likelihood of use for habitat – Comments
Limosa limosa melanuroides (Black-tailed Godwit)	R		2	2019	Breeds in Russia. Inhabits Australian coasts during summer, but there are no important sites in South Australia. Nine ALA records in search area.	Possible (suitable habitat and records in broader search area)
Numenius madagascariensis (Eastern Curlew)	E	CR	2	2018	Range includes large areas of the Australian coastline and inland areas. Forty-one ALA records in search area.	Possible (suitable habitat and records in broader search area)
Philomachus pugnax (Ruff)	R		2	1998	Two ALA records in search area.	Possible (suitable habitat and records in broader search area)
Pluvialis fulva (Pacific Golden Plover)	R		2	1985	Breeds in northern Siberia, and is otherwise widespread in Australasia, but in Australia most occur along the east coast. The nearest site of national importance is the Coorong. Eleven ALA records in search area.	Possible (suitable habitat and records in broader search area)
Thinornis cucullatus cucullatus (Hooded Plover (eastern))	V	VU	2	2021	Important areas in South Australia are Yorke Peninsula and Kangaroo Island (TSSC 2014). Two ALA records in search area, on beaches in Gulf St Vincent.	Unlikely (unsuitable habitat)
Tringa brevipes (Grey-tailed Tattler)	R		2	1964	Range includes large areas of the Australian coastline. Four ALA records in search area.	Possible (suitable habitat and records in broader search area)
Tringa glareola (Wood Sandpiper)	R		5		Breeds in north of Europe and Asia. More numerous in the north than the south of Australia (Birdlife Australia 2023k). No ALA records in search area.	Unlikely (no records)
Xenus cinereus (Terek Sandpiper)	R		2	1974	Breeds in Eurasia. In Australia during summer, it is more widespread and common on the coasts of northern and eastern Australia than southern Australia. One ALA record in search area, on Torrens Island.	Possible (suitable habitat and records in broader search area)
Other birds						
Neophema chrysostoma (Blue-winged Parrot)		VU	5		Overflies marine area. No ALA records in search area.	Unlikely (no records)

Criteria for the likelihood of occurrence of species within the Study area.

Likelihood	Criteria
Highly Likely/Known	Recorded in the last 10 years, the species does not have highly specific niche requirements, the habitat is present and falls within the known range of the species distribution or; The species was recorded as part of field surveys.
Likely	Recorded within the previous 20 years, the area falls within the known distribution of the species and the area provides habitat or feeding resources for the species.
Possible	Recorded within the previous 20 years, the area falls inside the known distribution of the species, but the area provides limited habitat or feeding resources for the species. Recorded within 20 -40 years, survey effort is considered adequate, habitat and feeding resources present, and species of similar habitat needs have been recorded in the area.
Unlikely	Recorded within the previous 20 years, but the area provides no habitat or feeding resources for the species, including perching, roosting or nesting opportunities, corridor for movement or shelter. Recorded within 20 -40 years; however, suitable habitat does not occur, and species of similar habitat requirements have not been recorded in the area. No records despite adequate survey effort.

4.3 Cumulative impact

When exercising a power or making a decision under Division 5 of the Native Vegetation Regulations 2017, the NVC must consider the potential cumulative impact, both direct and indirect, that is reasonably likely to result from a proposed clearance activity.

The direct impacts of clearance considered here are restricted to the areas shown in Figure 1 .

It is possible that construction activities (dredging and land reclamation) may result in turbid water which can have indirect impacts on seagrass through blocking of light or smothering by settling sediment. The scale and intensity of the impact depends on a number of factors, including the volume and composition of the dredged material, the dredging method used, and the materials and method used for land reclamation. According to the EPA Dredge Guideline (EPA 2020), the dredging volume (550 m^3) corresponds to low risk, the dredging duration (2 weeks) corresponds to low–medium risk, the distance from the mudflat to the dredging (<500 m and possibly within the plume area) corresponds to medium–high risk and the percentage of fines within the dredged material (58%) corresponds to high risk.

Based on monitoring results from the Outer Harbor Channel Widening Project, the dense *Zostera* beds known to exist downstream on the opposite side of the river are not likely to be impacted by the proposed dredge operations. The density of *Zostera* was unchanged, relative to control sites, at monitoring sites situated one kilometre from the Outer Harbor swing basin, from which more than 400,000 m^3 of material was dredged using a Trailer Suction Hopper Dredge and about 50,000 m^3 using a Backhoe Dredge. The proposed dredging is three orders of magnitude lower in volume. There is also the potential to use mitigation measures including silt curtains to reduce the risk of indirect impacts to seagrass on or near the mudflat south of Berth 6.

4.4 Address the Mitigation Hierarchy

When exercising a power or making a decision under Division 5 of the Native Vegetation Regulations 2017, the NVC must have regard to the mitigation hierarchy. The NVC will also consider, with the aim to minimize, impacts on biological diversity, soil, water and other natural resources, threatened species or ecological communities under the EPBC Act or listed species under the NP&W Act.

a) Avoidance – outline measures taken to avoid clearance of native vegetation

The dredge footprint avoids seagrass. The land reclamation necessary to construct the wharf extension cannot avoid clearance of seagrass.

b) Minimization – if clearance cannot be avoided, outline measures taken to minimize the extent, duration and intensity of impacts of the clearance on biodiversity to the fullest possible extent (whether the impact is direct, indirect or cumulative).

Only the minimum area required for the wharf extension will be reclaimed.

Measures to be considered to avoid indirect impacts on seagrasses include construction outside of warmer months when seagrass is building carbohydrate reserves and flowering (Short et al. 2017), and potential use of silt curtains.

Dredging during winter months may also overlap with periods of naturally elevated turbidity due to storms, such that turbidity associated with dredging is less likely to have an impact.

c) Rehabilitation or restoration – outline measures taken to rehabilitate ecosystems that have been degraded, and to restore ecosystems that have been degraded, or destroyed by the impact of clearance that cannot be avoided or further minimized, such as allowing for the re-establishment of the vegetation.

There is no option to rehabilitate the area, as it will be maintained as a berth and channel for ongoing use.

d) Offset – any adverse impact on native vegetation that cannot be avoided or further minimized should be offset by the achievement of a significant environmental benefit that outweighs that impact.

The NVC will only consider an offset once avoidance, minimization and restoration have been documented and fulfilled. The SEB Policy explains the biodiversity offsetting principles that must be met.

The clearance will be offset by a payment into the Native Vegetation Fund, unless the possibility arises of a suitable offset associated with support of seagrass restoration in the Port River.

4.5 Principles of Clearance (Schedule 1, *Native Vegetation Act 1991*)

The Native Vegetation Council will consider Principles 1(b), 1(c) and 1(d) when assigning a level of Risk under Regulation 16 of the Native Vegetation Regulations. The Native Vegetation Council will consider all the Principles of clearance of the Act as relevant, when considering an application referred under the *Planning, Development and Infrastructure Act 2016*.

Principle of clearance	Considerations
Principle 1a - it comprises a high level of diversity of plant species	Relevant information The number of native plant species in each association is one and the Native Plant Species Diversity score is 7 for each.
	Assessment against the principles Not at variance (Native Plant Species Diversity score < 10)
	Moderating factors that may be considered by the NVC Only a small amount of *Zostera* will be impacted relative to the amount within the Port River/Barker Inlet estuary (a small fraction of a percentage).
Principle 1b - significance as a habitat for wildlife	Relevant information As discussed in Section 4, use of the proposed clearance area by threatened species is likely to be negligible or insignificant. The Threatened Fauna score is 1 because of historical records of several State-listed rare species within the block and the possible presence of several nationally listed threatened species within the wider search area.

	The proposed clearance area has no significance as a corridor or habitat refuge, representing a fraction of a percentage of *Zostera* seagrass area in the Port River. The Unit Biodiversity Score is 35.46 for the "Dense intertidal/shallow subtidal *Zostera* association" (and 8.65 for the "Very sparse subtidal *Zostera*" association).
	<u>Assessment against the principles</u> Seriously at variance (Threatened Fauna score < 0.05 and Unit Biodiversity score < 60).
	<u>Moderating factors that may be considered by the NVC</u> The non-essential nature of the habitat and low impact significance for the species that may be present moderate the assessment against this principle to "At Variance". The habitat represents a very small fraction of the available intertidal *Zostera* in the Port River. The loss of this habitat would not have a significant impact on any threatened species through reduction in population size or area of occupancy, fragmentation of any population, decline due to habitat impacts, introduction of invasive species or interference of the recovery of any species. The clearance area does not provide essential habitat for the species assessed as possibly using it. They breed in the northern hemisphere. The Port River is not a recognised site of significance for any of the species. It is considered that the clearance will have a negligible impact on that species local population over the long term.
Principle 1c - plants of a rare, vulnerable or endangered species	<u>Relevant information</u> No species within the assessment area are listed as rare, vulnerable or endangered in the NPW Act or EPBC Act. Threatened Flora Score = 0.
	<u>Assessment against the principles</u> Not at variance (Threatened Flora score = 0) for all associations.
	<u>Moderating factors that may be considered by the NVC</u> N/A
Principle 1d - the vegetation comprises the whole or part of a plant community that is Rare, Vulnerable or Endangered.	<u>Relevant information</u> No vegetation within the proposed clearance area comprises the whole, or part of, a rare or threatened plant community under the EPBC Act.
	<u>Assessment against the principles</u> Not at variance for all associations.
	<u>Moderating factors that may be considered by the NVC</u> N/A
Principle 1e - it is significant as a remnant of vegetation in an area which has been extensively cleared.	<u>Relevant information</u> The proposed clearance would have a negligible impact on the seagrass in the Port River/Barker Inlet, i.e. remnancy > 99% The Total Biodiversity score is 18.68
	<u>Assessment against the principles</u> Not at variance (remnancy > 30% and Total Biodiversity Score < 50).
	<u>Moderating factors that may be considered by the NVC</u> N/A

Principle 1f - it is growing in, or in association with, a wetland environment.	Relevant information There is a Nationally Important wetland encompassing Barker Inlet & St Kilda, but the *Zostera* at the western extent of the Port River is not considered to be associated with this wetland.
	Assessment against the principles Not at variance for all associations.
	Moderating factors that may be considered by the NVC N/A
Principle 1g - it contributes significantly to the amenity of the area in which it is growing or is situated.	Relevant information As a subtidal feature, or intertidal feature with no profile, seagrass makes little or no contribution to the visual amenity of the area.
	Assessment against the principles Not at variance for all associations.
	Moderating factors that may be considered by the NVC N/A
Principles 1h–1l	Not applicable: (terrestrial)
Principle 1m - the clearance of vegetation would cause significant harm to the Adelaide Dolphin Sanctuary (ADS)	Seagrass clearance could have some impact on dolphin prey. However, for the reasons identified in Section 4.2, in particular the functional equivalence of some of the habitat to bare substrate and the availability of substantially more seagrass elsewhere in the Port River, it is not considered that the clearance would cause significant harm to the ADS.

4.6 Risk Assessment

Determine the level of risk associated with the application

Total clearance	No. of trees	0
	Area (ha)	0.61
	Total biodiversity Score	18.68
Seriously at variance with principle 1(b), 1(c) or 1 (d)		Seriously at variance with principle 1(b) based on Threatened Fauna Score but the non-essential and low impact significance of the habitat moderate the assessment to "At variance". Not at variance with principles 1(c) or 1(d).
Risk assessment outcome		Level 3

5. Clearance summary

Clearance Area(s) Summary table

Block	Site	Species diversity score	Threatened Ecological community Score	Threatened plant score	Threatened fauna score	UBS	Area (ha)	Total Biodiversity score	Loss factor	Loadings	Reductions	SEB Points required	SEB payment	Admin Fee
1	1	7	1	0	0.1	35.46	0.50	17.73	1			18.62	27,787.79	1528.33
1	2	7	1	0	0	8.65	0.11	0.95	1			1.00	1490.85	82.00
						Total	**0.61**	**18.68**				**19.62**	**$29,278.64**	**$1610.33**

Totals summary table

	Total Biodiversity score	Total SEB points required	SEB Payment	Admin Fee	Total Payment
Application	18.68	19.62	**$29,278.64**	**$1610.33**	**$30,888.97**

6. Significant Environmental Benefit

A Significant Environmental Benefit (SEB) is required for approval to clear under Division 5 of the *Native Vegetation Regulations 2017*. The NVC must be satisfied that as a result of the loss of vegetation from the clearance that an SEB will result in a positive impact on the environment that is over and above the negative impact of the clearance.

ACHIEVING AN SEB

Indicate how the SEB will be achieved by ticking the appropriate box and providing the associated information:

☐ Establish a new SEB Area on land owned by the proponent.

☐ Use SEB Credit that the proponent has established. Provide the SEB Credit Ref. No. __________

☐ Apply to have SEB Credit assigned from another person or body. The application form needs to be submitted with this Data Report.

☐ Apply to have an SEB to be delivered by a Third Party. The application form needs to be submitted with this Data Report.

☒ Pay into the Native Vegetation Fund.

PAYMENT SEB

If a proponent proposes to achieve the SEB by paying into the Native Vegetation Fund, summary information must be provided on the amount required to be paid and the manner of payment:

Payment of $29,278.64 (excluding GST) plus admin fee of $1,610.33 (including GST) will be made in a single payment into the Native Vegetation Fund.

7. References

AAP (2018), *Leopard Seals.* Australian Antarctic Program, viewed 23 June 2021, https://www.antarctica.gov.au/about-antarctica/animals/seals/leopard-seals.

Ball D, Parry GD, Heislers S, Blake S, Werner G, Young P, and Coots A (2010), *Victorian multi-regional seagrass health assessment 2004–07*. Fisheries Victoria Technical Report No.66. Department of Primary Industries Victoria, Queenscliff, Victoria.

BirdLife Australia (2023a), Cape Barren Goose. Viewed October 2023, https://birdlife.org.au/bird-profile/cape-barren-goose.

BirdLife Australia (2023b), Sooty Oystercatcher. Viewed October 2023, https://birdlife.org.au/bird-profile/sooty-oystercatcher.

BirdLife Australia (2023c), Pied Oystercatcher. Viewed October 2023, https://birdlife.org.au/bird-profile/pied-oystercatcher.

Birdlife International (2023), Kelp Gull. Viewed October 2023, https://birdlife.org.au/bird-profile/kelp-gull.

BirdLife Australia (2023d), Banded Stilt. Viewed October 2023, https://www.birdlife.org.au/bird-profile/banded-stilt.

Birdlife Australia (2023e). Wood Sandpiper. Viewed October 2023, https://www.birdlife.org.au/bird-profile/wood-sandpiper.

BMT WBM (2017), *Technical Memorandum: 2017 Seagrass Habitat Mapping*. Memorandum to Flinders Ports.

Boskalis (2019), *Dredge Management Plan*. Outer Harbor Channel Widening Project.

DEH (2008), *Marine Habitats in the Adelaide and Mount Lofty Ranges NRM Region.* Final Report to the Adelaide and Mount Lofty Ranges Natural Resources Management Board for the program: Facilitate Coast, Marine and Estuarine Planning and Management by Establishing Regional Baselines. Prepared by the Department for Environment and Heritage, Coast and Marine Conservation Branch.

DEW (2023), EGIS data: *State Marine Benthic Habitats*, viewed October 2023, http://location.sa.gov.au/lms/Reports/ReportMetadata.aspx?p_no=1233&pu=y&pa=dewnr. Department for Environment and Water, Adelaide, South Australia.

DEW (2022), *South Australian Recovery Plan for Eastern Osprey and White-bellied Sea Eagle.* Department for Environment and Water, Adelaide, South Australia

DCCEEW (2023), *Species Profile and Threats Database*, viewed September 2023, https://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl. Australian Government Department of Climate Change, Energy, the Environment and Water.

DSEWPaC (2012), Conservation Management Plan for the Southern Right Whale: A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999 2011–2021, Department of Sustainability, Environment, Water, Population and Communities, Canberra.

East West (2022), *ANI Seabed Survey Report.* East West Dive and Salvage Pty Ltd.

EPA (2020), *Dredge Guideline*. Environment Protection Authority, South Australia.

Golder Associates (2017), *Project LISA: Port River Habitat Assessment.* Report for Origin Energy Power Limited.

Hirst, AJ, McGain, S & Jenkins, GP (2017), The impact of burial on the survival and recovery of the subtidal seagrass *Zostera nigricaulis*, *Aquatic Botany* 142, pp: 10-15.

Iron Road, 2014. Central Eyre Iron Project Infrastructure Environment Protection and Biodiversity Conservation Act 1999 (Cth). Referral to Australian Government. Central Eyre Iron Project.

Jones, TC, Gemmill, CEC & Pilditch, CA (2008), Genetic variability of New Zealand seagrass (*Zostera muelleri*) assessed at multiple spatial scales, *Aquatic Botany* 88, pp: 39-46.

Milne, T & Milne, S (2020), *Native Vegetation Clearance Draft Data Report*. Report prepared for JBS&G Pty Ltd and Venice Energy.

NRS (2004), *Section Bank, Outer Harbor South Australia: Baseline monitoring program to assess the potential impacts on seagrass and mangrove communities from the proposed sand dredging*. Report by Natural Resource Services Pty

Ltd, in conjunction with SEA Pty Ltd, David Blackburn Environmental Pty Ltd and Oceanique Perspectives, for the South Australian Department of Environment and Heritage.

Short J, Fraser M, McLean D, Kendrick G, Byrne M, Caley J, Clarke D, Davis A, Erftemeijer P, Field S, Gustin-Craig S, Huisman J, Keesing J, Keough M, Lavery P, Masini R, McMahon K, Mergersen K, Rasheed M, Statton J, Stoddart J & Wu P (2017), Effects of dredging-related pressures on critical ecological processes for organisms other than fish or coral. Report of Theme 9 - Project 9.1 prepared for the Dredging Science Node, Western Australian Marine Science Institution, Perth, Western Australia, 47 pp.

Tanner, J.E., Jones, A., Segaran, R. R., Hennekam, M., Asanopoulos, C., Clarke, K., Gillanders, B.M., Turner, A., Gaylard, S., Daly, R. and Fernandes, M. (2021). *Potential for Zostera seagrass recovery and rehabilitation to enhance blue carbon in South Australia*. Report prepared for the Adelaide and Mount Lofty Ranges Natural Resources Management Board Blue Carbon Futures Fund, SA Water and the Environment Protection Authority. South Australian Research and Development Institute (Aquatic Sciences), Adelaide. SARDI Publication No. F2021/000211-11. SARDI Research Report Series No. 1098. 40pp.

TSSC (2014), Conservation Advice, *Thinornis rubricollis rubricollis*, hooded plover (eastern). Australian Government Threatened Species Scientific Committee.

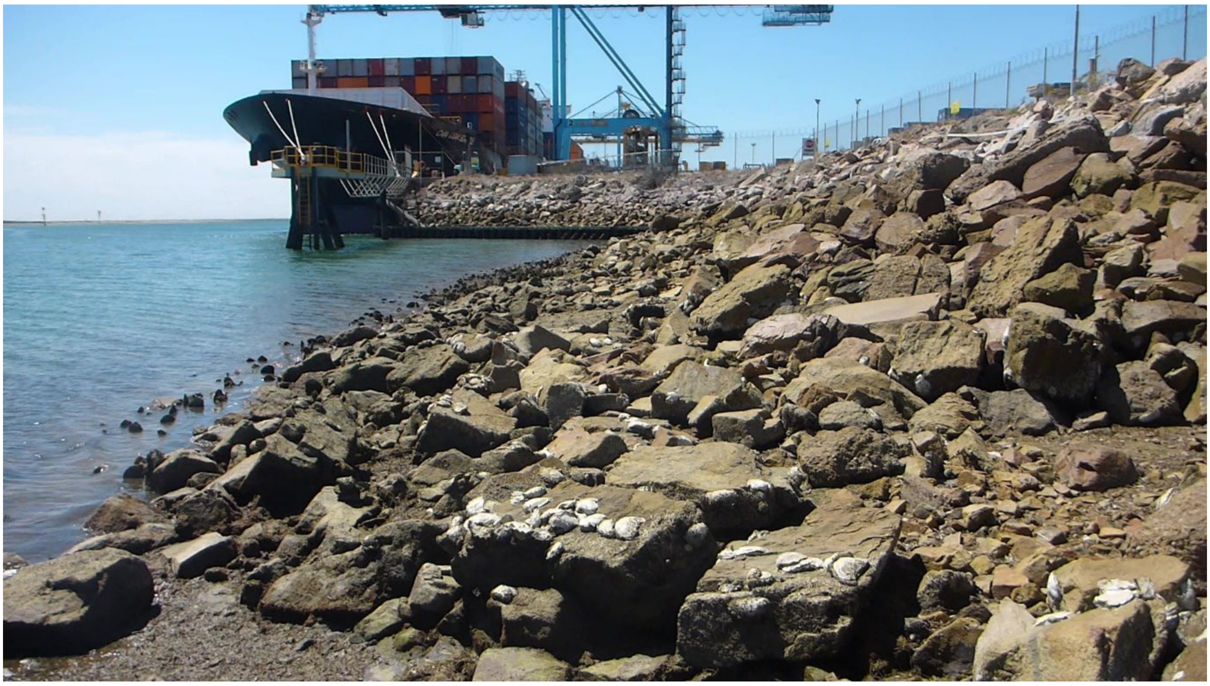
8. Appendices

Appendix 1. Marine Assessment Scoresheets associated with the proposed clearance and SEB Area

Appendix F
Benthic survey report

EMM
creating opportunities

Outer Harbor Berth 6 Benthic survey report



Report for Flinders Port Holdings

J Diversity Pty Ltd

Rev 1
31 May 2024

Cover photo: Outer Harbor looking east towards Berth 6. Taken by J. Brook, March 2024.

Disclaimer

The findings and opinions expressed in this publication are those of the author and do not necessarily reflect those of JBS&G or Flinders Port Holdings. While reasonable efforts have been made to ensure the contents of this report are factually correct, the author does not accept responsibility for the accuracy and completeness of the contents. The author does not accept liability for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on, the contents of this report.

Revision history

Rev	**Date**	**Comment**	**Author**	**Reviewed/ approved**
A	08/04/2024	Initial Draft	J. Brook	N. Patten
0	06/05/2024	Addressed review comments	J. Brook	N. Patten
1	31/05/2024	Modified Figure 8	J. Brook	N. Patten

Table of Contents

Table of Figures

Table of Tables

Table of Plates

1 Introduction

Flinders Port Holdings are proposing to extend Outer Harbor Berth 6 by 179 m to the south-west of the existing berth. The works would include land reclamation and dredging, in the areas shown in Figure 1.

Figure 1. Areas of proposed dredging and land reclamation

J Diversity Pty Ltd was engaged to undertake a benthic survey within the areas potentially impacted by dredging and land reclamation, and adjacent marine area. The purpose of the survey was to map benthic habitats, particularly seagrass, and characterise and quantify the fauna, with a focus on bivalves, pest species and species of conservation significance.

2 Previous surveys

A survey of the proposed dredging area and northern section of the proposed reclamation area was undertaken by commercial divers in May 2020, reporting seagrass at densities of 5–100%, based on two transects (Golder 2020, Figure 2). One of the species illustrated in the report and captioned as a seagrass was the pest macroalga *Caulerpa cylindracea*, therefore the cover of seagrass was overstated by an unknown amount.

Figure 2. Map produced by Golder (2020) based on survey by commercial divers in May 2020.

Surveys of *Caulerpa taxifolia* undertaken in 2015 and 2016 (Wiltshire & Deveney 2017) found a sparse (<5%) cover of this species at Berth 6 in 2015, and up to 75% adjacent to the mud flat north of Royal South Australian Yacht Squadron (RSAYS) in both years (Figure 3).

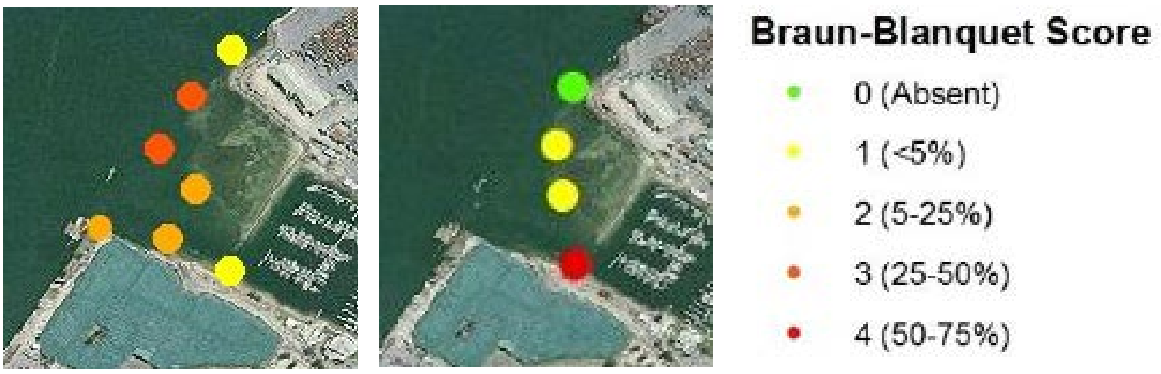


Figure 3. Percentage cover of *Caulerpa taxifolia* recorded during surveys in the vicinity of the benthic survey area during 2015 (left) and 2016 (right). Source: Wiltshire & Deveney (2017).

3 Methods

3.1 Study area

The proposed benthic survey area was designed to meet the following criteria:

- include the areas potentially impacted by dredging and land reclamation
- include a reasonable buffer around these areas, noting that there may be indirect impacts associated with construction activity that extent beyond the construction footprint
- include any notable topographical features
- comply with port security requirements
- allow the survey to be practicably completed within a reasonable timeframe.

The survey area is shown in Figure 4, and included three sub-areas (see below). The buffer area around the dredging and land reclamation footprints was variable in size. It:

- extended offshore into the shipping channel for approximately double the distance of the construction footprint.
- avoided the Waterside Restriction Zone of the dredging area, which is a working berth area and already a highly modified environment.
- extended to the south far enough to capture the entirety of the shallow/intertidal mud flat between Berth 6 and RSAYS.

The survey area was divided into three sub-areas, reflecting the requirement for different survey methods to address safety and practicality requirements.

- The northern area required diving using surface supplied breathing apparatus (SSBA) as best safety practice in a busy port area and deeper water (to approximately 15 m depth).
- The south-eastern area was too shallow to survey using scuba or snorkel during most tides and was surveyed at the lowest tide using a drone.
- The south-western area was outside of shipping channels and sufficiently deep to snorkel during some tides.

Figure 4. Benthic survey area and sub-areas

3.2 SSBA surveys

The SSBA surveys were undertaken on 7–8 and 25 March 2024 with the support of Adelaide Commercial Diving. Transect lines were set by deploying a weighted rope from the vessel between GPS marks, or by using a 50 m tape deployed by the diver in different directions from a central point. Diving was undertaken by the author or other commercial divers with marine science qualifications and training, and video was captured from a head-mounted camera. Discretionary still photos were also taken using the same camera. The location of the transect lines is shown in Figure 5.

3.3 Snorkel surveys

Snorkel surveys were undertaken on 8 March 2024 from fixed points within the south-western study area at which the water was sufficiently shallow to see the seafloor from the vessel. A 50 m tape was deployed towards the mud flat, specifically in a direction towards the south-eastern corner of the study area. Habitat transitions (to nearest metre) were recorded during a first pass along each transect, then fauna within one metre to one side of the line were recorded during a second pass. The layout of transects is shown in Figure 6. Discretionary still photos were taken using a Panasonic Lumix camera.

3.4 Drone surveys

The images were captured using a DJI Mavic Air 2 Drone, which has a horizontal hovering accuracy of 1.5 m. The camera has a field of view of 84° and captured images of 4000 x 3000 pixels, i.e. an aspect ratio of 4:3. The drone was flown at 80 m, providing for images covering approximately 115 x 86 m. The grid spacing was such to provide for an overlap of 50% in each dimension (Figure 7).

The drone survey was undertaken at 12:30 pm on 8 March 2024, which was close to low tide.

The images were processed using the OpenDroneMap (ODM) software to construct a georeferenced orthomosaic of the images. This orthomosaic was confined largely to the emergent areas, because images over water can be quite uniform and reflective, and it can be difficult to match points between images, as these points are not static (due to water movement).

3.5 Intertidal survey

A survey was undertaken along the base of the rock revetment north-west from RSAYS, spanning 160 m, during low tide on 8 March 2024. Presence of intertidal species was recorded and video was captured allowing the number of Pacific oyster *Magallana gigas* to be estimated.

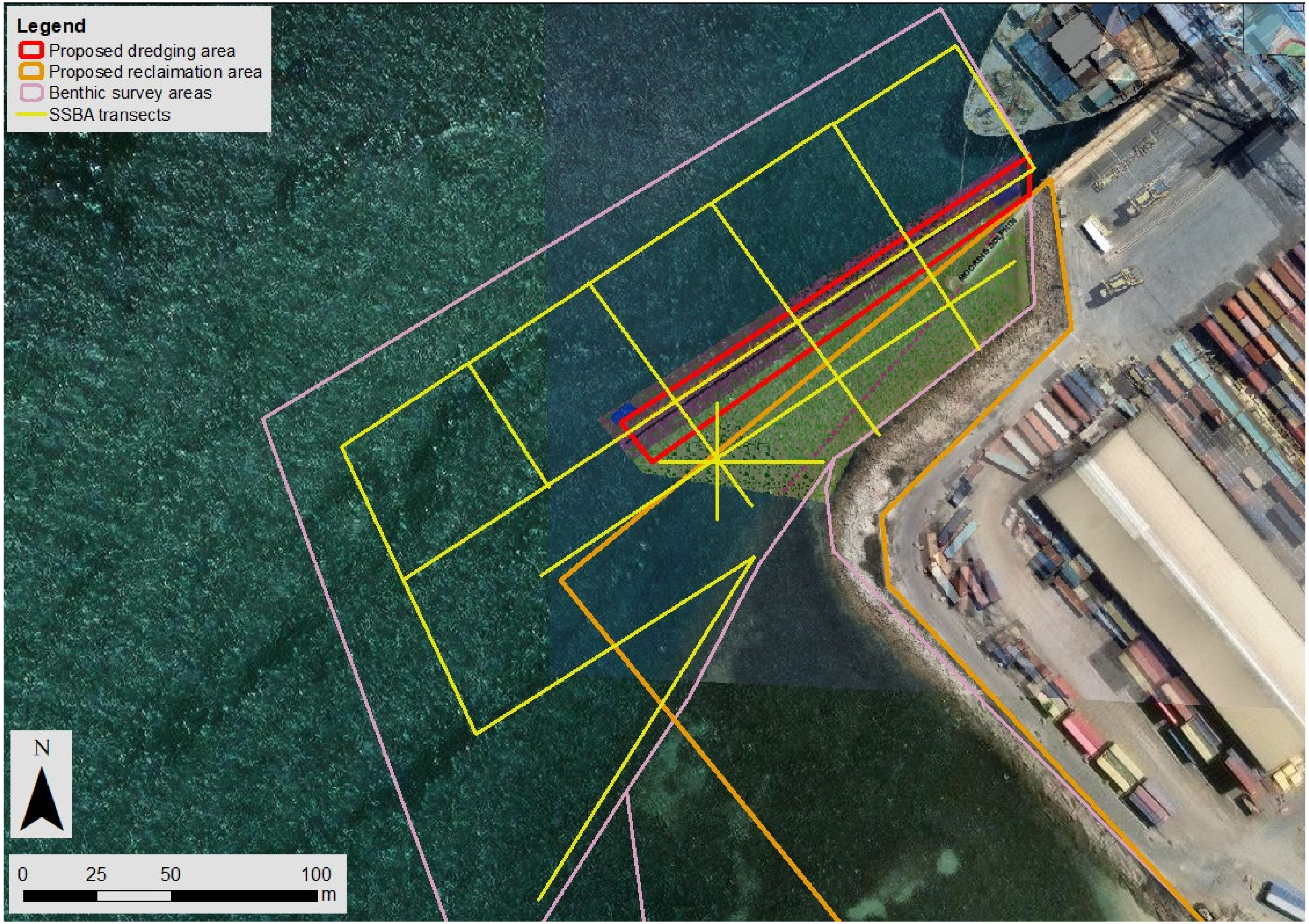


Figure 5. Layout of transects undertaken using surface supplied breathing apparatus (SSBA).

Figure 6. Snorkel transects undertaken in the south-western sub-area of the benthic survey area.

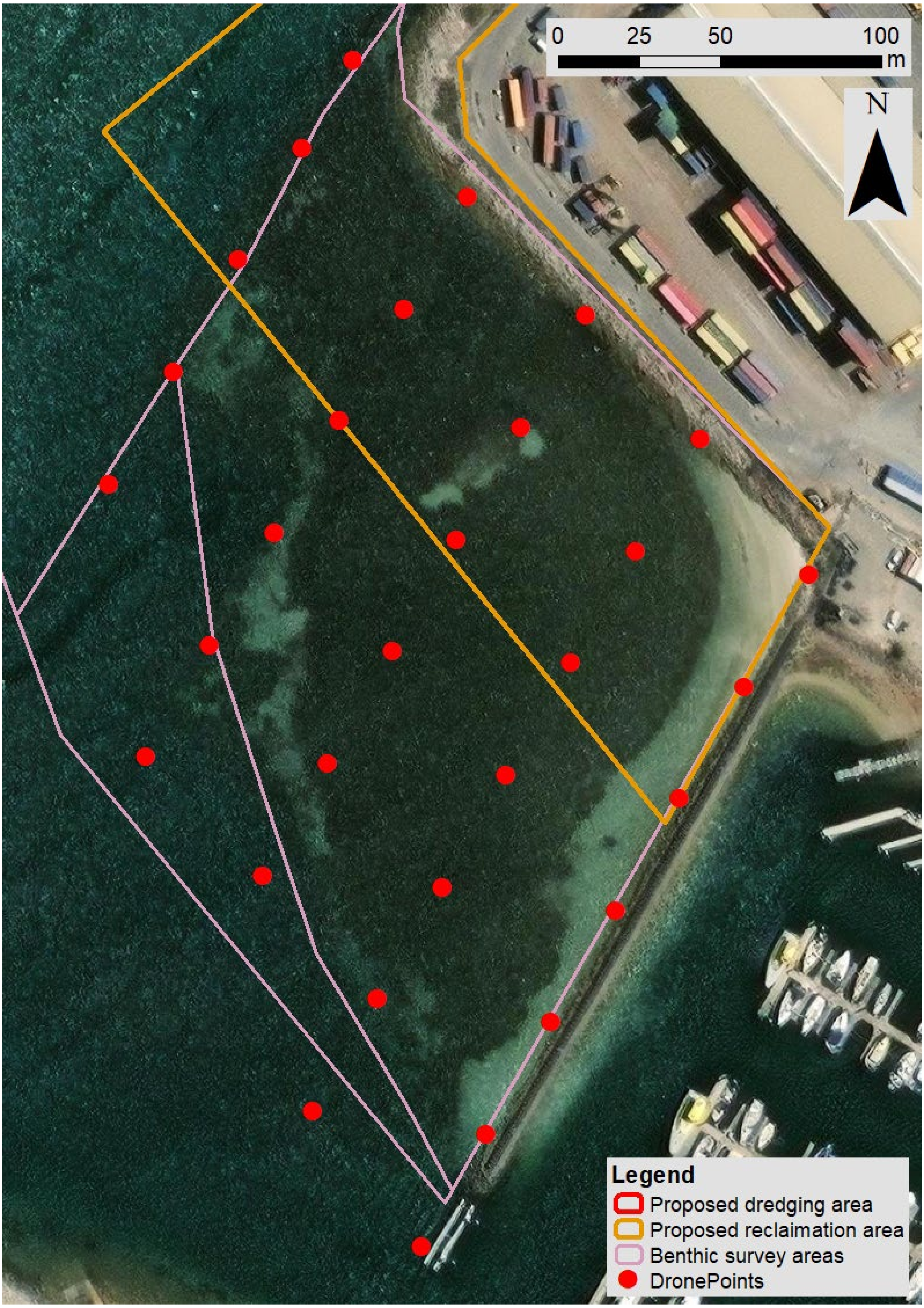


Figure 7. Locations of drone photopoints

4 Results

4.1 Benthic Habitat

Most of the area covered by SSBA was silt or fine sand with varying densities of seagrass wrack, including within the proposed dredging area (Figure 8). Some *Zostera* was recorded towards the west of the survey area in depths less than 13.5 m, initially very sparse (<1% cover) but reaching medium density (approximately 50%) in depths less than 5 m (Plate 1).

Very sparse *Zostera*, with distances between tufts of 1–5 m, was also recorded near the mooring dolphin, extending eastwards into the intertidal zone, generally amongst seagrass wrack. Medium density *Zostera* was recorded near the rock revetment in two locations 50–70 m south-west of the rock revetment (Plate 2). Very sparse seagrass was also recorded in part of the area previously identified as dense (50–100% cover) seagrass, but not in other parts of that area.

Approximately 0.9 ha of intertidal *Zostera* was identified from drone footage (Figure 8), of which approximately 0.5 ha was within the proposed reclamation area. The seagrass mapping was ground-truthed in some areas during low tide (Plate 3 to Plate 6), and by snorkel (Figure 8). Degraded *Zostera* (denuded stems or rhizomes) was also recorded during snorkel survey outside the areas identified from the drone survey (Figure 8).

A consolidated map of the seagrass as determined from the three survey methods is provided in Figure 9.

Neither *Caulerpa taxifolia* nor *C. cylindracea* was recorded during the survey.

Figure 8. Benthic habitats identified during SSBA, snorkel and drone surveys

Figure 9. Seagrass associations mapped from SSBA, snorkel and drone surveys.

Plate 1. Medium density *Zostera* towards western side of study area

Plate 2. Medium density *Zostera* south-west of mooring dolphin

Plate 3. Mudflat with seagrass patches looking north

Plate 4. Seagrass patch looking south

Plate 5. Seagrass patch looking north

Plate 6. Seagrass patch close-up

4.2 Fauna

The dominant fauna on the mud flat between Berth 6 and RSAYS were razor clams *Pinna bicolor*, but four other bivalves were recorded on 50 m snorkel transects, namely hammer oyster *Malleus meridianus,* queen scallop *Equichlamys bifrrons*, spiny scallop *Scaeochlamys livida*, which is an introduced species, and mud cockle *Katelysia* sp. (Table 1).

Table 1. Fauna recorded during snorkel surveys on mud flat.

Species	Common name	Abundance per transect	
		Northern	**Southern**
Pinna bicolor	Razor clam	170	47
Malleus meridianus	Hammer oyster	7	1
Equichlamys bifrrons	Queen scallop	1	
Scaeochlamys livida	Spiny scallop	4	
Katelysia sp.	Mud cockle		4

Razor clams were quantified from the drone-sourced imagery. Within the proposed reclamation area, 2421 razor clams protruding sufficiently to cast a shadow were identified with high certainty, and a further 1118 potential razor clams were identified from surface bumps, yielding a total of 3539 razor clams (Figure 10). Outside the proposed reclamation area 1253 razor clams were identified with high certainty and a further 4290 possible razor clams, totalling 5543 (Figure 11).

Pacific oysters *Magellana gigas* were prevalent along the rock revetment north-east of the mud flat (Plate 7), with 1053 recorded during review of the video captured along the base of the revetment. A number of gastropods were also observed in crevices or under rocks, including *Bembicium* sp. (Plate 8), western black crow *Nerita atramentosa* (Plate 9) and limpet *Cellana* sp. (Plate 10).

Fauna recorded during the SSBA transects are summarised in Table 2, noting that additional large quantities (tens) of razor clams were observed in shallower water, near the rock revetment. Other than bivalve species, recorded fauna included the European fan worm *Sabella spallanzanii,* declared noxious under the *Fisheries Management Act 2007*, Feather duster worm *Myxicola infundibulum*, several fish species, blue swimmer crab *Portunus armatus* and sponges.

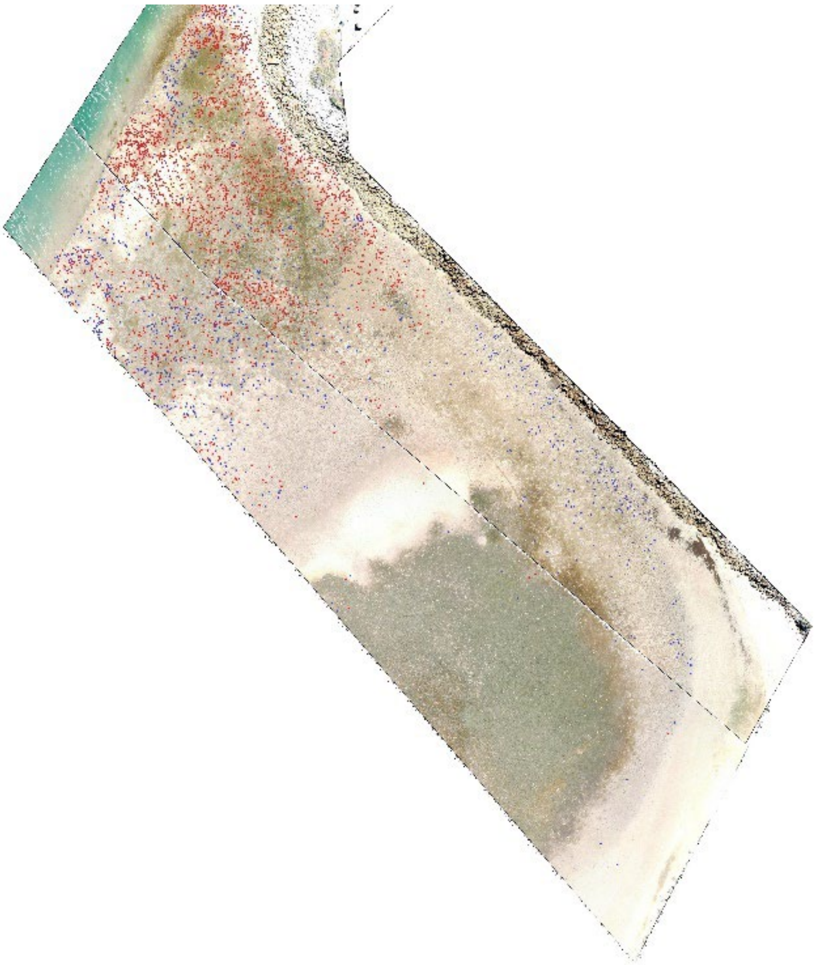


Figure 10. Razor clams identified inside the proposed reclamation area[1] identified from drone-sourced imagery. Red dots indicate a higher certainty of razor clam presence than blue dots.

[1] Note that line through image is a result of processing the image in two phases either side of when there was a change in proposed reclamation area.

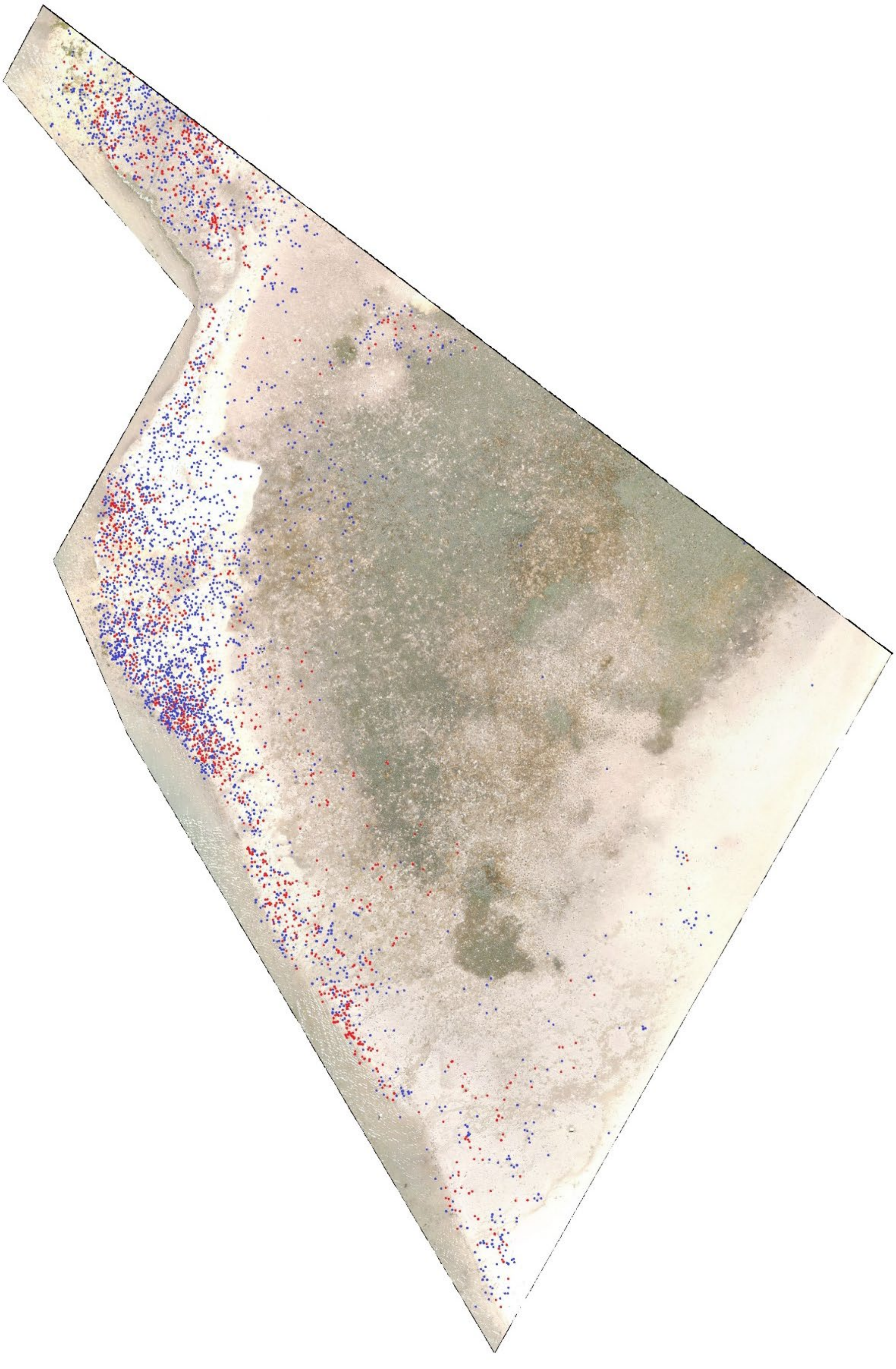


Figure 11. Razor clams (red dots) identified outside the proposed reclamation area identified from drone-sourced imagery.

	
Plate 7. Pacific oyster *Magellana gigas*	**Plate 8. *Bembicium* sp.**
	
Plate 9. Western black crow *Nerita atramentosa*	**Plate 10. Limpet *Cellana* sp.**

Table 2. Species recorded during SSBA transects.

Notes: * indicates clusters (rather than individuals); # indicates introduced or cryptogenic species. Abundances of *Pinna bicolor* does not include those in shallow (<2 m) water.

Species	**Common name**	**Abundance**
Porifera spp.	Sponges	7
Sabella spallanzanii #	European fan worm	*41
Myxicola infundibulum #	Feather duster worm	5
Portunus armatus	Blue swimmer crab	43
Brachyura spp.	Undifferentiated crabs	*1
Asteroidea sp.	Sea star	1
Hypselodoris infurcata	Painted nudibranch	1
Pinna bicolor	Razor clam	4
Malleus meridianus	Hammer oyster	*9
Equichlamys bifrrons	Queen scallop	7
Scaeochlamys livida	Spiny scallop	1
Ostrea angasi	Native oyster	*7
Hapalochlaena maculosa	Southern blue ringed octopus	1
Ascidacea spp.	Ascidians	2
Aracana spp.	Cowfish	8
Platycephalus spp.	Flathead	9
Pleuronectiformes spp.	Flounder	1
Parapercis haackei	Wavy grubfish	22

5 Discussion and Conclusions

Several methods were used to survey the flora and fauna within a study area surrounding the proposed reclamation and dredging areas. The surveys coveredan area to the south-west of the existing berth area including the shipping channel with a depth of approximately 14 m, and batter slope to a depth of a few metres, shallower water adjacent to the rock revetment south of the berth, the intertidal mudflat to the south of the channel, and the base of the rock revetment east of the mudflat.

5.1 Benthic Habitat

The previous survey of the proposed dredging area and the northern part of the proposed reclamation area mapped seagrass (including species *Zostera nigricaulis*[2] and *Posidonia australis*) at varying densities throughout the area surveyed (Golder 2020). However, there are uncertainties associated with extrapolating from two transects, and an unknown amount of the seagrass was instead the pest macroalga *Caulerpa cylindracea* (Section 2).

The current survey found no seagrass in the channel, but identified an area of approximately 0.1 ha of very sparse *Zostera*, extrapolated from isolated tufts on a few transects in depths of 5–13 m. In the shallow water immediately adjacent to the rock revetment there was a thin band of dense *Zostera* (Figure 9). No *Posidonia* seagrass was recorded, nor was *Caulerpa cylindracea* or *C. taxifolia* (another pest macroalga).

In summary, changes since the previous survey included (Figure 2, Figure 9):

- *Posidonia* seagrass was absent
- *Caulerpa cylindracea* was absent
- Dense subtidal *Zostera* was restricted to a thin band near the northern rock revetment, and a patch near the western boundary of the survey area
- The sparse subtidal Zostera was very sparse (<1%), compared with 5–10% recorded in 2020

Although no formal surveys of *Caulerpa* species in the Port River have been published since 2017, the author and other scientists[3] have observed that both *C. taxifolia* and *C. cylindracea* are much less common than ten years ago.

The very sparse *Zostera* is likely to be functionally equivalent, in an ecological sense, to bare silt.

More than half of the mud flat south of Berth 6 was covered by intertidal *Zostera* (about one hectare), and about half of this seagrass was within the proposed reclamation area (Figure 9). This seagrass is likely to be an important component of the mudflat as feeding habitat for shorebirds (Unsworth & Butterworth 2021), of which there were some incidental observations during the survey.

5.2 Fauna

A number of bivalve species were recorded during the survey, but were not evenly distributed. Pacific oysters were dominant on the rocks at the base of the rock revetment. Razor clams were dominant around the sea-facing edges of the intertidal mudflat and in the shallow water adjacent to

[2] Reported using previous name *Heterozostera tasmanica*
[3] e.g. Dr. M. Deveney, SARDI Aquatic Sciences, pers. comm. 14 August 2023

the northern rock revetment, and there were other isolated individuals in deeper water in and adjacent to the shipping channel. Small numbers (<10) of other bivalves were recorded both on the mudflat and in or adjacent to the shipping channel, including mud cockles (mudflat only), spiny scallops, queen scallops, hammer oysters and native oysters (deep water only).

The most commonly recorded subtidal fauna species were European fan worms, blue swimmer crabs and fish including wavy grubfish, cowfish and flathead. The European fan worm has been identified as one of the introduced species of most concern within South Australia (PIRSA undated) and declared ‘noxious’ under the *Fisheries Management Act 2007* (PIRSA 2019). The feather duster worm *Myxicola infundibulum*, is possibly also introduced (Wiltshire et al. 2010) but is not considered to be a pest species.

Although a detailed survey of the rock revetment was beyond the scope of this study, a number of gastropods were observed on or under rocks (Section 4.2). The species recorded were also recorded during an intertidal survey undertaken for the Venice Energy LNG Project (Venice Energy 2020).

No species were recorded which are Matters of National Environmental Significance under the EPBC Act 1999, nor were listed Marine species recorded, including fish from the family Syngnathidae (pipefish, seahorses and seadragons), which are also listed as Protected under the South Australian *Fisheries Management Act 2007*. It should be noted, however, that Syngnathids, particulary pipefish, are very cryptic and visual detection can be difficult. Connolly (1994) recorded wide-bodied pipefish *Stigmatophora nigra* and deep-bodied pipefish *Kaupus costatus* in shallow *Zostera* beds in the Port River and Barker Inlet, collectively comprising 2.5% of individuals samples using seine nets. Visual search using SSBA or snorkel is unlikely to be as effective as seine netting for surveying Syngnathids, and the absence of evidence of Syngnathids is not complete evidence of their absence. However, it is considered unlikely that there would be a high abundance of Syngnathids in the seagrass surveyed.

In conclusion, the main issues that will need to be addressed for the project are approval and offset for native vegetation (seagrass) clearance, management of removal of bivalves in relation to the Pacific Oyster Mortality Syndrome (POMS), and prevention of the spread of European fan worms.

6 References

Connolly, R. (1994), A comparison of fish assemblages from seagrass and unvegetated areas of a southern Australian estuary. Australian Journal of Marine and Freshwater Research 45: 1033-1044.

Golder (2020), *Flinders Ports Berth 6 Dredging Seagrass Survey, Sediment Sampling and Characterisation*. Report to Flinders Ports by Golder Associates Pty Ltd.

PIRSA (undated), *Stop aquatic pests harming our environment*, brochure produced by Primary Industries and Regions South Australia.

PIRSA (2019), *Noxious fish list*, Primary Industries and Regions South Australia, Government of South Australia, Adelaide, viewed 24 July 2020,
http://pir.sa.gov.au/biosecurity/aquatics/aquatic_pests/noxious_fish_list.

Unsworth, RKF & Butterworth, EG (2021), Seagrass Meadows Provide a Significant Resource in Support of Avifauna *Diversity* 13, no. 8: 363.

Venice Energy (2020), Outer Harbor LNG Project Development Application.

Wiltshire, K.H and Deveney, M.R. (2017), The introduced alga *Caulerpa taxifolia* in South Australia: infestation boundary surveys and feasibility of control for populations outside the containment area. Report for PIRSA Biosecurity SA. South Australian Research and Development Institute (Aquatic Sciences), Adelaide. SARDI Publication No. F2017/000204-1. SARDI Research Report Series No. 946. 16pp.

Wiltshire, K, Rowling, K & Deveney, M (2010), *Introduced marine species in South Australia: a review of records and distribution mapping*, SARDI Aquatic Sciences, Publication No. F2010/000305-1

Appendix G

POMS management plan

Outer Harbor Berth 6 Precinct Upgrade Pacific Oyster Mortality Syndrome (POMS) Management Plan

Prepared for Flinders Port Holdings

J Diversity Pty Ltd

Rev 1
3 June 2024

Cover photo: Pacific oysters on rock revetment between Berth 6 and Royal South Australian Yacht Squadron. Taken by J. Brook, March 2024.

Disclaimer

The findings and opinions expressed in this publication are those of the author and do not necessarily reflect those of JBS&G or Flinders Port Holdings. While reasonable efforts have been made to ensure the contents of this report are factually correct, the author does not accept responsibility for the accuracy and completeness of the contents. The author does not accept liability for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on, the contents of this report.

Revision history

Rev	Date	Comment	Author	Reviewed/ approved
A	10/04/2024	Initial Draft	J. Brook	N. Patten
0	02/05/2024	Addressed review comments. Approved for release to client	J. Brook	N. Patten
1	03/06/2024	Updated to include rock revetment reuse	J. Brook	N. Patten

Table of Contents

Table of Figures

1 Introduction

Flinders Port Holdings are proposing an upgrade to Berth 6 and its supporting services within the Flinders Adelaide Container Terminal (FACT) in Outer Harbor, Port of Adelaide ('Berth 6 precent upgrade' or 'the project' herein). The Berth 6 precinct upgrade comprises an extension of Berth 6 to the south-west of the existing berth to a length of 179 m. The works for the project would include dredging and land reclamation in the areas shown in Figure 1. Removal (and reuse where appropriate for the works) of the rock revetment is also proposed.

During a recent survey in March 2024, Pacific oysters *Magallana gigas* (on the rock revetment), razor clams *Pinna bicolor* and a hammer oyster *Malleus meridianus* were recorded in the proposed reclamation area and several bivalves including queen scallop *Equichlamys bifrons*, native oyster *Ostrea angasi* and hammer oyster were recorded in the proposed dredging area (J Diversity 2024).

This Pacific Oyster Mortality Syndrome (POMS) Management Plan has been developed in response to those findings.

Figure 1. Areas of proposed dredging and land reclamation

2 Background

The Pacific Oyster Mortality Syndrome (POMS) is a disease which affects Pacific oyster *Magellana*[1] *gigas* and is caused by a virus called OsHV-1 microvariant (OsHV). There are no human health or food safety concerns, but it causes rapid death and high mortality rates in farmed Pacific oysters (up to 100% within days of being detected) and can spread quickly if introduced. The virus is not known to affect other oyster species but they can be contaminated with the virus (PIRSA 2020). Mussels have been found to be infected despite not dying, and other marine invertebrates could function as possible carriers, reservoirs or even alternative hosts of these oyster pathogens (O'Reilly et al. 2017, Bookelaar 2018).

POMS was detected (for the first time in South Australia) in feral oysters in the Port River in late February 2018 and is now endemic (PIRSA undated). Mortality of 50–90% of feral Pacific oysters was reported, but the survivors can act as carriers of the disease (Evans et al. 2017, cited by BMT WBM 2019). POMS remains inactive during cooler months, but ongoing detection of outbreaks are expected when seawater temperatures rise above 17°C for extended periods (PIRSA undated b). This is consistent with the findings by De Kantzow et al. (2016) that mortality from OsHV at temperatures of 26, 22, 18 and 14°C resulted in mortalities of 84, 77, 23 and zero per cent, respectively. POMS is generally spread through movement of live oysters, bivalve products or equipment that has been in contact with infected animals (PIRSA 2020). It is currently contained within the Port River estuary. The nearest commercial growing area is approximately 60 km away (PIRSA 2020).

Eradication of feral Pacific oysters and the virus is not considered to be achievable in the Port River estuary (PIRSA undated). PIRSA undertook a program to reduce feral oyster populations in the Port River, promoted vessel cleaning and equipment decontamination and banned the removal of bivalves, including oysters, mussels, cockles and razor clams, from the Port River (PIRSA 2020).

Although Pacific oyster can be found attached to hard substrates, rocks, debris and shells from the lower intertidal zone to depths of 40 m (Herbert et al. 2016), it is generally found only in the intertidal zone within the Port River (S. Owen, marine biologist/commercial diver, pers. comm., July 2020), and was recorded during the survey of the rock revetment within the proposed reclamation area for the for the Berth 6 Precinct upgrade.

3 Management context

3.1 Legislative framework

There is currently a ban on the removal of bivalves from the Port River (PIRSA 2022) under the *Fisheries Management (General) Regulations 2017*, including removal by dredging and removal of rock revetment with attached bivalves.

The deposit of exotic species, including the reuse of rock revetment with attached Pacific oysters, is prohibited under the Fisheries Management Act 2007.

These activities (removal of bivalves or deposit of rocks with Pacific oyster) would require a Determination and a Ministerial permit under the *Fisheries Management Act 2007.*

[1] Formerly known as *Crassostrea gigas* and is thus referred to in numerous documents relevant to POMS.

A new Biosecurity Act for South Australia is currently being developed which would merge several existing pieces of biosecurity legislation into one, to strengthen protection of the state's economy, terrestrial and aquatic environments and communities from the impacts of pests, diseases and other biosecurity matters (PIRSA 2023). Certain provisions for aquatic pests in the *Fisheries Management Act 2007* would also shift to the new legislation (PIRSA 2023). The Biosecurity Bill is expected to progress through the parliamentary process this year. This new Biosecurity Act may include aspects related to POMS.

3.2 Previous local dredging projects

The Outer Harbor Channel Widening Project (OHCWP), completed in 2021, dredged approximately 770,000 m^3 from the Port River near Outer Harbor and transferred it to a dredged material placement area (DMPA) in central Gulf St Vincent. A POMS Management Plan was developed for that project, and management measures were prescribed in the Dredge Management Plan (DMP) (Boskalis 2019). Similarly, the Venice Energy Project was approved to dredge 1.8 million m^3 from the Port River near Outer Harbor and transport it to the same DMPA. A DMP Framework developed for the Venice project included measures for managing POMS (Venice Energy 2021). Because ocean disposal was intrinsic in both of these projects, there was considerable emphasis on the removal and disposal to land of bivalves, and bivalve testing and monitoring, prior to dredging and transfer to the DMPA.

3.3 Potential vectors

POMS may spread through:

- carrier organisms, including larvae (Pacific oysters or other bivalves);
- by water or sediment contaminated by the virus or by
- translocation on vessels or equipment.

Vessels act as a vector by transporting carriers fouling their hulls, or via ballast water, but equipment in general can transport the virus on its surfaces.

4 Project activities with risk to POMS

The key activity which poses a risk to the spread of POMS is dredging.

For the project, dredging of the area adjacent to Berth 6 in the shipping channel is required to achieve channel design depth of 14.2 m CD. This involves dredging approximately 690 m^2 of sediment with a sediment volume of approximately 550 m^3.

Dredging methodology is to be confirmed following detailed design but would likely involve a cutter suction dredger.

The proposed location for disposal of dredge spoil is to existing Pelican Point Dredge Pond located approximately 1 km from the dredge location. However if the extension of Berth 6 involves a sheet pile wharf, spoil may be used as low level backfill behind the sheet pile.

Removal and reuse of the rock revetment as new rock armour also has the potential to spread POMS if rocks with attached bivalves are placed back into the intertidal zone.

5 Management measures

Controls and management measures for minimising the risk of spreading POMS beyond the Port River during dredging are outlined below and include potential timing constraints, disposal of spoil to land, vessel cleaning and a vessel navigation plan (Sections 5.1 to 5.5). Management measures for rock revetment removal and potential reuse are outlined in section 5.6.

5.1 Timing

The proposed dredging is to occur in 2025 but the exact timing within that year is yet to be confirmed. However, because of the lower transmission of POMS in water temperatures typical of winter compared with temperatures typical of summer, dredging activities would be undertaken, where practicable, during the window of cooler water temperatures, i.e. May through September inclusive, when water temperature would be below 16°C (Figure 2).

The duration of the dredging activity is also not known but based on the volume of material to be dredged (and with assumed cutter suction dredging methodology), is likely to be of the order of two weeks.

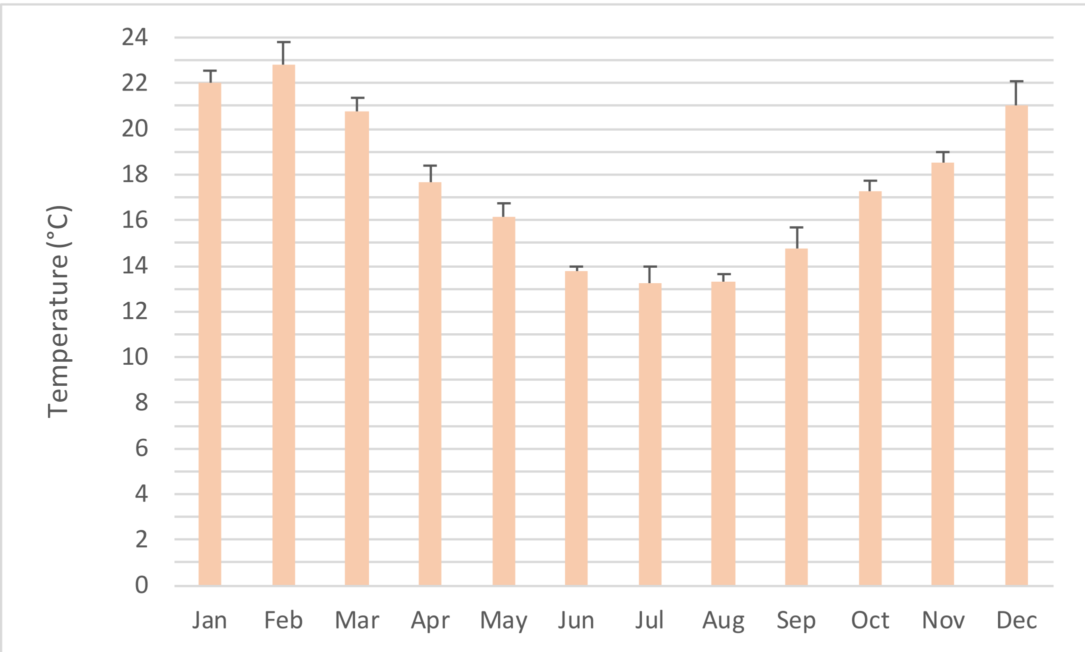


Figure 2. Mean monthly water temperatures from Outer Harbor during 1998–2008. Error bars show standard error of mean. Source: EPA, unpublished data.

5.2 Dredge spoil disposal

As described in Section 4, dredge spoil will be disposed of on land, to a series of ponds to settle out fines prior to returning water back to the Port River. These dredge ponds are located approximately 1km from the location of Berth 6 where dredging is proposed. Accumulated sediments (and bivalves) will be excavated out of the settlement areas for drainage and to increase the capacity of the pond. Discharged sediments (and bivalves) will remain within the footprint of the dredge ponds.

In the event of sheet pile wharf construction, dredge spoil may also be used in the same location as the existing Berth 6, as low level backfill for the Berth 6 extension.

5.3 Vessel inspection and cleaning

Vessel inspections and cleaning requirements for biofouling management would be outlined in the contractor's Dredge Management Plan and would be guided by:

- *Australian biofouling management requirements* (DAFF 2023).
- *National biofouling management guidelines for non-trading vessels* (Australian Government 2009)
- *Code of practice for vessel and facility management (marine and inland waters)* (EPA 2019)
- PIRSA.

The Australian biofouling management requirements (ABFMR) set out vessel operator obligations for the management of biofouling when operating vessels under biosecurity control within Australian territorial seas to comply with the *Biosecurity Act 2015.*

Operators of all commercial vessels subject to biosecurity control must provide information relating to biofouling management through the mandatory pre-arrival report. This information is reported through the department's Maritime and Aircraft Reporting System (MARS) and ideally includes one of the three management practice below:

- Implementation of an effective biofouling management plan
- Hull and niche areas cleaned of all biofouling within 30 days prior to arriving in Australian territory, or
- Implementation of an alternative biofouling management method pre-approved by the department.

This information would be used by the Australian and/or State Government to inform any vessel interventions including further vessel cleaning prior to undertaking dredging activities, and/or following dredging activities.

5.4 Navigation Plan

The project is located is more than 50 km away from the nearest oyster growing area.

A navigational plan to ensure that any vessel associated with the project does not navigate within 10 km of a commercial oyster growing area in South Australian waters would be implemented.

The navigational plan would document a route that avoided commercial oysters growing areas by at least 10 km. Oyster growing areas in Gulf St Vincent include Port Vincent, Stansbury, Coobowie Bay, American River and Western Cove; all more than 50 km from the project location. Sites further west include Port Lincoln, Coffin Bay, Streaky Bay, Smoky Bay and Ceduna (Figure 3).

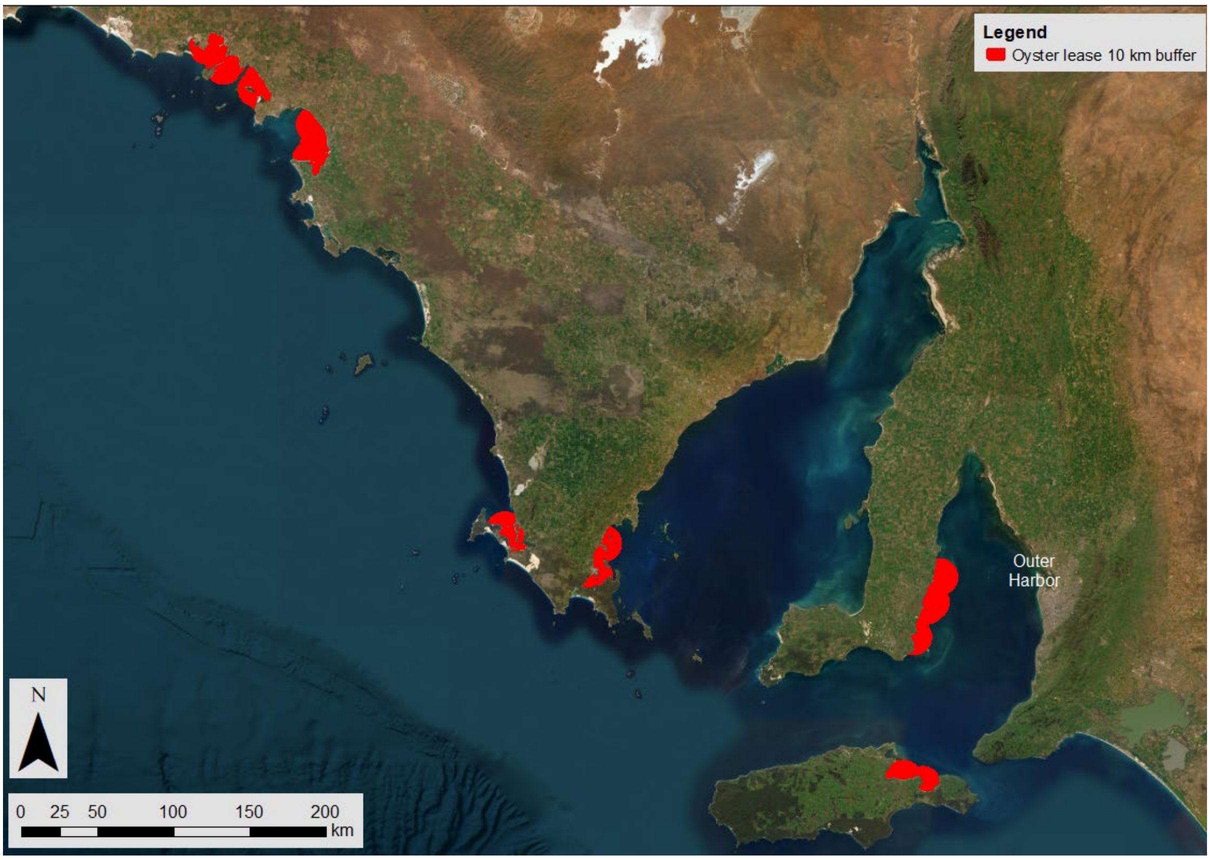


Figure 3. Ten kilometre buffers around oyster growing areas in South Australia.

5.5 Ballast water

Ballast water management would be documented in the contractors Dredge Management Plan.

Ballast water would be managed in accordance with the International Maritime Organization (IMO) Ballast Water Management Convention (IMO 2004) and by the applicable standard (exchange or preferably treatment) in accordance with the Australian Ballast Water Management Requirements, Version 8 (DAWE 2020).

5.6 Rock revetment

Land based works to remove the existing rock revetment would be documented in a construction environmental management plan. It is proposed that rocks may be reused onsite for the reinstatement of a new rock revetment wall, and/or for low level backfill to new pavement.

A Determination and Ministerial Permit under the *Fisheries Management Act 2007* would be sought prior to works involving rock revetment with bivalves present.

6 References

Australian Government (2009), *National Biofouling Management Guidelines for Non-Trading Vessels*, National System for the Prevention and Management of Marine Pest Incursions.

BMT WBM (2019), *Adelaide Outer Harbor Channel Widening Project: POMS Management Plan*.

Bookelaar, B. (2018). Understanding and minimizing the impacts of host pathogen- environment interactions in the Pacific oyster Crassostrea gigas. PhD Thesis, University College Cork.

Boskalis (2019), *Dredge Management Plan*. Outer Harbor Channel Widening Project.

DAWE (2020), *Australian Ballast Water Management Requirements Version 8*. Department of Agriculture, Water and the Environment.

DAFF (2023), *Australian biofouling management requirements version 2*, Department of Agriculture, Fisheries and Forestry, Canberra.

de Kantzow, Hick P, Becker JA and Whittington RJ (2016). Effect of water temperature on mortality of Pacific oysters *Crassostrea gigas* associated with microvariant ostreid herpesvirus 1 (OsHV-1 microvariant). *Aquaculture Environment Interactions*, 8: 419–428.

EPA (2019), *Code of practice for vessel and facility management (marine and inland waters)*, Environment Protection Authority, South Australian Government.

Herbert, RJH, Humphreys, J, Davies, CJ *et al.* (2016). Ecological impacts of non-native Pacific oysters (*Crassostrea gigas*) and management measures for protected areas in Europe. *Biodiversity Conservation* 25, 2835–2865.

IMO (2004). *International Convention for the Control and Management of Ships' Ballast Water and Sediments*. International Maritime Organisation.

J Diversity (2024), *Outer Harbor Berth 6 Benthic survey report.* Report prepared for Flinders Port Holdings by J Diversity Pty Ltd.

O' Reilly AJ, Laide C, Maloy A, Hutton S, Bookelaar B, O' Sullivan K, Lynch SA, Culloty SC. (2017). The role of the mussel *Mytilus spp.* in the transmission of ostreid herpesvirus-1 microVar. Parasitology. DOI: 10.1017/S0031182017002244

PIRSA (undated), *Frequently asked questions: Port River POMS outbreak*. Primary Industries and Regions South Australia.

PIRSA (2020), *Pacific Oyster Mortality Syndrome (POMS),* https://www.pir.sa.gov.au/aquaculture/aquatic_animal_health/pacific_oyster_mortality_syndrome.

PIRSA (2022), *Bivalve shellfish – Port River system,* https://pir.sa.gov.au/recreational_fishing/rules/fishing_closures/closure_areas/species_closures/bivalve_shellfish_port_river_system

PIRSA (2023). Draft Biosecurity Bill Overview. Developing a new Biosecurity Act for South Australia. Department of Primary Industries and Regions (PIRSA), Government of South Australia.

Venice Energy (2021), *Outer Harbor LNG Project Dredge Management Plan Framework*. Prepared by Venice Energy Pty Ltd and JBS&G Australia Pty Ltd.

Appendix H
EPBC self-assessment

EMM
creating opportunities

Berth 6 Precinct upgrade – EPBC Self-assessment

Flinders Port Holdings

Report

JBS&G 66422 | 159,356

3 June 2024

We acknowledge the Traditional Custodians of Country throughout Australia and their connections to land, sea and community.

We pay respect to Elders past and present and in the spirit of reconciliation, we commit to working together for our shared future.

Caring for Country The Journey of JBS&G
Artist: Patrick Caruso, Eastern Arrernte

Table of Contents

List of Tables

List of Figures

Appendices

Appendix A **EPBC Act Protected Matters Report**

Appendix B **BDBSA Search**

Abbreviations

Term	Definition
ALA	Atlas of Living Australia
BDBSA	Biological Databases of South Australia
CE	Critically Endangered
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DEW	South Australian Department for Environment and Water
DoE	Department of the Environment
E	Endangered
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
FACT	Flinders Adelaide Container Terminal
FPH	Flinders Port Holdings
Mi	Migratory
MNES	Matters of National Environmental Significance
PDI Act	*Planning, Development, and Infrastructure Act 2016*
PMST	Protected Matters Search Tool
POMS	Pacific Oyster Mortality Syndrome
Proposed Development	Upgrade of Berth 6
TEC	Threatened Ecological Community
TSSC	Threatened Species Scientific Committee
V	Vulnerable

1. Introduction

The Flinders Adelaide Container Terminal (FACT), owned and operated by Flinders Port Holdings (FPH) is the only container terminal facility in South Australia, located in Outer Harbor in the Port of Adelaide (Figure 1-1). The FACT currently includes two berths (Berths 6 and 7) and has a total quay length of 660 m.

Container vessel capacity, size and weight have increased significantly from the time of original design of the berths in 1974. Container trade has been steadily increasing over recent years and with continued growth expected over the coming decades (Flinders Port Holdings, 2024). The completion of the Outer Harbor Chanell Widening Project in 2019, which resulted in a widening of the shipping channel from 130 m to 170 m, has also contributed to the FACT receiving larger vessels.

- During peak periods, the FACT is currently operating at above industry standard and above 100% capacity. In the near future, vessels may reach up to 366 m in length; a length which cannot currently be accommodated by Berth 6 with its current design. The following key issues have been identified: Lack of ground slots within the terminal yard to provide sufficient capacity to handle existing and near-term trade levels.
- Insufficient berth line to simultaneously berth two larger container vessels without imposing restrictions and/or impacting on operations on neighbouring Berth 8 (used for handling grain vessels)
- Insufficient flexibility to cater for future ship to shore cranes, both in terms of loading and gauge.

To address these issues and accommodate the forecast higher vessel volumes and vessel sizes, FPH are proposing an upgrade to Berth 6 Precinct ('Berth 6 Precinct upgrade' or 'Proposed Development' herein). The Berth 6 Precinct upgrade requires planning approval under the *Planning, Development, and Infrastructure Act 2016* (PDI Act) (South Australia). FPH are currently preparing this development application, which will include assessment against South Australia's Planning and Design (the Code) and assessment of potential impacts in an environmental, social and economic context.

This report presents the analysis and outcomes of a self-assessment of potential impacts to Matters of National Environmental Significance (MNES) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). In turn, JBS&G have assessed whether a referral of the Proposed Development is warranted under the Commonwealth EPBC Act.

The self-assessment concludes that the Proposed Development **is not likely** to have a significant impact on MNES.

Figure 1-1: General location of the Flinders Adelaide Terminal Container and location of Berth 6

2. Details of the Activity

2.1 Proposed Development description

The Berth 6 Precinct upgrade includes the following elements and activities as described in Table 2-1 and represented in Figure 2-1. It is noted that the Berth 6 Precinct upgrade works are in the design phase, with construction planned to commence in May 2025. Construction works would be undertaken over a period of approximately 12 months; and with dredging to occur over a few weeks (maximum).

Table 2-1: Berth 6 Precinct upgrade elements and activities

Project element	Activity description
Extension of Berth 6	• Extension of Berth 6 to a length of 179 m and width of 28 m. • A new mooring dolphin located 18 m west from the edge of the proposed Berth 6 extension, connected to Berth 6 via a suspended walkway. • Piling operations will most likely be required. Considered options include driving piles, sheetpiles or king piles.
Land reclamation	• Methodology for land reclamation will be confirmed following detailed design.
Pavement and services upgrades	• Demolition of existing cargo shed and maintenance buildings. • Decommissioning of existing services (low voltage and high voltage electrical, data, communication, security, light towers, sewer and stormwater). • Construction of new services (low voltage and high voltage electrical, data, communication, security, light towers, sewer and stormwater). • Extension of existing fire services. • Excavation of existing pavement material and disposal off site (re-use where appropriate). • Construction of new pavement and bitumen surface.
Existing Berth 6 concrete remediation/bollard/fender upgrade.	• Demolition of existing fenders and bollards • Demolition of approximately 30% of existing front concrete capping beam. • Reconstruction of new capping beam on the front face. • Installation of new fenders and fender interface support brackets. • Installation of new 150T double bollards. • The extent of works includes approximately 300m of the existing Berth 6.
Dredging	• Dredging of the area adjacent to Berth 6 in the shipping channel to achieve channel design depth of 14.2 mCD. • This involves dredging approximately 690 m^2 of sediment with a sediment volume of approximately 550 m^3. These estimates include a vertical allowance of 0.3 m of over-dredging and a horizontal 0.5 m batter slope, to consider slumping during dredging. • Proposed disposal of dredge spoil to existing Pelican Point Dredge Pond located approximately 1 km from the dredge location. However if the extension of Berth 6 involves a sheet pile wharf, spoil may be used as low level backfill behind the sheet pile. • Dredging methodology to be confirmed following detailed design but would likely involve cutter suction methodology.
Rock revetment •	• Removal of the rock revetment and reuse in the new rock armour or as low level backfill to new pavement,

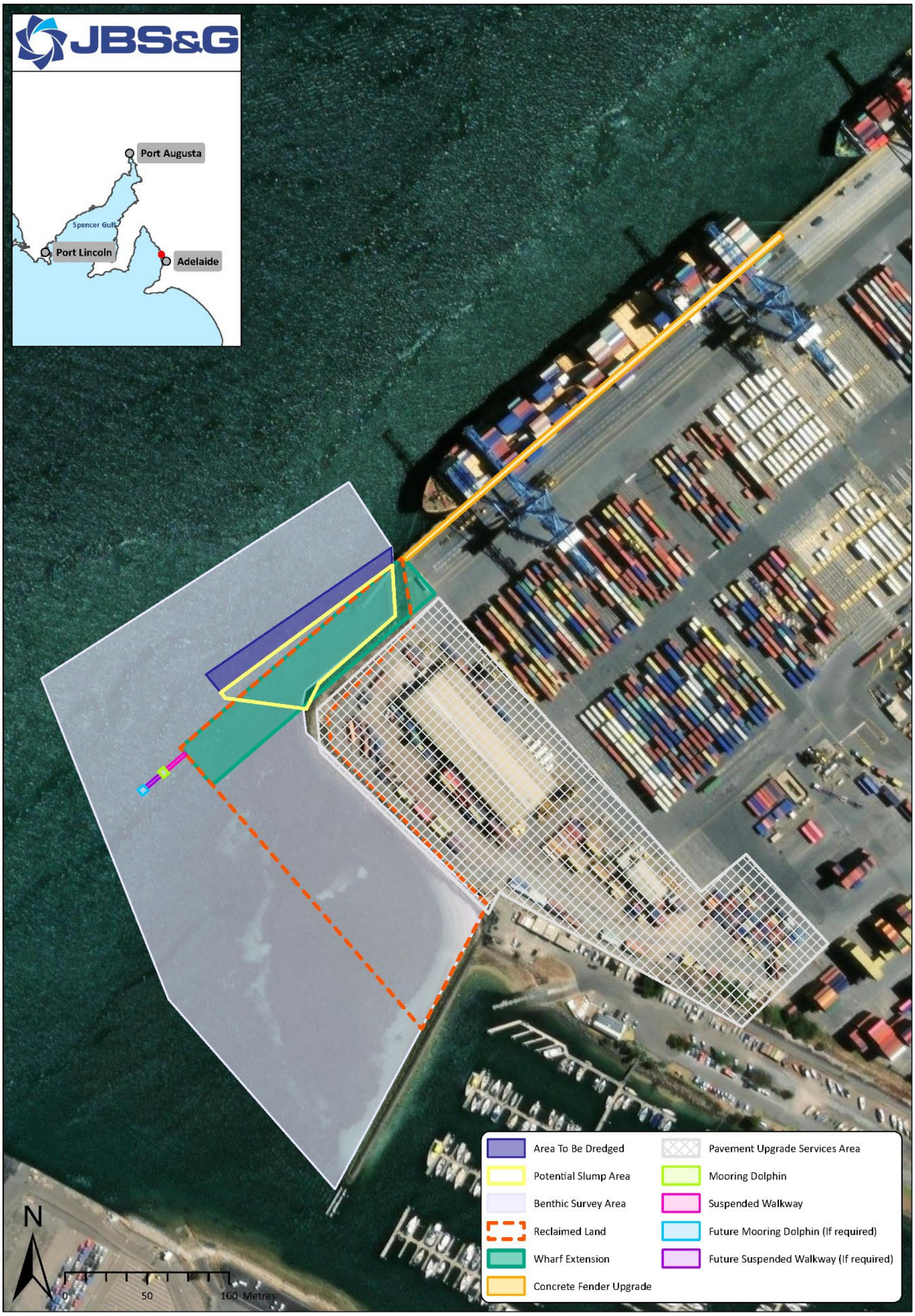


Figure 2-1: Proposed upgrade works at Berth 6

2.2 Proposed Development Location

The Proposed Development is located in the Port of Adelaide at Outer Harbor, on the northern tip of the Lefevre Peninsula, approximately 22 km north of Adelaide (Figure 1-1). The area accommodates a range of industries including port-related activities, bulk handling and storage of minerals, agricultural and petroleum products, transport and warehousing, electricity generation and manufacturing.

The Proposed Development site is predominantly comprised of land which has been reclaimed from the natural intertidal mangrove and samphire flats which originally formed this part of the Lefevre Peninsula. The adjacent Port River, which forms the sea entrance to the Port of Adelaide, has been utilised as a shipping channel since European settlement and is also utilised by FPH vessels (e.g. tugboats), tourist vessels, commercial fishers, recreational boaters and anglers and kayakers. The Port River is tidal, and at Outer Harbor has been subject to regular dredging programs to maintain channel depth and width which allows larger container and cruise ships to be accommodated. A previous dredging campaign was referred under the EPBC Act in 2004 (2004/1339) and was determined as 'not a controlled action'.

The current state of the landside Berth 6 Precinct upgrade site is developed with no existing vegetation (Figure 2-2). The Port River side adjacent to Berth 6 comprises a mudflat with intertidal seagrass (*Zostera* sp.) and extending out into a highly modified shipping channel of largely silty/sandy bottom interspersed with sparse small patches of seagrass (*Zostera* sp.) with shell fragments and bivalves (predominantly the razor clam *Pinna bicolor,* and sparse Hammer oyster *Malleus meridianus*, Queen scallop *Equichlamys bifrons*, Spiny scallop *Scaeochlamys livida* and Mud cockle *Katelysia sp*.). The introduced seaweed *Caulerpa cylindracea* is also present within the Port River (Wiltshire and Deveney 2017, J Diversity 2024), however in the case of the Project site, *Caulerpa cylindracea* was not detected along any of the surveyed transects (J Diversity 2024).

Several conservation parks and reserves occur within 5 km of Berth 6 (Figure 2-3). The Adelaide International Bird Sanctuary National Park (Winaityinaityi Pangkara) is approximately 4 km east from Berth 6. Torrens Island Conservation Park and Mutton Cove Conservation Reserve are located approximately 3 km and 2 km east of Berth 6 respectively. The Barker Inlet – St Kilda Aquatic Reserve and the St Kilda – Chapman Creek Aquatic Reserve are located 3 km east and 3.5 km northeast respectively, from Berth 6 in the adjacent Port River estuary and associated mangroves.

The Port River and wider coastal area is located within the area established for the Adelaide Dolphin Sanctuary under the *Adelaide Dolphin Sanctuary Act 2005* (Figure 2-3).

Figure 2-2: Aerial view of the site

Figure 2-3: Conservation reserves and sanctuaries in the vicinity of Berth 6

2.3 Potential impacts

Potential impacts during construction of the Proposed Development include, but are not limited to:

- Vegetation clearance (seagrass)
- Loss of habitat due to dredging
- Increased turbidity and sedimentation from dredging
- Underwater noise and vibration
- Introduction of pests, weeds and diseases, including the Pacific Oyster Mortality Syndrome (POMS)
- Dust generation
- Noise and visual amenity
- Impacts to the coastal and marine environment through stormwater runoff
- Impact to cultural heritage
- Traffic and infrastructure impacts

These potential impacts, together with control and mitigation measures will be detailed as part of the Development Application prepared under the PDI Act (2016).

Whilst potential impacts have been identified for investigation, current studies and preliminary impact assessment in relation to sources, pathways and receptors is concluding that significant impacts are unlikely.

3. Self-assessment process

3.1 Legislative Background

The Commonwealth EPBC Act protects the following MNES:

- world heritage properties
- national heritage places
- wetlands of international importance (listed under the Ramsar Convention)
- listed threatened species and ecological communities
- migratory species protected under international agreements
- Commonwealth marine areas
- the Great Barrier Reef Marine Park
- nuclear actions (including uranium mines)
- a water resource, in relation to coal seam gas development and large coal mining development.

A person who proposes to take an action that will have, or is likely to have, a significant impact on a matter of national environmental significance must refer that action to the minister for a decision on whether assessment and approval is required under the EPBC Act.

3.2 Methodology

The self-assessment follows the process outlined in the MNES significant impact guidelines (DoE, 2013).

The self-assessment uses findings from a benthic assessment undertaken at the site (detailed Section 3.2.1) together with findings from a desktop review as detailed below in 3.2.2

3.2.1 Benthic survey

A benthic survey of the dredge footprint was undertaken in March 2024 by J Diversity Ltd Pty (J Diversity, 2024), and included:

- **Surface supplied breathing apparatus (SSBA) surveys**, undertaken on 7th and 8th March 2024, with benthic habitat along transects captured via a head-mounted video camera. Discretionary still photos were also taken, and fauna recorded.
- **A snorkel survey**, for ground truthing of seagrass distribution, undertaken along transect lines on the 7th and 8th March 2024. Habitat transitions and fauna were recorded.
- **A drone survey**, undertaken close to low tide, at 12:30 pm on 08 March 2024. The drone was flown at 80 m, providing for images covering approximately 115 x 86 m.
- **An intertidal survey**, undertaken during low tide on 8th March 2024, along the base of the rock revetment, and spanning a distance of 160 m. Presence of intertidal species was captured via video camera and recorded.

No EPBC-listed species were recorded during the benthic survey (J Diversity, 2024).

3.2.2 Desktop review

The desktop review undertaken for this self-assessment used the following databases and search tools:

- EPBC Act Protected Matters Search Tool (PMST) on the Proposed Development area (plus a 5 km buffer) (Appendix A) (accessed 29 April 2024).
- A search of the Biological Databases of South Australia (BDBSA) (accessed via NatureMaps) around the Proposed Development area (plus a 5 km buffer).
  - A data set was obtained on 26 April 2024 and provides records of State and Nationally listed flora and fauna species within 5 km of each of the Proposed Development area (DEW, 2024) (Appendix B).
- The species profile and threats database (DCCEEW, 2024a), approved conservation advice, recovery plans and other published information were used to obtain further information for individual species.

3.2.3 Assessment of the likelihood of occurrence

The likelihood of each threatened flora and fauna species occurring within the Proposed Development area (plus a 5 km buffer) was assessed. A likelihood of occurrence rating (Highly Likely/Known; Likely; Possible and Unlikely) (Table 3-1) was assigned to each threatened ecological community and species identified in the PMST and BDBSA search.

Table 3-1: Criteria for the likelihood of occurrence within the Proposed Development area

Likelihood	Criteria
High Likely/ Known	Recorded in the last 10 years, the species does not have highly specific niche requirements, the habitat is largely intact and falls within the known Proposed Development area.
Likely	Recorded within the last 20 years, the Proposed Development area falls within the known distribution of the species and the area provides species habitat which is largely in intact.
Possible	Recorded within the previous 20 years, the Proposed Development area falls inside the known distribution of the species, but the area provides limited habitat or feeding resources for the species. Recorded within 20 – 40 years, survey effort is considered adequate, habitat is present and intact, and species of similar habitat needs have been recorded the Proposed Development area.
Unlikely	Recorded within the 20 – 40 years, however suitable habitat does not occur, and species of similar habitat requirements have not been recorded the Proposed Development area. No records within the previous 40 years, despite suitable habitat being known to occur in the Proposed Development area. No records despite adequate survey effort.

4. Self-assessment of impacts to MNES

The assessment of the likelihood of significant impacts from the Proposed Development on the nine MNES listed under the EPBC Act is summarised in Table 4-1, and further detail is provided in Sections 4.1 to 4.3.

The self-assessment has indicated that significant impacts to MNES are considered **not likely** to occur. Consequently, submission of a referral under the EPBC Act is not required.

Table 4-1: Summary of MNES relevant to the Proposed Development Area

Category	NES Matter	Details	Is the Proposed Development likely to have a significant impact?
World Heritage Properties	None	-	-
National Heritage Places	None	-	-
Wetlands of international importance (Ramsar wetlands)	None	-	-
Threatened species and ecological communities	The PMST modelled the potential for one threatened ecological community to occur in the region. In addition, 60 threatened species have the potential to occur in the region.	Refer Section 4.1 and Section 4.2.	No
Migratory species protected under international agreements	65 migratory bird species have the potential to occur in the region as modelled by the PMST.	Refer Section 4.3	No
Commonwealth marine areas	None	-	-
Great Barrier Reef Marine Park	None	-	-
Nuclear actions (including uranium mining)	None	-	-
Water resource in relation to CSG or coal mining	n/a	-	-

4.1 Threatened ecological communities

The Subtropical and Temperate Coastal Saltmarsh Threatened Ecological Community (TEC) was predicted to occur within 5 km of the Proposed Development by the PMST. Table 4-2 details this TEC, its likelihood of occurrence and the likelihood of significant impact from the Proposed Development.

Table 4-2: Likelihood of occurrence and assessment of impact significance for EPBC listed TEC in the Proposed Development Area

Name	EPBC Status	Details	Likelihood of occurrence	Is Proposed Development likely to have a significant impact?
Subtropical and Temperate Coastal Saltmarsh	V	This TEC is predicted by PMST to occur within 5 km of Proposed Development Area. The Proposed Development area is entirely developed. Closest predicted occurrence of this TEC is within the Mutton Cove Conservation Reserve and the Torrens Island Conservation Park, 2 km and 3 km from the Proposed Development area respectively. This TEC does not constitute a MNES. The significant impact guidelines (DoE, 2013) state that listed ecological communities in the Vulnerable category are not MNES for the purposes of Part 3 of the EPBC Act (requirements for environmental approvals). While this TEC is not a MNES, the Proposed Development will not significantly impact this TEC.	Unlikely	N/A – see 'details' column for justification

4.2 Listed Threatened Fauna and Flora

The PMST predicted five nationally threatened flora species and fifty-five[1] nationally threatened fauna species to occur or use habitat in the Proposed Development area (see PMST results in Appendix A). Bird species comprised the majority of the fauna species. Records for listed threatened species within the search areas are further provided (BDBSA records Appendix B).

Assessment of impact significance has considered the DoE (2013) significant impact criteria set out in Table 4-3 below. The likelihood of occurrence and assessment of impact significance for these species is summarised Table 4-4.

Table 4-3: Significant impact criteria for threatened species

Critically endangered and endangered species	Vulnerable species
An action is likely to have a significant impact if there is a real chance or possibility that it will:	
• Lead to a long-term decrease in the size of a population	• Lead to a long-term decrease in the size of an important population of a species
• Reduce the area of occupancy of the species	• Reduce the area of occupancy of an important population
• Fragment an existing population into two or more populations	• Fragment an existing important population into two or more populations
• Adversely affect habitat critical to the survival of a species	• Adversely affect habitat critical to the survival of a species
• Disrupt the breeding cycle of a population	• Disrupt the breeding cycle of an important population
• Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	• Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
• Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	• Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
• Introduce disease that may cause the species to decline	• Introduce disease that may cause the species to decline
• Interfere with the recovery of the species	• Interfere substantially with the recovery of the species

Four threatened birds were assessed as possibly occurring within the Proposed Development area, however none of these species were considered dependent on habitat within the site (Table 4-4).

Two threatened marine mammals, one threatened species of shark and one threatened species of turtle were also considered as having the potential to occur within the site of Proposed Development as transient visitors.

The Proposed Development area is small (9.3 ha) and includes an area of currently existing hardstand (Figure 2-2), with no terrestrial vegetation present. The adjacent Port River comprises a mudflat with intertidal seagrass and extending out into a highly modified shipping channel of largely silty/sandy bottom interspersed with sparse small patches of seagrass (*Zostera* sp.) interspersed with shell fragments and bivalves. .Intertidal seagrass on the mudflat represents a very small fraction of available intertidal seagrass in the Port River. The

[1] Species that are listed as conservation dependent under the EPBC Act are not considered as MNES for the purposes of Part 3 of the EPBC Act and consequently have not been included in the assessment.

loss of this habitat would not have a significant impact on any threatened species through reduction in population size or area of occupancy, fragmentation of any population, disruption of breeding cycle, decline due to habitat impacts, introduction of invasive species or interference of the recovery of the species.

Consequently, the Proposed Development is **not likely** to have a significant impact on listed threatened species.

Table 4-4: Likelihood of occurrence and assessment of impact significance for EPBC listed threatened flora and fauna in the Proposed Development area

EPBC Act Conservation Status: R=Rare, V=Vulnerable, E=Endangered, CE=Critically Endangered, MI=Migratory

Scientific Name	Common Name	EPBC Status	Details	Likelihood of occurrence	Is the Proposed Development likely to have a significant impact?
Plants					
Caladenia tensa	Greencomb Spider-orchid, Rigid Spider-orchid	E	Occurs in *Callitris spp.* (cypress pine), *Eucalyptus leucoxylon* (Blue gum) woodland and *Melaleuca uncinata* (Broombush) mallee on Tertiary and Quaternary aeolian sandy loams in the Murray-Darling Depression bioregion (TSSC 2016a). There are no BDBSA records within 5 km of the Proposed Development area or in the wider region. Unlikely to be present in saline soils.	Unlikely	No
Prasophyllum validum	Sturdy Leek-orchid, Mount Remarkable Leek-orchid	V	Tends to grow in drier woodland habitats, generally with a low sparse understorey. In South Australia, occurs in *Eucalyptus cladocalyx* woodland with porcupine grass Triodia species understorey, on loamy soils (Duncan, 2010). There are no BDBSA records within 5 km of the Proposed Development area or in the wider region. Unlikely to be present in saline soils.	Unlikely	No
Senecio macrocarpus	Large-fruit Fireweed, Large-fruit Groundsel	V	Previously widespread species occurring from the Yorke Peninsula in west of South Australia to Victoria. In South Australia, the species occurs most commonly in depressions in low lying closed sedgeland but may occur in sedgeland, herbland, low shrubland to low open woodland where competition from understorey plants is low. The soils range from clay to loamy sand. In South Australia, species occurs in the Messent Conservation Park, Gum Lagoon Conservation Park and at Yalkiri Station (Sinclair, 2010). There are no BDBSA records within 5 km of the Proposed Development area or in the wider region. Unlikely to be present in saline soils.	Unlikely	No
Tecticornia flabelliformis	Bead Glasswort, Bead Samphire	V	Species is endemic to, and widely distributed across southern Australia. It grows on margins of salt lakes and coastal salt marshes over gypsum deposits, and often	Unlikely	No

Scientific Name	Common Name	EPBC Status	Details	Likelihood of occurrence	Is the Proposed Development likely to have a significant impact?
			associated with other *Tecticornia* species. It generally occurs on periodically (but not regularly) inundated depressions on clay (occasionally sandy) soils, often (but not always) in saline area (Carter, 2010). There are several BDBSA records of this species within 5 km of the Proposed Development area in the Torrens Island Conservation Park (all records prior to the year 2000). The Proposed Development area is entirely developed with no terrestrial vegetation. Possible occurrence of this species in the broader vicinity of the Proposed Development. The Proposed Development will only cause local disturbance to the Proposed Development Area with no expected impact to the surrounding terrestrial environment.		
Swainsona pyrophila	Yellow Swainson-pea	V	Species is a short-lived, fire adapted species and occurs from the northern Eyre Peninsula east to north-western Victoria and south-western and central-western New South Wales, generally within the 250–400 mm rainfall zone. Occurs in mallee scrub on well drained sands, sandy loams and heavier clay loams (Tonkinson & Robertson, 2010). There are no BDBSA records within 5 km of the Proposed Development area or in the wider region. Unlikely to be present in saline soils.	Unlikely	No
Terrestrial Mammals and Reptiles					
Pteropus poliocephalus	Grey-headed Flying-fox	V	Occurs in the coastal belt from central Queensland, through New South Wales, Victoria and into South Australia. Requires foraging resources and roosting sites. Species is a canopy-feeding frugivore and nectarivore, which utilises vegetation communities including rainforests, open forests, closed and open woodlands, Melaleuca swamps and Banksia woodlands (DAWE, 2021). There is 1 BDBSA record approximately 5 km north east and south east of the Proposed Development area (from 2020). A roosting colony was first recorded at Botanic Park (approximately 20 km south east of the Proposed Development) in	Unlikely	No

Scientific Name	Common Name	EPBC Status	Details	Likelihood of occurrence	Is the Proposed Development likely to have a significant impact?
			2010. The species forages over a wide area, with individuals capable of traveling 40 km between roost and feeding sites. The Proposed Development area is entirely developed with no vegetation to provide suitable habitat for this species.		
Aprasia pseudopulchella	Flinders Ranges Worm-lizard	V	Distribution of this species ranges from the Flinders Ranges, SA, to the Mt Lofty Ranges. Its habitat includes open woodland, native tussock grassland, riparian habitats and rocky isolates. Preferred habitat is stony soils or clay soils with a stony surface (DEWHA, 2008a). The Proposed Development area is just outside of the known distribution of this species (DCCEEE, 2024a) There are no BDBSA records of this species within 5 km of the Proposed Development. Closest records are approximately 20 km of the site (records between 2021 and 2023). The Proposed Development area is entirely developed and does not provide suitable habitat for this species.	Unlikely	No
Sharks, Turtles, Fish and Marine Mammals					
Carcharodon carcharias	White Shark, Great White Shark	V, Mi	Marine species. Widely but not evenly, distributed in Australian waters with the majority of recorded movements occurring between the coast and the 100 m depth contour. Areas in South Australia where observations are more frequent include waters in and around some Fur Seal and Sea Lion colonies (e.g. the Neptune Islands), areas of the Great Australian Bight, and regions with high prey densities (e.g. pinniped colonies). Limited information is known on the species' breeding and life cycles (DSEWPC, 2013). No BDBSA records for the wider marine environment. Species is highly mobile. Rare visitor to Port River estuary and possible transient visitor to the broader marine environment. No areas of known aggregation within the vicinity of the Proposed Development.	Possible transient visitor	No

Scientific Name	Common Name	EPBC Status	Details	Likelihood of occurrence	Is the Proposed Development likely to have a significant impact?
Dermochelys coriacea	Leatherback Turtle, Leathery Turtle, Luth	E, Mi	Oceanic species found in all the oceans of the world. Migrates great distances between cooler feeding grounds. No known breeding habitat in Australia (DEWHA, 2008b). One historical BDBSA record (from 1996) within 5 km of the Proposed Development area. Several other records within 25 km of the site (from 1988 to 1997).	Unlikely	No
Caretta caretta	Loggerhead Turtle	E, Mi	Oceanic species. Worldwide tropical and subtropical distribution. Breeds in northern Australia. In Australia, occurs in coral reefs, bays and estuaries in tropical and warm temperate waters off coast of Queensland, Northern Territory, Western Australia and New South Wales (DEE, 2017). There are no BDBSA records of this species within 5 km of the Proposed Development area. Closest historical record is more than 45 km away from the Proposed Development.	Unlikely	No
Chelonia mydas	Green Turtle	V, Mi	Ocean-dwelling species spending most of their life at sea. Occurs in coral reefs rich in seaweeds, and coastal seagrass pastures in tropical and subtropical areas worldwide. Key breeding and foraging habitat is in tropical Australia (DEE, 2017). Occasional visitor to South Australia, possibly associated with currents. No critical habitat or breeding grounds occur in southern Australia. Two historical BDBSA records within 5 km of the Proposed Development area near Bird Island and in Barker Inlet during the last 20 years. Possible in the vicinity of the Proposed Development area, however species rarely travels to southern Australia.	Possible, however species rarely travels to southern Australia.	No
Eubalaena australis	Southern Right Whale	E, Mi	Seasonally present along the Australian coast between late April and early November. While the entire South Australian coast is considered potential habitat, species tends to aggregate in predictable locations outside Spencer Gulf along the South Australian coast, with major calving grounds in the Great Australian Bight and smaller aggregations in Fowlers Bay and Encounter Bay (DSEWPC 2012). There are no BDBSA records of this species within 5 km of the Proposed Development (closest BDBSA record is more than 80 km from the site).	Possibility of visitation to Gulf St Vincent by an individual whale or whale pairs	No

Scientific Name	Common Name	EPBC Status	Details	Likelihood of occurrence	Is the Proposed Development likely to have a significant impact?
			Species rarely occurs in Port River estuary, however there are two recent records near the western end of the shipping channel in 2019 (Boskalis 2019). No known current or historical aggregation areas within South Australian Gulfs which are not part of the species migration path.	(i.e. mother/calf)	
Neophoca cinerea	Australian Sea Lion	E	Marine mammal. Prefers onshore habitats including exposed islands and reefs, rocky terrain, sandy beaches and vegetated fore dunes and swales. There are six BDBSA records (between 2005 and 2019) within 5 km of the Proposed Development area. A haul-out site for the species exists at the Outer Harbor breakwaters in Port River however, there are no colonies or significant feeding sites for the species in the vicinity of the Proposed Development.	Possible transient visitor to the Proposed Development area	No
Birds					
Acanthiza iredalei rosinae	Slender-billed Thornbill (Gulf St Vincent)	V	Mainly restricted to chenopod shrublands, particularly samphire dominated by shrubby glasswort (*Sclerostegia arbuscular*), on narrow coastal saline mudflats usually within 20 m of a tidal channel or saline lake. Mostly forages in dense, tall samphire, but occasionally from the surface of mud and among smaller samphires, and in grey mangrove (*Avicennia marina*) adjacent to samphire shrublands (DoE, 2015a). Several BDBSA records within 5 km of the Proposed Development area in the Torrens Island Conservation Park (last record 2020). The Proposed Development area is small and would not provide important habitat for this species. Intertidal seagrass on the mudflat represents a very small fraction of available intertidal seagrass in the Port River. The loss of this habitat would not have a significant impact on the species through reduction in population size or area of occupancy, fragmentation of any population, disruption of breeding cycle, decline due to habitat impacts, introduction of invasive species or interference of the recovery of the species.	Possible	No

Scientific Name	Common Name	EPBC Status	Details	Likelihood of occurrence	Is the Proposed Development likely to have a significant impact?
Aphelocephala leucopsis	Southern Whiteface	V	Species live in a wide range of open woodlands and shrublands (usually dominated by acacias or eucalypts) with understory of grasses or shrubs or both. Species favours habitat with low tree densities and an herbaceous understorey litter cover (DCCEEW, 2023a). No BDBSA records within 5 km of the Proposed Development area. Closest record (2016) is approximately 10 km from the site. No preferred habitat for the species in the Proposed Development area.	Unlikely	No
Ardenna grisea	Sooty Shearwater	V, Mi	This species breeds in the southern hemisphere including in southern Australia on islands off New South Wales and Tasmania. This species was found to be a moderately common migrant and visitor to South Australia, although no breeding islands are identified in this State (DCCEEW, 2023b). No BDBSA records within 5 km of the Proposed Development area. Closest record is approximately 90 km from the site. No preferred habitat for the species in the Proposed Development area.	Unlikely	No
Arenaria interpres	Ruddy Turnstone	V, Mi	During the non-breeding season, this species occurs in coastal regions around most of Australia. Preferred habitats are rocky shores or beaches with large deposits of rotting seaweed. This species does not breed in Australia (DCCEEW, 2024b). There are two historical BDBSA records (from 1984) within 5 km of the Proposed Development area and scattered records within 10 km of the Proposed Development area (all prior to 1986).The Proposed Development area is small and does not provide quality habitat for this species. Habitats within the Proposed Development area unlikely to be used significantly by the species.	Unlikely	No
Botaurus poiciloptilus	Australasian Bittern	E	Preferred habitat comprises wetlands with tall dense vegetation, where it forages in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water. Favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and reeds (e.g. *Phragmites*, *Cyperus*, *Eleocharis*, *Juncus*, *Typha*, *Baumea*, *Bolboschoenus*) or cutting grass (*Gahnia*) growing over a muddy or peaty substrate (TSSC, 2019a).	Unlikely	No

Scientific Name	Common Name	EPBC Status	Details	Likelihood of occurrence	Is the Proposed Development likely to have a significant impact?
			No BDBSA records within 5 km of the Proposed Development area. Closest record (from 1996) is approximately 6 km within the Torrens Island Conservation Park. No preferred habitat for the species in the Proposed Development area.		
Calidris acuminata	Sharp-tailed Sandpiper	V, Mi	This species has a widespread distribution; and found within all states of Australia. Suitable habitats comprise fresh and hypersaline environments including mudflats, wetlands and sewage ponds, as well as rocky and sandy beaches. This species does not breed in Australia (DCCEEW, 2024c). Numerous BDBSA records within the past twenty years (most recent record 2020) within 5 km of Proposed Development area, in the Torrens Island Conservation Park and the Mutton Cove Reserve. The Proposed Development area is small and would not provide important habitat for this species. Intertidal seagrass on the mudflat represents a very small fraction of available intertidal seagrass in the Port River. The loss of this habitat would not have a significant impact on the species through reduction in population size or area of occupancy, fragmentation of any population, disruption of breeding cycle, decline due to habitat impacts, introduction of invasive species or interference of the recovery of the species.	Possible	No
Calidris canutus	Red Knot, Knot	V, Mi	Species does not breed in Australia. In Australasia, mainly inhabits intertidal mudflats, sandflats and sandy beaches of sheltered coasts and sometimes on sandy ocean beaches or shallow pools on exposed rock platforms. Occasionally seen on terrestrial saline wetlands near the coast and on sewage ponds and saltworks (DCCEEW, 2024d). There are no BDBSA records of this species within 5 km of the Proposed Development area. The Proposed Development area is small and would not provide important habitat for this species. Habitats within the Proposed Development area unlikely to be used	Unlikely	No

Scientific Name	Common Name	EPBC Status	Details	Likelihood of occurrence	Is the Proposed Development likely to have a significant impact?
			significantly by the species. Habitat at nearby shores/mudflats would not be impacted by the Proposed Development.		
Calidris ferruginea	Curlew Sandpiper	CE, Mi	In Australia, mainly occurs on intertidal mudflats in sheltered coastal areas, such 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 (DCCEEW, 2023c). Occurs in both fresh and brackish waters. Does not breed in Australia. Several BDBSA records within 5 km of the Proposed Development area in the Torrens Island Conservation Park and the Mutton Cove Reserve (all records prior to 2000). The Proposed Development area is small and would not provide important habitat for this species. Habitats within the Proposed Development area unlikely to be used significantly by the species. Habitat at nearby shores/mudflats would not be impacted by the Proposed Development.	Unlikely	No
Calidris tenuirostris	Great Knot	V, Mi	In Australia, prefers sheltered coastal habitats with large intertidal mudflats or sandflats including inlets, bays, harbours, estuaries and lagoons. Occasionally found on exposed reefs or rock platforms, shorelines with mangrove vegetation, ponds in saltworks, at swamps near the coast, salt lakes and non-tidal lagoons. Typically, roosts in large groups in open areas, often at the water's edge or in shallow water close to feeding grounds (DCCEEW, 2024e). No BDBSA records within 5 km of the Proposed Development area. Closest records are within the Torrens Island Conservation Park. The Proposed Development area is small and would not provide important habitat for this species. Habitats within the Proposed Development area unlikely to be used significantly by the species. Habitat at nearby shores/mudflats would not be impacted by the Proposed Development	Unlikely	No
Charadrius leschenaultii	Greater Sand Plover, Large Sand Plover	V, Mi	Mainly occurs on sheltered sandy, shelly or muddy beaches, large intertidal mudflats, sandbanks, salt-marshes, estuaries, coral reefs, rocky islands, rock	Unlikely	No

Scientific Name	Common Name	EPBC Status	Details	Likelihood of occurrence	Is the Proposed Development likely to have a significant impact?
			platforms, tidal lagoons and dunes near the coast (DCCEEW, 2023d) Does not breed in Australia. One BDBSA record within 5 km of the Proposed Development area (from 1988). The Proposed Development area is small and would not provide important habitat for this species. Habitats within the Proposed Development area unlikely to be used significantly by the species. Habitat at nearby shores/mudflats would not be impacted by the Proposed Development		
Charadrius mongolus	Lesser Sand Plover, Mongolian Plover	E, Mi	Species is almost strictly coastal during the non-breeding season, preferring sandy beaches, mudflats of coastal bays and estuaries, sand-flats and dunes near the coast and occasionally frequenting mangrove mudflats in Australia. Mainly feeds on extensive, freshly exposed areas of intertidal sandflats and mudflats in estuaries or beaches, or in shallow ponds in saltworks (TSSC, 2016b). There are no BDBSA records within 5 km of the site of Proposed Development area. Closest records (from 1980) are near the salt evaporation pans approximately 9 km from the proposed developed area. The Proposed Development area is small and would not provide important habitat for this species. Habitats within the Proposed Development area unlikely to be used significantly by the species. Habitat at nearby shores/mudflats would not be impacted by the Proposed Development.	Unlikely	No.
Falco hypoleucos	Grey Falcon	V	An elusive species endemic to mainland Australia, occurring in arid and semi- arid Australia, including the Murray Darling Basin and Eyre Basin, central and western Australia. The species frequents timbered low land plains, particularly acacia shrublands that are crossed by tree-lined water (TSSC, 2020). There are no BDBSA records within 5 km of the of the Proposed Development area. Closest record of this species is more than 20 km from the Proposed Development area. No suitable habitat for the species in the Proposed Development area.	Unlikely	No

Scientific Name	Common Name	EPBC Status	Details	Likelihood of occurrence	Is the Proposed Development likely to have a significant impact?
Gallinago hardwickii	Latham's Snipe, Japanese Snipe	V, Mi	In Australia, this species has a widespread on the eastern coasts from northern Queensland to South Australia. Does not breed in Australia. This species can be found in small wetlands such as urban water bodies, saltmarshes and creek edges. Preferred habitat present a dense cover of sedges, grasses, lignum, reeds and rushes. Foraging habitat comprise soft mudflats and shallow water (DCCEEW, 2024f) There are no BDBSA records within 5 km of the of Proposed Development area. Closest record (from 2000) is approximately 10 km from the Proposed Development area next to the salt evaporation pans. No preferred habitat for the species in the Proposed Development area.	Unlikely	No
Grantiella picta	Painted Honeyeater	V	Species endemic to mainland Australia. Sparsely distributed from south-eastern Australia to north-western Queensland and eastern Northern Territory. Highest number of records and concentrations occur from south of 26°S on inland slopes of the Great Dividing Range. Species shows seasonal north-south movements largely governed by fruiting of mistletoe with which its breeding is closely matched (DoE, 2015b). There are no BDBSA records within 5 km of the Proposed Development area or in the wider region. No suitable habitat for the species in the Proposed Development area.	Unlikely	No
Halobaena caerulea	Blue Petrel	V	Marine species breeding on subantarctic islands and foraging in Antarctic and subantarctic waters. (TSSC, 2015a). There are no BDBSA records within 5 km of the Proposed Development area. Closest record (from 1991) is more than 10 km from the Proposed Development area. No suitable habitat for the species in the Proposed Development area.	Unlikely	No
Hirundapus caudacutus	White-throated Needletail	V, Mi	Mostly aerial in Australia, from heights of less than 1 m up to more than 1000 m above the ground. Although occurs over most types of habitat, is recorded most often above wooded areas, including open forest and rainforest, and may also fly	Unlikely	No

Scientific Name	Common Name	EPBC Status	Details	Likelihood of occurrence	Is the Proposed Development likely to have a significant impact?
			below the canopy between trees or in clearings. Roosts in trees amongst dense foliage in the canopy or in hollows (TSSC, 2019b). This species was recorded once in 1995 within 5 km of the Proposed Development area. No suitable habitat for the species in the Proposed Development area.		
Limosa lapponica baueri	Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit	E	Occurs mainly in coastal habitats such as large intertidal sandflats, spits and banks. Can be also found within mudflats, estuaries, coastal lagoons and bays, often near beds of seagrass or saltmarshes. Has also been recorded in sandy ocean beach, rock platforms, coral reef flats, coastal sewage farms, saltworks and port (DCCEEW, 2024g). Does not breed in Australia. There are no BDBSA records within 5 km of the of Proposed Development area. Closest record is more than 30 km form the Proposed Development area near the Adelaide International Bird Sanctuary – Winaityinaity Pangkara. The Proposed Development area is small and would not provide important habitat for this species. Habitats within the Proposed Development area unlikely to be used significantly by the species.	Unlikely	No
Limosa limosa	Black-tailed Godwit	E, Mi	Coastal species whose preferred habitat comprise sheltered bays, estuaries, and lagoons with large intertidal mudflats and/or sandflats. This species can also be found around muddy lakes and within wetlands with shallow waters (DCCEEW, 2024h). There are 3 BDBSA records within 5 km of the Proposed Development area (prior to 2000). There are several records of this species within the salt evaporation pans within 10 km of the Proposed Development area. The Proposed Development area is small and would not provide important habitat for this species. Habitats within the Proposed Development area unlikely to be used significantly by the species.	Unlikely	No

Scientific Name	Common Name	EPBC Status	Details	Likelihood of occurrence	Is the Proposed Development likely to have a significant impact?
Melanodryas cucullata cucullata	South-eastern Hooded Robin, Hooded Robin (south-eastern)	E	Species prefer dry eucalypt and acacia woodlands and shrublands with an open understorey, some grassy areas and a complex ground layer. In agricultural landscapes, the species prefer patches greater than 10 ha with deep soils (DCCEEW 2023e). There are no BDBSA records within 5 km of the site of Proposed Development area. Closest record is more than 20 km from the Proposed Development area. No suitable habitat for the species in the Proposed Development area.	Unlikely	No
Neophema chrysogaster	Orange-bellied Parrot	CE	Breeds in south-west Tasmania in summer and migrates to coast of south-east mainland Australia for winter. Habitat varies throughout the year, including salt marshes, coastal dunes, pastures, shrub lands, estuaries, islands, beaches and moorlands generally within 10 km of the coast (DELWP, 2016). Non-breeding birds usually found along coast of South Australia and Victoria with the species' current mainland distribution, covering approximately 1000 km of coastline, from the mouth of the Murray River in South Australia, along the coast, to southeast Victoria. There are no BDBSA records within 5 km of the Proposed Development area. This species was recorded once in 2006 in the salt evaporation pans within 10 km of the Proposed Development area. No suitable habitat for the species in the Proposed Development area.	Unlikely	No
Neophema chrysostoma	Blue-winged Parrot	V	Species breeds in Tasmania, coastal south-eastern South Australia and southern Victoria. Species occur in a range of habitats from coastal, sub-coastal and inland areas, through to semi-arid zones. Species favours grasslands and grassy woodlands, and are often found near wetlands near the coast and in semi-arid zones (DCCEEW, 2023f). The species may also use altered environments such as airfields, golf-courses and paddocks. There are no BDBSA records within 5 km of the site of Proposed Development. This species was recorded once within 10 km of Berth 6 prior to 2000. No suitable habitat for the species in the Proposed Development area.	Unlikely	No

Scientific Name	Common Name	EPBC Status	Details	Likelihood of occurrence	Is the Proposed Development likely to have a significant impact?
Numenius madagascariensis	Eastern Curlew, Far Eastern Curlew	CE, Mi	Migratory species, breeding in Northern Hemisphere, and flying to the Southern Hemisphere in the southern spring and summer. During the non-breeding season in Australia, is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass (Zosteraceae). Occasionally occurs on ocean beaches (often near estuaries), and coral reefs and rock platforms (DCCEEW, 2023g). There are several BDBSA records within 5 km of the Proposed Development area in the Mutton Cove reserve and the Torrens Island Conservation Park, however only one record in the last 20 years (from 2006). The Proposed Development area is small and would not provide important habitat for this species. Intertidal seagrass on the mudflat represents a very small fraction of available intertidal seagrass in the Port River. The loss of this habitat would not have a significant impact on the species through reduction in population size or area of occupancy, fragmentation of any population, disruption of breeding cycle, decline due to habitat impacts, introduction of invasive species or interference of the recovery of the species.	Possible	No
Pachyptila turtur subantarctica	Fairy Prion (southern)	V	Oceanic species. Breeds on Macquarie Island and several subantarctic Islands outside of Australia. Spends most of its life (except nesting) in flight, fishing from ocean. Can be seen in coastal waters in winter to early spring, on continental shelf edge, and from shore during storms which blow them closer in shore (TSSC, 2015b). No BDBSA records within the wider region. Considered a vagrant in this region.	Unlikely	No
Pedionomus torquatus	Plains-wanderer	CE	Inhabits sparse grasslands with approximately 50% bare ground, with most vegetation less than 5 cm in height and some widely spaced plants up to 30 cm high. May occasionally use lower-quality habitat including cereal stubble, but cannot persist in an agricultural landscape (DoE, 2015c).	Unlikely	No

Scientific Name	Common Name	EPBC Status	Details	Likelihood of occurrence	Is the Proposed Development likely to have a significant impact?
			There are no BDBSA records within 5 km of the Proposed Development or in the wider region. No suitable habitat for the species in the Proposed Development area.		
Pluvialis squatarola	Grey Plover	V, Mi	In Australia, preferred habitat for this species comprises on sandy areas, estuaries or lagoons. This species can also be found mangrove mudflats, and occasionally on anthropogenic wetlands such as saltworks and port. Has previously been observed on artificial islands created by dredge spoil. Does not breed in Australia. (DCCEEW, 2024i) There are no BDBSA records within 5 km of the of Proposed Development Area. There are several records of this species within the salt evaporation pans within 10 km of the Proposed Development Area. No suitable habitat for the species in the Proposed Development area.	Unlikely	No
Rostratula australis	Australian Painted Snipe	E	Occurs in shallow freshwater (occasionally brackish) wetlands, both ephemeral and permanent, such as lakes, swamps, claypans, inundated or waterlogged grassland/saltmarsh, dams, rice crops, sewage farms and bore drains, generally with a good cover of grasses, rushes and reeds, low scrub, *Muehlenbeckia spp*. (lignum), open timber or samphire (DCCEEW, 2022). There are no BDBSA records within 5 km of the Proposed Development Area. There are a few records within 10 km of the Proposed Development Area, the most recent being in 2002. No suitable habitat for the species in the Proposed Development area.	Unlikely	No
Stagonopleura guttata	Diamond Firetail	V	Species occur in eucalypt, acacia or casuarina woodlands, open forests and other lightly timbered habitats, including farmland and grassland with scattered trees. Preferred habitat has relatively low tree density, few large logs, and little litter cover but high grass cover (DCCEEW, 2023h). Birds roost in dense shrubs or in smaller nests built especially for roosting. There are no BDBSA records within 5 km of the site of Proposed Development. Closest record is more than 20 km from the Proposed Development area.	Unlikely	No

Scientific Name	Common Name	EPBC Status	Details	Likelihood of occurrence	Is the Proposed Development likely to have a significant impact?
			No suitable habitat for the species in the Proposed Development area.		
Sternula nereis nereis	Australian Fairy Tern	V	Species utilises a variety of habitats including offshore, estuarine or lacustrine (lake) islands, wetlands, beaches and spits (DAWE, 2022). There are numerous recent BDBSA records of this species within 5 km of the site of Proposed Development Area on Bird Island. This species is known to nest to on the adjacent Bird Island located about 1 km north of the Proposed Development Area (BirdLife Australia, 2019). The Proposed Development area is small and would not provide important habitat for this species.Habitats within the Proposed Development area unlikely to be used significantly by the species. Proposed activities for Berth 6 Precinct upgrade, while would occur within approximately 1 km of Bird Island, are not considered likely to significantly impact the Fairy Tern. The Fairy Tern breeding areas are principally on the northern side of Section Banks / Bird Island (BirdLife Australia, 2019) and are separated from the channel and dredging /reclamation area by at least 1 km. Proposed dredging activities, and any other activities associated with the Berth 6 precinct upgrade, are not expected to result in impacts outside the Proposed Development area.	Possible	No
Diomedea antipodensis	Antipodean Albatross	V, Mi	Oceanic species, spending most of their life (except nesting) in flight, fishing from ocean (DSEWPC, 2011). Can be seen in coastal waters in winter to early spring, on continental shelf edge, and from shore during storms which blow them closer in shore. The Indian Yellow-nosed Albatross was recorded in 1994 within 5 km of the site of Proposed Development. There are no BDBSA records of the other species in the vicinity of the Proposed Development Area or within the wider area. No suitable habitat for these species in the Proposed Development area.	Unlikely	No
Diomedea sanfordi	Northern Royal Albatross	E, Mi			
Diomedea epomophora	Southern Royal Albatross	V, Mi			
Diomedea exulans	Wandering Albatross	V, Mi			
Thalassarche carteri	Indian Yellow-nosed Albatross	V, Mi			

Scientific Name	Common Name	EPBC Status	Details	Likelihood of occurrence	Is the Proposed Development likely to have a significant impact?
Thalassarche cauta	Shy Albatross	E, Mi			
Thalassarche impavida	Campbell Albatross, Campbell Black-browed Albatross	V, Mi			
Thalassarche melanophris	Black-browed Albatross	V, Mi			
Phoebetria fusca	Sooty Albatross	V, Mi			
Thalassarche steadi	White-capped Albatross	V, Mi			
Macronectes giganteus	Southern Giant Petrel	E, Mi			
Macronectes halli	Northern Giant Petrel	V, Mi			
Pterodroma mollis	Soft-plumaged Petrel	V			
Thinornis cucullatus cucullatus	Eastern Hooded Plover	V	Inhabits ocean beaches, particularly wide beaches backed by dunes with large amounts of seaweed, creek mouths and inlet entrances. May also occur on near-coastal saline and freshwater lakes and lagoons, tidal bays and estuaries, on rock platforms, or on rocky or sandy reefs close to shore (DoE, 2014). There are no BDBSA records within 5 km of the Proposed Development Area. Closest record is more than 10 km from the Proposed Development Area. No suitable habitat for the species in the Proposed Development area.	Unlikely	No
Tringa nebularia	Common Greenshank	E, Mi	Shorebird with a widespread distribution in coastal regions. Occurs in estuaries and mudflats, mangrove, swamps and lagoons, and in billabongs, swamps, sewage farms, and flooded crops. Does not breed in Australia. (DCCEEW, 2024j)	Unlikely	No

Scientific Name	Common Name	EPBC Status	Details	Likelihood of occurrence	Is the Proposed Development likely to have a significant impact?
			There are numerous historical BDBSA records (from more than 20 years ago) of this species within 5 km of the site of Proposed Development in Torrens Island Conservation Park and the Mutton Cove Reserve. However, the most recent observation was recorded in 2002. The Proposed Development area is small and would not provide important habitat for this species. Habitats within the Proposed Development area unlikely to be used significantly by the species.		
Xenus cinereus	Terek Sandpiper	V, Mi	Shorebird found in sheltered coastal mudflats, including muddy sections of mangrove swamps. Can also be found in sandflats and estuaries, coral reefs, sandy beaches, sandbars or mudflats at mouths of rivers, coastal swamps, and saltpans. Does not breed in Australia (DCCEEW, 2024k) This species was recorded once within 5 km of the Proposed Development Area in the Torrens Island Conservation Park, prior to 2000. The Proposed Development area is small and would not provide important habitat for this species. Habitats within the Proposed Development area unlikely to be used significantly by the species.	Unlikely	No

4.3 Migratory species

The PMST predicted up to 65 migratory species to occur or use habitat in the Proposed Development Area (refer PMST results in Appendix A). The majority of these were bird species. Records for migratory species within the search areas are further provided (BDBSA records Appendix B).

Assessment of impact significance has considered the DoE (2013) significant impact criteria. An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- substantially modify, destroy or isolate an area of important habitat for a migratory species
- result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

The likelihood of occurrence and assessment of impact significance on these listed migratory species is summarised in Table 4-5. Note that some of these species are also listed threatened species and detail for these species is addressed above in Table 4-4.

Approximately a third of the migratory bird species were assessed as possibly occurring within the Proposed Development area. However, it was considered that the Proposed Development Area would not provide important habitat for any of these migratory species.

Consequently, the Proposed Development is **not likely** to have a significant impact on migratory species.

Table 4-5: Likelihood of occurrence and assessment of impact significance for migratory species in the Proposed Development area

Scientific Name	Common Name	EPBC Status	Details	Likelihood of occurrence	Is the Proposed Development likely to have a significant impact?
Marine mammals, reptiles, sharks					
Balaenoptera edeni	Bryde's Whale	Mi	These species are marine and are mostly uncommon to Port River Estuary. For EPBC listed species, see further detail in Table 4-4. There are no BDBSA records of any of these whale, dolphin or shark species in the vicinity of the Proposed Development area or within the wider area. The Proposed Development area is small would not provide important habitat for any of these species.	Unlikely	No
Megaptera novaeangliae	Humpback Whale	Mi			
Lagenorhynchus obscurus	Dusky Dolphin	Mi			
Caperea marginata	Pygmy Right Whale	Mi			
Dermochelys coriacea	Leatherback Turtle, Leathery Turtle, Luth	E, Mi			
Caretta caretta	Loggerhead Turtle	E, Mi			
Lamna nasus	Porbeagle, Mackerel Shark	Mi			
Carcharodon carcharias	White Shark, Great White Shark	V, Mi	All EPBC listed species – see further detail in Table 4-4.	Possible	No
Eubalaena australis	Southern Right Whale	E, Mi			
Chelonia mydas	Green Turtle	V, Mi			
Marine birds					
Ardenna carneipes	Flesh-footed Shearwater	Mi	For EPBC listed species see further detail in Table 4-4. Flesh-footed Shearwater is primarily an oceanic species. Spend most of life (except nesting) in flight, fishing from ocean. One record of the species within 5 km of the Proposed Development Area in 2000. The Proposed Development area is small would not provide important habitat for any of these species	Unlikely	No
Ardenna grisea	Sooty Shearwater	V, Mi			
Diomedea antipodensis	Antipodean Albatross	V, Mi			
Diomedea epomophora	Southern Royal Albatross	V, Mi			
Diomedea exulans	Wandering Albatross	V, Mi			
Diomedea sanfordi	Northern Royal Albatross	E, Mi			

Scientific Name	Common Name	EPBC Status	Details	Likelihood of occurrence	Is the Proposed Development likely to have a significant impact?
Macronectes giganteus	Southern Giant Petrel	E, Mi			
Macronectes halli	Northern Giant Petrel	V, Mi			
Phoebetria fusca	Sooty Albatross	V, Mi			
Thalassarche carteri	Indian Yellow-nosed Albatross	V, Mi			
Thalassarche cauta	Shy Albatross	E, Mi			
Thalassarche impavida	Campbell Albatross	V, Mi			
Thalassarche melanophris	Black-browed Albatross	V, Mi			
Thalassarche steadi	White-capped Albatross	V, Mi			
Thalasseus bergii	Greater Crested Tern	Mi	Widespread distribution in Australia around the coast and estuaries. Nesting habitat comprises flat open sites on offshore islands, low-lying coral reefs, sandy or rocky coastal islets, coastal spits, lagoon mudflats or islets in saltpans and sewage work (DAWE, 2020). There are a few BDBSA records of this species within 5 km of the Proposed Development area including on Bird Island, Torrens Island National Park and Mutton Cove Reserve. Most recent record is 2021. The Proposed Development area is small and would not provide important habitat for this species. Intertidal seagrass on the mudflat represents a very small fraction of available intertidal seagrass in the Port River. The loss of this habitat would not modify, isolate, or destroy important habitat, result in establishment of invasive species, nor disrupt the lifestyle of a population.	Possible	No

Scientific Name	Common Name	EPBC Status	Details	Likelihood of occurrence	Is the Proposed Development likely to have a significant impact?
Sternula albifrons	Little Tern	Mi	Widespread in Australia, with breeding sites widely distributed from north-western Western Australia, around the northern and eastern Australian coasts to south-eastern Australia. No breeding sites are known close to the site of Proposed Development. There are no BDBSA records of this species within 5 km of the site of Proposed Development area. Closest record (from 2005) is within 10 km of the Proposed Development area. The Proposed Development area is small and would not provide important habitat for this species. Intertidal seagrass on the mudflat represents a very small fraction of available intertidal seagrass in the Port River. The loss of this habitat would not modify, isolate, or destroy important habitat, result in establishment of invasive species harmful to the species, nor disrupt the lifestyle a population.	Possible	No
Shorebirds (waders)					
Limicola falcinellus	Broad-billed Sandpiper	Mi	For EPBC listed species, see further detail in Table 4-4. These migratory species do not breed in Australia. They primarily inhabit intertidal mudflats, sandflats, sandy beaches of sheltered coasts and saltmarsh. They can sometimes be found in salt work and sewage farm ponds (DCCEEW, 2024a). No BDBSA records within 5 km from the Proposed Development area in the last 20 years and/or not suitable habitat was identified within the Proposed Development area.	Unlikely	No
Calidris canutus	Red Knot, Knot	V, Mi			
Charadrius mongolus	Lesser Sand Plover, Mongolian Plover	E, Mi			
Calidris alba	Sanderling	Mi			
Calidris subminuta	Long-toed Stint	Mi			
Charadrius leschenaultii	Greater Sand Plover, Large Sand Plover	V, Mi			

Scientific Name	Common Name	EPBC Status	Details	Likelihood of occurrence	Is the Proposed Development likely to have a significant impact?
Charadrius veredus	Oriental Plover, Oriental Dotterel	Mi	The Proposed Development area is small and would not provide important habitat for these species.		
Limosa limosa	Black-tailed Godwit	E, Mi			
Numenius minutus	Little Curlew, Little Whimbrel	Mi			
Phalaropus lobatus	Red-necked Phalarope	Mi			
Philomachus pugnax	Ruff (Reeve)	Mi			
Pluvialis squatarola	Grey Plover	V, Mi			
Tringa brevipes	Grey-tailed Tattler	Mi			
Tringa glareola	Wood Sandpiper	Mi			
Tringa stagnatilis	Marsh Sandpiper, Little Greenshank	Mi			
Tringa totanus	Common Redshank, Redshank	Mi			
Calidris tenuirostris	Great Knot	V, Mi			
Xenus cinereus	Terek Sandpiper	V, Mi			
Arenaria interpres	Ruddy Turnstone	V, Mi			
Actitis hypoleucos	Common Sandpiper	Mi			
Calidris ferruginea	Curlew Sandpiper	CE, Mi			
Calidris melanotos	Pectoral Sandpiper	Mi			
Calidris ruficollis	Red-necked Stint	Mi			
Charadrius bicinctus	Double-banded Plover	Mi			
Limosa lapponica	Bar-tailed Godwit	Mi			

Scientific Name	Common Name	EPBC Status	Details	Likelihood of occurrence	Is the Proposed Development likely to have a significant impact?
Pluvialis fulva	Pacific Golden Plover	Mi			
Tringa nebularia	Common Greenshank, Greenshank	E, Mi			
Calidris acuminata	Sharp-tailed Sandpiper	V, Mi	For EPBC listed species, see further detail in Table 4-4. These species do not breed in Australia. Suitable habitats comprise fresh and hypersaline environments including mudflats, wetlands and sewage ponds, as well as beaches and rocky shores. (DCCEEW, 2024a and 2024c). There are nine existing BDBSA records of Whimbrel occurring within 5 km of the Proposed Development area in the last 20 years. The Proposed Development area is small and would not provide important habitat for this species. Intertidal seagrass on the mudflat represents a very small fraction of available intertidal seagrass in the Port River. The loss of this habitat would not modify, isolate, or destroy important habitat, result in establishment of invasive species harmful to the species, nor disrupt the lifestyle of a population. Habitat at nearby shores/mudflats would not be impacted by the Project.	Possible	No
Numenius phaeopus	Whimbrel	Mi			
Numenius madagascariensis	Eastern Curlew, Far Eastern Curlew	CE, Mi			
Raptors					
Pandion haliaetus	Osprey	Mi	Considered moderately common in Australia occurring in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. Most abundant in northern Australia. This species requires extensive areas of open fresh, brackish or saline water for foraging (DAWE, 2020).	Possible as overflying species	No

Scientific Name	Common Name	EPBC Status	Details	Likelihood of occurrence	Is the Proposed Development likely to have a significant impact?
			There is one BDBSA record (in 1997) of this species within 5 km of the Proposed Development area. This species may overfly the Proposed Development area. The Proposed Development area is small and would not provide important habitat for the species.		
Wetland birds					
Gallinago hardwickii	Latham's Snipe, Japanese Snipe	V, Mi	See Table 4-4.	Unlikely	No
Gallinago megala	Swinhoe's Snipe	Mi	Does not breed in Australia. Occurs in habitats with saline and brackish water, saltmarsh, mangrove creeks around bays and beaches. There are no existing BDBSA records of these species within 10 km of the Proposed Development area. The Proposed Development area is small and would not provide important habitat this species.	Unlikely	No
Gallinago stenura	Pin-tailed Snipe	Mi			
Terrestrial birds					
Motacilla flava	Yellow Wagtail	Mi	For EPBC listed species, see further detail in Table 4-4. These migratory species do not breed in Australia. There are no existing BDBSA records of this species within 5 km of the Proposed Development area within the last 20 years. The Proposed Development area is small and would not provide important habitat these species.	Unlikely	No
Myiagra cyanoleuca	Satin Flycatcher	Mi			
Motacilla cinerea	Grey Wagtail	Mi			
Apus pacificus	Fork-tailed Swift	Mi			
Hirundapus caudacutus	White-throated Needletail	V, Mi			

5. Conclusions & Recommendations

JBS&G completed a EPBC Act self-assessment for the proposed Berth 6 precinct upgrade project based on a review of existing ecological databases and recent fieldwork completed on behalf of FPH. The self-assessment concludes that the Proposed Development **is not likely** to have a significant impact on any MNES. As such, referral of the Proposed Development under the EPBC Act is not required. Key findings leading to this conclusion are summarised below for those MNES relevant to the Proposed Development.

Threatened Ecological Communities

- The Proposed Development area is entirely developed. This TEC does not occur within the Proposed Development area. Closest predicted occurrence of this TEC is within the Mutton Cove Conservation Reserve and the Torrens Island Conservation Park, 2 km and 3 km from the Proposed Development area respectively.
- This TEC being listed as 'Vulnerable' does not however, constitute a MNES for the purposes of Part 3 of the EPBC Act.

Threatened and Migratory Species

- The Proposed Development area is small and does not provide suitable habitat for threatened or migratory species.
- No threatened or migratory species were considered dependent on habitat at the site of Proposed Development.
- In order to minimise impacts on cetaceans and marine megafauna, it is recommended that trained marine megafauna observers monitor marine species such as whales and dolphins during marine construction activities. In addition, appropriate measures for ceasing and recommencing marine work following sighting of megafauna will be adhered to.

6. Limitations

Scope of services

This report ("the report") has been prepared by JBS&G in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and JBS&G. In some circumstances, a range of factors such as time, budget, access and/or site disturbance constraints may have limited the scope of services. This report is strictly limited to the matters stated in it and is not to be read as extending, by implication, to any other matter in connection with the matters addressed in it.

Reliance on data

In preparing the report, JBS&G has relied upon data and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise expressly stated in the report, JBS&G has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. JBS&G has also not attempted to determine whether any material matter has been omitted from the data. JBS&G will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to JBS&G. The making of any assumption does not imply that JBS&G has made any enquiry to verify the correctness of that assumption.

The report is based on conditions encountered and information received at the time of preparation of this report or the time that site investigations were carried out. JBS&G disclaims responsibility for any changes that may have occurred after this time. This report and any legal issues arising from it are governed by and construed in accordance with the law as at the date of this report.

Environmental conclusions

Within the limitations imposed by the scope of services, the preparation of this report has been undertaken and performed in a professional manner, in accordance with generally accepted environmental consulting practices. No other warranty, whether express or implied, is made, including to any third parties, and no liability will be accepted for use or interpretation of this report by any third party.

The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose.

JBS&G accepts no liability for use or interpretation by any person or body other than the client who commissioned the works. This report should not be reproduced without prior approval by the client, or amended in any way without prior approval by JBS&G or reproduced other than in full, including all attachments as originally provided to the client by JBS&G.

7. References

BirdLife Australia (2019). Fairy Tern Monitoring on Bird Island, South Australia 21/22 Breeding Season Report. Retrieved from https://beachvol.birdlife.org.au/public_files/26/Bird%20Island%20SA%20Fairy%20Tern%202021_2022%20breeding%20season%20report.pdf

Boskalis (2019) Monthly Environmental Report – August 2019. Port Adelaide Outer Harbor Channel Widening Project. Report prepared for Flinders Ports, August, 2019. Retrieved from https://www.flindersportholdings.com.au/wp-content/uploads/2021/12/OHCW_EPA_MonthlyReport__September2019.pdf

Carter, O. (2010). National recovery plan for the Bead Glasswort *Tecticornia flabelliformis.* Department of Sustainability and Environment, Melbourne. Retrieved from: http://www.environment.gov.au/resource/national-recovery-plan-bead-glasswort-tecticornia-flabelliformis

DAWE (2020). Wildlife Conservation Plan for Seabirds. Department of Agriculture, Water and the Environment, Canberra. Retrieved from: http://www.dcceew.gov.au/environment/biodiversity/publications/wildlife-conservation-plan-seabirds-2022

DAWE (2021). National Recovery Plan for the Grey-headed Flying-fox *Pteropus poliocephalus*. Department of Agriculture, Water and the Environment, Canberra: Commonwealth of Australia. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/publications/recovery/grey-headed-flying-fox

DAWE (2022). National Recovery Plan for the Australian Fairy Tern (*Sternula nereis nereis*). Department of Agriculture, Water and the Environment, Canberra. Retrieved from: http://www.dcceew.gov.au/environment/biodiversity/threatened/publications/recovery/fairy-tern-2022

DCCEEW (2022). National Recovery Plan for the Australian Painted Snipe (*Rostratula australis*). Department of Climate Change, Energy, the Environment and Water, Canberra. Retrieved from: http://www.dcceew.gov.au/environment/biodiversity/threatened/publications/recovery/australian-painted-snipe-2022

DCCEEW (2023a). Conservation Advice for *Aphelocephala leucopsis* (southern whiteface). Canberra: Department of Climate Change, Energy, the Environment and Water. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/529-conservation-advice-31032023.pdf

DCCEEW (2023b). Conservation Advice for *Ardenna grisea* (sooty shearwater). Canberra: Department of Climate Change, Energy, the Environment and Water. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/82651-conservation-advice-21122023.pdf

DCCEEW (2023c). Conservation Advice for *Calidris ferruginea* (curlew sandpiper). Canberra: Department of Climate Change, Energy, the Environment and Water. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/856-conservation-advice-18122023.pdf

DCCEEW (2023d). Conservation Advice for *Charadrius leschenaultii* (greater sand plover). Canberra: Department of Climate Change, Energy, the Environment and Water. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/877-conservation-advice-18122023.pdf

DCCEEW (2023e). Conservation Advice for *Melanodryas cucullata cucullata* (hooded robin (south-eastern)). Canberra: Department of Climate Change, Energy, the Environment and Water. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/67093-conservation-advice-31032023.pdf

DCCEEW (2023f). Conservation Advice for *Neophema chrysostoma* (blue-winged parrot). Canberra: Department of Climate Change, Energy, the Environment and Water. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/726-conservation-advice-31032023.pdf

DCCEEW (2023g). Conservation Advice for *Numenius madagascariensis* (far eastern curlew). Canberra: Department of Climate Change, Energy, the Environment and Water. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/847-conservation-advice-18122023.pdf

DCCEEW (2023h). Conservation Advice for *Stagonopleura guttata* (diamond firetail). Canberra: Department of Climate Change, Energy, the Environment and Water. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/59398-conservation-advice-31032023.pdf

DCCEEW (2024a). Species Profile and Threats Database. Accessed between March and April 2024 at http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

DCCEEW (2024b). Conservation Advice for *Arenaria interpres* (ruddy turnstone). Canberra: Department of Climate Change, Energy, the Environment and Water. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/872-conservation-advice-05012024.pdf

DCCEEW (2024c). Conservation Advice for *Calidris acuminata* (sharp-tailed sandpiper). Canberra: Department of Climate Change, Energy, the Environment and Water. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/874-conservation-advice-05012024.pdf

DCCEEW (2024d). Conservation Advice for *Calidris canutus* (red knot). Canberra: Department of Climate Change, Energy, the Environment and Water. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/855-conservation-advice-05012024.pdf

DCCEEW (2024e). Conservation Advice for *Calidris tenuirostris* (great knot). Canberra: Department of Climate Change, Energy, the Environment and Water. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/862-conservation-advice-05012024.pdf

DCCEEW (2024f). Conservation Advice for *Gallinago hardwickii* (Latham's snipe). Canberra: Department of Climate Change, Energy, the Environment and Water. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/863-conservation-advice-05012024.pdf

DCCEEW (2024g). Conservation Advice for *Limosa lapponica baueri* (Alaskan bar-tailed godwit). Canberra: Department of Climate Change, Energy, the Environment and Water. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/86380-conservation-advice-05012024.pdf

DCCEEW (2024h). Conservation Advice for *Limosa limosa* (black-tailed godwit). Canberra: Department of Climate Change, Energy, the Environment and Water. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/845-conservation-advice-05012024.pdf

DCCEEW (2024i). Conservation Advice for *Pluvialis squatarola* (grey plover). Canberra: Department of Climate Change, Energy, the Environment and Water. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/865-conservation-advice-05012024.pdf

DCCEEW (2024j). Conservation Advice for *Tringa nebularia* (common greenshank). Canberra: Department of Climate Change, Energy, the Environment and Water. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/832-conservation-advice-05012024.pdf

DCCEEW (2024k). Conservation Advice for *Xenus cinereus* (terek sandpiper). Canberra: Department of Climate Change, Energy, the Environment and Water. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/59300-conservation-advice-05012024.pdf

DEE (2017). Recovery Plan for Marine Turtles in Australia. Australian Government, Department of Environment and Energy, Canberra. Retrieved from: http://www.environment.gov.au/marine/publications/recovery-plan-marine-turtles-australia-2017

DEW (2024). Biological Databases of South Australia – Overview. Department for Environment and Water, South Australia. Accessed on 26 April 2024 at http://www.environment.sa.gov.au/Science/Information_data/Biological_databases_of_South_Australia

DELWP (2016). National Recovery Plan for the Orange-bellied Parrot, *Neophema chrysogaster*. Australian Government, Canberra. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/recovery-plans/orange-bellied-parrot-2016

DEWHA (2008a). Approved Conservation Advice for *Aprasia pseudopulchella* (Flinders Ranges Worm-lizard). Canberra: Department of the Environment, Water, Heritage and the Arts. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/1666-conservation-advice.pdf

DEWHA (2008b). Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle). Canberra: Department of the Environment, Water, Heritage and the Arts. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/1768-conservation-advice.pdf

DoE (2013). *Matters of National Environmental Significance, Significant Impact Guidelines 1.1, Environment Protection and Biodiversity Conservation Act 1999*. Department of the Environment, Canberra.

DoE (2014). Conservation Advice *Thinornis rubricollis rubricollis* hooded plover (eastern). Canberra: Department of the Environment. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/66726-conservation-advice.pdf

DoE (2015a). Conservation Advice *Acanthiza iredalei rosinae* slender-billed thornbill (Gulf St Vincent). Canberra: Department of the Environment. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/67080-conservation-advice.pdf

DoE (2015b). Conservation Advice *Grantiella picta* painted honeyeater. Canberra: Department of the Environment. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/470-conservation-advice.pdf

DoE (2015c). Conservation Advice *Pedionomus torquatus* plains-wanderer. Canberra: Department of the Environment. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/906-conservation-advice.pdf

DSEWPC (2011). National recovery plan for threatened albatrosses and giant petrels 2011-2016. Department of Sustainability, Environment, Water, Population and Communities. Commonwealth of Australia, Hobart. Retrieved from https://www.dcceew.gov.au/sites/default/files/documents/albatrosses-and-giant-petrels-recovery-plan.pdf

DSEWPC (2012). Conservation Management Plan for the Southern Right Whale. A Recovery Plan under the *Environment Protection and Biodiversity Conservation Act 1999* 2011-2021. Canberra, ACT: Department of Sustainability, Environment, Water, Population and Communities. Retrieved from:

http://www.environment.gov.au/resource/conservation-management-plan-southern-right-whale-recovery-plan-under-environment

DSEWPC (2013). Recovery Plan for the White Shark (*Carcharodon carcharias*). Department of Sustainability, Environment, Water, Population and Communities. Retrieved from https://www.dcceew.gov.au/sites/default/files/documents/white-shark.pdf

Duncan, M. (2010). National Recovery Plan for the Sturdy Leek Orchid *Prasophyllum validum*. Department of Sustainability and Environment, Melbourne.

Flinders Port Holdings (2024). Case Study: Moving towards Smart Port status at Flinders Adelaide Container Terminal (FACT). Retrieved from https://www.flindersportholdings.com.au/wp-content/uploads/2024/01/CASE-STUDY_FACT_Smart-Port-Status_FINAL2024.pdf

J Diversity (2024). Outer Harbor Berth 6 Benthic Survey Report. Report from Flinders Ports Holdings.

Sinclair, S.J. (2010). National Recovery Plan for the Large-fruit Groundsel *Senecio macrocarpus*. Department of Sustainability and Environment, Melbourne. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/recovery-plans/national-recovery-plan-large-fruit-groundsel-senecio-macrocarpus

Tonkinson, D. & G. Robertson (2010). National Recovery Plan for Yellow Swainson-pea *Swainsona pyrophila*. Department of Sustainability and Environment, Melbourne. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/recovery-plans/national-recovery-plan-yellow-swainson-pea-swainsona-pyrophila

TSSC (2015a). Conservation Advice *Halobaena caerulea* blue petrel. Threatened Species Scientific Committee, Department of the Environment, Canberra. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/1059-conservation-advice-01102015.pdf

TSSC (2015b). Conservation Advice *Pachyptila turtur subantarctica* fairy prion (southern). Canberra: Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/64445-conservation-advice-01102015.pdf

TSSC (2016a). *Conservation Advice Caladenia tensa rigid spider-orchid*. Threatened Species Scientific Committee, Department of the Environment and Energy, Canberra. Retrieved from http://www.environment.gov.au/biodiversity/threatened/species/pubs/24390-conservation-advice-16122016.pdf

TSSC (2016b). Conservation Advice *Charadrius mongolus* Lesser sand plover. Threatened Species Scientific Committee, Department of the Environment, Canberra. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/879-conservation-advice-05052016.pdf

TSSC (2019a). Conservation Advice *Botaurus poiciloptilus* Australasian Bittern. Threatened Species Scientific Committee, Department of the Environment and Energy, Canberra. Retrieved from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/1001-conservation-advice-18012019.pdf

TSSC (2019b). Conservation Advice *Hirundapus caudacutus* White-throated Needletail. Threatened Species Scientific Committee, Department of the Environment and Energy, Canberra. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/682-conservation-advice-04072019.pdf

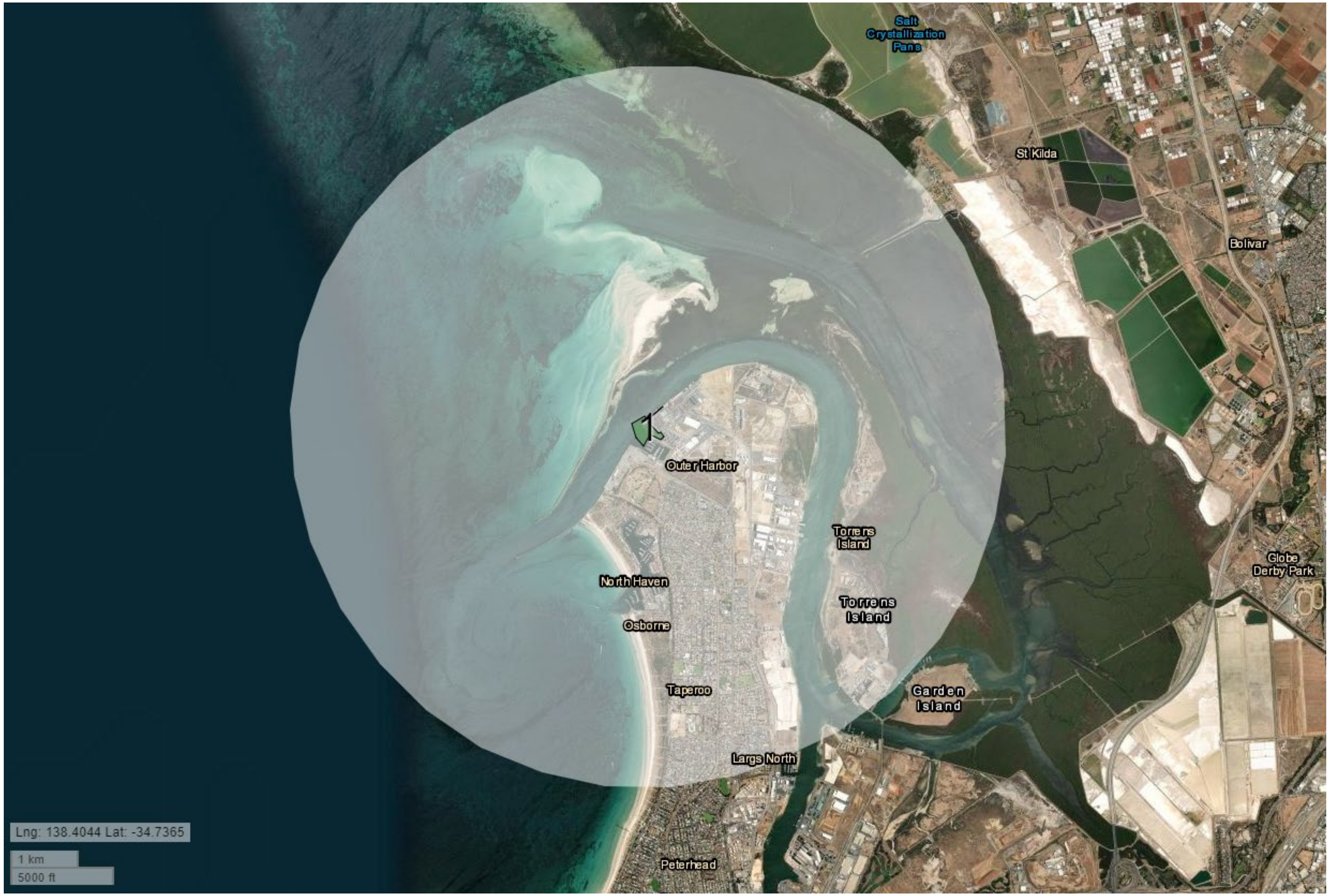
TSSC (2020). Conservation Advice *Falco hypoleucos* Grey Falcon. Threatened Species Scientific Committee, Department of Agriculture, Water and the Environment, Canberra. Retrieved from:

http://www.environment.gov.au/biodiversity/threatened/species/pubs/929-conservation-advice-09072020.pdf

Wiltshire, K.H and Deveney, M.R. (2017). The introduced alga *Caulerpa taxifolia* in South Australia: infestation boundary surveys and feasibility of control for populations outside the containment area. Report for PIRSA Biosecurity SA. South Australian Research and Development Institute (Aquatic Sciences), Adelaide. SARDI Publication No. F2017/000204-1. SARDI Research Report Series No. 946. 16pp.

Appendix A EPBC Act Protected Matters Report

©JBS&G Australia Pty Ltd



PMST search area, corresponding to a 5 km buffer around the Proposed Development area.

©JBS&G Australia Pty Ltd

Appendix B BDBSA Search

©JBS&G Australia Pty Ltd

BDBSA search area, corresponding to a 5 km buffer around the Proposed Development area.

©JBS&G Australia Pty Ltd

BDBSA search records for EPBC Act threatened species (search generated on 26 April 2024) with a 5 km buffer around the Proposed Development area.

V = Vulnerable; E = Endangered; CR = Critically Endangered, Mi = Migratory listed under EPBC Act

ssp. = at least one subspecies for this species has been given a conservation rating, sp. = the species level related to this subspecies has a rating.

Scientific name	Common name	EPBC Act listing	Number of records	Date of last records
Flora				
Tecticornia flabelliformis	Bead Samphire	V	10	02-May-1990
Euphrasia collina ssp. osbornii	Osborn's Eyebright	E	1	03-Oct-1943
Reptiles				
Chelonia mydas	Green Sea Turtle	V	2	03-Oct-2017
Dermochelys coriacea	Leatherback Turtle	E	1	07-May-1996
Mammals				
Neophoca cinerea	Australian Sea Lion	E	6	10-Jan-2019
Pteropus poliocephalus	Grey-headed Flying-fox	V	1	25-Feb-2020
Birds				
Acanthiza iredalei rosinae	Slender-billed Thornbill Gulf St Vincent	V	6	01-Nov-2020
Anthochaera chrysoptera	Little Wattlebird	ssp	1	22-Oct-2021
Arenaria interpres interpres	Ruddy Turnstone	sp	2	11-Nov-1984
Calidris acuminata	Sharp-tailed Sandpiper	V	20	01-Nov-2020
Calidris ferruginea	Curlew Sandpiper	CR	13	01-Dec-1985
Charadrius leschenaultii leschenaultii	Greater Sand Plover	sp	1	31-Jul-1988
Hirundapus caudacutus caudacutus	White-throated Needletail	sp	1	14-Feb-1995
Limosa lapponica	Bar-tailed Godwit	ssp	3	01-Jan-1984
Manorina flavigula	Yellow-throated Miner	ssp	1	02-Oct-1985
Numenius madagascariensis	Far Eastern Curlew	CR	12	03-Mar-2006
Platycercus elegans	Crimson Rosella	ssp	2	26-Nov-2014
Sternula nereis nereis	Fairy Tern	V	14	01-Oct-2022
Thalassarche carteri	Indian Yellow-nosed Albatross	V	1	10-Jan-1994
Tringa nebularia	Common Greenshank	E	18	18-Apr-2002
Xenus cinereus	Terek Sandpiper	V	1	01-Jan-1974

© JBS&G
This document is and shall remain the property of JBS&G. The document may only be used for the purposes for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

1.1.1.1 Document Distribution

Rev No.	Copies	Recipient	Date
0	Electronic	Flinders Port Holdings	29/04/2024
1	Electronic	Flinders Port Holdings	3/6/2024

1.1.1.2 Document Status

Rev No.	Author	Reviewer	Approved for Issue		
		Name	Name	Signature	Date
A	Morgane Maillard	Nicole Patten			3/04/2024
B	Morgane Maillard	Nicole Patten			8/4/2024
C	Morgane Maillard/ Nicole Patten	Cameron Miller	Cameron Miller		17/04/2024

www.jbsg.com.au

JBS&G

Adelaide

Kaurna Country | 100 Hutt St,
Adelaide, SA 5000
T: 08 8431 7113

Brisbane

Turrbal/Yuggera Country | Level 37,
123 Eagle Street, Brisbane, QLD 4000
T: 07 3211 5350

Bunbury

Wardandi Country | 177 Spencer
Street Bunbury, WA 6230
T: 08 9792 4797

Canberra

Ngunnawal Country | Level 1, The Realm
18 National Circuit Barton, ACT 2600
T: 02 6198 3278

Darwin

Larrakia Country | Suite G1, Level 1,
48-50 Smith Street, Darwin NT 0800
T: 08 8943 0600

Hobart

Muwununa/Nuenon Country | Level 6,
111 Macquarie Street Hobart, TAS 7000
T: 03 6108 9054

Melbourne

Wurundjeri Country | Level 19,
31 Queen Street, Melbourne VIC 3000
T: 03 9642 0599

Newcastle

Awabakal/Worimi Country | 61 / 63
Parry Street Newcastle West, NSW 2302
T: 02 8245 0300

Perth

Whadjuk Country | Allendale Square,
Level 9, 77 St Georges Terrace, WA 6000
T: 08 9380 3100

Sydney

Gadigal Country | Level 1,
50 Margaret Street, Sydney, NSW 2000
T: 02 8245 0300

Wollongong

Dharawal Country | Suite 1A, 280 - 286
Keira Street, Wollongong, NSW 2500
T: 02 4225 2647

Appendix I

Water quality monitoring program framework

creating opportunities

Berth 6 Upgrades – Water Quality Management Plan

Flinders Port Holdings

Report

JBS&G 66422 | 159,382

13 May 2024

We acknowledge the Traditional Custodians of Country throughout Australia and their connections to land, sea and community.

We pay respect to Elders past and present and in the spirit of reconciliation, we commit to working together for our shared future.

Caring for Country The Journey of JBS&G
Artist: Patrick Caruso, Eastern Arrernte

Table of Contents

List of Tables

List of Figures

Abbreviations

Term	Definition
µS	micro-Siemens
ANZG	Australian and New Zealand Guidelines for Fresh and Marine Quality
ASS	Acid Sulphate Soil
DMP	Dredge Management Plan
DO	Dissolved Oxygen
EPA	Environment Protection Authority
EP Act	*Environment Protection Act 1993*
FACT	Flinders Adelaide Container Terminal
FNU	Formazin Nephelometric Unit
FPH	Flinders Port Holdings
NTU	Nephelometric Turbidity Unit
NWQMS	National Water Quality Management Strategy
PDL	Proposed Dredging Location
The Project	Proposed Berth 6 Precinct upgrade
Water Quality EPP	Environment Protection (Water Quality) Policy 2015
WQMP	Water Quality Monitoring Plan

1. Introduction

Flinders Port Holdings (FPH) are proposing to undertake capital dredging as part of upgrade works to their Berth 6 Precinct ('Berth 6 Precinct upgrade' or 'the Project" herein). Berth 6 is part of the Flinders Adelaide Container Terminal (FACT) owned by FPH and located in Outer Harbor in the Port of Adelaide.

The proposed upgrade works include an extension of Berth 6 to a length of 179 m and width 27.89 m width to accommodate for the forecast higher vessel sizes and volumes over the coming decades.

As part of the Berth 6 extension work, dredging is required. The Proposed Dredging Location (PDL) represents an area of 690 m^2, and with a corresponding volume of approximately 550 m^3 of spoil. Spoil is proposed to be disposed of on land at dredge ponds located approximately 800 m from the PDL. Dredging methodology is to be confirmed following detailed design but would likely involve a cutter suction dredger.

Construction works would be undertaken over a nominal period of approximately 12 months with the dredging component to occur over a 2-4-week period, subject to constraints associated with weather, tides and Port traffic.

2. Purpose and scope

This Water Quality Monitoring Plan (WQMP) Framework has been prepared to support the development application for the Berth 6 Precinct upgrade works. This WQMP Framework should be read together with the Dredge Management Plan (DMP) Framework.

2.1 Monitoring Objectives

The WQMP Framework details the proposed water quality monitoring program that will be implemented by FPH before, during and after the proposed dredging activities in order to:

- understand existing water quality and natural variability at the PDL
- ensure compliance with existing legislation and regulations; and
- prevent any environmental harm resulting from proposed dredging activities.

This WQMP was prepared in accordance with:

- *Environment Protection Act 1993* (EP Act)
- Environment Protection (Water Quality) Policy 2015 (Water Quality EPP)
- National Water Quality Management Strategy (NWQMS)
- Australian and New Zealand Guidelines for Fresh and Marine Quality (ANZG) (2000, 2018)
- South Australian Environmental Protection Authority Dredge guideline (EPA, 2020); and
- National Assessment Guidelines for Dredging (Commonwealth of Australia, 2009).

3. Receiving Environment

3.1 Location of dredging activities

3.1.1 General location of the FACT

The FACT is located in the Port of Adelaide at Outer Harbor, on the northern tip of the Lefevre Peninsula, approximately 22 km north of Adelaide (Figure 3-1). The area accommodates a range of industries including port-related activities, bulk handling and storage of minerals, agricultural and petroleum products, transport and warehousing, electricity generation and manufacturing.

The FACT itself is predominantly comprised of land which has been reclaimed from the natural intertidal mangrove and samphire flats which originally formed this part of the Lefevre Peninsula. The adjacent Port River, which forms the sea entrance to the Port of Adelaide, has been utilised as a shipping channel since European settlement and is also utilised by FPH vessels (e.g. tugboats), tourist vessels, commercial fishers, recreational boaters and anglers and kayakers. The Port River is tidal, and at Outer Harbor has been subject to regular dredging programs to maintain channel depth and width which allows larger container and cruise ships to be accommodated.

3.1.2 Proposed Dredging Location

The PDL is a 690 m^2 area adjacent to the existing Berth 6 (Figure 3-2). The benthic habitat within the PDL is highly modified, reflecting the nature of the Port River as a shipping channel. The benthic habitat within the PDL and in the area adjacent to the PDL comprises of sandy silt clays interspersed with shell fragments and bivalves (predominantly the Razor clam *Pinna bicolor,* and sparse Hammer oyster *Malleus meridianus*, Queen scallop *Equichlamys bifrons*, Spiny scallop *Scaeochlamys livida* and Mud cockle *Katelysia sp*.) (J Diversity 2024). The are several sparse patches of seagrass (*Zostera*) within 300 m of the PDL (Figure 3-2).

3.1.3 Spoil Disposal Location

Spoil will be disposed of at the Pelican Point dredge ponds located approximately 800 m northeast of the PDL (Figure 3-1). These ponds have previously been used by FHP for their maintenance dredging projects. Spoil from the proposed dredging activities will be settled out in a series of dredge ponds and the return water directed back to the Port River. Water remaining in the dredge ponds at the end of the dredging activities will be left to evaporate.

Timing for dewatering is to be confirmed following detailed design.

Figure 3-1: General location of the Flinders Adelaide Terminal Container and location of Berth 6

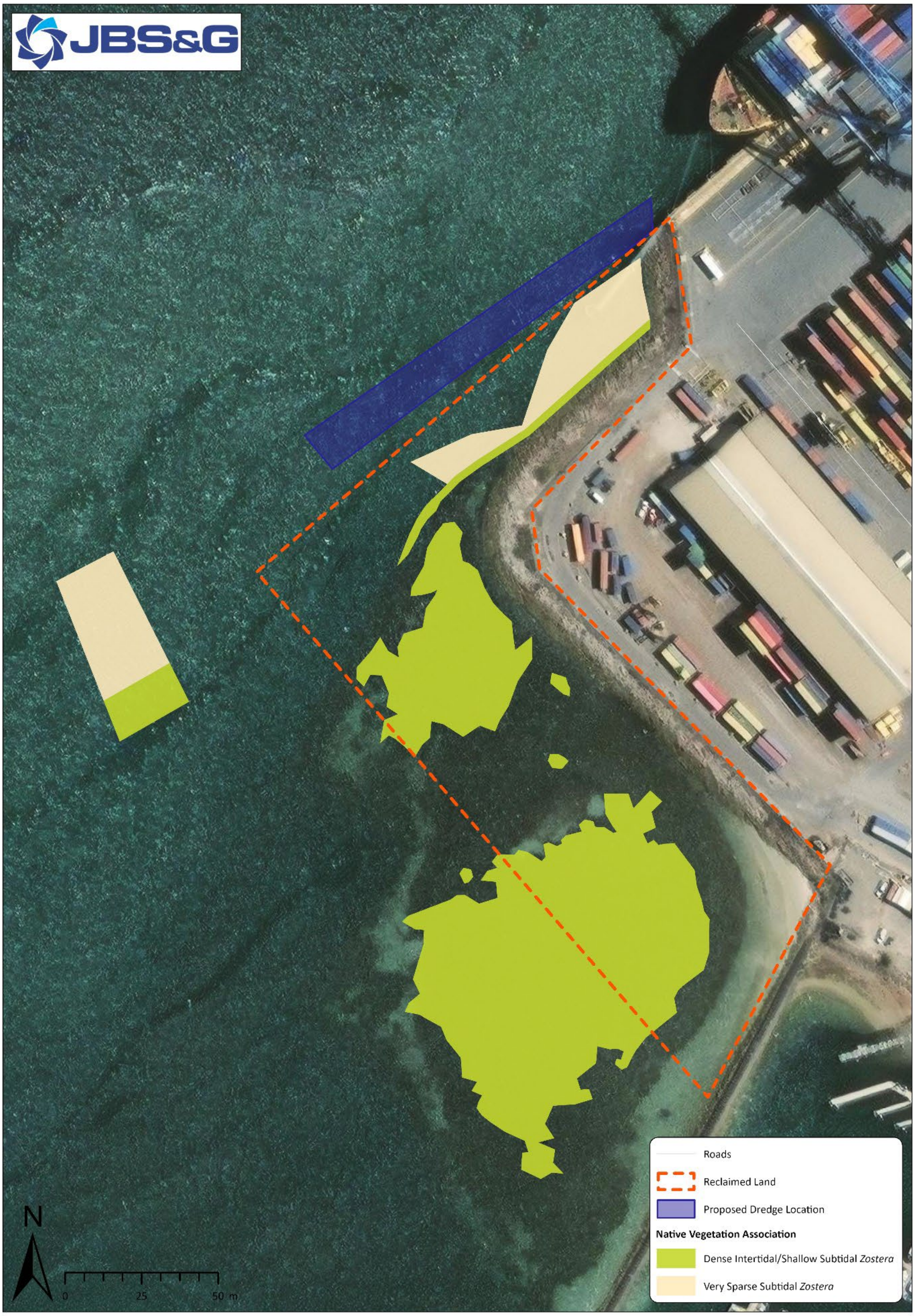


Figure 3-2: Proposed Location of Dredging

4. Review of existing data in the Port River

Water quality monitoring in the Port River estuary has been undertaken by the South Australian Environment Protection Authority (EPA) between 1995 and 2008. Nine sites were studied as part of this monitoring program, with Site 3 the closest site to the PDL, approximately 500 m northeast to the existing Berth 6 (Figure 3-1). Water samples were collected annually over the thirteen years, and analysed for a suite of physical, chemical and biological properties (see Table 4-1).

This reviewed data from EPA is publicly available[1] and / or described in reports prepared by the EPA (EPA 2002; EPA 2005; EPA 2008).

Table 4-1: Water quality parameters at Site 3 between 1995 and 2008

Parameter	Mean	Standard deviation	Median	Number of samples	ANZG guidelines value (2018) for slightly disturbed marine system[2]
Physical parameters					
Turbidity (NTU)	2.53	3.17	1.68	131	0.5-10
Conductivity* (salinity) (µS)	55,080	5,810	55,300	54	[3]
Temperature* (°C)	18.0	4.4	17.0	24	[3]
Chemical parameters					
Metal concentrations (total)					
Cadmium (mg/L)	0.004	0.002	0.005	135	0.0055
Copper (mg/L)	**0.010**	0.012	0.01	134	0.0013
Lead (mg/L)	**0.005**	0.004	0.005	135	0.004
Mercury (mg/L)	0.003	0.001	0.003	132	0.00004
Nickel (mg/L)	0.005	0.004	0.005	32	0.07
Total aluminium* (mg/L)	**0.074**	0.124	0.046	53	0.055
Total Zinc (mg/L)	**0.039**	0.040	0.03	135	0.008
Nutrient concentrations					
Ammonia-N (mg/L)	**0.162**	0.125	0.125	135	0.05
Oxidised N (mg/L)	**0.083**	0.075	0.061	115	0.05
Total N (mg/L)	0.485	0.286	0.445	115	1.0
Total phosphorus (mg/L)	0.045	0.054	0.035	135	0.1
Biological parameters					
Chlorophyll a (µg/L)	**3.211**	4.117	2.135	134	1, 5[4]

* Date collected during the period 1995 – 2000 (EPA, 2002).
NTU = Nephelometric Turbidity Unit; µS = micro-Siemens; N = Nitrogen
Bold indicates exceedance of guideline value.

[1] See http://report.epa.sa.gov.au/files/11377_port_3.csv
[2] Unless specified otherwise, values correspond to the default ANZG guidelines values for slightly disturbed marine system in South Australia. A 95% level of species protection was considered for metal concentrations.
[3] No guideline values; however default trigger values for marine ecosystems for thermal or saline impacts below or above ambient are given for the 20th and 80th percentiles respectively of the ambient temperature / salinity distribution (ANZG, 2018).
[4] For an estuarine system.

Analysis of the EPA's water quality monitoring data showed water turbidity in the Outer Harbor between 1995 and 2008 remained within the ANZG guidelines range for a slightly to moderately disturbed marine system. Metal levels in the Outer Harbor were variable, with cadmium, copper and nickel being within the ANZG guidelines range for a 95% level of species protection in slightly disturbed ecosystems. Lead, mercury, aluminium and zinc concentrations exceeded guideline values during that period.

Chlorophyll-a is used as a measure of the concentration of phytoplankton in the water column and is commonly used as an indicator of water quality. Chlorophyll-a concentration in the Outer Harbor was above ANZG guidelines value for slightly disturbed marine system, but below ANZG guidelines value for slightly disturbed estuarine system. This is consistent with the estuarine nature of the Outer Harbor. Average concentrations of Total Nitrogen and Total Phosphorous were below the ANZG default guideline values.

Additional water quality data available from Inner Harbour (sampled between February and March 2021) was also reviewed (Golder, 2021). While conditions in the Inner Harbour differ from the Outer Harbor due to lower level of flushing, it is useful to review this data to understand potential changes in metal concentrations in Port River over time.

Golder (2021) monitored water quality at two locations; the North Arm Beach site and the Birkenhead Beach site, which correspond to EPA's monitoring site 1 and 9, respectively. Table 4-2 compares results from the EPA data set (EPA, 2002) covering the period 1995 to 2000, with the Golder (2021) study. Overall, metals were generally of similar scale between the two data sets at North Arm, with the exception of cadmium being an order of magnitude lower in the 2021 study. All metals concentrations were lower, by approximately an order of magnitude, at the Birkenhead Beach site for the 2021 study. While there were exceedances of the ANZG guideline values even in the latter study for some metals and sites, the results indicate at least for the sites studied, that there has been no decline in water quality (in regard to metals) over the past few decades.

As part of the Golder (2021) study, pH was also measured, which ranged between 7.9 and 8.1. These pH values are within the expected range of estuarine / marine waters (Golder, 2021) and aligns with ANZG guidelines for slightly disturbed ecosystem (for both estuaries and marine).

Table 4-2: Average heavy metal concentrations in the Inner Harbour (EPA 2002; Golder 2021)

Metal	Site 1 / North Arm Beach site		Site 9 / Birkenhead Beach site		ANZG guidelines value (2018) for slightly disturbed marine system[5]
	EPA, 2002	Golder, 2021	EPA, 2002	Golder, 2021	
Copper (mg/L)	**0.012**	**0.020**	**0.014**	0.003	0.0013
Lead (mg/L)	**0.010**	**0.019**	**0.010**	0.004	0.0044
Mercury (mg/L)	0.00037	0.0002	0.00037	<0.0001	0.0004
Zinc (mg/L)	**0.051**	**0.058**	**0.04**	**0.023**	0.008
Cadmium (mg/L)	0.0020	<0.0002	0.0020	<0.0002	0.0055

Bold indicates exceedance of guideline value.

[5] Default ANZG guidelines values for slightly disturbed marine system in South Australia. A 95% level of species protection was considered for metal concentrations.

5. Potential Impacts and Relevant Indicators

Potential impacts from dredging activities for the Project are described below.

5.1 Increased Turbidity and sedimentation

A temporary increase in turbidity and resulting sedimentation is expected during dredging operations. An increase in turbidity and subsequent sedimentation can lead to a reduction in light levels for marine biota and temporary 'smothering' of benthic flora and fauna. In particular, there is the potential to indirectly impact seagrass through increased turbidity, resulting in lower light levels, and sedimentation, potentially leading to seagrass loss.

Seagrass species present in the Port River build their energy reserves and increase growth rates in spring and summer and are less active in autumn and winter when waters are cooler and light availability is lower.

To minimise turbidity impacts on marine biota, dredging would aim to be undertaken during the cooler months, as far as practicable.

Key parameters to be used as an indicator of elevated fine sediment levels in the water column will include:

- Water Turbidity; and
- Visible Plume Extent

Other parameters may include Total suspended solids.

5.2 Creation of anoxic conditions

The resuspension of sediments has the potential to result in an increase in nutrients in the water column, which can lead to increased phytoplankton biomass and subsequent oxygen depletion. Oxygen deletion can negatively impact marine flora and fauna occurring within the vicinity of the project.

Dissolved oxygen (DO) will be the key performance indicator of increased anoxic conditions in the water column.

5.3 Release of hazardous substances

Disturbance of sediment during dredging activities may release potential hazardous substances into the water column, including pollutants related to human activities such as heavy metals, and naturally occurring contaminants such as Acid Sulphate Soil (ASS).

Previous chemical analyses of sediment samples from the PDL showed that levels of pollutants of concern were below human health and ecological levels and National Water Quality Management Strategy guidelines (Golder, 2020). Therefore, monitoring of pollutant levels in the water is not considered to be needed as part of this WQMP.

Disturbance of ASS can lead to the acidification of waters, which in turn may impact flora and fauna within the dredge footprint. Potential ASS have previously been identified within the PDL, however, chemical analyses suggest there is sufficient neutralising capacity in the sediment and treatment or management of ASS is likely not needed (Golder, 2020).

Water pH will be the key parameters to be used as an indicator of acid release in the water column.

6. Water Quality monitoring methodology

Below describes the water quality methodology to be implemented for the project.

6.1 Baseline data

FPH have commenced measuring turbidity in various locations of the Port River.

A water quality probe (Xylem YSI EXO3 Multiparameter Sonde ('Sonde' herein)) was installed next to the Port Adelaide Terminal (Tide Hut), approximately 1 km west of Berth 6 (Figure 6-1) in January 2024. The Sonde measures turbidity in Formazin Nephelometric units (FNU). Data has so far been continuous since the day of installation.

Turbidity data is shown below for the period 11 January to 15 April 2024 is shown on (Figure 6-2). Negative values were converted to 0 as per manufacturer's instructions. For the displayed period, turbidity showed a mean value of 3.2 FNU (± 21.59 FNU) with occasional peaks exceeding 100 FNU and with a median value of 0.00 FNU. A simple moving average for a 6-hour window period was calculated (see red line on (Figure 6-2), with several peaks greater than 20 FTU, and on occasions, persisting at elevated turbidity levels (i.e. > 50 FTU) for more than 1 day.

Baseline data will continue to be collected for a period of 12 months at this location. Turbidity baseline data will be used together with sediment plume modelling results to determine, in consultation with EPA, appropriate ALARM and HOLD triggers (see Section 6.7).

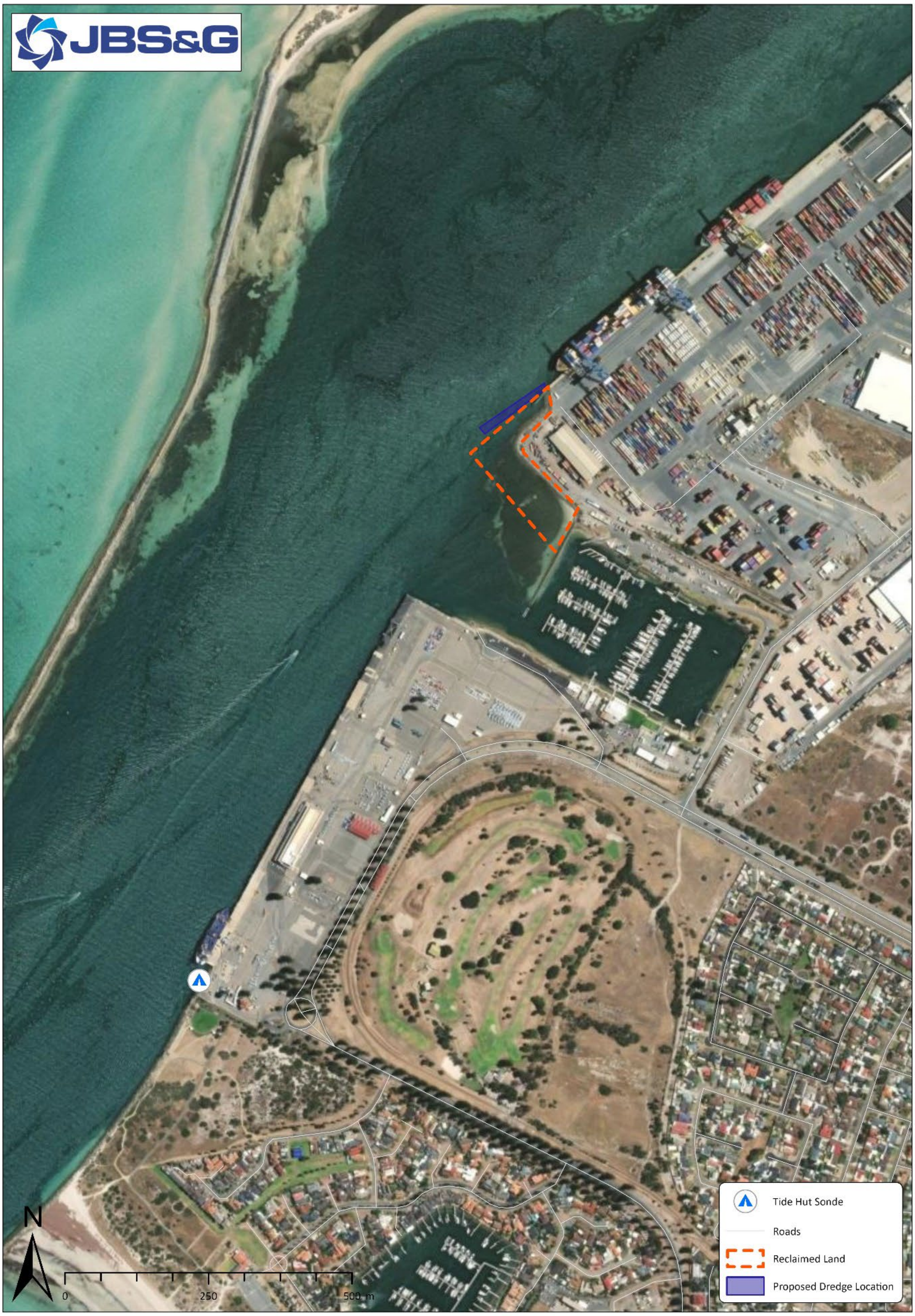


Figure 6-1: Location of the Sonde for measuring turbidity

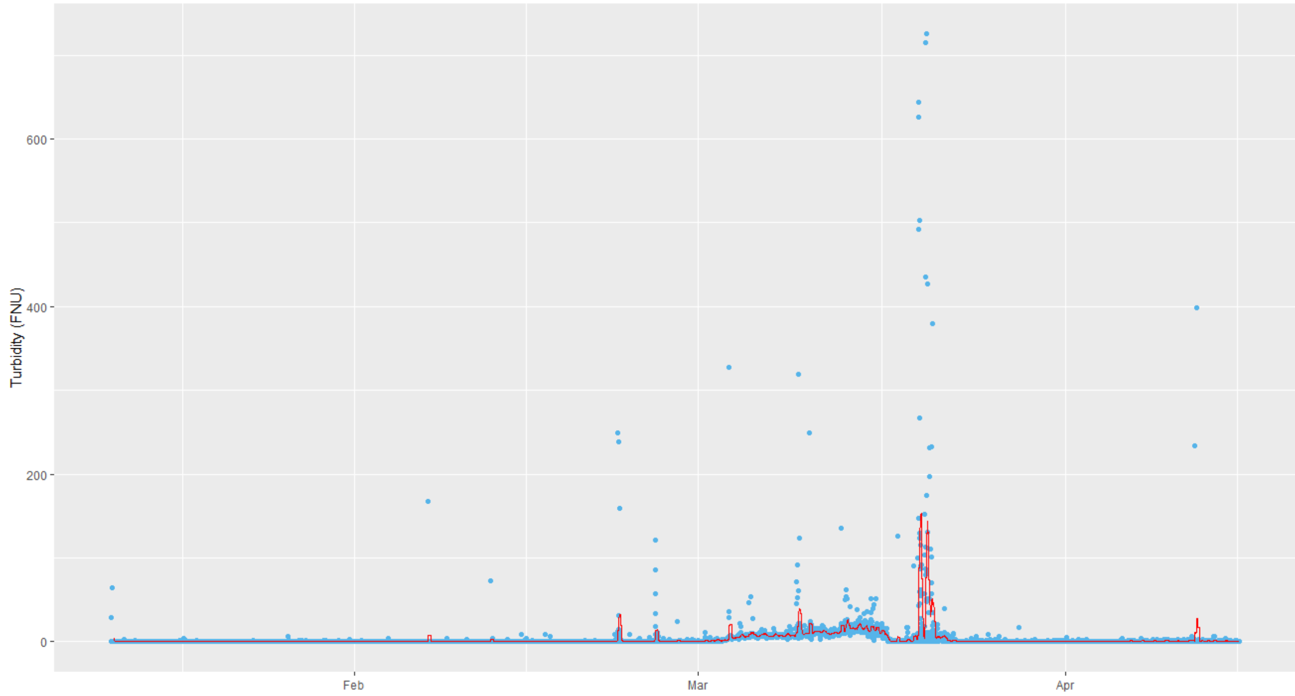


Figure 6-2: Water turbidity at Tide Hut from 11 January 2024 to 15 April 2024. Red line indicates simple moving average.

6.2 Monitoring sites

Sediment plume modelling is currently being undertaken for the project.

Sediment plume modelling results will inform the monitoring site(s) based on the three zones of impacts; Zone of High Impact, Zone of Moderate Impact, and Zone of Influence as defined by the EPA's Dredge guidelines (EPA, 2020). The zones of impact will also inform management triggers.

Discussions with EPA will confirm monitoring site(s) based on the sediment plume modelling and understanding of nearest sensitive receivers. At least one site will be located either within the zone of moderate impact or Zone of Influence, and one (control) site outside of the Zone of influence.

Monitoring will also be undertaken adjacent to the dredge pond to including:

- full perimeter inspection of the pond to check for structural integrity
- check discharge pipe flow, consistency, and colour
- check pond level and turbidity; and
- check return water is clear.

6.3 Parameters to be measured

Turbidity will be the key parameter measured to identify potential risk to the environment during project activities.

Turbidity provides a proxy for suspended sediments within the water column and will be measured via light scatter in units FNU.

Visual extent of plume would also be measured in conjunction with other parameters including:

- DO
- pH; and
- water temperature, if dredging outside of winter.

Other parameters to record daily include:

- Wind speed and direction
- Tide (Ebb, Flood, High, Low); and
- Cloud cover (%).

6.4 Monitoring equipment

Sonde loggers will be deployed at monitoring sites to record turbidity. Data will be logged every 15 minutes and telemetrically downloaded. Assessment of real-time turbidity data will allow for the detection of water quality exceedances (triggers to be determined – see Section 6.7), and response where necessary.

A water quality sensor would also be used to record other parameters including DO, pH and water temperature.

Details for discreet water sampling and analysis (if required) would be provided in the in the final water quality monitoring plan.

6.5 Equipment calibration

Instruments will be calibrated regularly according to manufacturer's specifications, with calibration details recorded.

Instruments will be used by qualified/ or trained operators.

6.6 Monitoring frequency

As detailed above, the water quality monitoring program for the proposed dredging activities will comprise baseline monitoring prior to dredging commencing (see Section 6.1), and during dredging.

The dredge pond would also be checked several times per day following spoil disposal, during dredging activities.

6.7 Triggers, management and contingency

As described in Section 6.3, turbidity would be the key parameter to signify potential risk of impact from dredging. Additional parameters including DO and PH will also be used.

In line with guidance from the EPA Dredge Guidelines (2020), adaptive management will be implemented for the Project. The adaptive management approach includes a set of management strategies to minimise and control potential impacts of dredging and disposal activities on sensitive receptors.

ALARM and HOLD Triggers will be selected to inform when impacts from dredging are likely to occur, or have already occurred. ALARM triggers forewarn the approach of HOLD Trigger and minimise non-compliance and resulting potential for environmental harm. Management measures will include, but not be limited to slow works, modifying dredge location and/or suspension of activities until better weather conditions prevail.

HOLD triggers represent the limit of acceptable impacts beyond which they may impose significant impact on the environment, and would include stop works until thresholds fall below the trigger value.

ALARM and HOLD trigger thresholds would be determined based on sediment plume modelling, baseline data and understanding of nearest sensitive receivers in consultation with EPA.

An example of a decision flow sheet for turbidity, adapted from EPA (2020) is shown in Figure 6-3. A detailed decision flow sheet would be updated in the final water qulaity monitoring plan following consultation with EPA.

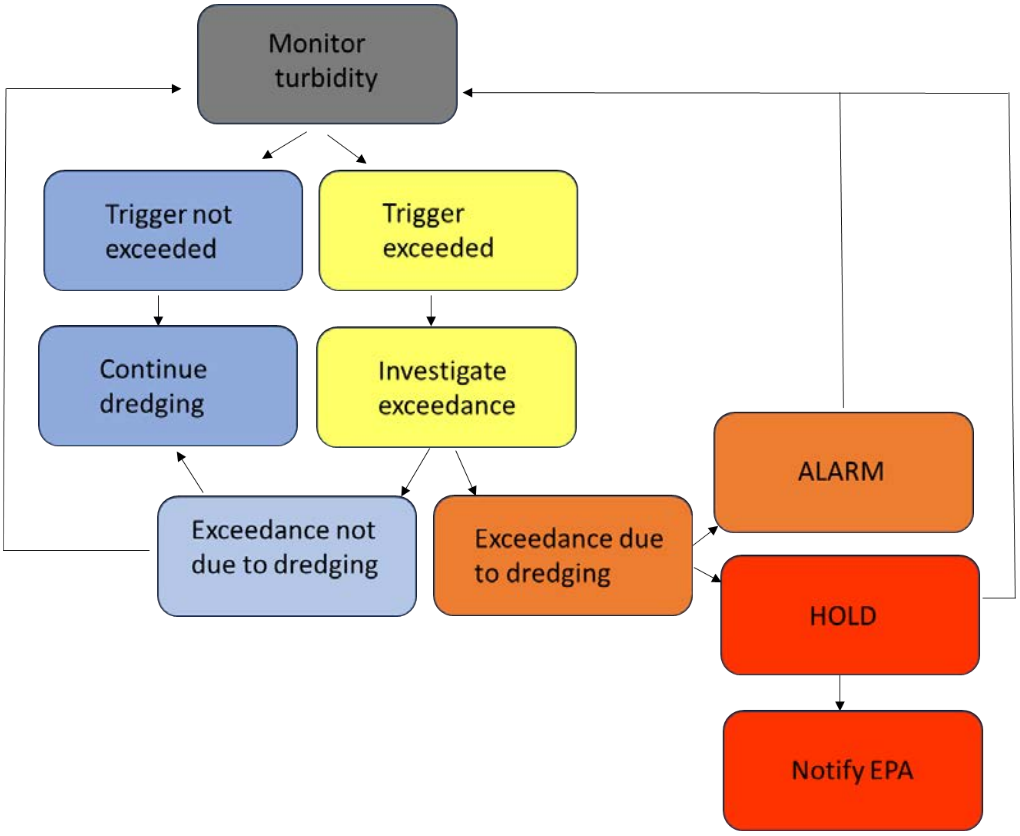


Figure 6-3: Decision flow sheet for turbidity (adapted from EPA 2020)

7. Reporting

A water quality monitoring report would be provided to EPA. The report would contain:

- All raw data collected
- A summary of the data in an acceptable format that may be used for reporting purposes; and
- Any exceedances of trigger values and mitigation measures/contingency measures implemented.

8. Limitations

Scope of services

This report ("the report") has been prepared by JBS&G in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and JBS&G. In some circumstances, a range of factors such as time, budget, access and/or site disturbance constraints may have limited the scope of services. This report is strictly limited to the matters stated in it and is not to be read as extending, by implication, to any other matter in connection with the matters addressed in it.

Reliance on data

In preparing the report, JBS&G has relied upon data and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise expressly stated in the report, JBS&G has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. JBS&G has also not attempted to determine whether any material matter has been omitted from the data. JBS&G will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to JBS&G. The making of any assumption does not imply that JBS&G has made any enquiry to verify the correctness of that assumption.

The report is based on conditions encountered and information received at the time of preparation of this report or the time that site investigations were carried out. JBS&G disclaims responsibility for any changes that may have occurred after this time. This report and any legal issues arising from it are governed by and construed in accordance with the law as at the date of this report.

Environmental conclusions

Within the limitations imposed by the scope of services, the preparation of this report has been undertaken and performed in a professional manner, in accordance with generally accepted environmental consulting practices. No other warranty, whether express or implied, is made, including to any third parties, and no liability will be accepted for use or interpretation of this report by any third party.

The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose.

JBS&G accepts no liability for use or interpretation by any person or body other than the client who commissioned the works. This report should not be reproduced without prior approval by the client, or amended in any way without prior approval by JBS&G or reproduced other than in full, including all attachments as originally provided to the client by JBS&G.

9. References

Commonwealth of Australia (2009). National Assessment Guidelines for Dredging, Canberra. Retrieved from https://www.dcceew.gov.au/sites/default/files/documents/guidelines09.pdf

EPA (2002). Ambient Water Quality Monitoring: Port River Estuary, September 1995 – August 2000: Environment Protection Authority South Australia. Adelaide, South Australia. May 2002.

EPA (2005). Port Waterways Water Quality Improvement Plan – Stage 1: Environment Protection Authority South Australia. Adelaide, South Australia. July 2005.

EPA (2008). Port Waterways Water Quality Improvement Plan: Environment Protection Authority South Australia. Adelaide, South Australia. May 2008.

EPA (2020). Dredge guidelines. Retrieve from https://www.epa.sa.gov.au/files/14712_dredge_guideline_2020.pdf

Flinders Port Holdings (2024). Case Study: Moving towards Smart Port status at Flinders Adelaide Container Terminal (FACT). Retrieved from https://www.flindersportholdings.com.au/wp-content/uploads/2024/01/CASE-STUDY_FACT_Smart-Port-Status_FINAL2024.pdf

Golder associates Pty Ltd (2020). Flinders Ports Berth 6 Dredging. Seagrass Survey, Sediment Sampling and Characterisation.

Golder associates Pty Ltd (2021). Flinders Ports - Inner Harbor Surface Water Sampling and Characterisation.

J Diversity Pty Ltd (2024). Outer Harbor Berth 6 Benthic survey report. Report for Flinders Ports Holdings.

© JBS&G
This document is and shall remain the property of JBS&G. The document may only be used for the purposes for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited

Document Distribution

Rev No.	Copies	Recipient	Date
0	Electonic	Flinders Ports Holding	13/05/2024

Document Status

Rev No.	Author	Reviewer	Approved for Issue		
		Name	Name	Signature	Date
A	Morgane Mallaird	Nicole Patten			
B	Morgane Mallaird	Nicole Patten			
C	Morgane Mallaird/ Nicole Patten	David Lenel	David Lenel		10/05/2024

www.jbsg.com.au

JBS&G

Adelaide
Kaurna Country | 100 Hutt St,
Adelaide, SA 5000
T: 08 8431 7113

Brisbane
Turrbal/Yuggera Country | Level 37,
123 Eagle Street, Brisbane, QLD 4000
T: 07 3211 5350

Bunbury
Wardandi Country | 177 Spencer
Street Bunbury, WA 6230
T: 08 9792 4797

Canberra
Ngunnawal Country | Level 1, The Realm
18 National Circuit Barton, ACT 2600
T: 02 6198 3278

Darwin
Larrakia Country | Suite G1, Level 1,
48-50 Smith Street, Darwin NT 0800
T: 08 8943 0600

Hobart
Muwununa/Nuenon Country | Level 6,
111 Macquarie Street Hobart, TAS 7000
T: 03 6108 9054

Melbourne
Wurundjeri Country | Level 19,
31 Queen Street, Melbourne VIC 3000
T: 03 9642 0599

Newcastle
Awabakal/Worimi Country | 61 / 63
Parry Street Newcastle West, NSW 2302
T: 02 8245 0300

Perth
Whadjuk Country | Allendale Square,
Level 9, 77 St Georges Terrace, WA 6000
T: 08 9380 3100

Sydney
Gadigal Country | Level 1,
50 Margaret Street, Sydney, NSW 2000
T: 02 8245 0300

Wollongong
Dharawal Country | Suite 1A, 280 - 286
Keira Street, Wollongong, NSW 2500
T: 02 4225 2647

Appendix J

BMT coastal processes assessment

creating opportunities

Port Adelaide Berth 6 Extension - Coastal Processes Assessment

Customer	Flinders Ports
Project	003195
Deliverable	001
Version	01
	10 June 2024

Document Control

Document Identification

Title	Port Adelaide Berth 6 Extension - Coastal Processes Assessment
Project No	003195
Deliverable No	001
Version No	01
Version Date	10 June 2024
Customer	Flinders Ports
Classification	BMT (OFFICIAL)

Author	Dr Paul Guard
Checked By	Dr Ian Teakle
Approved By	Dr Ian Teakle
Project Manager	Dr Paul Guard

Amendment Record

The Amendment Record below records the history and issue status of this document.

Version	Version Date	Distribution	Record
00	28 May 2024	Flinders Ports	Report
01	10 June 2024	Flinders Ports	Report

This report is prepared by BMT Commercial Australia Pty Ltd ("BMT") for the use by BMT's client (the "Client"). No third party may rely on the contents of this report. To the extent lawfully permitted by law all liability whatsoever of any third party for any loss or damage howsoever arising from reliance on the contents of this report is excluded.
Where this report has been prepared on the basis of the information supplied by the Client or its employees, consultants, agents and/or advisers to BMT Commercial Australia Pty Ltd ("BMT") for that purpose and BMT has not sought to verify the completeness or accuracy of such information. Accordingly, BMT does not accept any liability for any loss, damage, claim or other demand howsoever arising in contract, tort or otherwise, whether directly or indirectly for the completeness or accuracy of such information nor any liability in connection with the implementation of any advice or proposals contained in this report insofar as they are based upon, or are derived from such information. BMT does not give any warranty or guarantee in respect of this report in so far as any advice or proposals contains, or is derived from, or otherwise relies upon, such information nor does it accept any liability whatsoever for the implementation of any advice recommendations or proposals which are not carried out under its control or in a manner which is consistent with its advice.

© BMT 2024

Contents

1 Background

Extension of the Flinders Adelaide Container Terminal Berth 6 is required to support expected future container vessel traffic. This Project requires planning approval be put in place, which will include an assessment of coastal process impacts from the proposed ~179m long berth extension.

It is understood from Flinders Port's discussions with DEW and EPA officers that potential impacts of concern would be flushing, sedimentation and seagrass wrack accumulation impacts to the Royal South Australian Yacht Squadron (RSAYS) Marina located to the south-west of the proposed development. This coastal process report specifically addresses these concerns.

Concept level designs have been developed on behalf of Flinders Ports for the Berth 6 extension (see Figure 1.1). The conceptual design was used as the basis for this preliminary assessment of the potential coastal process impacts.

The coastal process assessment utilised BMT's existing three-dimensional hydrodynamic model of the Port River which was previously been used to support Flinders Ports Outer Harbor Channel Widening project in 2018/19. The existing model was refined in the area of Berth 6 and used to simulate both base and developed case berth configurations.

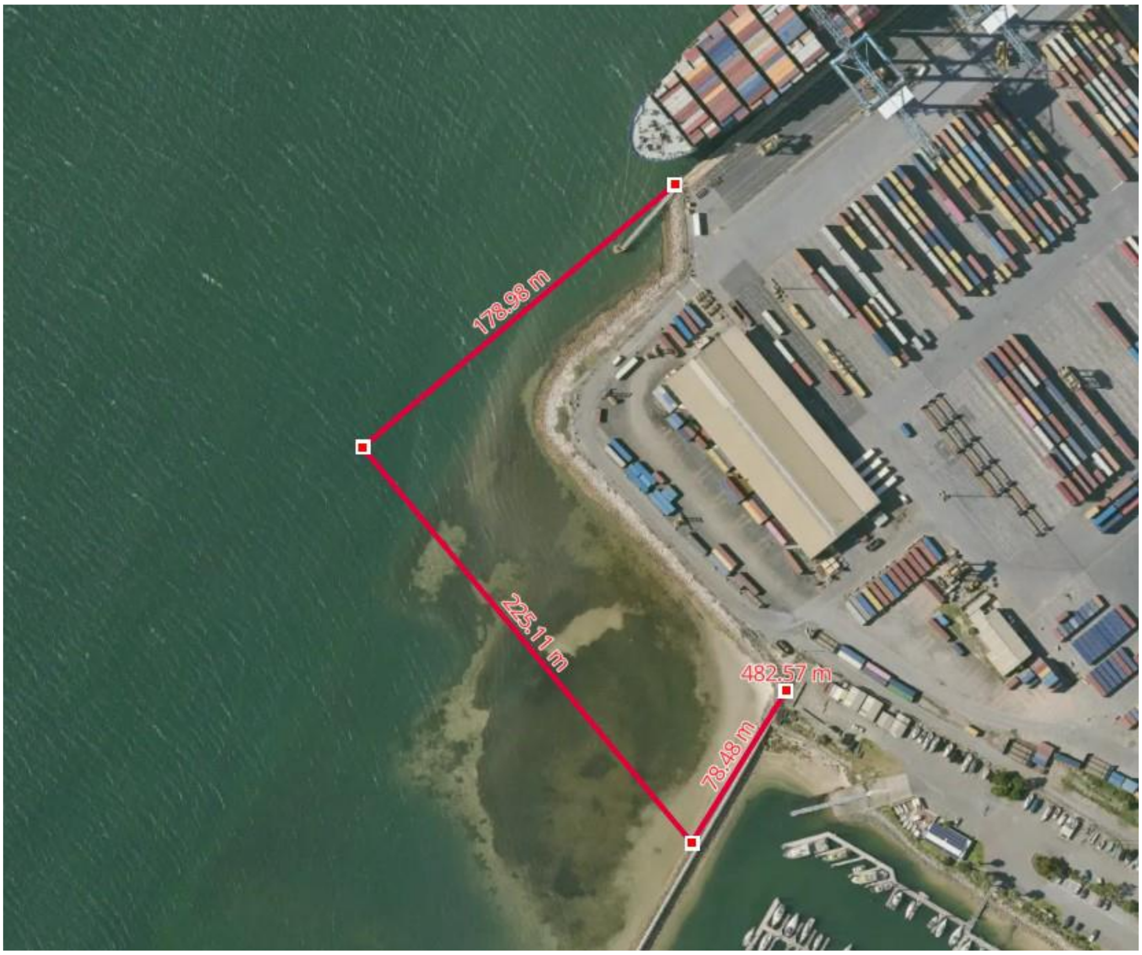


Figure 1.1 Conceptual layout of the Berth 6 Extension

2 Data Review

2.1 Aerial Photography Review

Analysis of aerial photography (from Nearmap and Google Earth) indicated that there has been little change in the appearance of the sand/mud flat that will be partially covered by the proposed extension of the wharf. The water level in the photos varies, but the extent of exposure of the sand/mud flat appears to be consistent over the last 20 years (see Figure 2.1).

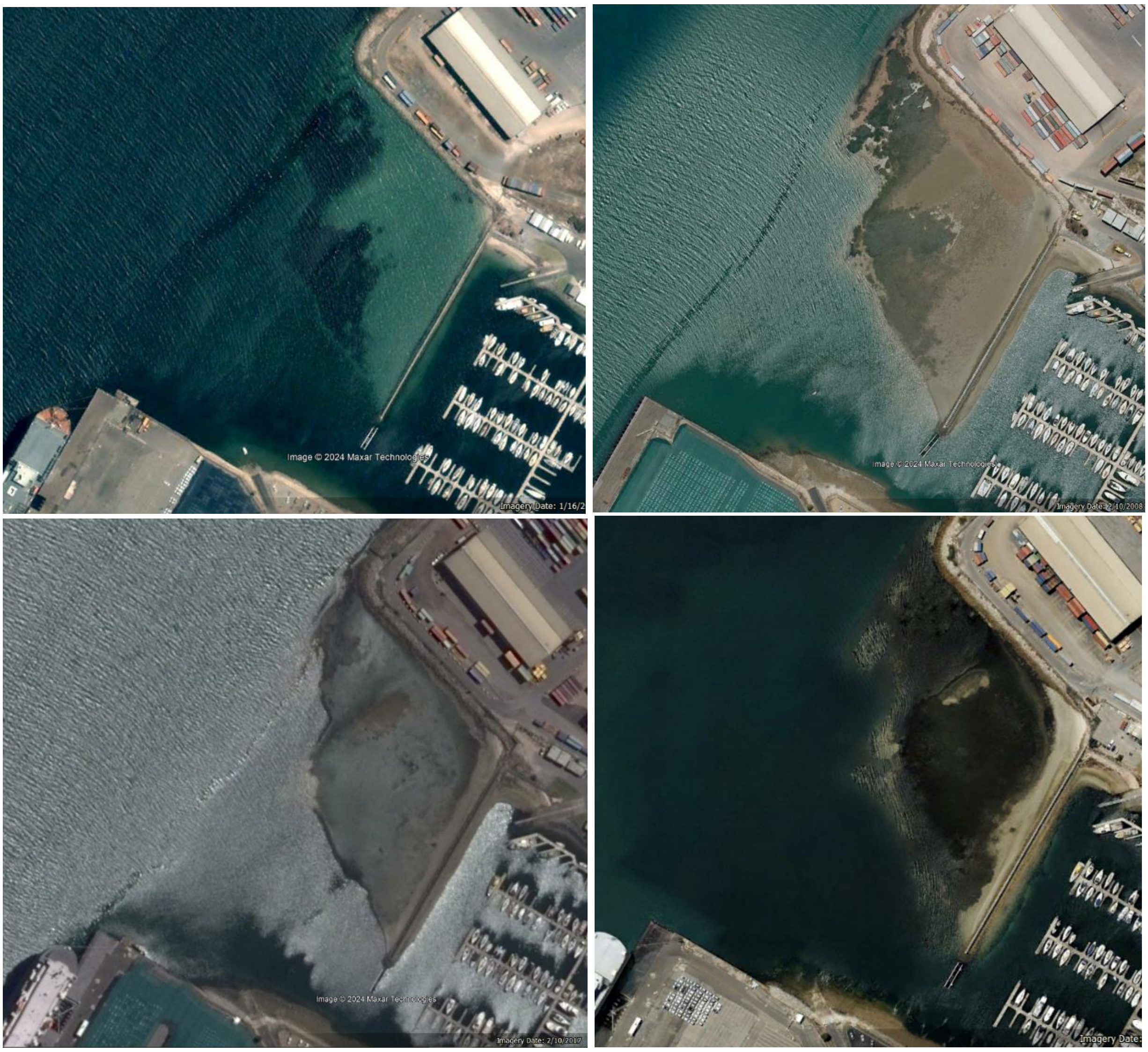


Figure 2.1 Aerial photos taken in January 2004 (top left), October 2008 (top right), October 2017 (bottom left) and December 2022 (bottom right) (source: Google Earth)

Analysis of the available photography also indicates the occasional presence of some amount of seagrass wrack near the entrance to the RSAYS Marina (see Figure 2.2).

Figure 2.2 Nearmap imagery showing evidence of some seagrass wrack accumulation at the RSAYS Marina entrance

© BMT 2024

2.2 Bathymetric Data Review

The available bathymetric survey data was compiled and analysed in a Geographic Information System. Bathymetric data sources included:

- Data from Hydro Survey (Flinders Ports) covering the full shipping channel and the RSAYS Marina. In the vicinity of Berth 6, data was provided from 2019, 2020, 2022 and 2023 surveys (though only the 2019 survey included the Marina)
- LiDAR topography data from the Elvis - Elevation and Depth - Foundation Spatial Data service (https://elevation.fsdf.org.au/)
- National Intertidal DEM (https://knowledge.dea.ga.gov.au/data/product/dea-intertidal/?tab=overview)
- Electronic chart data

The data did not reveal any trend in the morphological evolution of the seabed in the vicinity of the Berth 6 expansion footprint, due to lack of repeated surveys in the area of interest. However, the data quality is sufficient to accurately characterise the bed levels in the area of interest and throughout the Port area.

3 Model Configuration and Validation

3.1 Model Configuration and Validation

An existing model of Gulf St Vincent and the Port River was adopted for this study. Modifications were made in the Berth 6 Project study area to increase the resolution around the proposed reclamation and align the mesh with the proposed development. Validation was then carried out by comparing the modelled water levels with measurements from the Port gauge and by comparing the modelled water velocity and fluxes measured by BMT in late March 2024 using a boat-mounted current profiler (ADCP).

Model Bathymetry

Digital Electronic Navigational Chart (ENC) data sourced from the Australian Electronic Navigation Charts (AUSENC) data sets were used to develop baseline bathymetry information for most of the model. Additional high resolution bathymetric survey datasets described in Section 2.2 were used to improve the representation of the recently widened shipping channels, the RSAYS Marina, and the extensive intertidal areas throughout the Port River and adjacent Barker Inlet.

Boundary Conditions

The hydrodynamic and wave models were forced with predicted tidal water levels sourced from the FES2014 global model of ocean tides. The tide magnitude at the model boundary was adjusted slightly to improve the agreement with the measured tides at the Outer Harbour tide gauge.

Hydrodynamic model atmospheric forcing was sourced from the ERA5 global atmospheric model produced by the Copernicus Climate Change Service (C3S) at ECMWF (Hersbach, H. et al., 2018).

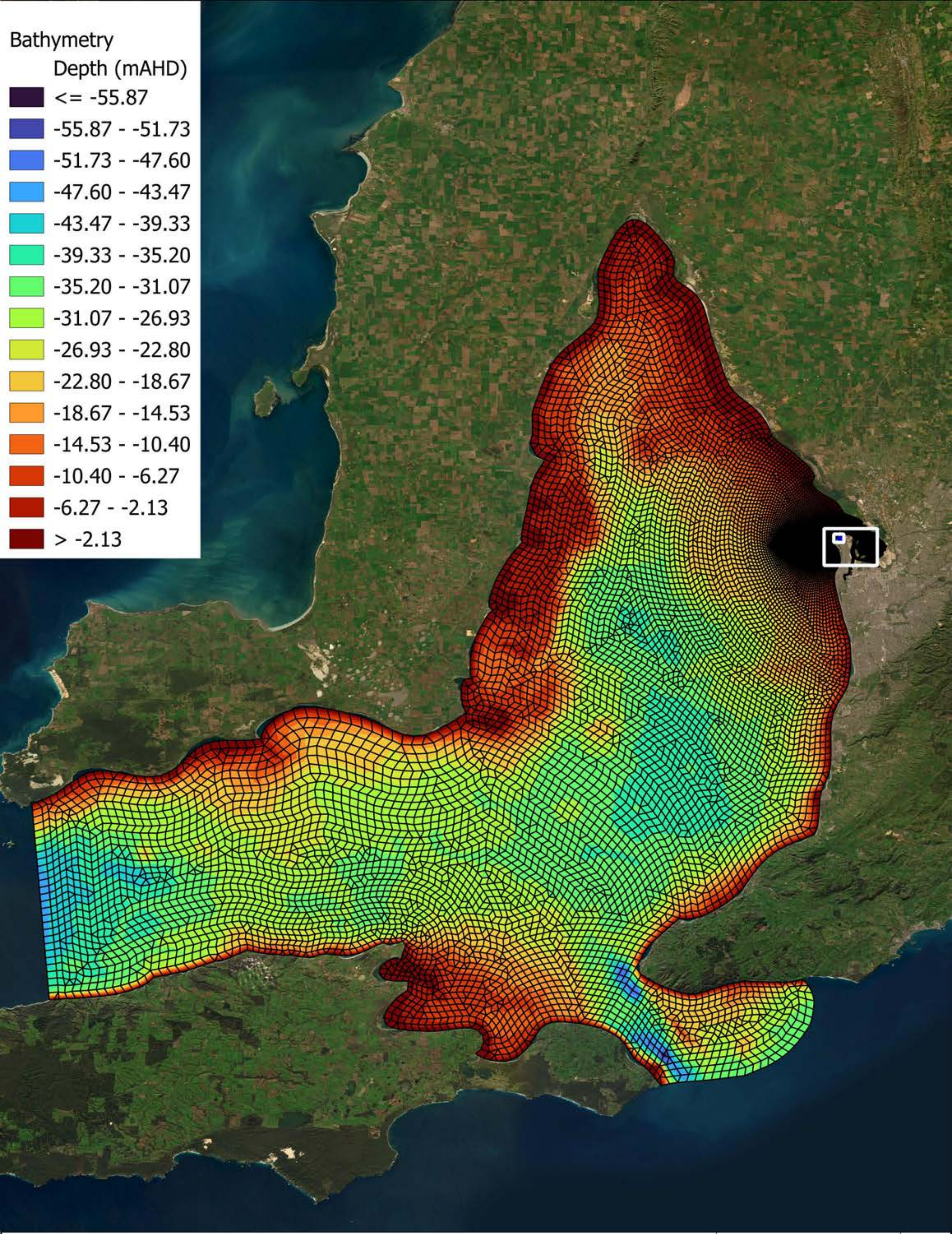
Offshore salinity and temperature profiles were sourced from the HYbrid Coordinate Ocean Model (HYCOM) global ocean model (http://hycom.org).

Modelling System

The hydrodynamic modelling for this assessment was undertaken using TUFLOW FV software, which is developed and distributed by BMT (https://www.tuflow.com/products/tuflow-fv/). The wave activity in the study area was not included in the modelling since the wave climate at Berth 6 is very low energy due to the sheltered environment.

TUFLOW FV is a numerical hydrodynamic model used to simulate the two-dimensional (2D) and three-dimensional (3D) Non-Linear Shallow Water Equations (NLSWE). The model is suitable for solving a wide range of hydrodynamic systems ranging in scale from open channels and floodplains, through estuaries to coasts and oceans. The Finite-Volume (FV) numerical scheme employed by TUFLOW FV is capable of solving the NLSWE on both structured rectilinear grids and unstructured meshes comprised of triangular and quadrilateral elements. The flexible mesh allows for seamless boundary fitting along complex coastlines or open channels as well as accurately and efficiently representing complex bathymetries with a minimum number of computational elements. The flexible mesh capability is particularly efficient at resolving a range of scales in a single model without requiring multiple domain nesting. Further details regarding the numerical scheme employed by TUFLOW FV are provided in the TUFLOW FV Science Manual (BMT, 2023).

The TUFLOW FV mesh domain extends from the Northern tip of Gulf St Vincent in the north to just outside of Backstairs Passage in the south and to the end of Investigator Strait in the West. Mesh resolution ranges from ~1300 m at the boundaries to ~10 m at Berth 6 study area. The model extents and bathymetry are presented in Figure 3.1 and Figure 3.2.



Title:

TUFLOW Model Mesh and Bathymetry (see Figure 3.2 for detail in the area bounded by the white box)

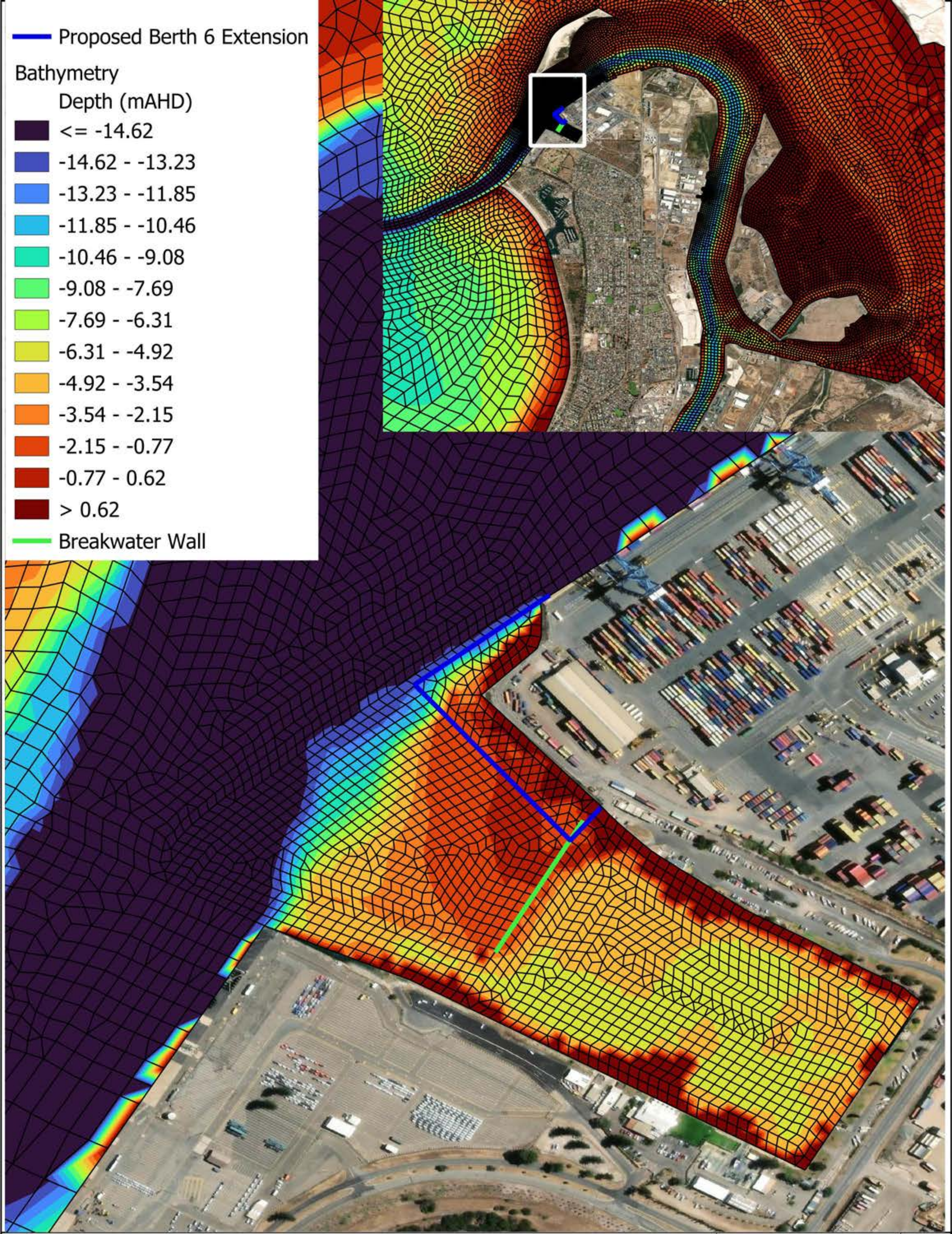
Figure: **3.1**

Rev: **A**

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

BMT
www.bmt.org

Filepath: L:\003195.L.pag.Port_Adelaide_Berth_6_Extension\02_GIS\qgis\port_adelaide_xyz_raster.qgz



Title:
TUFLOW Model Mesh and Bathymetry – Berth 6 Area

Figure: **3.2**

Rev: **A**

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

BMT
www.bmt.org

Filepath: L:\003195.L.pag.Port_Adelaide_Berth_6_Extension\02_GIS\qgis\port_adelaide_xyz_raster.qgz

3.2 Model Validation Results

Comparison between measured and modelled tides at the Outer Harbour tide gauge (Longitude 138.480728, Latitude -34.779761) for the period March 2024 show excellent agreement, as shown in Figure 3.3.

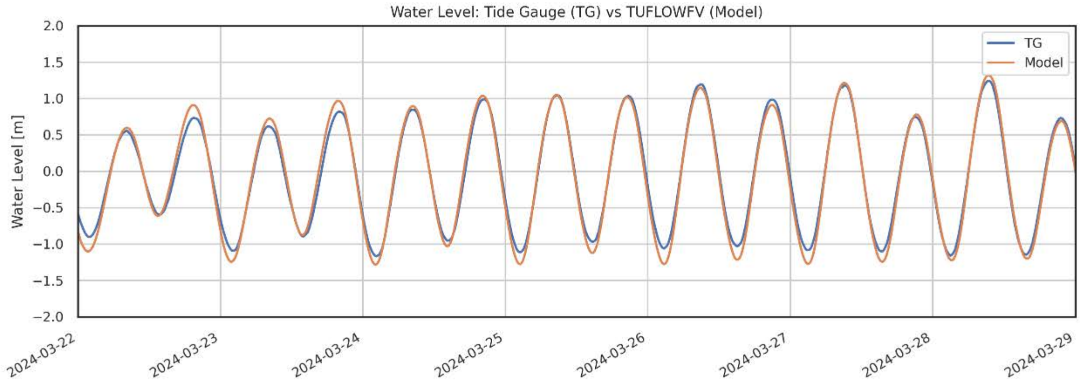


Figure 3.3 Comparison of Modelled and Measured Water Levels

BMT undertook measurements of the current velocities across several transects in the near vicinity of Berth 6 using a boat-mounted Acoustic Doppler Current Profiler on the 25th and 26th March 2024. The transects were measured repeatedly over two days to ensure that the full range of tidal conditions had been recorded, which then allowed the total flux of water to be calculated for each transect measurement. The time series of the total flux through each transect was then calculated by integrating the velocity and flow depth across each transect.

Figure 3.4 shows the location of the three measured transects, and Figure 3.5 shows the excellent agreement between the measured total flow and the modelled total flow across each transect. Figure 3.6 shows an example of the good agreement between the measured and modelled water velocity across an example transect during the peak flood tide, while Figure 3.7 shows the good agreement between the measured and modelled water velocity across one of the transects during the peak ebb tide.

© BMT 2024

Title:

Location of Three Transects for Current Measurements (P1, P2, and P3 represent Model Transects Location)

Figure: 3.4

Rev: A

BMT endeavours to ensure that the information provided in this map is correct at the time of publication. BMT does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

N 0 100 200 300 400 m

BMT
www.bmt.org

Filepath: L:\003195.L.pag.Port_Adelaide_Berth_6_Extension\02_GIS\qgis\port_adelaide_xyz_raster.qgz

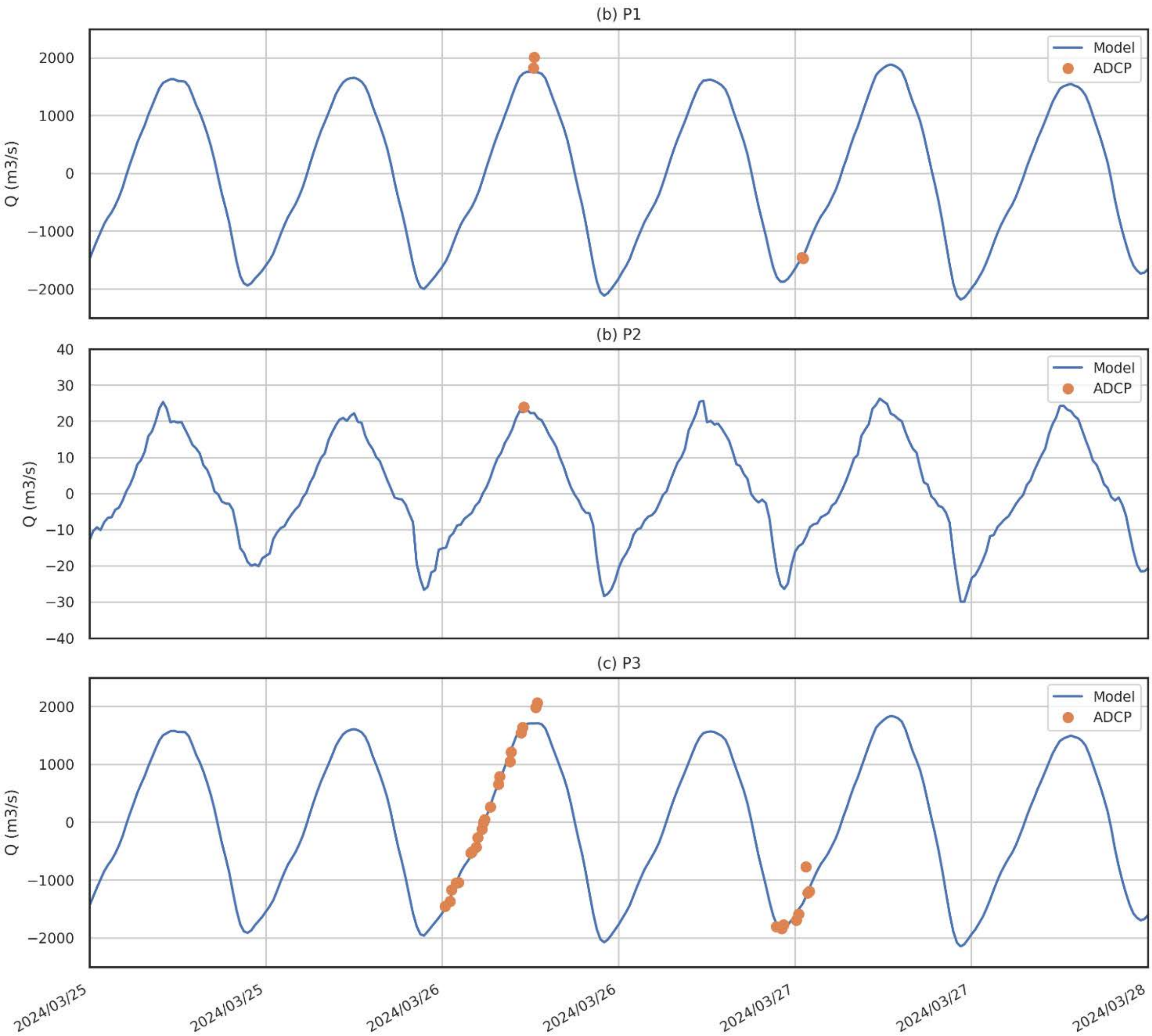


Figure 3.5 Comparison of Modelled and Measured Total Fluxes at Three Transects

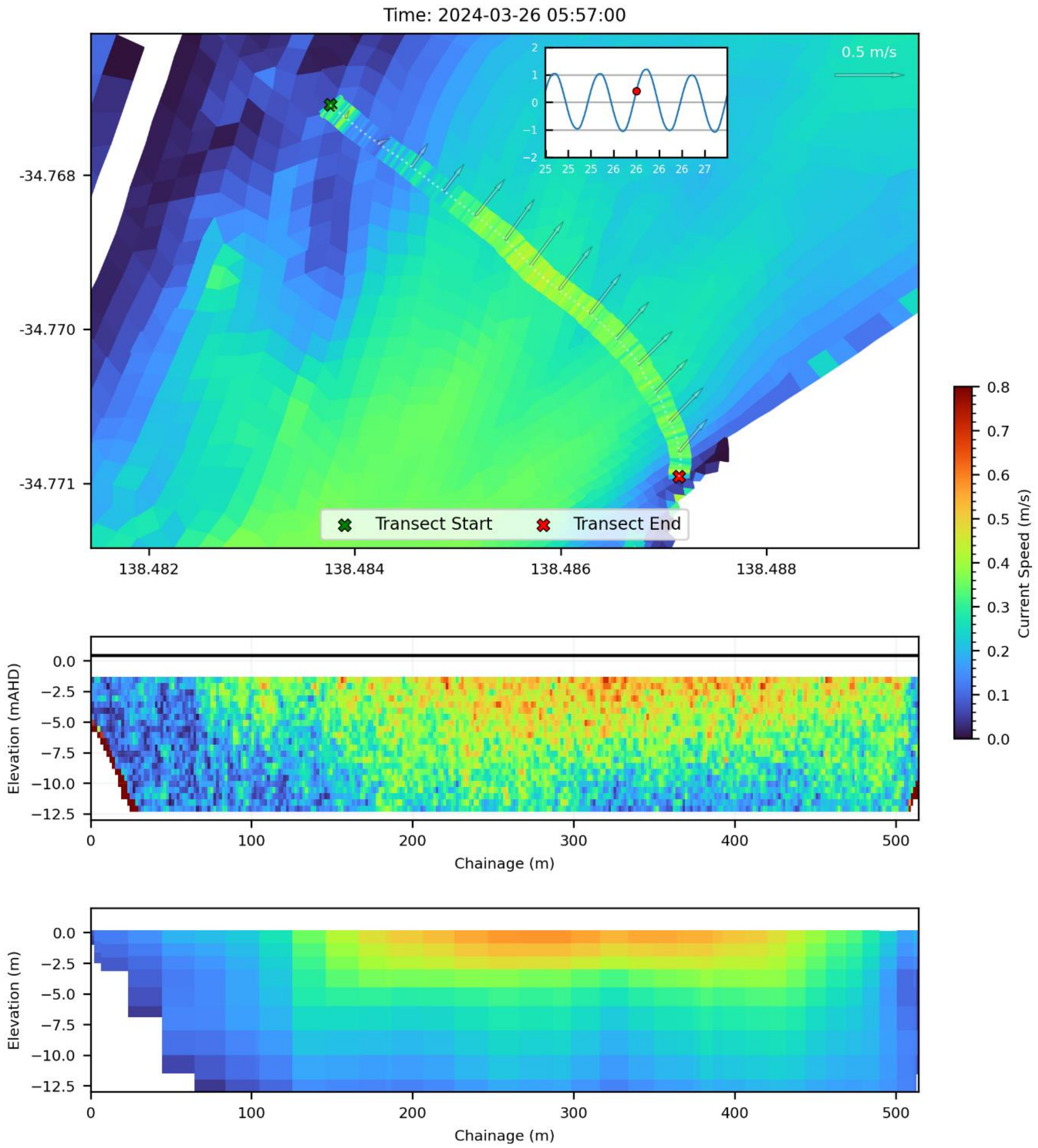


Figure 3.6 Peak Flood Tide Current Velocity Magnitude Comparison – Plan View (Top), Measured Velocity Curtain Plot (Middle) and Modelled Velocity Curtain Plot (Bottom)

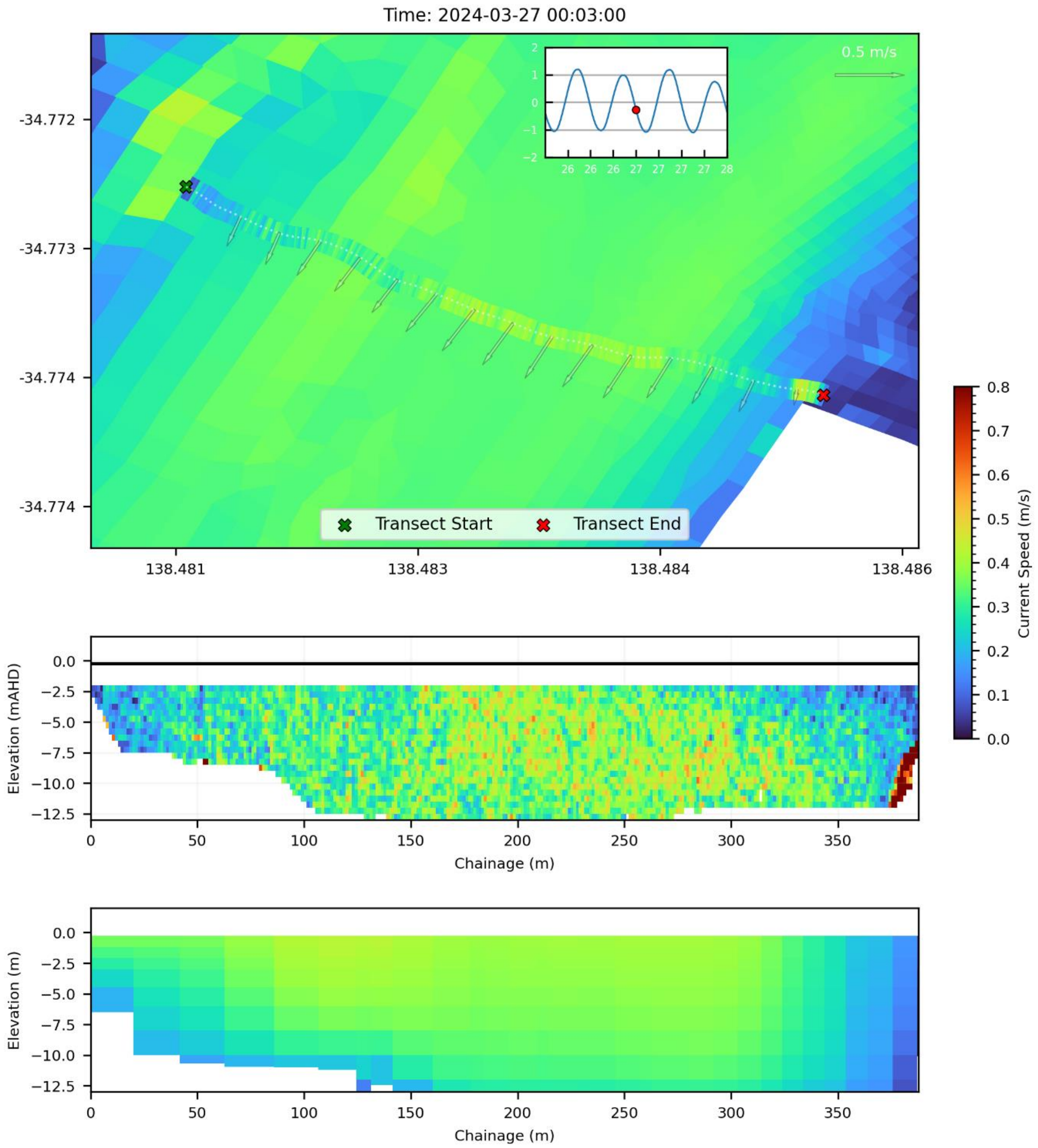


Figure 3.7 Peak Ebb Tide Current Velocity Magnitude Comparison – Plan View (Top), Measured Velocity Curtain Plot (Middle) and Modelled Velocity Curtain Plot (Bottom)

4 Model Results and Coastal Processes Assessment

4.1 Modelled Velocity Impacts

The validated numerical model was used to assess whether the construction of the Berth 6 extension would cause significant changes to the hydrodynamic conditions in the main channel, or in the entrance to the RSAYS marina.

The model was run for a 30-day period covering March 2024, for an existing case (current bathymetry and port layout) and a developed case (including the Berth 6 extension). It should be noted that due to the strong tidal currents in spring tide periods and the relatively sheltered environment (low wave energy) the results of the assessment will not be particularly sensitive to the choice of assessment period.

The modelling results were analysed, and the times when the peak ebb tide and peak flood tide velocities were observed were analysed. The times that were chosen for this analysis are shown in Figure 4.1.

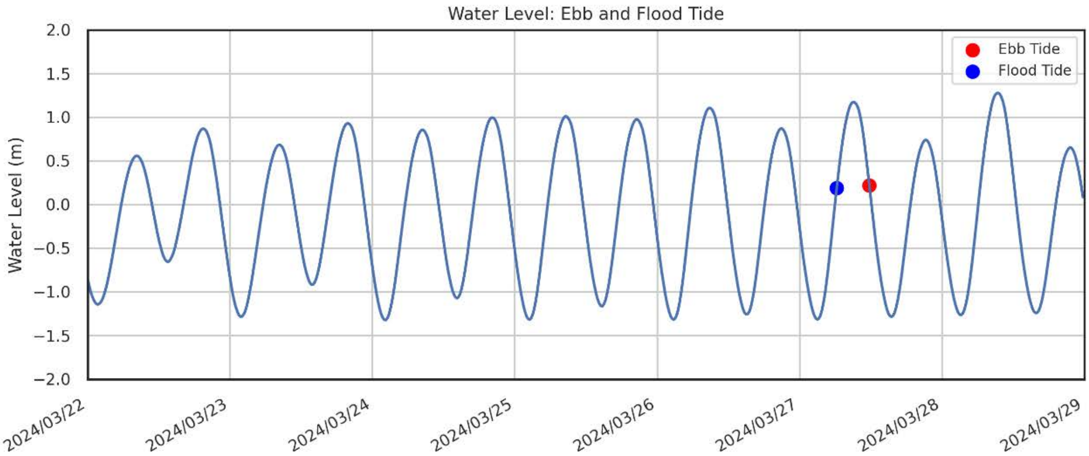


Figure 4.1 Timing of the Peak Ebb Tide and Peak Flood Tide Velocities

The existing peak flood tide velocity pattern is shown in the left panel of Figure 4.2. The flow velocity is up to 0.45m/s in the centre of the channel, and the flow velocity into the RSAYS marina is low (around 0.1m/s). The flow distribution in the developed case (middle panel of Figure 4.2) is very similar. The right panel of Figure 4.2 shows the difference in the depth-averaged flow velocity between the existing and developed cases, and shows that there is only a minor decrease in flow velocity near the corner of the proposed reclamation, and a minor increase further out in the shipping channel.

The existing peak ebb tide velocity pattern is shown in the left panel of Figure 4.3. The flow velocity is up to 0.45m/s in the centre of the channel, and the flow velocity out of the RSAYS marina is again observed to be low (around 0.1m/s). The flow distribution in the developed case (middle panel of Figure 4.3) is very similar to the existing case, although there is less flow through the area immediately outside the entrance to the marina. The right panel of Figure 4.3 shows the difference in the depth-averaged flow velocity between the existing and developed cases, and shows that there is only a minor decrease in flow velocity in the area outside the entrance to the marina, and a minor increase adjacent to Berth 6.

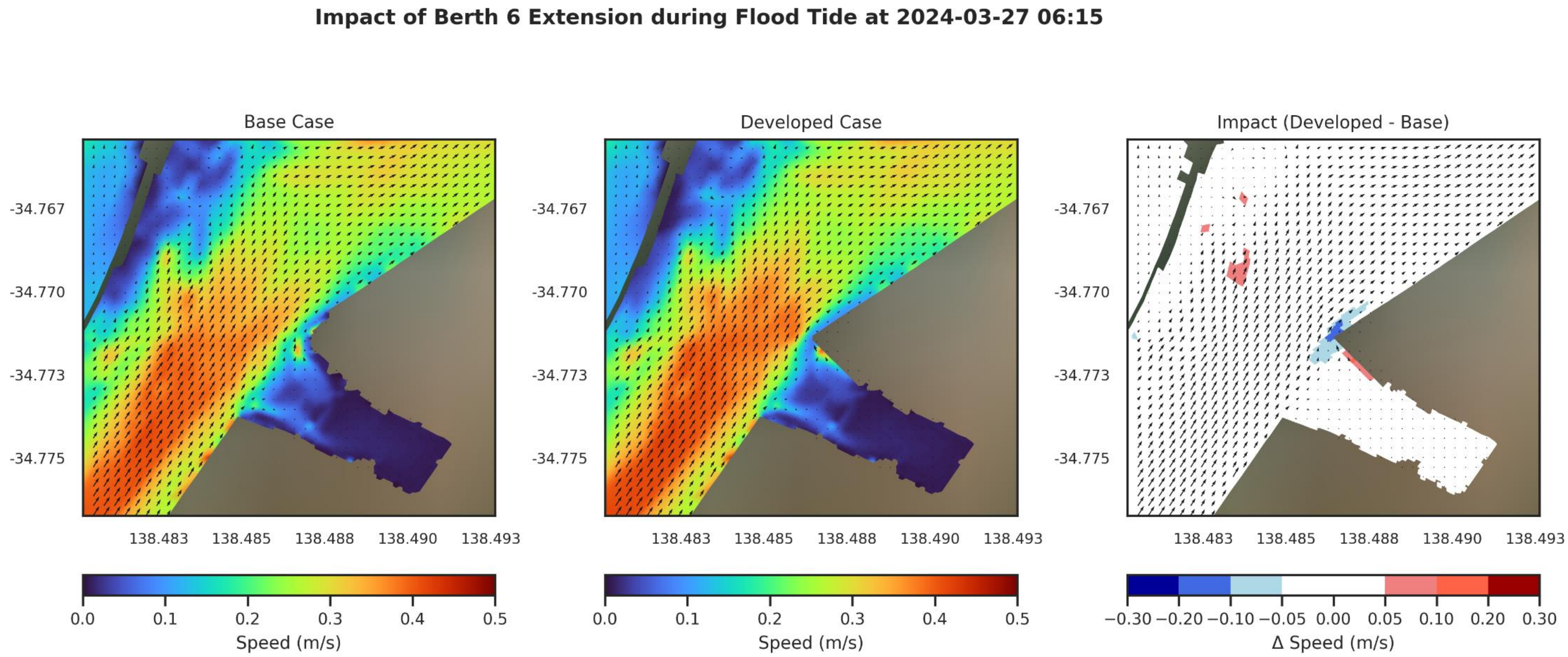


Figure 4.2 Peak Flood Tide Velocity – Existing (Left), Developed (Middle) and Impact (Right)

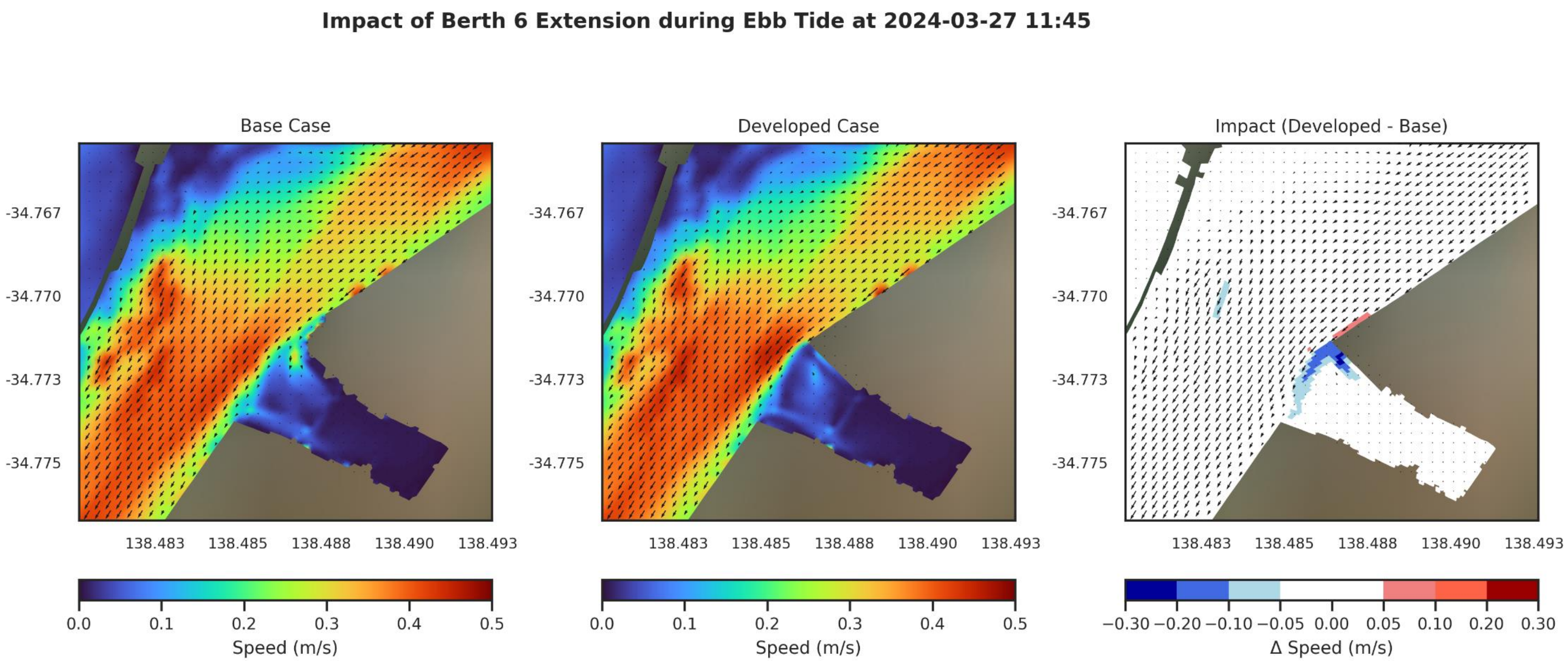


Figure 4.3 Peak Ebb Tide Velocity – Existing (Left), Developed (Middle) and Impact (Right)

4.2 Sediment Transport Impacts

The 95th percentile of the modelled bed shear stress during the one-month simulation period was calculated for each model cell in the existing case, and in the developed case. Figure 4.4 shows the magnitude of the 95th percentile bed shear stress in the existing and developed cases, and the difference between them. The model results indicate that there is only a small area to the south-west of the new reclamation where the peak bed shear stress is reduced, and the reduction in near-peak magnitude is not likely to cause major changes in sediment transport rates or cause major erosion/deposition. There is a small area immediately adjacent to the reclamation where the model indicates that peak bed shear stress will increase, however this is not expected to lead to major erosion since the increase is small relative to the existing peak magnitude.

4.3 Flushing Impacts

An assessment of potential impacts to the flushing capacity in the RSAYS marina was carried out by calculating the e-folding time for the model cells within the marina, for both the existing and developed cases. The e-folding time is calculated by setting the concentration of a non-settling tracer to a value of 1 in the model cells within the marina, and then measuring the time that it takes for the value to fall from 1 to a value of 1/e during the simulation.

Figure 4.5 shows a map of the e-folding time for the existing case, the developed case and the difference between them. The model indicates that the marina is well-flushed, in both the existing and developed cases, with an e-folding time of around 1.5 days. It is apparent that the minor change in the e-folding time due to construction of the Berth 6 extension is not significant.

4.4 Seagrass Wrack Accumulation Impacts

An assessment of potential impacts to seagrass wrack accumulation in the RSAYS marina was carried out by seeding the model with 1000 floating particles within the main shipping channel (near Berth 6) and assessing the differences in their dispersion at the end of the simulation in the existing and developed cases. The particles were assumed to be transported passively with the water movement, and were given a settling velocity of 0.2 m/s (based on measured data presented in Oldham *et al.* (2014).

Figure 4.6 shows a map of the initial distribution of particles, and the final distribution of the floating particles for the existing case and the developed case. In both cases, 6 particles (of the original 1000) remained within the RSAYS marina at the end of the simulation period. The model results therefore indicate that the change in the final distribution of the floating particles (representative of seagrass wrack) due to construction of the Berth 6 extension is not significant.

© BMT 2024

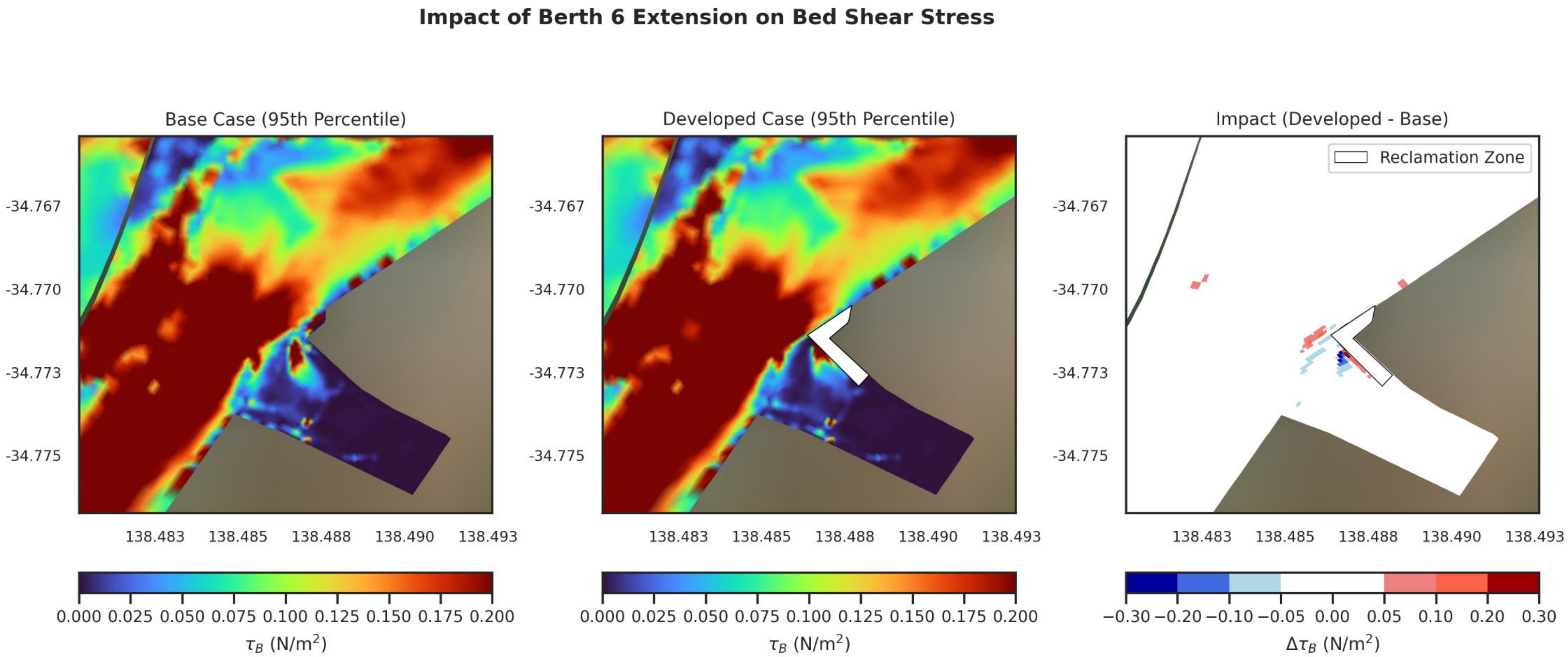


Figure 4.4 95th Percentile Bed Shear Stress – Existing (Left), Developed (Middle) and Impact (Right)

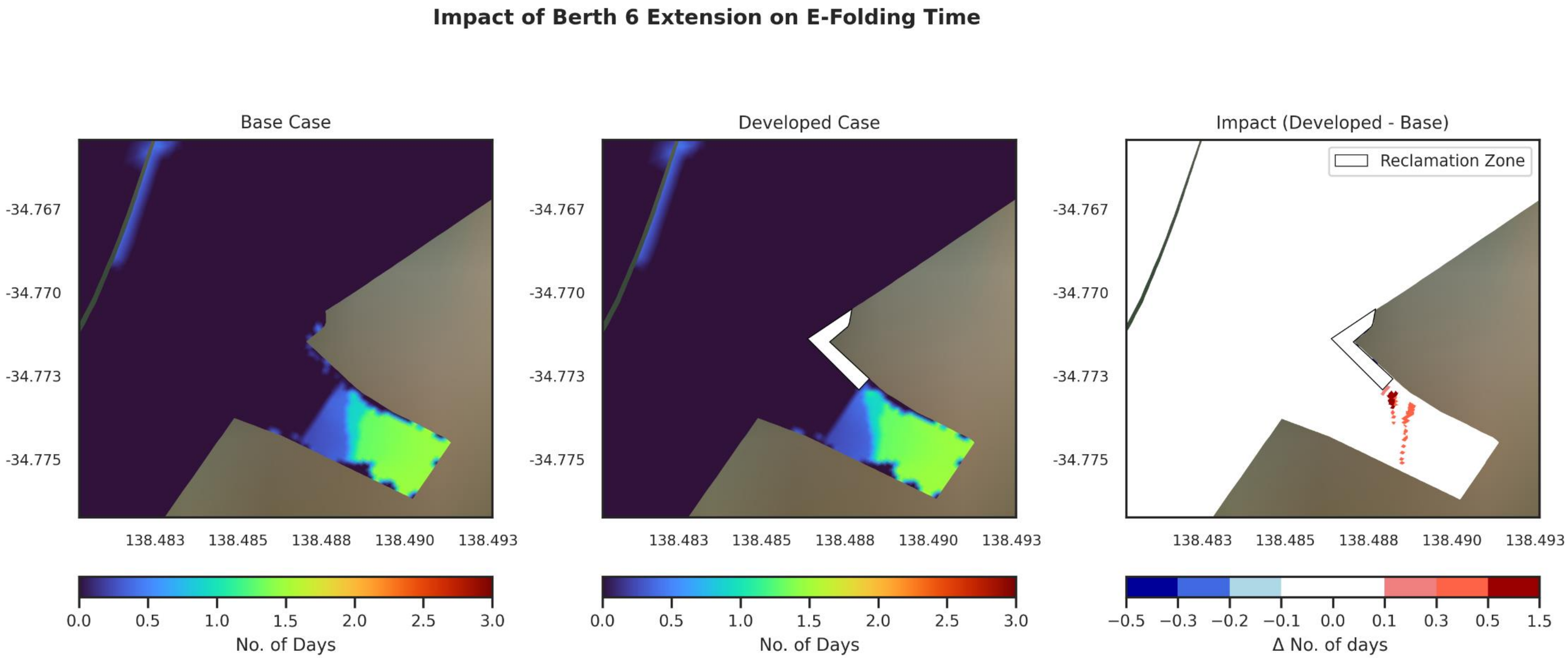


Figure 4.5 E-folding Time in the RSAYS Marina – Existing (Left), Developed (Middle) and Impact (Right)

© BMT 2024

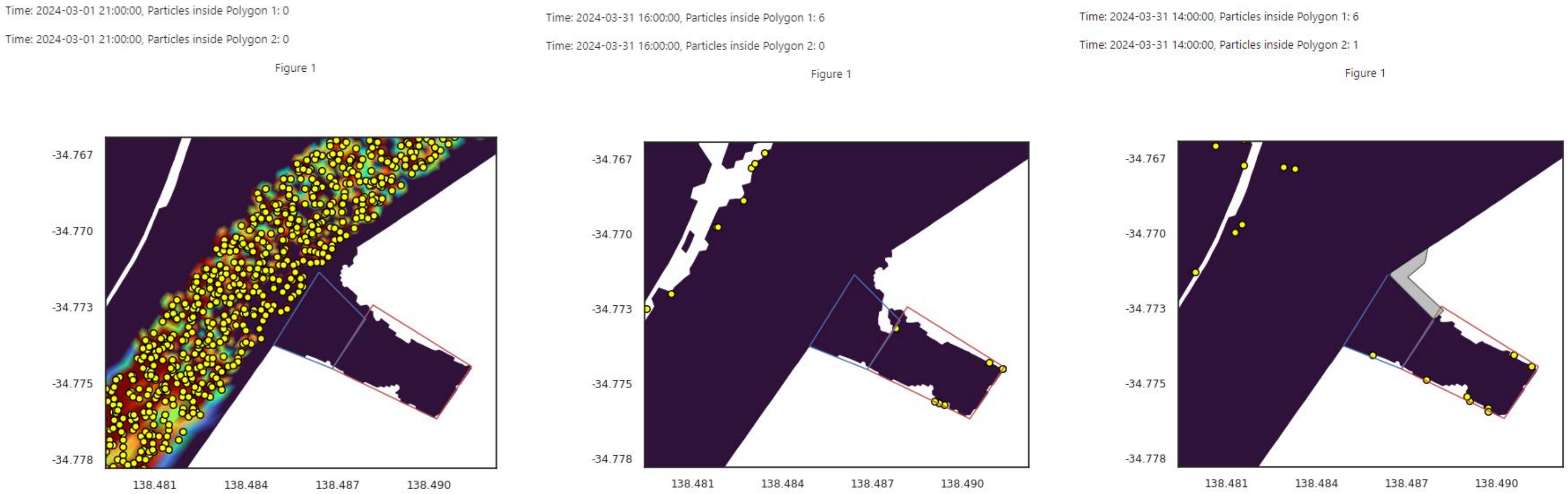


Figure 4.6 Distribution of Floating Particles – At Release Time (Left), at End of Base Case Simulation (Middle) and End of Developed Case Simulation (Right)

5 Conclusion

The modelling study assessed the potential for coastal process impacts in the vicinity of Berth 6 following completion of a proposed upgrade which involves reclamation of adjacent areas to extend the wharf.

The modelling results indicate that there will be very little change to the flow patterns and water velocity and no change to water levels in the vicinity of the proposed upgrade. There will also be minimal change to the 95th percentile (near-peak) bed shear stress distribution, so minimal change to sediment transport rates and erosion/deposition is expected. The changes to e-folding time in the RSAYS marina are also small, indicating that flushing capacity in the marina will not be significantly changed. And an assessment of seagrass wrack behaviour (based on modelling of floating particles) indicates that little change in wrack accumulation rates is expected as a result of the Berth 6 extension.

There is therefore expected to be:

- No significant change to patterns of sediment erosion or deposition in areas near the reclamation;
- No change to flushing capacity or water quality characteristics in the RSAYS Marina; and
- No significant change to sea wrack accumulation or sediment transport patterns in the area

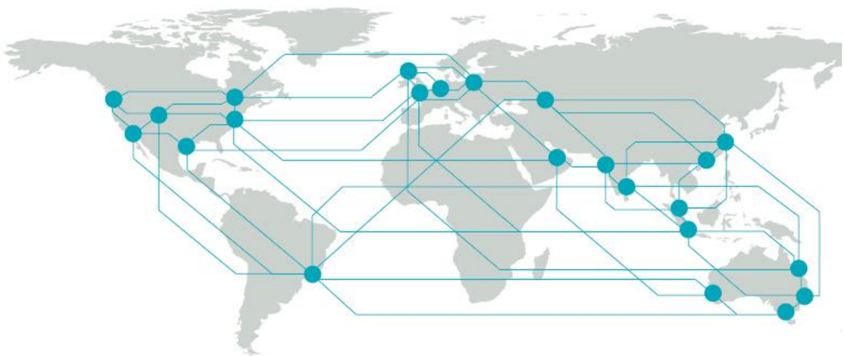
© BMT 2024

6 References

BMT, 2023. TUFLOW FV Science Manual. Available at https://downloads.tuflow.com/TUFLOWFV/Releases/Latest/TUFLOW_FV_Science_Manual.pdf

Hersbach, H., Bell, B., Berrisford, P., Biavati, G., Horányi, A., Muñoz Sabater, J., Nicolas, J., Peubey, C., Radu, R., Rozum, I., Schepers, D., Simmons, A., Soci, C., Dee, D., Thépaut, J-N. (2018): ERA5 hourly data on single levels from 1940 to present. Copernicus Climate Change Service (C3S) Climate Data Store (CDS), DOI: 10.24381/cds.adbb2d47, (Accessed on 07-APR-2024)

Oldham, Carolyn, McMahon, Kathryn, Brown, Eloise, Bosserelle, Cyprien, Lavery, Paul, (2014), A preliminary exploration of the physical properties of seagrass wrack that affect its offshore transport, deposition, and retention on a beach. Limnology and Oceanography: Fluids and Environments, 4, 10.1215/21573689-2844703, (Accessed on 07-MAY-2024)



BMT is a leading design, engineering, science and management consultancy with a reputation for engineering excellence. We are driven by a belief that things can always be better, safer, faster and more efficient. BMT is an independent organisation held in trust for its employees.

Level 5
348 Edward Street
Brisbane
QLD 4000
Australia
+61 7 3831 6744

Registered in Australia
Registered no. 010 830 421
Registered office
Level 5, 348 Edward Street,
Brisbane QLD 4000 Australia

For your local BMT office visit www.bmt.org

Contact us

enquiries@bmtglobal.com

www.bmt.org

Follow us

www.bmt.org/linkedin

www.bmt.org/youtube

www.bmt.org/twitter

www.bmt.org/facebook

Appendix K

Management of dredging and piling

EMM
creating opportunities

Dredge Management Plan Framework

Flinders Ports

Report

JBS&G 66422 | 159,531

13 May 2024

We acknowledge the Traditional Custodians of Country throughout Australia and their connections to land, sea and community.

We pay respect to Elders past and present and in the spirit of reconciliation, we commit to working together for our shared future.

Caring for Country The Journey of JBS&G
Artist: Patrick Caruso, Eastern Arrernte

Table of Contents

List of Tables

List of Figures

Appendices

Abbreviations

Term	Definition
AAR	Aboriginal Affairs and Reconciliation
ABMR	Australian Biofouling Management Requirements
ADS	Adelaide Dolphin Sanctuary
AMSA	Australian Maritime Safety Authority
ASS	Acid Sulfate Soil
ANZECC & ARMCANZ	Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand
Biosecurity Act	*Biosecurity Act 2015*
BTEXN	Benzene, Toluene, Ethylbenzene and Xylene
BWM Convention	International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004
CEMP	Construction Environmental Management Plan
COLREGS	Convention on the International Regulations for Preventing Collisions at Sea
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DEW	Department of Environment and Water
DGPS	Differential Global Positioning System
DMP	Dredge Management Plan
EPBC Act	*Environment Protection and Biodiversity Act 1999*
FACT	Flinders Adelaide Container Terminal
FPH	Flinders Port Holdings
MARPOL	International Convention for the Prevention of Pollution from Ships
MARS	Maritime and Aircraft Reporting System
MNES	Matters of National Environmental Significance
NAGD	National Assessment Guidelines for Dredging
PAH	Polycyclic Aromatic Hydrocarbons
PDL	Proposed Dredging Location
PDI Act	*Planning, Development, and Infrastructure Act 2016*
PIRSA	Primary Industries and Regions South Australia
POMS	Pacific Oyster Mortality Syndrome
SDS	Safety Data Sheets
SEB	Significant Environmental Benefit
TBT	Tributyltin
The Code	South Australia's Planning and Design Code
TOC	Total Organic Carbon
TRH	Total Recoverable Hydrocarbons

1. Introduction

1.1 Project overview

The Flinders Adelaide Container Terminal (FACT), owned and operated by Flinders Port Holdings (FPH) is the only container terminal facility in South Australia, located in Outer Harbor in the Port of Adelaide (Figure 1-1). The FACT currently includes two berths (Berths 6 and 7). FPH are proposing an upgrade to Berth 6 and its supporting services (Berth 6 precinct upgrade, or project herein) within the FACT due to:

- A lack of capacity to handle existing trade levels
- Insufficient berth line to simultaneously berth two larger container vessels without imposing restrictions and/or impacting on operations on neighbouring Berth 8; and
- Increasing numbers of vessels and vessels of larger sizes requiring accommodation at Berth 6.

Proposed works for the Berth 6 precinct upgrade include an extension of 179 m length and 27.89 m width to Berth 6. Capital dredging is required to establish the proposed extension. In addition, land reclamation, existing Berth 6 concrete remediation/bollard/fender upgrade and pavement and services upgrades are proposed to be undertaken for the Berth 6 precinct upgrade.

1.2 Flinders Port Holdings

FPH is a privately-owned port holding company in South Australia. FPH operates several ports throughout the states including the Flinders Adelaide Container Terminal located in Outer Harbor (Port Adelaide) on the Port River.

1.3 General location and site

The proposed development is located in the Port of Adelaide at Outer Harbor, on the northern tip of the Lefevre Peninsula, approximately 22 km north of Adelaide (Figure 1-1**)**. The area accommodates a range of industries including port-related activities, bulk handling and storage of minerals, agricultural and petroleum products, transport and warehousing, electricity generation and manufacturing.

The Project site itself is predominantly comprised of land which has been reclaimed from the natural intertidal mangrove and samphire flats which originally formed this part of the Lefevre Peninsula. The adjacent Port River, which forms the sea entrance to the Port of Adelaide, has been utilised as a shipping channel since European settlement and is also utilised by FPH vessels (e.g. tugboats), tourist vessels, commercial fishers, recreational boaters and anglers and kayakers. The Port River is tidal, and at Outer Harbor has been subject to regular dredging programs to maintain channel depth and width which allows larger container and cruise ships to be accommodated.

The closest residential area is located more than 800 m from Berth 6 in the suburb of North Haven (Figure 1-1).

Figure 1-1: General Location

1.4 Scope and objective of this report

This Dredge Management Plan (DMP) Framework for the proposed capital dredging works for the Berth 6 Precinct upgrade has been prepared to support the Development Application. This DMP Framework has been prepared in accordance with the SA EPA Dredge Guideline (EPA SA, 2020a).

The DMP Framework describes the Proposed Dredging Location (PDL), dredging activities and key environmental risks, identifies key mitigation measures and provides an appropriate environmental monitoring program to protect at-risk receptors from the potential impacts of dredging and disposal activities.

The DMP Framework sets out the proposed means of managing environmental issues associated with dredging for the Project and will form the basis for the detailed DMP that will be prepared by the dredge contractor and FPH for approval by the EPA, subsequent to Planning Approval for the Project and prior to commencement of dredging.

The DMP Framework is focussed on the activities and impacts associated with dredging and does not consider the potential impacts of land reclamation.

1.5 Roles and Responsibilities

FPH as the proponent, has ultimate responsibility for environmental management of the Project.

The dredge contractor will be responsible for the preparation of a detailed DMP, including detailed plans of operation for the dredging, implementation of their environmental management systems, compliance with all conditions of approval, all relevant legislation, monitoring and reporting of their activities as detailed and required at all times.

2. Overview of dredging

As part of the Berth 6 Precinct upgrade an area adjacent to Berth 6 in the Port River shipping channel is proposed to be dredged to achieve channel design depth of 14.2 mCD. This is intended to accommodate the Berth 6 extension and associated future arrival of increasing numbers and sizes of ships.

The PDL represents an area of 690 m^2, with a corresponding volume of approximately 550 m^3 of spoil to be removed. These estimates include a vertical allowance of 0.3 m of over-dredging and a horizontal 0.5 m batter slope, to consider slumping during dredging.

Dredging methodology is to be confirmed following detailed design but will likely involve a cutter suction dredger.

Proposed disposal of dredge spoil is to the existing Pelican Point Dredge Ponds located approximately 800 m from the PDL (Figure 2-1). Dredge spoil will be disposed to a series of ponds to settle out fines prior to returning water back to the Port River. Accumulated sediments (and bivalves) will be excavated out of the settlement areas for drainage and to increase the capacity of the pond. Discharged sediments (and bivalves) will remain within the footprint of the dredge ponds.

In the event of sheet pile wharf construction, dredge spoil may also be used in the same location as the existing Berth 6, as low level backfill for the Berth 6 extension.

It is noted that the Berth 6 Precinct upgrade works are in the design phase, with construction planned to commence in May 2025. Construction works would be undertaken over a nominal period of approximately 12 months with the dredging component to occur over a 2-4-week period, subject to constraints associated with weather, tides and Port traffic.

Figure 2-1: Proposed dredge location and spoil disposal

3. Legislative Framework

An overview of the legislative framework relevant to the Project is outlined in Table 3-1. Works may not commence until all necessary approvals are in place.

Table 3-1: Legislative Framework of the Proposed Dredging Activities

Legislation	Purpose	Relevance to Project
Commonwealth		
Environment Protection and Biodiversity Act 1999 (EPBC Act)	The EPBC Act was established to provide protection for Matters of National Environmental Significance (MNES), including listed threatened species and ecological communities and migratory species protected under international agreements. Projects that could result in significant impacts to matters of national environmental significance must be ‘referred’ to the Department of Climate Change, Energy, the Environment and Water (DCCEEW).	An assessment of the MNES relevant to the Project was undertaken in accordance with the EPBC Act and found that no significant impacts are expected to occur (JBS&G 2024).
Biosecurity Act 2015	The Act manages biosecurity risks in Australia, including introduced marine pests. The primary vectors for introduction of marine pests are ballast water and biofouling of vessels (Hewitt & Campbell 2010). Under the Act, the Australian Government has principal responsibility for the management of ship ballast water, while the States focus upon the biofouling as a vector, although the Commonwealth has the ability to manage biofouling-related risks where there is a biosecurity risk that needs to be managed. National best practice biofouling management guidelines have been developed, including the following which are applicable to dredging vessels: • *National Biofouling Management Guidance for Non-Trading Vessels* (Australian Government 2009a) • *National Biofouling Management Guidance for Commercial Vessels* (Australian Government 2009b).	There is a risk of translocating organisms in ballast water or on the hull of a dredge vessel. The management framework for addressing risks associated with ballast water and biofouling is described in Section 5.4.
Environment Protection (Sea Dumping) Act 1981	The *Environment Protection (sea Dumping) Act 1981* regulates the loading and dumping of waste at sea. Under the Act, the Australian Government aims to minimise pollution threats by prohibiting ocean disposal of waste considered too harmful to be released in the marine environment and regulating permitted waste disposal to ensure environmental impacts are minimised. This Act also fulfils Australia's international obligations under the Convention on the Prevention of Marine Pollution by *Dumping of Wastes and Other Matter 1972* (the ‘London Convention’).	Although this Act does not apply within the internal waters of South Australia (including Gulf St Vincent), the associated National Assessment Guidelines for Dredging (NAGD) (DEWHA 2009) have been applied for assessing potential contamination in marine sediments. Sediment characteristics within the Project site are detailed in Section 4.3. Contaminates in sampled sediments were found to be below the NAGD screening levels.

Legislation	Purpose	Relevance to Project
Australian Maritime Safety Authority Act 1990	Establishes the Australian Maritime Safety Authority (AMSA). AMSA is Australia's national maritime regulatory agency responsible for maritime safety, protection of the marine environment, and maritime aviation search and rescue. AMSA also coordinates and oversees the port State Control service. AMSA administers a range of legislation and intergovernmental agreements which implement international and national standards relating to marine navigation, protection of the sea and shipping registration. The *Navigation Act 2012,* administered by AMSA, gives effect to a number of international conventions for maritime issues where Australia is a signatory including the Convention on the International Regulations for Preventing Collisions at Sea (COLREGS) and the International Convention for the Prevention of Pollution from Ships (MARPOL).	Dredging activities will involve the use of vessels, and will need to comply with AMSA requirements.
International Convention for the Prevention of Pollution from Ships	MARPOL is the main international convention for addressing ship sourced pollution and includes regulations aimed at preventing both accidental pollution and pollution from routine vessel operations. Australia fulfils its obligations under MARPOL in relation to discharge of pollution through various legislative instruments including the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* and associated Regulations and Orders, e.g. Marine Orders 91, 93, 94, 95, 96, 97. This Act is reflected in State level legislation, including the *Pollution of Marine Waters (Prevention of Pollution from Ships) Act 1987* (South Australia).	Dredging activities will require the use, transport and storage of hydrocarbons and chemicals, and will produce waste including litter, sewage and vessel waste. The management framework for ensuring compliance with this Act is described in Sections 5.7 and 5.10.
South Australia		
Planning, Development and Infrastructure Act 2016 (PDI Act)	This Act regulates the planning system in South Australia.	The Berth 6 Precinct upgrade requires planning approval under the PDI Act.
Environment Protection Act 1993 (EP Act)	The EP Act provides the primary basis for the protection of the environment within South Australia. The Act lists dredging as an activity of environmental significance, which requires a licence under the Act. The EPA is also a key referral agency under the PDI Act	Dredging is considered a prescribed activity of environmental significance under this Act.
Coast Protection Act 1972	The *Coast Protection Act 1972* provides for the conservation and protection of the beaches and coast of South Australia and is administered by the Department for Environment and Water (DEW). The Act establishes the Coast Protection Board, which manages the beaches and coast using management plans and provides funds for protection works and undertakes said works. The Coast Protection Board is a key referral agency under the PDI Act that assesses proposals which interact with the coastal environment.	The PDL is located in a coastal environment. Development work including dredging will need to comply with this Act.

Legislation	Purpose	Relevance to Project
Native Vegetation Act 1991	Clearance of native vegetation requires approval unless there is an exemption under this Act. A 'Significant Environmental Benefit' (SEB) offset would be required if native vegetation were to be cleared. The terrestrial component of the Project Area falls within the metropolitan Adelaide exemption area (but with no terrestrial native clearance expected) and therefore the Act would only apply to marine species, specifically seagrass loss. If an SEB offset achieving a measurable net benefit to similar seagrass communities cannot be identified, then a payment can be made to the Native Vegetation Fund administered under the Act.	The benthic habitat within the PDL is partly covered with the native seagrass *Zostera* (J Diversity 2024).
Harbors and Navigation Act 1993	This Act provides for the administration, development and management of harbours and provides for the safe navigation of vessels in South Australian waters. The Act also addresses the establishment and control of State navigation aids, administers aquatic licences and addresses marine vessel registration.	Dredging activities will involve the use of vessels and will be undertaken within a commercial harbor. The Project will, therefore, need to comply with this Act.
Fisheries Management Act 2007	Administered by the Biosecurity SA division of PIRSA to manage risks to South Australia posed by animal and plant pests and diseases, including noxious and pest marine species and the Pacific Oyster Mortality Syndrome (POMS). The Act also provides for the management of fisheries and aquatic reserves and protection of aquatic habitats, mammals and resources.	There are two species of *Caulerpa* in the Port River, with *Caulerpa taxifolia* declared noxious under the Act and *Caulerpa cylindracea* declared exotic listed under the Act. Related management measures are discussed in Section 5.5. POMS was detected in feral oysters in the Port River in late February 2018 and is discussed in Section 5.6. A number of species including the white shark, all cetaceans and all seahorses, seadragons and pipefish are protected under the Act and a number of Aquatic Reserves, including the Barker Inlet-St Kilda and St Kilda-Chapman Creek Aquatic Reserves, have been declared under the *Fisheries Management Act 2007*. No aquatic reserves declared under the Act are expected to be affected.
Aboriginal Heritage Act 1988	Applies to the discovery of Aboriginal sites, objects or remains on land and provides that such discoveries may not be damaged, disturbed or interfered with, without prior approval from the Minister for Aboriginal Affairs and Reconciliation. As land is defined in the Act as including land lying beneath inland waters or the sea, dredging has the potential to result in the discovery of Aboriginal sites, objects or remains protected under the Act.	Due to the nature and level of previous disturbance of the Port River, the potential for Aboriginal archaeological values in the area is considered limited. The DMP Framework addresses management measures in the event of the discovery of Aboriginal sites, objects or remains (refer Section 5.8).
Adelaide Dolphin Sanctuary Act 2005	Provides for the establishment and management of a sanctuary to protect the dolphin population of the Port River estuary and Barker Inlet and its natural habitat.	The proposed dredging works will take place in the Port River within the Adelaide Dolphin Sanctuary. The DMP Framework addresses potential impacts from dredging

Legislation	Purpose	Relevance to Project
		works on cetaceans (refer Section 5.3)
Historic Shipwrecks Act 1981	Prohibits the damaging, destroying, interfering with, removing or disposing of an historic shipwreck or relic without a permit.	There are several recorded historical shipwrecks in the Outer Harbor. Although none of these shipwrecks are expected to be encountered within the vicinity of the PDL, the DMP Framework considers the potential for encountering undiscovered historic shipwreck material (refer Section 5.8)
National Parks and Wildlife Act 1972	This is the principal legislation in South Australia in respect to the establishment and management of reserves and parks. It also pertains to the conservation of native plants and animals, declaration of threatened species, the management of protected animals in respect to taking, keeping, farming and harvesting, and hunting, and interactions with marine mammals.	The PDL is within 5 km of protected area as detailed in Section 4.1. No protected areas under the Act are expected to be affected.
Landscape South Australia Act 2019	This Act provides the key framework for managing the State's land, water, pest plants and animals, and biodiversity across the state. The Act sets out a number of activities that must not be undertaken without a permit.	No activities have been identified for the Project that would require a permit.
Pollution of Marine Waters (Prevention of Pollution from Ships) Act 1987	This Act reflects the provisions of the Commonwealth *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*.	Dredging activities will require the use, transport and storage of hydrocarbons and chemicals, and will produce waste including litter, sewage and vessel waste. The management framework for ensuring compliance with this Act is described in Sections 5.7 and 5.10.
Biosecurity Act (in development)	A new Biosecurity Act for South Australia is currently being developed which would merge several existing pieces of biosecurity legislation into one, so as to strengthen protection of the state's economy, terrestrial and aquatic environments and communities from the impacts of pests, diseases and other biosecurity matters (PIRSA, 2023). Certain provisions for aquatic pests in the *Fisheries Management Act 2007* would also shift to the new legislation (PIRSA, 2023). The Biosecurity Bill is expected to progress through the parliamentary process this year. This new Biosecurity Act may include aspects related to the Pacific Oyster Mortality Syndrome (POMS).	There is a risk of translocating organisms in ballast water or on the hull of a dredge vessel. The management framework for addressing risks associated with ballast water and biofouling is described in Section 5.4.

4. Existing Environment

4.1 Conservation and Sanctuary areas

Several conservation parks and reserves occur within 5 km of Berth 6 (Figure 4-1). The Adelaide International Bird Sanctuary National Park (Winaityinaityi Pangkara) is approximately 4 km east from Berth 6. Torrens Island Conservation Park and Mutton Cove Conservation Reserve are located approximately 3 km and 2 km east of Berth 6, respectively. The Barker Inlet – St Kilda Aquatic Reserve and the St Kilda – Chapman Creek Aquatic Reserve are located 3 km east and 3.5 km northeast, respectively, from Berth 6 in the adjacent Port River estuary and associated mangroves.

4.2 Metocean Conditions

Metocean conditions of the Outer Harbor were previously studied for the Port Adelaide Outer Harbor Channel Widening Project and are detailed below (Boskalis 2019).

Waves in Gulf St Vincent are predominantly from the southwest throughout the year. Wave heights at the entrance to the Outer Harbor breakwaters are mostly below <1 m with a maximum of 2 m and are generally higher in winter than summer (Figure 4-2).

Winds during summer are predominantly from south to southwest. During winter, wind direction is more variable but most frequently from the north to northeast. High wind speeds (>10 m/s) occur more frequently in summer than winter.

Tides within Gulf St Vincent are semidiurnal, i.e. with two high and two low tides a day, but not always at equal levels (BOM 2024). Tidal movement varies over repeating cycles of about 15 days duration from spring to neap tides with maximum and minimal movement, respectively. A few times a year the water level is almost constant for several days, known as a 'dodge' tide.

Typical flood and ebb tidal current patterns in the Project area are shown in Figure 4-3 and Figure 4-4, respectively. Tidal currents outside the Port River estuary area generally northward during flood period and southward during ebb period, except close to the port entrance where currents are directed north during ebb also. Current velocities are higher during flood tides than ebb tides (Boskalis 2019).

Figure 4-1: Conservation reserves and sanctuaries in the vicinity of Berth 6

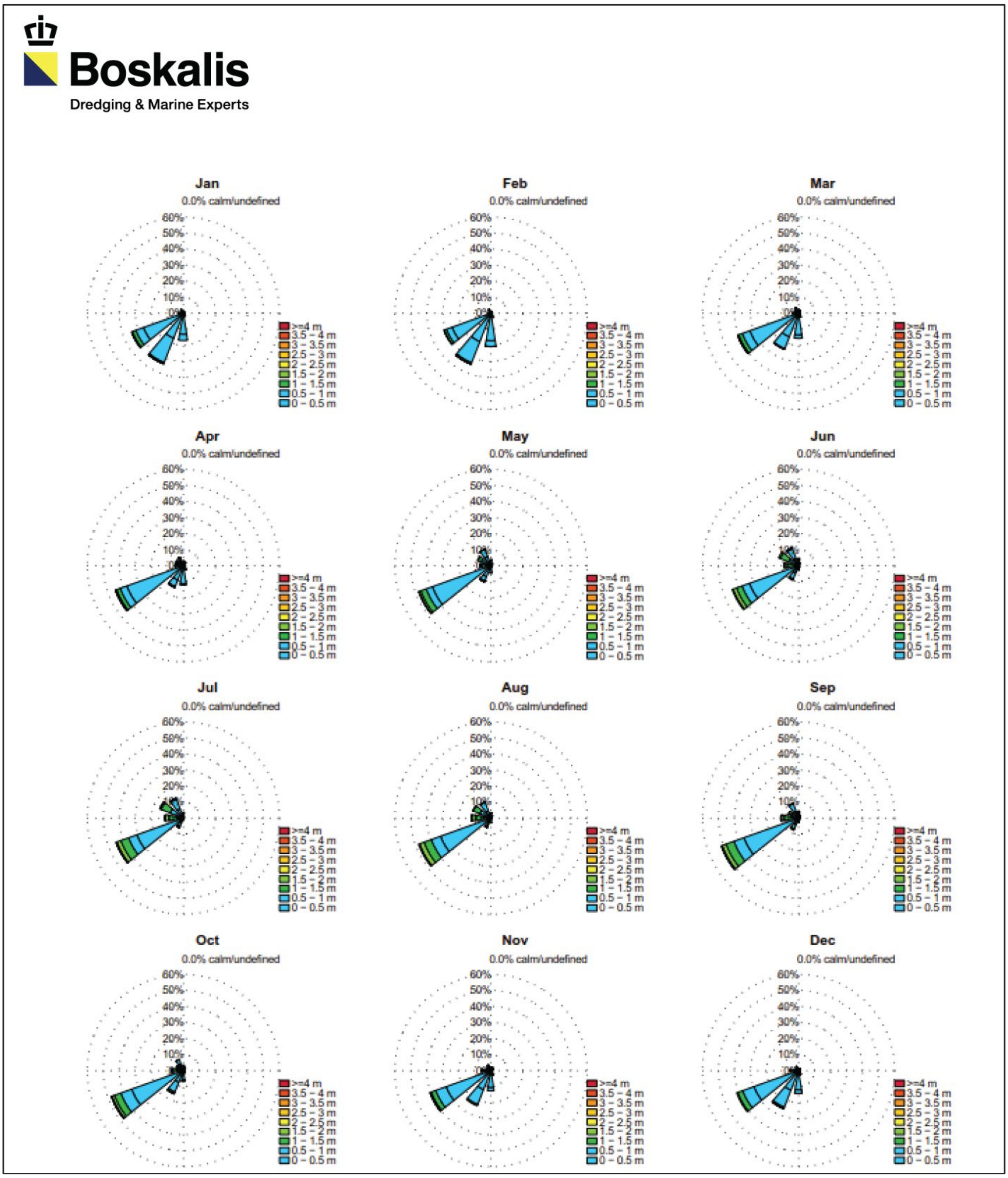


Figure 4-2: Wave Conditions at the entrance to the Outer Harbor breakwaters (Boskalis 2019)

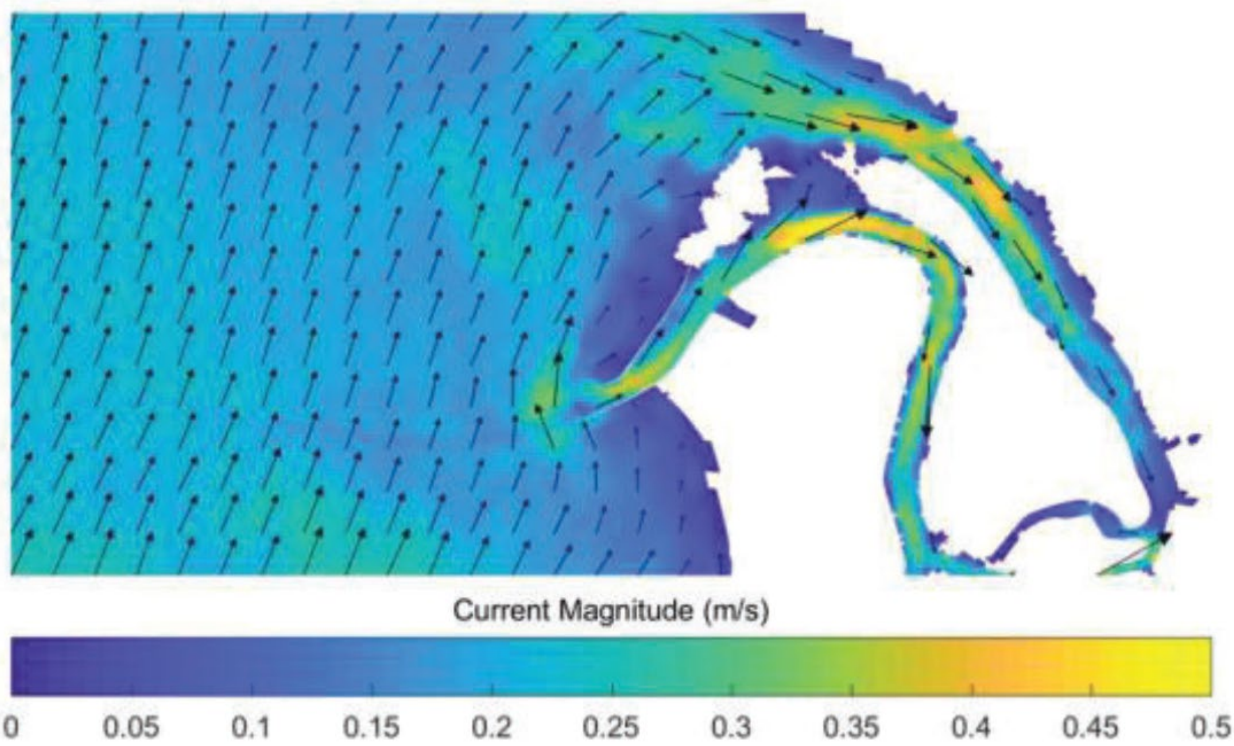


Figure 4-3: Typical flood tidal current (Boskalis 2019)

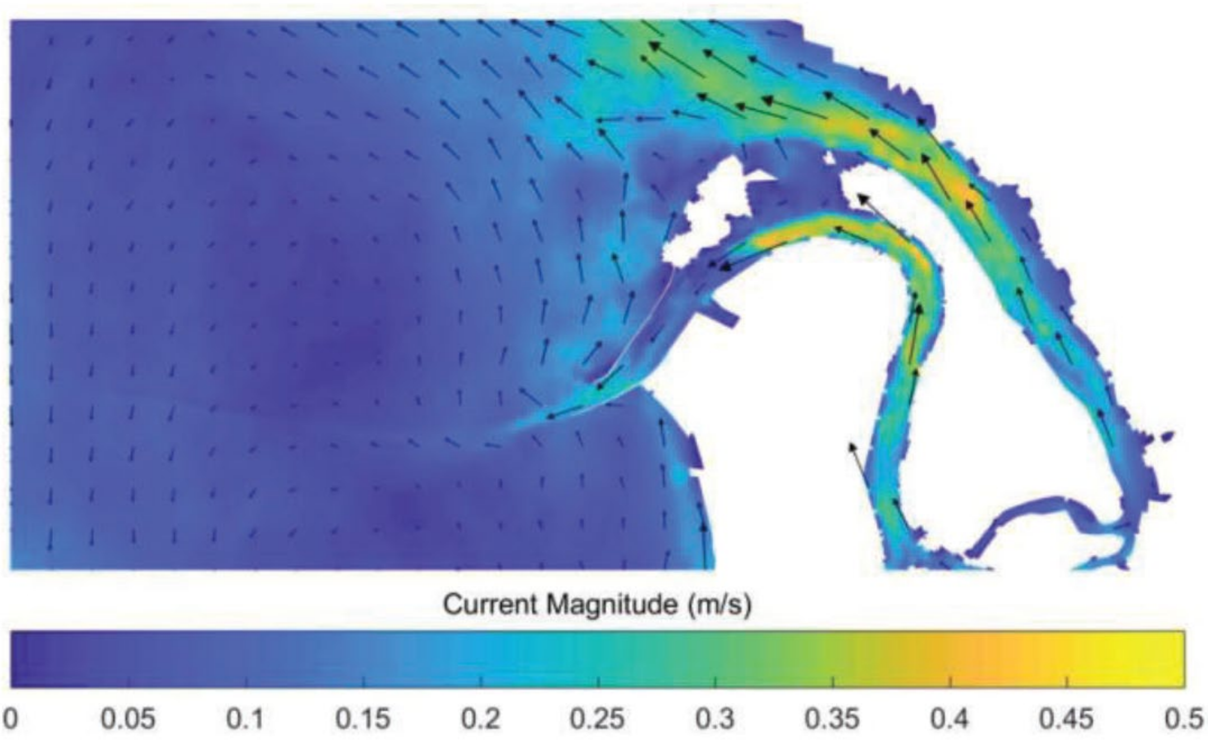


Figure 4-4: Typical ebb tidal current (Boskalis 2019)

4.3 Sediment Characteristics

An environmental assessment of sediments within the vicinity of Berth 6 was undertaken by Golder Associates Pty Ltd in 2020 (Golder Associates 2020). This environmental assessment included sediment characterisation and geotechnical testing of sediments sampled from the following:

- The PDL, including an adjacent batter material area; and
- The proposed area to be reclaimed.

Sediments collected from the PDL were generally characterised as being dark grey, silty sandy clay and muddy sand with shell inclusions and plant roots (Golder Associates 2020). Sediments within the PDL (for the depth range of 0 – 0.2 m) comprised on average 41.5 % sand, 47.5 % silt, 10.5 % clay and 0.5 % gravel.

Chemical analyses of samples within the PDL (to depths of 0.3 m) showed that total trace metals and hydrocarbons (TRH, BTEXN, PAH) were all below the Waste Fill criteria, the adopted human health and ecological screening guidelines, the Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand (ANZECC & ARMCANZ) water quality guidelines' Sediment Screening Levels, and the NAGD Sediment Screening Levels. Tributylin (TBT) was below NAGD and ANZECC & ARMCANZ guidelines (no waste disposal criteria for TBT).

One sediment sample taken with the PDL was tested for the chemical suite contained in the broad SA EPA Waste Screen. All chemical concentrations were below the limit of recording, with LORs below ANZECC and NAGD Sediment Screening Levels.

Sediment chemistry indicated sediments are potential acid sulphate soils (PASS). However, Golder (2020) noted there was likely sufficient neutralising capacity in the sediment and, therefore, no treatment management of sediments would be required.

4.4 Water Quality

A full description of existing water quality in the Outer Harbor is provided in the Water Quality Monitoring Program (Appendix B).

4.5 Benthic Habitat

The benthic habitat within the adjacent Port River is highly modified (given the nature of the Port River as a shipping channel).

A benthic survey undertaken by JDiversity in March 2024, showed the PDL, and wider area, to comprise bare sand or silt. Initially, very sparse *Zostera* (<1% cover) was recorded west of the survey area in depths less than 13.5 m, but reaching medium density (approximately 50%) in depths less than 5 m (JDiversity, 2024) (Figure 4-5).

Sparse *Zostera* was also recorded extending eastwards into the intertidal zone, generally amongst seagrass wrack. Medium density *Zostera* was recorded near the rock revetment in two locations 50 – 70 m south-west of the rock revetment. The intertidal and shallow area west and south of Berth 6 comprised two areas of dense Zostera, with degraded *Zostera* (denuded stems or rhizomes) also recorded amongst silty substrate (Figure 4-5).

The channel side, and the adjacent, proposed reclamation area eastward of the PDL, are comprised of bare substrate, with patches of degraded, sparse and medium *Zostera* (Figure 4-5).

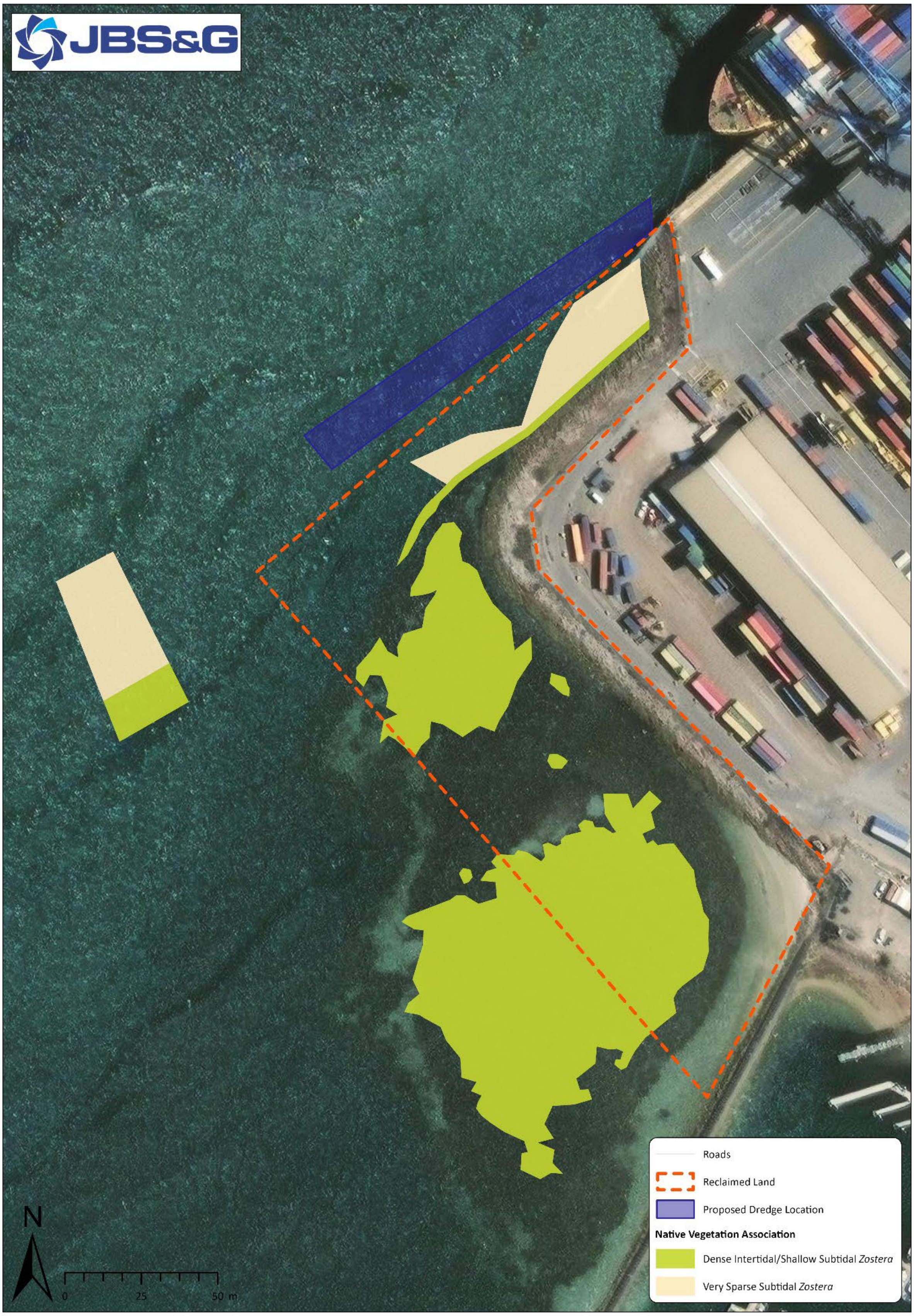


Figure 4-5: Benthic habitat near the PDL

4.6 Fauna, Marine Pests and Diseases

The dominant fauna on the mud flat within the surveyed area was the razor clam *Pinna bicolor*, with four other bivalves also recorded; hammer oyster *Malleus meridianus*, queen scallop *Equichlamys bifrons*, mud cockle *Katelysia sp* and spiny scallop *Scaeochlamys livida*, which is an introduced species (J Diversity, 2024).

Other pest species that were recorded within, or in close vicinity to the PDL included the European fan worm *Sabella spallanzanii* and Feather duster worm *Myxicola infundibulum*.

Caulerpa cylindreacea and *Caulerpa taxifolia*, two exotic species under the *Fisheries Management Act 2007,* were previously found to occur within the Port River (Wiltshire and Deveney 2017). *C. taxifolia* has been declared noxious under the *Fisheries Management Act 2007.* Neither *C. cylindreacea* nor *C.taxifolia* was recorded the benthic survey (J Diversity, 2024).

Pacific oysters *Magellana gigas*[1] were prevalent along the rock revetment north-east of the mud flat.

Pacific Oyster Mortality Syndrome (POMS) disease, which affects Pacific oyster but may be carried by other bivalves, was detected in feral oysters in the Port River in late February 2018 and is now endemic. The nearest commercial growing area is approximately 60 km away (PIRSA undated).

4.7 Marine megafauna

The entire Port River estuary is utilised by dolphins, including a resident population of 30 Indo-Pacific bottlenose dolphins *Tursiops aduncus*, and an estimated 400 transient dolphins including short-beaked common dolphin *Delphinus delphis* and the common bottlenose dolphin *Tursiops truncatus* (DEWNR 2007). The Port River estuary lies within the Adelaide Dolphin Sanctuary (ADS) under the *Adelaide Dolphin Sanctuary Act 2005* (Figure 4-1).

Marine megafauna species including sea lions, fur seals and turtles have occasionally been recorded in upper Gulf St Vincent and the Port River Estuary. There were two sightings of Southern Right Whales within the western end of the shipping channel of Port River during the Outer Harbor Channel Widening Project in 2019.

4.8 Cultural heritage

All shipwrecks older than 75 years are protected in South Australia under the *Historic Shipwrecks Act 1981* and the *Historic Shipwrecks Regulations 2017*, and in Australia under the Commonwealth's *Underwater Cultural Heritage Act 2018*.

Two registered shipwrecks are located within 1 km of the project. However, they are both more than 500 m from the PDL. Both are identified as 'protected' and 'not found' (Figure 4-1).

---

[1] The accepted genus name is now *Magallana* but *Crassostrea* is accepted as an alternative representation by the World Register of Marine Species and is the name used by PIRSA.

5. Impact Analysis and Risk Management

This framework describes environmental management measures for potential environmental impacts as a result of dredging activities for the Project and was developed using the template provided by the EPA in their Dredge Guideline (EPA 2020).

These management measures and strategies will be regularly reviewed and updated to reflect best practice, changes to construction processes and any approval conditions.

Each strategy outlines specific objectives, performance indicators, management actions and monitoring requirements that can measure the effectiveness of environmental performance during construction dredging activities.

General dredging operation requirements are outlined in Table 5-1.

Table 5-1: General Requirements for Dredging Operations

Item	Content
Applicability	• Dredging and disposal operations and associated activities must comply with relevant environmental duties and obligations as set out in legislation and dredge licence conditions.
Potential Impacts	• Dredging and disposal that are not compliant with existing legislation have the potential to impact on natural ecosystems and sensitive receivers.
Desired outcomes	• Compliance with development approval and dredge licence conditions
Controls	The dredge contractor will: • Develop a detailed DMP that responds to the requirements of this DMP Framework, and further based on the EPA licence requirements. The DMP will require approval by EPA prior to the commencement of any dredging works and will include: o environmental commitments o identification of environmental issues and potential impacts o control measures for routine operations to minimise the likelihood of environmental harm o contingency plans and emergency procedures for non-routine situations o organisational structure and responsibilities o staff training o record keeping o periodic review of environmental performance and continual improvement. • Develop a General Method Statement outlining the intended scope of works and methodology to be employed as part of the works, including: o description of the general scope of works o reference to international dredging standards and company standards (e.g. quality, occupational, health and safety and environmental management systems), and how they apply to the current project and any other project-specific document o responsibilities of the dredge contractor and key staff o a clear map of the areas where dredging activities will take place consistent with regulatory approvals. • Ensure that all measures, plant and equipment necessary to undertake the dredging are operated and maintained in a proper and efficient condition and in accordance with manufacturer's specifications. This includes appropriate servicing and maintenance of engines and emission control devices such that emissions comply with relevant guidelines and standards.

Item	Content
	• Ensure that operation of the dredging equipment will only be undertaken by personnel with relevant experience and training. • Develop a complaints response procedure that covers environmental complaints. • Take all reasonable and practicable measures to prevent and/or minimise the likelihood of environmental harm being caused by the Project. • Keep records of all data, records and monitoring results in a central register that can be made available to the EPA on request.
Monitoring	• Environmental audits undertaken regularly to ensure documentation and performance against the general requirements are being met.
Management Actions	• Management actions will be implemented in the context of any issues raised by regulatory bodies. • Management actions may also be required because of complaints from the community in accordance with the complaint response process outlined above.
Reporting	• Report of environmental compliance to be prepared by dredging contractor.

In addition to the general dredging operation requirements, the following key elements have been identified as requiring environmental management as part of the proposed dredging operations for the Project:

- Water Quality (refer Section 5.1)
- Sediment Quality (refer Section 5.2)
- Interactions with Marine Mammals (refer Section 5.3)
- Introduction of Marine Pests (refer Section 5.4)
- Spread of *Caulerpa taxifolia* (refer Section 5.5)
- Management of POMS (refer Section 5.6)
- Waste Management (refer Section 5.7)
- Cultural Heritage (refer Section 5.8)
- Noise (refer Section 5.9)
- Hazardous Substances (refer Section 5.10)
- Air Quality (refer Section 5.11)

The environmental management framework for each element is detailed below.

A preliminary risk assessment was undertaken for key elements of importance to the EPA. This risk assessment is based on the risk assessment framework detailed in EPA's dredge guideline (EPA, 2020), and considers current knowledge of the proposed dredging activities available to this date. A final risk assessment will need to be undertaken as detailed dredging methodology and timing become available.

5.1 Water Quality

An environmental management framework for water quality is summarised in Table 5-2.

Table 5-2: Environmental Management Framework – Turbidity and Impacts on Seagrass

Item	Content
Applicability	• Dredging would result in a temporary moderate turbidity plume in the immediate vicinity of the PDL and to a smaller extent, around the dredge pond water discharge location.
Potential Impacts	• Dredging will result in the production of fines within the water column, resulting in increased turbidity in the water column and potential for sedimentation of the nearby benthos.
Desired outcomes	• No impact to seagrass in close vicinity of the PDL as a result of increased turbidity from dredging.
Preliminary Risk Analysis	• Dredge spoil would have an approximate 58% silt/clay content, and <5% organic matter (Golder, 2020). • Volume of spoil is 550 m^3. • On land disposal of spoil to dredge ponds at Pelican Point. • Approximately 1 ha of intertidal seagrass is present on the mudflat adjacent to PDL. o Approximately half of this intertidal seagrass is likely to be directly impacted by the land reclamation activity of the project. o The remaining intertidal seagrass on the mudflat may experience some higher levels of turbidity during dredging but impacts would be short term and not expected to impact seagrass health in the long term, or result in seagrass loss. o Results of plume modelling will inform expected water turbidity levels during dredging and plume extent. • Dense seagrass beds (*Zostera*) occur at Section Bank, > 500 m from the PDL (northeast direction). These seagrass beds are not likely to be impacted by the proposed dredge operations. Results of plume modelling will inform expected water turbidity levels during dredging and plume extent. • Expected short dredging campaign duration of less than 2 weeks. • Risk = Low to Low/Medium
Controls	• Undertake dredging during cooler months as far as practicable. • Minimise the duration of dredging as far as practicable. • Utilise dredge methodology that would minimise plume extent as far as practicable. • Results of plume modelling will inform on the potential need to implement additional controls.
Monitoring	• Turbidity monitoring implemented throughout the dredging campaign to ensure dredging activities remain within the to be determined threshold(s) to minimise impact receiving environment. • Undertake an intertidal seagrass assessment on the mudflat before and after dredging.
Management Actions	• Slow or stop works in place if to be determined thresholds exceeded.
Reporting	• A baseline monitoring report will be prepared upon completion of baseline monitoring. • Baseline data to be used to inform potential threshold trigger values (to be determined in liaison with EPA). • Compliance reports will be prepared during/and or following the dredge campaign as required in by EPA and set in licence conditions.

5.2 Sediment Quality

As described in Section 4.3, characterisation and geotechnical testing of sediments within the vicinity of Berth 6 was undertaken in 2020 (Golder Associates 2020).

For those samples in dredge footprint (and all samples for that study) the following provides a summary from Golder (2020):

- Trace metals concentrations and TRH/BTEX/PAH were:
  - below the Waste Fill criteria and the adopted human health and ecological screening guidelines.
  - below the ANZECC Guidelines and NAGD Sediment Screening Levels.
- TBT normalised to TOC was 0.05 – 3.3 ug/Sn/kg and below NAGD and ANZECC guidelines.
- One sample in dredge footprint was tested for chemical contaminants in SA EPA Waste Screen, with concentrations below LOR; and below the human health and ecological investigation levels, Waste fill criteria and NAGD screening levels, and ANZECC guidelines.

Guidance was sought from EPA for whether this data set could be used for the Berth 6 Precinct upgrade. Based on JBS&G specialist review of this work it was considered:

- Sampling density is sufficient to cover the Berth 6 dredge footprint, including requirements of NAGD requirements and Waste Derived Fill (WDF) requirements (assuming no material change to proposed dredge volumes); and
- No material change to the chemical characteristics of sediments within the dredge footprint is expected to have occurred within the approximate 3.5-year period since the Golder assessment was completed given the nature of Berth 6 activities (i.e. general container storage/loading).

Whilst it is acknowledged that PFAS testing was not completed as part of the sediment characterisation works, similar assessments undertaken by JBS&G (personal communication) immediately east of Berth 8 (i.e. a similar area of the Port River) did not identify PFAS contamination in sediments.

Based on the understanding that the dredge depth and volume had not changed from the Golder (2020) assessment, EPA provided confirmation that this data set could be used for the Project.

No further impact analysis and risk analysis has been undertaken on sediments per se, however, sediment characterisation is geotechnical results are considered as part of impact analysis and risk management for Section 5.1 Water Quality and 5.7 Waste Management.

5.3 Interactions with Marine Mammals

An environmental management framework for managing interactions with marine megafauna is summarised in Table 5-3.

Table 5-3: Environmental Management Framework – Interactions with Marine Mammals

Item	Content
Applicability	• Works are located within Adelaide Dolphin Sanctuary (and the ADS Act) and there is a likelihood of marine mammals (particularly dolphins and to a lesser extent seals) entering the area within the vicinity of the PDL.
Potential Impacts	• Vessel strike • Underwater noise may disturb marine mammals
Desired outcomes	• No incidents of vessel-related disturbance or mortality to marine megafauna
Preliminary Risk Assessment	• Risk = Low, noting consultation with DEW will be required.
Controls	• Adherence to all speed limits within the Adelaide Dolphin Sanctuary and other vessel speed guidelines. • During dredge operations, a trained marine mammal observers (that satisfy DEW requirements) shall be present on and monitor from the dredge vessels. • Monitoring for the presence of marine mammals by trained marine megafauna observers (within 300 m of the dredge) and look for any strange behaviour. • A ‘caution zone’ of 150 m around the dredge vessel and a ‘pause operations’ requirement if a marine mammal is within 50 m shall be imposed during dredge operations (note - ‘pause’ is defined as a temporary suspension of work until the animal is out of the danger zone, but does not require all equipment to be shut down). • If any Dolphins or Seals are spotted within dangerous proximity (<5 m), operator is to cut power to the cutter head until they move away from the dredge cutter area.
Monitoring	• Monitoring based on visual observations undertaken by a trained marine mammal observer on board all dredge vessels during transit and operation.
Management Actions	• Actions to be undertaken in accordance with advice from regulatory agencies and Adelaide Dolphin Sanctuary managers prior to commencing works to determine what is required.
Reporting	• Daily log of all sightings to be recorded on the dredge vessels, indicating the sighting of each individual animal and actions taken. • Any instance of animal injury or mortality detailed in an incident report.

5.4 Introduction of Marine Pests

An environmental management framework for managing the introduction of marine pests is summarised in Table 5-4.

Table 5-4: Environmental Management Framework – Introduction of Marine Pests

Item	Content
Applicability	• There is a risk of translocating organisms in ballast water or on the hull of a dredge vessel. Other potential vectors during construction include jack-up barge legs, anchors, anchor chains, mooring lines and any seawater carried incidentally on vessels such as in bilges, inside pipes or pumps.
Potential Impacts	• Introduction of marine pests to Outer Harbour, leading to impacts on estuarine ecosystems.
Desired outcomes	Compliance with: • International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (BWM Convention) • *Biosecurity Act 2015* (Commonwealth) • *Australian Ballast Water Management Requirements Version 8* • *National Biofouling Management Guidance for Non-Trading Vessels* • *Code of practice for vessel and facility management (marine and inland waters) (EPA 2019)*
Preliminary Risk Analysis	• Risk = Low, noting consultation with PIRSA will be required.
Controls	<u>Biofouling</u> • Operators of all commercial vessels subject to biosecurity control must provide information relating to biofouling management through the mandatory pre-arrival report. This information is reported through the department's Maritime and Aircraft Reporting System (MARS). • If the dredge vessel (or any other associated vessels) is arriving from outside of Australia, operators of these vessels must provide information on how biofouling has been proactively managed prior to arrival. This information will then be used by the Australian and/ or State Government to inform any vessel interventions including further vessel cleaning prior to undertaking dredging activities, and or following dredging activities. • Undertake regular inspections of areas most prone to biofouling (e.g. damaged paint, propellers, bow and stern thrusters, sea chests and cooling pipes). • Renewal of antifouling coating to the hull and cavities before the coating's lifespan expires. • Inspect support vessels, ship hull, hopper and dredge gear (especially dredgehead) to ensure that no material which may transport organisms (sediments, organic material, or waters) is retained. This should be undertaken in accordance with PIRSA's Guidelines for Good Vessel Cleaning Practices. • The Australian biofouling management requirements (ABFMR) set out vessel operator obligations for the management of biofouling when operating vessels under biosecurity control within Australian territorial seas to comply with the *Biosecurity Act 2015*. <u>Ballast water</u> • Ballast water will be managed by the applicable standard (exchange or preferably treatment) in accordance with the *Australian Ballast Water Management Requirements, Version 8*.
Monitoring	• Inspection of dry-dock cleaning of vessel by specialised consultant if required.
Management Actions	In the event that known or suspected risk biota is detected after arrival in Australia, actions include: • collect and retain samples for DCCEEW and/or Primary Industries and Regions South

Item	Content
	Australia (PIRSA). • cooperate to identify remedial action/s and develop tailored action plan in consultation with DCCEEW and/or PIRSA. • re-inspect vesseland instigate appropriate remedial actions as may be warranted on the basis of that inspection.
Reporting	• Evidence of vessel loads, exchanges or discharges of ballast water to be recorded in the ballast water record book. • A biofouling management plan and record book should also be consistently maintained as a measure to minimise biofouling.

5.5 Spread of *Caulerpa taxifolia*

An environmental management framework for managing the spread of *Caulerpa taxifolia* is summarised in Table 5-5.

Table 5-5: Environmental Management Framework – Spread of *C. taxifolia*

Item	Content
Applicability	• *C. cylindracea,* an exotic species under the *Fisheries Management Act 2007* is already widespread within the Port River but *C. taxifolia,* declared noxious under the *Fisheries Management Act 2007* has only limited distribution (Wiltshire and Deveney 2017). While *Caulerpa* was not observed during the benthic survey; the potential presence for this species will be managed.
Potential Impacts	• Spread of *Caulerpa* to other areas in Port River.
Desired outcomes	• Compliance with: o *Fisheries Management Act 2007* (South Australia) o Development Approval and EPA dredge licence conditions.
Preliminary Risk Analysis	• Risk = Low, noting consultation with PIRSA will be required.
Controls	• Pre-works checks by video transect or diving were undertaken to identify the presence and extent of *C. taxifolia*. No *Caulerpa* present.
Monitoring	• Identification of *Caulerpa* during dredging.
Management Actions	• Should any *Caulerpa* be identified, the specimens will be removed, reported and disposed of in accordance with the instructions in the PIRSA brochure – "Identifying *Caulerpa* in South Australian Waters", refer Appendix A.
Reporting	• If *Caulerpa* identified during dredging, its presence will be reported to PIRSA.

5.6 Management of POMS

An environmental management framework for POMS management is summarised in Table 5-6.

Table 5-6: Environmental Management Framework – POMS

Item	Content
Applicability	• POMS was detected in feral oysters in the Port River in late February 2018 and is now endemic. • Dredging may facilitate the spread POMS either by translocation of contaminated bivalve and/or contaminated material through the movement of dredge material, or by disturbance by the dredge head followed by entrainment in the water column.
Potential Impacts	• Contribute to the spread of the POMS beyond the Port River estuary
Desired outcomes	• Compliance with: o *Fisheries Management Act 2007* (South Australia)[2] o Development Approval and EPA dredge licence conditions.
Preliminary Risk Analysis	• Within the PDL, four Razor clams were recorded during the benthic survey. No Pacific oysters were detected within the PDL (J Diversity 2024). • High densities of razor clams were recorded within the area of reclamation and Pacific oysters recorded along the rock revetment. • Spoil to be disposed of on land. • Risk = Low, increasing to Low/Medium risk if dredging undertaken during summer when sea water is warm.
Controls	• A POMS management plan will be developed for the Project and approved by PIRSA Biosecurity SA prior to the commencement of dredging activities.
Monitoring	• On arrival at the Port Adelaide, the dredge is to operate in accordance with DCCEEW and Australian Quarantine regulations.
Management Actions	• Biosecurity SA would be consulted to determine whether additional management measures are required.
Reporting	• If bivalve removal required, a clearance report will be prepared before the commencement of dredging.

[2] A new Biosecurity Act for South Australia is currently being developed which would merge several existing pieces of biosecurity legislation into one, to strengthen protection of the state's economy, terrestrial and aquatic environments and communities from the impacts of pests, diseases and other biosecurity matters (PIRSA 2023). Certain provisions for aquatic pests in the *Fisheries Management Act 2007* would also shift to the new legislation (PIRSA 2023). The Biosecurity Bill is expected to progress through the parliamentary process this year. This new Biosecurity Act may include aspects related to POMS.

5.7 Waste Management

An environmental management framework for waste management is summarised in Table 5-7.

Table 5-7: Environmental Management Framework – Waste management

Item	Content
Applicability	• Dredging activities may produce waste including – but not restricted to – litter, vessel waste and sewage. • Return of discharge water to Port River following fines settlement in dredge ponds.
Potential Impacts	• Release of waste into the environment impacting the marine environment.
Desired outcomes	• Compliance with all local regulations applicable to waste management and the International Convention for the Prevention of Pollution from Ships (IMO 2024).
Preliminary Risk Analysis	• Small volume of spoil to be removed (550 m^3). • No plastics/debris were found during sediments analysis (Golder 2020). • Chemical analyses of sediments within the PDL concluded that future spoil can be classified as Waste Fill according to the *Environment Protection Regulations 2023* (Golder 2020). • Risk = Low increasing to Medium depending on the level of waste generated on site from wider Project construction activities.
Controls	• Have regard to EPA waste management hierarchy. Adopt waste minimisation initiatives wherever possible and practical, including during procurement. • Segregate chemicals and hazardous waste from other solid waste and store, transport and dispose of them in accordance with regulatory requirements. • Provide adequate waste receptacles dedicated to and clearly labelled for each waste type and ensure their contents can be secured at sea. • Where practicable, compact material to reduce risk of unintentional loss. • Employ approved and licensed waste contractors for pick up and disposal of vessel waste and listed wastes. • Manage sewage in accordance with MARPOL 73/78 Annex, and dispose of black and grey water to an appropriate sewage treatment facility where possible. • Apply procedures to minimise spills or leakage during storage and place spill kits near areas where liquid wastes are stored.
Monitoring	• Inspections to ensure no accumulation of waste materials in work areas and appropriate storage of wastes. • Vessel garbage logs and waste receipts maintained on board. • Spoil discharge and pipelines must be inspected daily for litter and general housekeeping maintained. • Audits and vessel inspections.
Management Actions	• In the event that waste is lost overboard all reasonable and practicable measures must be employed to retrieve the waste.
Reporting	• Quantities and types of waste and disposal method. • Report any significant loss of waste material to client as soon as practicable.

5.8 Cultural Heritage

An environmental management framework for cultural heritage management is summarised in Table 5-8.

Table 5-8: Environmental Management Framework – Cultural Heritage

Item	Content
Applicability	• Dredging activities have the potential to uncover artefacts of cultural significance. • Dredging activities may disturb historic shipwreck in the vicinity of the Project site.
Potential Impacts	• Potential to damage or destroy items of cultural significance including Aboriginal sites, objects or remains and historic shipwreck.
Desired outcomes	• Avoid damage, destruction, interference with, removal or disposal of an historic shipwreck or relic. Compliance with all requirements of the Historic Shipwrecks Act 1981 and any permit granted under that Act. • Avoid damage, disturbance or interference with any Aboriginal site, object or remains. Compliance with all requirements of the *Aboriginal Heritage Act 1988.*
Controls	• Dredge operators will undergo cultural heritage inductions conducted by an appropriately trained professional, addressing: o the potential for undiscovered historic shipwreck material or Aboriginal sites, objects or remains o the steps to take should potential shipwreck material or Aboriginal sites, objects or remains be discovered.
Monitoring	• Monitoring of dredged material for articles related to ships and Aboriginal heritage.
Management Actions	• If at any time during the work, an Aboriginal site or a site containing items that could be associated with aboriginal occupation are uncovered, or any item or site of any cultural, archaeological or heritage significance is discovered or disturbed, work shall cease immediately, with reporting to relevant authorities (see below).
Reporting	• Encounters of articles related to ships to be reported to DEW as per Management Actions above. • Discovery of any Aboriginal sites, objects or remains to be reported to the Minister for Aboriginal Affairs and Reconciliation (AAR) in accordance with the *Aboriginal Heritage Act 1988*.

5.9 Noise

An environmental management framework for noise management is summarised in Table 5-9.

Table 5-9: Environmental Management Framework – Noise

Item	Content
Applicability	• Dredging activities (and other in-water activities such as piling) will produce terrestrial and underwater noise.
Potential Impacts	• Deterioration of acoustic amenity of surrounding sensitive receivers • Acoustic impacts (including hearing loss) on marine fauna
Desired outcomes	• Terrestrial noise level complying with the *Environment Protection (Commercial and Industrial Noise) Policy 2023.* • No complaints about noise associated with dredge operations from the public or port users. • No detectable impact of underwater noise on marine fauna.
Preliminary Risk Analysis	• Dredging activities may be undertaken 24 hours a day, 7 days a week, provided all EPA noise requirements and EPA regulations during working hours are met (e.g. Sunday starting times, noise levels between 10 pm and 7 am, etc). • Nearest residential sensitive receivers are located in North Haven > 800 m from the PDL. • Expected short dredging campaign duration of less than 2 weeks. During this time, dredging activities would emit a low pitch continuous noise. • Piling activities can emit multiple pulses at a rate of 30 to 60 per minute, generally at low frequencies (DIT, 2023). • Implementation of soft start of ten minutes at the beginning of piling and after any prolonged (>30 minute) break in piling. • Marine mammals most likely present within the vicinity of Port River are dolphins and seals; these mammals are highly mobile and would likely move a sufficient distance from any in-water noise generating activity (dredging and piling) can move away from the dredging activity. • Dredging and piling activities would be undertaken within the Adelaide Dolphin Sanctuary. • Risk = Low to Medium for dredging; and Medium to High for any piling activities (dependent on duration and timing of piling).
Controls	• Ensure all engines and equipment on board dredge vessels are properly maintained in good working order. • Development of noise management zones including: o an Observation Zone (where animals are detected and monitored, and the activity is prepared to be ceased if the animal continues to approach) o a Shutdown Zone (where piling shuts down as soon as reasonably practicable if the animal enters this zone) • A soft start of ten minutes at the beginning of piling and after any prolonged (>30 minute) break in piling. • A trained marine mammal observer. • Management of piling noise impacts would be consistent with the Underwater Piling and Dredging Noise Guidelines (DIT, 2023).
Monitoring	• A register will be maintained of noise complaints. • Noise complaints will be investigated, and an assessment made of the need for further investigation, e.g. handheld noise measurements to validate noise levels.
Management Actions	• All public complaints will be logged onto a complaint register and reviewed on an as

Item	Content
	needed basis by the project team and with the EPA. Works may be put on hold if required and as negotiated with the EPA/client. • Corrective measures in response to validated noise complaints include fixing faulty machinery.
Reporting	• The result of any noise investigations and corrective actions are to be provided to the client within two days of a complaint being received.

5.10 Hazardous substances

An environmental management framework for hazardous substances (including bunkering and spills) is summarised in Table 5-10.

Table 5-10: Environmental Management Framework – Hazardous substances

Item	Content
Applicability	• Dredging activities will require the use, transport and storage of hydrocarbons and chemicals. • Dredging activities will involve the disturbance of sediments from an industrial area, which have the potential to be contaminated with hazardous substances.
Potential Impacts	• Hydrocarbons and chemicals are released in the environment causing damage to existing ecosystem. • Potential existing contaminants within the sediments are released in the environment during dredging activities • Acidification of waters from potential Acid Sulphate Soil (ASS)
Desired outcomes	• Compliance with all local regulations applicable to hydrocarbon and chemical management and the International Convention for the Prevention of Pollution from Ships (IMO 2024). • No incidents during the delivery, transport or storage of hydrocarbons and chemicals. • No contamination of waters resulting from the release of potential hazardous substances contained in spoil.
Preliminary Risk Analysis	• The PDL is located within an industrial area (Port River) • Sediments are not considered a source of contaminants: o Sediments characterisation has shown chemical testing results are below ANZECC and NADG sediment screening levels and waste fill criteria under the *Environment Protection Regulations 2009* (Golder 2020). o While sediments were found to be potential ASS, the sediments contain sufficient neutralising capacity and would not need treatment or management (Golder 2020). • Refuelling will occur on land in a bunded area, where practicable, and follow relevant checklists and procedures. • Risk will depend on chosen refuelling methodology: o Risk = Low if vessels and machinery are refuelled on land within bunded area. o Risk = Medium if vessels and machinery are refuelled on land but area is not bunded o Risk = High if refuelling is undertaken over or directly adjacent water
Controls	• The following relevant checklists and procedures are followed for all fuelling events: o MCF042 - Fuel Transport and Bunkering Checklist o SWP094 - Fuel Transport and Bunkering o SWP077 - Spills and Leaks Cleanup Procedures o SWP121 - Bunkering Fuel Anchor Barge to Dredge o SWP134 - Marine Spill Control and Clean Up • Pre-start checks of plant and machinery • General housekeeping, hazardous material storage and waste management • Functional spill kits • Fuelling procedures and checklists • Use licensed suppliers for fuel transfer and transport.

Item	Content
	• Induct personnel in regard to spill management practices. • Adequately train all relevant staff and crew on procedures related to bunkering. • Ensure bunkering complies with the Flinders Ports bunkering procedure and permitting process, with appropriate spill controls and containment measures in place. • Maintain communication between bunkering vessels and the fuel supply during bunkering. • Ensure that all plant and equipment is fit for purpose, well maintained, and operated by an appropriately trained person. • Ensure vessels are equipped with sufficient low-pressure alarms and shutdown systems to minimise hydrocarbon loss to the marine environment in the event of a hydraulic hose failure. • Provide storage and handling of oils, grease and chemicals that comply with Australian Standard 1940-2004. • Maintain up-to-date Safety Data Sheets (SDS) for all oil and chemical products. • Inspect storage of all hazardous materials and hydrocarbons regularly.
Monitoring	• Undertake routine and pre-bunker hose and coupling monitoring/inspection. • Maintain and reconcile records of liquids received, stored and dispensed. • Undertake visual monitoring of hoses, couplings and the sea surface before and during bunkering operations.
Management Actions	• Implement spill contingency management. • If necessary, change hydrocarbon procedures and inform crew (via toolboxes).
Reporting	• Audits and incident reporting.

5.11 Air Quality

An environmental management framework for air quality management is summarised in Table 5-11.

Table 5-11: Environmental Management Framework – Air Quality

Item	Content
Applicability	• Transfer of spoil out of waters may release odour causing nuisance. • Drying of spoil may generate dust.
Potential Impacts	• Deterioration of amenity of surrounding sensitive receivers
Desired outcomes	• Odour level complying with Schedule 3 of the Environment Protection (Air Quality) Policy 2016. • No complaints about odour or air quality associated with dredge operations from the public or port users.
Preliminary Risk Analysis	• Disposal location is within industrial land use area and the nearest resident located 800 m from dredge pond. • Spoil has low levels of organic matter that generate odour (less than 5%, Golder 2020). • Sediments in the PDL were found to be potential ASS (Golder 2020), and therefore have the potential to general odours. However, sediments were assessed as having have sufficed neutralising capacity with no management required (Golder 2020) • All public complaints will be logged onto the complaints register and reviewed on an as needed basis by the project team and with the EPA/client. Works may be put on hold if significant odour persists. • Spoil consists of fine sediment (silt and clay) with the potential to result in dust when dry. • Risk = Medium
Controls	• A concerns and complaints register will be developed, implemented and maintained during dredging activities.
Monitoring	• Odour and dust complaints will be investigated, and an assessment made of the need for further investigation
Management Actions	• All public complaints will be logged onto the complaints register and reviewed on an as needed basis by the project team and with the EPA. • Works may be put on hold if significant odour persists.
Reporting	• A register will be maintained of odour and air quality complaints.

6. Limitations

Scope of services

This report ("the report") has been prepared by JBS&G in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and JBS&G. In some circumstances, a range of factors such as time, budget, access and/or site disturbance constraints may have limited the scope of services. This report is strictly limited to the matters stated in it and is not to be read as extending, by implication, to any other matter in connection with the matters addressed in it.

Reliance on data

In preparing the report, JBS&G has relied upon data and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise expressly stated in the report, JBS&G has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. JBS&G has also not attempted to determine whether any material matter has been omitted from the data. JBS&G will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to JBS&G. The making of any assumption does not imply that JBS&G has made any enquiry to verify the correctness of that assumption.

The report is based on conditions encountered and information received at the time of preparation of this report or the time that site investigations were carried out. JBS&G disclaims responsibility for any changes that may have occurred after this time. This report and any legal issues arising from it are governed by and construed in accordance with the law as at the date of this report.

Environmental conclusions

Within the limitations imposed by the scope of services, the preparation of this report has been undertaken and performed in a professional manner, in accordance with generally accepted environmental consulting practices. No other warranty, whether express or implied, is made, including to any third parties, and no liability will be accepted for use or interpretation of this report by any third party.

The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose.

JBS&G accepts no liability for use or interpretation by any person or body other than the client who commissioned the works. This report should not be reproduced without prior approval by the client, or amended in any way without prior approval by JBS&G or reproduced other than in full, including all attachments as originally provided to the client by JBS&G.

7. References

Australian Government (2009a), National Biofouling Management Guidelines for Non-Trading Vessels, National System for the Prevention and Management of Marine Pest Incursions.

Australian Government (2009b), National Biofouling Management Guidelines for Commercial Vessels, National System for the Prevention and Management of Marine Pest Incursions

BOM (2024). South Australian Tide Tables, 2024. Bureau of Meteorology, Australian Government. Retrieved from http://www.bom.gov.au/oceanography/projects/ntc/sa_tide_tables.shtml

Boskalis (2019). Dredge Management Plan, Port Adelaide Outer Harbor Channel Widening.

DEECCW (2024). Australasian Underwater Cultural Heritage Database. Access on 09 April 2024 at https://www.dcceew.gov.au/parks-heritage/heritage/underwater-heritage/auchd

DEWHA (2009). National Assessment Guidelines for Dredging, Commonwealth of Australia, Department of the Environment, Water, Heritage and the Arts, Canberra, 2009.

DEWNR (2007), Adelaide Dolphin Sanctuary – Reference Paper 1: Dolphins, Department of Environment, Water and Natural Resources, Government of South Australia.

DIT (2023). Underwater Piling and Dredging Noise Guidelines. Environment and Heritage Technical Manuel, Attachment 7E. Retrieved from https://www.dit.sa.gov.au/standards?a=955077

EPA (2020). Dredge Guideline. Environment Protection Authority South Australia. Retrieved from https://www.epa.sa.gov.au/environmental_info/water_quality/programs/dredge-guideline

Flinders Port Holdings (2024). Case Study: Moving towards Smart Port status at Flinders Adelaide Container Terminal (FACT). Retrieved from https://www.flindersportholdings.com.au/wp-content/uploads/2024/01/CASE-STUDY_FACT_Smart-Port-Status_FINAL2024.pdf

Golder associates Pty Ltd (2020). Flinders Ports Berth 6 Dredging. Seagrass Survey, Sediment Sampling and Characterisation.

Hewitt, CL & Campbell, ML (2010), The relative contribution of vectors to the introduction and translocation of marine invasive species, Report for the Department of Agriculture, Fisheries and Forestry, the National Centre for Marine Conservation and Resource Sustainability, Australian Maritime College, University of Tasmania, Launceston.

IMO (2024), International Convention for the Prevention of Pollution from Ships (MARPOL), Accessed on 09 April 2024 at https://www.imo.org/en/about/Conventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-(MARPOL).aspx International Maritime Organisation.

JBS&G Pty Ltd (2024). Berth 6 Precinct Upgrade – EPBC Self-assessment. Report for Flinders Ports Holdings.

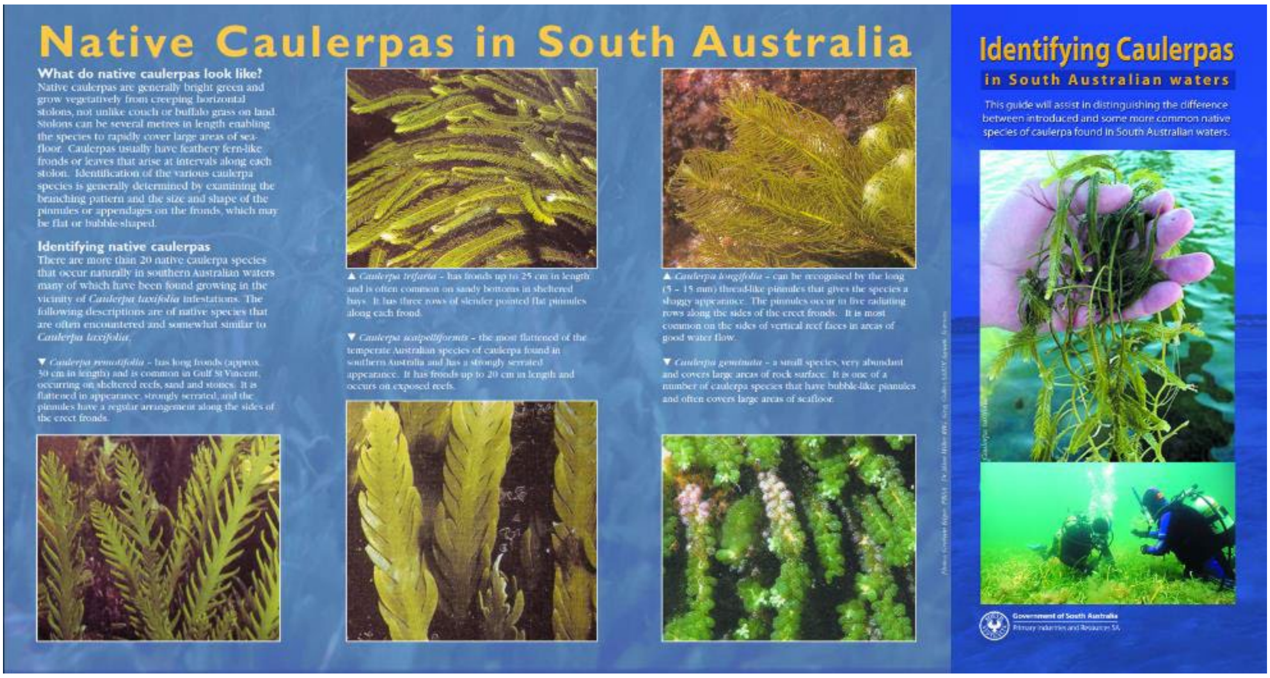
J Diversity Pty Ltd (2024). Outer Harbor Berth 6 Benthic survey report. Report for Flinders Ports Holdings.

PIRSA (undated), Frequently asked questions: Port River POMS outbreak. Primary Industries and Regions South Australia.

PIRSA (2023). Draft Biosecurity Bill Overview. Developing a new Biosecurity Act for South Australia. Department of Primary Industries and Regions (PIRSA), Government of South Australia.

Wiltshire, K.H and Deveney, M.R. (2017). The introduced alga *Caulerpa taxifolia* in South Australia: infestation boundary surveys and feasibility of control for populations outside the containment area. Report for PIRSA Biosecurity SA. South Australian Research and Development Institute (Aquatic Sciences), Adelaide. SARDI Publication No. F2017/000204-1. SARDI Research Report Series No. 946. 16pp.

Appendix A *Caulerpas* in South Australia



Native Caulerpas in South Australia

What do native caulerpas look like?

Native caulerpas are generally bright green and grow vegetatively from creeping horizontal stolons, not unlike couch or buffalo grass on land. Stolons can be several metres in length enabling the species to rapidly cover large areas of sea-floor. Caulerpas usually have feathery fern-like fronds or leaves that arise at intervals along each stolon. Identification of the various caulerpa species is generally determined by examining the branching pattern and the size and shape of the pinnules or appendages on the fronds, which may be flat or bubble-shaped.

Identifying native caulerpas

There are more than 20 native caulerpa species that occur naturally in southern Australian waters many of which have been found growing in the vicinity of *Caulerpa taxifolia* infestations. The following descriptions are of native species that are often encountered and somewhat similar to *Caulerpa taxifolia*.

▼ *Caulerpa remotifolia* – has long fronds (approx. 30 cm in length) and is common in Gulf St Vincent, occurring on sheltered reefs, sand and stones. It is flattened in appearance, strongly serrated, and the pinnules have a regular arrangement along the sides of the erect fronds.

▲ *Caulerpa trifaria* – has fronds up to 25 cm in length and is often common on sandy bottoms in sheltered bays. It has three rows of slender pointed flat pinnules along each frond.

▼ *Caulerpa scalpelliformis* – the most flattened of the temperate Australian species of caulerpa found in southern Australia and has a strongly serrated appearance. It has fronds up to 20 cm in length and occurs on exposed reefs.

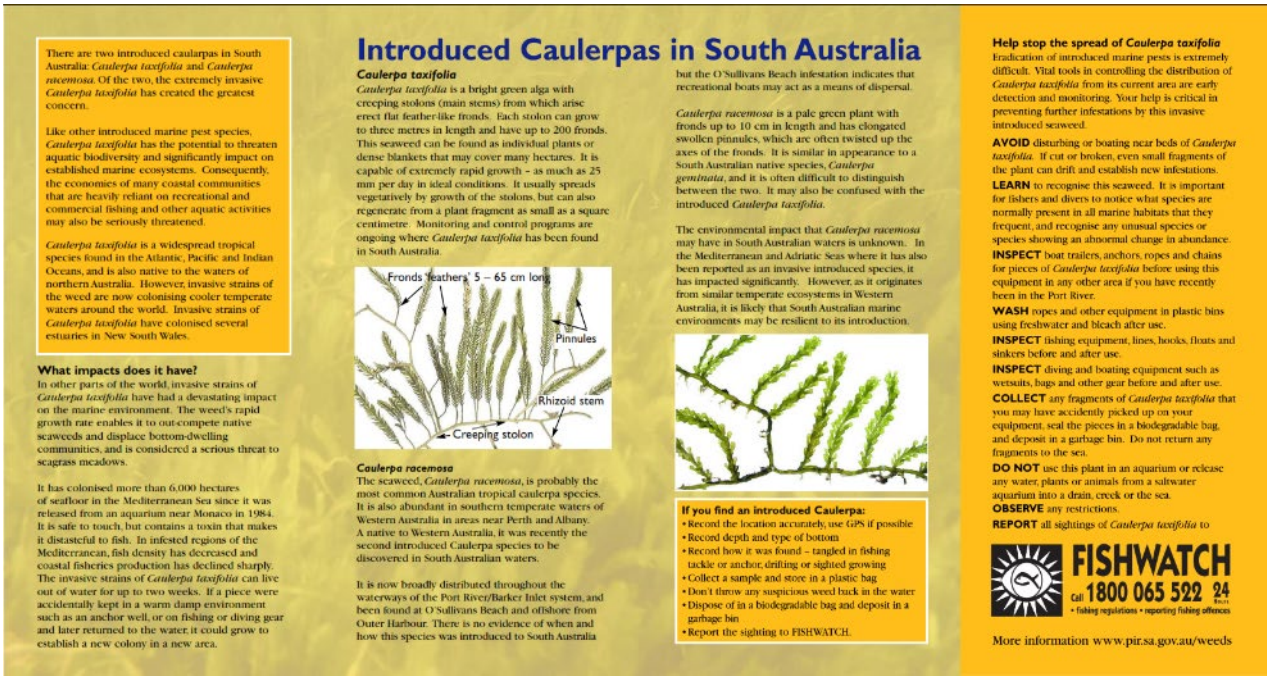
▲ *Caulerpa longifolia* – can be recognised by the long (5 – 15 mm) thread-like pinnules that gives the species a shaggy appearance. The pinnules occur in five radiating rows along the sides of the erect fronds. It is most common on the sides of vertical reef faces in areas of good water flow.

▼ *Caulerpa geminata* – a small species, very abundant and covers large areas of rock surface. It is one of a number of caulerpa species that have bubble-like pinnules and often covers large areas of seafloor.

Identifying Caulerpas in South Australian waters

This guide will assist in distinguishing the difference between introduced and some more common native species of caulerpa found in South Australian waters.

Government of South Australia
Primary Industries and Resources SA



There are two introduced caularpas in South Australia: *Caulerpa taxifolia* and *Caulerpa racemosa*. Of the two, the extremely invasive *Caulerpa taxifolia* has created the greatest concern.

Like other introduced marine pest species, *Caulerpa taxifolia* has the potential to threaten aquatic biodiversity and significantly impact on established marine ecosystems. Consequently, the economies of many coastal communities that are heavily reliant on recreational and commercial fishing and other aquatic activities may also be seriously threatened.

Caulerpa taxifolia is a widespread tropical species found in the Atlantic, Pacific and Indian Oceans, and is also native to the waters of northern Australia. However, invasive strains of the weed are now colonising cooler temperate waters around the world. Invasive strains of *Caulerpa taxifolia* have colonised several estuaries in New South Wales.

What impacts does it have?

In other parts of the world, invasive strains of *Caulerpa taxifolia* have had a devastating impact on the marine environment. The weed's rapid growth rate enables it to out-compete native seaweeds and displace bottom-dwelling communities, and is considered a serious threat to seagrass meadows.

It has colonised more than 6,000 hectares of seafloor in the Mediterranean Sea since it was released from an aquarium near Monaco in 1984. It is safe to touch, but contains a toxin that makes it distasteful to fish. In infested regions of the Mediterranean, fish density has decreased and coastal fisheries production has declined sharply. The invasive strains of *Caulerpa taxifolia* can live out of water for up to two weeks. If a piece were accidentally kept in a warm damp environment such as an anchor well, or on fishing or diving gear and later returned to the water, it could grow to establish a new colony in a new area.

Introduced Caulerpas in South Australia

Caulerpa taxifolia

Caulerpa taxifolia is a bright green alga with creeping stolons (main stems) from which arise erect flat feather-like fronds. Each stolon can grow to three metres in length and have up to 200 fronds. This seaweed can be found as individual plants or dense blankets that may cover many hectares. It is capable of extremely rapid growth – as much as 25 mm per day in ideal conditions. It usually spreads vegetatively by growth of the stolons, but can also regenerate from a plant fragment as small as a square centimetre. Monitoring and control programs are ongoing where *Caulerpa taxifolia* has been found in South Australia.

Caulerpa racemosa

The seaweed, *Caulerpa racemosa*, is probably the most common Australian tropical caulerpa species. It is also abundant in southern temperate waters of Western Australia in areas near Perth and Albany. A native to Western Australia, it was recently the second introduced Caulerpa species to be discovered in South Australian waters.

It is now broadly distributed throughout the waterways of the Port River/Barker Inlet system, and been found at O'Sullivans Beach and offshore from Outer Harbour. There is no evidence of when and how this species was introduced to South Australia but the O'Sullivans Beach infestation indicates that recreational boats may act as a means of dispersal.

Caulerpa racemosa is a pale green plant with fronds up to 10 cm in length and has elongated swollen pinnules, which are often twisted up the axes of the fronds. It is similar in appearance to a South Australian native species, *Caulerpa geminata*, and it is often difficult to distinguish between the two. It may also be confused with the introduced *Caulerpa taxifolia*.

The environmental impact that *Caulerpa racemosa* may have in South Australian waters is unknown. In the Mediterranean and Adriatic Seas where it has also been reported as an invasive introduced species, it has impacted significantly. However, as it originates from similar temperate ecosystems in Western Australia, it is likely that South Australian marine environments may be resilient to its introduction.

If you find an introduced Caulerpa:

- Record the location accurately, use GPS if possible
- Record depth and type of bottom
- Record how it was found – tangled in fishing tackle or anchor, drifting or sighted growing
- Collect a sample and store in a plastic bag
- Don't throw any suspicious weed back in the water
- Dispose of in a biodegradable bag and deposit in a garbage bin
- Report the sighting to FISHWATCH.

Help stop the spread of *Caulerpa taxifolia*

Eradication of introduced marine pests is extremely difficult. Vital tools in controlling the distribution of *Caulerpa taxifolia* from its current area are early detection and monitoring. Your help is critical in preventing further infestations by this invasive introduced seaweed.

AVOID disturbing or boating near beds of *Caulerpa taxifolia*. If cut or broken, even small fragments of the plant can drift and establish new infestations.

LEARN to recognise this seaweed. It is important for fishers and divers to notice what species are normally present in all marine habitats that they frequent, and recognise any unusual species or species showing an abnormal change in abundance.

INSPECT boat trailers, anchors, ropes and chains for pieces of *Caulerpa taxifolia* before using this equipment in any other area if you have recently been in the Port River.

WASH ropes and other equipment in plastic bins using freshwater and bleach after use.

INSPECT fishing equipment, lines, hooks, floats and sinkers before and after use.

INSPECT diving and boating equipment such as wetsuits, bags and other gear before and after use.

COLLECT any fragments of *Caulerpa taxifolia* that you may have accidently picked up on your equipment, seal the pieces in a biodegradable bag, and deposit in a garbage bin. Do not return any fragments to the sea.

DO NOT use this plant in an aquarium or release any water, plants or animals from a saltwater aquarium into a drain, creek or the sea.

OBSERVE any restrictions.

REPORT all sightings of *Caulerpa taxifolia* to

FISHWATCH
Call 1800 065 522 24 hours
• fishing regulations • reporting fishing offences

More information www.pir.sa.gov.au/weeds

Appendix B Water Quality Monitoring Program

Click or tap here to enter text.

©JBS&G Australia Pty Ltd

© JBS&G
This document is and shall remain the property of JBS&G. The document may only be used for the purposes for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited

Document Distribution

Rev No.	Copies	Recipient	Date
0	Electronic	Flinders Port Holdings	13/05/2024

Document Status

Rev No.	Author	Reviewer	Approved for Issue		
		Name	Name	Signature	Date
A	Morgane Mallaird	Nicole Patten			
B	Morgane Mallaird / Nicole Patten	David Lenel	David Lenel		10/05/2024

©JBS&G Australia Pty Ltd

Appendix L

Tonkin stormwater assessment

Building exceptional outcomes together

Memorandum

To	Mark Wildman (Flinders Ports)		
From	James Farrall (Tonkin)	Date	16 January 2025
Job Number	241265.04		
Subject	Gateway SA – Berth 6 Extension – Stormwater assessment memo for Development Approval		

Summary

Flinders Port Holdings (FPH) and GatewaySA have requested Tonkin to prepare a memorandum regarding a site stormwater assessment for the Berth 6 Extension (Coghlan Road, Outer Harbor) to support submission of a Development Approval (DA) application.

This memorandum considers the following specific requirements (shown in blue) as outlined by Port Adelaide Enfield Council (PAEC) as part of a recent DA application for the nearby Lot 9 development completed by FPH:

Stormwater

1. *Stormwater Management Plan should be submitted for the development areas which demonstrates:*

   1.1. *The design of stormwater quality improvement systems should ensure the following reduction targets are achieved: 90% gross pollutants (greater than 50mm), 80% total suspended solids (TSS), 60% total phosphorus (TP), 45% total nitrogen (TN) and demonstrated reduction of hydrocarbons (oils and greases). Typically, we see the following stormwater quality treatment measures where Lots discharge directly to the Port River:*

   a. *Tertiary treatment device which has undergone SQIDEP certification sized based on first flush stormwater flows (4-EY)*

   See commentary in the "Water Quality Improvement Strategy" section.

   b. *Tidal flap gate to prevent sea water entering tertiary treatment device*

   A tidal flap gate shall be installed in network prior to outfall into the Port Adelaide River to prevent backflow into water quality treatment devices.

   1.2. *HGL stormwater calculations which demonstrates the site is not subject to flooding under tidal conditions. Following downstream tailwater levels should be adopted within the modelling/calculations:*

   a. Major Storm (1% AEP): 1.25m AHD
   b. Minor Storm (0.2-EY): 2.5m AHD

   Based on the local catchment analysis there is no identified adverse impacts to external parties or external infrastructure as a consequence of the proposed development as use of an outfall independent of any external upstream catchments is proposed.

It should be noted that the proposed configuration utilising the existing local stormwater drainage outfall will result in some localised ponding at surface level in a major storm event.

Based on discussion with Flinders Ports, the presence of localised ponding or flooding within their site is acceptable to them as the ultimate asset owner.

Ponding associated with the major storm event could be mitigated via use of a new larger outfall pipe if desired.

Civil

2. *Detailed Civil Plans showing survey data, finished surface treatments, site levels, finished floor levels, earthworks/retaining walls, existing trees, services, infrastructure etc. intended to be constructed. Proposed (new) permanent buildings should have a finished surface levels above minimum coastal flooding freeboard requirements.*

Berth 6 Extension drawings are being prepared by another consultancy and should be cognisant of the proposed stormwater solution.

Preliminary Stormwater Assessment

FPH propose to undertake a Berth 6 extension at the Flinders Adelaide Container Terminal (FACT), the extent of these works is shown below on aerial. The works consist of approximately 4250m^2 additional hardstand area.

Figure 1 - Proposed Berth 6 Extension Extent

Generally, there is an independent stormwater network and outfall for each berth at FACT (berth 6, berth 7, berth 8) as shown in the existing site configuration in Figure 2. Drainage of the Berth 6 Extension is proposed operate independently of these major trunk outfalls and rather is proposed to discharge via the existing cargo shed outfall shown in Figure 3 or a new outfall.

Figure 2 – Existing Stormwater Network

The berth 6 extension area is currently undeveloped and adjacent to an existing cargo shed building. The existing cargo shed building is understood the drain via its own 375mm outfall pipe independent of the large trunk outfalls based on historical plans as shown in Figure 3.

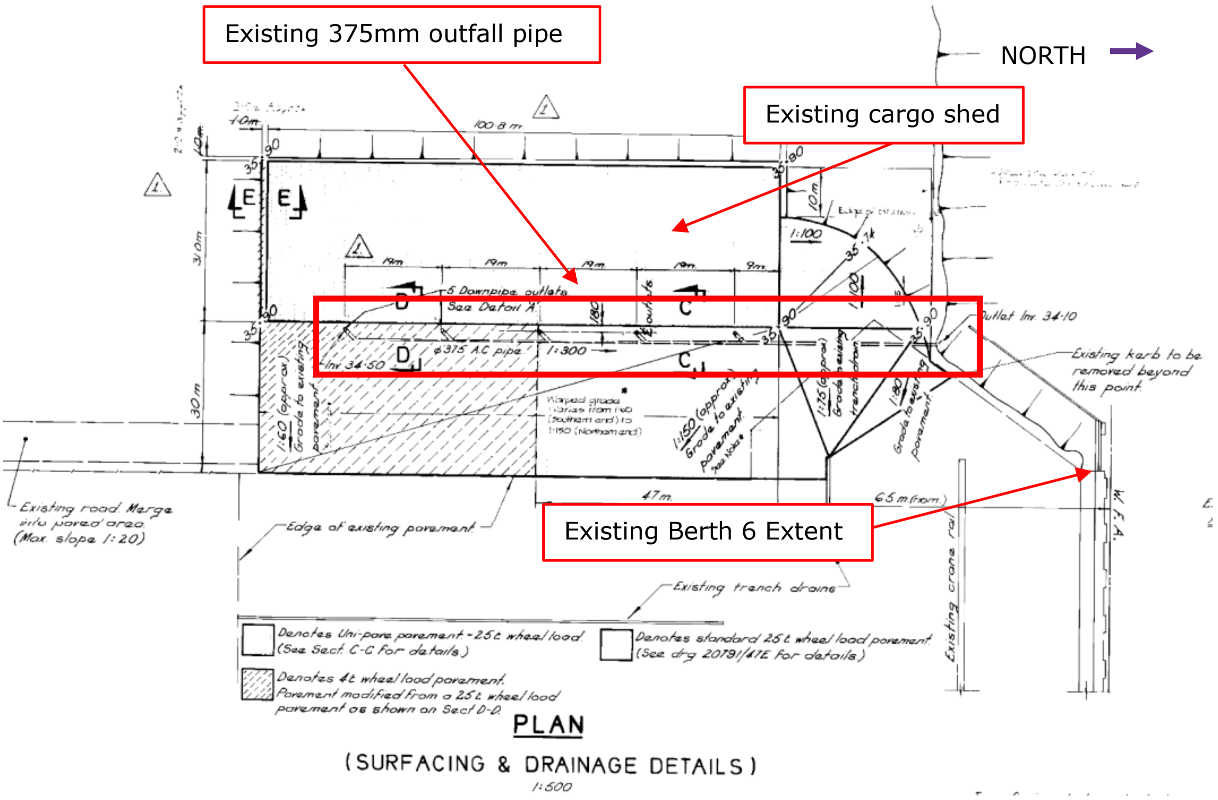


Figure 3 - Outer Harbor No 6 Container Berth Cargo Shed Historical Drawing 21297-15, Registered 9.2.81

A review of the sites existing topography and drainage catchments suggests that the proposed Berth 6 extension may discharged via the Cargo Shed's outfall pipe or a new outfall independent of the two major Berth 6 drainage outfalls. This would prevent impacts to the upstream network.

The current Berth 6 drainage strategy was also reviewed as part of these works. Historical drawings (see Figure 4) show that the northern crane rail forms a ridge and the existing berth generally grades inland to a series of strip drains before discharging to the harbour. As the existing berth crane rail is expected to be extended through the berth extension, the same grading arrangement will need to be maintained. Although, the strip drains may be replaced with an alternative inlet structure such as grated inlet pits and spoon drains of kerbing.

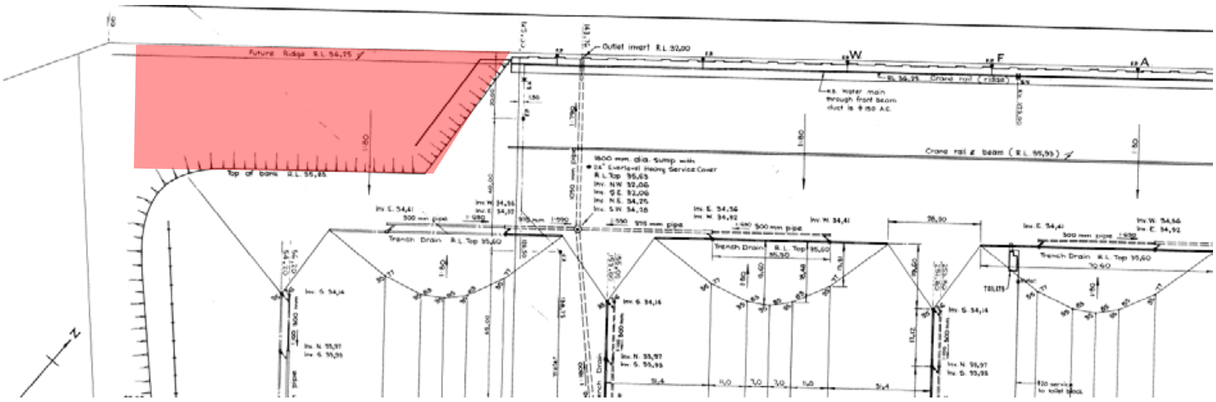


Figure 4 - Historical Drainage Drawing 20280/15 registered drawing 8.1.75

The abovementioned drainage strategy was assessed through the development of a localised DRAINS model. A previous model had been developed for the wider site to assess the capacity of the proposed major trunk drainage network however as the proposed strategy is to drain the berth 6 extension independent of these trunk outfalls only a smaller more localised model was able to be used. Catchment extents from the larger model were considered in the development of the smaller localised model to ensure all catchment areas within FACT had been accounted for.

Our assessment considered a 0.2 EY storm event and a check was also completed for a 1% AEP event. Both events have been based on the tidal tailwater conditions stipulated by Council (Major Storm (1% AEP): 1.25m AHD and Minor Storm (0.2-EY): 2.5m AHD)

The data used to prepare this assessment was provided by FPH and consists of historical drawings and recently obtained site survey (SKS Surveys, dated 05/08/2024). It is noted that the survey did not provide inverts for the existing 375mm outfall, and as such, several assumptions have still been made regarding the network which will need to be confirmed during detailed design.

Hydrological Parameters

As required by Council, the DRAINS model used a downstream boundary constraint of 1.25 mAHD for the 1% AEP major storm and 2.5 mAHD for the 0.2 EY minor storm.

An IL-CL hydrological model was used with DRAINS model with the following parameters:

Impervious Area Initial Loss (mm) = 1mm

Impervious Area Continuing Loss (mm/hr) = 0mm/hr

Pervious Area Initial Loss (mm) = 29mm

Pervious Area Continuing Loss (mm/hr) = 4mm/hr

A combination of lumped and discrete catchment areas has been used throughout this assessment. Catchments were considered to be 100% impervious with time of concentrations between 5- and 11-minutes dependent on catchment size.

Berth 6 Extension Network

The existing Berth 6 major stormwater network currently accepts and conveys runoff from Coghlan Road and Berth 6 FACT. The proposed outfall for the Berth 6 extension is independent of this larger network and has been assessed as out falling via the existing cargo shed outfall pipe.

The green area outlined below is understood to currently discharge via the existing 375mm cargo shed outfall. The remaining roof and surrounding pavement area currently discharges via an alternative stormwater network.

Figure 5 - Existing outfall proposed drainage strategy

The existing outfall has been assessed assuming that the cargo shed catchment remains in place. In reality the cargo shed is expected to be removed in the near future as part of other FACT reconfiguration works, should this occur the original Berth 6 drainage strategy would be expected to be reinstated and the shed area currently utilising the 375mm outfall would instead be drained via the existing pavement drainage network as was originally depicted in historical drawings. Our approach therefore considers the worst case of the shed catchment and Berth 6 expansion utilising the 375mm outfall at the same time.

The Berth 6 Expansion is expected to have approximately a 4230m^2 catchment area. We have assumed at this stage use of strip drains along the extensions interface with the existing pavement area. Proprietary ACO strip drain is able to be installed up to a maximum length of 40m while maintaining a consistent internal longitudinal grade of 0.5%. Two 40m lengths of ACO have therefore been assessed against the extensions catchment area. Given the restriction on ACO drain installation lengths the first 40m length of strip drain would be collected and conveyed via a 375mm pipe to the existing 375mm outfall. The second 40m length of ACO drain could discharge via a new junction box along the existing 375mm outfall pipe.

1% AEP and 0.2EY findings and DRAINS screenshots are presented below.

0.2EY Event

Drains modelling suggests use of the existing 375mm outfall in the 0.2EY event is feasible with at least 0.15m freeboard being achieved within the localised pipe network. Peak flows within the pipe network and a long section of the outfall pipe segment are presented below.

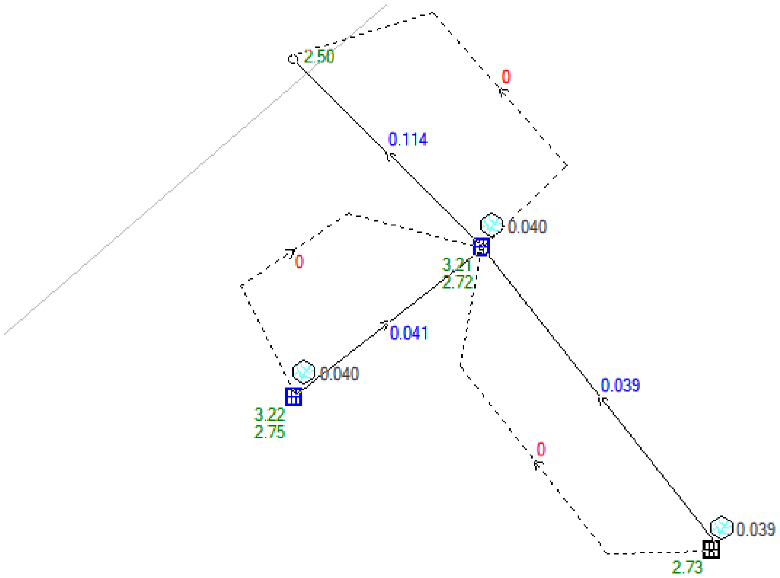


Figure 6 – 0.2 EY Proposed Berth 6 Extension connection to existing cargo shed outfall pipe

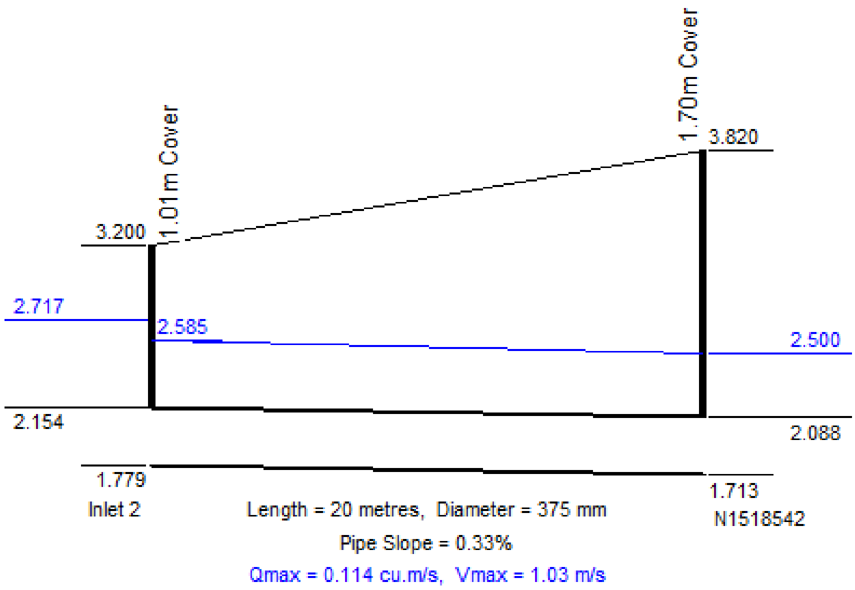


Figure 7 - 375mm outfall pipe HGL 0.2 EY

1% AEP

Use of the existing 375mm outfall in the 1% AEP is feasible with a small amount of ponding occurring during the peak of the storm event along the proposed strip drain or alternative inlet structure.

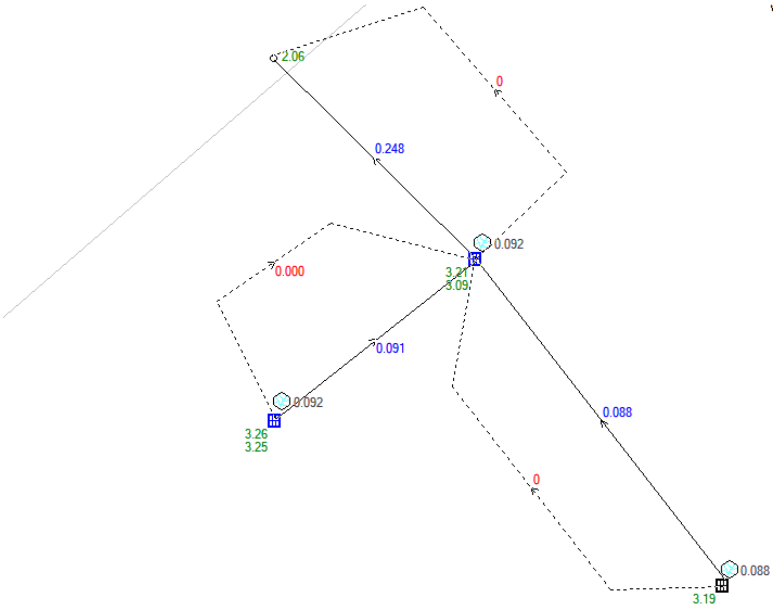


Figure 8 – 1% AEP Proposed Berth 6 Extension connection to existing cargo shed outfall pipe

During the 1% AEP event, freeboard in the outfall pipe is reasonable however further upstream the HGL is at or near surface. Discharge of the network via the existing 375mm is ultimately still capable of occurring and clearing the 1% AEP occurs with some surface ponding. Any ponding would be contained within the FACT site before discharging and ponding would not cause nuisance or inundation to others. A larger outfall pipe could be installed to improve the 1% AEP freeboard levels but this would only occur at Flinders Ports discretion should a higher level of service be required for any reason.

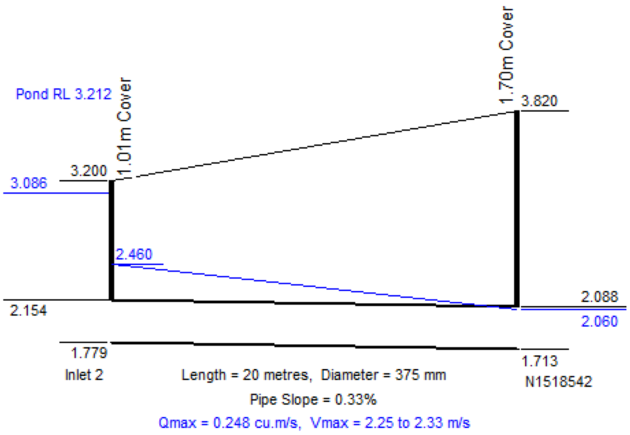


Figure 9 - 375mm outfall pipe HGL 1% AEP

Water Quality Improvement Strategy

As part of the proposed drainage works for the Berth 6 Extension, the outfall may be provided with a new water quality treatment device prior to discharge. This will ensure that runoff is treated prior to discharging to the receiving waters. This device should be an "off-line" type, meaning that flow rates exceeding the system capacity will be routed around the treatment device.

Council requires the following reduction objectives to be met:

- 90% gross pollutants (greater than 50mm)
- 80% total suspended solids (TSS)
- 60% total phosphorus (TP)
- 45% total nitrogen (TN)
- demonstrated reduction of hydrocarbons (oils and greases).

A GPT is typically sized to treat the 3-month (4EY) flow rate. DRAINS modelling suggests a treatment flow rate of approximately 40L/s would be required for the GPT unit. Numerous proprietary GPT units exist and would be suitable for installation within the network. The exact device should be determined during detailed design as consideration of a units potential buoyancy with such high tailwater and therefore groundwater levels may influence the most applicable unit configuration. The final performance of a selected treatment device may be assessed using MUSIC software during software or alternatively published performance criteria and an adequate treatment flow rate may be used to determine selection of an appropriate GPT.

As an example, an Atlan Ecoceptor paired with a storm sack may be capable of achieving the required treatment rates and demonstrated hydrocarbon reduction and has available units with treatment flow rates exceeding our required treatment flow rate. Numerous alternatives are also available and as mentioned above, final selection may occur during detailed design works.

Tested Treatment Efficiencies*

POLLUTANT	EFFICIENCY
Gross Pollutants (GP)	95%
Total Suspended Solids (TSS)	71%
Total Phosphorus (TP)	69%
Total Nitrogen (TN)	47%
Petroleum Hydrocarbon	93%

*Contact Atlan to confirm approved performance for the project LGA
Organic/particulate component of the nutrient only.

Figure 10 - Published Altan Ecoceptor Treatment Efficiencies

POLLUTANT	EFFICIENCY
Gross Pollutants (GP)	100%
Total Suspended Solids (TSS)	45%
Total Phosphorus (TP)	47%
Total Nitrogen (TN)	25%

*Contact Atlan to confirm approved performance for the project LGA

Figure 11 - Published Altan StormSack Treatment Efficiencies

Figure 12 - MUSIC treatment train

A MUSIC model was developed to assess the treatment train efficiency of the proposed 4000 Series Ecoceptor and StormSack combination. Pollutant loads from the South Australian MUSIC Guidelines were used to assess the treatment train effectiveness.

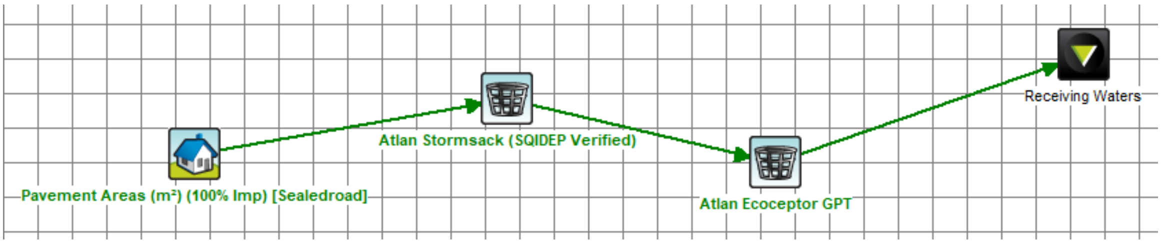


Figure 13 - MUSIC Treatment Train

The resultant treatment train effectiveness is presented in Figure 14 below. This treatment train effectiveness exceeds Councils Objectives.

Treatment Train Effectiveness - Receiving Waters

	Sources	Residual Load	% Reduction
Flow (ML/yr)	3.09	3.09	0
Total Suspended Solids (kg/yr)	1100	190	82.8
Total Phosphorus (kg/yr)	1.82	0.327	82
Total Nitrogen (kg/yr)	7.56	3.09	59.1
Gross Pollutants (kg/yr)	88.1	0.265	99.7

Figure 14 - Treatment Train Effectiveness

Appendix M

Traffic management plan

EMM
creating opportunities

Traffic Management Plan – FACT

This Traffic Management Plan establishes the controls required to ensure safe movement of all vehicles, plant, and pedestrians onsite at Flinders Adelaide Container Terminal.

This plan applies to all Flinders Port Holdings (FPH) workers, labour hire workers, visitors, contractors and third parties who enter the FACT site.

Critical risks to be aware of:

Key Hazards	Critical Risks
Pedestrians near vehicles operating, including trucks reversing and mobile plant e.g. straddle carriers	Pedestrian struck by mobile plant.
Mobile plant e.g., Empty container movers (MTMs)/ Straddle carriers operating near other mobile plant e.g., Reach Stackers/ straddle carriers	Collision between mobile plant and other mobile plant.
Pedestrians, vehicles, and mobile plant operating near Quay Cranes	Struck by load.

What needs to go right to keep our site safe

- All authorised vehicles and trucks must enter and exit the site through the following gates:
  - Gate 3 – entry and exit for Light Vehicles to Empty Container Park / FACT Training Centre
  - Gate 2 – entry and exit for Heavy Vehicles to FACT or Empty Container Park
  - Gate 1 – entry and exit for Light Vehicles to FACT
- Upon entering **visitors, contractors and truck drivers must stop** and **report to the security hut.**
- Truck drivers and contractors entering FACT must complete an online induction prior to gaining access.
- External stakeholder and site visitors to be accompanied by a site escort whilst on site.
- Truck drivers once parked in designated loading/ unloading bay, must remain in the **driver safe zone**.
- Whilst FACT straddle carriers are in FWD2-FACT/ FWD1-FACT interchange grid no other personnel are allowed to enter.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

PPE requirements at FACT in operational areas are hi-vis clothing, steel capped footwear and hard hat.

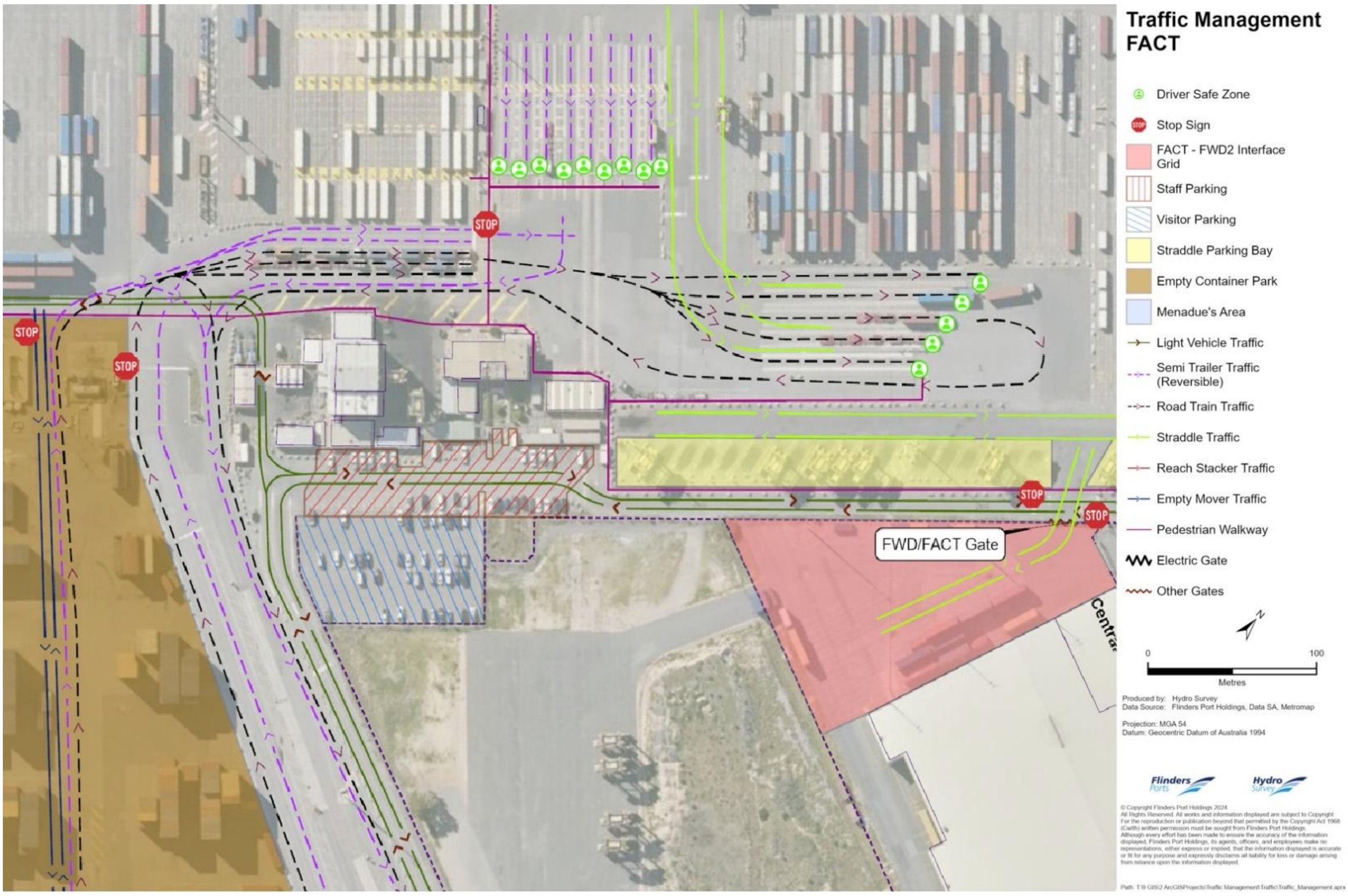
 ☒ Hi-Viz	 ☒ Safety Shoes	 ☒ Hard Hat

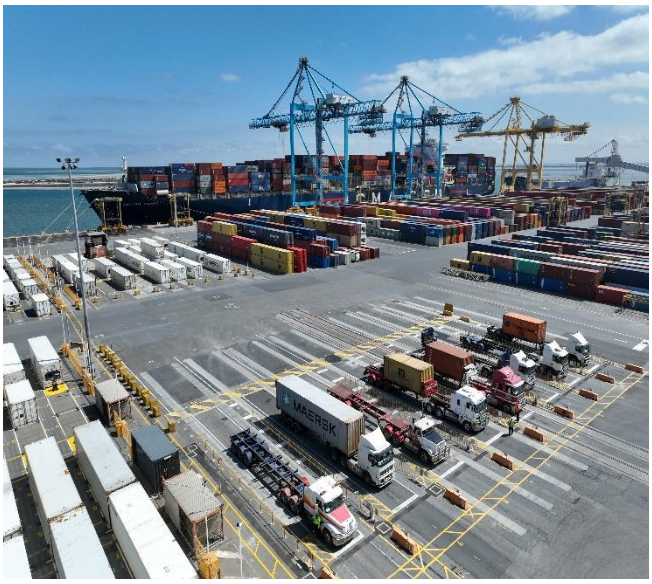
1.1 - FACT SITE CONSISTS OF:

- Main Administration Building for FACT Management and Stevedore amenities area.
- Container Terminal/ Yard stacking area.
- Empty container park stacking area.
- Maintenance Building Workshop and Maintenance personnel amenities area.
- FACT Store.
- Menadue container repairs building / shed.
- Single point entry and exit sliding electric gates with MSIC security access for all light vehicles.
- Single point entry and exit with security access hut for heavy vehicles.
- Visitor and employee light vehicle car park bays.
- Truck loading and unloading servicing zones.
- 2 Vessel Berth with associated stacking areas.
- Dual rail spurs with associated stacking area (including designated QUBE interchange area).
- FWD1/FWD2-FACT interchange grids.
- Weighbridge for trucks.

1.2 TRAFFIC FLOW DIAGRAM

1.3 TRAFFIC FLOW DIAGRAM – For Semi Trailer and Road Train Lanes





1.4 TYPES OF TRAFFIC FLOW

Heavy Vehicle and Mobile Plant Movements

Plant movements include:

- Trucks delivering and collecting containers (Singles & Road Trains)
- Trucks/ couriers delivering goods.
- Forklifts for handling loads/goods.
- Reach Stackers for loading and unloading containers on/off train carriages.
- Reach Stackers may be required for OOG movement within container terminal area under escort/direction.
- Empty container movers for loading and unloading containers on/off train carriages.
- Empty container movers for the Empty Container Park – including interchange area.
- Straddle Carriers for loading and unloading containers to and from Yard stacking area, trucks, vessel, rail and FWD interchange grids.
- ITVs / Bomcarts for container movements.
- Maintenance plant movements
- Elevated Work Platforms
- Train movements

Light Vehicle Movements

Light vehicle movements include cars, Utes, vans, and courier vehicles accessing the light vehicle car parks, light vehicles accessing the wharf (the Northern roadway is the preferred method to access the wharf from the admin building), light vehicles accessing the store. Only FPH approved light vehicles are to travel in operational area, any other movements are to be under escort conditions.

Pedestrians

Pedestrian movements may include FPH workers, other third parties operating on site (truck drivers), visitors or contractors.
Non-MSIC visitors must be escorted by FPH personnel.
All visitors must remain in pedestrian areas, and have prior notified a FPH representative and/or checked in with security of their intended visit.

1.5 SITE ENTRY AND EXIT

- Entry and exit to FACT for light vehicles is via Gate 1.
- Entry and exit to FACT or Empty Container Park for Heavy Vehicles is via Gate 2.
- Entry and exit to Empty Container Park for light vehicles is via Gate 3.

Site security / access requirements:

- Site induction and MSIC security clearance, as applicable, required prior to entering site.
- Contractors and visitors (including passengers) must report to Security Hut to sign in, complete induction and allocated an escort for whilst on site, as required.

1.7 TRUCK LOADING, UNLOADING CONTAINERS

- The loading and unloading zones have designated line marking and signage to identify where trucks must park and the bay number.
- Drivers must drive to the designated loading bay. Once positioned, driver must engage the park brake, turn off the ignition, exit the truck, and stand in the driver safe zones.
- If the driver moves out of the driver safe zone, then the straddle carrier operator must stop and cease operations until the person has moved back into their safe zone.
- Pedestrians should never stand under a suspended load.
- Truck drivers must not climb on top of their trucks as there is the potential risk of a fall.

1.9 PARKING ON SITE

- Visitor car parking for those who have access to the site is located adjacent to the maintenance and office buildings. Gate 1 is used for light vehicle entry, once through the two main gates traverse down the light vehicle access roadway until the maintenance building is reached, from there you will turn right to the car park. The speed limit on the light vehicle access roadway is 25kph.
- Visitor car parking for those who do not have access to the site, is located adjacent to the security hut. Gate 1 is still used for entry, although the intercom button will need to be pressed so that you are able to talk to security. From there they will open the first main gate so that the visitor parking is able to be accessed. Once parked, adhere to the site access/ security requirements.
- Visitor and employee parking for the training centre and empty depo is via gate 3.
- Plant and Equipment have designated parking bays (e.g., EWP's and Straddles)

1.10 VEHICLE MOVEMENTS WHILST ON SITE

- The drivers of vehicles entering the FACT site must AT ALL TIMES adhere to all signs for traffic flow, speed and right of way.
- All persons travelling in vehicles on site must wear their seatbelt whenever the vehicle is in motion.
- Authorised use of Mobile phones shall only be used in hands free mode when driving the vehicle, however it is at the discretion of the driver if they stop the vehicle to take the call. The FPH preference is to pull over into a safe location. Mobile phone usage whilst moving within the terminal or whilst in the truck servicing lanes is strictly prohibited.
- Vehicles and plant must only park in designated parking areas.
- Vehicle engines must be switched off when unattended unless specified by relevant work instructions.
- When approaching a blind or obstructed corner the operator / driver must proceed with caution at walking pace.
- No vehicles or plant are permitted to enter the rail operational area whilst a train is entering into the terminal, the Yard Leaders Ute will be parked at the rail-yard interface to ensure no unauthorised access to the area.

1.11 HIERARCHY OF CONTROL FOR GIVING WAY

The following hierarchy of control is to be applied for all vehicle and plant movement within FPH controlled yards, roadways, sites, and facilities:

- The smaller vehicle must always give way to the larger vehicle.
- Pedestrians must give way to plant at all times (unless they are at the pedestrian crossing from the admin building to the reefer rows, then to proceed with caution).

1.12 SPEED MANAGEMENT ON SITE

Speed Limits

- The maximum speed limit in the light vehicle car park is 10km/h as indicated by signage.
- The maximum site speed limit at FACT is 25km/h. Signage is installed at various locations around site.
- The maximum speed limit for vehicles driving over the weighbridge is 5km/h.
- The maximum speed limit for light vehicles driving between maintenance buildings near oil store across the marked zebra crossing is 5km/h.

Speed Limiting Devices on Mobile Plant

- Straddle carriers are limited to 22kph, this maximum speed limiting will be reduced depending on other operational conditions including spreader height, carrying a load, and cornering.
- Empty container handlers are limited to a top speed of 12kph when locked onto a container and 18kph when unlocked from a container.
- Reach Stackers are limited as per AS 2359.1

Speed Limiting Devices/ Aids

- Speed humps installed on light vehicle entry/ exit roadway.
- Mobile speed indicator positioned along the Northern roadway heading from the straddle park area into the light vehicle car park where the speed limit changes from 25km/h to 10km/h.

1.13 SEPARATING VEHCILES, MOBILE PLANT AND PEDESTRIANS

The following control measures aim to keep pedestrians and vehicles apart:

- Hard barriers are used to separate pedestrians from vehicles, where possible.
- Barrier posts installed at end of light vehicle parking bays where pedestrians may walk near buildings.
- Fencing in between truck lanes for segregation.
- Designated pedestrian walkways which are line marked in yellow on the ground.
- Pedestrian walkways must always be kept clear of obstructions.
- Truck drivers MUST remain in their vehicles AT ALL TIMES whilst waiting in the outer or inner VBS areas.

1.14 PEDESTRIANS WORKING WITH VEHICLES / PLANT

The following control measures aim to keep pedestrians and vehicles apart whilst in the truck servicing lanes, this is to ensure truck drivers are staying safe on site:

- Designated truck driver safe zones painted with yellow crosshatch pattern to indicate where the truck drivers must stand when being serviced. If a truck driver leaves the safe zone, then the operator must stop until the truck driver moves back into the safe zone.
- Truck drivers are to release trailer twist locks once inside the servicing lane and return to the yellow cross hatched safety zone located next to the driver's side bollard ASAP.
- Truck drivers are not to hold discussions in other truck lanes whilst waiting for service.
- Truck drivers are not to leave their truck-servicing lane or yellow hatched safety zone unless advised to see FACT R+D.
- Truck driver to provide clear hand signals to the straddle operator on the status of container (e.g., container on twist locks correctly, container clear of trailer, etc).
- Truck driver shall not proceed back to twist locks or alter trailer configuration until straddle carrier has departed the servicing lane and is completely clear of the trailer.
- Truck driver shall not enter their truck cabin until the straddle carrier has departed the servicing lane and is completely clear of the trailer.

1.15 PASSENGERS IN TRUCKS OR LIGHT VEHCILES

- Truck drivers must inform the security hut if they have a passenger. Passengers must sign in and be inducted. Any passengers under the age of 16 are not allowed in operational areas and must remain in the security office.
- Passengers must remain in the driver safe zone whilst loading and unloading is occurring.

1.16 WALKING ON SITE (including walkways and crossings)

- Pedestrians at FACT must use designated walkways where marked.
- Pedestrians must always be on the lookout for moving plant and equipment, this includes when walking on a marked walkway or in protected zones. Make eye contact with the plant operator if possible.
- Pedestrians must not stand with their back to mobile plant/vehicles.
- No pedestrian access to or in rail area. Access to area via vehicles only.
- All pedestrians entering the reefer area must do so using the "Reefer safety system" - Access control system linked to gate entry with flashing lights when pedestrians are in the reefer area, if a straddle was to enter the reefer area when a pedestrian is in that area, it breaks the laser which triggers a loud audible alarm and flashing blue lights.

1.17 REVERSING VEHICLES

Where possible, you **must avoid the need for vehicles to reverse** as this is a major cause of fatal incidents.

FPH requires vehicles to adhere to the following rules for reversing:

- Do not reverse excessive distances over 10 metres.
- Always check and adjust the mirrors on the vehicle.
- Always check behind the vehicle and the immediate surroundings for any blind spots.
- Do not rely solely on reversing cameras and sensors as these are secondary safety devices.

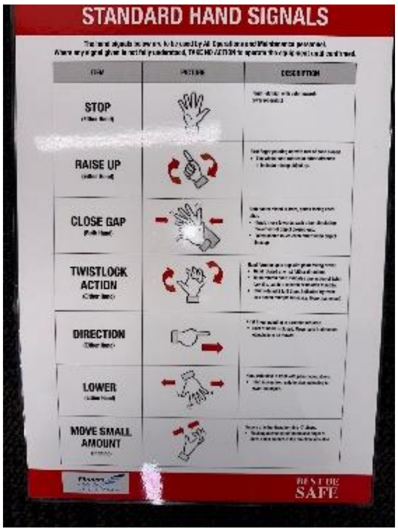
1.18 SIGNS AND WARNING DEVICES

- All FPH workers, third parties, truck drivers, visitors and contractors must adhere to all safety signage.

1.19 LIGHTING

- Adequate lighting is provided throughout the whole FACT site.
- All vehicles and mobile plant must ensure that they have fully operational and effective head lights, taillights, and flashing warning beacons (where applicable) which are turned on when visibility is poor.

1.20 COMMUNICATION METHODS



- Vehicle Booking System (VBS) in place to control when trucks arrive on site to minimise long queues.
- FACT website has live truck turnaround times for external truck companies to check and plan their arrival times to avoid busy periods.
- Hand signals are used for communication between truck drivers and straddle operators. Signage is placed on each truck lane to remind truck drivers of correct hand signals.

- Traffic lights on Coghlan Road to indicate to truck drivers when they can proceed to enter FACT. Signage to indicate which truck lane to use.

- Traffic lights for entry to road train lanes for trucks, and straddles.

- The Terminal is equipped with a radio communication system to assist in operations and provide radio contact between the control functions and the operators on the Terminal.
  - There are 8 radio channels available for internal communication at FACT.
  - Channel allocation may be varied at the Operations Supervisor discretion to suit any contractors working in the Terminal Container Rows.
  - The use of radios shall be kept strictly to work-related matters, i.e., reporting breakdowns, stacking instruction, warning other traffic when approaching, warning calls etc. In consideration of other radio users, there shall be no idle chatter or profanities used when talking on the radios.
  - Whenever an emergency arises, the Shift Supervisor shall allocate a channel as the sole frequency to be used by all personnel involved in the emergency. This may require the reallocation to another channel of any operation that was using the channel selected for the emergency.

Review and Document Control

VERSION	CHANGE	REVIEWED BY	AUTHORISED BY	DATE ISSUED
1	Initial issue	WHS Business Partner	Terminal Manager	24/04/2024

Appendix N
Noise impact assessment

creating opportunities

Resonate

GatewaySA

Environmental Noise and Vibration Assessment

A241000RP1 Revision 0

Tuesday, 3 December 2024

Document Information

Project	GatewaySA
Client	Flinders Port Holdings
Report title	Environmental Noise Assessment
Project Number	A241000

Revision Table

Report revision	Date	Description	Author	Reviewer
0	3 December 2024	DRAFT	Nick Henrys	Darren Jurevicius

Disclaimer

This report has been prepared by Resonate Consultants Pty Ltd (Resonate) for the exclusive use of our Client. Our advice is not intended for use by any third parties, and any reliance on our advice by third parties shall be entirely at their own risk. Resonate accepts no responsibility or liability for any consequences arising from the use of our advice by persons other than our Client. Our advice has been prepared for the specific purpose and scope agreed with our Client. It is not intended to be a substitute for professional advice in other contexts or to address other issues outside the scope of work for this project.

The information, findings, and recommendations are based on the conditions and data available at the time of preparation. Any opinions or recommendations expressed are subject to the assumptions, limitations, and conditions as stated. Any reliance on external information has been accepted in good faith as being accurate and valid.

Glossary

A-weighting	A spectrum adaption that is applied to measured noise levels to represent human hearing. A-weighted levels are used as human hearing does not respond equally at all frequencies.
Ambient sound	Sound that would be present in the absence of a specified activity. Ambient sound can be anthropogenic (e.g. industrial or shipping) or natural (e.g. wind, biota).
Auditory frequency weighting	The process of band-pass filtering sounds to reduce the importance of inaudible or less-audible frequencies for individual species or groups of species of aquatic mammals. In other terms, a frequency weighting function that compensates for a species' (or functional hearing group's) frequency-specific hearing sensitivity.
CEMP	Construction Environmental Management Plan
CNVMP	Construction Noise and Vibration Management Plan
Continuous noise level	A-weighted noise level of a continuous steady sound that, for the period over which the measurement is taken using fast time weighting, has the same mean square sound pressure as the noise level which varies over time when measured in relation to a noise source and noise-affected premises in accordance with the Noise Policy
Day	Between 7 am and 10 pm as defined in the Noise Policy
dB	Decibel—a unit of measurement used to express sound level. Decibels express the ratio of sound relative to a reference level on a logarithmic scale. For airborne noise the reference level is 20 µPa, while for underwater noise the reference level is typically 1 µPa.
dB(A)	Units of the A-weighted sound level.
dBpeak	Peak sound pressure over the measurement period, expressed in dB re 1 µPa.
dBrms	Root mean square sound pressure over the measurement period, expressed in dB re 1 µPa.
EIS	Environmental Impact Statement
Frequency (Hz)	The number of times a vibrating object oscillates (moves back and forth) in one second. Fast movements produce high frequency sound (high pitch/tone), but slow movements mean the frequency (pitch/tone) is low. 1 Hz is equal to 1 cycle per second.
Hearing group	Category of animal species when classified according to their hearing sensitivity and to the susceptibility to sound. Examples for marine mammals include low-frequency (LF) cetaceans, high-frequency (HF) cetaceans, very high-frequency (VHF) cetaceans, otariid pinnipeds in water (OPW), phocid pinnipeds in water (PPW), sirenians (SI), other marine carnivores in air (OCA), and other marine carnivores in water (OCW). (Southall et al. 2019).

Hearing threshold	The hearing threshold represents the lowest signal level an animal can detect at a particular frequency, usually referred (and measured) as the threshold at which an animal will indicate detection 50% of the time.
HF	High frequency cetaceans hearing group.
Impulsive sound	Transient sound that has extremely short duration and a high peak sound pressure level.
Indicative noise level	Indicative noise level determined under clause 5 of the Noise Policy.
LF	Low frequency cetaceans hearing group.
L_{90}	Noise level exceeded for 90 % of the measurement time. The L90 level is commonly referred to as the background noise level.
L_{95}	Noise level exceeded for 95 % of the measurement time.
L_{eq}	Equivalent Noise Level—Energy averaged noise level over the measurement time.
L_{max}	The maximum instantaneous noise level.
MFO Level 1	Marine Fauna Observer, Level 1. A person with qualifications in ecology, zoology or environmental sciences and demonstrated experience with the identification and management of dolphins or whales, including behaviour, as well as distance estimation.
MFO Level 2	Marine Fauna Observer, Level 2. A person who has sufficient experience in marine fauna identification and distance estimation.
Night	Between 10.00 p.m. on one day and 7.00 a.m. on the following day as defined in the Noise Policy.
Noise source	Premises or a place at which an activity is undertaken, or a machine or device is operated, resulting in the emission of noise.
OCA	Other carnivores in air hearing group.
OCW	Other carnivores in water hearing group.
OPW	Otariid pinnipeds in water hearing group.
PPW	Phocid pinnipeds in water hearing group.
PTS	Permanent threshold shift (PTS) is a permanent reduction in hearing sensitivity caused by irreversible damage to the sensory hair cells of the ear.
SEL	Level of the sound exposure as defined in ISO 18405. In underwater acoustics, the reference value of time-integrated squared sound pressure is 1 μPa^2 s.

$SEL_{24\ hour}$	The cumulative sound exposure level, which includes multiple acoustic pulses from piling or the time duration of dredging within a 24 hour period. It is also assumed for intermittent, repeated exposure that there is no recovery between subsequent exposures.
SI	Sirenians hearing group.
Source level	Source level (SL) is the sound pressure level at a distance of 1 m from a hypothetical point source radiating the same amount of sound energy as the actual source. Units: dB re 1 $\mu Pa^2 \cdot m^2$ (sound pressure level), dB re 1 $\mu Pa^2 \cdot m^2$ s (sound exposure level).
SPL	Sound pressure level (SPL) is the root-mean-square sound pressure expressed in the decibel (dB) scale. Units: dB re 1 μPa^2 (underwater), dB re 20 μPa (air).
TTS	Temporary threshold shift (TTS) is a temporary reduction in hearing sensitivity as a result of exposure to sound. Exposure to high levels of sound over relatively short time periods can cause the same amount of TTS as exposure to lower levels of sound over longer time periods. The duration of TTS varies depending on the nature of the stimulus.
VHF	Very high frequency cetaceans hearing group.

Table of Contents

1 Introduction

Flinders Port Holdings group (collectively ‘the Group’ or ‘FPH’), is the leading privately-owned port operator in South Australia, handling the vast majority of the state’s international imports and exports each year.

Originally established in 2001 through the acquisition of 99-year land leases, associated assets and licenses for the operation of Port Adelaide and six regional ports across South Australia (Port Lincoln, Port Pirie, Thevenard, Port Giles, Wallaroo and Klein Point), FPH has since grown to offer a wide range of port related services. These services range from pilotage, hydrographic survey and marine control services, as well as operation of South Australia’s sole container terminal, landside stevedoring and supply chain, warehousing and logistics services. FPH also provides services to three other commercial ports in South Australia on behalf of third parties at Whyalla, Port Bonython and Ardrossan.

The traditional port ecosystem is changing, demographical, technological and sustainable drivers are affecting daily business and shaping future operations. It is therefore becoming increasingly critical for the whole supply chain (and ports, terminals and logistics sectors) to find new ways to optimise operations, deliver productivity, reduce carbon emissions and adverse community impact and increase resilience.

It is in this context FPH have recognised the opportunity to make a step change in its operations and this will be achieved through the GatewaySA Terminal Transformation Program. GatewaySA represents the largest project ever undertaken at Flinders Ports Holdings. The program of works is a multi-million-dollar investment that will create a sustainable container terminal to meet the growing needs of FPH and South Australia well into the future.

1.1 Project background

In recent years, restructuring of container shipping industry services has seen a steady increase in the length, beam and height of container vessels globally. The continuation of increasingly larger vessels calling into Adelaide was anticipated under the Flinders Port Holdings (FPH) Masterplan. However, as a consequence of the covid pandemic there was a rapid acceleration of the investment of larger vessels by container shipping lines and that has resulted in a rapid acceleration of the timeframe within which larger container vessels are expected to enter into Australian shipping routes and call Adelaide.

FPH is currently receiving vessels (up to 337m LOA and 45m beam) in Adelaide and vessel sizes are forecast to further increase in the near term (up to 366m LOA and 52m beam). This causes operational issues for FPH, as the current quay-line length restricts the ability to simultaneously service two larger vessels.

1.2 Project scope

The Flinders Adelaide Container Terminal (FACT) consists of two berths (Berth 6 and Berth 7) and has a total quay line length of 650m. FPH is planning to:

- Extend Berth 6 by up to 135m.
- Remove existing mooring dolphin and catwalk
- Construct new mooring dolphin and catwalk
- Reclaim approx. 20m strip of land to rear of wharf extension to provide access
- Demolish a cargo shed

Resonate

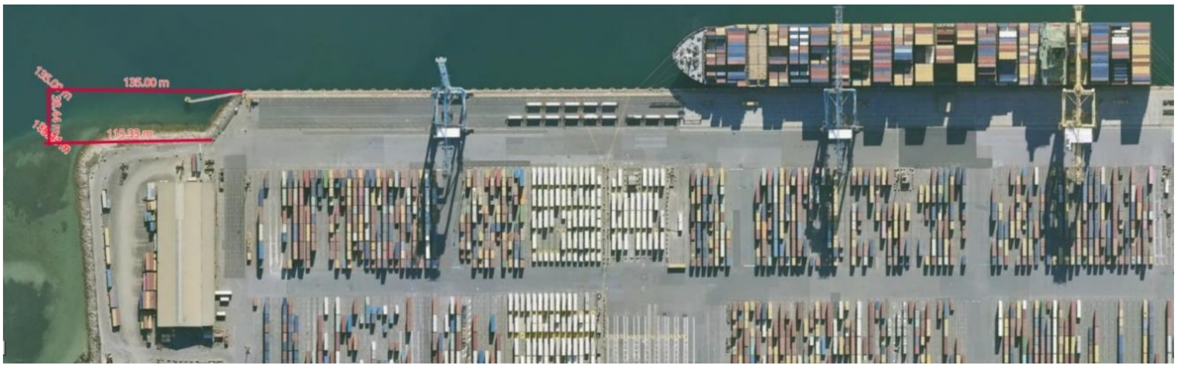


Figure 1: Location of Outer Harbor Berth 6 Extension

Construction may involve piling of either sheet pile or cylindrical steel piles, in-situ concrete pour and pre-cast concrete blocks. The construction methodology will be determined during later design phases.

It is understood that the Project will also include:

- Relocation of the primary FACT truck access route to the indicative location shown in Figure 2
  - It is expected that this will also require relocation of truck loading/unloading (i.e. with straddle carriers) although the final layout of the terminal and loading areas post-project is yet to be determined.
- Extension of quay crane tracks to new Berth 6.

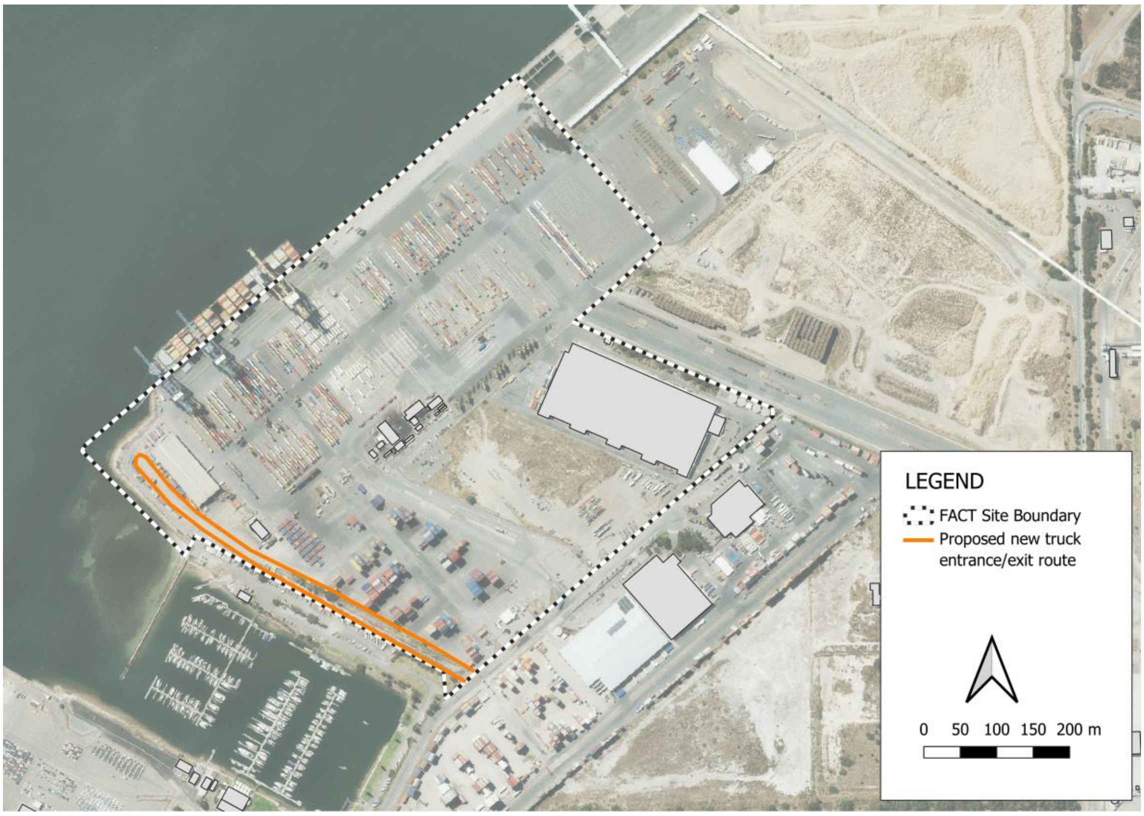


Figure 2: Indicative location of proposed new truck entrance/exit route

1.3 Project schedule

The indicative proposed project schedule is as follows, noting this is subject to change due to a myriad of factors:

Table 1: Project schedule

Milestone	Timeline
30% design completion	26 January 2025
ECI Phase kick off	1 February 2025
70% design completion of preferred design option	1 May 2025
Construction commencement (inclusive of temporary and early works)	1 July 2025
Complete Construction	31 December 2026

1.4 Noise and vibration assessment scope

The scope of this assessment is to:

- Undertake monitoring of the baseline noise environment in the vicinity of the project, including noise from existing FACT operations and other ambient noise sources in the area
- Undertake assessment of terrestrial (airborne) noise associated with operation and construction of the Project. Note that while the Project does not introduce any new noise sources to the FACT site, the relocation of some sources (in particular the truck access route) is expected to result in a change in operation noise levels at noise sensitive receiver locations.
- Undertake an assessment of underwater noise emissions associated with construction of the Project. We note that underwater noise from operation of the Project (post-construction) will not be materially different to underwater noise from the existing FACT operation. Assessment of underwater noise from the operational phase of the Project is therefore excluded from this assessment.
- Undertake an assessment of vibration due to construction of the Project. Note that due to the large separation distance from the Project to the nearest vibration-sensitive receptors, there is a very low risk of adverse impacts resulting from vibration. This assessment is therefore qualitative in nature, noting that a more detailed assessment may be carried out during construction phase if required.
- Operation of the Project is expected to result in negligible vibration at sensitive receiver locations, therefore assessment of operational vibration is excluded from this assessment.

Resonate

2 Existing noise and vibration environment

2.1 Terrestrial noise

Background noise monitoring in the vicinity of the Project area was undertaken by Resonate from 15 November to 26 November 2026. Monitoring locations are shown in Figure 3 below.

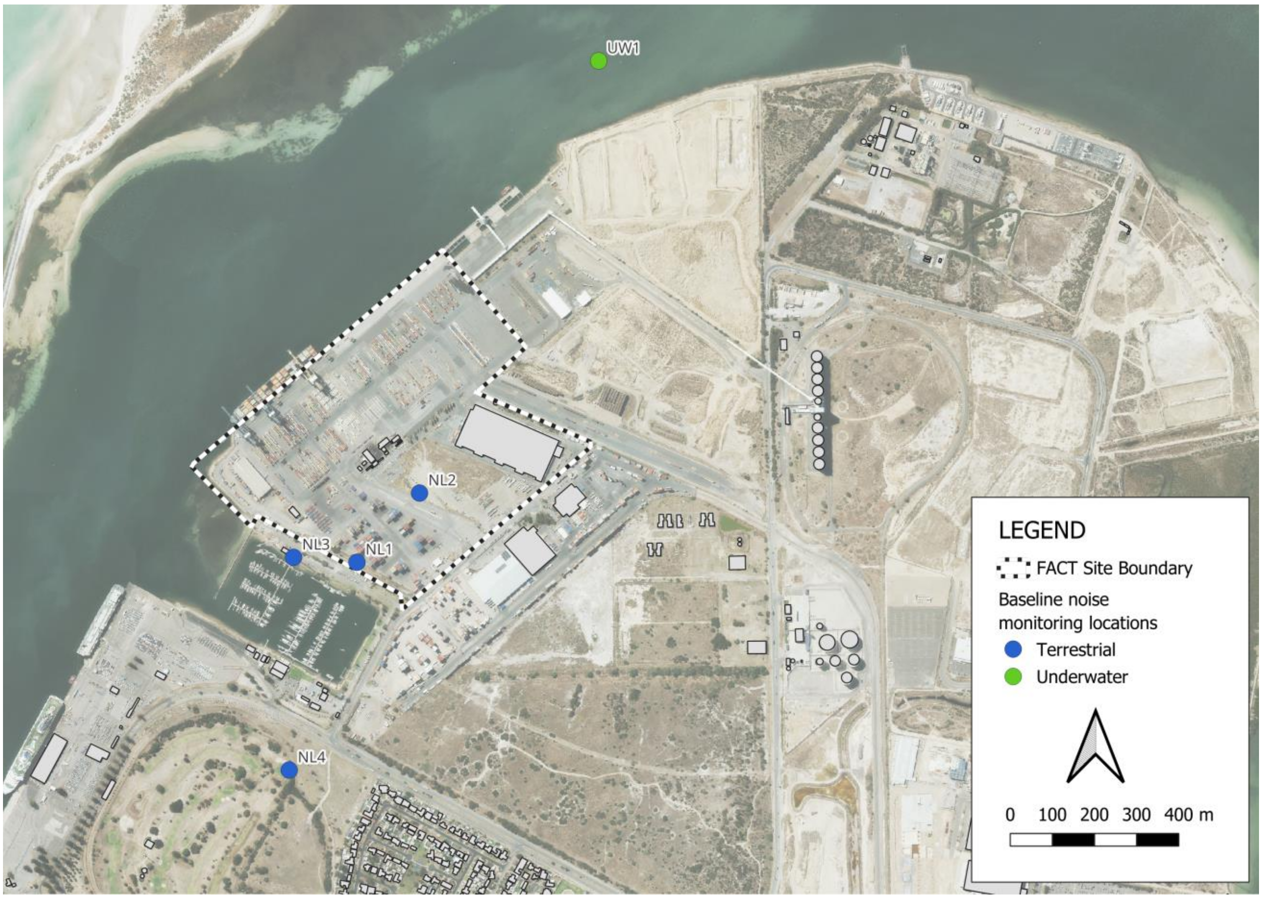


Figure 3: Baseline noise monitoring locations

All sound level measurement instrumentation used for the purposes of this assessment are classified as a Class 1 or Class 2 measurement device, as described in Australian Standard AS IEC 61672.1—2004. Acoustic calibration was conducted before and after the logging period and no significant calibration drift was observed. Each sound level meter unit holds current calibration certification by an independent NATA certified laboratory. Copies of the certificates are available on request.

Resonate

Table 2: Noise monitoring results summary - Day

Location	Type/SN	Date period	Average measured noise level, dB(A)		
			L_{eq}	L_{90}	L_{max}
NL1	NL-42 946975	15/11/24 – 26/11/24	57	46	71
NL2	NL-42 1000320	15/11/24 – 26/11/24	58	50	71
NL3	NL-42 1000321	15/11/24 – 26/11/24	59	49	72
NL4	NL-42 1000323	19/11/24 – 26/11/24	60	41	66

Table 3: Noise monitoring results summary - Night

Location	Type/SN	Date period	Average measured noise level, dB(A)		
			L_{eq}	L_{90}	L_{max}
NL1	NL-42 946975	15/11/24 – 26/11/24	52	41	66
NL2	NL-42 1000320	15/11/24 – 26/11/24	55	48	69
NL3	NL-42 1000321	15/11/24 – 26/11/24	55	45	65
NL4	NL-42 1000323	19/11/24 – 26/11/24	47	37	60

Summary plots showing the measured time series data are presented in Appendix A.

During monitor deployment and collection, the ambient noise environment included noise from existing FACT operations, noise from other adjacent industrial/transport land uses, noise from road traffic, and noise from natural sources including birds and wind-induced noise.

2.2 Underwater noise

The ocean is filled with sound that is generated by a variety of natural sources, such as rain, breaking waves, marine life, and man-made sources, such as shipping and sonar activity.

The study area is a shallow water river and coastal environment. Ambient noise levels in shallow water vary widely in frequency and level distributions depending on time and location. The three primary sources in most shallow water regions are shipping, industrial, or geophysical-survey noise; wind and wave noise; and biological noise.

In comparison to deep water, a wider range of ambient noise levels occurs in shallow water under corresponding wind and wave conditions (Richardson et al. 1995). Above approximately 500 Hz, ambient noise levels in coastal areas are often 5-10 dB higher than in deep water for the same wind speeds. In the absence of shipping and biological noise, however, low-frequency (<300 Hz) ambient noise levels can be lower in shallow water than in deep water.

Ambient noise levels in shallow waters are directly related to wind speed. For wind speeds above 2.5 m/s, the ambient noise level in the frequencies range between 50 Hz and 20 kHz is better predicted by wind speed than by wave height (Richardson et al. 1995).

The marine traffic density in the vicinity of the project site is shown in Figure 4. The figure indicates considerable marine traffic in Port River, which also means that the underwater ambient noise in the Port River will include regular marine traffic noise as a feature of the area.

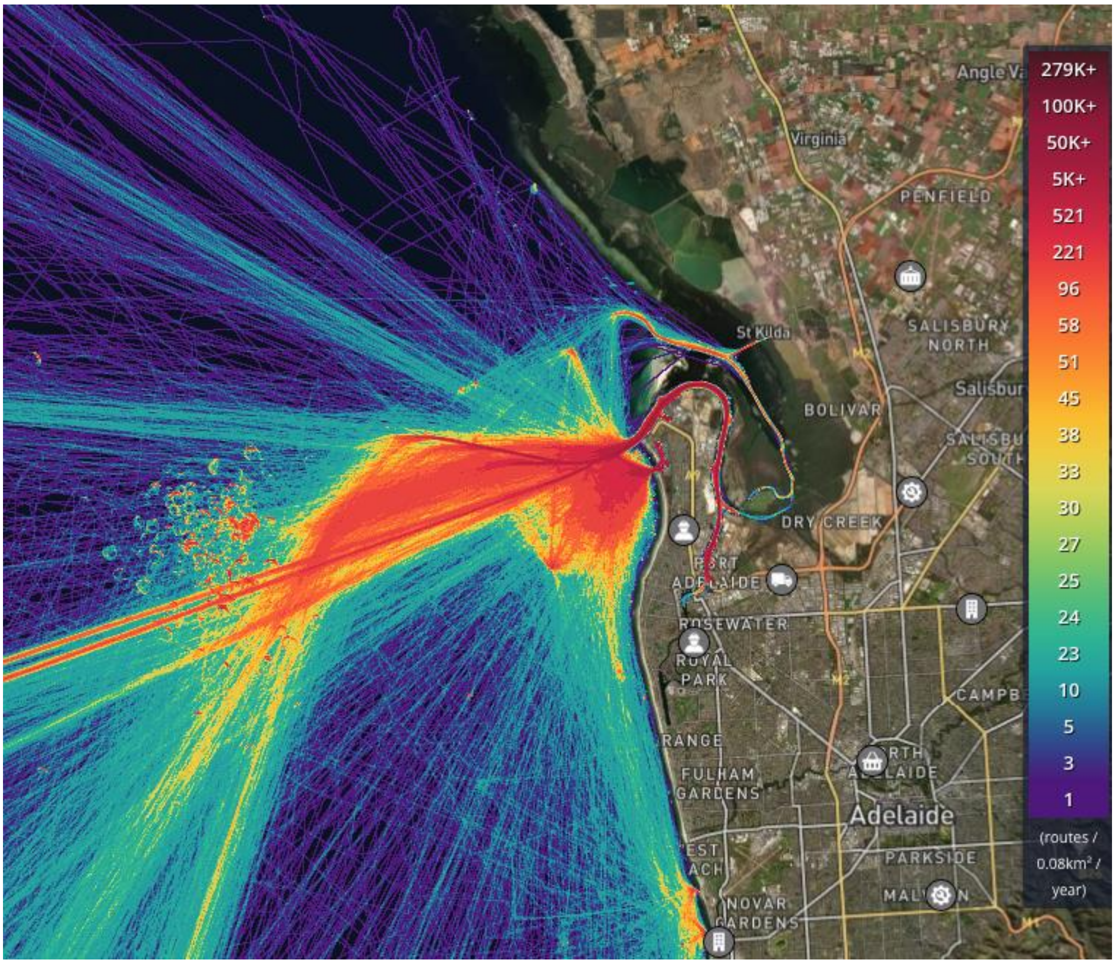


Figure 4: Marine traffic density in the vicinity of the project site, 2022 (Source: www.marinetraffic.com)

2.2.1 Baseline underwater noise measurements

Resonate have previously undertaken underwater noise measurements within the Port River between the 22nd to 24th June 2020 continuously, using a Loggerhead Instruments DSG-ST Ocean Acoustic Datalogger Hydrophone. Data was collected at a sampling rate of 50 kHz. We believe the data collected is sufficient to characterise the ambient underwater noise levels in the marine area of interest.

Measurements were undertaken in the location shown in Figure 3, with the hydrophone located at a depth of approximately 6 m adjacent the Port River shipping channel. The hydrophone was deployed from a boat and anchored to the seabed using weights. The instrument was suspended in the water column by a combination of self-buoyancy and a supplementary buoy, such that the transducer was approximately 1.5 m above the seabed. The hydrophone was tethered to the adjacent channel marker (23) to assist retrieval, rather than using a surface buoy.

2.2.2 Results

Underwater noise data were processed in intervals of 100 seconds. For each interval, the overall average sound pressure level (dBrms) and spectra were calculated from the raw waveform data. The variation of overall sound pressure level (SPL dB re 1 μPa^2) over time is shown in Figure 5. In summary, the results indicate:

- SPLs generally varied between 104 and 144 dB dB re 1 μPa^2
- Over a 2 day period, there were more than 20 vessel movements passing by the measurement location (i.e. with reference to Figure 5, the SPL 'spikes' indicate vessel pass-bys). The audio signature of the movements also indicated that they were various larger vessels (rather than smaller outboard craft). The SPL ranged between 122 to 144 dB.
- The quietest periods measured were during a slack tide (i.e. the lull in tidal movement as the direction changes).
- The typical background level (i.e. 104 to 110 dB), was dominated by 'snapping shrimps' and a constant mechanical hum (potentially seawater intakes pumps from Pelican Point Power Station and other distant mechanical noise).

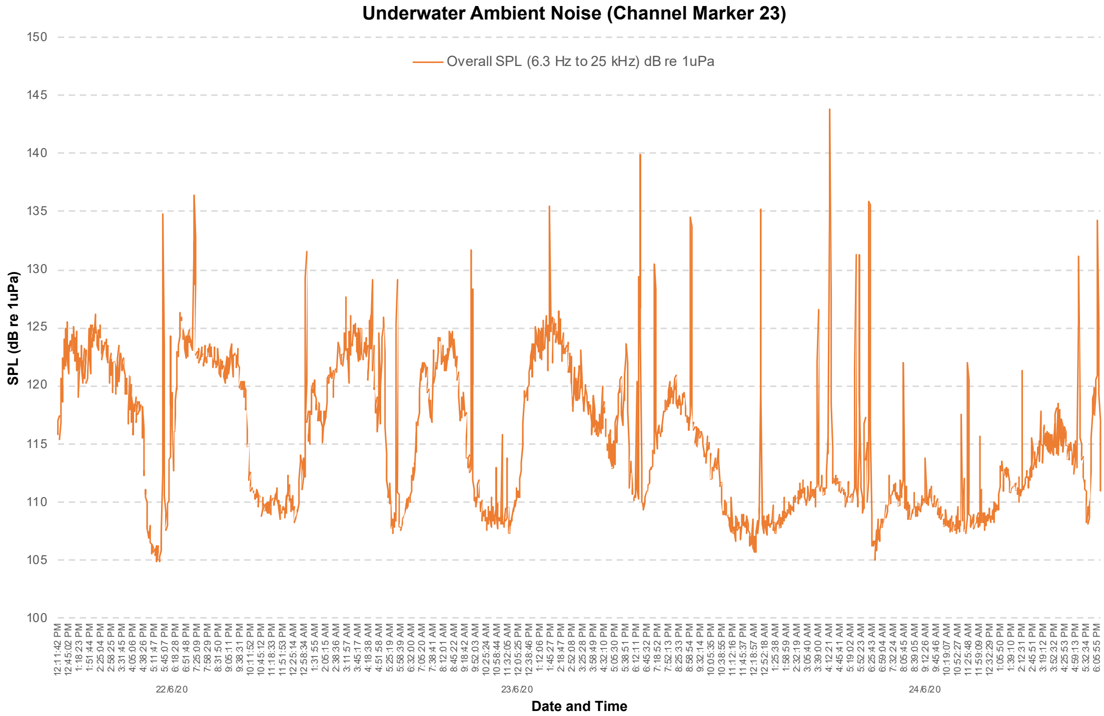


Figure 5 : Overall sound pressure level variation over time

A summary of the wind speed recorded at the Bureau of Meteorology weather station located at Outer Harbor over the logging period is also provided in Figure 6. Some correlation between wind speed and overall sound pressure level is evident i.e. less extraneous noise was noted during periods of low wind speed.

Resonate

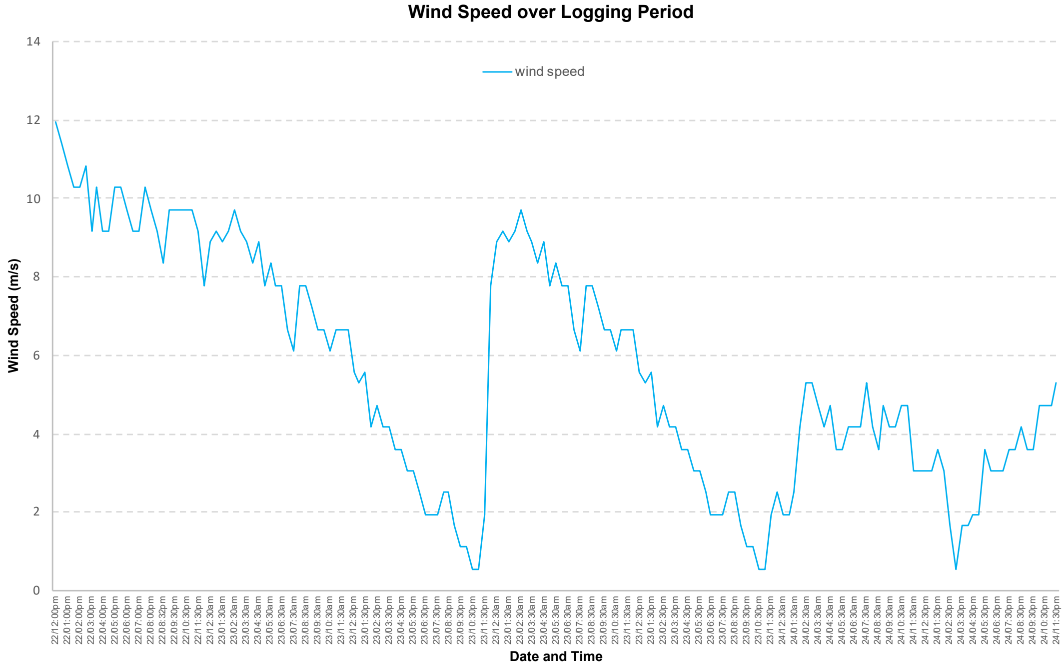


Figure 6 : Overall sound pressure level variation over time

One third octave spectra were also determined for a typical range as well as the noisiest vessel movements for comparison against the typical lowest background noise level. The spectra are presented in Figure 7.

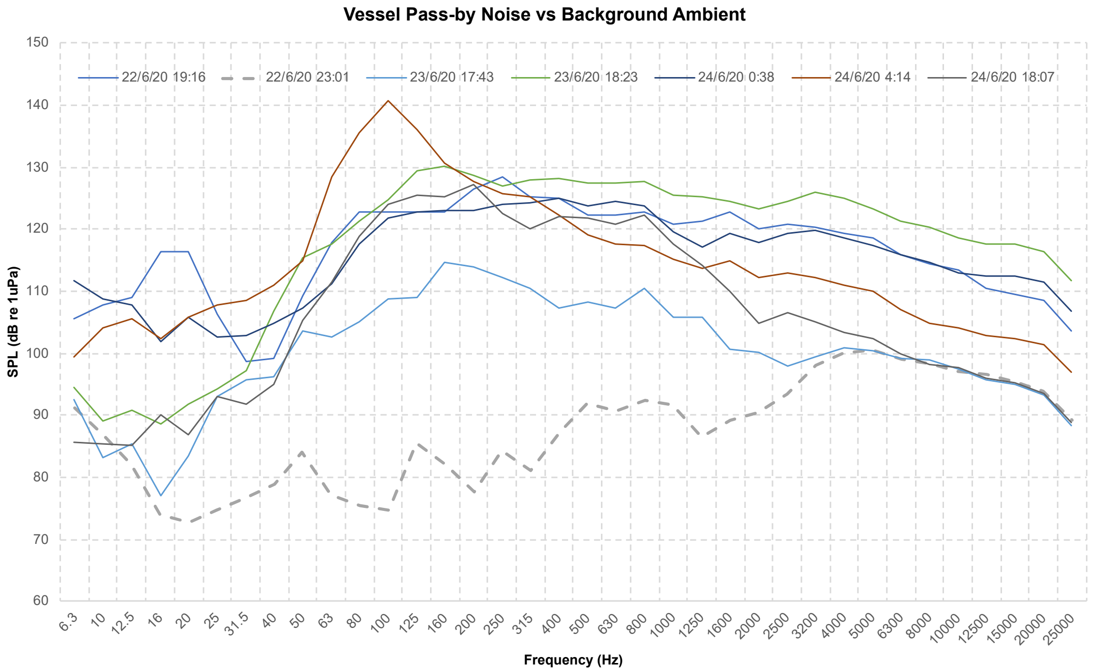


Figure 7: One third octave band sound pressure levels to compare a selection of typical vessel pass-by by noise with the typical lowest background noise level (dashed line)

The results indicate a significant increase in ambient sound pressure level during a ship pass-by. Although the SPLs increased across the entire frequency range measured, the dominant energy is generally between 63 Hz to 6300 Hz, with the highest levels between 63 to 200 Hz.

Analysis of the background noise level also indicates constant mechanical noise occurring as evidenced by the one third octave band tones prevalent at 50 and 125 Hz. This is further illustrated by the ‘red’ bands in the spectrogram shown in Figure 8.

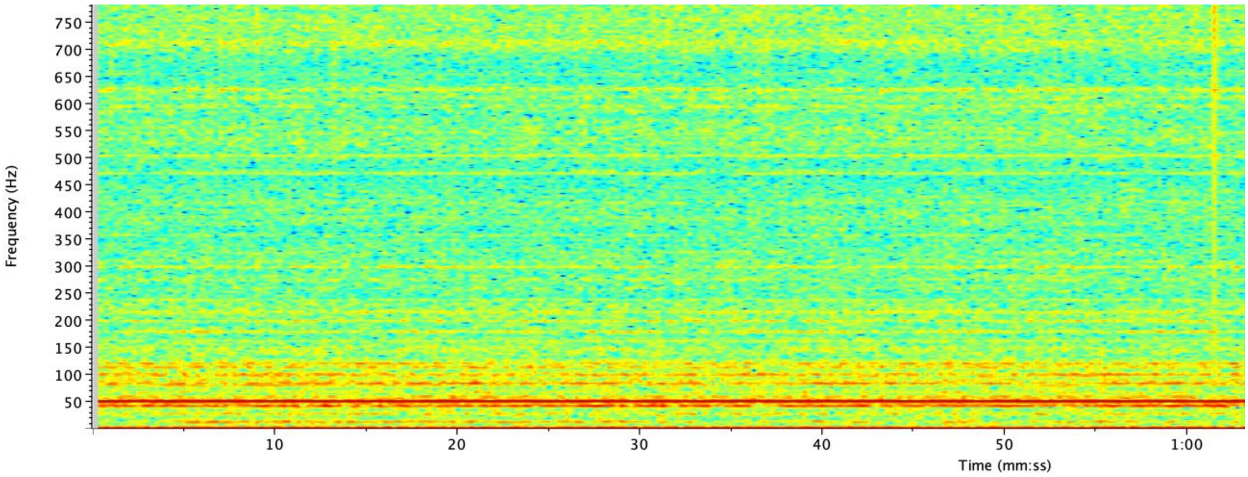


Figure 8: Spectrogram showing constant mechanical noise (red banding) at nominally 50 to 125 Hz

2.2.3 Summary

In summary, the underwater baseline noise conditions in the marine area consist mainly of snapping shrimp noise underpinned by continuous low frequency mechanical noise (<250 Hz). However, this background noise is largely masked in the immediate vicinity of the site as vessels pass by. The number of vessel movements traversing along Port River are significant, including operating at all times of the day or night. Given that the channel width at the location of measurements is 200m and in the assumption that vessels are largely traversing in the centre of the channel, the source levels of the various vessels measured are calculated to be in the range 150 to 175 dB re 1 μPa^2 at 1m.

3 Planning & Design Code

3.1 Zoning

Figure 9 shows the relevant zones and sub-zones of the subject site and surrounding areas.

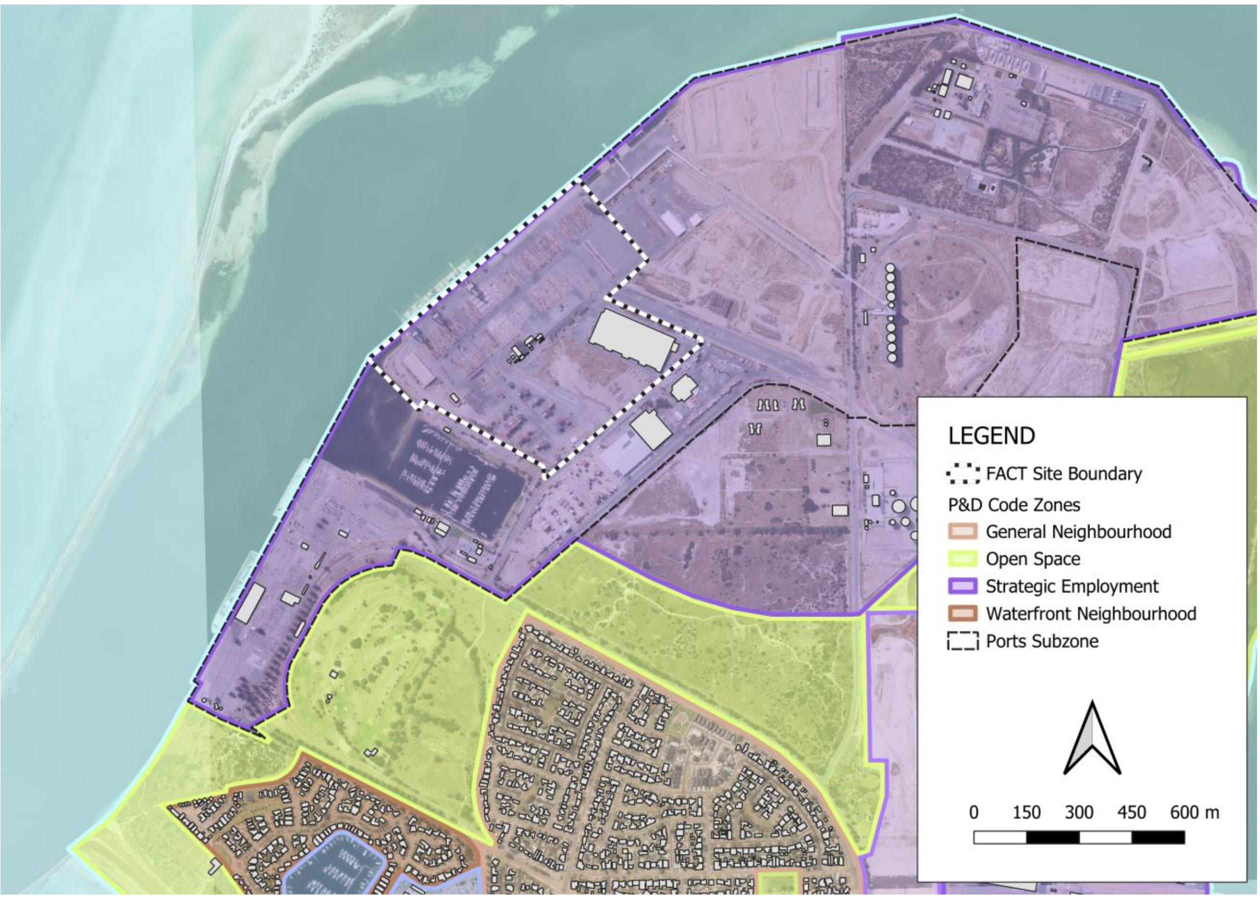


Figure 9: Relevant Planning & Design Code Zones

3.1.1 Subject site

The subject site is wholly contained within the Strategic Employment Zone and Ports sub-zone. The relevant Desired Outcome is shown below.

Table 4: Relevant Desired Outcome—Ports sub-zone

Desired Outcome	
DO1	A range of port related activities that support the ongoing strategic and economic state significance of the area for the handling of export and import commodities

Resonate

3.1.2 Adjacent land

The closest noise sensitive receivers are located approximately 450 m to the south of the site along Victoria Road, within the suburb of North Haven. The nearest residences face away from the subject site, with backyards, sheds and boundary fences separating the dwellings from the Key Freight Route of Victoria Road.

The receptors are located in the General Neighbourhood zone. The relevant Desired Outcome for the General Neighbourhood zone is outlined in Table 5.

Table 5: Relevant Desired Outcome —General Neighbourhood zone

Desired Outcome	
DO1	Low-rise, low and medium-density housing that supports a range of needs and lifestyles located within easy reach of services and facilities. Employment and community service uses contribute to making the neighbourhood a convenient place to live without compromising residential amenity.

More distant residential dwellings are situated approximately 1 kilometres to the south of the site, in the area of North Haven situated south of Lady Ruthven Drive. These receptors are located within a Waterfront Neighbourhood zone, with the relevant Desired Outcome for the zone outlined in Table 6.

Table 6: Relevant Desired Outcome — Waterfront Neighbourhood zone

Desired Outcome	
DO1	A diverse range of housing which takes advantage of waterfront locations. Development enhances public access to waterfront areas. Dual aspect allotments incorporate designs to enhance the streetscape.

3.2 Interface between land uses

Interface between Land Uses is a General Development Policy that is relevant to the subject site. The relevant Assessment Provisions relating to noise are outlined in Table 7.

Table 7: Relevant Assessment Provisions—Activities generating noise or vibration

Relevant Assessment Provisions	
Desired Outcome	
DO1	Development is located and designed to mitigate adverse effects on or from neighbouring and proximate land uses.
Performance Outcome	**Deemed-to-Satisfy Criteria / Designated Performance Feature**
PO 4.1 Development that emits noise (other than music) does not unreasonably impact the amenity of sensitive receivers (or lawfully approved sensitive receivers).	DTS/DPF 4.1 Noise that affects sensitive receivers achieves the relevant Environment Protection (Noise) Policy criteria.

4 Assessment criteria

4.1 National Legislation

4.1.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act) is the central piece of environmental legislation relevant to this assessment. It provides the legal framework to protect and manage nationally and internationally important biota, ecological communities and heritage places, which are defined in the Act as 'matters of National Environmental Significance' (MNES). Under the provisions of the Act, it is an offence for any person to take an action that is likely to have a significant impact on MNES without approval.

4.2 State Legislation

4.2.1 Adelaide Dolphin Sanctuary Act 2005

The *Adelaide Dolphin Sanctuary Act 2005* was proclaimed in June 2005 to protect the Indo-Pacific bottlenose dolphin (*Tursiops aduncus*) that live in and around the Port River estuary and Barker Inlet. About 30 or more individuals are seen on a regular basis in this vicinity, with around 400 more thought to visit the area. The Adelaide Dolphin Sanctuary was established for their protection and the protection of their habitat. The dolphins habitat and food requirements can all be found in the mangroves, seagrass, saltmarsh, tidal flats, tidal creeks and estuarine rivers in the region (DENR 2011). Section 32 of this Act states that there is a general duty of care for a person to take all reasonable measures to prevent or minimise any harm to the sanctuary through his or her actions or activities.

4.2.2 Environment Protection Act 1993

The general environmental duty in section 25 of the *Environment Protection Act 1993* (EP Act) states that:

> A person must not undertake an activity that pollutes, or might pollute, the environment unless the person takes all reasonable and practicable measures to prevent or minimise any resulting environmental harm.

4.2.3 Fisheries Management Act 2007

Section 77 of the *Fisheries Management Act 2007* (FM Act) states that a person must not engage in an operation involving or resulting in interference with aquatic animals of any waters forming part of an aquatic reserve, except as authorised by the regulations or a permit issued by the Minister.

4.2.4 Heritage Places Act 1993

The *Heritage Places Act 1993* (*HP Act*) makes provision for the identification, recording and conservation of places and objects of non-Aboriginal heritage significance; to establish the South Australian Heritage Council; and for other purposes.

4.2.5 Historic Shipwrecks Act 1981

Any wreck in South Australian waters which is 75 years old is automatically protected under the Historic Shipwrecks Act 1981. Under this Act, historically significant shipwrecks that are less than 75 years old, may be protected by Ministerial declaration. A protected historic shipwreck includes articles associated with the ship, including moveable artefacts. It is illegal to damage, destroy, interfere with, or to dispose of, any historic shipwrecks or historic relics.

4.2.6 Local Nuisance and Litter Control Act 2016

The *Local Nuisance and Litter Control Act 2016* (*LNLC Act*) is administered by local government and provides the community with an effective and consistent local service for the management of nuisance complaints and heightened deterrence for littering and illegal dumping. The *LNLC Act* is designed so that the majority of activities licensed by the EPA are excluded as these are already regulated under the *EP Act*. The exceptions are activities associated with a vehicle, such as earthworks drainage, dredging and waste transport.

In most cases, the responsible authority for managing construction noise that is not associated with public infrastructure works is the local council under the *LNLC Act*. However, the Environment Protection Authority (EPA) is responsible for managing construction noise at sites where an authorisation to conduct an activity of environmental significance applies.

4.2.7 National Parks and Wildlife Act 1972

Section 68 of the *National Parks and Wildlife Act 1972* (NPW Act) states that a person must not interfere with, harass or molest a protected animal, or undertake or continue an act or activity that is, or is likely to be, detrimental to the welfare of a protected animal unless authorised by a permit granted by the South Australian Department for Environment and Water. The marine mammal species listed as 'protected animals' under the Act are also listed under the EPBC Act.

4.2.8 Planning, Development and Infrastructure Act 2016

The *Planning, Development and Infrastructure Act 2016* (*PDI Act*) provide for matters that are relevant to the use, development and management of land and buildings, including by providing a planning system to regulate development within the State, rules with respect to the design, construction and use of buildings, and other initiatives to facilitate the development of infrastructure, facilities and environments that will benefit the community.

4.3 Operational Noise (terrestrial)

4.3.1 Environmental noise policy

As noted in DTS/DPF 4.1, environmental noise emissions from the subject site should comply with the *Environment Protection (Commercial & Industrial Noise) Policy 2023* (the **Noise Policy**). Compliance with the Noise Policy will also satisfy the requirements of the *EP Act* in relation to noise pollution.

The noise goals in the Noise Policy are based on the zoning of the development and the closest noise affected premises in the relevant development plan. The land uses primarily promoted by the zones are used to determine the environmental noise criteria with the indicative noise factors shown in Table 8.

Table 8: Excerpt from Noise Policy—Table 2(subclause(1)(b))

Land use category	Indicative noise factor dB(A)	
	Day (7 am to 10 pm)	Night (10 pm to 7 am)
Rural living	47	40
Residential	52	45
Rural industry	57	50
Light industry	57	50
Commercial	62	55
General industry	65	55
Special industry	70	60

The noise level criteria are based on the Indicative noise factors contained within the Noise Policy, in context with the relevant Planning & Design Code zones.

As the noise affected premises is situated in a 'quiet noise designated area', being a zone where the Residential land use is principally promoted, a continuous noise criterion of L_{eq} 52 dB(A) day, and L_{eq} 45 dB(A) and L_{max} 60 dB(A) at night, 10 pm to 7 am, is also applicable.

Notwithstanding the above, the noise sensitive receivers are generally separated from some or all of the study area by an intervening land use that spans at least 100 metres. We have therefore conservatively applied the indicative noise factors to the Residential land use category to determine the indicative noise level criteria. We note that the indicative noise factor for the residential land use category is the same as the continuous noise requirements for a 'quiet noise designated area'.

Based on the commentary above, the indicative noise level (INL) criteria for the residential receivers are as follows.

South of the site in North Haven (General Neighbourhood or Waterfront Neighbourhood zone):

- 52 dB(A) during the day, 7 am to 10 pm
- 45 dB(A) at night, 10 pm to 7 am.

Whilst noise a 'noise sensitive receiver' in accordance with the definition in the Planning & Design Code, the Royal South Australian Yacht Squadron (RSAYS) is included in this assessment on the basis that it is the closest non-residential receiver to the proposed Project and has the potential to be impacted by noise from construction and operation. The INL for RSAYS are as follows:

RSAYS (Strategic Employment Zone and Ports sub-zone):

- 70 dB(A) during the day, 7 am to 10 pm
- 60 dB(A) at night, 10 pm to 7 am.

The 5 dB(A) 'planning penalty' has not been applied to the criteria derived above on the basis that operational noise sources associated with the Project are existing noise sources already associated with the current operation of FACT.

We note that the 5 dB(A) planning penalty (under Part 5 of the Noise Policy) is in recognition of increased sensitivity to new noise sources, the increased scope for the inclusion of reasonable and practicable noise reduction measures, and the cumulative effect of noise with other industrial sources. As the operational noise assessment presented in this report considers the impact of cumulative noise from the relocated noise sources along with the existing FACT noise sources, we believe the intent of the planning penalty has been met.

We also note that under Part 5, Clause 19(6) of the Noise Policy, exceedance of the recommended criterion does not necessarily mean action is required under the Noise Policy. Some of the following matters should be considered when considering action:

- the amount by which the criterion is exceeded (in dB(A))
- the frequency and duration for which the criterion is exceeded
- the ambient noise that has a noise level similar to the predicted noise level
- the times of occurrence of the noise source
- the number of persons likely to be adversely affected by the noise source and whether there is any special need for quiet.

4.3.2 Characteristic penalties

Penalties can also be applied to a noise source for a variety of characteristics, such as impulsive, low frequency, modulating or tonal characters. For a characteristic penalty to be applied to a noise source is must be fundamental to

Resonate

the impact of the noise and dominate the overall noise impact. Given the proximity of the noisy Victoria Road to the nearest noise sensitive receivers, operation of the proposed Project is not generally expected to dominate the overall noise impact, as evidenced by the existing noise environment characterised in Section 2.

4.4 Construction noise (terrestrial)

Construction noise may be governed by local council under the LNLC Act or the Environment Protection Authority (EPA) under the EP Act.

The LNLC Act declares construction noise a local nuisance in Part 2 (section 4 (a)(i)):

(c) in the case of construction noise—the noise has travelled from the location of the construction activity to neighbouring premises—

- *on any Sunday or public holiday; or*
- *after 7pm or before 7am on any other day;*

For sites that hold EPA authorisation, construction noise that causes an 'adverse impact on amenity' is only permitted between 7am and 7pm, Monday to Saturday.

For construction activities, an adverse impact on amenity is defined as an average noise of 45dB(A) or any singular noise event with a maximum noise level of 60dB(A) at a noise receiver.

Construction activities which are undertaken within standard hours (i.e. 7am to 7pm Monday to Saturday) are not subject to quantitative noise limits under the LNLC Act or EP Act. However, reasonable and practicable measures must be taken to minimise noise resulting from the activity and to minimise its impact.

4.5 Construction vibration impact on humans and structures

Ground vibrations from construction works as part of the Project can have the following effects:

- Human disturbance – disturbance to building occupants: vibration which inconveniences or interferes with the activities of the occupants or users of the building
- Effects on building structures, including underground pipework – vibration which may compromise the condition of the building structure itself.
- Disruption or damage to sensitive equipment.

In general, vibration criteria for maintaining human comfort are more stringent than vibration criteria aimed at lowering the potential risk of building damage due to vibration. Building occupants will normally feel vibration at levels well below those which may cause a risk of cosmetic or structural damage to a building (i.e. 0.3 to 0.5 mm/s).

In recognition of the above, this EIS identifies vibration targets for human comfort and vibration goals to lower the risk of vibration damage to residential dwellings, state heritage places and buildings and infrastructure within the ONS.

4.5.1 Vibration targets for human comfort

Vibration screening criteria applicable to occupied spaces within buildings are detailed in Table 9.

The screening criteria are derived from British Standard BS 6472-1:2008 *Guide to evaluation of human exposure to vibration in buildings*, and *Assessing Vibration: A technical guideline* (NSW Department of Environment and Conservation, 2006).

The vibration criteria are given as a range, with the lower value indicating the preferred vibration level and the upper value representing the maximum.

Table 9: Human comfort vibration screening criteria

Sensitive receiver	Vibration Screening Criteria Vibration Velocity (PPV) mm/s	
	Day	Night
Critical working areas[1] (for example, hospital operating theatres)	0.14 – 0.28	
Residential	0.28 – 0.56	0.2 – 0.4
Other non-residential buildings	0.56 – 1.1	

(1) This does not include sensitive research or manufacturing equipment (for example lithography or microscopy) which may be affected by vibration levels below the threshold of human perception. Specialist advice should be sought where this equipment exists adjacent the project area of works.

The vibration criteria presented above are conservative screening levels and it does not necessarily follow that an exceedance will result in disturbance.

4.5.2 Vibration goals for structural damage

Potential vibration impacts should be managed such that damage does not result to building structures and underground pipework. The limits presented in this assessment are typically adopted as part of the project vibration management framework in infrastructure projects in South Australia, and are referred to in the Department for Infrastructure and Transport's (DIT) *Guideline for the Management of Noise and Vibration: Construction and Maintenance Activities*, available as Attachment 7D to DIT's Environment and Heritage Technical Manual.

Buildings and structures

German Standard DIN 4150-3 *Structural Vibration, Part 3 – Effects of Vibration on Structures* is a suitable reference for guideline vibration limits to avoid cosmetic and structural damage to buildings. The following DIN 4150-3 values are specified as PPV levels measured in any direction at or adjacent to the building foundation. The presented levels in Table 10 are the lowest applicable limit for each structure category.

Table 10: DIN 4150-3 Vibration guideline values

Reference: DIN 4150, Part 3, Table 1	Vibration Velocity, mm/s (PPV)			
	At foundation, at a frequency of:			Plane of floor of uppermost storey
Type of Structure	<10Hz	10-50Hz	>50Hz	All frequencies
Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 - 40	40 - 50	40
Dwellings and buildings of similar design and/or use	5	5 - 15	15 - 20	15
Structures that because of their particular sensitivity to vibration do not correspond to those listed above and have intrinsic value	3	3 - 8	8 - 10	8

DIN 4150-3 states that exposing buildings to vibration levels higher than that recommended above would not necessarily result in damage. Rather it recommends these values as maximum levels of short-term construction vibration at which experience has shown that damage that reduces the serviceability of structures will not occur due to vibration effects. DIN 4150-3 is considered to be suitable for the assessment of both structural and cosmetic damage as the Standard considers a reduction in serviceability of the structure is deemed to have occurred if:

- Cracks form in plastered surfaces of walls
- Existing cracks in the building are enlarged
- Partitions become detached from loadbearing walls or floors.

Underground infrastructure

The DIN 4150 also provides guidelines for the short-term vibration exposure of buried pipelines. The guidelines provide peak particle velocity (PPV) vibration limits applicable at the pipe surface in any of the three orthogonal directions (i.e. x, y, z). These limits are provided in Table 11.

Table 11: Underground Pipework Vibration Limits

Pipe material	Peak Particle Velocity (PPV) limit, mm/s
Steel (including welded pipes)	100
Clay, concrete, reinforced concrete, pre-stressed concrete, metal (with or without flange)	80
Masonry, plaster	50

It is noted that these limits are based on pipework built to modern construction standards. Where the integrity of the pipework is uncertain, further investigation may be required.

Electrical and communications infrastructure

If construction activities occur in close vicinity of existing electrical and communications infrastructure the vibration goals presented in the Australian Coal Industry's Research Program (ACARP) Report *Effect of Blasting on Infrastructure, ACARP Project No C14057*, dated 20 October 2008 will be utilised (presented in Table 12).

Table 12: Suggested vibration limits near electrical and communications infrastructure

Service	Peak Particle Velocity (PPV) limit, mm/s
Power lines – concrete and timber poles	100
Power lines – steel towers	100
Buried communication cables and pipelines	100

4.6 Noise impacts on marine fauna

The *Underwater Piling and Dredging Noise Guidelines* (2023) (the Guidelines) have been developed by the Department for Infrastructure and Transport (DIT) to provide guidance for addressing underwater noise for marine maintenance activities or a marine infrastructure project.

Substantial progress has been made in quantifying marine mammal hearing and the effects of noise on hearing for a range of taxa since the review provided by Southall et al. (2007), which formed the basis of the former DIT (2012) underwater piling noise Guidelines. Southall et al. (2019), considering subsequent scientific findings over the past decade, presented estimated audiograms for six species groupings, including all marine mammal species. Southall et al. (2019) also advise that substantial uncertainties and data gaps remain in the understanding marine mammal hearing.

Southall et al. (2019) provides dual exposure metrics for impulsive noise criteria, including frequency-weighted SEL and unweighted peak sound pressure level. Exposures exceeding the specified respective criteria level for any exposure metric are interpreted as resulting in predicted temporary threshold shift (TTS) or permanent threshold shift (PTS) onset. For continuous noise sources, exposure criteria are given in frequency-weighted SEL.

4.6.1 Physiological impacts on marine mammals

Table 13 summarises the Southall et al. (2019) noise exposure criteria for physiological impacts adopted by the DIT Guidelines. The criteria are essentially also identical to that adopted by NFMS (2018). Note that SEL_{cum} is expressed as $SEL_{24\ hour}$ under the Guidelines for clarity on the assessment period.

Table 13: Underwater noise exposure criteria for physiological impacts on marine mammals

Functional hearing group	Impact	Physiological noise exposure onset criteria	
		Impact piling (Impulsive)	Vibratory / DTH piling and Dredging (Continuous)
Low-frequency cetaceans	TTS	Peak 213 dB $SEL_{24\ hour}$ 168 dB(LF)	$SEL_{24\ hour}$ 179 dB(LF)
	PTS	Peak 219 dB $SEL_{24\ hour}$ 183 dB(LF)	$SEL_{24\ hour}$ 199 dB(LF)
High-frequency cetaceans	TTS	Peak 224 dB $SEL_{24\ hour}$ 178 dB(HF)	$SEL_{24\ hour}$ 179 dB(HF)
	PTS	Peak 230 dB $SEL_{24\ hour}$ 185 dB(HF)	$SEL_{24\ hour}$ 198 dB(HF)
Very high-frequency cetaceans	TTS	Peak 196 dB $SEL_{24\ hour}$ 140 dB(VHF)	$SEL_{24\ hour}$ 153 dB(VHF)
	PTS	Peak 202 dB $SEL_{24\ hour}$ 155 dB(VHF)	$SEL_{24\ hour}$ 173 dB(VHF)
Pinnipeds (Phocid carnivores in water)	TTS	Peak 212 dB $SEL_{24\ hour}$ 170 dB(PCW)	$SEL_{24\ hour}$ 181 dB(PW)
	PTS	Peak 218 dB $SEL_{24\ hour}$ 185 dB(PCW)	$SEL_{24\ hour}$ 201 dB(PCW)
Pinnipeds (other carnivores in water)	TTS	Peak 226 dB $SEL_{24\ hour}$ 188 dB(OCW)	$SEL_{24\ hour}$ 199 dB(OCW)
	PTS	Peak 232 dB $SEL_{24\ hour}$ 203 dB(OCW)	$SEL_{24\ hour}$ 219 dB(OCW)
Pinnipeds – Phocid Carnivores in Air(2)	TTS	Peak 128 dB $SEL_{24\ hour}$ 123 dB(PCA)	$SEL_{24\ hour}$ 134 dB(PCA)
	PTS	Peak 144 dB $SEL_{24\ hour}$ 138 dB(PCA)	$SEL_{24\ hour}$ 154 dB(PCA)
Pinnipeds – Other Carnivores in Air(2)	TTS	Peak 161 dB $SEL_{24\ hour}$ 146 dB(OCA)	$SEL_{24\ hour}$ 157 dB(OCA)
	PTS	Peak 167 dB $SEL_{24\ hour}$ 161 dB(OCA)	$SEL_{24\ hour}$ 177 dB(OCA)

(2) Note: TTS = Temporary threshold shift, PTS = Permanent threshold shift

(3) dB re 20 μPa

4.6.2 Behavioural response of marine mammals

Summaries of behavioural responses of marine mammals to human-made noise show a large variability in the received levels (differing by many tens of decibels) and the severity in the response from minor to severe (C.Erbe et al. 2018). Furthermore, there is limited data on behavioural responses of marine mammals exposed to pile driving activities (both impact and vibratory), especially associated with smaller near shore projects (Appendix B - NOAA Ocean Noise Strategy).

Table 14 summarises noise exposure criteria adopted by the Guidelines for the assessment of behavioural impacts.

Table 14: Underwater noise exposure criteria for behavioural response

Species	Behavioural noise exposure criteria	
	Impact piling	**Vibratory / DTH Piling and Dredging [1]**
Cetaceans	SPL 160 dB rms	SPL 120 dB rms
Pinnipeds	SPL 160 dB rms	SPL 120 dB rms

(4) The 120 dB rms threshold may be adjusted if it can be demonstrated that the ambient levels are above this level.

4.6.3 Fishes and marine turtles

Table 15 provides the underwater noise exposure criteria adopted by the Guidelines for noise impacts on fishes and marine turtles. Popper et al. (2014) note that where insufficient data exist to make a recommendation for guidelines development, a subjective approach is adopted in which the relative risk of an effect is placed in order of rank at three distances from the source:

- Near (N) = tens of meters from the source
- Intermediate (I) = hundreds of meters from the source
- Far (F) = thousands of meters from the source.

Table 15: Underwater noise exposure criteria for fishes and marine turtles

Functional Hearing Group	Source character	Organ damage / increased risk of fatality	PTS	TTS	Behavioural Response
Fish (no swim bladder) For example: • Great White Shark Mackeral Shark	Continuous	**N**: Low **I**: Low **F**: Low	**N**: Low **I**: Low **F**: Low	**N**: Moderate **I**: Low **F**: Low	**N**: Moderate **I**: Moderate **F**: Low
	Impulsive	Peak 213 dB $SEL_{24\ hour}$ 219 dB	Peak 213 dB $SEL_{24\ hour}$ 216 dB	$SEL_{24\ hour}$ 186 dB	**N**: High **I**: Moderate **F**: Low
Fish (with swim bladder) For example: • Pipefish • Seahorses Seadragons	Continuous	**N**: Low **I**: Low **F**: Low	SPL 170 dB for 48 h	SPL 158 dB for 12 h	**N**: High **I**: Moderate **F**: Low
	Impulsive	Peak >207 dB $SEL_{24\ hour}$ 207 dB	Peak >207 dB $SEL_{24\ hour}$ 203 dB	$SEL_{24\ hour}$ 186 dB	**N**: High **I**: High **F**: Moderate

Functional Hearing Group	Source character	Organ damage / increased risk of fatality	PTS	TTS	Behavioural Response
Marine Turtles For example: • Loggerhead Turtle • Green Sea Turtle • Leatherback Turtle • Pacific Ridley Turtle	Continuous	**N**: Low **I**: Low **F**: Low	**N**: Low **I**: Low **F**: Low	**N**: Moderate **I**: Low **F**: Low	**N**: High **I**: Moderate **F**: Low
	Impulsive	Peak 207 dB $SEL_{24\ hour}$ 210 dB	**N**: High **I**: Low **F**: Low	**N**: High **I**: Low **F**: Low	**N**: High **I**: Moderate **F**: Low

(5) TTS = Temporary threshold shift, PTS = Permanent threshold shift

(6) Relative risk of an effect is placed in order of rank at three distances from the source: Near (N) = tens of meters from the source, Intermediate (I) = hundreds of meters from the source, Far (F) = thousands of meters from the source.

Given that it is generally not practical to assign safety zones for these species, a potential effects zone is defined by the Guidelines to assist a risk-based assessment for those species known to occur within the marine area of interest.

Resonate

5 Operational noise assessment

A noise model has been developed by Resonate to assess potential worst-case cumulative environmental noise impacts from current and proposed operations at FACT, including from noise sources which will be relocated as part of the proposed Project.

5.1 Previous noise modelling

Resonate have previously undertaken site-wide noise modelling of the FACT site, as described in Resonate report *Flinders Ports Container Terminal Noise—Noise Modelling Report A200592RP3A* (Revision A, dated 25 July 2023). This report describes a noise survey undertaken to obtain source sound level data for input into the noise model, and model validation undertaken by comparison to previous monitoring data. For brevity this content is not repeated here.

5.2 Noise modelling methodology

5.2.1 Model parameters

Noise modelling has been undertaken using two noise propagation algorithms to represent different meteorological conditions as follows:

- The ISO 9613-2:1996 algorithm, predicts sound pressure levels under meteorological conditions favourable to propagation from noise sources. These conditions are for downwind propagation, or, equivalently, propagation under a well-developed moderate ground-based temperature inversion, such as that which commonly occurs at night
- Conservation of Clean Air and Water in Europe (CONCAWE) algorithm, using CONCAWE meteorological category 6 to represents weather conditions that are the most conducive to noise propagation (the worst case situation with the highest predicted noise levels).

CONCAWE Metrological Category 6 generally represents worst-case conditions (downwind conditions combined with a severe temperature inversion) which are likely to occur rarely in practice, while ISO 9613-2 represents either light downwind or moderate temperature inversion which could occur relatively frequently.

Both modelling algorithms also consider:

- attenuation of noise source due to distance
- barrier effects from buildings, topography and the like
- air absorption
- ground effects

5.3 Noise sources

Sound power level data have been determined from measured sound pressure levels (as described in *Flinders Ports Container Terminal Noise—Noise Modelling Report A200592RP3A*). Where appropriate, measurement results have been supplemented with manufacturer's noise data, Resonate's noise source database, and other available literature. The noise source sound power level data input into the model is presented in Appendix B.

5.4 Modelling scenarios

FACT operation (including operation of the Project) may occur on a 24/7 basis, although the intensity of operation may vary significantly, largely depending on the timing of container vessel movements.

FACT have previously provided quantities of relevant noise sources associated with nominal 'peak' and 'typical' operation as presented in Table 16. It is assumed that these quantities will not change as a direct result of the proposed Project.

Table 16: Operational noise sources

Noise source	Quantity	
	Peak	Typical
Truck movements (per hour)	42	21
Refrigerated container	320	160
Container handler - Hyster 12EC	4	2
Quay Crane	2	1
Straddle carrier	20	10
Reach stacker	2	1
Container Ship	2	1

Modelling scenarios aligned with nominal peak and typical operation are outlined in Table 17.

Table 17: Modelling scenarios

Scenarios	Meteorological conditions	Scenario ID
Existing: peak operations	Worst-case (CONCAWE Category 6)	E1
	Moderate downwind (ISO 9613)	E2
Existing: typical operations	Worst-case (CONCAWE Category 6)	E3
	Moderate downwind (ISO 9613)	E4
Proposed Project: peak operations	Worst-case (CONCAWE Category 6)	P1
	Moderate downwind (ISO 9613)	P2
Proposed Project: typical operations	Worst-case (CONCAWE Category 6)	P3
	Moderate downwind (ISO 9613)	P4

Resonate

5.5 Predicted noise levels

Operational noise levels have been predicted for all noise-sensitive receptors in the vicinity of the Subject Site. The predicted noise level from each scenario at selected representative receiver locations is shown in Table 18 below a

Table 18 Predicted noise levels at selected locations

Location	Predicted noise level, L_{eq} dB(A)								Relevant criteria, L_{eq} dB(A)	
	E1	E2	E3	E4	P1	P2	P3	P4	Day	Night
1 South Australia One Dr	44	39	41	37	44	39	41	37	52	45
4 Comorin Ct	45	39	43	36	45	39	43	36	52	45
34 Oronsay Dr	47	42	44	39	47	42	44	39	52	45
50 Aurelia Dr	39	37	37	34	39	37	37	34	52	45
Royal South Australian Yacht Squadron	53	49	51	47	54	51	52	48	70	60

Predicted noise levels comply with the daytime and night time objective criteria of 45 dB(A) at all locations with the exception of at 34 Oronsay Dr (and other locations along Oronsay Dr and Himalaya Drive) where night time criteria are exceeded by up to 2 dB(A) during peak operation under worst-case meteorological conditions. However it should be noted that background noise levels due to road traffic on Victoria Road are generally high in this location.

The proposed Project is also not predicated to result in a noticeable increase in overall FACT noise emissions at this location, compared to existing operations.

Operational noise levels are predicted to comply with the relevant daytime and night time criteria at all locations under all other operating scenarios.

Predicted noise level contours for the peak operations under worst-case meteorological conditions (i.e. scenarios E1 and P1) are presented in Appendix C.

5.6 Discussion

The noise modelling described above is based on limited input information because the GatewaySA project is in the early stages of design. It is recommended that further assessment is undertaken in the event that the final FACT layout and quantities of key noise sources change, either as a direct or indirect result of the Project (including from subsequent stages of GatewaySA). Further design work may also identify opportunities for additional noise mitigation, where reasonable and practicable. Potential noise mitigation options could include:

- Strategic design of future FACT site layout to place container stacks to the south of the site (i.e. in between noise sources and sensitive receiver locations where they may provide incidental ‘shielding’ of noise emissions from trucks and other sources
- Selection of quieter equipment items, where possible. This may include selection of plant that does not exhibit any tonality or other special characteristics which may otherwise make the noise more noticeable or annoying to residential receivers.

6 Construction noise assessment

Limited information is available at this stage of the project to be able to undertake a detailed quantitative assessment of terrestrial construction noise emissions.

Also as noted in Section 4.4, construction activities which are undertaken within standard hours (i.e. 7am to 7pm Monday to Saturday) are not subject to quantitative noise limits under the LNLC Act or EP Act. However, reasonable and practicable measures must be taken to minimise noise resulting from the activity and to minimise its impact

Given this requirement, it is recommended that the preparation of a Construction Noise and Vibration Management Plan (CNVMP) is developed by the contractor responsible for managing the construction works. The CNVMP is required to specifically address any noisy works that may be undertaken outside of the hours identified above.

Table 19 summarises general noise mitigation and management measures, including who is typically accountable, to be considered during the development of the CNVMP.

Table 19: Typical noise mitigation and management measures

Control Measure	Accountability
The site induction shall cover noise (and vibration) management and complaints, which will be reiterated through on-site training, such as toolbox talks or pre-starts.	Site Manager/Site Supervisor
Effective communication with the potentially affected community is a key mitigation measure.	Community Team
The potential shielding provided by site topography shall be considered in locating equipment.	Site Manager/Site Supervisors
Equipment that emits noise predominantly in a particular direction shall be sited such that noise is directed away from occupied premises where feasible.	Site Manager/Site Supervisor
Works planning shall consider preventing vehicles and equipment queuing, idling or reversing near occupied premises where practicable.	Site Manager/Site Supervisor
Truck movements on local roads shall be limited as much as is practicable.	Site Manager/Site Supervisor
Truck operators shall ensure tailgates are cleared and locked at the designated points.	Site Manager/Site Supervisor
Truck movements along uneven surfaces shall be restricted to minimum speed near sensitive receivers.	Site Manager/Site Supervisor
Equipment that is used intermittently shall be shut down or throttled down to a minimum during periods where it is not in use.	Site Manager/Site Supervisor
Equipment shall be well maintained and have mufflers and silencers installed that meet the manufacturer's specifications where relevant.	Site Manager/Site Supervisor
Where a noisy plant is to be fixed in a stationary location, such that it may impact sensitive receivers for a significant length of time, an acoustic enclosure shall be installed where reasonable or practical, or an appropriately silenced generator or lighting tower used.	Site Manager/Site Supervisor
Acoustic screening shall be considered and implemented around noisy above ground equipment where noise levels are predicted to exceed the relevant noise level targets at sensitive land uses, where safe and practical.	Site Manager/Site Supervisor

Control Measure	Accountability
Two-way radio chatter and volume settings shall be kept to the minimum practical.	Operators
The beeping of horns shall not used as a communication method, except for safety reasons in an emergency.	Operators
Where practical, all reversing plants used at night will be fitted with broadband reversing alarms, noting that it may not be possible to do so where the plant is called in at short notice to replace other plant requiring maintenance. All broadband reversing alarms shall be installed and operating in accordance with all relevant Occupational Health and Safety requirements.	Project Engineer
Where it cannot be guaranteed that plant will not be fitted with broadband reversing alarms (e.g., trucks that only attend the site on occasion), the site shall be set up as far as practicable so that those vehicles do not need to reverse.	Project Engineer
Materials shall not be dropped from a height, causing a loud noise wherever possible.	Operators
Where materials are to be dropped into an empty truck tray or disposal bin and may cause a loud noise, the tray/bin shall be lined with soil or an equivalent material to reduce impact noise where feasible.	Operators

7 Construction vibration assessment on humans and structures

7.1 Vibratory piling

Vibration generated by vibratory hammer piling is explained as follows:

- Vibratory drivers produce a steady-state vibration, forcing the ground particles to vibrate in a certain mode, regardless of the ground characteristic frequency. The vibration typically consists of several frequencies, but the dominant frequency is that of the vibratory driver itself. Resonance can also occur when the vibration frequency coincides with the characteristic pile/ground frequency.
- When sheet piles connect, friction between them increases vibration (3-5 times) especially with worn piles or misaligned driving. New piles and precise driving reduce this effect (Deckner et al., 2010).
- Clamping the piles off-centre also creates an uneven bending force, causing larger lateral vibrations (2-3 times) compared to vertical ones (Deckner et al., 2010).
- Vibration propagates away from the pile in the form of different wave types depending on whether the waves are emitted along the pile shaft and/or from the pile toe. At the toe (bottom of the pile), compression waves (P-waves) and shear waves (S-waves) occur, which both extend as spherical waves in all directions. When the waves reach the surface, they are reflected and refracted. The refracted waves are spread as surface waves (R-waves), which propagate with lower attenuation than body waves (e.g. P or S-waves) along the ground surface.

7.1.1 Vibratory piling predictions

Vibratory sheet piling vibration predictions have been undertaken utilising the approach described by Attwell et al. 1992, which uses an empirically derived quadratic regression model.

Modelling assumptions:

- Sheet pile = AZ 24-700
- Pile length = 14m
- Vibratory driver = 1000 kN centrifugal force, 250 kW hydraulic power
- Driving frequency = 27 Hz

Table 20 provides a summary of the predicted sheet piling vibration levels (mm/s PPV) from the pile with distance.

Table 20: Predicted vibration levels (mm/s PPV) in accordance with Attwell et al. 1992 – sheet vibratory piling

Distance (m)	Best Fit, mm/s PPV	Half Standard Deviation, mm/s PPV	One Standard Deviation, mm/s PPV
10m	6.7	11.9	21.2
20m	3.2	5.6	10.0
50m	0.9	1.7	3.0
100m	0.3	0.6	1.0
200m	0.1	0.2	0.3

7.2 Impact piling

Vibration generated by impact piling is explained as follows:

- The impact of the pile hammer on the pile helmet generates a stress wave that propagates through the pile.

- Dynamic forces develop along the interface between the pile and the surrounding soil, which causes vibration. The magnitude of the vibration generated varies with respect to the dynamic soil resistance.
- Vibration propagates in the form of different wave types depending on whether the waves are emitted along the pile shaft and/or from the pile toe. At the toe (bottom of the pile), compression waves (P-waves) and shear waves (S-waves) occur, which both extend as spherical waves in all directions. When the waves reach the surface, they are reflected and refracted. The refracted waves are spread as surface waves (R-waves), which propagate with lower attenuation than body waves (e.g. P or S-waves) along the ground surface.
- Vibrations attenuate with increasing distance from the pile, although in some soil layers and buildings, they may become amplified due to resonance effects.

7.2.1 Impact piling predictions

Impact piling vibration predictions have been undertaken utilising the Attwell et al. 1992 (quadratic regression model).

Modelling assumptions:

- Impact hammer = IHC S-150 Hydrohammer (7500 kg hammer, 150 kJ maximum energy)
- Hammer efficiency = 95% (conservative, typically we would expect the hammer to be less efficient than this)
- Pile diameter = 610 mm
- Pile length = 22 m
- Pile material = Steel

Table 21 provides a summary of the predicted impact piling vibration levels (mm/s PPV) from the pile with distance.

Table 21: Predicted vibration levels (mm/s PPV) in accordance with Attwell et al. 1992 – impact piling

Distance (m)	Best Fit, mm/s PPV	Half Standard Deviation, mm/s PPV	One Standard Deviation, mm/s PPV
10m	11.9	19.9	33.2
20m	7.3	12.1	20.3
50m	3.3	5.4	9.1
100m	1.6	2.6	4.4
200m	0.7	1.1	2.0

7.3 Assessment of vibration impacts

Note that in relation to the above predictions, it is typical to expect a reduction in vibration level as the vibration energy transfers from the ground to the building foundation or structure (e.g. Jurevicius et al. 2015). Therefore, the predictions are conservative in nature and a general guideline for the potential vibration impacts.

7.3.1 Potential impact to humans

The vibration targets for human comfort are unlikely to be exceeded at residential premises given the distance from the works, being at least 500 metres from the proposed works. We note that the maximum baseline vibration levels resulting from road traffic on Victoria Road are generally above the adopted criteria.

7.3.2 Potential impact to heritage structures

The nearest heritage structure to the proposed works is the shipwreck *Corsair* which is located approximately 1 km to the northeast of the proposed Berth 6 extension.

Based on the predicted vibrational levels outlined in Section 7 above, it can be concluded that potential vibration impacts on heritage structures are not expected.

7.4 Construction vibration mitigation and management

Similarly to construction noise, the mitigation and management of vibration generated from construction activities may be assessed and documented in a Construction Noise and Vibration Management Plan (CNVMP) developed by the contractor responsible for managing the construction works. The CNVMP should consider the potential impact of vibration on human comfort to any occupied building as well as any damage to nearby structures and heritage assets.

Resonate

8 Marine fauna noise assessment

8.1 What is underwater noise?

Sound is an acoustic pressure wave that travels through a medium, such as water or air, and occurs as an oscillatory motion of the water or air particles driven by a vibrating source. The magnitude of the water or air particle motion determines the intensity of the sound. The rate at which the water or air particles oscillate determines its frequency, given in cycles per second or Hertz (Hz).

Sound travels about four-and-a-half times faster in water than in air. The absorption of sound at frequencies where man-made noise generally has the most energy is much smaller in water than in air. As a result, noise is typically audible over much greater ranges underwater than in air. Most sources of noise, including pile driving, and movement of large shipping vessels generate acoustic energy over a broad range of frequencies. Screeching or whistling noises are composed mainly of high frequency sounds while rumbles or booms are composed mainly of low frequency sounds.

Sounds are usually characterized according to whether they are continuous or impulsive in character. Continuous sounds occur without pauses and examples include shipping noise and dredging. Impulsive sounds are of short duration and can occur singularly, irregularly, or as part of a repeating pattern. Blasting represents a single impulsive event whereas the periodic impacts from a pile driving rig results in a patterned impulsive sequence. Impulsive signals typically sound like bangs and generally include a broad range of frequencies.

8.2 Overview of noise effects

The following provides a brief overview of the effects that may occur because of an animal being exposed to underwater noise. Consideration of this information, together with information on the biological importance of the habitat for the considered species, e.g. breeding, calving or resting areas, or confined migratory routes or feeding areas, is used to assess the likely impact of a noise source.

- Risk of fatality – When exposed to significant noise levels, either immediate mortality or tissue and/or physiological damage can result. The injury may be sufficiently severe that death occurs sometime later due to decreased fitness. Mortality can also have a direct effect upon animal populations, especially if it affects individuals close to maturity. Tissue and other physical damage or physiological effects, that are recoverable, but which may place animals at lower levels of fitness, may render them more open to predation, impaired feeding and growth, or lack of breeding success, until recovery takes place.
- Hearing injury – Short or long term changes in hearing sensitivity (TTS or PTS) may, or may not, reduce fitness and survival. Impairment of hearing may affect the ability of animals to capture prey and avoid predators, as well as cause deterioration in communication between individuals. This may affect growth, survival, and reproductive success.
- Masking – The presence of man-made sounds may make it difficult to detect biologically significant sounds against the noise background. Masking of sounds from predators may result in reduced survival. Masking of sounds used for orientation and navigation may affect the ability to find preferred habitats and in the case of fish, spawning areas, affecting recruitment, growth, survival, and reproduction.
- Behavioural responses – Behavioural responses may cause displacement from preferred habitats, which could affect feeding, growth, predation, survival, and reproductive success (if a mammal is displaced from preferred habitat).

Figure 10 acknowledges that the severity of noise effects relates to distance from the noise source, however, note that the ‘zones’ of hearing injury, masking and behavioural response may overlap. Overlap, results, from comparing cumulative sound exposure threshold metrics with single event peak or behavioural sound level metrics.

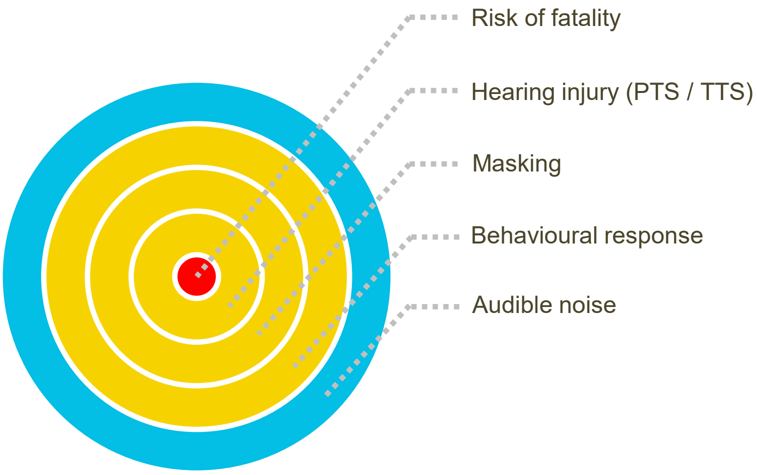


Figure 10Overview of potential noise effects upon marine fauna (source: DIT)

8.3 Significant marine fauna

A marine ecological assessment previously been undertaken for a defence project in close proximity to the subject site. Table 22 provides an overview of the Matters of National Environmental Significance (MNES) and other species of significance identified by J Diversity (2023) within 5 km of the Outer Harbor breakwaters. Furthermore, Succession Ecology (2024) reviewed the J Diversity (2023) report and identified that a total of five threatened or protected marine fauna species under the EPBC Act and/or NPW Act were identified as *possible, likely or certain* to be impacted by the Development.

Those species highlighted in **bold** are listed as MNES. Species that are not protected by the EPBC, NPW Act and FM Act have not been listed. Species with a 'rare' SA status only are also not listed. In relation to other species, all Syngnathids (fish) are listed under the FM Act and the remaining are listed under the NPW Act.

Table 22: List of significant species recorded within 5 km of the Outer Harbor breakwaters (J. Brook 2023)

Types of species	*EPBC Act* and/or *NPW Act* species identified as possible, likely or certain to be impacted by the Development – Succession Ecology (2024)
Fish	
Pipefish (*Syngnathinae*)	×
Seahorses (*Hippocampus abdominalis* and *breviceps*)	×
Seadragon (*Phyllopteryx taeniolatus*)	×
Sharks	
White Shark (*Caracharondon carcharias*)	×
Mackerel Shark (*Lamna nasus*)	×
Marine Turtles	
Loggerhead Turtle (*Caretta caretta*)	×
Green Turtle (*Chelonia mydas*)	×

Types of species	*EPBC Act* and/or *NPW Act* species identified as possible, likely or certain to be impacted by the Development – Succession Ecology (2024)
Leatherback Turtle (*Dermochelys coriacea*)	×
Pacific Ridley Turtle (*Lepidochelys olivacea*)	×

Table 23: List of significant marine mammals recorded within 5 km of the Outer Harbor breakwaters (J. Brook 2023)

Marine Mammals	*EPBC Act* and/or *NPW Act* species identified as possible, likely or certain to be impacted by the Development – Succession Ecology (2024)
Low Frequency Cetaceans	
Humpback Whale (*Megaptera novaeangliae*)	×
Southern Right Whale (*Eubaleana australis*)	×
Pygmy Right Whale (*Caperea marginata*)	×
Bryde's Whale (*Balaenoptera edeni*)	×
High Frequency Cetaceans	
Common Dolphin, Short-beaked Common Dolphin (*Delphinus delphis*)	✓
Indian Ocean bottlenose dolphin (*Tursiops aduncus*)	✓
Common bottle-nosed dolphin (*Tursiops truncatus*)	✓
Dusky Dolphin (*Lagenorhynchus obscurus*)	×
Killer Whale (*Orcinus orca*)	×
Sperm Whale (*Physeter macrocephalus*)	×
Pinnipeds – Other Carnivores	
Australian Sea Lion (*Neophoca cinerea*)	✓
Subantarctic fur seal (*Arctocephalus tropicalis*)	×
Long-nosed fur seal (*Arctocephalus forsteri*)	✓
Australian fur seal (*Arctocephalus pusillus*)	×
Pinnipeds – Phocid Carnivores	
Leopard seal (*Hydrurga leptonyx*)	×

8.4 Fish and sharks

All fishes have ears to detect sound and convey sensitivity to gravity and to linear and angular acceleration (Popper et al. 2014). The adaptations that provide fish with additional sensitivity to sound pressure are gas-filled structures near the ear and/or extensions of the swim bladder that functionally affect the ear. The enclosed gas changes volume in response to fluctuating sound pressure, generating particle motion.

Resonate

In fishes where the swim bladder is near the ear (or connected to it mechanically as in the *Otophysi)*, the particle motion radiated from the bladder is sufficiently large to cause the sensory epithelium to move relative to the otolith. Fishes with these adaptations generally have lower sound pressure thresholds and wider frequency ranges of hearing than do the purely particle motion-sensitive species.

Conversely, fish species that lack a gas-filled cavity, including sharks, are not as vulnerable to trauma from extreme sound pressure changes as fish with a gas-filled space. This difference has been demonstrated by comparing the effects of pile driving sounds on fishes with and without a swim bladder (Halvorsen et al. 2012c).

Hearing abilities among sharks have demonstrated highest sensitivity to low frequency sound (40Hz to approximately 800Hz), which is sensed solely through the particle-motion component of an acoustical field. Free-ranging sharks are attracted to sounds possessing specific characteristics: irregularly pulsed, broad-band (most attractive frequencies: below 80Hz), and transmitted without a sudden increase in intensity. Such sounds are reminiscent of those produced by struggling prey. A sound, even an attractive one, can also result in immediate withdrawal by sharks from a source, if its intensity suddenly increases 20 dB or more above a previous transmission (Myrberg 2001).

8.5 Marine turtles

Data on hearing of marine turtles is very limited. Electrophysiological studies on hearing have been conducted on juvenile green sea turtles, juvenile Kemp's Ridleys, and on juvenile loggerheads. Ridgway et al. (1969) obtained an auditory evoked potential (AEP) audiogram to aerial and vibrational stimuli that extended from below 100 Hz to 2000 Hz with the lowest threshold at 400 Hz. Other studies using AEPs found similar low-frequency responses to vibrations delivered to the tympanum (the external ear on the surface of the head) for the loggerhead sea turtle, and to underwater sound stimuli for the loggerhead, Kemp's Ridley, and green sea turtles.

Martin et al. (2012) measured underwater thresholds in the loggerhead sea turtle (*Caretta caretta*) by both behavioural and AEP methods. Behavioural sensitivity showed the lowest thresholds between 100 and 400 Hz, with thresholds at about 100 dB re 1 µPa. AEP measurements on the same individual were up to 8 dB higher; however, both techniques showed a similar frequency response and a high frequency loss of sensitivity above 400 Hz of about 37 dB per octave. These results are presented in Figure 11.

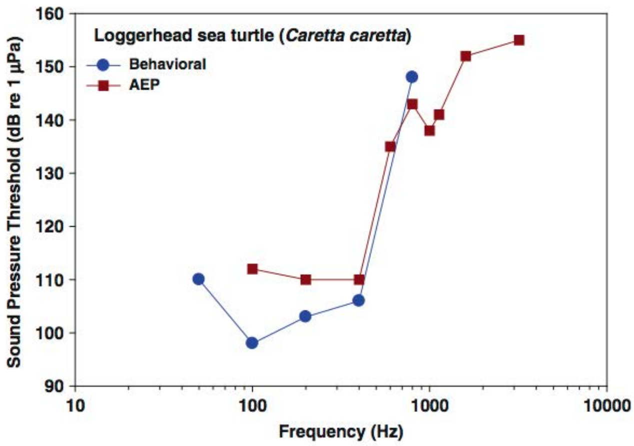


Figure 11: Behavioural and auditory evoked potential thresholds for the Loggerhead sea turtle (Martin et al. 2012)

Morphological examinations of green and loggerhead sea turtles (Ridgway et al. 1969; Wever 1978; Lenhardt et al. 1985) describe the sea turtle as having a typical reptilian ear with a few underwater modifications, supporting the proposal that fish hearing, rather than mammalian hearing, is the better model to use for sea turtles until there are much more data.

8.6 Marine mammal sounds

Marine animals live in an environment in which vision is not the primary sense because light does not penetrate far beneath the surface of the ocean. As such, marine mammals have become reliant upon sound, instead of light, as their primary sense for communication and being aware of their surrounding environment. Marine mammal communication has a variety of functions such as intra-sexual selection, mother/calf cohesion, group cohesion, individual recognition and danger avoidance.

Baleen whales produce sounds that are primarily at frequencies below 1kHz and have durations from approximately 0.5 to over 1 second and sometimes much longer (Richardson et al. 1995). Humpback whales and some other species produce sounds with frequencies above 1kHz. Many baleen whale sounds are uncomplicated tonal moans or sounds described as knocks, pulses, ratchets, thumps, and trumpet-like. Blue whales for example produce low frequency moans in the frequency range of 10-15Hz.

Pinnipeds, including hair and eared seals and sea lions, produce underwater vocalisations sounding like barks and clicks with frequencies ranging from below 1kHz to 4kHz (Richardson et al. 1995). Pinnipeds are especially vocal during the breeding season.

Bottlenose dolphins make many different sounds that have been recorded and described by researchers for over 60 years. This species, *Tursiops truncatus*, has the ability to hear and produce sounds over a range of at least 150 kilohertz (kHz). Although human hearing is limited in bandwidth to less than 20 kHz, dolphin sounds have historically been described as humans perceive them e.g. whistles, squeals, buzzes, barks, quacks, pops, etc. (Jones et al. 2019).

In summary, baleen whales produce sounds that are dominant at frequencies that overlap with man-made industrial noise (e.g. drilling). In contrast, the social sounds produced by pinnipeds and dolphins (toothed whales) occur above the low-frequency range where most man-made sounds have their dominant energy (with the exception of sonar).

8.7 Marine mammal hearing sensitivity

The hearing sensitivity of marine animals generally varies with frequency. Audiograms are therefore used to represent an animal's sensitivity to sounds of different frequencies. An audiogram of a species relates the absolute threshold of hearing (in dB re 1μPa) of that species to frequency. An animal is most sensitive to sounds at frequencies where its absolute threshold of hearing is lowest. As an example, human beings are most sensitive to sounds between 2-4kHz where the absolute threshold is lowest.

Substantial progress has been made in quantifying marine mammal hearing and the effects of noise on hearing for a range of taxa since the review provided by Southall et al. (2007). Southall et al. (2019), in light of subsequent scientific findings over the past decade, presents estimated audiograms for six species groupings, including all marine mammal species. In-air audiograms are also provided for amphibious species.

The intent of Southall et al. (2019) was to provide the best scientific interpretation and application of the available information within different marine mammal hearing groups while acknowledging data limitations for specific topics and for some hearing groups. However, substantial uncertainties and data gaps remain in understanding marine mammal hearing (Southall et al. 2019).

The following sections briefly summarise the audiograms that relate to specific hearing groups of marine mammals considered in this assessment.

8.7.1 Low Frequency Cetaceans

With reference to

Table 23, the low frequency (LF) cetaceans relevant to this study include:

- Humpback Whale (*Megaptera novaeangliae*)
- Southern Right Whale (*Eubaleana australis*)
- Pygmy Right Whale (*Caperea marginata*)
- Bryde's Whale (*Balaenoptera edeni*).

The Southall et al. (2019) estimated audiogram for this hearing group is presented in Figure 13.

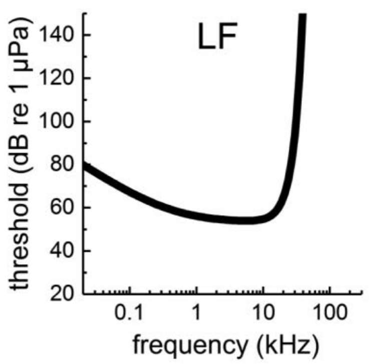


Figure 12: Estimated group audiogram for low-frequency (LF) cetaceans (Southall et al., 2019)

In relation to the audiogram presented in Figure 12, Southall et al. (2019) advise that no direct hearing data (behavioural or electrophysiological) were available at any frequency for any species. That is, there are no comprehensive, directly measured audiograms for any baleen whale from which an estimate of the LF cetacean group audiogram can be made (as was with all the other hearing groups), where an alternative approach was adopted. Nevertheless, the presented audiogram represents the latest scientific understanding for this hearing group.

Baleen whale vocalisations are low in frequency content for a number of species, and the frequency range of acute hearing presumably includes the frequency range of vocalisations. From behavioural observations, it is apparent that baleen whales are quite sensitive to frequencies below 1kHz, but can hear sounds up to a considerably higher but unknown frequency (Richardson et al. 1995).

The audiogram in Figure 12 indicates that the frequencies where the hearing is most sensitive ranges from 100Hz to 10kHz.

8.7.2 High Frequency Cetaceans

With reference to

Table 23 the high frequency (HF) cetaceans relevant to this study include:

- Common Dolphin, Short-beaked Common Dolphin (*Delphinus delphis*)
- Indian Ocean bottlenose dolphin (*Tursiops aduncus*)
- Common bottle-nosed dolphin (*Tursiops truncatus*)
- Dusky Dolphin (*Lagenorhynchus obscurus*)
- Killer Whale (*Orcinus orca*)
- Sperm Whale (*Physeter macrocephalus*).

The Southall et al. (2019) estimated audiogram for this hearing group is presented in Figure 13.

Resonate

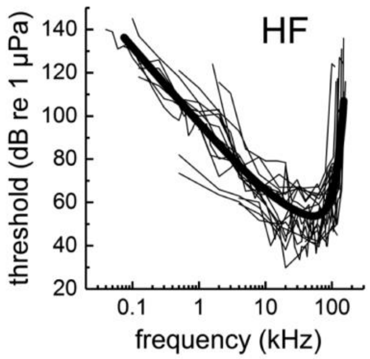


Figure 13: Estimated group audiograms based on original behavioural threshold data for high-frequency (HF) cetaceans (Southall et al., 2019).

The audiogram in Figure 13 indicates that the frequencies where the hearing is most sensitive for this group ranges from 8kHz to 100kHz. Note that noise from shipping, drilling and piling activities occur predominantly in the frequency region where the high frequency cetaceans hearing is the least sensitive.

8.7.3 Pinnipeds

Pinnipeds, comprise the extant families *Odobenidae* (walrus), *Otariidae* (the eared seals: sea lions and fur seals), and *Phocidae* (the earless seals, or true seals). The relevant species to this study can be split into two hearing groups (Southall et al., 2019), namely 'Phocid Carnivores' and 'Other Carnivores'.

Phocid Carnivores (PC):

- Leopard seal (*Hydrurga leptonyx*)

Other Carnivores (OC):

- Australian Sea Lion (*Neophoca cinerea*)
- Subantarctic fur seal (*Arctocephalus tropicalis*)
- Long-nosed fur seal (*Arctocephalus forsteri*)
- Australian fur seal (*Arctocephalus pusillus*).

The audiograms for Phocid Carnivores in water/air (PCW / PCA) and Other Carnivores in water/air (OCW / OCA) are presented in Figure 14 and Figure 15.

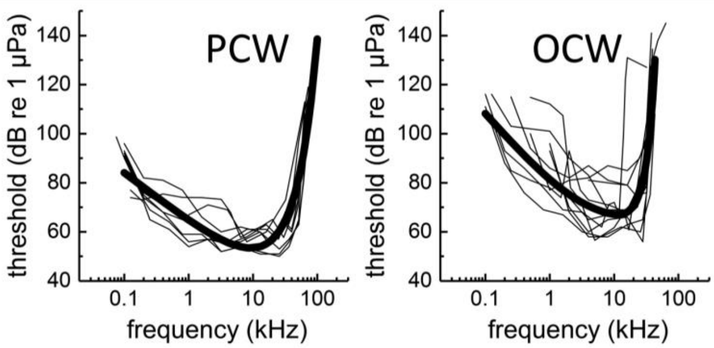


Figure 14: Estimated group audiograms based on original behavioural threshold data for phocid carnivores in water [PCW] and other carnivores in water [OCW] (Southall et al., 2019)

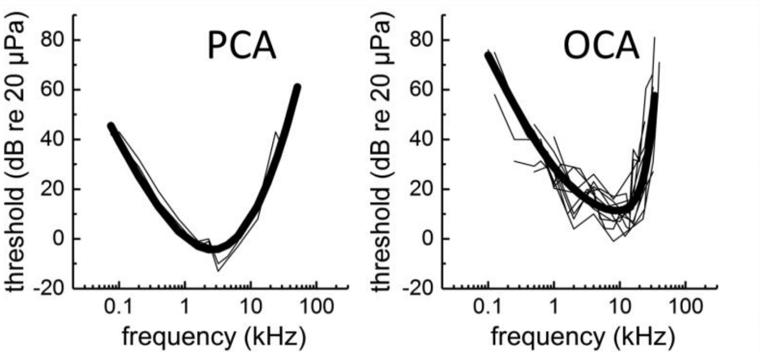


Figure 15: Estimated group audiograms based on original behavioural threshold data for phocid carnivores in air [PCA] and other carnivores in air [OCA] (Southall et al., 2019)

The audiograms indicate that phocid carnivores are generally more sensitive over a wider frequency range than other carnivores in both water and air. Phocid carnivores are also more sensitive to the lower frequencies where piling and shipping noise emissions are mostly dominant. Of note, the maximum hearing sensitivity of phocid carnivores is 10 kHz in water and 3 kHz in air, while other carnivores are similar at around 10 kHz in both water and air. Furthermore, both species have greater hearing sensitivity in water than in air, particularly at lower frequencies.

In comparison to toothed whales (i.e. high frequency cetaceans), pinnipeds generally tend to have maximum hearing sensitivity at lower frequencies and therefore more able to hear man-made noise.

8.8 Construction noise source characterisation

As described above, the construction activities likely to impact the marine environment include dredging and piling and to a lesser extent, support vessel movements.

8.8.1 Piling

At the time of this assessment, limited details are available regarding the sheet piling design for the site. This assessment therefore considers a worst-case design option which involves sheet pile driving in the water.

Pile driving techniques include impact pile driving, where a pile is hammered into the ground by a hydraulic ram, and vibro-driving, where rotating eccentric weights create an alternating force on the pile, vibrating it into the ground.

- Impact piling – Impulsive in character with multiple pulses occurring at blow rates in the order of 30 to 60 impacts per minute. Typical source levels range from SEL 170–225 dB re 1 $\mu Pa^2 \cdot s$ for a single pulse, and peak level 190–245 dB re 1 μPa^2. Most of the sound energy usually occurs at lower frequencies between 100 Hz and 1 kHz. Factors that influence the source level include the size, shape, length and material of the pile, the weight and drop height of the hammer, and the seabed material and depth.
- Vibro-driving – Continuous in character and usually of a much lower level than impact piling. Typical source levels range from SPL 160–200 dB re 1 μPa^2, with most of the sound energy occurring between 100 Hz and 2 kHz. Strong tones at the driving frequency and associated harmonics may occur with the driving frequency typically ranging between 10 and 60 Hz. Sound propagation at such low frequencies is often poor in shallow water environments, such that the tones may not be noticeable at greater distances from the source.

Sheet piles are likely to be installed using a vibratory hammer (i.e. vibro-driving) fitted to a 150T crawler crane (or similar). In the event that the vibratory hammer cannot penetrate the pile into a rock layer, an impact hammer could also be mobilised to install the sheet pile to the correct depth.

Summaries of measured sound pressure data for vibro-driving sources are presented in Table 24 (Burgess et al. 2006; URS 2007; Illinworth & Rodkin 2007; Stadler et al. 2009).

Table 24: Comparison of sound pressure levels for pile driving using vibratory hammers

Vibratory Hammer	Drive Force	Pile Type	Distance from Pile (m)	Relative Water Depth (m)	Maximum Received Levels SEL (dB re 1 µPa²s)	RMS (dB re 1 µPa²)	Peak (dB re 1 µPa²)
APE 200	202 US ton	Sheet pile	15	10	-	169	189
APE400B	362 US ton	0.6m AZ Sheet pile	10	15	165	165	182
APE400B	362 US ton	Sheet pile	56	18	-	162	-

It is recognised that the adopted vibro hammer for the Project is likely to be smaller than those presented in Table 24 , i.e. with a driving force in the order of 50 – 70 tonnes.

Table 25 provides a summary of measured sound pressure data for an impact sheet piling source obtained from Rodkin & Pommerenck (2014) for sheet steel and steel and concrete piles at indicative diameters. Note that the tabulated data relates to a single pile blow only.

Table 25: Summary of near-source (10m) sound pressure levels for pile driving using an impact hammer

Pile size (m)	Pile Type	Relative water depth (m)	Sound pressure levels level at near-source (10m) per hammer blow		
			SEL (dB re 1 µPa² s)	RMS (dB re 1 µPa²)	Peak (dB re 1 µPa²)
0.61	AZ steel sheet	~15	180	205	205
0.36	Steel Pipe Pile	~15	174	184	200
0.61	Steel Pipe Pile	~15	178	194	207
0.61	Steel Pipe Pile	~5	177	190	203
0.3	Concrete Pile	Land based	146	-	176
0.46	Concrete Pile	<3	155	166	185
0.61	Concrete Pile	~5	160	170	185
0.61	Concrete Pile	~15	166	176	188

In summary, the impact piling of sheet piles generates a 15 dB higher SEL than vibro-driving. Furthermore, the adoption of concrete tubular piles as opposed to steel tubular piles results in a significantly lower underwater noise emission (ie.12 – 17 dB reduction) if practical. For the purposes of this study, steel sheet piles have been adopted to present a worst case scenario.

8.8.2 Operational noise

As noted in Section 1, underwater noise from operation of the Project (post-construction) will not be materially different to underwater noise from the existing FACT operation. Potential impacts of operational noise on marine fauna have therefore not been assessed.

8.9 Modelling methodology

Underwater noise modelling has been undertaken in dBSea software using both a spherical and cylindrical model (S+CS model) for low frequencies (31.5 Hz to 80 Hz) and a ray tracing model for high frequencies (100 Hz to 16 kHz). The adopted crossover point between the two models is 80 Hz. Calculations have been undertaken in one-third octave bands.

The S+CS model turns the spreading loss into one of cylindrical form at a distance equivalent to the depth to account for energy largely being constrained within the water layer by the surface and seabed boundaries (no calculation of reflection coefficient takes place). The transmission loss (TL) is calculated as spherical until radii (r_d) equals the depth (D) at source location. From then on, a cylindrical spreading is assumed. This model does take frequency dependent attenuation into account, but not reflection nor refraction.

The ray tracing (RT) model calculates the formation of a sound field by summating many calculated ray paths through media. At interactions with sediment, an effective reflection coefficient is also calculated. The RT model performs well for higher frequencies, although it is prone to error at low frequencies. Combining the two models is expected to improve accuracy over the full frequency range considered. The crossover frequency was adjusted based on the spectral profile with range from the source to ensure a smooth transition to that expected from field measurements.

Bathymetry data has been obtained from the GEBCO 2024 global ocean and land terrain model. GEBCO operates under the joint auspices of the International Hydrographic Organization(IHO) and the Intergovernmental Oceanographic Commission (IOC) (of UNESCO).

8.10 Modelling results

In relation to the envisaged construction methodology, impact piling is anticipated to be the highest-energy source of underwater noise during the construction and/or operation of the Project. Noise from impact piling will be considerably louder than the ambient underwater noise environment in the vicinity of the piling. Furthermore, the impacts from vibratory sheet piling have also been assessed.

Modelling results are presented in Appendix D

8.10.1 Vibratory sheet piling

Our assessment has assumed that 50 piles will be vibro-driven in the water for a duration of 1 minute each within a 24 hour period with the addition of impact piling if required to ensure the sheet pile is driven to the correct depth (should hard/dense soil substrates be encountered).

Fish, sharks and marine turtles

Vibro-driving is considered a continuous non-impulsive noise source. This means, that for a source level of 163 dB re 1 μPa^2 at 10 m, the predicted physiological impacts are:

- TTS could occur at distances < 35 m under the assumption of a continuous 12 hour exposure
- PTS could occur at distances < 2 m under the assumption of a continuous 48 hour exposure.

Given the above predictions, the potential for permanent physiological injury is low, particularly in the understanding that a behavioural response to avoid higher noise levels is likely (Popper et al., 2014).

Marine mammals

Table 26 provides cumulative SEL comparisons versus exposure time and distance to meet the adopted criteria for marine mammals.

Table 26: Marine mammals weighted distance to TTS/PTS – Vibro driven sheet piling

Hearing Group	Exposure time within a 24 hour period	Weighted distance to TTS/PTS criteria compliance (m)	
		TTS	PTS
Low Frequency (LF) Cetaceans	50 minutes	390	8
High Frequency (HF) Cetaceans	50 minutes	16	1
Pinnipeds – Phocid Carnivores in water (PCW)	50 minutes	240	4
Pinnipeds – Other Carnivores in Water (OCW)	50 minutes	7	1

(7) TTS = Temporary Threshold Shift, PTS = Permanent Threshold Shift

The greatest impact potential is on low frequency cetaceans and phocid carnivores, given their increased hearing sensitivity at low frequencies. For these species, even with a 50 minute exposure time, the potential for permanent hearing injury is considered negligible, given the very short distances in comparison to the mobility potential of the animals. The potential is even less for high frequency cetaceans and other pinniped carnivores.

Furthermore, the potential for temporary hearing impacts is possible for phocids and low frequency cetaceans remaining within approximately 400 m of vibro-driving, however given the mobility potential of these animals, particularly for migratory low frequency cetaceans, this is considered unlikely. The potential for temporary hearing impacts for high frequency cetaceans and other pinniped carnivores is considered unlikely given the significantly shorter distances in comparison to the mobility potential of these animals.

Pinnipeds in air

Given that pinnipeds are amphibious, the airborne exposure also needs to be considered, particularly for impact piling. The predicted results for air borne noise exposure results are presented in Table 30. Note that the airborne noise level drops off at 20 $\log_{10}(r)$ with *r* the distance from the source and the dB level relates to a different reference pressure i.e. 20 µPa (air) instead of 1 µPa (water).

The predicted results for pinnipeds in air are presented in Table 27.

Table 27: Pinnipeds weighted distance to TTS/PTS in air – Vibro driven sheet piling

Hearing Group	SPL (RMS) [1] dB re 20 µPa at 1 m	Exposure time within a 24 hour period	Weighted Cumulative SEL @ 1m (dB re 20 µPa²s)	Weighted distance to PTS criteria compliance (m) [20logR propagation]	
				TTS	PTS
Phocid Carnivores in Air (PCA)	130	50 minutes	163	-	-
Other Carnivores in Air (OCA)	130		164	-	-

(8) SPL derived from BS 5228-1 2009 for vibratory sheet piling.

(9) Weighting factor adjustment 2.5 kHz determined in accordance with Southall et al. 2019

(10) TTS = Temporary Threshold Shift, PTS = Permanent Threshold Shift

The results indicate a nil potential noise exposure impact on pinnipeds in air.

8.10.2 Impact sheet piling

To calculate the cumulative SEL (SEL_{24}), the number of pile blows needs to be considered. This is calculated using the following equation.

$$\boldsymbol{SEL\ cumulative = SEL\ single\ blow + 10log(total\ number\ of\ blows)}$$

The following sections provide the cumulative SEL comparisons versus exposure time and distance to meet the noise criteria. Our calculations have assumed sheet steel pile being driven with a source level of 180 dB re 1 μPa^{2}s water at 10 m.

The following predictions assume an equivalent exposure time of 1 minute up to 4 hours (i.e. 7200 hammer blows) of cumulative piling noise over a 24-hour period. It is estimated that the number of sheet piles that may require to be driven by an impact hammer is the equivalent of one fully driven pile per day, that is, approximately 1800 hammer blows.

Fish, sharks and marine turtles

The following predictions presented in Table 28 calculate the impact of various exposure times of cumulative piling noise over a 24-hour period on fish, sharks and marine turtles.

Table 28: Fish, Sharks and Marine Turtles – distance to physiological criteria – Impact driven sheet steel pile

Hearing Group	Total number of hammer blows	Exposure time @ 30 blows /minute	Un-weighted distance to criteria compliance (m)		
			Organ damage / increased Risk of fatality	TTS	PTS
Fish (no swim bladder) • Great White Shark • Mackeral Shark	30	1 minute	0	75	0
	60	2 minutes	0	140	0
	150	5 minutes	0	290	0
	450	15 minutes	0	610	1
	1800	**60 minutes**	**3**	**1300**	**5**
	3600	2 hours	5	1700	8
Fish (with swim bladder) • Pipefish • Seahorses • Seadragons	30	1 minute	0	75	2
	60	2 minutes	2	140	3
	150	5 minutes	3	290	8
	450	15 minutes	9	610	23
	1800	**60 minutes**	**35**	**1300**	**85**
	3600	2 hours	70	1700	160
Marine Turtles • Loggerhead Turtle • Green Sea Turtle • Leatherback Turtle • Pacific Ridley Turtle	30	1 minute	0	n/a	n/a
	60	2 minutes	0	n/a	n/a
	150	5 minutes	2	n/a	n/a
	450	15 minutes	5	n/a	n/a

Hearing Group	Total number of hammer blows	Exposure time @ 30 blows /minute	Un-weighted distance to criteria compliance (m)		
			Organ damage / increased Risk of fatality	TTS	PTS
	1800	**60 minutes**	**18**	**n/a**	**n/a**
	3600	2 hours	35	n/a	n/a

(11) Assumed maximum piling duration over 24 hours indicated in **bold**.

The results indicate that the effect on fish, sharks and turtles relates to the length of exposure time, which also relates to the mobility of the animals in the area during piling activities. The greatest impact potential is on fish with swim bladders given their increased hearing sensitivity. For marine turtles, the distance is approximately half that of fish with swim bladders at longer exposure times. For an assumed 60 minutes equivalent of continuous piling noise over a 24 hour period, fish with swim bladders and marine turtles, may incur organ damage and an increased risk of fatality within 35 m and 18 m respectively.

A temporary hearing threshold shift could occur for fish (both with/without swim bladders) within approximately 75 m of initial piling commencement, depending upon the direction of travel and behavioural response to the noise to move away from the noise. For an assumed 60 minutes equivalent of continuous piling noise over a 24 hour period, fish remaining within an area of approximately 1300 m from the piling noise, may incur temporary hearing threshold shift.

Marine mammals

The predicted results for impact driven sheet steel piles are presented in Table 29.

Table 29: Marine mammal weighted distance to TTS / PTS – Impact driven sheet steel pile

Hearing Group	Total number of Hammer blows	Exposure time @ 30 blows/ minute	Weighted distance to TTS/PTS criteria compliance (m)	
			TTS	PTS
Low Frequency (LF) Cetaceans	150	5 minutes	2300	470
	450	15 minutes	3100	890
	1800	**60 minutes**	**4100**	**1700**
	3600	2 hours	4700	2100
High Frequency (HF) Cetaceans	150	5 minutes	25	6
	450	15 minutes	75	15
	1800	**60 minutes**	**240**	**60**
	3600	2 hours	400	110
Pinnipeds – Phocid Carnivores in water (PCW)	150	5 minutes	1700	240
	450	15 minutes	2400	520
	1800	**60 minutes**	**3400**	**1200**
	3600	2 hours	3900	1500
Pinnipeds – Other Carnivores in Water (OCW)	150	5 minutes	160	6
	450	15 minutes	380	18
	1800	**60 minutes**	**880**	**65**
	3600	2 hours	1300	130

(12) TTS = Temporary Threshold Shift, PTS = Permanent Threshold Shift

(13) Assumed maximum piling duration over 24 hours indicated in **bold**.

The results indicate that the effect on marine mammals relates to the length of exposure time, which also relates to the mobility of the animals in the area during piling activities. The greatest impact potential is on low frequency cetaceans and phocid carnivores, given their increased hearing sensitivity at low frequencies. For these species, even short exposure times (i.e. 5 minutes) at distances of 240 m (PCW) to 470 m (LFC) from the piling noise source may cause permanent hearing injury.

A temporary hearing threshold shift could occur for these mobile animals within approximately 1700 m (PCW) to 2300 m (LFC) of the noise source for only 5 minutes of exposure and the level of exposure beyond 5 minutes would depend on the direction of travel and behavioural response to move away from the noise.

Comparatively, the potential for permanent or temporary physiological impacts for high frequency cetaceans and other carnivores is significantly less than low frequency cetaceans and phocid carnivores. This is because the significantly shorter distances to meet the adopted criteria relative to the mobility potential of the animal and likely behavioural response to the noise. Whilst the two species (i.e. HFC, OCW) have a similar sensitivity to permanent hearing injury with distance, the other pinniped carnivores have the greater potential for a temporary threshold shift to their hearing, with the exposure time versus distance almost 4 times that of high frequency cetaceans at 60 minutes of exposure.

Pinnipeds in air

The predicted results for air borne noise exposure results are presented in Table 30.

Table 30: Pinnipeds weighted distance to TTS / PTS in air – Impact driven sheet steel pile

Hearing Group	SEL single blow @ 10m[1]	Total number of Hammer blows	Exposure time @ 30 blows/minute	Weighted Cumulative SEL @ 1m	Weighted Distance to TTS / PTS criteria compliance (m)	
	(dB re 20 $\mu Pa^2 s$)			(dB re 20 $\mu Pa^2 s$)	[20logR propagation]	
					TTS	**PTS**
Phocid Carnivores in Air (PCA)	110	30	1 minute	143	2	1
	110	60	2 minutes	146	2	1
	110	150	5 minutes	150	4	2
	110	450	15 minutes	154	7	3
	110	**1800**	**60 minutes**	160	13	7
	110	**3600**	**2 hours**	163	19	9
	110	7200	4 hours	166	27	13
Other Carnivores in Air (OCA)	110	30	1 minute	144	1	0
	110	60	2 minutes	147	1	0
	110	150	5 minutes	151	2	0
	110	450	15 minutes	155	3	1
	110	**1800**	**60 minutes**	161	6	1
	110	**3600**	**2 hours**	164	8	1
	110	7200	4 hours	167	12	2

(14) SEL derived from BS 5228-1 2009 for vibratory sheet piling.

(15) Weighting factor adjustment 2 kHz determined in accordance with NFMS 2018

(16) TTS = Temporary Threshold Shift, PTS = Permanent Threshold Shift

The results clearly indicate that pinnipeds (particularly the phocid carnivores) are significantly less sensitive to piling noise exposure in air than in water. As an example, for phocids, for an exposure time of 5 minutes the TTS comparison between water and air is 1700 m and 4 m respectively. In summary, controlling the waterborne noise exposure impact would also effectively eliminate the air borne noise exposure impact.

8.11 Summary of noise impacts on marine fauna

The following provides a summary of the predicted noise impacts associated with the proposal in context with the existing conditions.

8.11.1 Fish, sharks and marine turtles

Objective criteria for the assessment of noise exposure impacts associated with continuous and non-impulsive noise sources (i.e. vibro-driving) are only applicable to fish with swim bladders. In summary, the potential for temporary or permanent physiological impact from non-impulsive sources is very low, particularly in the understanding that a behavioural response to avoid higher noise levels is likely (Popper et al., 2014).

In relation to impact piling (i.e. impulsive noise source), the results indicate that the effect on fish, sharks and turtles relates to the length of exposure time, which also relates to the mobility of the animals in the area during piling activities. The greatest impact potential is on fish with swim bladders given their increased hearing sensitivity.

However, marine turtles also have a similar (albeit marginally lower) risk of organ damage or fatality compared to fish with swim bladders. For these species, prolonged exposure (i.e. > 15 minutes) at distances of <9 m from the piling noise source may cause organ damage or fatality.

A temporary hearing threshold shift could also occur for fish (both with/without swim bladders) within approximately 75 m of initial piling commencement, depending upon the direction of travel and behavioural response to the noise to move away from the noise. For an assumed 1 hour equivalent of continuous piling noise over a 24 hour period, fish remaining within an area of approximately 1300 m from the impulsive piling noise, may incur temporary hearing threshold shift.

8.11.2 Marine mammals

The results indicate that the effect on marine mammals relates to the length of exposure time, which also relates to the mobility of the animals relative to the distance from each noise source.

In general terms, the greatest impact potential is on low frequency cetaceans and phocid carnivores, given their increased hearing sensitivity at low frequencies. A summary of the predicted noise exposure impact upon these species is provided below for each noise source:

- Vibro-driving - in comparison to impact piling, vibro-driving of sheet piles has a significantly lower potential to impact. Even with a 50 minute exposure time, the potential for permanent hearing injury is considered negligible, given the very short distances in comparison to the mobility potential of the animals. Furthermore, the potential for temporary hearing impacts is possible for phocids and low frequency cetaceans remaining within approximately 240 and 390 m of vibro-driving respectively, however given the mobility potential of these animals, particularly for migratory low frequency cetaceans, this is considered unlikely.
- Impact piling - even short exposure times (i.e. 5 minutes) at distances of 240 m (phocids) to 470 m (low frequency cetaceans) from the piling noise source may cause permanent hearing injury. A temporary hearing threshold shift could occur for these mobile animals within approximately 1700 m (phocids) to 2300 m (low frequency cetaceans) of the noise source for only 5 minutes of exposure and the level of exposure beyond 5 minutes would depend on the direction of travel and their behavioural response to move away from the noise.

In relation to high frequency cetaceans (e.g. Port River Dolphin) and other pinniped carnivores, a summary of the predicted noise exposure impact upon these species is provided below for each noise source:

- Vibro-driving - the potential for permanent or temporary hearing impacts for high frequency cetaceans and other pinniped carnivores is considered unlikely given the significantly short distances to meet the physiological impact criteria relative to the mobility potential of these animals.
- Impact Piling - comparatively, the potential for permanent or temporary physiological impacts for high frequency cetaceans and other carnivores is significantly less than low frequency cetaceans and phocid carnivores. This is because the significantly shorter distances to meet the physiological impact criteria relative to the mobility potential of the animals and their likely behavioural response to the noise. Whilst the two species have a similar noise exposure sensitivity to permanent hearing injury with distance, the other pinniped carnivores have the greater potential for a temporary threshold shift to their hearing, with the exposure versus time distance almost four times that of high frequency cetaceans.

The assessment has indicated that pinnipeds (particularly the phocid carnivores) are significantly less sensitive to noise exposure in air than in water. In summary, controlling the waterborne noise exposure impact would also effectively eliminate the air borne noise exposure impact upon these species.

8.12 Noise mitigation and management for marine fauna

From the impact assessment undertaken, mitigation and management measures are considered necessary for impact sheet piling in particular and to a lesser extent dredging and vibratory piling. In relation to impact piling however, it is expected that most of the piling would be undertaken using vibro-driving, and impact piling only required if very stiff soils are encountered. Mitigation and/or management measures are not required for vessel movements.

The following sections outline the range of practical options available.

8.12.1 Mitigation options

Piling in low tide or dry conditions

Piling noise propagates less efficiently in very shallow water (i.e. <1 m), and is negligible during dry conditions. Consideration of the low tide times with respect to the piling plan may provide an opportunity to reduce the underwater noise propagation and associated noise exposure.

Soft start

Adopting a soft start procedure in which the piling impact energy is gradually increased over a 10 minute time period may alert marine mammals (including fish, sharks and marine turtles) to the presence of the piling rig and enable animals to move away to distances where injury is unlikely. The soft start procedure should also be used after long breaks of more than 30 minutes in piling activity.

Note that when comparing the SPL of soft start versus full hammer energy, the difference is likely to be in the order of 10 dB (e.g. Bailey et. al. 2010).

Avoid whale migration season

To reduce the potential for noise impact on low frequency cetaceans, impact piling works should ideally be undertaken outside of the whale migration season (May to September).

Bubble curtains

A bubble curtain may be utilised to attenuate impact piling activities, where practical and cost effective. A bubble curtain is a sheet of air bubbles that are produced around the location where piling activity occurs. The bubbles in the bubble curtain create an acoustic impedance mismatch between the water and air trapped in the bubble, which results in sound attenuation across the bubble curtain (i.e. the bubble curtain acts as a reflector, the bubbles also resonate in response to sound and absorb sound energy).

Reported noise reductions range from 3 to 20 dB. However, bubble curtains may not be as effective in shallow water and care is required in these situations to not over prescribe expected attenuation performance. At this stage, we don't expect that a bubble curtain will be required.

Table 31 illustrates the effectiveness of bubble curtains for varying levels of attenuation performance upon marine mammals.

Table 31: Bubble curtain attenuation level versus TTS/PTS distances for 1800 sheet pile hammer impacts over 24 hours

Hearing Group	Attenuation	Weighted distance to TTS/PTS criteria compliance (m)	
		TTS	PTS
Low Frequency (LF) Cetaceans	3 dB	3600	1300
High Frequency (HF) Cetaceans	3 dB	140	30

Hearing Group	Attenuation	Weighted distance to TTS/PTS criteria compliance (m)	
		TTS	PTS
Pinnipeds – Phocid Carnivores in water (PCW)	3 dB	2900	790
Pinnipeds – Other Carnivores in Water (OCW)	3 dB	600	35
Low Frequency (LF) Cetaceans	5 dB	3200	1100
High Frequency (HF) Cetaceans	5 dB	90	19
Pinnipeds – Phocid Carnivores in water (PCW)	5 dB	2600	600
Pinnipeds – Other Carnivores in Water (OCW)	5 dB	440	22
Low Frequency (LF) Cetaceans	10 dB	2400	530
High Frequency (HF) Cetaceans	10 dB	30	7
Pinnipeds – Phocid Carnivores in water (PCW)	10 dB	1800	270
Pinnipeds – Other Carnivores in Water (OCW)	10 dB	190	7

(17) TTS = Temporary Threshold Shift, PTS = Permanent Threshold Shift

8.12.2 Safety Zones

In accordance with the DIT Guidelines, Safety Zones include an *Observation Zone* and *Shut-down Zone* for marine mammals, which are a defined radius around the works with intent to be monitored for the presence of mega fauna (in particular) prior to and/or during noisy activities. Safety zones are not applicable to fishes and marine turtles.

Safety zones aim to minimise the likelihood of temporary or permanent hearing injury to occur to marine mammals, where the sizing of which is only applicable in non-biologically important habitat. The zones are not intended to prevent behavioural responses to audible, but non-physical injury noise events.

It is likely that marine mammals in the vicinity of a noisy activity will show an avoidance reaction to the noise, which reduces the chance of marine mammals approaching the source close enough to enter the zone of hearing injury (i.e. shut-down zone). The impacts of such a temporary displacement are unlikely to be significant unless it occurs during critical behaviours, such as breeding, feeding and resting, or in important areas such as migratory corridors, calving or nursery grounds and foraging areas.

Safety zones are not applicable when piling in dry (or very shallow <1m) conditions.

Observation Zone

In the observation zone, the movement of marine mammals shall be monitored to determine whether they are approaching or entering the shut-down zone. When a marine mammal is sighted within or appears to enter the shut-down zone, piling or dredging activities must be stopped as soon as reasonably practical.

Under the DIT Guidelines, the shut-down zone is equivalent to an exclusion zone. The observation zone is sized based on a nominal 250 m distance from the outer edge of the shut-down zone. In this report, only the shutdown zones are illustrated.

Shutdown Zone

Shut-down zones are sized based on the potential for a Temporary Threshold Shift (TTS) in marine mammals.

The shut-down zone allows for the cumulative effect of multiple hammer strikes during impact piling and the time duration of a continuous noise source. This allows some time for the marine mammal to move away from the noise source thereby reducing the likelihood of hearing injury to occur. However, the cumulative sound exposure from other underwater noise sources (i.e. industrial sources of noise, major shipping channels), in addition to the piling or dredging activity, may also contribute to the cumulative sound exposure.

8.12.3 Potential Effects Zones

Under the DIT Guidelines, the potential effects zones are applicable to the impact assessment upon fishes and marine turtles for impact piling activities (i.e. impulsive sound) only. The potential effects zones are not applicable for vibratory or dredging activities (i.e. continuous sound sources).

The potential effects zones for fishes and marine turtles are not to be considered a shut-down zone, but zones to inform the projects risk evaluation process and identification of reasonable and practicable noise mitigation measures where required. Mitigation measures could include the adoption of alternative lower noise methods, design changes (e.g. pile material type, number of piles required) and soft starts to warn fish and marine turtles.

8.12.4 Preliminary Safety Zones

To effectively manage the shutdown zone to minimise the potential for temporary hearing impacts (i.e. TTS) requires consideration of the:

- modelled TTS distances versus exposure time
- mobility potential of the animals as well as in response to the noise.

Avoiding whale migration season is preferable where practical for low frequency cetaceans. With reference to J Diversity (2023) report the potential for a phocid carnivore (i.e. Leopard Seal) to be present within the study area is also unlikely.

Note that the proposed Safety Zones are preliminary and are based on conservative assumptions, that is the noise source levels and noise propagation characteristics adopted for this assessment are conservative.

In consideration of the above, the preliminary shutdown zones and potential effects zone are presented in Appendix E

The preliminary shutdown zones distances (without additional attenuation measures) are summarised as follows:

- Vibro-driven sheet piles – 390 m for low frequency cetaceans and phocid carnivores
- Impact-driven piles:
  - 4.1 km for low frequency cetaceans and phocid carnivores
  - 880 m for pinniped ‘other’ carnivores
  - 240 m for high frequency cetaceans.

The potential effects zone for fishes is also illustrated for impact-driven piles only.

8.12.5 Marine Fauna Observers

Under the DIT Guidelines, the requirements for different levels of marine fauna observers are as follows:

- Marine Fauna Observer (MFO) Level 1 – a person who is a suitably qualified marine fauna specialist with experience in marine mammal identification, including behaviour, as well as distance estimation.
- Marine Fauna Observer (MFO) Level 2 – a person who has sufficient experience in marine fauna identification and distance estimation.

The MFO level relates the likelihood for the project activities to be significant under the definition contained within the *Significant Impact Guidelines 1.1 - Matters of National Environmental Significance*. In these cases, a marine fauna observer (MFO) Level 1 required to be present for the duration of related works or to train MFO Level 2 with project and site-specific details.

Table 32 provides an overview of the Matters of National Environmental Significance (MNES) and other species of significance identified by J Diversity (2023) within 5 km of the Outer Harbor breakwaters, for the attention of the MFO.

Table 32: Relevant species for monitoring for MFO reference

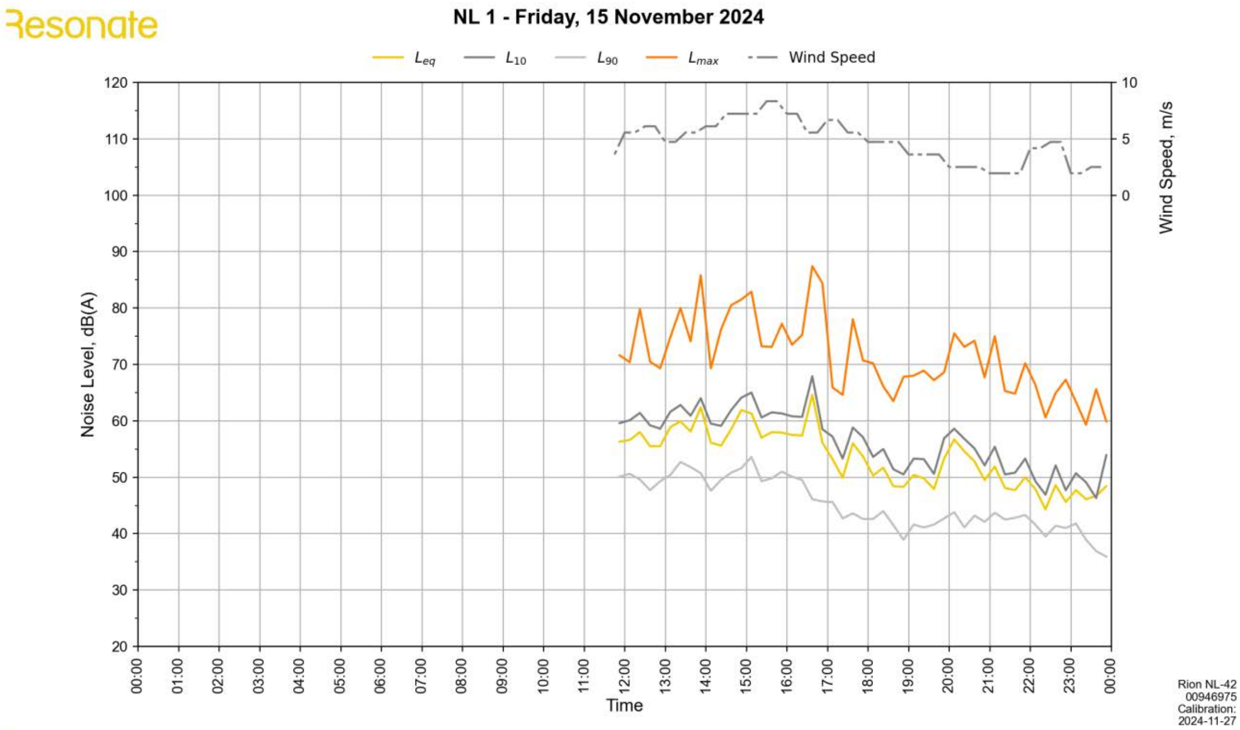
Low Frequency Cetaceans	High Frequency Cetaceans	Pinnipeds Phocid Carnivore (PC)	Pinnipeds Other Carnivore (OC)
Humpback Whale (*Megaptera novaeangliae*)	**Common Dolphin, Short-beaked Common Dolphin** (*Delphinus delphis*)	**Leopard seal** (*Hydrurga leptonyx*)	**Australian Sea Lion** (*Neophoca cinerea*)
Southern Right Whale (*Eubaleana australis*)	**Indian Ocean bottlenose dolphin** (*Tursiops aduncus*) a.k.a. Port River Dolphin		**Subantarctic fur seal** (*Arctocephalus tropicalis*)
Pygmy Right Whale (*Caperea marginata*)	**Common bottle-nosed dolphin** (*Tursiops truncatus*)		**Long-nosed fur seal** (*Arctocephalus forsteri*)
Bryde's Whale (*Balaenoptera edeni*)	**Dusky Dolphin** (*Lagenorhynchus obscurus*)		**Australian fur seal** (*Arctocephalus pusillus*)
	Killer Whale (*Orcinus orca*)		
	Sperm Whale (*Physeter macrocephalus*)		

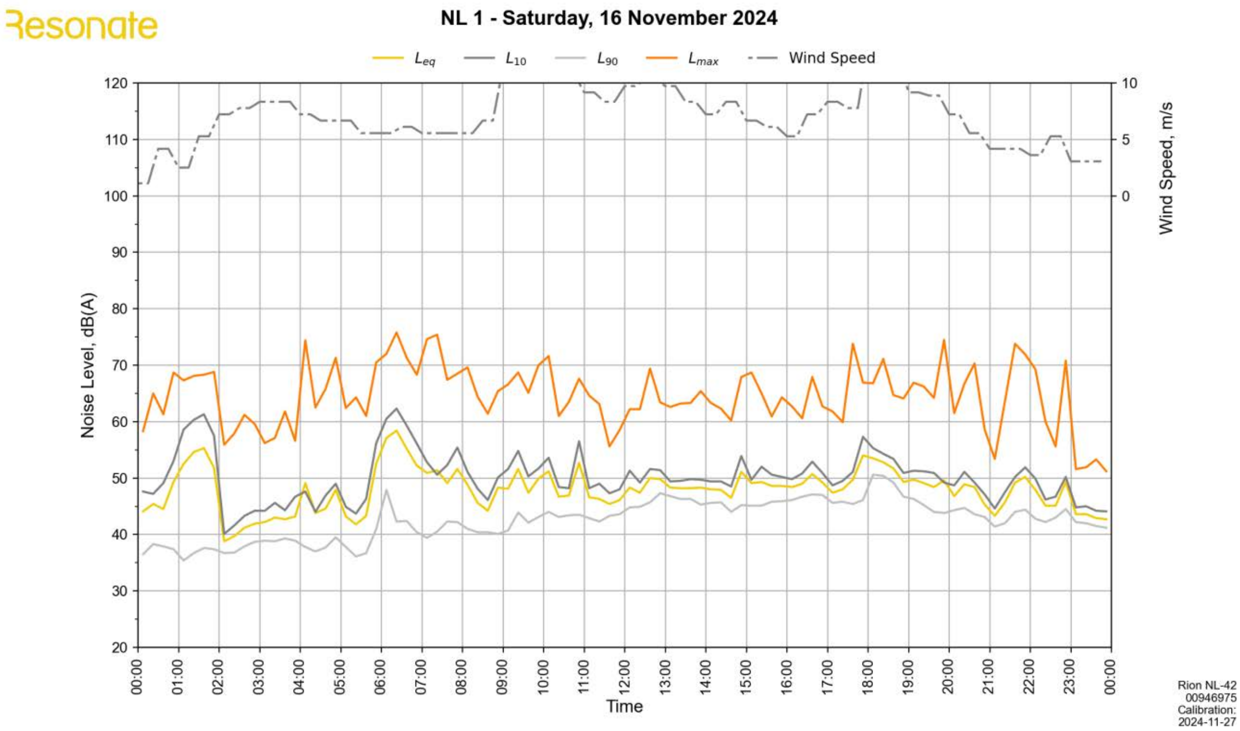
9 Conclusion

Resonate has undertaken an environmental noise and vibration impact assessment for Stage 1 of the GatewaySA project. The assessment has considered both the construction and operation of the facility.

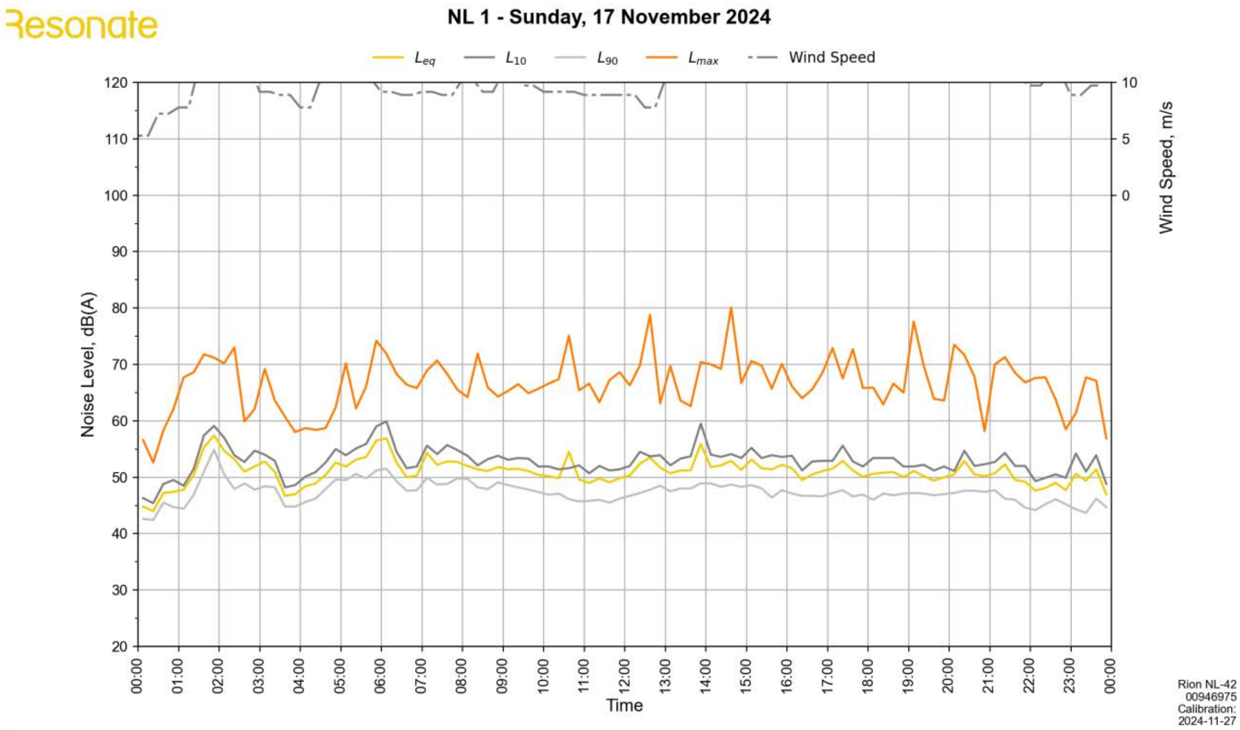
Based on this assessment the planned construction and operation of the Project will be able to meet its environmental obligations as required by national and state legislation including the Planning & Design Code and Noise Policy. This will be achieved through the implementation of recommended mitigation and management measures outlined in this report. These measures may be refined and reviewed as the design progresses.

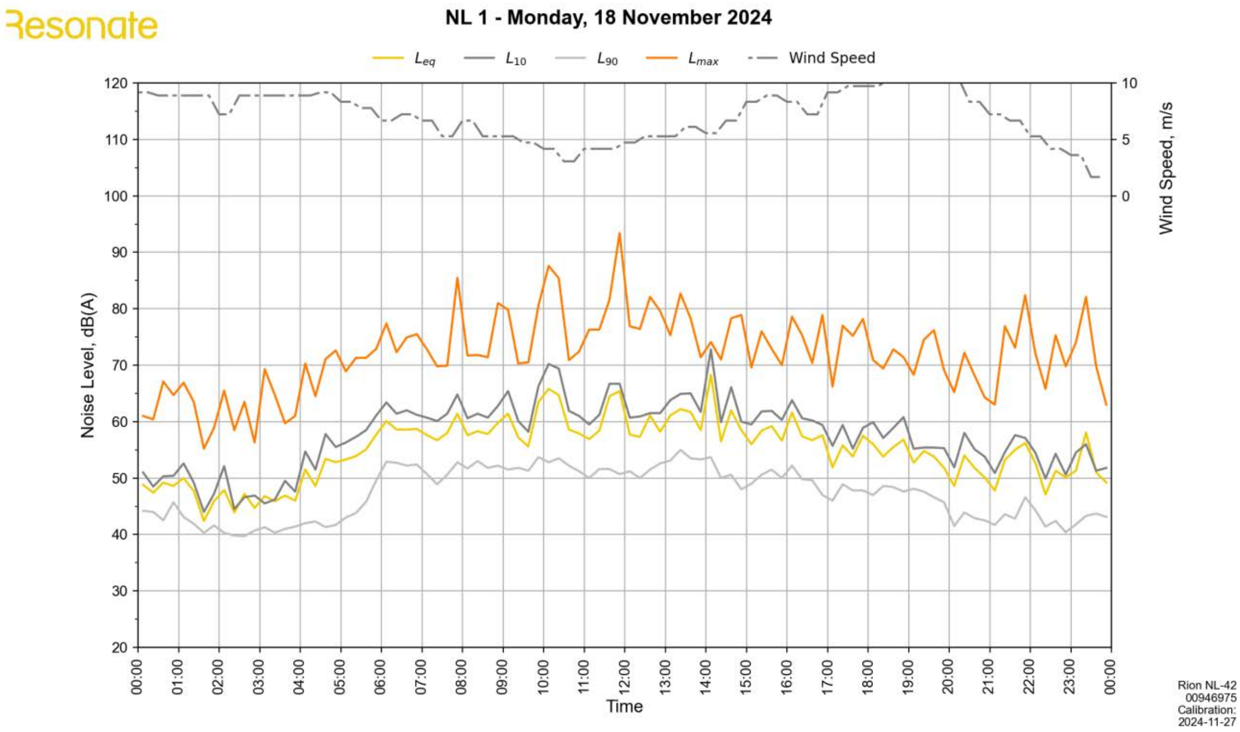
Appendix A – Baseline noise monitoring data

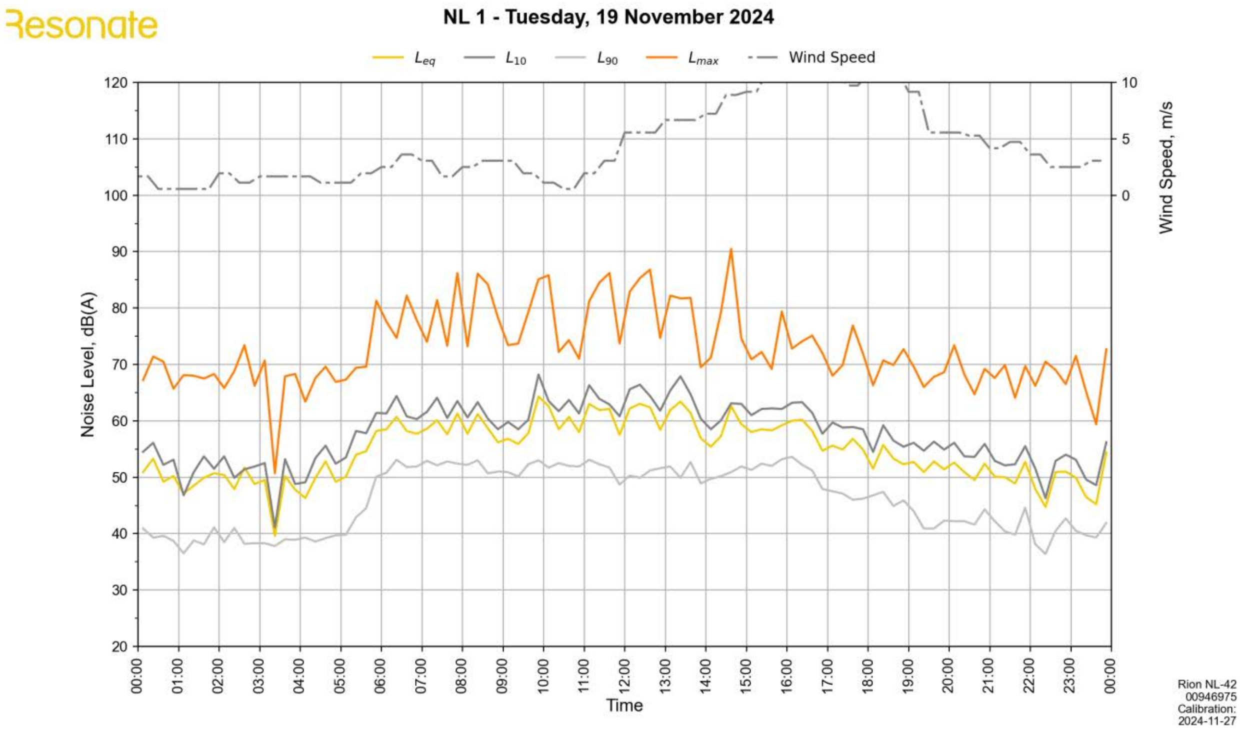

Resonate
NL 1 - Friday, 15 November 2024
L_{eq}
L_{10}
L_{90}
L_{max}
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
00946975
Calibration:
2024-11-27

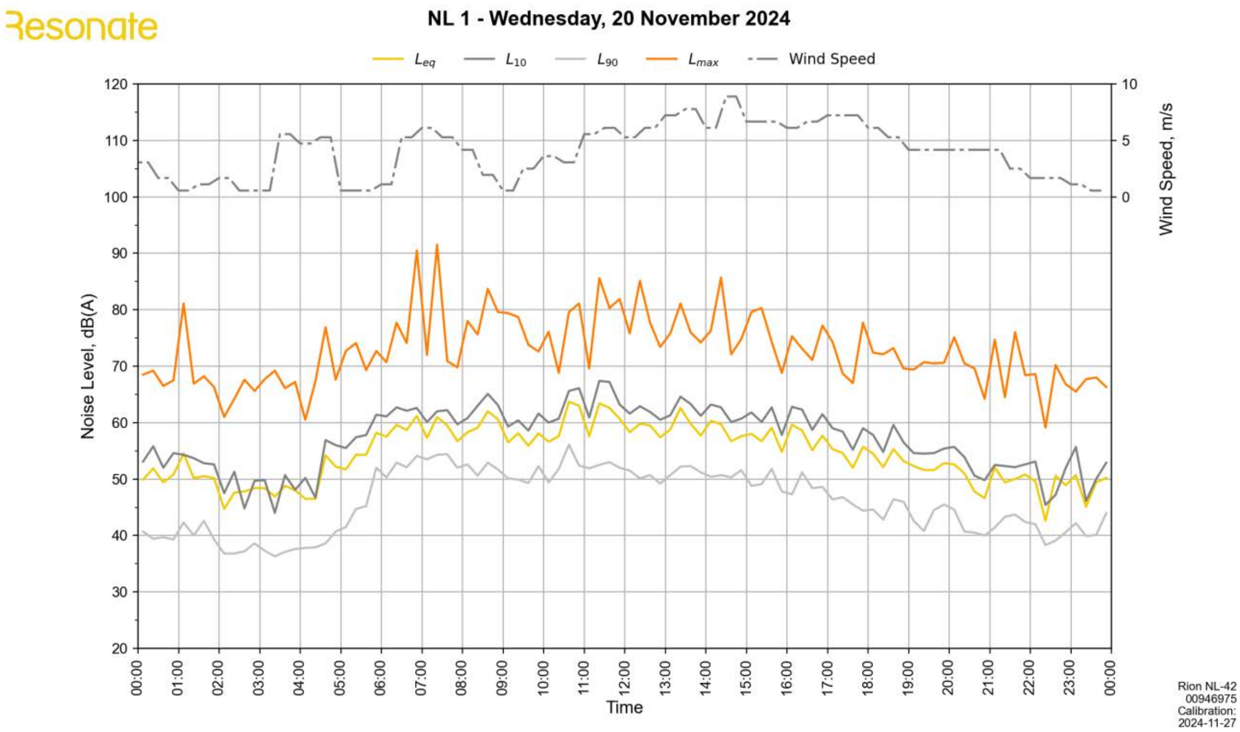

Resonate
NL 1 - Saturday, 16 November 2024
L_{eq}
L_{10}
L_{90}
L_{max}
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
00946975
Calibration:
2024-11-27

Resonate

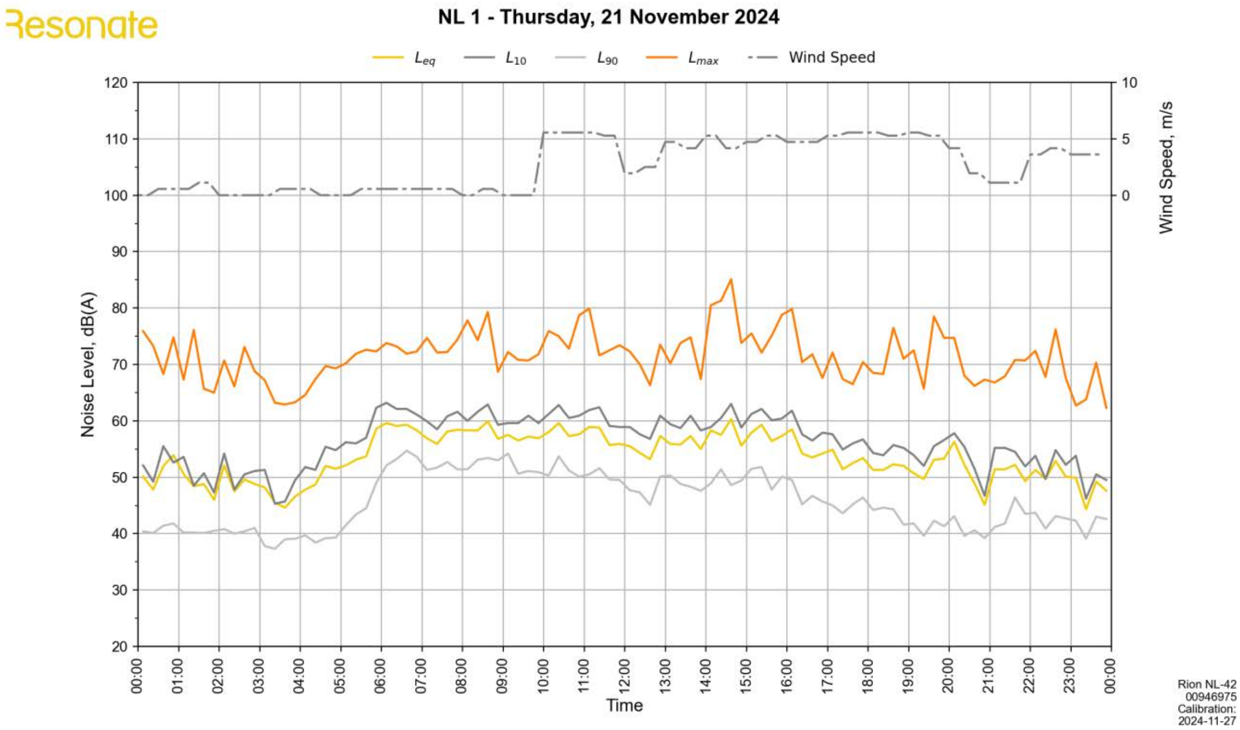

NL 1 - Sunday, 17 November 2024
Leq
L10
L90
Lmax
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
00946975
Calibration:
2024-11-27


NL 1 - Monday, 18 November 2024
Leq
L10
L90
Lmax
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
00946975
Calibration:
2024-11-27

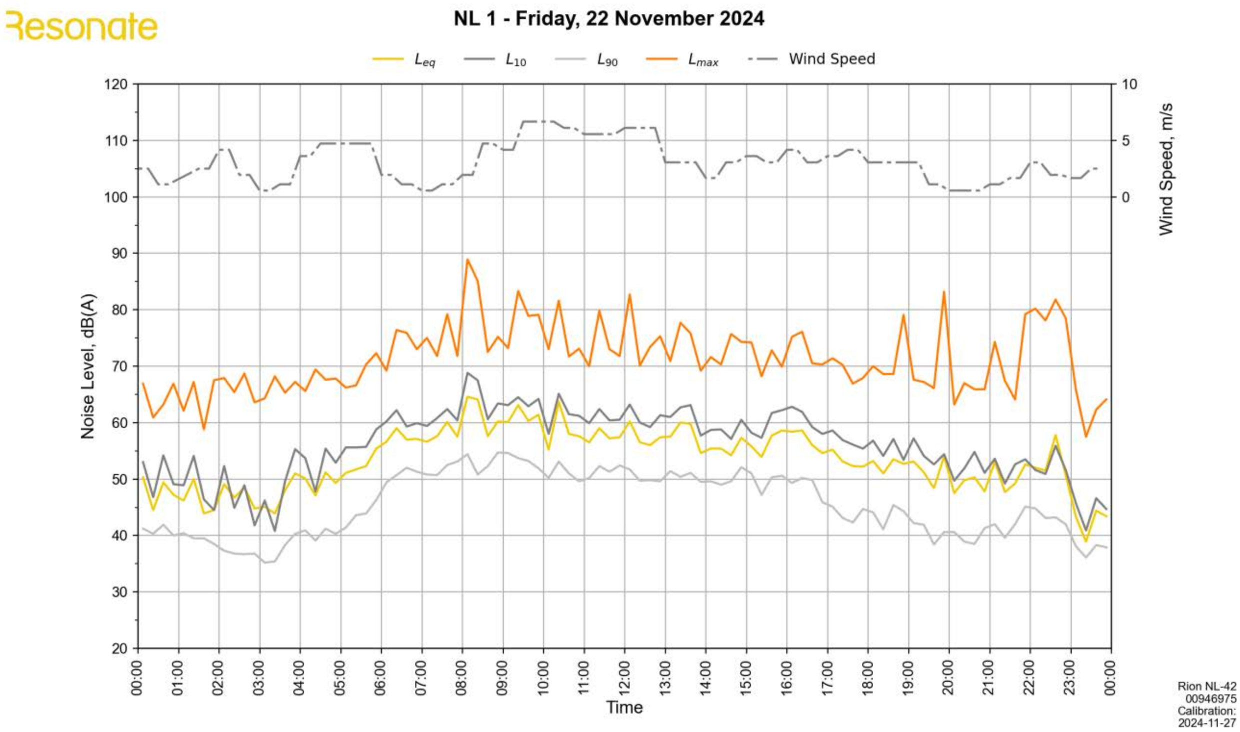

Resonate
NL 1 - Tuesday, 19 November 2024
Leq
L10
L90
Lmax
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
00946975
Calibration:
2024-11-27


Resonate
NL 1 - Wednesday, 20 November 2024
Leq
L10
L90
Lmax
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
00946975
Calibration:
2024-11-27

Resonate

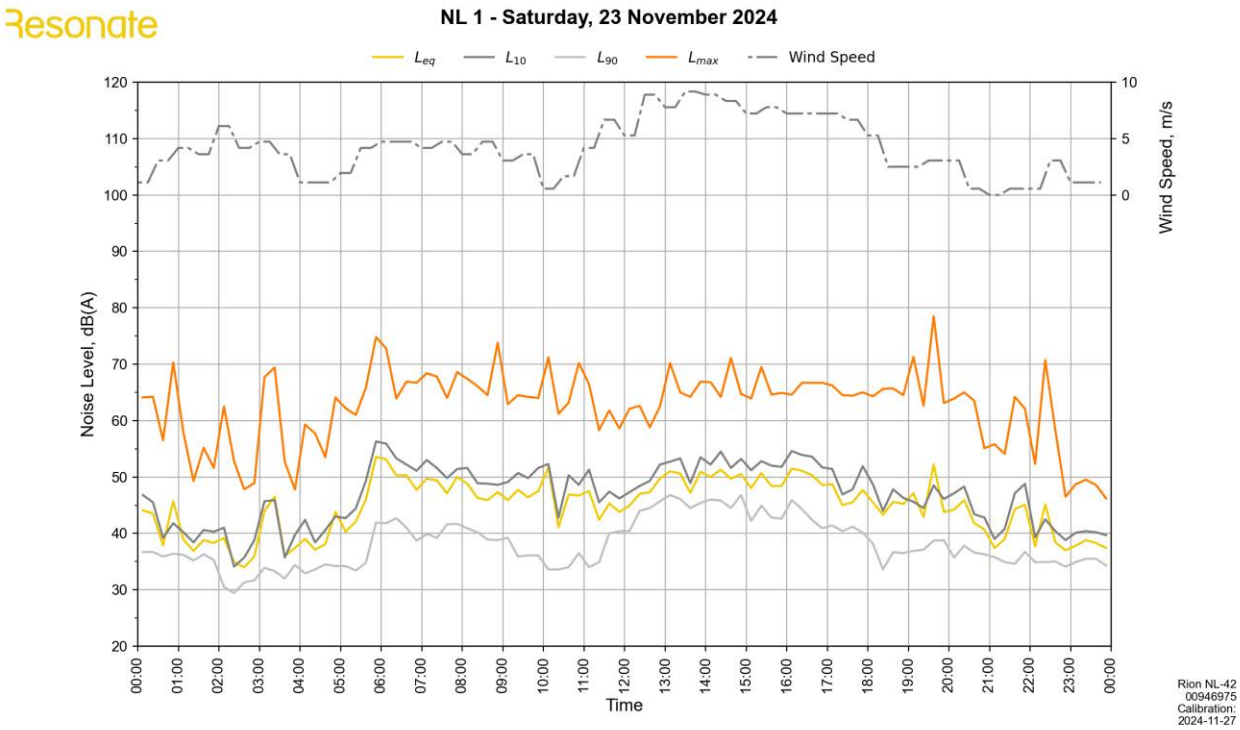


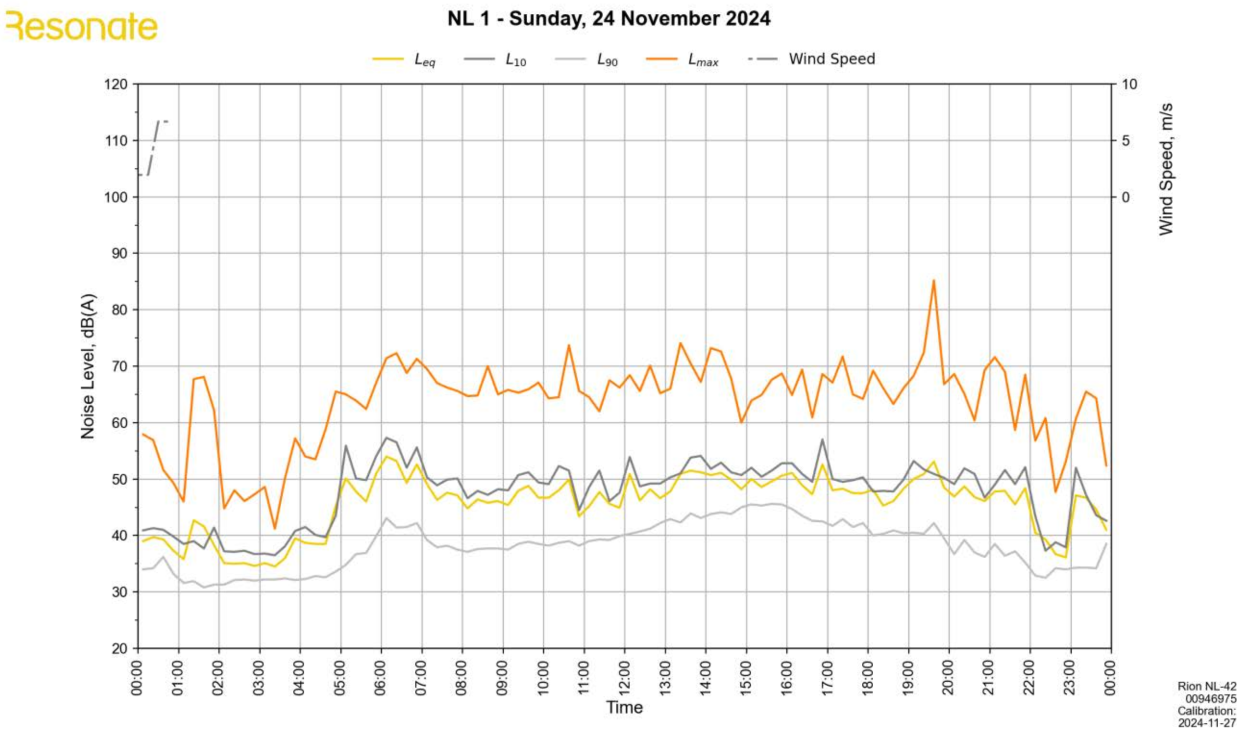
Resonate
NL 1 - Thursday, 21 November 2024
L_{eq}
L_{10}
L_{90}
L_{max}
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
00946975
Calibration:
2024-11-27

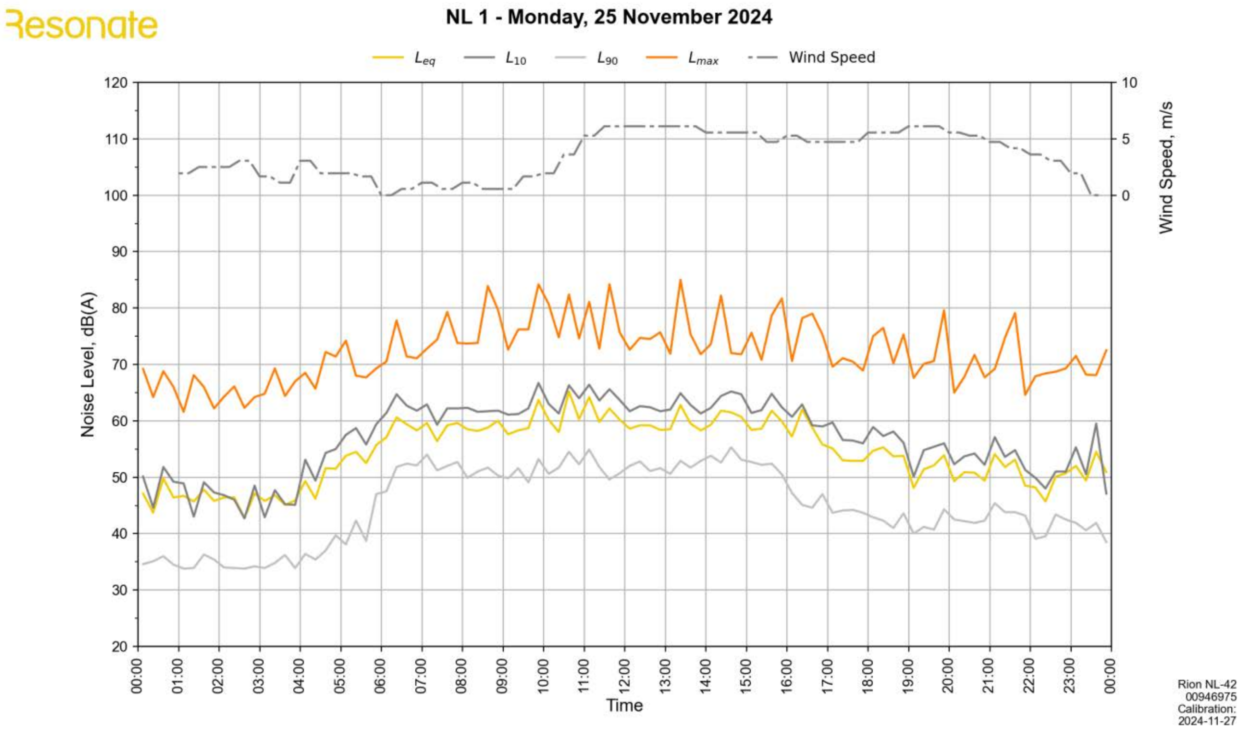


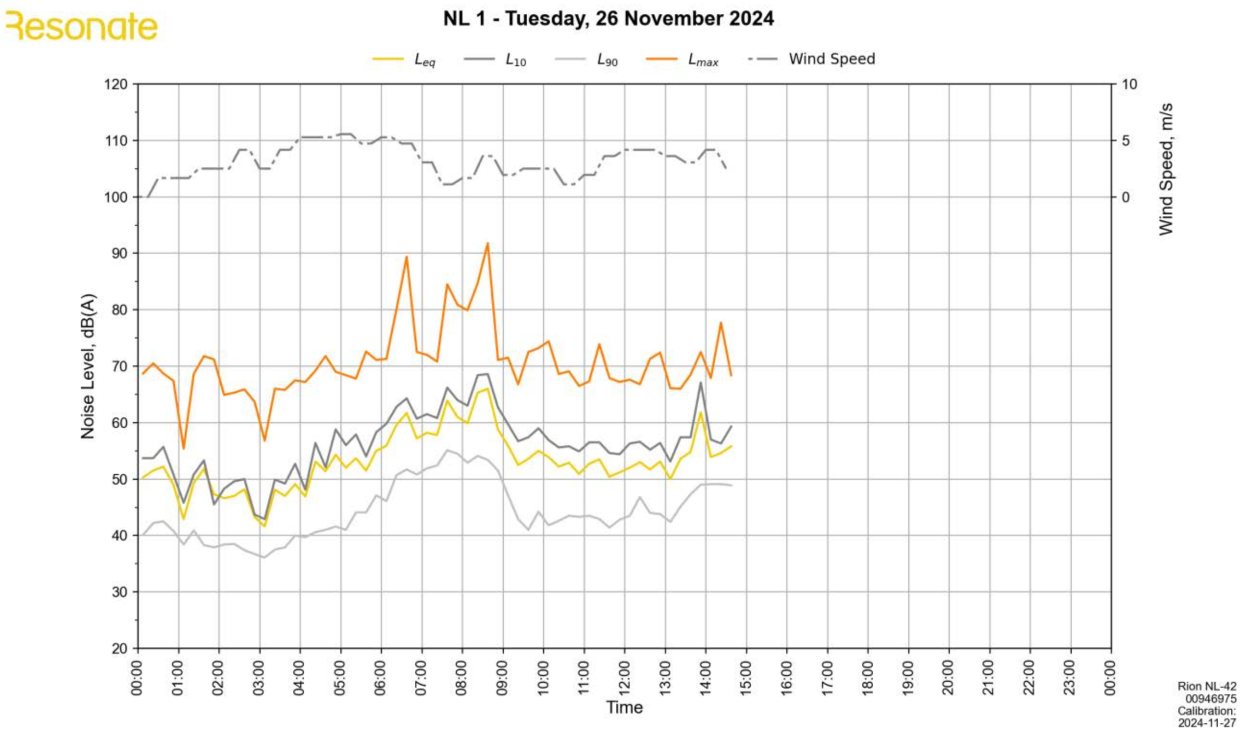
Resonate
NL 1 - Friday, 22 November 2024
L_{eq}
L_{10}
L_{90}
L_{max}
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
00946975
Calibration:
2024-11-27

Resonate

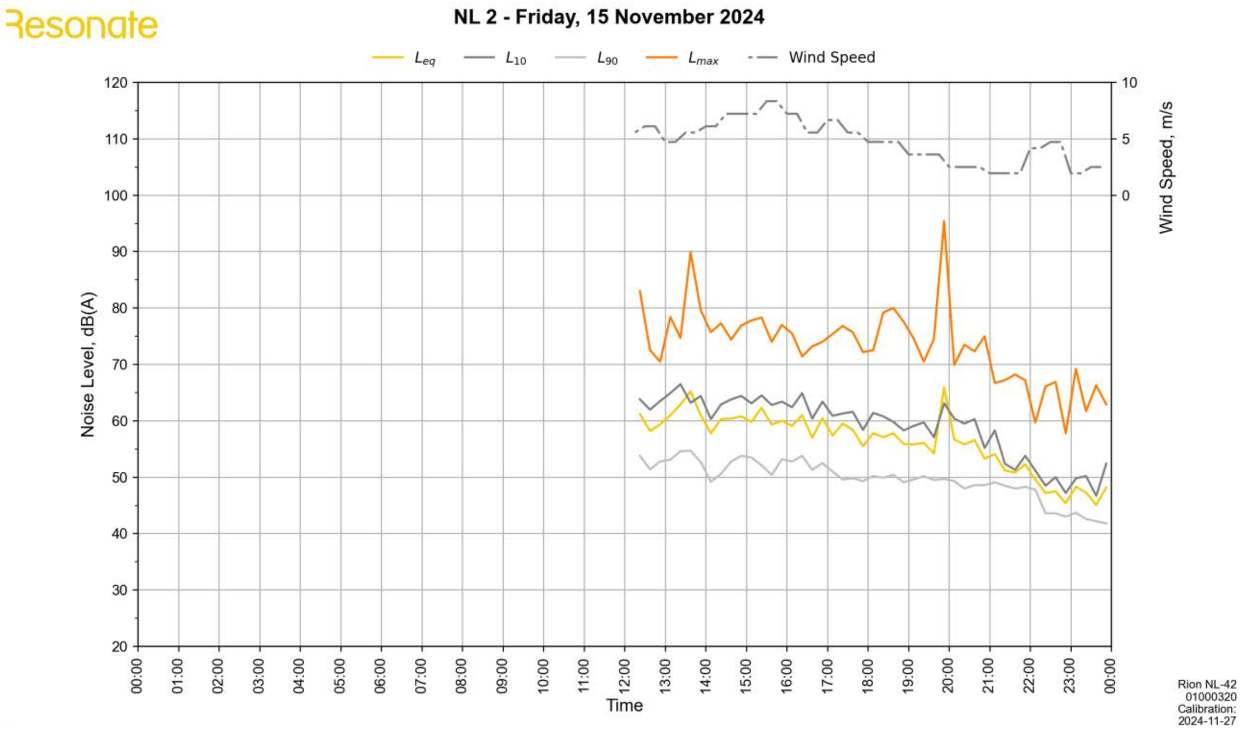

Resonate
NL 1 - Saturday, 23 November 2024
Leq
L10
L90
Lmax
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
00946975
Calibration:
2024-11-27

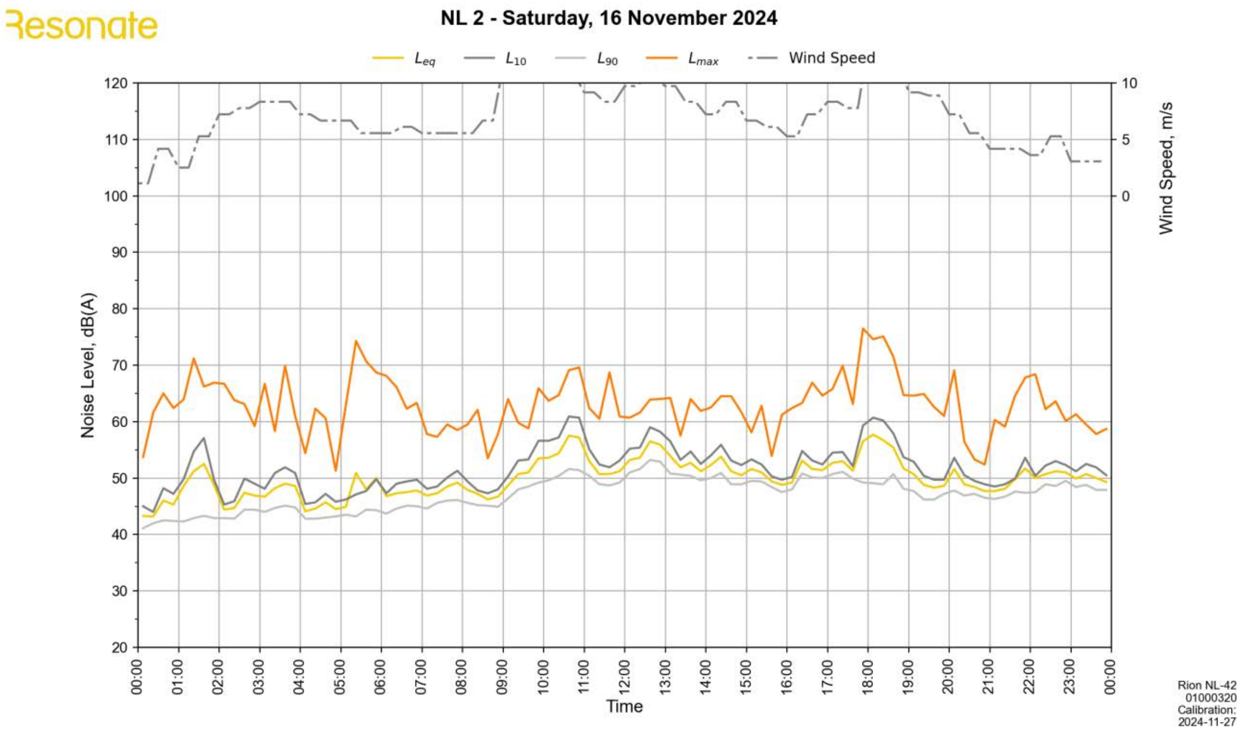

Resonate
NL 1 - Sunday, 24 November 2024
Leq
L10
L90
Lmax
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
00946975
Calibration:
2024-11-27

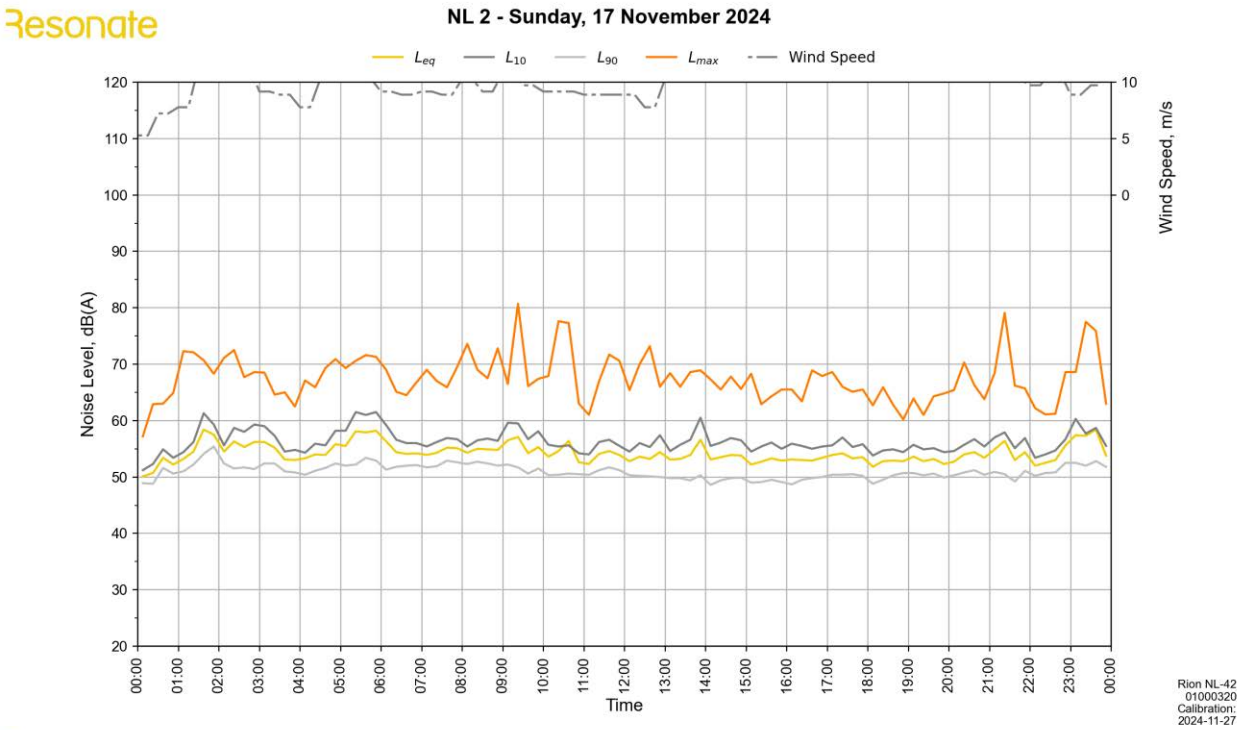

Resonate
NL 1 - Monday, 25 November 2024
Leq
L10
L90
Lmax
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
00946975
Calibration:
2024-11-27

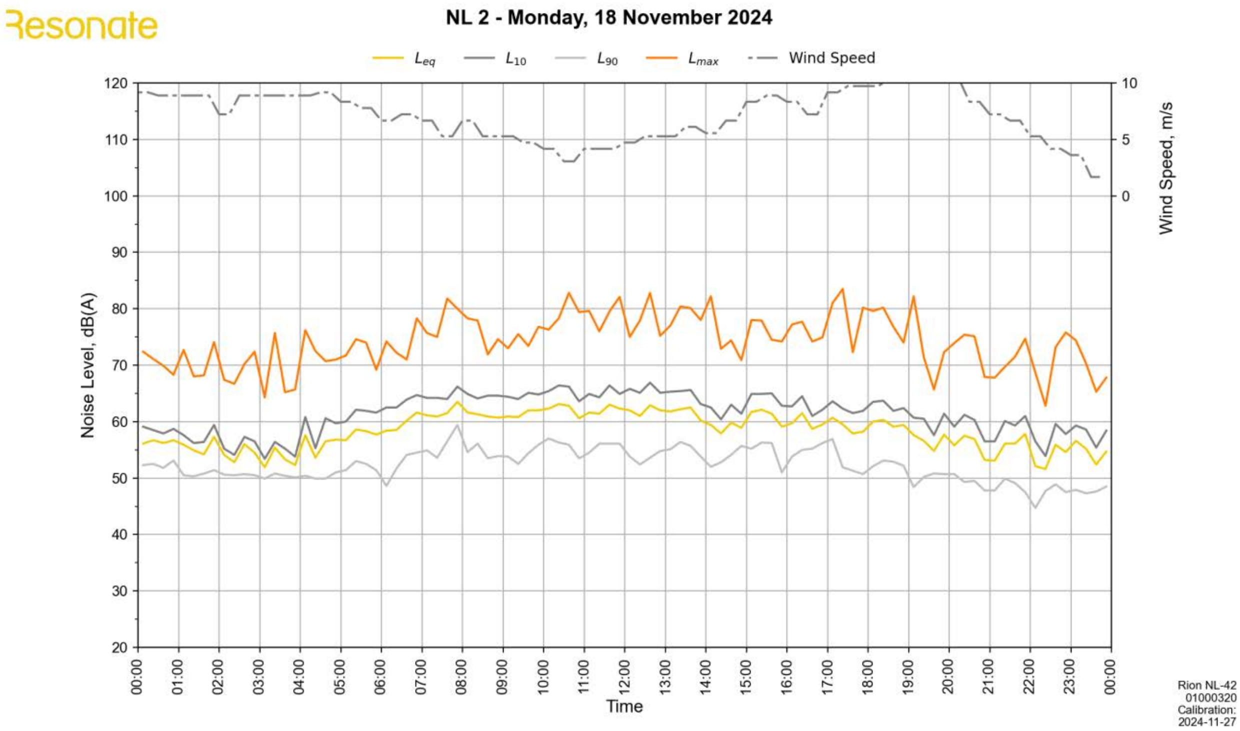

Resonate
NL 1 - Tuesday, 26 November 2024
Leq
L10
L90
Lmax
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
00946975
Calibration:
2024-11-27

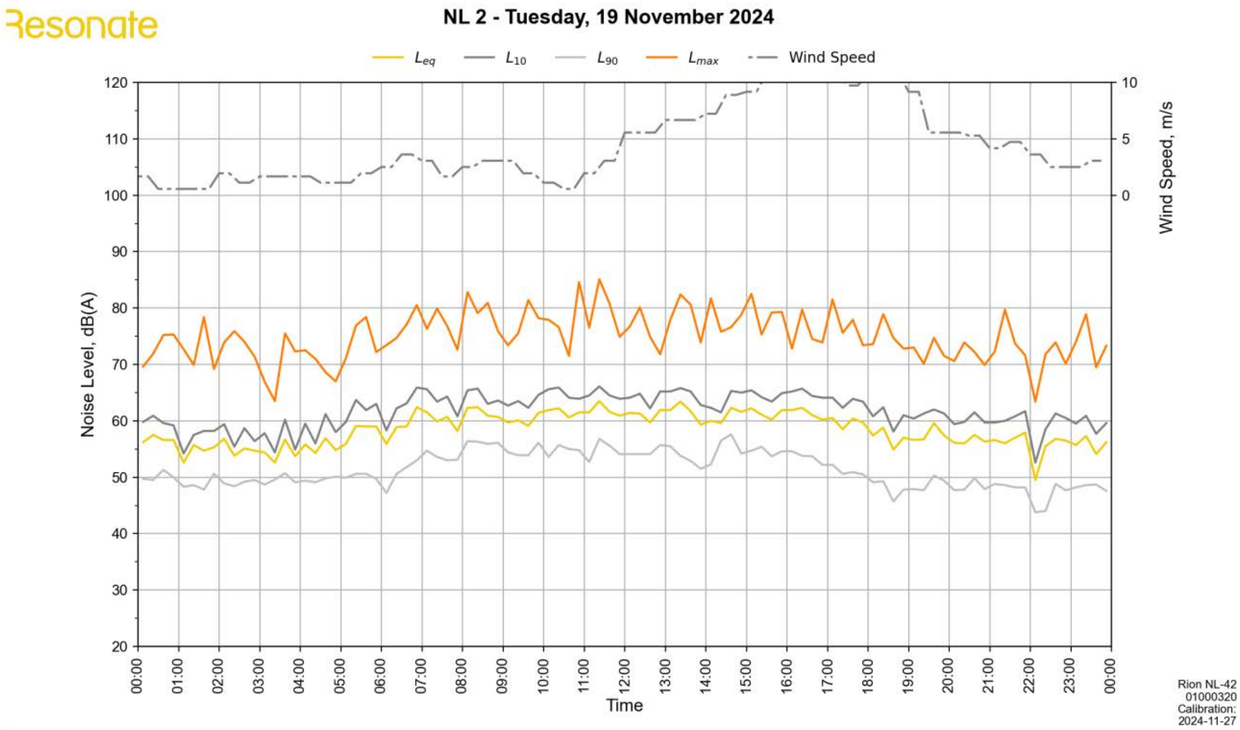
Resonate

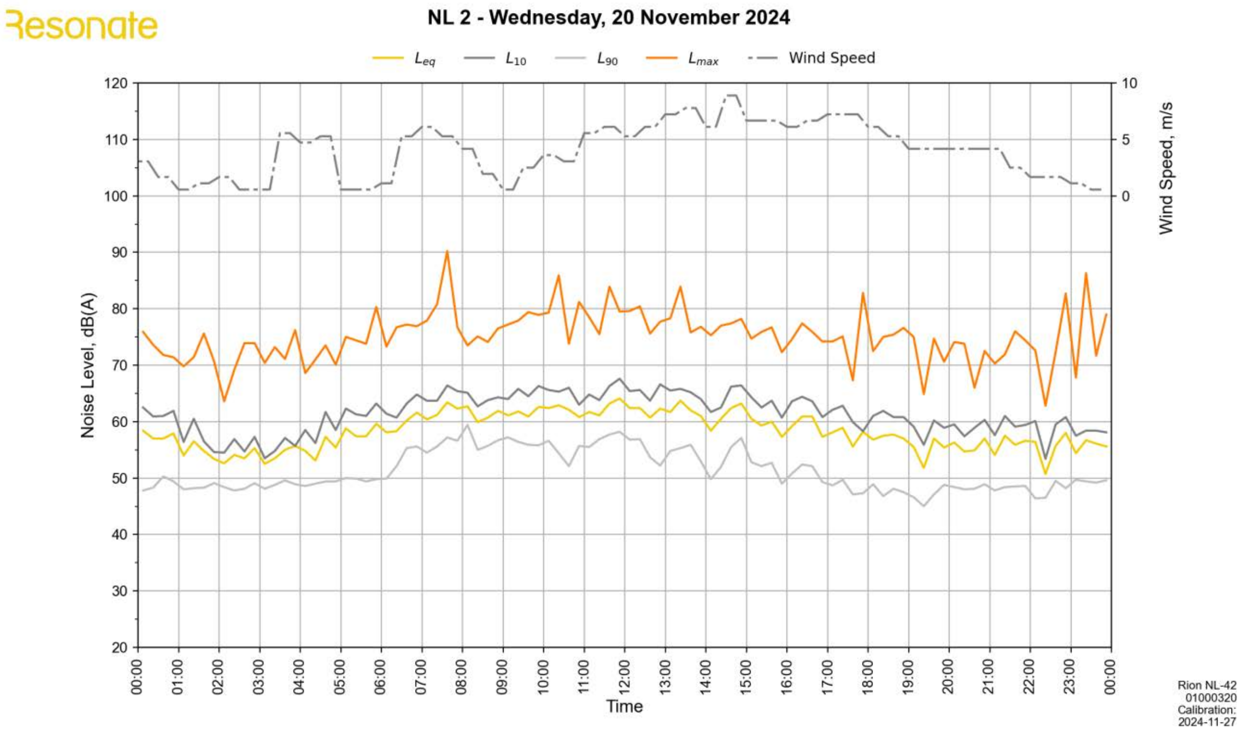

Resonate
NL 2 - Friday, 15 November 2024
L_{eq} L_{10} L_{90} L_{max} Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000320
Calibration:
2024-11-27

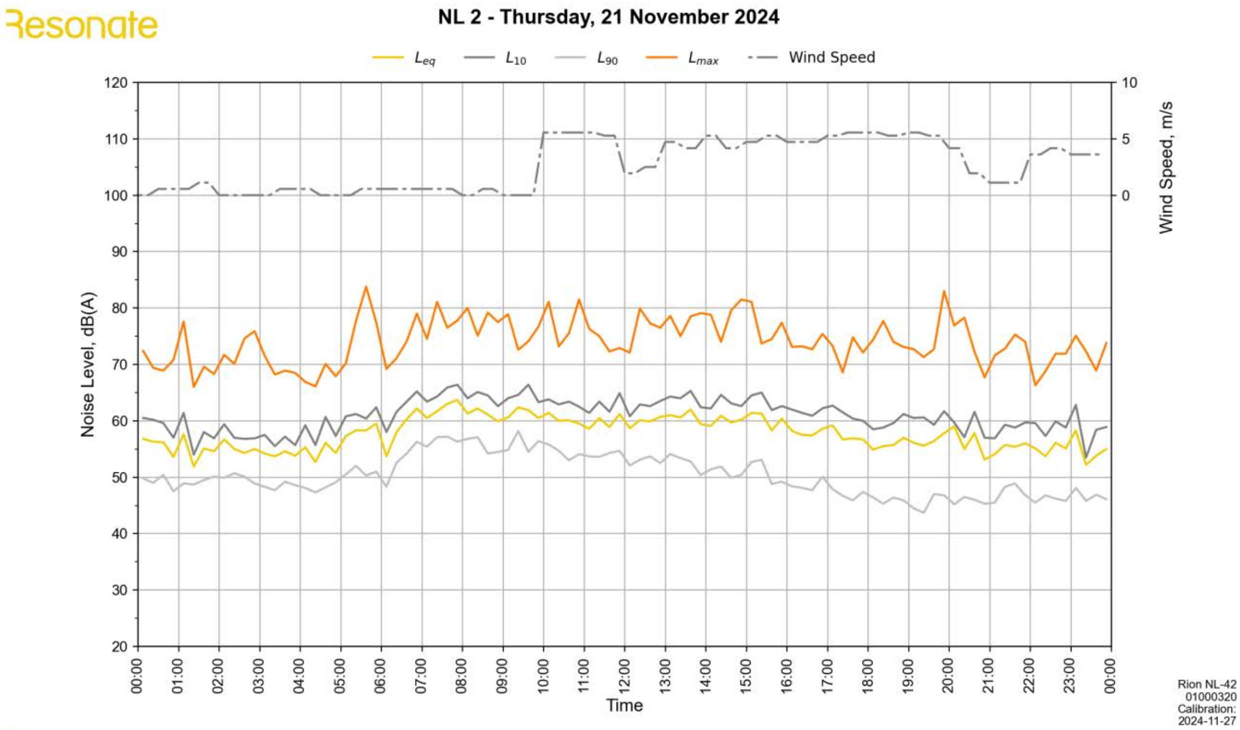

Resonate
NL 2 - Saturday, 16 November 2024
L_{eq} L_{10} L_{90} L_{max} Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000320
Calibration:
2024-11-27

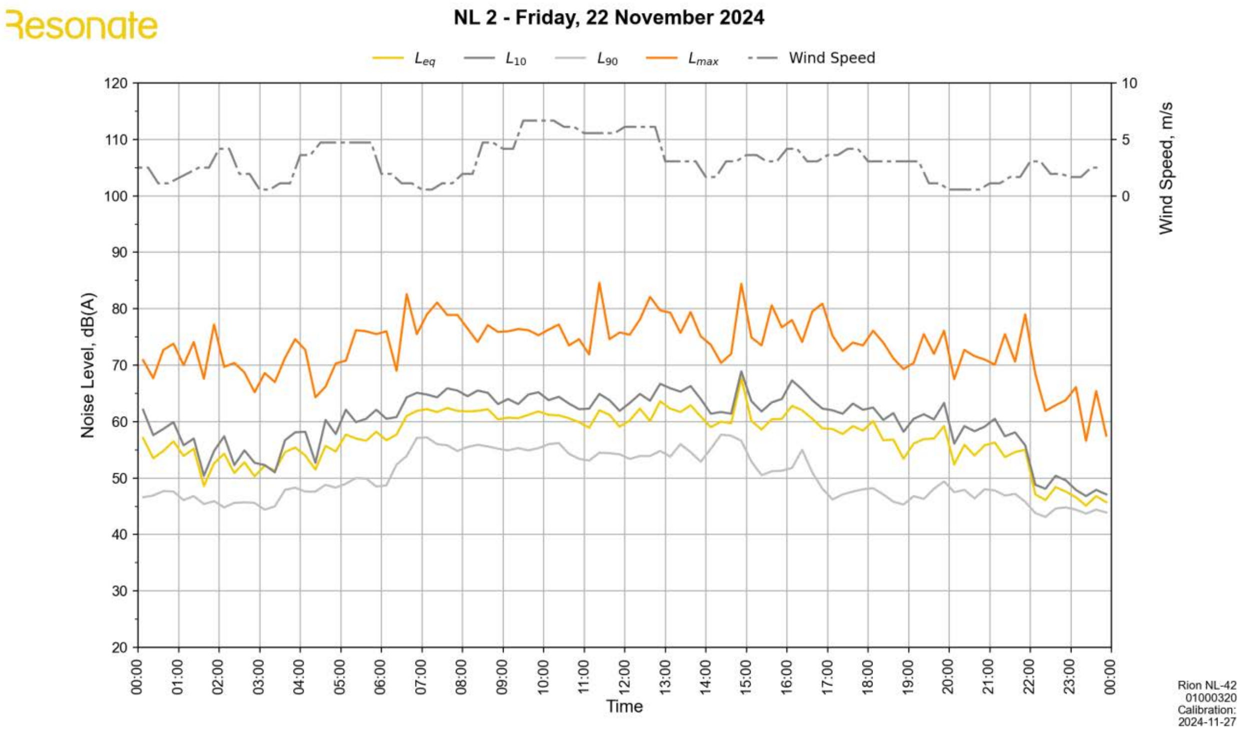

Resonate
NL 2 - Sunday, 17 November 2024
Leq
L10
L90
Lmax
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000320
Calibration:
2024-11-27


Resonate
NL 2 - Monday, 18 November 2024
Leq
L10
L90
Lmax
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000320
Calibration:
2024-11-27

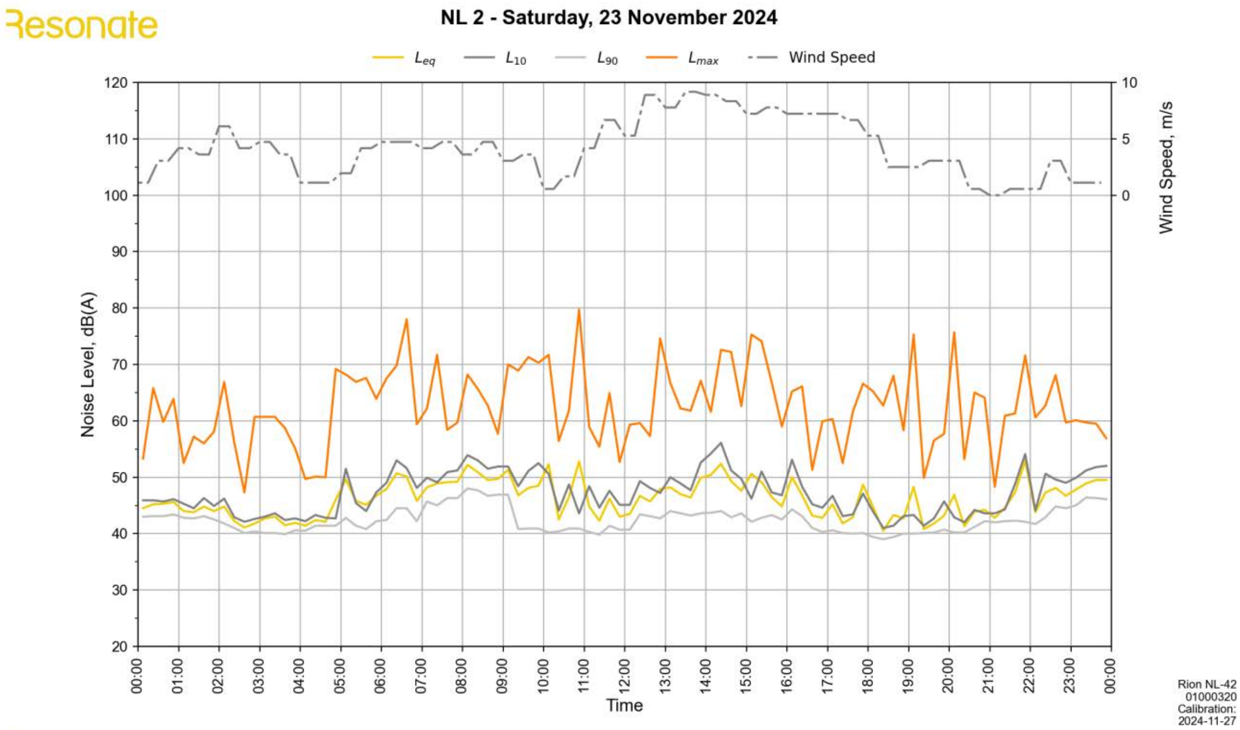

Resonate
NL 2 - Tuesday, 19 November 2024
Leq
L10
L90
Lmax
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000320
Calibration:
2024-11-27

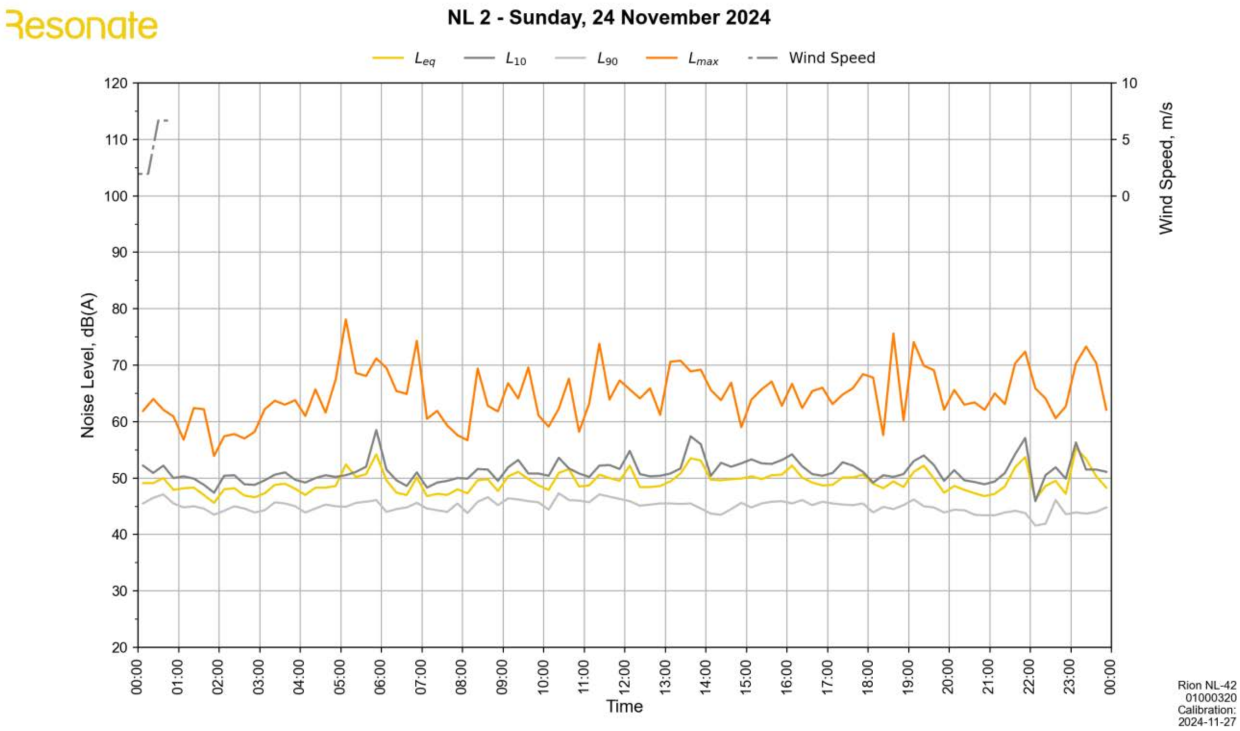

Resonate
NL 2 - Wednesday, 20 November 2024
Leq
L10
L90
Lmax
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000320
Calibration:
2024-11-27

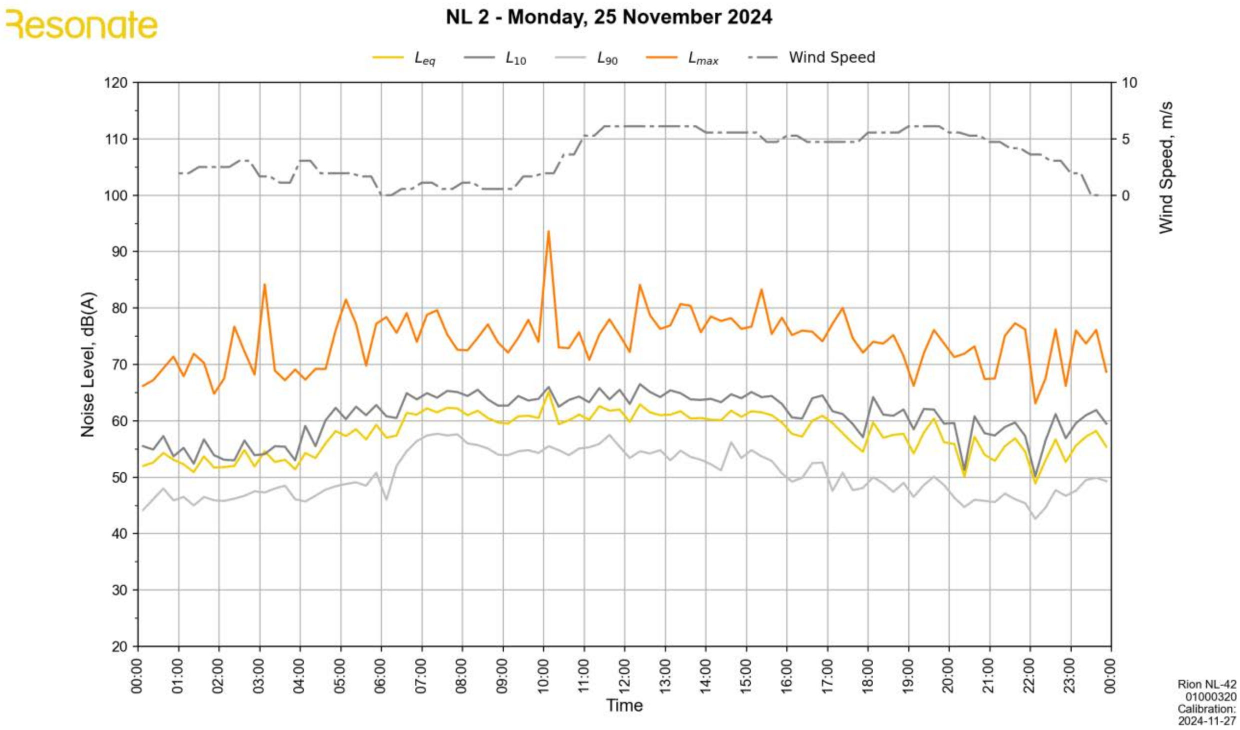

NL 2 - Thursday, 21 November 2024
Leq
L10
L90
Lmax
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000320
Calibration:
2024-11-27

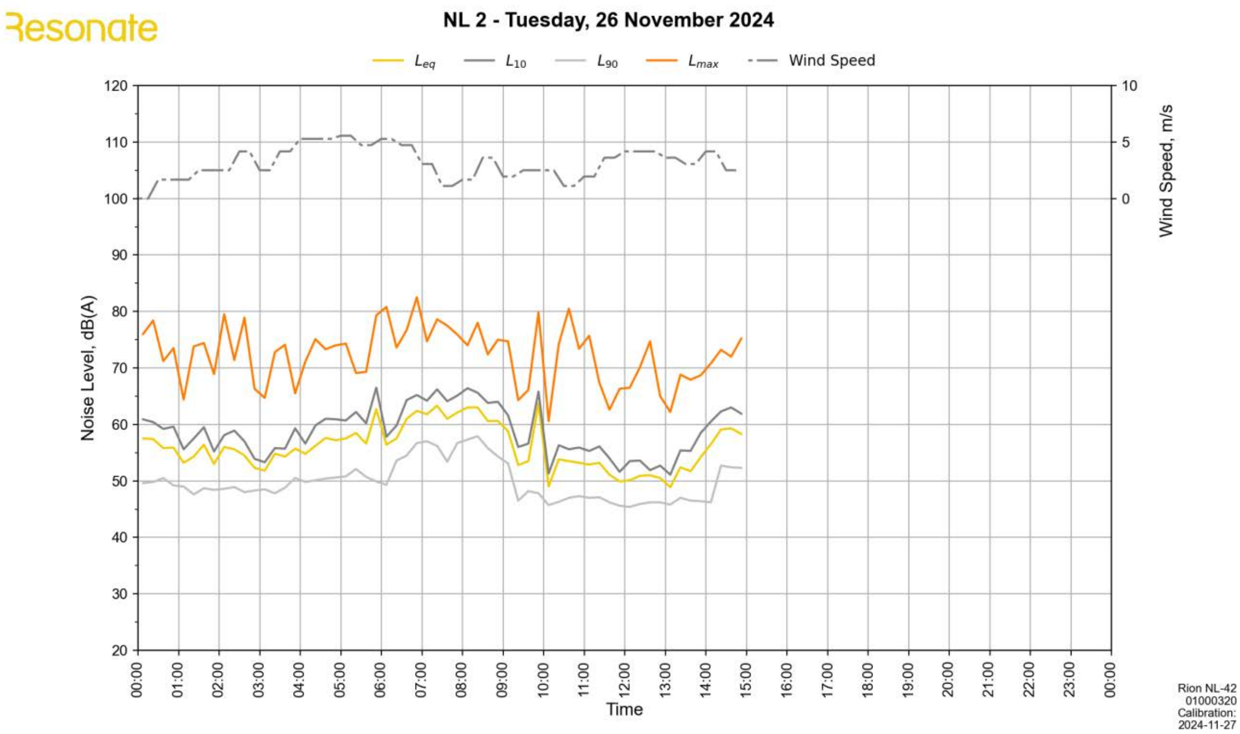

NL 2 - Friday, 22 November 2024
Leq
L10
L90
Lmax
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000320
Calibration:
2024-11-27

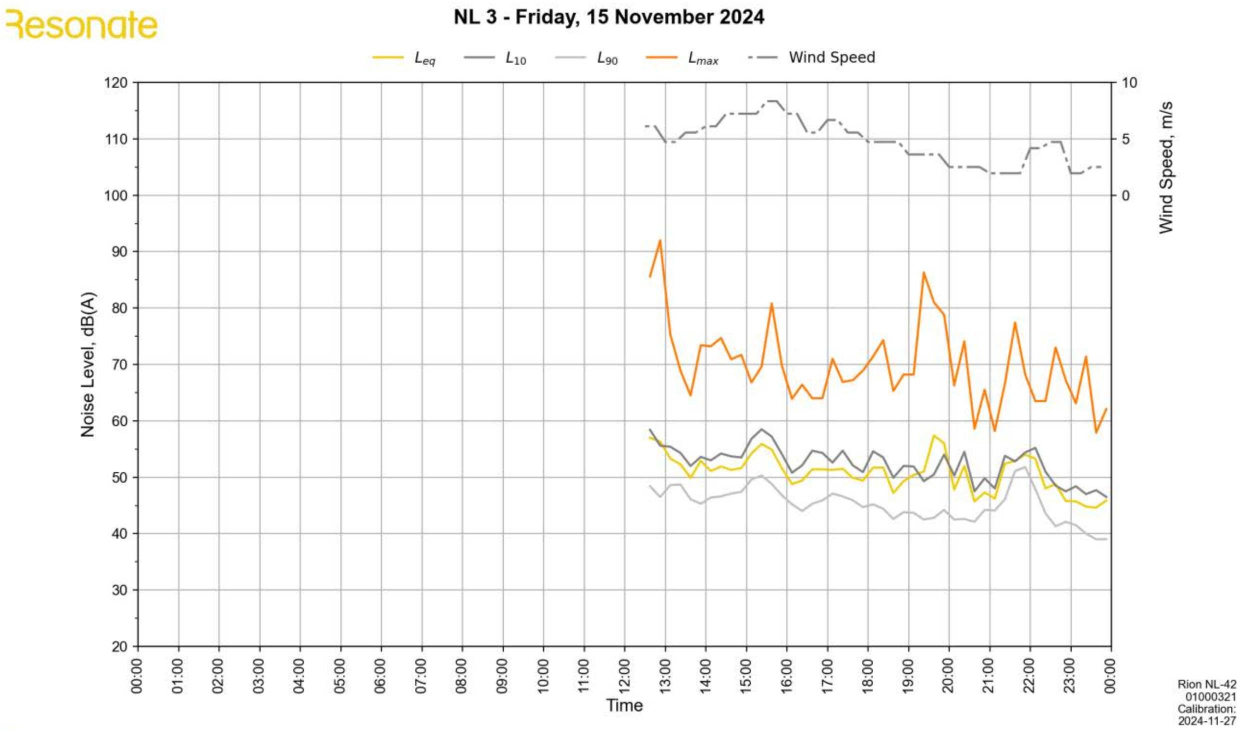
Resonate

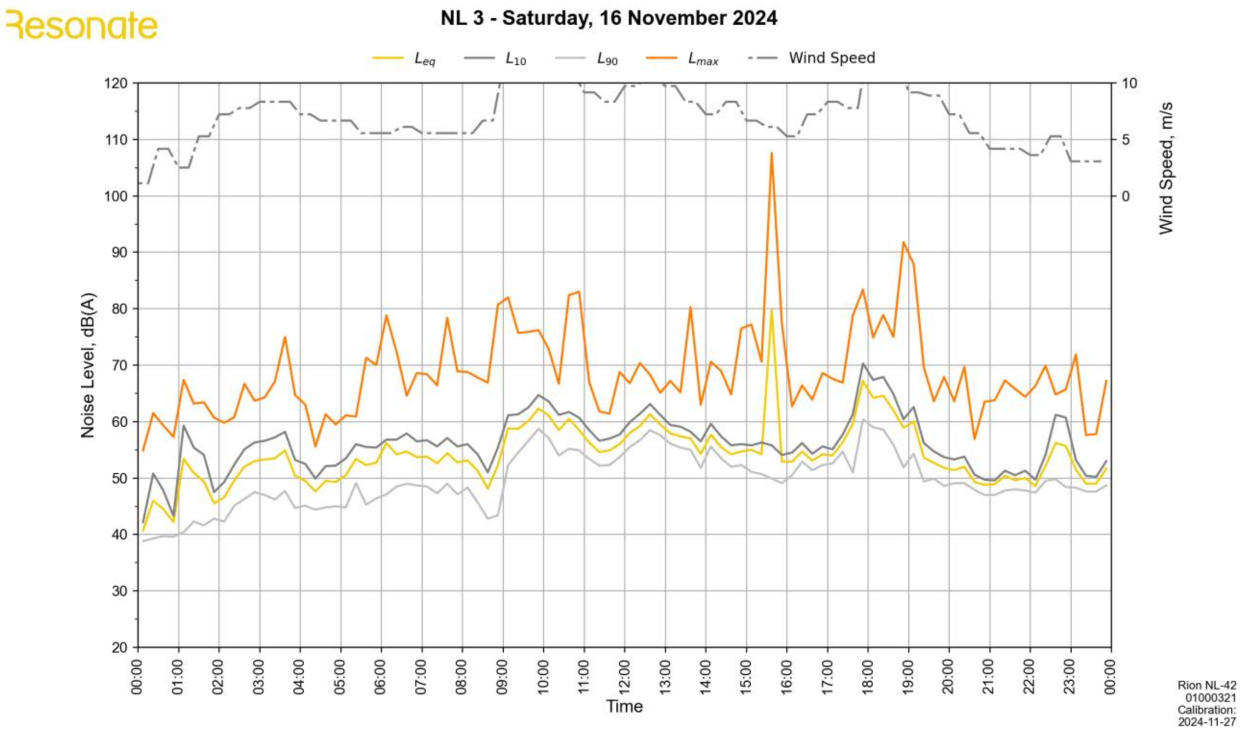

Resonate
NL 2 - Saturday, 23 November 2024
L_{eq} L_{10} L_{90} L_{max} Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000320
Calibration:
2024-11-27


Resonate
NL 2 - Sunday, 24 November 2024
L_{eq} L_{10} L_{90} L_{max} Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000320
Calibration:
2024-11-27

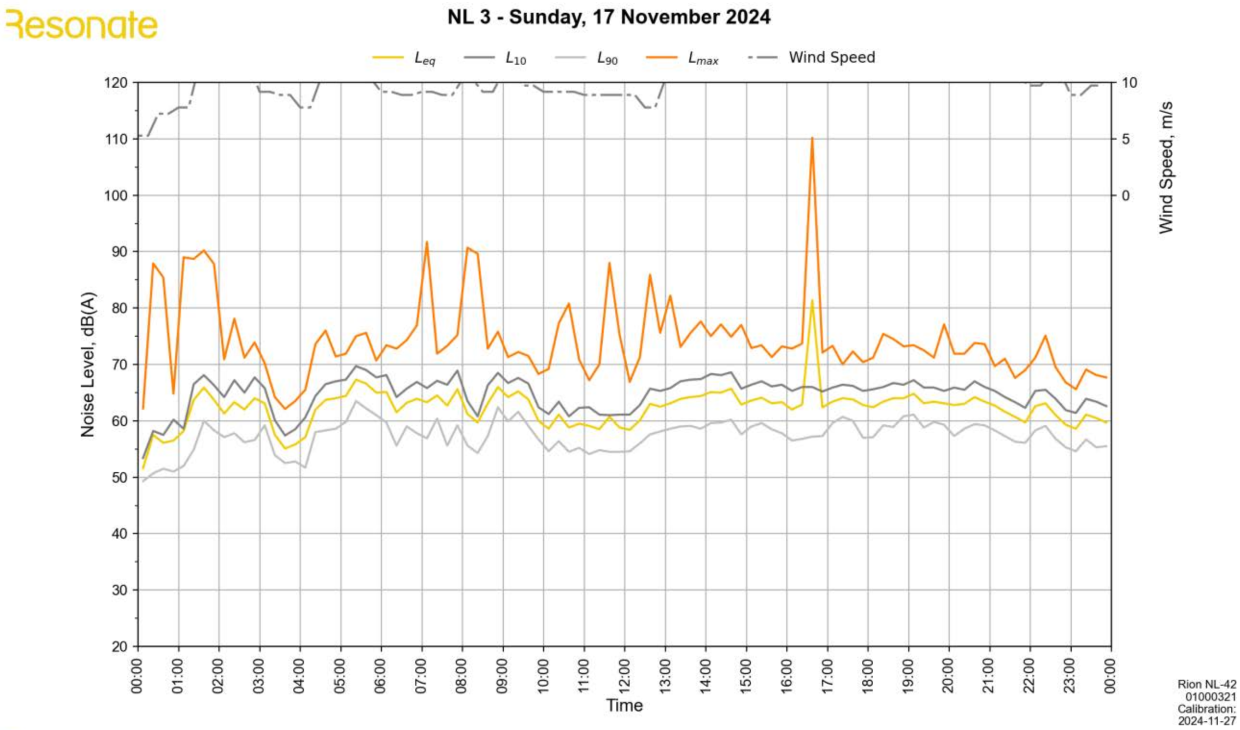

Resonate
NL 2 - Monday, 25 November 2024
L_{eq}
L_{10}
L_{90}
L_{max}
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
120
110
100
90
80
70
60
50
40
30
20
10
5
0
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Rion NL-42
01000320
Calibration:
2024-11-27

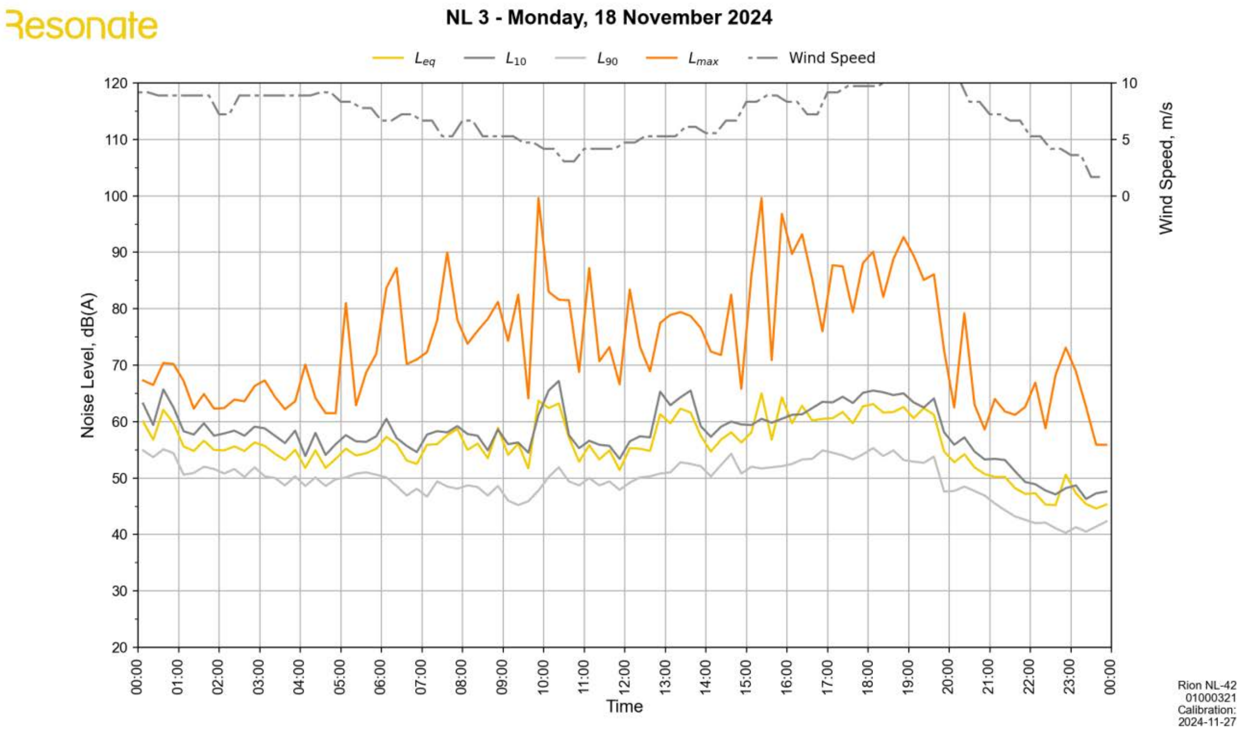

Resonate
NL 2 - Tuesday, 26 November 2024
L_{eq}
L_{10}
L_{90}
L_{max}
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
120
110
100
90
80
70
60
50
40
30
20
10
5
0
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Rion NL-42
01000320
Calibration:
2024-11-27

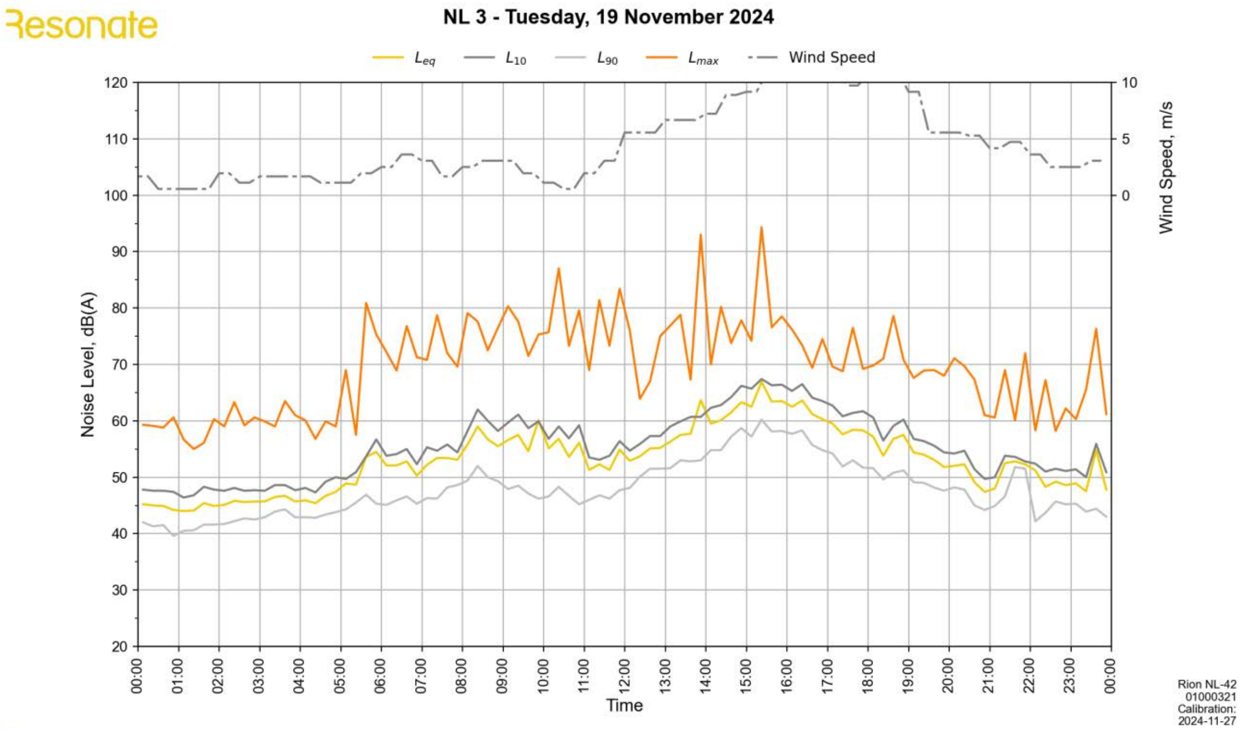

Resonate
NL 3 - Friday, 15 November 2024
Leq
L10
L90
Lmax
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000321
Calibration:
2024-11-27

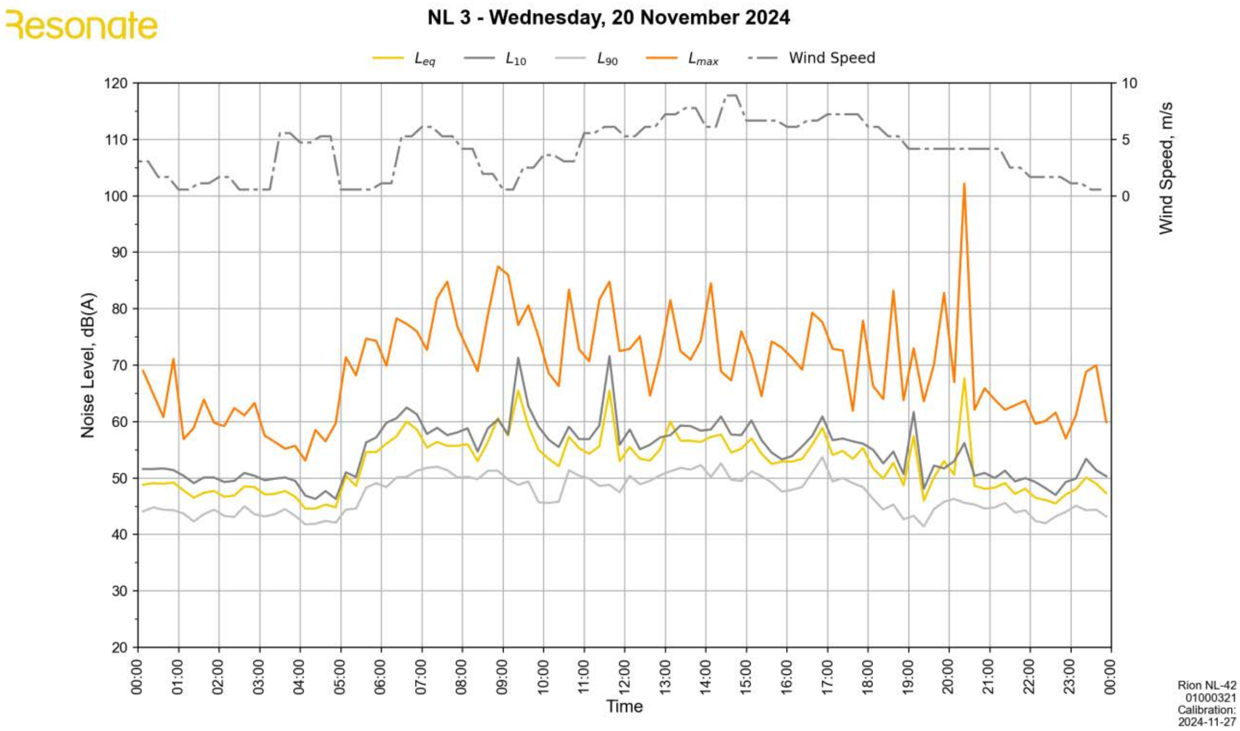

Resonate
NL 3 - Saturday, 16 November 2024
Leq
L10
L90
Lmax
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000321
Calibration:
2024-11-27

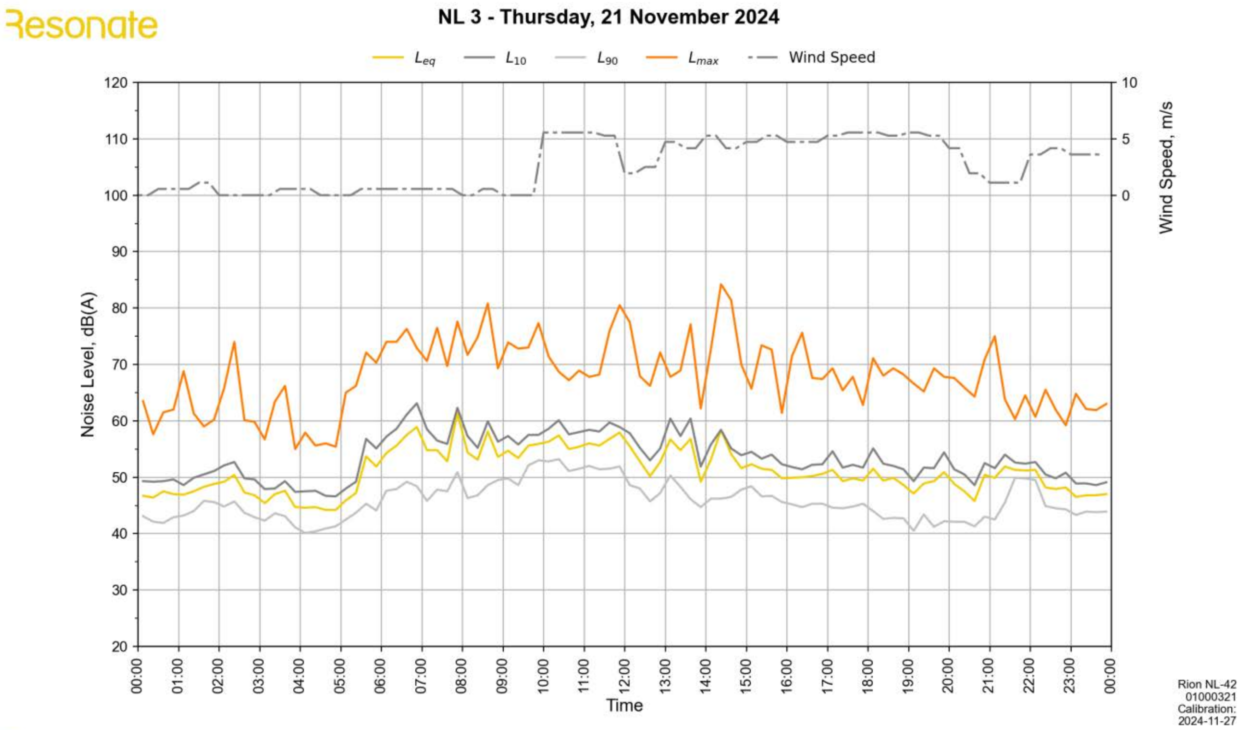
Resonate

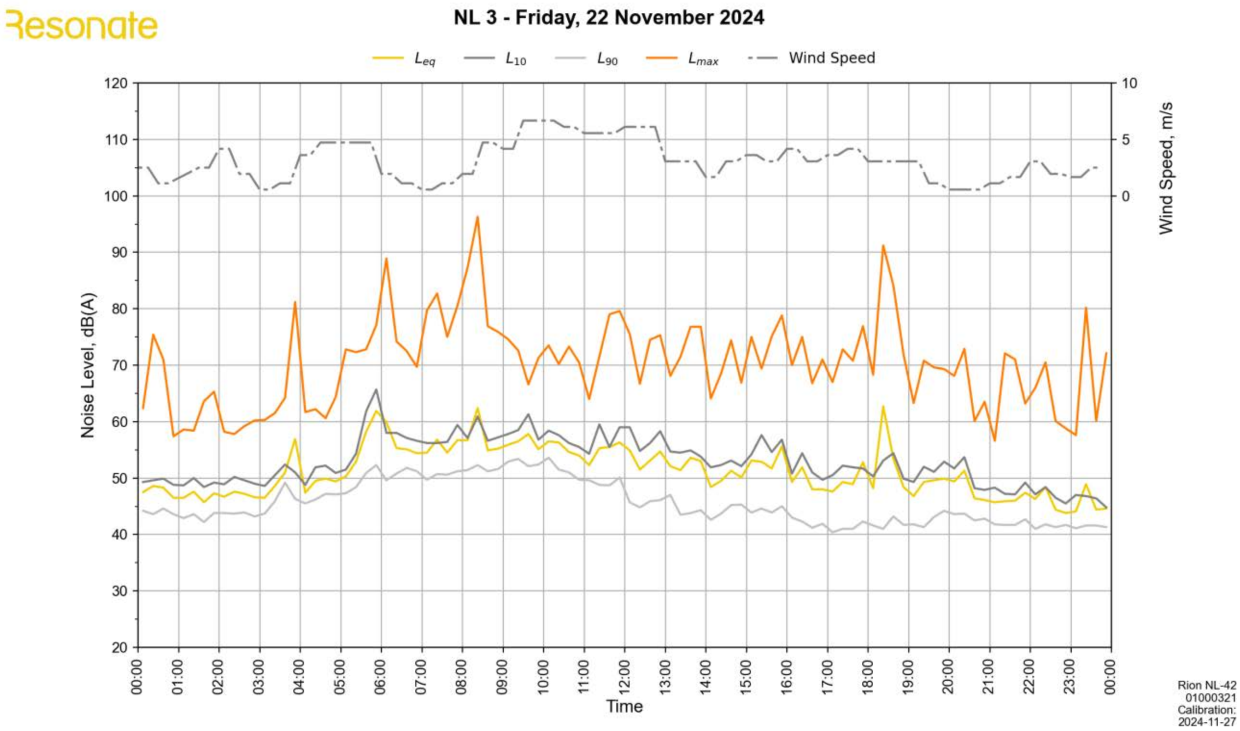

Resonate
NL 3 - Sunday, 17 November 2024
L_{eq} L_{10} L_{90} L_{max} Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000321
Calibration:
2024-11-27


Resonate
NL 3 - Monday, 18 November 2024
L_{eq} L_{10} L_{90} L_{max} Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000321
Calibration:
2024-11-27

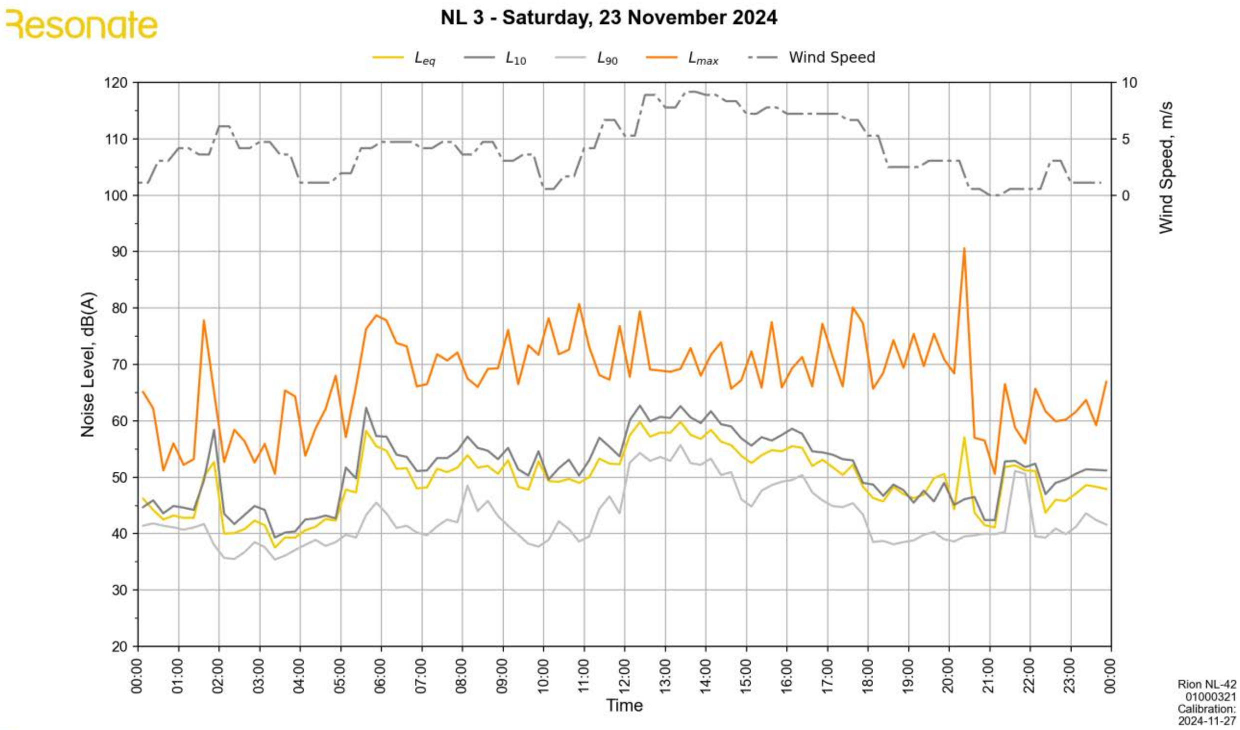

Resonate
NL 3 - Tuesday, 19 November 2024
Leq
L10
L90
Lmax
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000321
Calibration:
2024-11-27

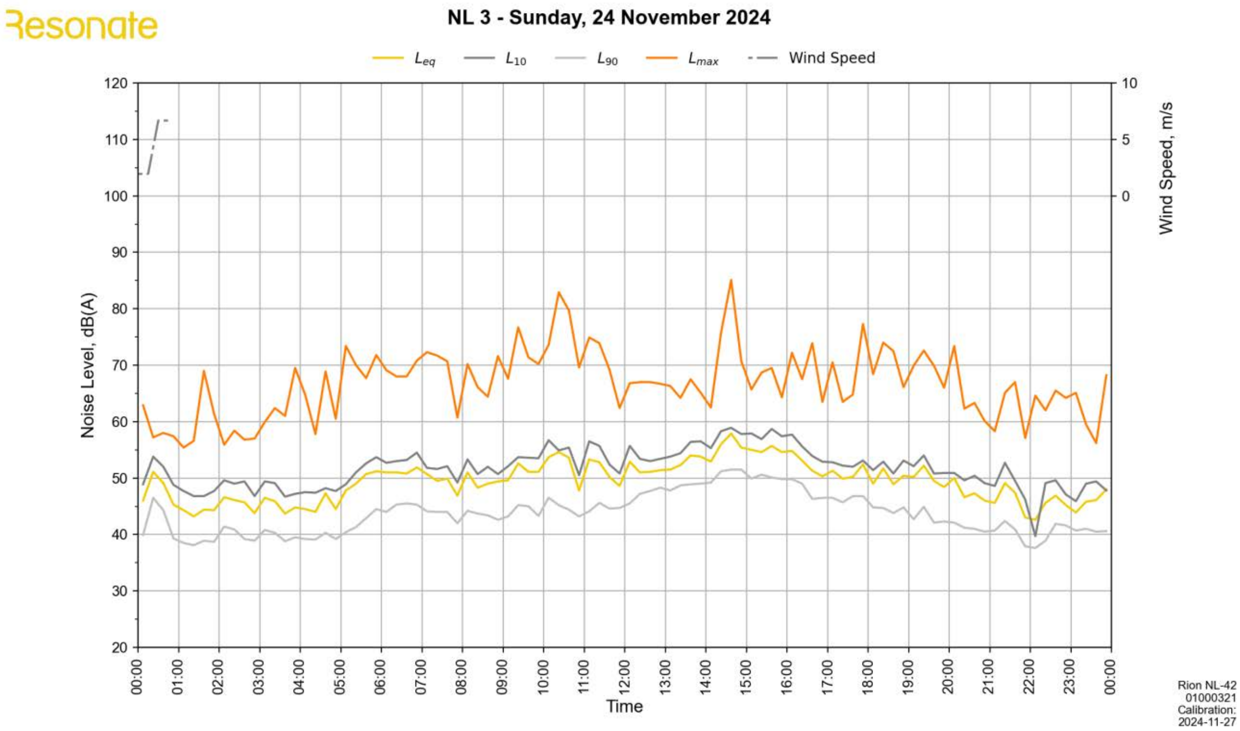

Resonate
NL 3 - Wednesday, 20 November 2024
Leq
L10
L90
Lmax
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000321
Calibration:
2024-11-27

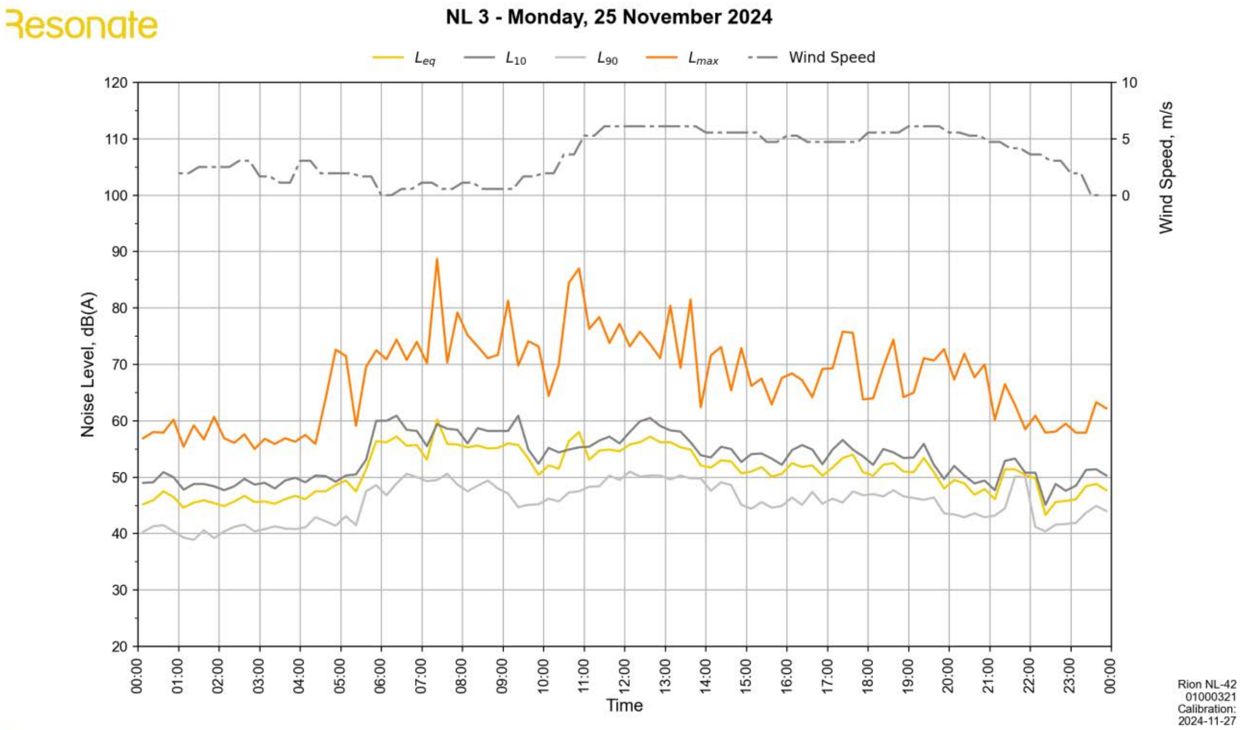

NL 3 - Thursday, 21 November 2024
Leq
L10
L90
Lmax
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000321
Calibration:
2024-11-27


NL 3 - Friday, 22 November 2024
Leq
L10
L90
Lmax
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000321
Calibration:
2024-11-27

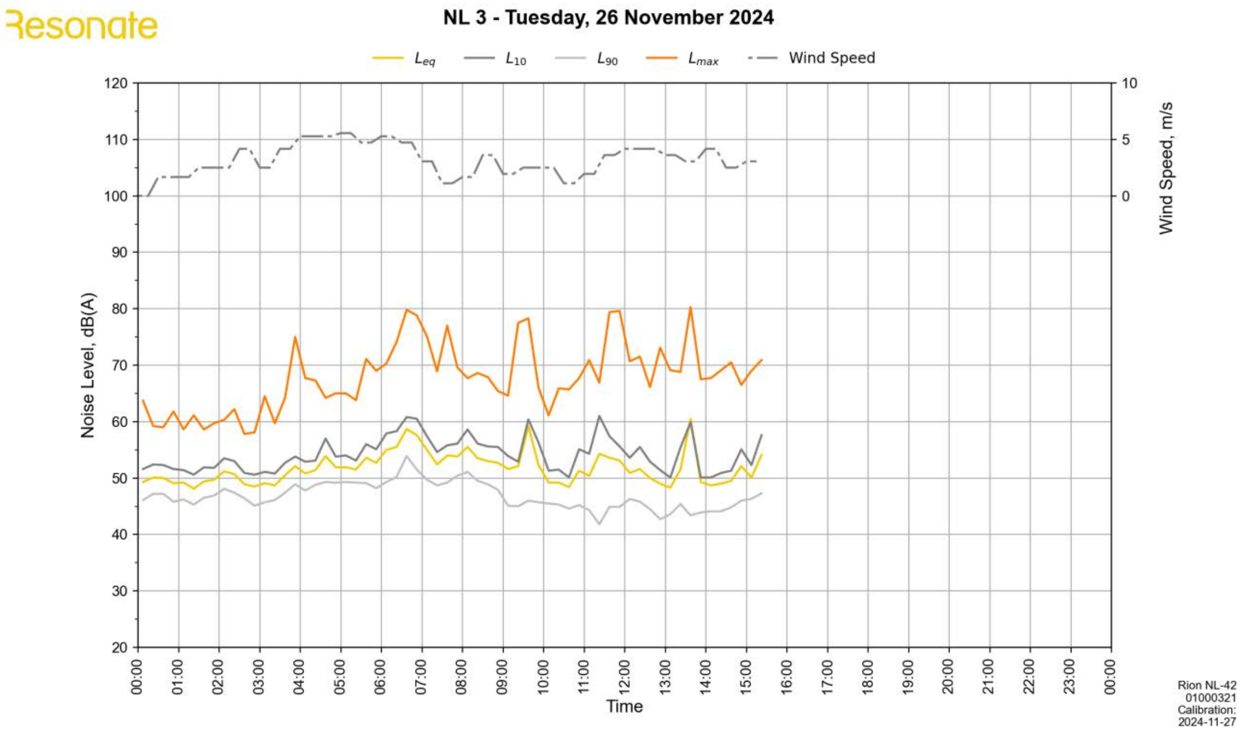
Resonate


Resonate
NL 3 - Saturday, 23 November 2024
L_{eq}
L_{10}
L_{90}
L_{max}
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000321
Calibration:
2024-11-27


Resonate
NL 3 - Sunday, 24 November 2024
L_{eq}
L_{10}
L_{90}
L_{max}
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000321
Calibration:
2024-11-27

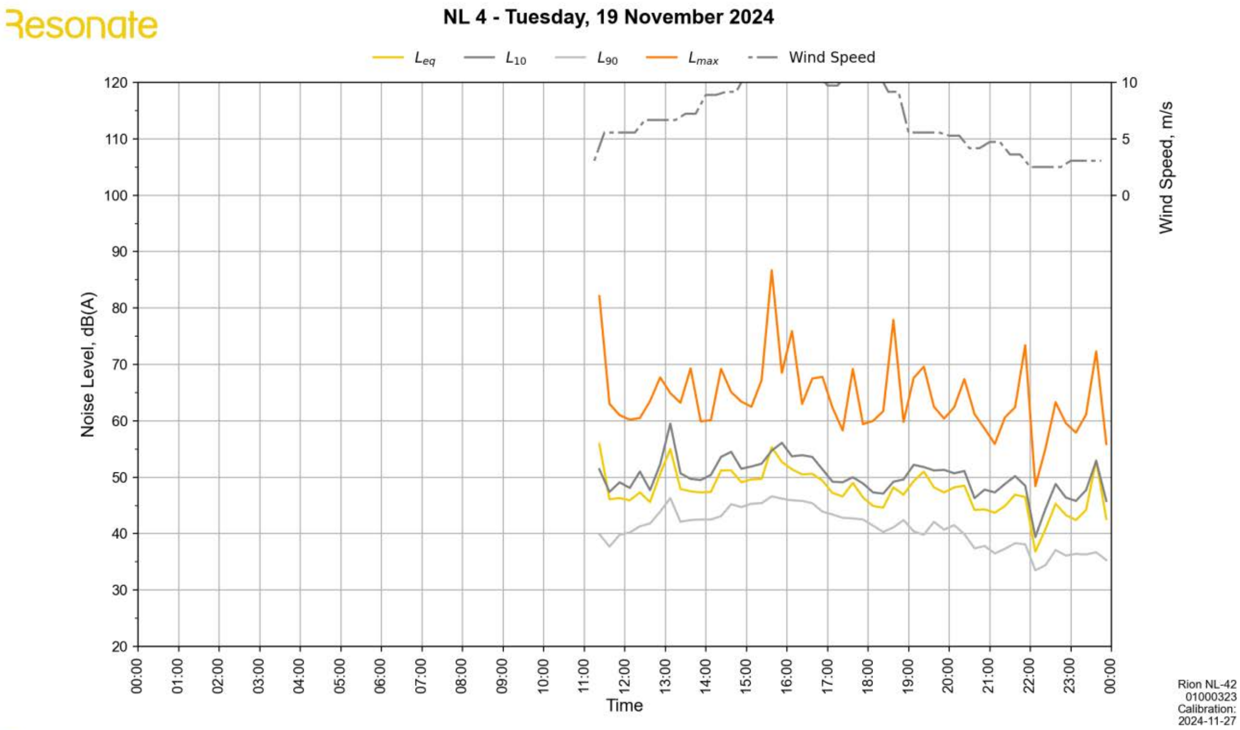


Resonate
NL 3 - Monday, 25 November 2024
L_{eq}
L_{10}
L_{90}
L_{max}
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000321
Calibration:
2024-11-27

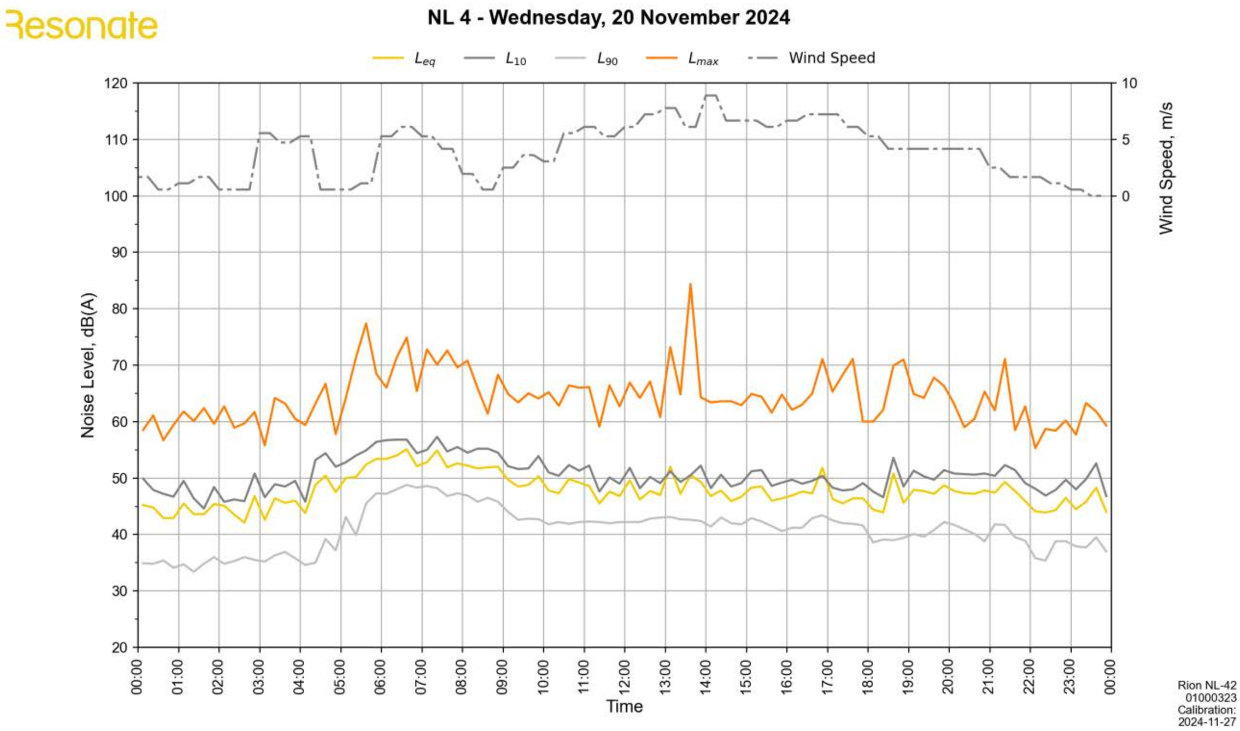


Resonate
NL 3 - Tuesday, 26 November 2024
L_{eq}
L_{10}
L_{90}
L_{max}
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000321
Calibration:
2024-11-27

Resonate

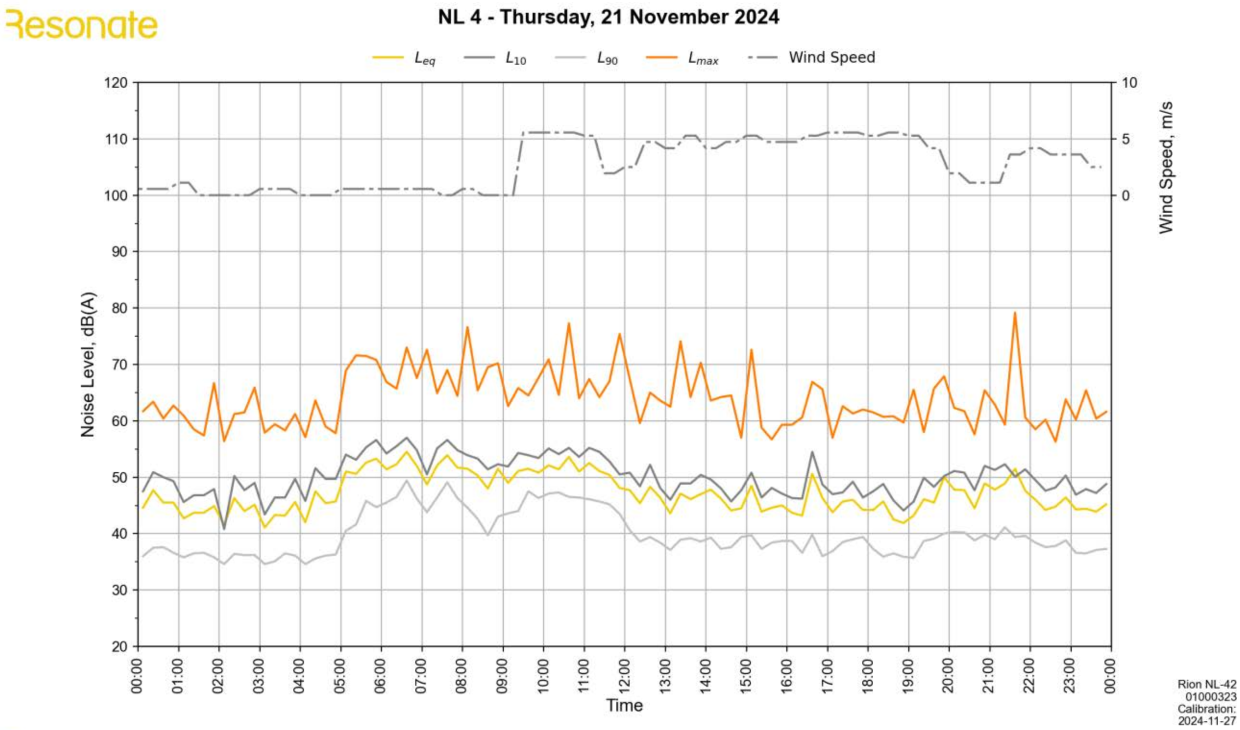


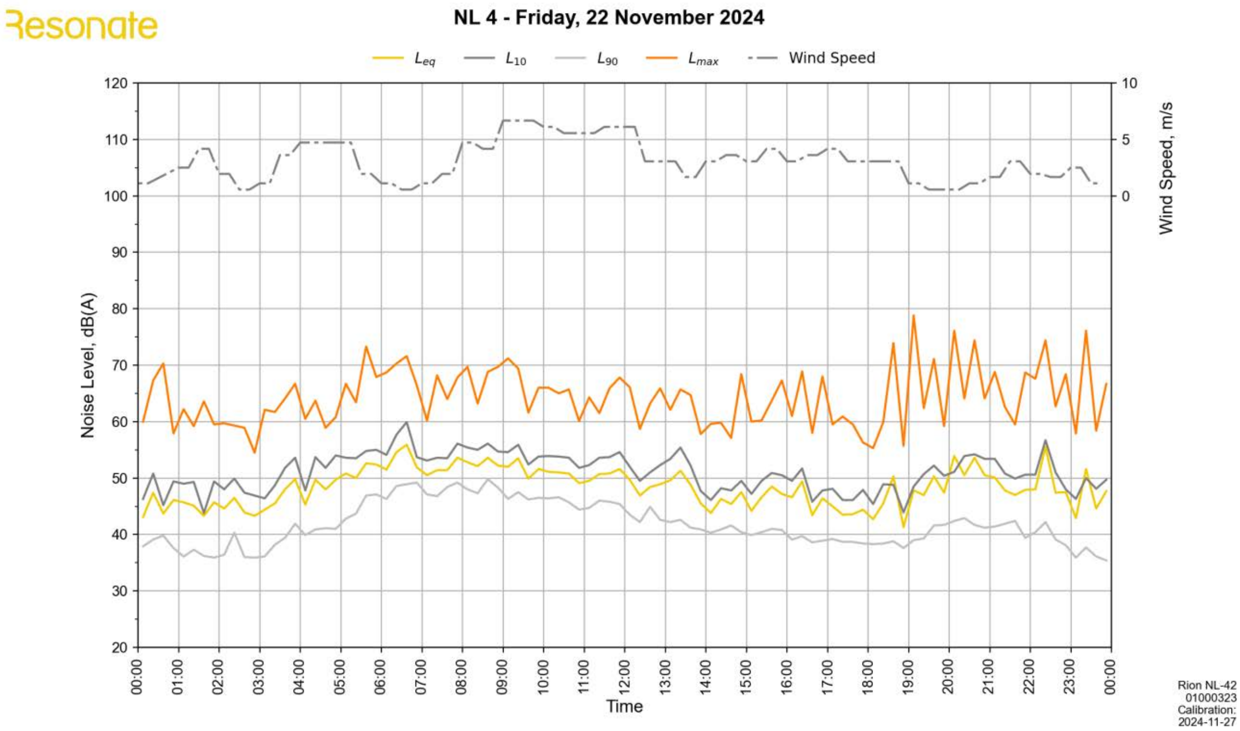
Resonate
NL 4 - Tuesday, 19 November 2024
L_{eq}
L_{10}
L_{90}
L_{max}
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000323
Calibration:
2024-11-27

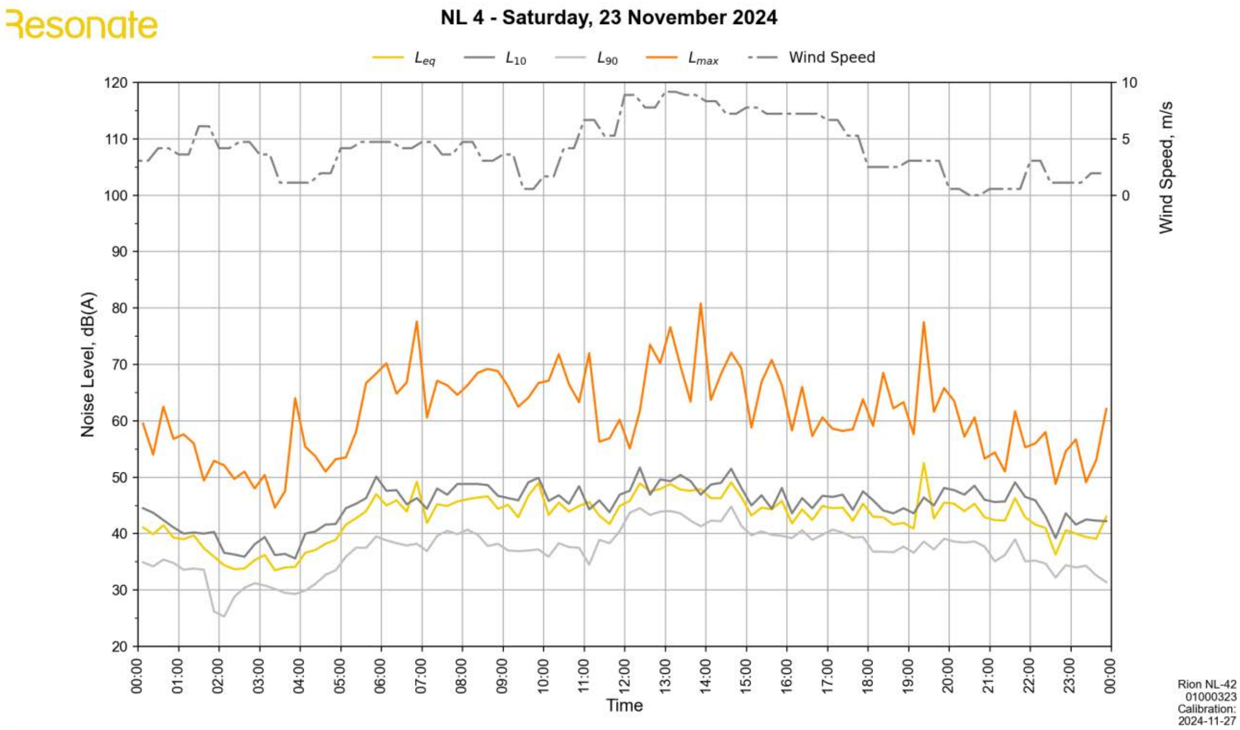


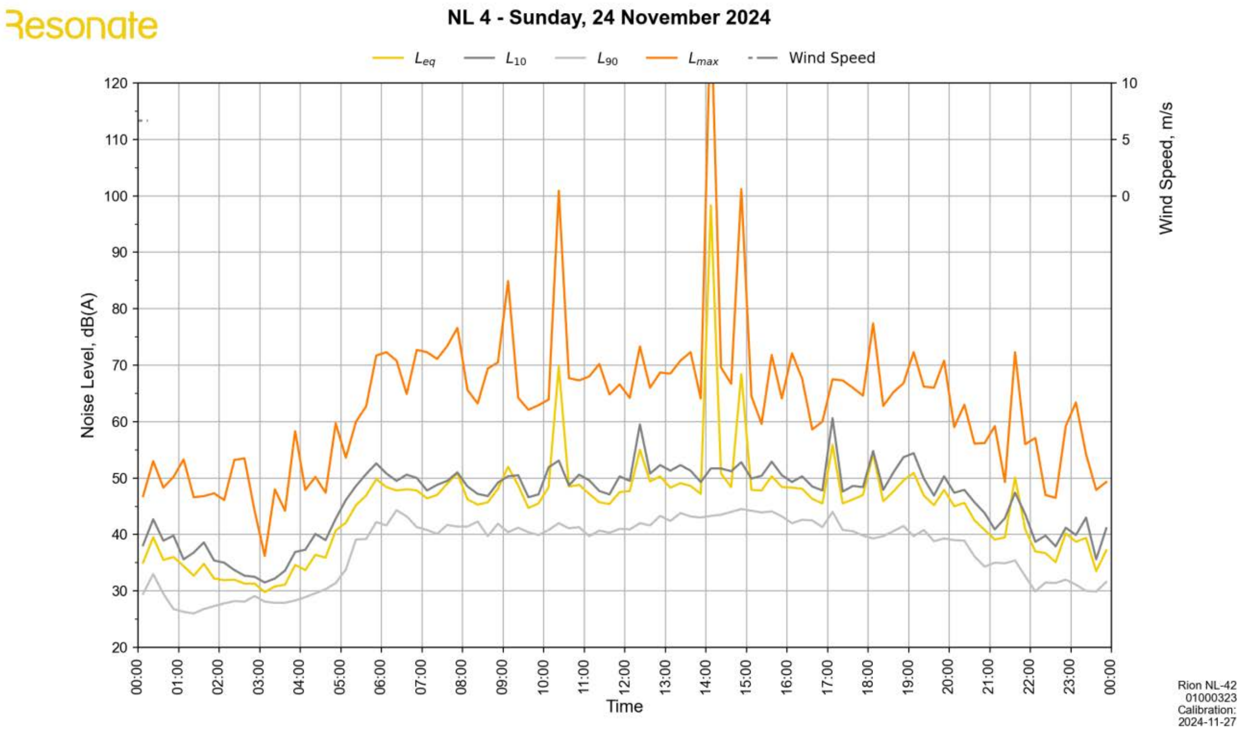
Resonate
NL 4 - Wednesday, 20 November 2024
L_{eq}
L_{10}
L_{90}
L_{max}
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000323
Calibration:
2024-11-27

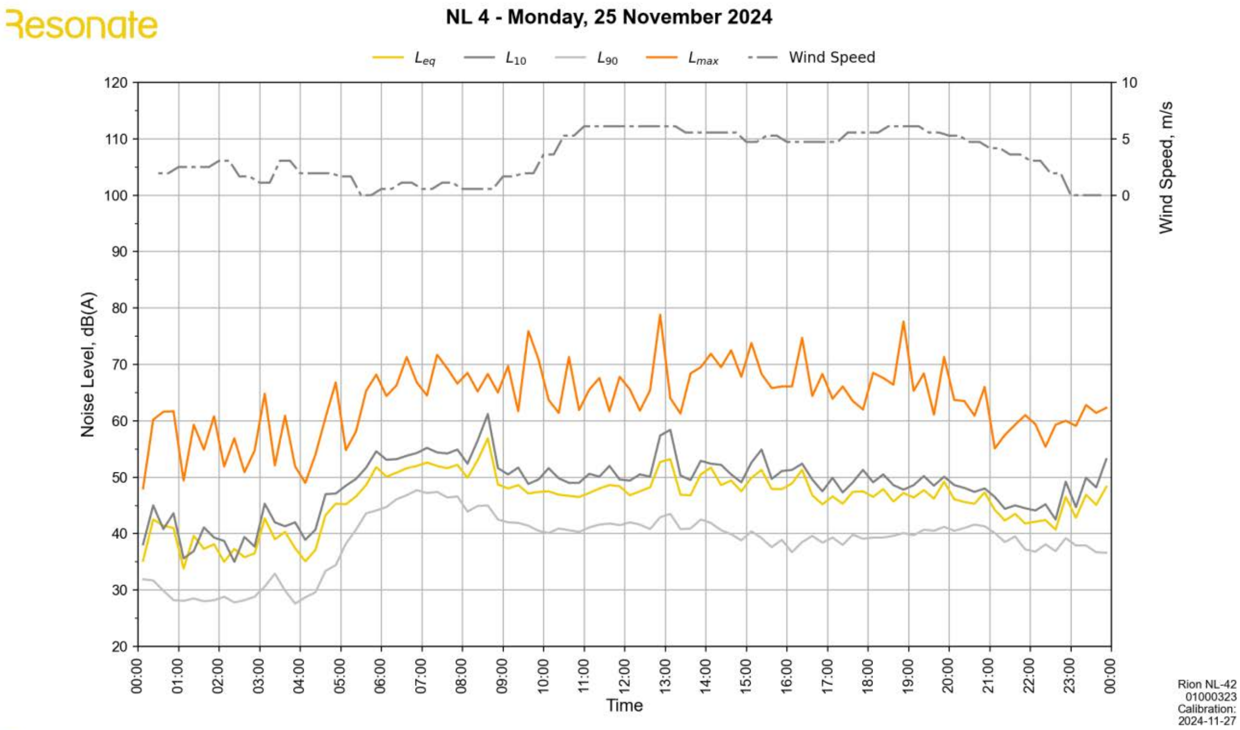
Resonate

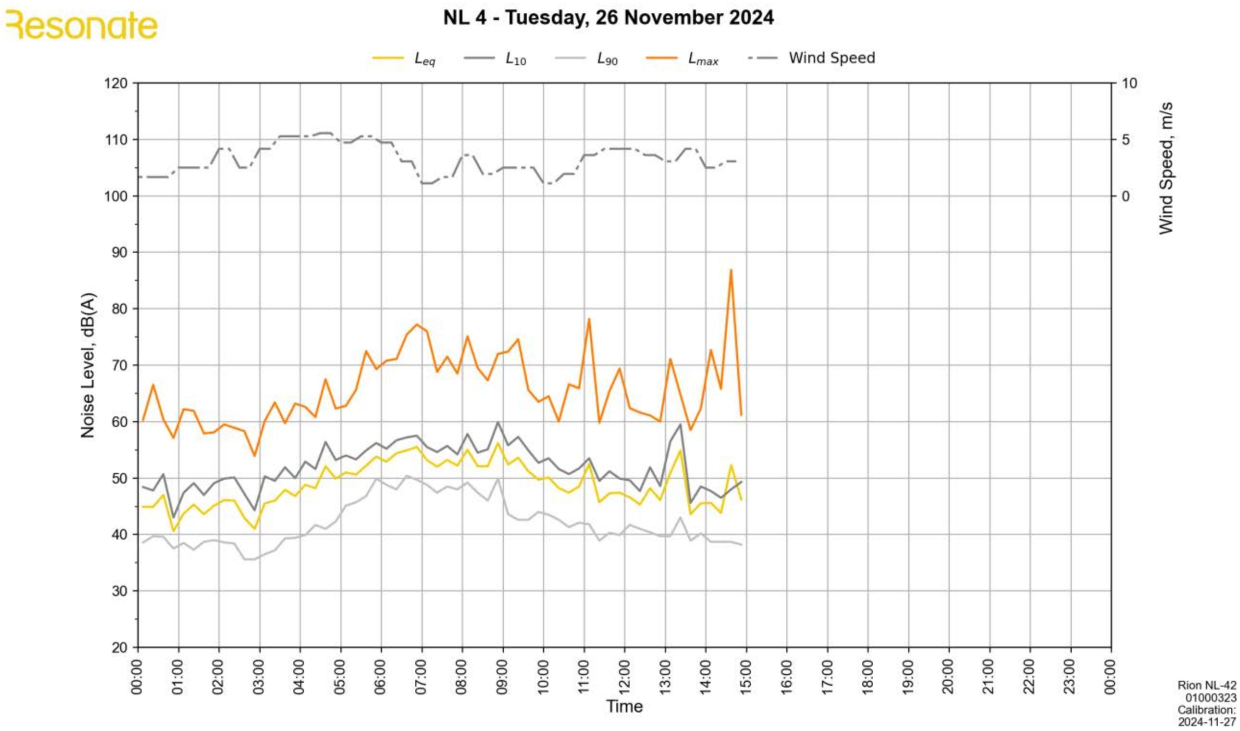

Resonate
NL 4 - Thursday, 21 November 2024
L_{eq}
L_{10}
L_{90}
L_{max}
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000323
Calibration:
2024-11-27


Resonate
NL 4 - Friday, 22 November 2024
L_{eq}
L_{10}
L_{90}
L_{max}
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000323
Calibration:
2024-11-27


Resonate
NL 4 - Saturday, 23 November 2024
L_{eq}
L_{10}
L_{90}
L_{max}
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000323
Calibration:
2024-11-27


Resonate
NL 4 - Sunday, 24 November 2024
L_{eq}
L_{10}
L_{90}
L_{max}
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000323
Calibration:
2024-11-27


Resonate
NL 4 - Monday, 25 November 2024
Leq
L10
L90
Lmax
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000323
Calibration:
2024-11-27


Resonate
NL 4 - Tuesday, 26 November 2024
Leq
L10
L90
Lmax
Wind Speed
Noise Level, dB(A)
Wind Speed, m/s
Time
Rion NL-42
01000323
Calibration:
2024-11-27

Appendix B – Noise source data

Resonate

Noise source	Octave band sound power level, L_W dB							Overall, L_W dBA
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	
Truck movement	106	99	94	92	93	90	84	**97**
Truck idling	85	85	80	87	84	81	78	**89**
Refrigerated container	84	85	81	79	77	74	69	**82**
Container handler - Hyster 12EC	112	110	108	104	101	98	92	**107**
Quay Crane	90	89	96	96	108	105	96	**111**
Straddle carriers	107	102	99	97	98	97	94	**103**
Reach stacker	116	114	112	108	105	102	96	**111**
Ship	122	126	97	93	89	86	83	**110**

Appendix C – Operational noise contours

Appendix D – Underwater noise contours

Appendix E – Preliminary shutdown and effects zones

Resonate

Appendix O

WGA geotechnical gap assessment

EMM
creating opportunities

WGA

TECHNICAL MEMORANDUM

PROJECT NO.: WGA221312

DATE: 27 SEPTEMBER 2024

COMPANY NAME	GatewaySA (Flinders Ports Holdings)
ATTENTION	Manikandan Palaniswamy
SUBJECT	OH6 Berth Extension – Geotechnical Gap Assessment
REVISION	A (27-09-2024)

1. PURPOSE

The purpose of this technical memorandum is to summarize WGA's review of the available historical geotechnical investigations and provide advice regarding the suitability of the existing information for informing the design and subsequent construction of the Outer Harbor 6 (OH6) berth extension (circa. 135m long extension in addition to a new mooring dolphin). Key consideration in this review include:

- Sufficiency of the historical information to inform design parameters for tubular piles and sheet piling design.
- Consideration of pile driving risks and presence of underwater obstructions or hard driving conditions.
- Consideration of contractors risk considerations to reduce geotechnical latent condition risk.

2. HISTORICAL GEOTECHNICAL INFORMATION

The following historical geotechnical information has been provided to WGA (Table 1).

Table 1: Existing Available Geotechnical Information

REF.	YEAR	DOCUMENT
1	1973	20546-15 (Sheet 3) Original design drawings of the OH6 sheet pile wall, showing the geotechnical layers and corresponding parameters adopted in the design
2	1990	Connell Wagner, A2086/1-AC Proposed Extension to No.6 Container Berth Results of Pile Load Testing and Further Geotechnical Studies
3	2005	Parsons Brinckerhoff Geotechnical Investigation Berth 6 Sheet Pile Wall Outer Harbor Stage 3
4	2005	Independent Geoscience Pty Ltd, 200529 Adelaide Port Berth 7 – Dynamic Pile Testing
5	2008	Connell Wagner, 29114-001 Rev 7 Review of Berth Capacity for New Container Cranes Berth 6 Container Terminal
6	2008	Various Records - Independent Geoscience Pty Ltd Port Adelaide Berth 7 Extension – Pile Driving Records and CAPWAP Summaries

REF.	YEAR	DOCUMENT
7	2009	AECOM, 60096211 R02 Port Adelaide OH Berth 6 Wharf Independent Capacity Assessment
8	2012	AECOM Wharf Bulkhead Wall Geotechnical and Structural Capacity Assessment Journal paper: Australian Geomechanics Vol 47 No 3, September 2012
9	2012	Golder Associates, 117662048-001 Geotechnical Investigation Berth 4 Outer Harbor
10	2018	Arup, 253257-GE-RP-0001 Rev 5 Outer Harbor Channel Widening Geotechnical Report
11	2021	CMW Geosciences, ADL2021-0133AB Rev 0 Outer Harbor Container Terminal FACT Shed Pavement Design Project Geotechnical Investigation Report
12	2021	CMW Geosciences, ADL2021-0133AC Rev 0 Outer Harbor Container Terminal Additional Container Slots and LV Road Realignment Project Geotechnical Investigation Report
13	2024	Adelaide Commercial Dive (ACD) Underwater inspection photos and videos (March 2024). Includes western end of OH6 and adjacent rock revetment.

3. GEOTECHNICAL GAP ASSESSMENT

3.1 Review of Historical Geotechnical Information

A summary of key parameters proposed in various previous studies referenced in Table 1 is shown in Figure 1, Figure 2 and Figure 3. These are provided for reference only, with recommended parameters for the Berth 6 Extension provided in Section 3.2. The inferred geotechnical parameters proposed are based on a combination of historical Berth 4 and Berth 6/7 geotechnical investigations. This is to be updated following the gap assessment.

The closest available boreholes found in the historical geotechnical information provided is BH01 and BH02 as shown in Figure 4, however, these were only taken to a depth of 4m and are too shallow to infer geotechnical parameters for pile design.

Soil Unit	Soil Description	Depth (m)	c_u (kPa)	c' (kPa)	Φ'(degree)	E' (MPa)
Fill	Fill	0 – 6	-	-	34	4
St Kilda	Loose Sand	6 – 8.5	-	2	34	6
Formation	Medium Dense Sand	8.5 – 11	-	2	34	20
Glanvill	Very Loose to Dense	11 – 14	-	-	34	6
Formation	Sand/Gravelly Sand					
Transition Zone	Clay and Clayey Sand	14 – 17.5	75	5	30	25
Hindmarsh Clay	Vst- Clay	17.5 – 22	150[1]	5	30	75
	H- Clay	22 – 26	200[1]	10	30	120
Sand/Clayey Sand	Dense Sand	26 – 28	-	-	35	100

Figure 1: Extract from Section 3.5 Ref. 8 (AECOM, 2012)

Unit/Material	Depth to Base (m)			Friction Angle	Cohesion	Unit Density
	LAT (m)	DMH (m)	AHD (m)	ϕ_u (degrees)	C_u (kPa)	(kg/m^3)
100-150mm Spalls	9.3	21.6	-10.8	30	0	16
Transitional Hindmarsh Clay	10.7	20.2	-12.2	0	100	21
Very Stiff Hindmarsh Clay	13.5	16.5	-14.9	0	125	21
Hard Hindmarsh Clay	>31	< 0	<-32.4	0	200	21

Figure 2: Extract from Section 3.5 Ref. 3 (Parsons Brinkerhoff, 2005)

Soil depth (LAT) m from	to	Ultimate Shaft Adhesion f_s kPa
4.0	-8.0	25
-8.0	-11.0	50
-11.0	-19.0	125
-19.0	-30.0	170
from	to	Ultimate Base Resistance f_b kPa
-19.0	-30.0	4140

Based on the extent of the previous geotechnical investigations, the apparent degree of conservatism in the selection of the geotechnical parameters and the likelihood that positive set up of the piles has occurred, a geotechnical reduction factor of Φ_g = 0.7 has been adopted to determine the design geotechnical strength ΦRug.

Figure 3: Extract from Section 3.5 Ref. 5 (Connell Wagner, 2008)

Figure 4: Extract from Ref. 11 (CMW Geosciences, 2021)

3.2 Inferred Geotechnical Properties

On review of the various historical geotechnical investigations, we consider there is sufficient information to derive inferred geotechnical parameters suitable for design. These are:

- Parameters to be used for driven and CFA pile design is shown in Table 2.
- Parameters to be used for sheet pile wall design is shown in Table 3.

However, we note that the size of the project may still warrant further geotechnical investigation for the following purposes:

- Further validate and potentially refine the adopted parameters.
- Provide further assurance and reduce latent condition risk with the ECI Contractor.

As such, the geotechnical parameters proposed should be considered preliminary (suitable for 30% design development) and is to be updated following any further geotechnical investigation results.

Table 2: Geotechnical Model for Static Analysis of CFA or Driven Piles (for existing ground conditions)

TYPICAL DEPTH (mCD) (1)	UNIT	c_u (2) (kPa)	ϕ' (2) (°)	E_u' (2) (MPa)	v_u (2)	f_s (3) (kPa)	f_b (4) (kPa)	P_y (5) (kPa)
Surface to -1.0	Unit 1: Fill (mainly granular)	Neglect for the purposed of pile design						
-1.0 to -3.50	Unit 2: St Kilda Formation (SM)	-	30	8	0.3	10	Not suitable	150 to 400 (7)
-3.50 to -6.0	Unit 3: Pooraka Formation (assume cohesive, CL)	40	-	10	0.5	20		400
-6.0 to -9.0	Unit 4a: Glanville Formation (GP/SP/SC)	-	33	35	0.3	30		800
-9.0 to -12.5	Unit 4b: Glanville Formation (CH/SC)	80	-	20	0.5	40		720
-12.5 to -21.0	Unit 5a: Hindmarsh Clay (CH)	200	-	90	0.4	90 to 100	2400 (6)	1800
Beyond -21.0	Unit 5a: Hindmarsh Clay (CVst)	250	-	100	0.4	125	4140	2000

Notes:

1. Typical depths across the site. Refer to borehole logs for further information.
2. c_u – undrained shear strength, ϕ' – drained internal angle of friction, E_u' – undrained Young's modulus for vertical loading; v_u – undrained Poisson's ratio.
3. f_s – average skin friction.
4. f_b – ultimate end bearing capacity.
5. P_y: limiting ultimate pile-soil pressure for lateral loading.
6. Assumes piles are founded in clay of hard consistency (minimum undrained shear strength of 200 kPa). A higher end bearing resistance may be appropriate where piles are founded deeper than 20 m, subject to further geotechnical investigations.
7. During strong earthquake motion, the lateral resistance of the St Kilda Formation soils would be greatly reduced.

Table 3: Geotechnical Design Parameters for Sheet Pile Wall Design

TYPICAL DEPTH (mCD) (1)	UNIT	γ (2) (kN/m^3)	c_u (2) (kPa)	c'(2) (kPa)	ϕ'(2) (°)	E_h' (2) (MPa)	v' (3)	K_a (3)	K_p (3)	K_0 (3)
Surface to -1.0	Unit 1: Existing Fill (mainly granular) (4)	19.5	0	0	32	10	0.25	0.31	3.2	0.65
-1.0 to -3.50	Unit 2: St Kilda Formation (SM)	16	0	0	30	4	0.35	0.33	3.0	0.5
-3.50 to -6.0	Unit 3: Pooraka Formation (CL) Sandy refers to medium dense sand in BH1 below 8.5 m	17	400 (sandy)	20 (sandy)	28 (33 sandy)	6	0.35	0.36	2.6	0.6
-6.0 to -9.0	Unit 4a: Glanville Formation (GP/SP/SC)	18	0	0	33	25	0.3	0.30	3.4	0.46
-9.0 to -12.5	Unit 4b: Glanville Formation (CH/SC)	19	80	5	28	15	0.35	0.36	2.8	0.75
Beyond -21.0	Unit 5: Hindmarsh Clay (CH)	20.5	200	20	27	60	0.3	0.38	2.7	1.5

Notes:

1. Typical depths across the site. Refer to borehole logs for further information. Depth has been converted to CD as approximate.
2. γ – bulk unit weight; c_u – undrained cohesion; c' – drained cohesion; ϕ' – drained internal angle of friction; E_h' – drained horizontal modulus; v' – drained Poisson's ratio.
3. K_a – coefficient of active lateral earth pressure; K_p – coefficient of passive lateral earth pressure; K_0 – coefficient of lateral earth pressure at rest.

   K_a and K_p assume no wall friction/adhesion and ground surface slope of 0°. No partial strength reduction factors have been applied.

   WGA cannot warrant the engineering performance of the fill. The design parameters presented are based on a pragmatic engineering assessment of the fill materials observed and are expected to be slightly conservative. The fill at depth is expected to be weaker than the fill in the upper 2 m.

3.3 Recommended Further Geotechnical Investigations

WGA recommend that a Geophysical Investigation and minimum of two boreholes are carried out for the project (refer Figure 5). These are further described in the following sections.

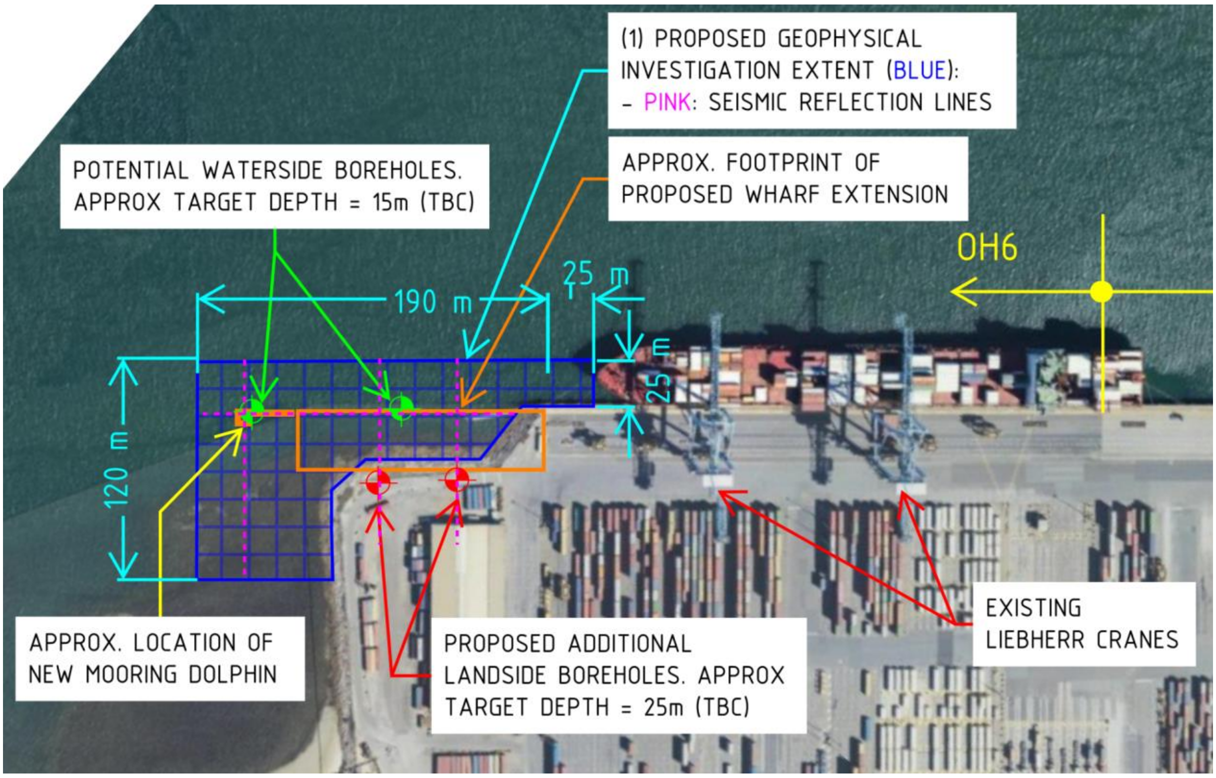


Figure 5: Proposed Additional Geotechnical Investigations

3.3.1 Geophysical Investigation

Proposed scope of Geophysical Investigation works:

- Site investigations inclusive of:
  - Seismic reflection to a minimum depth of 20m below seabed. Extent as shown in the area in blue.
  - Seismic refraction on 4 sections to a minimum depth of 20m below seabed. Two of these are to extend on land to overlap potential borehole locations. Locations as shown in pink.
  - Seabed levels survey over the extent of the geophysical investigation area.
  - Side Scan Sonar/Magnetic Survey to investigate for below seabed obstructions.
- Produce investigations summary report. This is to be interpretive in nature and correlate historical geotechnical information (and the additional landside boreholes) to geophysical investigation results. The report is to provide interpretation of expected conditions observed in the geotechnical investigation based on this, highlighting any caveats/limitations in doing so.
- Provide CAD export of all survey results. Level datum is to be “mCD”.

The key intent of the geophysical investigation is to determine variability of strata conditions throughout the wharf extent. Further to this, the magnetic survey would assess for likely below seabed buried obstructions.

WGA propose we would engage with Marine and Earth Sciences, has previously carried out investigations for the channel widening project. We anticipate a cost of ~$40-50k for this (TBC with Marine and Earth Sciences). Ideally, this would be carried out either prior or during the 70% design progression stage. It is not required to inform the 30% design progression stage.

3.3.2 Geotechnical Boreholes

Two potential options exist for the borehole locations, as shown in Figure 5. Ideally, these would be carried out in the water, along the front of wharf alignment. However, given the anticipated cost of this exercise, alternatively two (deeper) boreholes could be carried out on land just behind the rock revetement. The geophysical investigation could then overlap these boreholes to assist in calibration of the geophysical.

We propose that this could be carried out during the 70% design progression stage upon completion of the ECI Contractors own geotechnical gap assessment. Alternatively, the landside boreholes could be carried out earlier and substituted with in water boreholes at a later date if deemed valuable by the Contractor to further minimize latent geotechnical condition risk.

Should you have any queries or require clarifications regarding the contents of this memo, please don’t hesitate to contact the project team.

Kind Regards

David McKay
Technical Director
WALLBRIDGE GILBERT AZTEC

Appendix P

Construction environmental management plan

Flinders Port Holdings

Construction Environmental Management Plan

Revision	Date	Details	Author	Reviewer	Approver
A	5/12/2024	Document Created	J Manning	EMM Consulting	Josh Smith

This page is intentionally left blank.

Contents

1. Flinders Port Holdings

Flinders Port Holdings is the leading privately-owned port operator in South Australia, handling the vast majority of the state's international imports and exports each year. Originally established in 2001 through the acquisition of 99-year land leases, associated assets and licenses for the operation of Port Adelaide an six regional ports across South Australia. Flinders Port Holdings has grown to offer a wide range of port-related services. These services range from, pilotage, hydrographic survey and marine control services, as well as operation of South Australia's sole container terminal.

1.1 Operational Locations

Throughout these sites of operations there are projects in capital and maintenance nature that are required to ensure the continual safe and effective use of the assets and infrastructure.

Figure 1 – Project Locations

2. Project Program Context

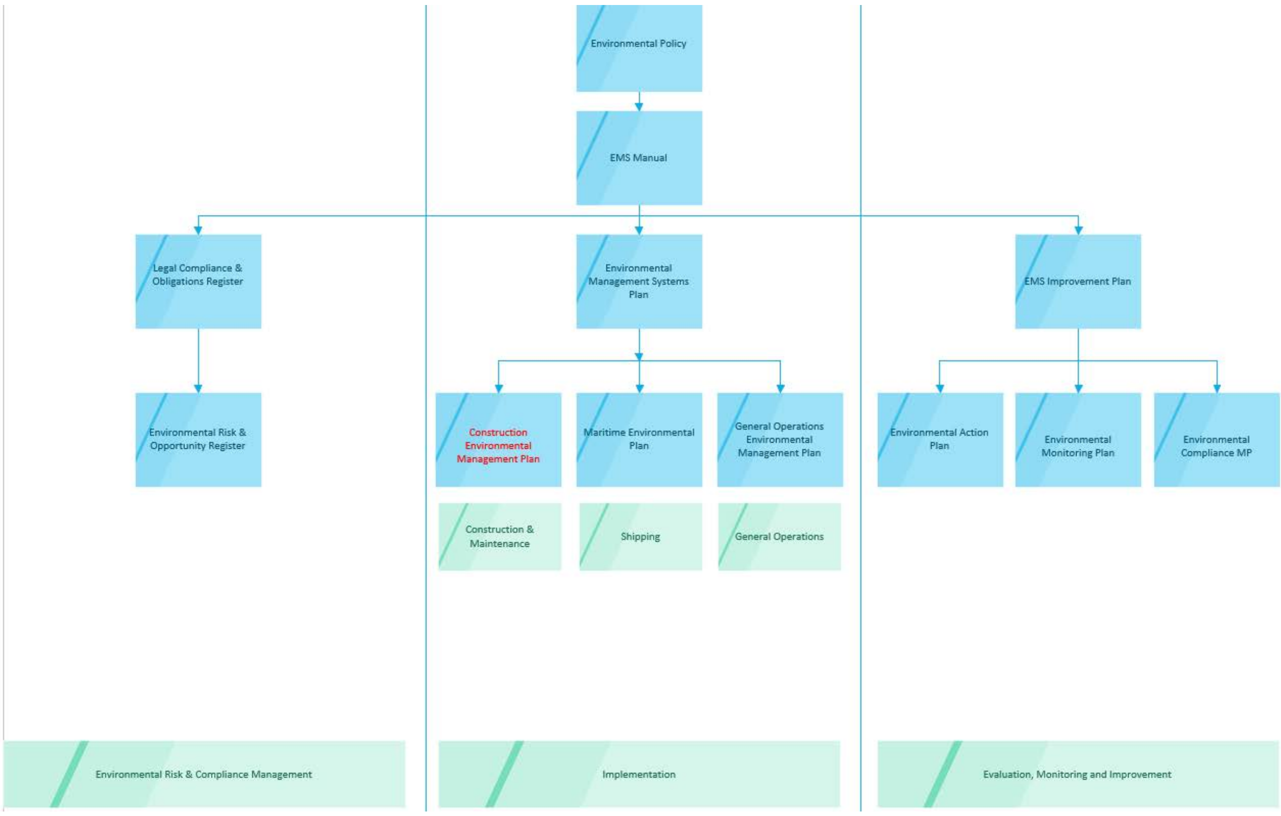
This Construction Environmental Management Plan (now referred to as CEMP hereafter) is a guidance tool for project teams undertaking construction activities to identify their potential impacts and related mitigation measures. As this CEMP covers a broad range of construction activities it is written in an overarching guidance structure. Specific risks of projects will be identified and managed on the project level through the ***Risk Management Procedure.***

To ensure continuity and continual improvement of Flinders Port Holding's infrastructure, assets and equipment an asset management plan and Capital Delivery Plan are required. The asset management plan and capital delivery plan require construction and maintenance activities/projects that may have potential impacts to the environment through a variety of aspects. This CEMP's main purpose is to allow project teams undertaking construction activities to identify and manage environmental aspects and impacts associated with their work scopes. This CEMP has been written in accordance with the EPA SA CEMP guideline and the ISO14001:2016 standard.

3. Interface with System Documents

As depicted in Figure 2 below the ***Construction Environmental Management Plan*** sits under the ***Environmental Management Systems Plan*** as this plan directly relates to managing the environment for construction and maintenance activities.

Figure 2: Construction Environmental Management Plan



3.1 Construction Environmental Management Plan Distribution

There are no limitations to the distribution of the issued for use of the Construction Environmental Management Plan. The plan will be accessible to all relevant stakeholders of the project upon request.

All relevant documents that contain information to sectors of the business will be distributed as required.

3.2 Interested Parties

The contractor understands there are certain interested parties involved with the project and they may have requirements. Table 1 depicts the key interested parties and their relationship to the project.

Table 1: Interested Parties

Key Stakeholder	Relationship
Environmental Protection Authority	Regulator
Coastal Protection Board	Regulator
City of Port Adelaide Enfield	Regulator
Department of Water and Environment	Regulator
Subcontractors	Service Provider
Lease Tenants	Clientele
Customers	Clientele
Local Community	Sensitive Receptors
Flinders Port Holding Employees	FPH business conductors

3.3 Subcontractor and Supplier Management

All subcontractors are expected to undertake their work in accordance with the requirements of this plan. The environmental performance of subcontractors will be monitored and managed appropriately to meet the requirements of this plan.

If a subcontractor is undertaking a scope of work that has an environmentally significant activity required, the subcontractor will be required to evidence a licence or approved plan with the regulator unless otherwise approved by the Project Manager.

4. Roles and Responsibilities

Table 2.0 below depicts the roles and responsibilities of the key individuals undertaking the project.

Table 2: Roles and Responsibilities

Role	Responsibilities
Project Manager	• Ensure the businesses' environmental policies, standards are upheld at all times • Effective implementation and approval of this plan • Adequately resource and nominate key personnel to support the implementation of this plan • Report significant environmental incidents to regulators as per environmental legislative and contractual requirements • Empower the project team to undertake their respective responsibilities identified within this plan • Managing appropriate corrective and preventative actions for all high potential outcome environmental incidents • Monitor environmental performance and make sure that continuous improvement is occurring during the project

Role	Responsibilities
	• Responsible for ensuring continuous improvement is being carried out for environmental performance • Approving all sub management plans of this document • Provide leadership and authorise this plan for how it is used • Incident coordinator/controller for all serious environmental incidents
Superintendent	• Ensuring environmental controls are implemented to mitigate all environmental hazards and risk associated with work scopes • Be aware of all environmental obligations, approvals and conditions the project must comply with • Encourage reporting of environmental hazards, near misses and incidents • Undertake monitoring or inspections to determine if environmental controls are in place and working effectively • Ensure the supervision team are competent in understanding their environmental obligations • Incident coordinator/controller for all serious environmental incidents
Supervisors	• Incident coordinator/controller for all serious environmental incidents • Report all environmental incidents appropriately to Superintendent and senior management • Be aware of all environmental obligations, approvals and conditions the project must comply with • Encourage reporting of environmental hazards, near misses and incidents • Undertake monitoring or inspections to determine if environmental controls are in place and working effectively
HSE Representative	• Authority to stop or cease works if believed material or serious environmental harm is occurring from a construction activity • Report all environmental incidents appropriately to Superintendent and senior management • Provide advice to the project team regarding environmental risks and how they should be managed • Provide environmental awareness training to all roles involved in the project • Collate all environmental data and report on environmental performance to Project Manager • Support project team to achieve environmental objectives • Report internally and externally requirements for the project to all relevant stakeholders • Main contact internally and externally for all environmental matters • Ensure all environmental permits and approvals have been obtained for the works to proceed • Review and update this plan as necessary • Lead the tracking and reporting for environmental objectives of the project • Functional and technical leader for all the project's environmental obligations • Develop, review and implement all procedures and processes for ensuring effective environmental performance of the project • Investigate and report environmental incidents of non-conformance and ensure preventative and corrective actions are carried out

Role	Responsibilities
General Workforce	• Ensure environmental controls that are implemented are adequately maintained • Report all environmental non-conformances to supervision • Actively participate in risk assessing environmental hazards associated with their works and reporting them as required to supervision

5. Stakeholder Engagement

Due to the nature of construction activities there is a potential for nearby residents to be adversely affected. Maintaining open and constructive communications with potentially affected parties can help to reduce conflicts and complaints. Stakeholder engagement with internal and external stakeholders will be conducted as required. A complaints register will be utilised to track the nature of any complaint and how any corrective/preventative actions were required to resolve the complaint.

6. Planning

6.1 Risk and Opportunity Identification

Risk and opportunities will be identified during the tender phase process and documented in a tender risk assessment register. All risks and opportunities that are identified in the tender risk assessment register will be communicated and transferred through to the project HSE risk register which will be continually updated with scopes of works as the project is delivered.

6.2 Managing Environmental Aspects and Impacts

The project risk register is a combined risk register that should capture all risks and opportunities with each scope of work that is to be undertaken for the project. It is a live document that is continually reviewed and updated as work scopes begin, change or require adaptation.

The below listed sections of the CEMP address what the environmental aspects and impacts of the project are as well as how they planned to be managed throughout the duration of the project:

- *Section 8 – Table 4 – Environmental Aspects and Impacts*
- *Section 9 – Table 5 – Environmental Mitigation Measures*

6.3 Environmental Compliance Obligations

6.3.1 Legislation and Approvals

To ensure legal obligations and requirements are met and achieved by the environmental management system the following document ***Compliance & Obligations Register*** is maintained and reviewed on an annual basis.

Environmental legislation that will affect the project are listed below:

- Aboriginal Heritage Act 1988
- Adelaide Dolphin Sanctuary Act 2005
- Environment Protection Act 1993
- Environment Protection Regulations 2009
- Environment Protection (Water Quality) Policy 2015
- Environment Protection (Air Quality) Policy 2016
- Environment Protection (Waste to Resources) Policy 2010

- Environment Protection (Noise) Policy 2007
- Environment Protection (Movement of Controlled Waste) Policy 2014
- Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)
- Heritage Places Act 1993
- Harbors and Navigation Act 1993
- Harbors and Navigation Regulations 2009
- International Maritime Organisation (IMO) Ballast Water Convention
- International Convention for the Prevention of Pollution from Ships (MARPOL)
- Landscape South Australia Act 2019
- Planning, Development and Infrastructure Act 2016
- Protection of Marine Waters (Prevention of Pollution from Ships) Act 1987
- Protection of the Sea (Harmful Anti-fouling Systems) Act 2006 (Commonwealth)
- Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (Commonwealth)
- National Parks and Wildlife Act 1972

6.3.2 Environmental Directives

This Constrution Environmental Management Plan will be used as the foundational environmental directive that the project must comply with as a minimum standard for environmental management practices. All objectives listed in table 3 should be demonstrated and able to be evidenced during a project.

6.3.3 Contractual Environmental Obligations

All contractual environmental obligations that are stipulated in the contract between the client and contractor must be adhered to by the contractor. The obligations of the contract can be reviewed at anytime throughout the project and in the case of potential project scope changes.

7. Environmental Objectives

Table 3 below summarises all environmental aspects and impacts identified and anticipated from the project works and activities.

Table 3: Environmental Aspects and Impacts

Objective	Lead Performance Indicator		Lag Performance Indicator	
	Description	**Target**	**Description**	**Target**
Ensure compliance with all relevant environmental legislation and contractual requirements	Number of major non-conformances raised during internal audit	Zero	No fines, penalties or clean up orders have been incurred	Zero
	Planned environmental inspections are completed	100%	Statutory Notices Received	Zero
Effective data reporting	Monthly report submitted	100%	Client requests monthly report	Zero

8. Environmental Aspects and Impacts

Table 4 below summarises all environmental aspects and impacts identified and anticipated from the project works and activities.

Table 4: Environmental Aspects and Impacts

Aspect	Activity	Event	Impact
Water Quality	• Dredging • Vessel Transport • Chemical Storage • Handling/using hazardous chemicals	• Pollutant Discharge • Sediment Discharge • Radioactivity leachate • Dissolve oxygen reduction • Spills	• Injury/death to aquatic flora and fauna
Air Quality	• Earthworks	• Dust leaving site boundary • Small organic matter leaving site boundary	• Nearby amenity assets impacted • Pest fauna attracted
Noise	• Plant and equipment • General works	• db(A) noise levels exceed regulated thresholds	• Local stakeholders impacted • EPA license conditions breached
Site Contamination	• Earthworks	• Spills • Movement of contaminated soil	• Contamination • Cross/spread contamination
Vibration	• Piling • Pavement works	• Assets/infrastructure become damaged	• Impact to local stakeholders or nearby existing infrastructure
Heritage	• Earthworks	• Damage/disturbance to protected heritage	• Legal Ramifications • Reputational loss for business
Fauna	• Handling/using hazardous chemicals • Vessel Movement • General works	• Spills • Pollutant discharge • Sediment discharge • Vessel strikes fauna • Terrestrial Machine/equipment strikes fauna • Transfer of noxious species	• Injury/death to aquatic fauna • Noxious species causes impact on local fauna and flora/agricultural land
Flora	• Earthworks • Handling/using	• Topsoil becomes contaminated	• Injury/death to aquatic/terrestrial flora

Aspect	Activity	Event	Impact
	hazardous chemicals • Storing of materials	• Flora cleared without approval • Spills • Pollutant discharge • Transfer of noxious species	• Noxious species causes impact on local fauna and flora/agricultural land
Hazardous Substances	• Storage • Handling/using hazardous chemicals	• Spills	• Injury/death to aquatic fauna & flora • Contamination of soil

8.1 Air Quality

Construction activities can negatively affect air quality resulting in impacts upon nearby sensitive stakeholders as well as the construction team themselves. Air quality is most impacted by work activities that generate excessive dust (PM10) and emissions. It is important to undertake mitigation measures and plan works for how to reduce dust and emissions. Dust generation should be limited to prevent excessive emissions leaving the site. All equipment and plant should be adequately repaired and maintained if they are generating excessive emissions.

8.2 Noise

The EPA construction hour time frame restrictions aim to balance the construction industry's needs with residents' enjoyment of their properties. Quiet activities, like painting, are not restricted, but noise levels must remain low. If in doubt, these activities should occur between 7 am and 7 pm, Monday to Saturday.

To assess applications for out-of-hours construction, the EPA requires the following information:

- Construction start and finish dates.
- Daily work hours.
- Contact details of a company representative for any EPA queries.
- Justification for why the work must occur outside standard hours.
- Activity location (address and landmarks, if applicable).
- A noise management plan detailing how noise will be minimised.
- Type of construction work (e.g., demolition, concrete pour).
- Types of noise expected (e.g., power tools, cranes).
- Distance to the nearest potentially affected properties.
- Number of residents potentially impacted.
- A copy of the notification letter to affected residents, including a company contact number.

Under the **Environmental Protection Act**, all reasonable efforts must be made to minimise noise. Contractors should apply recommendations from **AS 2436–2010** to control noise and vibration impacts. Adverse construction noise occurs if:

- Continuous noise exceeds 45 dB(A), or
- Maximum noise exceeds 60 dB(A).

Best practice for managing noise is to have a modelling assessment undertaken based on the proposed construction methodologies has been undertaken by a suitable qualified consultant. The noise modelling assessment will further be validified by in-situ noise monitoring during project construction. Noise monitoring may be deemed required based on stakeholder interest or pressures.

8.3 Vibration

Due to the risk of vibration works from asphalt works and piling, it is worthwhile undertaking due diligence through the means of a dilapidation survey prior and post to work commencing at a site. This pre and post dilapidation survey will provide evidence to demonstrate that no impacts occurred to assets from vibration emission caused from construction activity.

Terrestrial Piling

Terrestrial piling can cause large vibrational emissions which are a hazard to nearby assets, buildings and stakeholders. It is important to have a vibration assessment conducted to understand what structures or stakeholders may be at risk. It is important to determine if monitoring is required based on proximity of assets to provide data that validates the assessment to ensure compliance and due diligence. It is important to note that humans feel vibration much more than a load bearing structure does when considering nearby stakeholder impacts. All vibration measures (PPV & mm/s) should be analysed against the DIN 4150 German standard.

8.4 Site Contamination

Site contamination is an important environmental, health, economic and planning issue and can have implications for landowners and occupiers, developers, relevant authorities, and local communities. Site contamination is often identified during assessment required as part of the development approval processes associated with a subdivision, development or redevelopment of a parcel of land.

Any site contamination issues should be addressed by a suitably qualified and experienced site contamination consultant. For contaminated soil that may be discovered on site during earthworks a ***Contaminated Finds Discovery Protocol*** is referenced in Appendix B.

8.4.1 Soil Testing Requirements

The assessment of site contamination should be undertaken whenever contamination has been identified at a site, or when there is a reasonable suspicion of site contamination arising from a current or previous activity or use of the site.

This provides a 'trigger' to initiate the recommended processes for assessment outlined in Schedule A of the National Environment Protection (Assessment of Site Contamination) Measure (ASC NEPM).

Use of these triggers and following the assessment process should ensure that there is adequate protection of human health and the environment wherever site contamination has occurred.

The EPA only suspects site contamination to exist at the site because potentially contaminating activities (PCAs) have taken place – ie the circumstances at section 103H(1)(b) of the Environment Protection Act 1993 (EP Act) exist.

The following requirements can be summarised in the below key points in table 5.

Table 5: Soil Testing Requirements

Activity	Obligations
Dilapidation purposes (prior or post tenants/stakeholders using the land)	Best business practice requirement /potential commercial obligation
If soil is to move land parcel or be disposed of at a facility	Legislative obligation
If soil appears to be visibly contaminated (discolouration/odour) or is known/suspected to be contaminated (refer to previous EPA excerpt)	Legislative obligation

In the event it is still unclear whether testing of soil is required, it is advised to reach out to the Flinders Port Holdings environmental team for direction.

8.4.2 Soil Classification

Certain waste streams may be suitable for beneficial reuse as fill material, offering potential environmental and economic benefits. For example, waste soil or recovered aggregates can be repurposed for land levelling or construction purposes. However, the use of unsuitable waste materials or filling land in inappropriate locations can pose significant risks to both the environment and human health.

Materials that may be eligible for use as waste-derived fill (WDF) include waste soil, clay, rock, sand, or other natural mineral materials that contain no other waste substances. Clean, crushed concrete, bricks, ceramics, or mineralogically homogeneous industrial residues may also be considered suitable, provided that any chemical substances present do not exceed the concentration limits specified in the **Environment Protection Regulations 2023** for waste fill materials.

Before any soil is transferred between land parcels, a contamination report must be prepared by a qualified professional. This report must assess the soil in accordance with the **EPA Standard for the Production and Use of Waste-Derived Fill** and the **National Environment Protection (Assessment of Site Contamination) Measure 1999**. The report will classify the soil and determine its potential for reuse or disposal, ensuring compliance with relevant environmental and health standards.

8.4.3 Material Tracking

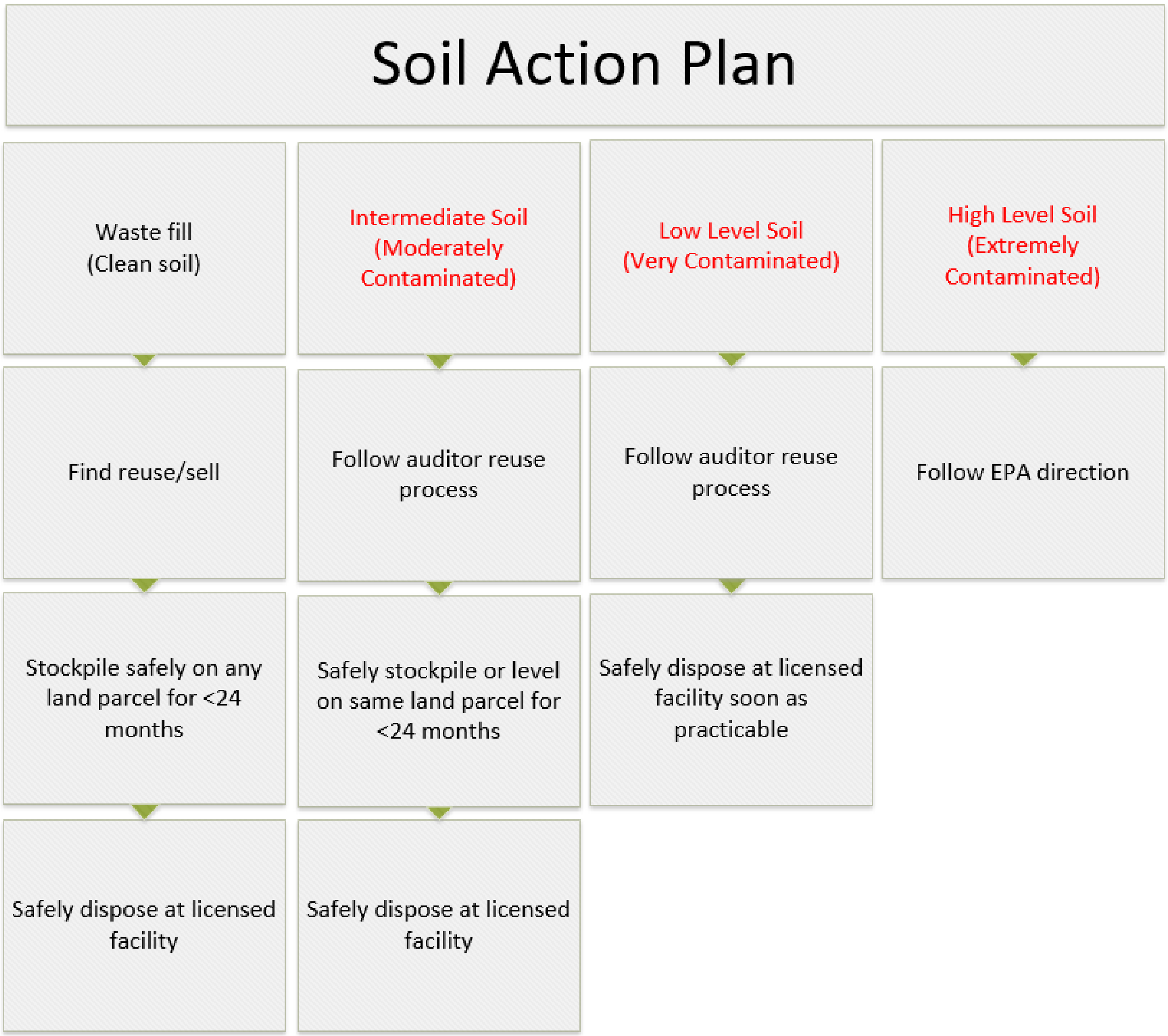
A ***Material Tracking Register*** will be used to ensure all movement of all materials is effectively documented for compliance purposes. The ***Material Tracking Register*** will capture the following information, time, material classification, license plate, driver name, movement between zones, EPA Waste Tracking Certificate, weigh bridge docket numbers, internal or external movement, certificate of titles. The Material Tracking register to capture all material movements that are internal, external and to site (this includes imported ballast, rock, soil). The ***Material Tracking register*** must be in the form of an excel spreadsheet for continuity purposes.

8.4.4 Auditor Process

Clean soil can be used without EPA approval across land parcels. However, contaminated soil requires an auditor process to verify the risk of reuse and subsequent EPA approval. Please further see information for the auditor process in the *Standard for the production and use of Waste Derived Fill* EPA SA 2013 document.

8.4.5 Soil Action Plan

Figure 3: Soil Action Plan



The soil action plan is a tool to help understand what actions can or are required to be undertaken for different classifications of soil to ensure safe movement and disposal of soil generated from construction and maintenance activities.

8.4.6 Stockpile management

Stockpiling soil onsite can present as a hazard if it is not managed correctly. To reduce the risk of contaminated soil running off or dust traversing the site boundary, certain measures can be undertaken. There are many mitigation measures to ensure that stockpiling of material does not pose as a hazard and create risks for environmental impacts. See table 6 Environmental Mitigation measures for a list of controls that can significantly reduce the risk of dust or cross contamination from stockpiling material onsite.

Long term stockpiles require more effort to manage and require more extensive controls than short term/temporary (<24h) stockpiles and should not remain for more than 24 months.

8.4.7 Acid Sulphate Soils

Acid sulphate soils occur when previous sea levels were higher and coastal soil becomes waterlogged and nutrient rich. Once this soil is unearthed and exposed to oxygen a chemical reaction occurs where iron sulphites become iron sulphates. The chemical reaction results in sulphuric acid being released into the environment. If potential acid sulphate soils are identified through contamination testing or visible indicators such as dark colour or odour monitoring of affected water courses must occur regularly. The pH in the watercourse must be monitored to ensure it does not drop below <6.5 pH indicating an acidification event.

If potential/actual acid sulphate soils are discovered during excavations the ***Contaminated Finds Protocol*** referenced in Appendix A should be followed.

8.5 Waste

8.5.1 General waste management

Waste materials that may be generated during demolition and construction include concrete, steel, aluminium, plasterboard, bricks and tiles, plastic and glass. Effective construction planning can minimise the production of waste, and appropriate storage of wastes – particularly suitable source separation of waste materials – can greatly improve recycling rates and potentially lower disposal fees. The waste management hierarchy provides a framework to maximise the useful life of materials when waste cannot be avoided. Waste from construction and building sites should be managed in accordance with the waste management hierarchy. Waste that is produced must be kept on-site and managed to prevent nuisance such as litter, dust and vermin, and to stop leachate from entering stormwater drains.

Figure 4: Waste Hierarchy

8.5.2 Listed Wastes

EPA SA have a list of wastes that are regulated and tracked by the Commonwealth Government. For these wastes to be transported in SA and interstate they must be tracked appropriately through the EPA SA online tracking system. The list of wastes that required to be tracked are listed in Part B (page 17) of the Environmental Protection Act 1993.

Asbestos-containing materials were used extensively in buildings, structures, plant and equipment and may be encountered during demolition activities, along with other hazardous materials. Asbestos-containing materials need to be handled in accordance with the Safework Australia code of practice How to safely remove asbestos (2018) and Safework SA requirements. Other hazardous materials need to be transported and disposed of in accordance with EPA requirements.

Under the *Environment Protection (Waste to Resources) Policy 2010*, hazardous waste is banned from being disposed to landfill in South Australia.

Types of hazardous waste generated at FPH ports that can be readily reused/recycled include:

- sludge from vessels
- tyres
- used oil
- oily rags
- batteries
- aerosol cans
- empty paint cans

All hazardous waste, whether reused/recycled or disposed off-site, must:

- be stored on-site in accordance with SA EPA guidelines
- collected by a licenced waste contractor
- have relevant Consignment Authorisations and Transport Certificates lodged in the EPA Online Waste Tracker.

An ***Asbestos Discovery Protocol*** is referenced in Appendix B.

8.6 Heritage

8.6.1 Aboriginal Heritage

During construction or maintenance activities that include excavation work or any works that break the soil surface, there is the potential for the discovery of Aboriginal sites, objects or remains. All operators are required to comply with the *Aboriginal Heritage Act 1988*, in the event of a discovery of a site, artefacts or remains.

Under section 23 of the *Aboriginal Heritage Act 1988,* it is an offence to damage, disturb or interfere with an Aboriginal site, object or remains without an authorisation from the Minister for Aboriginal Affairs and Reconciliation (The Premier of South Australia).

Refer to Appendix C for the ***Heritage Discovery Stop Works Protocol***.

8.6.2 European Heritage

South Australia's heritage sites help maintain our cultural identity and document the State's development from the initial period of European exploration, through the early development of whaling, mining, agriculture and government infrastructure.

The purpose of the *Heritage Places Act 1993* is to conserve places of heritage value, which include buildings, railways, jetties, bridges, shipwrecks, walls and trees.

According to the *Planning, Development and Infrastructure Act 2016*, any work that will materially impact the heritage value of a State Heritage Place, a local heritage place specified by the Planning and Design Code or a regulated tree, is development and will require development authorisation. Development activities include demolition, removal, conversion, alteration, or painting.

Refer to Appendix C for the ***Heritage Discovery Stop Works Protocol***.

8.7 Water Quality

8.7.1 Surface & Marine Waters

Surface water can cause environmental harm if it becomes contaminated from construction activities with pollutants and sediment. At all times through the construction phase stormwater infrastructure is to be protected to minimise and prevent sediment and pollutant discharge from surface water. When working over or near a marine body all works must avoid discharging pollutants through the means of containment.

When revetment infrastructure or soil near the river is excavated or rock is placed in the river there is a risk of sediment pluming. It is important to reduce the size of the sediment pluming by washing any rock material that is to be placed in the water and have a silt curtain acting as containment for any works that may cause sediment plumes.

8.7.2 Spills

All spills must be reported as soon as practicable to project management. All spills must be treated using the four C's, control, contain, communicate and clean. The process is outlined below:

1. Stop the spill at source by controlling it,
2. contain the spill with the use of spill kit materials,
3. communicate the spill to management and
4. clean up and dispose of the contaminated materials.

It is important to ensure all materials contaminated with hydrocarbons or contaminants are placed into a used spill kit bin for appropriate disposal.

Refuelling/fuel storage

Refuelling and fuel storage present risk of environmental impacts when working near or over a marine ecosystem. It is important that there are appropriate mitigation measures in place to prevent spills or leaks that results in pollutant discharging to the waterbody.

8.7.3 Dredging

Dredging is deemed an environmentally significant activity and therefore a dredging license and associated dredge management plan must be submitted and approved by the regulatory authority (EPA SA). All mitigation measures for dredging activities required for the project are stipulated in the project's dredge management plan.

8.7.4 Dewatering

Dependent on construction methodology dewatering during construction of the wharf may be required. The volume of water to be dewatered will be >100kL which triggers the requirement for an approved dewatering management plan by the EPA. The dewatering plan will address all key mitigation measures to ensure dewatering does not cause environmental impact to the river.

Using the EPA guideline *Environmental management of dewatering during construction activities* the project can determine the type of approval and dewatering plan required for the scope planned.

8.8 Fauna & Flora

8.8.1 Fauna

Fauna can be impacted through unplanned events during construction activities. To help reduce the likelihood of impacting fauna during delivery of the project several preventative measures can be undertaken. All fauna impacts are to be reported to the project management team as soon as practicable so corrective actions can be undertaken. Native fauna or wildlife is defined as animals that are indigenous to Australia. These animals are given protection and formal legal recognition under the *National Parks and Wildlife Act 1972* as Endangered, Vulnerable or Rare. Permits from the Department of Environment and Water (DEW) are required to rescue or manage native animals.

8.8.2 Flora

Native flora or vegetation refers to any naturally occurring local plant species that is indigenous to South

Australia, this includes small ground covers, native grasses, shrubs, trees and water plants such as seaweed. Natural regrowth and dead trees can also be classified as native vegetation in certain cases. In some circumstances, the management of native vegetation is protected by legislation.

The *Native Vegetation Act 1991* and the Native Vegetation Regulations 2017 are the key pieces of legislation related to managing native vegetation on private and public land in South Australia. They promote the conservation, management and regeneration of native vegetation and also seek to ensure personal and public safety.

Before any work commences that involves the pruning, trimming or removal of vegetation on a FPH site, the project team must ensure that any approvals that may be required under the *Native Vegetation Act 1991* are in place.

8.8.3 Biosecurity Requirements

Biosecurity issues can cause severe impacts to native landscapes and agricultural productivity. It is very important that biosecurity hygiene practices are effective and maintain minimal to no risk of transferring invasive and noxious species from the project site.

All declared species must not be disturbed on site. Alternatively, if they must be disturbed rather than must be removed safely to a licenced EPA landfill facility.

8.9 Hazardous Substances

Safe and responsible storage, handling, use and disposal of dangerous goods and hazardous chemicals reduce the risk to human health and safety and the environment.

Dangerous goods are materials that exhibit toxic, corrosive, flammable or other dangerous characteristics and are listed in the Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG Code). The *Dangerous Substances Act 1979* applies to dangerous goods as well as some hazardous chemicals. Hazardous chemicals are regulated in South Australia by the *Work Health and Safety Act 2012.*

When using and storing dangerous goods and hazardous chemicals all reasonable and practicable steps need to be taken to prevent impacts to human health and the environment.

9. Environmental Mitigation Measures

Below demonstrates what environmental mitigation measures should be utilised where reasonable and practicable to manage the identified environmental aspects and associated impacts. Each aspect has nominated responsible person/s who must assess and ensure whether those mitigation measures can be or are implemented effectively and practicably.

Table 6: Environmental Mitigation Measures

Aspect	Activity	Mitigation Measure	Responsible Person
Water Quality	• General works	• Divert surface water away from construction zones and bare soil • Silt socks/choir logs placed at stormwater entry pits • Ballast rock used to reduce sediment transported in drainage lines • Ensure drainage lines are free from sediment and pollutants • Containment through bunding/encapsulation • Stablised haul tracks/exits to reduce drag out • Street sweeper to remove debris from roads and stormwater drainage on regular basis	Superintendent/General Workforce
Water Quality	• Chemical Storage • Handling/using hazardous chemicals • Spills	• Spill drill simulations • Spill kits available for each work front with appropriate spill kit materials • Work crews are familiar with emergency spill response • Use Panolin (biodegradable hydraulic oil) where practicable for working over/adjacent to marine waterbody • All refuelling occurs >10m from watercourse where possible, if not a documented risk assessment must be undertaken • Bunkering and refuelling must be undertaken by appropriately trained personnel • Fuel cans to be bunded • Nozzles and fit for purpose equipment to be used during refuelling	Superintendent/Project Manager

Aspect	Activity	Mitigation Measure	Responsible Person
		• Machinery and plant are to be turned off during refuelling	
Water Quality	• Dredging	• To be undertaken as per the controls identified in the relevant approved dredge management plan	Superintendent/General Workforce
Water Quality	• Dewatering	• Sediment tank/baffle tank • Silt curtain at discharge location • Water quality monitoring as described in Dewatering Management Plan • Water quality assessment against ANZECC thresholds	Superintendent/ HSE Representative
Air Quality	• General Works	• minimising vegetation clearance, clearing in stages, stabilisation of cleared areas by regular light watering or use of matting or coarse material to minimise soil transport by wind • managing soil stockpiles through stabilisation, light watering or the use of covers (including using polymer dust binders/suppressants) • using a water spray when transferring soil or rubble from earthmoving equipment to trucks • controlling the speed of dumping from tip trucks • covering or stabilising materials during transport into and within the construction site • minimising wheel-generated dust by watering roadways • minimise soil disturbance • monitor the weather forecast and reduce high dust risk activities during periods of high wind • cover loads in transit • select equipment for concrete cutting that suppresses the generation of dust via the use of water or extraction	Superintendent/General Workforce

Aspect	Activity	Mitigation Measure	Responsible Person
Air Quality	• Stockpiling	• dampen disturbed/stockpiled soil and other materials (e.g. with the use of sprinklers or water carts) • for any long-term activities (i.e. greater than six months) treat unpaved areas with binders or similar, or pave, if feasible to do so • only stockpile materials if there is no alternative • cover stockpiles with a tarpaulin or similar • Visually monitor dust leaving site boundary	Superintendent/General Workforce
Noise	• General Works	• Using noise sensitive equipment • Positioning noise generating equipment and plant away from nearby sensitive stakeholders • Undertaking noise monitoring to demonstrate compliance or validate noise modelling assessments • Conducting noisiest works during 9am - 3pm • Providing communication about noisy works to key stakeholders • Undertake piling works during daylight hours • Provide early notification of when piling works will occur near sensitive receivers including a time frame of the scope of works • Have a noise modelling assessment undertaken • Undertake noise monitoring to verify and validate noise modelling	Superintendent/HSE Representative
Noise	• Piling	• Impact piling uses a soft start method where the hammer gradually increases in energy over a 15 minute period • An observation (500m) and exclusion zone (250m) are set from piling location and clearly communicated with the crew for known marine megafauna species in that ecosystem • Marine fauna observers are suitably trained observe mega marine	

Aspect	Activity	Mitigation Measure	Responsible Person
		fauna and to document and instruct a stop works instruction if piling is occurring when marine megafauna enters the exclusion zone • Marine fauna observers are to observe 30 minutes prior to start up of piling and ensure no sightings in that time otherwise the 30 minutes must be reset • If a marine mega-fauna enters the observation zone they are to notify the operator and put them on caution to pause if required • If the marine megafauna species enters the exclusion zone the operator to be cease piling and wait 30 minutes or until the animal is seen having left the exclusion zone • Marine megafauna observations must be documented to evidence the process	
Vibration	• Piling	• Dilapidation survey of all nearby assets, structures and equipment • Vibration monitoring when in closest proximity to a sensitive aspect • Vibration modelling undertaken with a risk assessment of the methodology to determine potential impacts	Project Manager/Superintendent
Contamination	• Soil Classification	• general waste produced during construction will be managed in accordance with the waste management hierarchy • the use of WDF will comply with the processes outlined in the Standard for the production and use of waste derived fill – this is confirmed by contamination consultant • Unclassified soil can be disposed offsite as long as it has an EPA Waste Tracking Certificate associated and is taken to a licensed facility as unclassified soil • Soil that is determined as WDF (clean) must not be blended with contaminated material to reduce contamination	Project Manager/Superintendent

Aspect	Activity	Mitigation Measure	Responsible Person
Contamination	• Stockpiling	• Stockpiles heights do not exceed >3m and do not exceed the height of the boundary fence • Stockpiles are kept a minimum of >5m away from a watercourse • Dust suppression is applied through the use of water or binders during dry months • Contaminated stockpiles are not stored on clean soil • Contaminated stockpiles are covered with builder's plastic to prevent run off from rain events • Install a silt fence to prevent run off towards a watercourse or leave site boundary	Superintendent/General Workforce
Contamination	• Excavation (discovery of contaminated soils/potential acid sulphate soils)	• Contaminated Finds Protocol • Excavate the area to the beginning of the PASS layer then excavate the PASS layer at one time for straight disposal • Minimise disturbance as much as practical • Treatment of PASS onsite is to be avoided • PASS treatment onsite must have an EPA SA approved management plan prior • Ongoing pH monitoring of potentially affected watercourses • Visually monitor for red colours in soil and green/blue sheens in waterbody • Hydrated lime is to be used to neutralise and treat an acidification event	Project Manager/Superintendent

Aspect	Activity	Mitigation Measure	Responsible Person
Heritage	• Excavation	• Heritage Discovery Stop Works Protocol • If a potential/suspected object of archaeological significance is uncovered during excavation works, all work that may impact the site or object must stop as soon as practicable and be reported to the client. • FPH will contact an archaeologist who will attend site and determine if the item is an Aboriginal site, remains or object. • Archaeologist will provide direction to FPH for when project works can resume which will be communicated with contractor	Superintendent/HSE Representative
Fauna & Flora (biosecurity)	• General Works	• Materials are to be hygienic prior to arriving to site (i.e sheet piles etc). • When material inspections are undertaken by engineering to determine quality, defects etc on materials from overseas, they also inspect to find any of the following: foreign soil, foreign organic material, foreign living organisms. • Plant/equipment must be free from soil, organic material/living organisms prior to mobilising to site – berthing (initial induction) of plant/equipment is the mechanism to verify this. If a piece of plant is not deemed hygienic it must be removed from site for cleaning prior to remobilising. • Stablised exits (through the use of cattle grids/ballast) and/or washdown bays are to be utilised to prevent transfer of weeds/seeds on the project site – being mindful of buffel grass (declared noxious species) in the area these controls are very important. • Weed/pest management on an ad hoc basis is also advised to maintain lower risk of transfer of invasive seeds off the site • A site induction that communicates requirements around declared	Superintendent

Aspect	Activity	Mitigation Measure	Responsible Person
		species management should be used as a key administrative control for awareness. • Construction sites are be surveyed for declared species prior to works commencing	
Flora	• General Works	• Materials are not to be stored in the dripline of trees • Exclusion zones created by bunting known as Tree Protection Zones (TPZs) are to be in place around all vegetation that is in the project site and not planned for removal • Relevant approvals are to be in place prior to clearance of protected vegetation	Superintendent/General Workforce
Fauna	• General Marine works	• Vessels are to slow down (<5 knots) when in proximity to marine megafauna • Vessels are not to change suddenly in direction when in proximity to marine megafauna	Superintendent/General Workforce
Hazardous Substances	• General Works	• obtain Safety Data Sheets (SDS) for all hazardous chemicals and ensure they are readily accessible to all employees • obtain an updated SDS at least every 5 years • maintain a register of all hazardous chemicals and dangerous goods in the workplace • store hazardous chemicals and dangerous goods in accordance with relevant legislation and Australian Standards • label all containers with the correct ADG and Globally Harmonised System of Classification and Labelling of Chemicals (GHS) symbols and warnings • train all relevant employees in the safe and environmentally responsible handling of hazardous chemicals	HSE Representative/General Workforce

Aspect	Activity	Mitigation Measure	Responsible Person
		• maintain adequate spill equipment and consumables to contain minor land-based spills (where safe to do so).	

10. Incident Management, Reporting and Investigation

All incident management, reporting and investigation must be undertaken in accordance with ***the Incident Management and Investigation Procedure.***

10.1 Emergency Preparedness and Response

The business has processes in place to respond to different types and levels of environmental incidents, as documented in the following:

- ***Emergency Management Plan***
- ***Site Emergency Response Plans***
- ***Incident Management and Investigation Procedure***

These plans and procedures can facilitate the necessary actions required in response to an emergency of different varieties such as, security breaches, health and safety or environmental.

10.2 Management of Change

Management of change will be managed in accordance with the ***Business/Process Change Management Corporate Policy***.

11. Training

A site induction that includes content relevant to environmental management and the requirements of this CEMP will be created and undertaken by all employees participating in the project.

Specific environmental mitigation measures will be highlighted and discussed with project team through the means of, daily coordination meetings, toolboxes and ad hoc advise as the project progresses.

All training requirements and needs will be captured in the project specific **Training Needs Analysis Matrix (TNA Matrix)**. The TNA matrix will be used to evidence and track what individuals in the project require specific training based on their roles.

11.1 Environmental Awareness Training

Environmental awareness training will be undertaken through a multitude of methods. Please see table 7 below which describes what these methods are and how they will be delivered during the project.

Table 7: Environmental Awareness Training

Training Platform	Description
Project Induction	A mandatory presentation is provided by the project team for all individuals involved with the project. The project induction will communicate environmental awareness around hazard identification, obligations and reporting non-conformances.
Pre-starts	Each day a pre-start meeting is held to brief the team about what scope of work is to be completed and what environmental or safety hazards may need to be managed.
Toolboxes	Scheduled toolboxes will be presented by the project team that focus on key hazards and risks regarding the current phase of construction. An environmental section will be included that raises awareness of topical environmental hazards.

Training Platform	Description
	Information will be provided about upcoming environmentally sensitive scopes and how the project intends to manage any associated risks.

12. Reporting

A monthly report will be provided to the client which provides insight into environmental compliance data and a description of any non-conformances that may have occurred. External reporting of events and environmental data will be reported as required to relevant organisations and stakeholders.

12.1 Internal and External Issues

Table 8: Internal and External Issues

Factor	Risk	Outcome	Control Measure	Monitoring and Review
Resourcing	Lack of Competency of personnel involved with EMS implementation	Environmental performance reduces and incidents are more frequent and severe in nature	Define skill and competency of personnel prior to employment	Internal audits
Resourcing	Insufficient personnel to undertake required workload	Environmental performance reduces and incidents are more frequent and severe in nature	Determine relevant number of personnel for workload	Internal audits
Operating	CEMP not being followed	Statutory notice received, penalties and fines	Monitor and evaluate environmental performance data	Non-conformance reports, environmental inspections, environmental monitoring data
Leadership	Delegation of authority of EMS to Project Manager	environmental performance declines	Senior management ensure effectiveness of leaders is relevant with EMS requirements	External Audits

13. Continuous Improvement

13.1 Non-Conformity and Corrective Action

Corrective actions as well as preventative actions may be identified and recognized through the means of, environmental inspections, audits, incidents, management reviews and internal/external justified complaints. Corrective/preventative actions are logged, tracked, managed and closed out through the online compliance database. The online compliance database is the primary function for addressing and evidencing non-conformities and corrective actions occurring within the business.

At any stage if there are changes for improvement through this function from an environmental non-conformity the system will be updated and incorporated to reflect it. This document and other documents in the environmental management system framework will be updated to reflect any changes in practice for managing corrective/preventative actions and non-conformities.

13.2 Environmental Incident Alerts

In the scenario where a serious environmental incident has occurred or nearly occurred, an environmental incident alert will be issued to sites and business units to promote awareness of the risk and control measures to mitigate further occurrences.

13.3 Continual Improvement

The core functions of continuous improvement of the CEMP is conducted through the means of the ***Management System Auditing Procedure***. Within these processes it allows for strengths, weaknesses and most importantly opportunities for improvement to be identified and actioned for close out.

Appendix A

Contaminated Finds Protocol

1. **Initial Indicators of Contaminated Soil**

- Be alert to signs of contamination, which may include unusual odours (e.g., chemical, petroleum, or rotten) or discolouration of the soil (e.g., blackened, oily, or greenish hues).
- Any soil exhibiting these characteristics should be treated as potentially contaminated and handled accordingly.

2. **Immediate Action Upon Discovery**
    - Stop work immediately in the affected area.
    - Mark or cordon off the contaminated area to prevent further disturbance.
    - Alert the site supervisor and relevant personnel.
3. **Safety Considerations**
    - Move workers and personnel to a safe distance from the contaminated area.
    - Ensure personal protective equipment (PPE) is worn by all personnel in the vicinity of the contamination.
    - Assess and isolate any potential hazards (e.g., chemical fumes, water contamination).
4. **Reporting the Discovery**
    - Document the discovery, including the location, appearance, and suspected type of contamination.
    - Report the find to Flinders Port Holdings Environmental Governance Team.
5. **Expert Assessment**
    - Carry out appropriate testing (e.g., soil sampling) to confirm the type and extent of contamination.
6. **Containment and Safety Measures**
    - Implement containment measures to prevent the spread of contamination (e.g., temporary barriers or excavation limits).
    - Ensure proper disposal procedures are in place for any contaminated soil or materials.
7. **Further Actions**
    - Ensure the site remains secure and monitored until the contamination is fully assessed and managed.
    - Adjust the excavation or construction plan to avoid further disturbance of the contaminated area.
    - Continue with remediation or decontamination procedures as advised specialist consultant.

Appendix B

Asbestos Finds Protocol

1. **Initial Indicators of Asbestos Materials**
    - Be vigilant for materials that may contain asbestos, such as **insulation materials** (fibrous, grey or white), **roofing tiles**, **floor tiles**, **pipe lagging**, **textured ceilings**, and **brake linings**.
    - Asbestos-containing materials (ACMs) may appear **cracked, crumbling, or deteriorated**, or exhibit **fibres or dust** becoming airborne. If you suspect asbestos, treat the material as such and follow the protocol.
2. **Immediate Action Upon Discovery**
    - **Stop work immediately** in the affected area to prevent further disturbance.
    - **Do not pick up or interact with the suspected asbestos material.**
    - **Cordon off** or clearly mark the area to restrict access and minimise the risk of asbestos exposure.
    - **Alert the site supervisor** and relevant personnel, including health and safety officers and site managers as soon as practicable.
3. **Safety Considerations**
    - **Evacuate all personnel** from the immediate area of the suspected asbestos material.
    - **Avoid disturbing the material**. Do not cut, drill, or break the material, as this could release harmful asbestos fibres into the air.
    - Ensure **air monitoring** is conducted and implement **adequate ventilation** to minimise exposure.
4. **Assessment and Expert Consultation**
    - **Contact a licensed asbestos assessor** or a qualified asbestos removal professional to evaluate the material.
    - Arrange for **air monitoring** or **laboratory analysis** by a separate 3rd party assessor(e.g., polarised light microscopy) to confirm the presence and type of asbestos.
    - The assessor will provide guidance on whether the material can be safely managed in situ or needs to be removed.
5. **Containment and Safety Measures**
    - Implement appropriate **containment procedures** to prevent asbestos fibres from escaping, such as using **plastic sheeting** to seal off the area or painting the item.
    - If removal is required, ensure that only **licensed asbestos removalists** (Class A or B) carry out the work, following all procedures outlined in the **SafeWork Australia Asbestos Guidelines**.
    - Follow **SafeWorkSA guidelines** for the proper handling, removal, and disposal of asbestos-containing materials, including the use of **sealed containers** for transport and disposal.
6. **Further Actions**
    - **Secure the site** and prevent unauthorised access until the asbestos material is safely assessed and managed.
    - **Adjust the construction or excavation plan** to avoid further disturbance of any potential asbestos material, minimising risk to workers and the public.
    - Continue with **asbestos remediation and removal** in accordance with SafeWorkSA regulations and expert guidance, ensuring that all safety and environmental procedures are followed throughout the process.
    - Display and communicate asbestos air quality sampling and testing results to the wider project team.

Appendix C

Heritage Discovery Protocol

1. **Immediate Action Upon Discovery**
    - Stop work immediately in the affected area.
    - Mark or cordon off the find to prevent further disturbance.
    - Alert the site supervisor and HSE representative.
2. **Safety Considerations**
    - Move workers to a safe distance.
    - Secure the site to prevent unauthorised access.
    - Assess any potential hazards in the area (e.g., unstable ground, unwanted access).
3. **Reporting the Find**
    - Report the find to Flinders Port Holdings Environmental Governance Team.
    - Document the discovery, including location and type of find with photographs.
    - Report the find to the project manager and subsequently the client as soon as practicable.
4. **Preserving the Find**
    - Avoid further excavation or disturbance without expert advice.
    - If removal is necessary, do so with care and legal guidance.
5. **Compliance and Legal Requirements**
    - Ensure all actions comply with local heritage protection laws.
    - Obtain necessary approval from project management before resuming work.
6. **Further Actions**
    - Adjust construction plans if required to protect the find.

Australia

SYDNEY
Ground floor 20 Chandos Street
St Leonards NSW 2065
T 02 9493 9500

NEWCASTLE
Level 3 175 Scott Street
Newcastle NSW 2300
T 02 4907 4800

BRISBANE
Level 1 87 Wickham Terrace
Spring Hill QLD 4000
T 07 3648 1200

CANBERRA
Suite 2.04 Level 2
15 London Circuit
Canberra City ACT 2601

ADELAIDE
Level 4 74 Pirie Street
Adelaide SA 5000
T 08 8232 2253

MELBOURNE
Suite 9.01 Level 9
454 Collins Street
Melbourne VIC 3000
T 03 9993 1900

PERTH
Suite 3.03
111 St Georges Terrace
Perth WA 6000
T 08 6430 4800

Canada

TORONTO
2345 Yonge Street Suite 300
Toronto ON M4P 2E5
T 647 467 1605

VANCOUVER
422 Richards Street Unit 170
Vancouver BC V6B 2Z4
T 604 999 8297

CALGARY
606 4th Street SW 11 Floor
Calgary Alberta T2P 1T1

linkedin.com/company/emm-consulting-pty-limited

emmconsulting.com.au

creating opportunities

www.emmconsulting.com.au