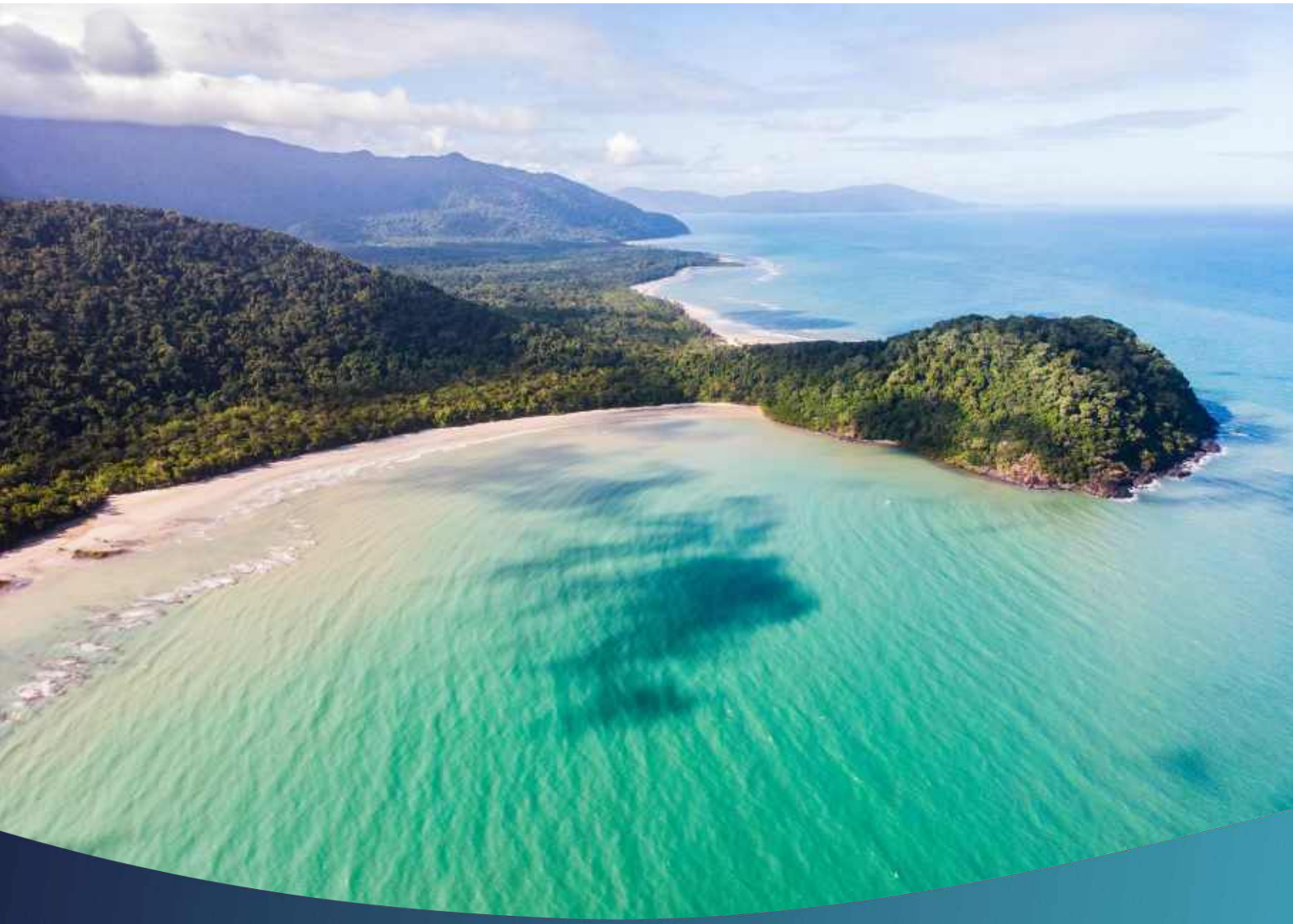
Ashburton Infrastructure Project

Marine Operations Environmental Management and Monitoring Plan



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Version Register

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Rev A	Draft	[redacted]			
Rev B	Draft			Internal review comments incorporated into updated Revision	
Rev C	Draft			Client review comments incorporated into updated Revision	
Rev 0	Final			Peer review comments incorporated	[redacted]
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Rev 2	Final			Client review comments incorporated	
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Rev 4	Final			DCCEEW comments incorporated to support draft PER	

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Rev 5	Final	[redacted]		DCCEEW comments incorporated to support final PER	
Rev 6	Final			DCCEEW comments incorporated to support final PER	
Rev 7	Final			Final to address MEB comments	
Rev 8	Final			Amendment to facilitate loading of OGVs at all five anchorage locations.	[redacted] 15/05/2024

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Summary

Mineral Resources Limited (MinRes) has gained approval to construct and operate the proposed Ashburton Infrastructure Project (AIP) that encompass' both landside and marine facilities to facilitate the export of iron ore from the Port of Ashburton. The AIP Development Envelope (DE) comprises four separate DEs, the Haul Road DE and three port marine DEs (Landside DE, Nearshore DE and Offshore DE). Export facilities within the Port include a dedicated nearshore berth facility and the offshore anchorages. The AIP will initially support the export of approximately 30 million tonnes per annum (Mtpa) of iron ore through the Port over a 10-year period as a Direct Shipping Ore (DSO). Future plans (pending approvals) are for the AIP to support export of up to 40 Mtpa over a 30-year period.

This document provides the framework to manage marine environmental risks associated with routine operational activities associated with the Ashburton Infrastructure Project.

Summary of Project Details

Title of Project	Ashburton Hub – Ashburton Infrastructure Project	
Short Description	Mineral Resources Limited has gained approvals to construct and operate the proposed Ashburton Infrastructure Project under EPBC: 2021/9064 and Ministerial Statement (MS) 1203hich is located within the Port of Ashburton, Western Australia (WA), to facilitate the export of iron ore.	
Proponent Name	Onslow Infraco Pty Ltd (ACN 612 668 201, herein MinRes), a wholly owned subsidiary of Mineral Resources Limited (ACN 118 549 910),	
EPBC Assessment No.	EPBC 2021-9064	
Ministerial Statement No.	MS 1204	
Scope and Purpose of this Plan	This Marine Operational Environmental Management and Monitoring Plan (MOEMMP) has been prepared to detail how environmental impacts will be managed by MinRes during routine operations of the marine components of the Ashburton Infrastructure Project. The MOEMMP provides the overall environmental management framework and specific management measures to address relevant environmental factors and impacts to Matters of National Environmental Significance (MNES) identified by the WA Environmental Protection Authority (EPA) and Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) through the initial environmental assessment stage, for the marine operational phase of the Project. The MOEMMP provides the overall environmental management framework and specific management measures to address relevant environmental factors and mitigate potential impacts from routine operational activities. MinRes is required to comply with this MOEMMP which demonstrates how MRL will address environmental management for risks relating to marine environmental quality during the operational phase of the Project.	
Key environmental factors considered in this Plan	*Marine Environmental Quality*	*To maintain the quality of water, sediment and biota so that environmental values are protected*
	Marine Fauna	*To protect marine fauna so that biological diversity and ecological integrity are maintained*
	Benthic Communities and Habitats	*To protect benthic communities and habitats so that biological diversity and ecological integrity are maintained*
MNES	• Listed threatened species and communities (sections 18 & 18A); and • Listed migratory species (sections 20 & 20A).	
EPA Environmental Quality Objectives	• EQO1: Maintenance of ecosystem integrity. EQO1 is split into four sub-objectives, being: Maximum, High, Moderate and Low LEPs	

Title of Project	Ashburton Hub – Ashburton Infrastructure Project
	• EQO2: Seafood (caught) is of a quality safe for human consumption. • EQO3: Water quality is suitable for aquaculture purposes. • EQO4: Water quality is safe for primary contact recreation (e.g., swimming and diving). • EQO5: Water quality is safe for secondary contact recreation (e.g., fishing and boating). • EQO6: Aesthetic values of the marine environment are protected. • EQO7: Cultural and spiritual values of the marine environment are protected. • EQO8: Water quality is suitable for industrial supply purposes.
Key Provisions in the Plan	Key provisions include: • Identification of Environmental Values and Environmental Quality Objectives relevant to the AIP; • Spatially define the levels of ecological protection relevant to the Project area; • Identify Environmental Quality Indicators for each Environmental Objective and assign Establish Environmental Quality Criteria to provide measurable levels of acceptable change; • Establish protocols and procedures for the monitoring, management and reporting to assess ensure Environmental Quality Objectives are met and Environmental Values are protected including: o Commissioning and validation of brine discharge modelling and predicted impacts o Ongoing monitoring and management of brine discharge and cargo handling operations

Acronyms and Abbreviations

Acronyms/Abbreviation	Description
ACN	Australian Company Number
ACW	Ashburton Cargo Warf
AFC	Antifoulant Coating
AIP	Ashburton Infrastructure Project
ANSIA	Ashburton North Strategic Industrial Area
ANZG	Australian and New Zealand Guidelines
APHA	The Animal and Plant Health Agency
ASTM	The American Society for Testing and Materials
BCH	Benthic Communities and Habitat
BCH	Benthic Community and Habitat
CEO	Chief Executive Officer
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DE	Development Envelope
DEC	Department of Environmental Conservation
DO	Dissolved Oxygen
DSO	Direct Shipping Ore
DWER	Department of Water and Environmental Regulation
EPA	Environmental Protection Authority
EPBC	Environmental Protection Biodiversity Conservation
EQC	Environmental Quality Criteria
EQI	Environmental Quality Indicator
EQMF	Environmental Quality Management Framework
EQO	Environmental Quality Objective
ESA	Ecotox Services Australia
ESD	Environmental Scoping Document
EV	Environmental Value
HEPA	High Ecological Protection Area
IMO	International Maritime Organisation
ISO	International Organization for Standardization
LAT	Lowest Astronomical Tide
LEP	Level of Ecological Protection
LEPA	Low Ecological Protection Area
LOR	Limit of Reporting

Acronyms/Abbreviation	Description
MEPA	Moderate Ecological Protection Area
MEQ	Marine Environmental Quality
MEQP	Marine Environmental Quality Plan
MFO	Marine Fauna Observer Dedicated MFO: A suitably trained and dedicated person engaged undertake marine fauna observations and mitigation measures associated with construction pile-driving. The person will have demonstrated knowledge and experience in marine fauna species observation, distance estimation and reporting. They will not have any other duties while engaging in visual observations. Trained MFO: A crew member trained in marine fauna species observations and mitigation measures, consistent with Project environment management plans. The trained MFO will be on duty on Project vessels during construction and operations and may have other vessel duties.
MGA	Map Grid of Australia
MOEMMP	Marine Operational Environmental Management & Monitoring Plan
MinRes	Mineral Resources Limited
MS	Ministerial Statement
Mtpa	Million tonnes per annum
NATA	National Association of Testing Authorities
NWQMS	National Water Quality Management Strategy
OGV	Ocean-Going Vessel
Port	Port of Ashburton
PPA	Pilbara Ports Authority
PQL	Practical Quantitation Limits
QAQC	Quality Assurance & Quality Control
RO	Reverse Osmosis
SDP	Seawater Desalination Plant
SOP	Standard Operating Procedure
SPL	Species Protection Level
SWQMS	State Water Quality Management Strategy
SWRO	Sea Water Reverse Osmosis
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TRH	Total Recoverable Hydrocarbons

Acronyms/Abbreviation	Description
TSVs	Transshipping Vessels
USEPA	United States Environmental Protection Authority
WA	Western Australia
WET	Whole Effluent Toxicity
XEPA	Maximum Ecological Protection Area

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1. Introduction

Onslow Infraco Pty Ltd (ACN 612 668 201, herein MinRes) a wholly owned subsidiary of Mineral Resources Limited (ACN 118 549 910) is undertaking planning for iron ore mining and export developments in the West Pilbara region of Western Australia (WA) (**Figure 1**). The Ashburton Infrastructure Project (AIP, the Project) will support and facilitate export of stranded iron ore product from the West Pilbara region of WA.

The Project has been assessed and approved under the WA *Environmental Protection Act 1986* (EP Act) including Minor or preliminary work under s. 41A(3) for marine construction (dredging and piling) approved 31 October 2022 and overall Project implementation under Ministerial Statement (MS) 1204) on 3 July 2023. the Project was also assessed and approved under the *Environmental Protection, Biodiversity and Conservation 1999* (EPBC Act) EPBC 2021/9064 on 12 December and a Sea Dumping Permit (SD2022-4018) was issued under the hat was approved for implementation by DCCEEW on 22 November 2022 under the *Environment Protection (Sea Dumping) Act 1981* (Sea Dumping Act) o

1.1. Proposal Description

As part of an overarching business and operational strategy, MinRes is undertaking planning to unlock stranded mineral assets in the West Pilbara region. The AIP will support MinRes's approved mine, the Buckland Project (herein referred to as Bungaroo South), (Ministerial Statement [MS] 906 and MS1147), other future iron ore deposits at Kumina and facilitate export opportunities for third party stranded iron ore from the West Pilbara.

The AIP includes a fully sealed private haul road, commencing at the boundary of the approved Bungaroo South haul road and will continue approximately 150 km west to the Port of Ashburton (Port), where landside and marine facilities are proposed to be developed to export iron ore. The AIP Development Envelope (DE) comprises four separate DEs, the Haul Road DE and three port marine DEs (Landside DE, Nearshore DE and Offshore DE (**Figure 2**).

Export facilities within the Port include a dedicated nearshore berth facility along with offshore anchorages. The AIP will initially support the export of approximately 30 million tonnes per annum of (Mtpa) of iron ore through the Port over a 10-year period as a Direct Shipping Ore (DSO). Future plans (pending approvals) are for the AIP to support export of up to 40 Mtpa over a 30-year period.

The Port was established by Chevron for the Wheatstone Liquified Natural Gas Project (Wheatstone) and is located within the Ashburton North Strategic Industrial Area (ANSIA) and is managed by the Pilbara Ports Authority (PPA).

In 2020, a change in the nominated proponent from Chevron to PPA was approved for the shipping channel, Ashburton Cargo Warf (ACW), and access road at the Port. Through consultation with PPA, MinRes understands that a Section 45C application under the EP Act is required to amend MS1131 to allow for the development of the AIP. MinRes are planning on entering a commercial arrangement with PPA (via the submission of Development and Construction Applications), whereby, MinRes enter into a lease agreement with PPA, allowing the AIP to be developed and for MinRes to carry out activities on PPA vested lands, seabed or water areas.

The AIP will utilise proposed and existing marine facilities to load ore onto Transhipping Vessels (TSVs) that will travel along the existing PPA's dredged shipping channel, out to deep water (up to 40 m depth), to five dedicated anchorage points approx. 10 km west from Thevenard Island (**Figure 2**). Iron ore will be loaded from TSVs onto Capesize, Ocean Going Vessels (OGVs) at the five anchorage points at any one time. Five anchorage points have been included within the AIP to allow for operational flexibility to factor in for adverse weathers conditions, operational issues, maintenance requirements and ship scheduling.

In relation to the Port, the location of the jetty and associated components within the Landside and Nearshore DEs are situated away from mangroves adjacent to existing port infrastructure. The design of the piled jetty structures also minimises impacts on longshore current patterns.

MinRes undertook a dredging program to support the construction and development of the AIP in 2023 where, Department of Transport's existing Spoil Ground C adjacent to the Port was used for the placement of dredge material. Utilising an existing offshore disposal location for the dredged material, instead of developing new disposal areas either offshore or onshore, was considered to present a better overall outcome, due to the avoidance of new disturbance to the seabed or native vegetation. Detailed investigation into onshore disposal was not recommended nor undertaken due to the known nature of potential spoil material from the AIP being unsuitable composition for onshore disposal.

The final location of the five anchorage points within the Offshore DE were selected to avoid benthic habitat, which was mapped within the anchorage investigation area as being limited to the 30 m depth contour, with the seabed beyond this depth being predominantly bare sand (O2 Marine 2021a).

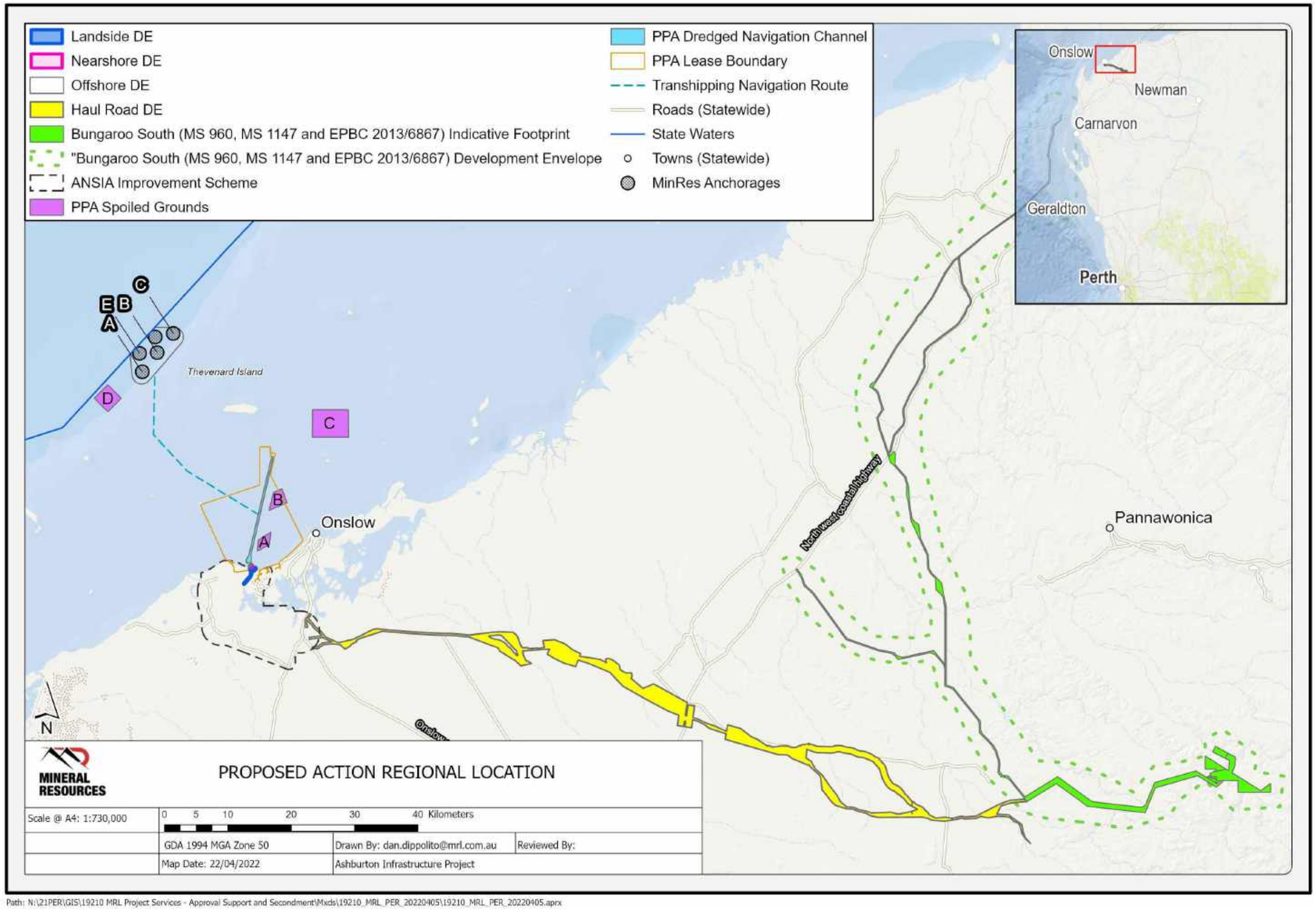

Figure 1 AIP regional setting

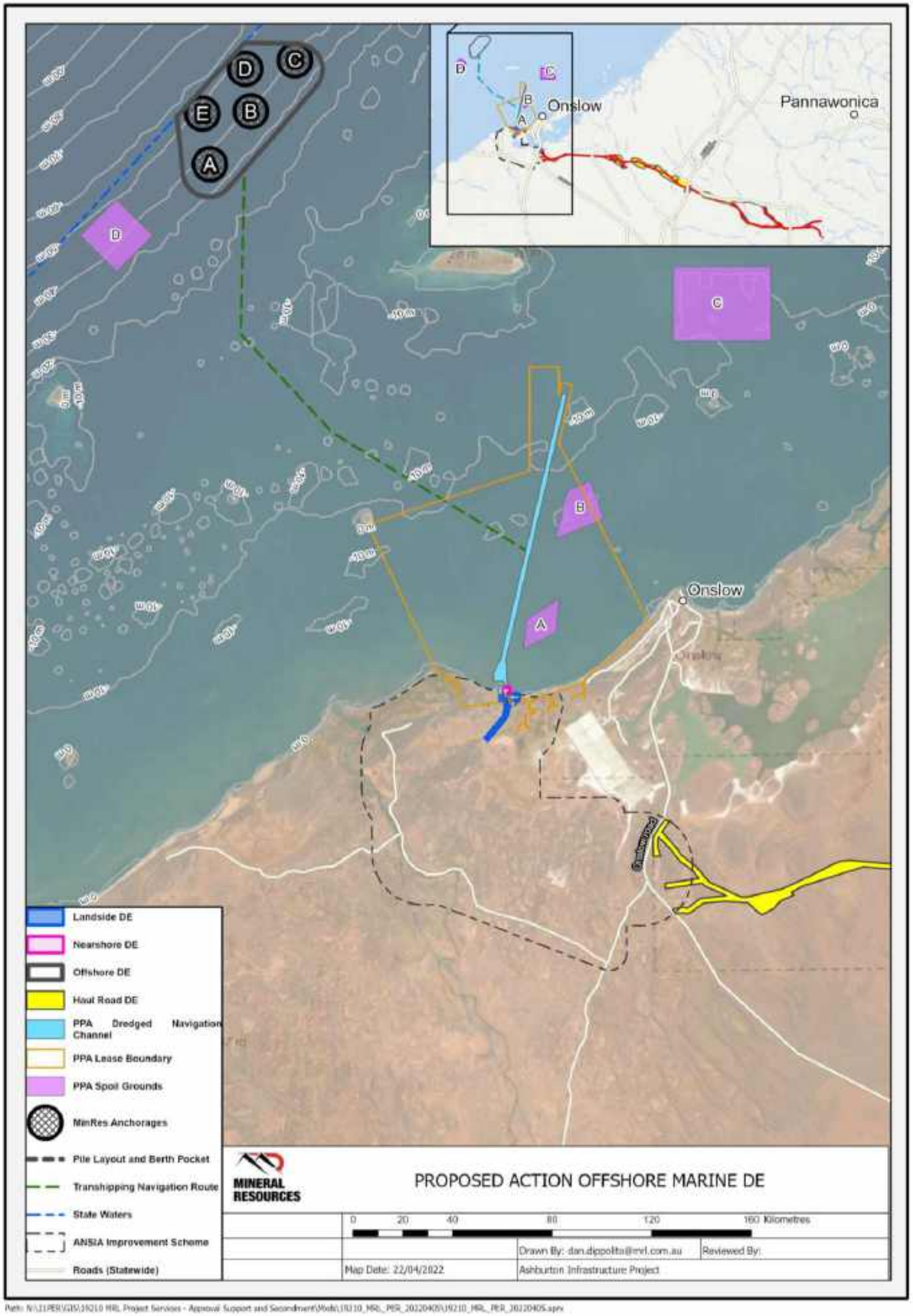

Figure 2 AIP location of major marine facilities and development envelopes

1.2. Purpose of the Plan

The purpose of this Marine Operations Environmental Management and Monitoring Plan (MOEMMP; the Plan) is to establish a framework to ensure that the implementation of the Project does not compromise the Environmental Factors, Values (EVs) and the associated Quality Objectives (EQOs) of the Project Area.

The MOEMMP provides the overall environmental management framework and specific management measures to address relevant environmental factors and impacts to Matters of National Environmental Significance (MNES) identified by the WA Environmental Protection Authority (EPA) and Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) through the initial environmental assessment stage, for the marine operational phase of the Project.

The MOEMMP sets out a process for monitoring and reporting to allow residual impacts to be assessed against acceptable limits of ecological change during the lifecycle of the project. Where results outside the limits of acceptable change are reported, a pre-determined, risk-based response is triggered to ensure the EVs and EQOs are not compromised.

Specifically, the objectives of this MOEMMP are to:

- Present the EVs and clearly define EQOs relevant to the Project area;
- Spatially define levels of ecological protection relevant to the Project area;
- Establish Environmental Quality Criteria to provide measurable levels of acceptable change to Environmental Quality Indicators for each EV (see Section 3.2 for definitions); and
- Establish protocols and procedures for the monitoring, management and reporting to assess ensure EQOs are met and EVs are protected.

This MOEMMP also outlines the management actions, management targets, monitoring and contingency actions designed to meet the environmental objectives for environmental factors and relevant MNES (Listed threatened species and communities (Sections 18 & 18A) and Listed migratory species (Sections 20 & 20A) identified for the Project.

1.3. Scope of the Plan

The scope of the MOEMMP applies to AIP discharge of brine and marine operations that have the potential to impact on:

1. The environmental quality in the marine environment of the Project
2. Marine fauna existing within the Projects operational boundaries.

The MOEMMP applies to the following operational activities of the AIP:

1. Brine wastewater discharge, including the commissioning process; and
2. Cargo handling operations at the nearshore berth facility and offshore anchorage.

Project activities associated with offshore and onshore constructions are managed through their respective, dedicated construction environmental management plans. Offshore construction management plans include the Dredge Spoil and Disposal Management Plan (DSDMP) and the Marine

Construction Environmental Management Plan (MCEMP). Impacts from these construction activities to Marine Environmental Quality (MEQ) are covered by management and monitoring programs, specific to these activities and are not covered further within the scope of the present Plan.

The MOEMMP is relevant to management, monitoring, assessment and reporting protocols required during each of the operational phase of the Project. The MOEMMP considers EPA's Instructions on how to prepare *Environmental Protection Act 1986* Part IV Environmental Management Plans and details the specific process for continual revision and improvement of the Plan any time the Project progresses, or at any time key processes alter and new risks are identified.

This MOEMMP will be a key tool for compliance with environmental approvals obtained under the WA EP and Commonwealth EPBC Acts. It outlines the management actions, management targets, monitoring and contingency actions designed to meet the environmental objectives for environmental factors and relevant MNES (Listed threatened species and communities (Sections 18 & 18A) and Listed migratory species (Sections 20 & 20A)) identified for the Project.

Shipping and pilotage activities as well as management of waste are to be managed in accordance with existing PPA protocols under the PPA handbook (2020) therefore further procedures are not covered within the scope of this Plan.

Impacts of light pollution on marine fauna are excluded from this management scope as this issue is addressed by Pendoley (2021). Lastly, the recreational code of conduct is out of scope for this plan and has been addressed by the Proponent.

1.4. Key Environmental Factors and MNES

The AIP operations include the release of brine wastewater and Port operations (including cargo loading and unloading) which, if unmanaged have the potential to impact the quality of the marine environment (**Section 3**). The brine discharge will release wastewater with higher salinity and altered temperature, and dissolved oxygen, compared to the receiving environment. Cargo handling and general shipping activities present the potential for product and hydrocarbon spillages into the marine environment.

The key Environmental Factors, Values (EVs) and the associated Quality Objectives (EQOs) (as defined in EPA 2018, and further discussed below, that are relevant to aforementioned project activities are summarised in **Table 1**.

Table 1 Key environmental factors, values, and objectives, relevant to the Ashburton Infrastructure Project

EPA Theme	EPA Factor	Environmental Values	Environmental Quality Objective	Pathway
Sea	Marine environmental quality	Ecosystem health	Maintenance of Ecosystem Integrity	The Project has the potential to modify water quality during the operational phase through processing of seawater and discharge of the desalination waste stream (brine).
				The Project has the potential to modify water quality during the operational phase through operational activities associated with cargo loading and unloading.
		Recreation and aesthetics	Maintenance of Aesthetic values	Impacts to social surroundings and values may occur due to changes to water quality during the discharge of brine during the operational phase.
	Marine Fauna	Ecosystem health	Maintenance of Ecosystem Integrity	The Project has the potential to alter habitat and life history strategies during the operational phase through processing of seawater and discharge of the desalination waste stream (brine).
				The Project has the potential to alter habitat and life history strategies as well as posing fatality risk the operational phase through operational activities associated with cargo loading, unloading and TSV movement.
		Recreation and aesthetics	Maintenance of Aesthetics	Impacts to social surroundings and values may occur due to changes to water quality during the discharge of brine during the operational phase.

Threatened marine fauna desktop assessments were undertaken by O2 Marine (2021b) to identify marine fauna species with the potential to occur and be potentially impacted by the AIP. Threatened marine fauna species were defined as those:

- Listed as threatened or migratory under the EPBC Act, or the *WA Biodiversity Conservation Act 2016* (BC Act) as threatened or priority species; and
- With a high likelihood of occurrence within the AIP DEs.

The marine waters within and adjacent to the AIP area support a variety of fauna, several of which are listed under the EPBC Act and/or WA BC Act. Database searches of the online EPBC Act Protected Matters Search Tool (PMST) and DBCA NatureMap databases were conducted with a 30km radius (from the Offshore DE and Nearshore DE) to include the bounds of potential impacts from the AIP. Additional searches were undertaken using the DBCA threatened species database, and the State of Fisheries and the State-wide Recreational Fishing Survey reports. All searches were undertaken in April 2021. A desktop review of relevant publications and reports was also undertaken to provide a Likelihood of Occurrence Assessment based on identified criteria.

Some 95 threatened and migratory fauna have been previously recorded within 30 km of the AIP area, comprising 45 fish (inclusive of sharks and rays), 29 mammals (including cetaceans) and 21 reptiles. Their likelihood of occurrence within the AIP area was informed by survey work and the results of the desktop study. Based on this assessment, and in conjunction with database searches from the desktop review, the species classified as 'likely' or 'known to have occurred' within a 30km radius were deemed to have a moderate to high likelihood of occurring directly within the AIP area (O2 Marine 2021b).

Of the MNES species recorded within the 30 km search radius, 18 were assessed to determine their likelihood of occurrence in the AIP Area, comprising six fish (inclusive of sharks and rays), seven mammals (including cetaceans) and five reptiles (O2 Marine 2021b) (**Table 2**).

Table 2 Marine Species Assessed for Likelihood of Occurrence in the AIP Area.

Fish	Reptiles	Mammals
Whale Shark (*Rhincodon typus*) (Medium Likelihood of Occurrence)	Flatback Turtle (*Natator depressus*) (High Likelihood of Occurrence)	Blue Whale (*Balaenoptera musculus*) (Low Likelihood of Occurrence)
Green Sawfish (*Pristis zijsron*) (High Likelihood of Occurrence)	Loggerhead Turtle (*Caretta caretta*) (Medium Likelihood of Occurrence)	Humpback Whale (*Megaptera novaeangliae*) (High Likelihood of Occurrence)
Dwarf Sawfish (*Pristis clavata*) (Medium Likelihood of Occurrence)	Green Turtle (*Chelonia mydas*) (High Likelihood of Occurrence)	Southern Right Whale (*Eubalaena australis*)* (Low Likelihood of Occurrence)
Largetooth Sawfish (*Pristis pristis*) (Medium Likelihood of Occurrence)	Hawksbill Turtle (*Eretmochelys imbricata*) (High Likelihood of Occurrence)	Dugong (*Dugong dugon*) (High Likelihood of Occurrence)
Giant Manta Ray (*Mobula birostris*) (Medium Likelihood of Occurrence)	Leatherback Turtle (*Dermochelys coriacea*) (Medium Likelihood of Occurrence)	Australian Humpback Dolphin (*Sousa sahulensis*) (High Likelihood of Occurrence)
Reef Manta Ray (*Mobula alfredi*) (Medium Likelihood of Occurrence)	-	Australian Snubfin Dolphin (*Orcaella heinsohni*) (Low Likelihood of Occurrence)

Fish	Reptiles	Mammals
-	-	Indo-Pacific Bottlenose Dolphin (*Tursiops aduncus*) (High Likelihood of Occurrence)

*Included due to high conservation status, may occur in the AIP area

Ten listed MNES species are considered to have a High likelihood of occurrence within AIP area with eight other listed MNES species are considered to have a Medium likelihood of occurrence (O2 Marine 2021b) within the AIP area, with a number of these species known to migrate through the area.

Biologically Important Areas (BIAs), as defined in DCCEEW (2022a) are spatially defined zone where aggregations of individuals of a species are known to display biologically important behaviours such as breeding, foraging, resting or migration (DCCEEW 2022a). They are important components of species recovery plans, where those plans exist. Of the 18 species assessed, six of the species had BIAs that spatially overlapped with the AIP Area (**Table 3**).

Two of the mammal species, the Southern Right Whale and the Australian Snubfin Dolphin, were deemed to have a low likelihood of occurrence in the area, they were included in the assessment given their high conservation status. These species are not considered an important population or have habitat critical to their survival in the AIP area. Fauna that are listed under the EPBC Act. but were classified as absent ("not present") from the AIP area are not considered further in this section.

Benthic Communities and Habitat (BCH) has the potential to be impacted through changes in water quality as part of Project activities, however these factors are considered to be protected through maintenance of marine environmental quality and achieving the environmental objectives.

Table 3 Biologically Important Area (BIA) That Spatially Overlap with the Proposed Action DE

Species	Type	Marine Component
Humpback Whale	Migration	Nearshore DE, Transshipment NR and Offshore DE
Pygmy Blue Whale	Distribution	Nearshore DE, Transshipment NR and Offshore DE
Whale Shark	Foraging	Offshore DE, southwestern boundary of BIA
Flatback Turtle	Nesting, inter-nesting	Nearshore DE, Transshipment NR Offshore DE
Hawksbill Turtle	Inter-nesting	Not in DE, >30km east from Nearshore
Green Turtle	Foraging	Not in DE, >40 km north east of Offshore

2. Relevant Legislation and Guidance

2.1. Marine Environmental Quality

The WA EPA's environmental objective for the factor Marine Environmental Quality (MEQ) is '*To maintain the quality of water, sediment and biota so that environmental values are protected* (EPA 2016j).'

The relevant policy and guidance considered in the assessment of the MEQ factor are:

- Statement of Environmental Principles, Factors and Objectives (EPA 2020e);
- Instructions on how to prepare an Environmental Review Document (EPA 2020c);
- Environmental Factor Guideline – Marine Environmental Quality (EPA 2016j); and
- Technical Guidance – Protecting the Quality of Western Australia's Marine Environment (EPA 2016c).

2.2. Approved Conservation Advice, Listing Advice and Recovery Plans

Approved conservation advice and recovery plans for MNES known or likely to occur in the vicinity of the Project are in place. These guidance documents identify overall conservation objectives, critical habitat, important populations, key threats, and priority management actions and are therefore relevant to the assessment process. The Minister must consider the content of approved conservation advice to ensure the Project aligns with the conservation advice and/or recovery plan objectives. Guidance and policy documents relevant to MNES impacted by Project activities include:

2.2.1. Conservation advice:

- Approved Conservation Advice for Green Sawfish (DEWHA 2008b); and
- Conservation Advice *Rhincodon typus* whale shark (TSSC 2015).

2.2.2. Listing Advice:

- Commonwealth Listing Advice Megaptera novaeangliae Humpback Whale (DCCEEW 2022);
- Commonwealth Listing Advice on Incidental catch (bycatch) of Sea Turtle during coastal otter-trawling operations within Australian waters north of 28 degrees South (TSSC 2001a);
- Commonwealth Listing Advice for *Pristis zijsron* (Green Sawfish) (TSSC 2008); and
- Commonwealth Listing Advice on *Rhincodon typus* (Whale shark) (TSSC 2001b).

2.2.3. Recovery Plans:

- Recovery Plan for Marine Turtles in Australia (DoEE 2017);
- Sawfish and River Sharks Multispecies Recovery Plan(DoE 2015a);
- Conservation Management Plan for the Blue Whale (DoE 2015b);
- Wildlife Conservation Plan for Seabirds (DCCEEW 2020) and;
- Conservation Management Plan for the Southern Right Whale (DoSWPC 2012).

2.3. Threat Abatement Plans

Threat Abatement Plans (TAPs) establish national frameworks to guide and coordinate Australia's response to threats to biodiversity. These documents identify research, management and other priority actions required to protect threatened species. The Australian Government develops and facilitates the implementation of the TAPs by establishing partnerships and cooperative programs. When considering the approval of a project, the Minister must not act inconsistently with a TAP.

The TAPs and the associated objectives for each plan are outlined in **Table 4**.

Table 4 Threat Abatement Plans

Threat Abatement Plan	Objectives
Threat abatement plan for predation by feral Cats (DoE 2015c)	The goal of this TAP is to minimise the impact of feral Cats on biodiversity by: • Protecting affected threatened species; and • Preventing further species and ecological communities from becoming threatened. The TAP has four objectives: • Effectively control feral Cats in different landscapes; • Improve the effectiveness of existing control options for feral Cats; • Develop or maintain alternative strategies for threatened species recovery; and • Increase public support for feral Cat management and promote responsible cat ownership.
Threat abatement plan for predation by the European Red Fox (DEWHA 2008c)	This TAP identifies localised fox control measures applicable in specific areas of high conservation value and where: • Chances of reinvasion must be nil or very close to it; • All foxes must be accessible and at risk during the control operation; • Foxes must be killed at a higher rate than their ability to replace losses through breeding; and Where local eradication is not practicable, two strategies for localised management can be used, as follows: • Sustained management, where control is implemented on a continuing, regular basis, or • Intermittent management, where control is implemented at critical periods when damage is greatest and short-term control will reduce impacts to acceptable levels.

Threat Abatement Plan	Objectives
Threat abatement plan for predation, habitat degradation, competition and disease transmission by feral pigs (DoEE, 2017b)	The objectives of this TAP are: • Prioritise key species, ecological communities, ecosystems and locations across Australia for strategic feral pig management • Encourage the integration of feral pig management into land management activities at regional, state and territory, and national levels • Encourage further scientific research into feral pig impacts on nationally threatened species and ecological communities, and feral pig ecology and control • Record and monitor feral pig control programs, so their effectiveness can be evaluated • Build capacity for feral pig management and raise feral pig awareness amongst landholders and land managers, and Improve public awareness about feral pigs and the environmental damage and problems they cause, and the need for the feral pig control.
Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (DoEE 2018)	This TAP provides national guidance on action to prevent and mitigate the impacts of harmful marine debris on vertebrate marine life through five major objectives: • Contribute to long-term prevention of the incidence of marine debris • Understand the scale of impacts from marine plastic and microplastic on key species, ecological communities and locations • Remove existing marine debris • Monitor the quantities, origins, types and hazardous chemical contaminants of marine debris, and assess the effectiveness of management arrangements for reducing marine debris • Increase public understanding of the causes and impacts of harmful marine debris, including microplastic and hazardous chemical contaminants, to bring about behaviour change.

3. Environmental Quality Management Framework

3.1. Background

The Environmental Quality Management Framework (EQMF) was developed to implement the National Water Quality Management Strategy Guidelines No. 4 and 7 (ANZG 2018). In Western Australia the EQMF process has been utilised as a guide to implement water quality monitoring and management after being incorporated into the State Water Quality Management Strategy No.6 (SWQMS 2004). The Environmental Protection Authority (EPA) provides further guidance for the development and application of the EQMF as a consistent and standardised approach for measuring and reporting on MEQ across other areas of Western Australia's marine environment (EPA 2016). The key structural elements of the EQMF are shown in **Figure 3.**

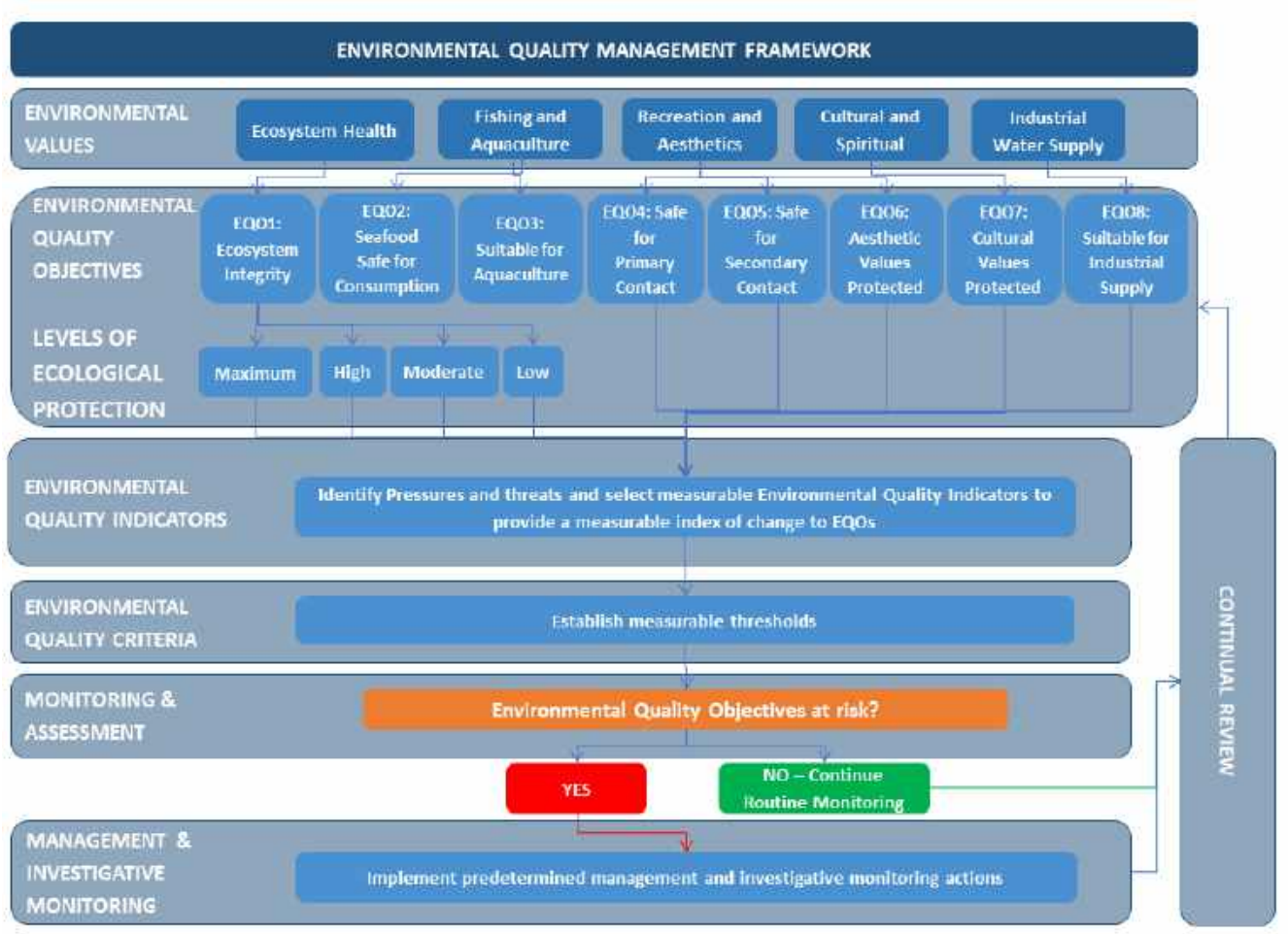

Figure 3 Environmental Quality Management Framework

The following sections outline how the EQMF framework has been applied to define the EVs, EQOs and spatial Levels of Ecological Protection (LEPs) for the AIP.

3.2. Environmental Values & Environmental Quality Objectives

EVs are defined as "*Particular values or uses of the environment that are important for a healthy ecosystem or for public benefit, welfare, safety or health and which require protection from the effects*

of pollution, waste discharges and deposits" (ANZG 2016). EQOs are high level management objectives that describe what must be achieved to protect each EV (EPA 2016).

The EVs and associated EQOs for the Pilbara marine environment are already well established in Pilbara Coastal Waters Consultation Outcome (DoE 2006). Five EVs and eight corresponding EQOs apply to the area surrounding and including the AIP. These EVs and corresponding EQOs are presented in **Table 5.**

Note that while the five EVs and eight EQOs are relevant to the project, only EQOs No. 1, 4 and 6 require development of Environmental Quality Indicators (EQIs) under this plan, as the remaining EQOs are protected through maintenance of ecosystem integrity (i.e. EQO2, EQO3, EQO5, EQO7 and EQO8 are considered met, if EQO1 is satisfied).

Table 5 Environmental Values and Environmental Quality Objectives applicable to the Project area

Environmental Values	Environmental Quality Objectives	Separate Environmental Quality Indicators required?
Ecosystem Health	EQO1: Maintenance of ecosystem integrity. EQO1 is split into four sub-objectives, being: Maximum, High, Moderate and Low LEPs (Refer Section 3.3 below).	Yes
Fishing and Aquaculture	EQO2: Seafood (caught) is of a quality safe for human consumption.	No (Protection of Ecosystem Health will protect this EQO)
	EQO3: Water quality is suitable for aquaculture purposes.	No (Protection of Ecosystem Health will protect this EQO)
Recreation & Aesthetics	EQO4: Water quality is safe for primary contact recreation (e.g., swimming and diving).	Yes
	EQO5: Water quality is safe for secondary contact recreation (e.g., fishing and boating).	No (Protection of primary contact recreation EQO will protect this EQO)
	EQO6: Aesthetic values of the marine environment are protected.	Yes
Cultural & Spiritual	EQO7: Cultural and spiritual values of the marine environment are protected.	No (Protection of Ecosystem Health will protect this EQO)
Industrial Water Supply	EQO8: Water quality is suitable for industrial supply purposes.	No (Protection of Ecosystem Health will protect this EQO)

3.3. Levels of Ecological Protection

In accordance with EPA (2016), the objective for 'Ecosystem Health' is spatially allocated into four LEPs: Maximum, High, Moderate and Low. Each LEP area is assigned an acceptable limit of change as described within EPA (2016). The spatial distribution of the LEPs enables measurable EQOs to be allocated for areas in accordance with expectations for ecosystem health condition. For example, important areas for conservation are assigned a Maximum LEP and maintained within the limits of natural variation, whereas large changes from natural variation may be allowed in small areas assigned a Low LEP around a brine discharge where EVs may not be protected.

LEP boundaries have been previously described for the Port and surrounding waters in the *Pilbara Coastal Water Quality Consultation Outcomes* (DoE 2006). These existing LEP boundaries were reviewed and updated in the context of the AIP desalination outfall and marine infrastructure to spatially define proposed LEPs around the AIP (**Figure 4**).

The proposed modified LEP boundaries were defined in accordance with EPA (2016) and included consideration of the following:

1. Existing Maximum and High LEP areas as presented in the *Pilbara Coastal Water Quality Consultation Outcomes* (DoE 2006) were retained.
2. The existing Low and Moderate LEP areas currently applied for Ashburton Port were retained.
3. The existing Moderate LEP area applied for Ashburton Port was extended with a 250 m buffer to cover the proposed AIP infrastructure, including the berthing pocket and jetty facilities.
4. Additional Moderate LEPs have been applied to the proposed transhipping anchorages with a 250 m buffer.
5. An additional Low LEP has been proposed as a 30 m buffer surrounding the two brine outfall locations. This was allocated based upon interpretation of modelled dilution contours required to meet the 90% species protection level as presented in O2 Metocean (2021) and includes a 10 m buffer.

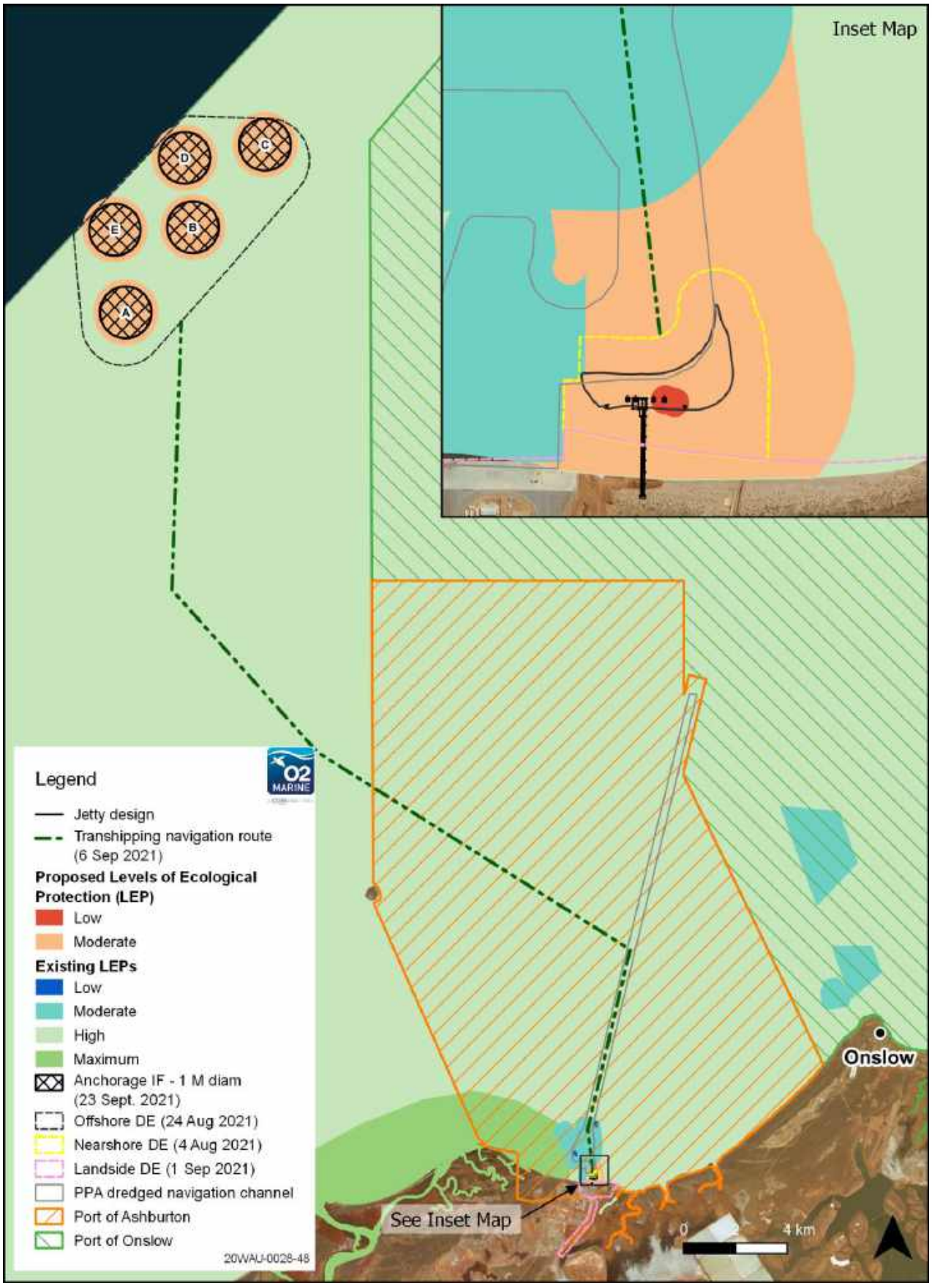

Figure 4 Levels of Ecological Protection for the AIP and surrounding waters

4. EPBC Act EMP Risk Assessment

This risk assessment has been prepared in accordance with the key principles of the *2014 MP Guidelines* to ensure that this MOEMMP clearly presents how conclusion about risks have been reached (DoE, 2014). **Appendix A** presents the approach used to complete the risk assessment. The qualitative risk assessment methodology has been implemented as outlined in the *2014 MP Guidelines,* has been undertaken to ensure that risks are effectively translated into actual mitigation and management actions. Impacts with higher risk ratings usually require more management actions and controls. This minimises the likelihood of the risk occurring and reduced the consequence to acceptable levels (DoE, 2014).

Potential impacts on the environment identified in the assessment process and presented in the PER were rated in terms of risk of likelihood of occurrence and consequence and the resultant combined risk rating is presented in below **Table 6**. The risk ratings are presented as initial risk without mitigation and residual risk with mitigation. Where appropriate potential impacts of a similar nature in terms of effective receptor and rating have been combined under the same headings to reduce the number of individual risks presented.

Table 6 Identified risks and associated risk ratings

Potential impacts on the environment	Initial risk rating	Residual risk rating
Impacts to marine fauna from injury from vessel strike	Low	Low
Impacts on marine fauna from light pollution	Low	Low
Impacts to marine fauna from entanglement/ plastic ingestion from marine debris	Low	Low
Impacts to marine fauna from Osmotic stress from brine discharge	Low	Low
Impacts to marine water quality from Osmotic stress from brine discharge	Medium	Low
Impacts from hydrocarbon spill causing marine fauna injury or fatalities	Low	Low
Impacts to marine water quality from hydrocarbon spill	Low	Low
Impacts from hydrocarbon spill causing impact on critical habitat	Low	Low
Impacts from the introduction of marine pest species from project vessels	Low	Low

5. Conceptual Model of Pressures/Threats and Selection of Environmental Quality Indicators

5.1. Brine Wastewater Discharge

The production process associated with the Project will produce a high-salinity brine (i.e., estimated approximately 70 ppt) that will be discharged into the marine environment through two diffusers located along the nearshore berthing jetty. Key elements of the preliminary diffuser design and configuration are provided in **Table 7.**

Table 7 Preliminary Diffuser Design and Configuration (Source O2 Metocean, 2021)

Item	Units	Low-flow option	High-flow option
Outfall flow rate	GL/a	0.29	2
	L/s	9	65
	m^3/h	32	230
Outfall / Diffuser location	MGA-50	294288 m East, 7600866 m West	Nozzle 1: 294288 m East, 7600866m West Nozzle 2: 294306 m East, 7600860 m West
Water depth at discharge	m LAT	- 7.00	- 7.00
Number of ports		1	2
Port spacing		N/A	21 m
Port Depth	m LAT	- 6.00	- 6.00
Port diameter	m	0.045	0.075
Discharge velocity (m/s)		5.7	7.1
Port elevation angle	°	65	45
Port azimuth		Perpendicular to tidal currents	Perpendicular to tidal currents

5.2. Port Operations (Cargo Loading and Unloading)

The AIP includes the export of bulk iron ore. The product will be loaded onto TSVs using conveyors and ship-loading infrastructure, then the TSV will travel offshore and re-load the product onto commercial OGVs anchored offshore. Whilst state of the art equipment and management is proposed, there is a risk of product spillage during the loading of vessels.

Vessel movements within the Port area are also likely to continually mobilise and redistribute fine sediments in the vicinity of the berth pocket, and to a lesser extent, at the offshore anchorage. Other operational vessel activities, such as pilotage, towing, and bunkering of the transhipper and commercial vessels will be managed in accordance with existing PPA protocols and practices.

5.2.1. Port Operations (Cargo Loading and Unloading)

The use of TSVs travelling throughout the Project area offshore to deposit product onto commercial OGVs anchored offshore poses the risk of:

- Vessel strike to marine fauna (e.g., resulting in injury or death); and
- Acoustic stress to marine fauna (e.g., threshold shift, masking, or area avoidance, as outlined in Talis 2022).

5.3. Key Threats to Marine Environmental quality

5.3.1. Brine wastewater discharge

Desalination plants produce brine effluent that may also contain constituents that can potentially impact MEQ, including high salt concentrations, chemicals, and metals. However, the Project will not include discharge of biocides or process chemicals other than chorine which is added weekly as a disinfectant.

Key MEQ impacts may arise as a result of:

- Reduced dissolved oxygen (in the lower waters) if density stratification of the water column occurs;
- Changes to marine salinity causing osmotic stress to organisms;
- Elevated return water temperature;
- Release of toxicants in brine effluent used in the reverse osmosis process; and
- Recirculation arising from slow dispersion of effluent after discharge leading to potential increases in salinity in adjacent water column which may affect desalination intake.

5.3.2. Port operations (Cargo loading and Unloading)

Possible accidental hydrocarbon spills to the marine environment in this area will be managed in accordance with leading industry operating procedures. As such, they represent a relatively low risk, inherent to all port operations.

5.4. Key Threats to Marine Fauna

The following marine fauna have been identified by the EPBC act and PER guidelines as conservation significant marine fauna who are exposed to risk from both brine wastewater discharge and port operations.

Listed threatened species and ecological communities:

- Flatback Turtle (*Natator depressus*) –Vulnerable
- Loggerhead Turtle (*Caretta caretta*) – Endangered
- Green Turtle (*Chelonia mydas*) – Vulnerable, Migratory
- Hawksbill Turtle (*Eretmochelys imbricata*) – Vulnerable, Migratory
- Leatherback Turtle (*Dermochelys coriacea*) – Endangered, Migratory
- Blue Whale (*Balaenoptera musculus*) – Endangered, Migratory
- Humpback Whale (*Megaptera novaeangliae*) – Vulnerable, Migratory

- Southern Right Whale (*Eubalaena australis*) – Endangered, Migratory
- Whale Shark (*Rhincodon typus*) – Vulnerable, Migratory
- Green Sawfish (*Pristis zijsron*) – Vulnerable, Migratory
- Dwarf Sawfish (*Pristis clavate*) – Vulnerable, Migratory

Listed migratory species:

- Giant Manta Ray (*Mobula birostris*) – Migratory
- Reef Manta Ray (*Mobula alfredi*) – Migratory
- Dugong (*Dugong dugon*) – Migratory
- Australian Humpback Dolphin (*Sousa sahulensis*) – Migratory
- Australian Snubfin Dolphin (*Orcaella heinsohni*) – Migratory
- Indo-Pacific Bottlenose Dolphin (*Tursiops aduncus*,) – Migratory

5.4.1. Brine Wastewater Discharge

The resulting impacts of the brine discharge of high levels of salinity, total alkalinity, increase chemical and metals in the environment and alteration to the temperature resulting in osmotic stress have the potential to impact marine organisms such as the development of species, survival of larva and breeding and reproductive traits (Danoun,2007; Palomar & Losada, 2011).

5.5. Conceptual Model of Pressure-Response Pathways

In accordance with EPA (2016) a conceptual site model has been developed for AIP, which presents the key threats and their associated pressures presented by this Project. These are contextualised into the pressure/response pathways through identification of the environmental indicators though which the pressures and threats act to reduce MEQ if not appropriately managed.

The conceptual model and subsequent EQIs selected for the Project are presented within **Figure 5.**

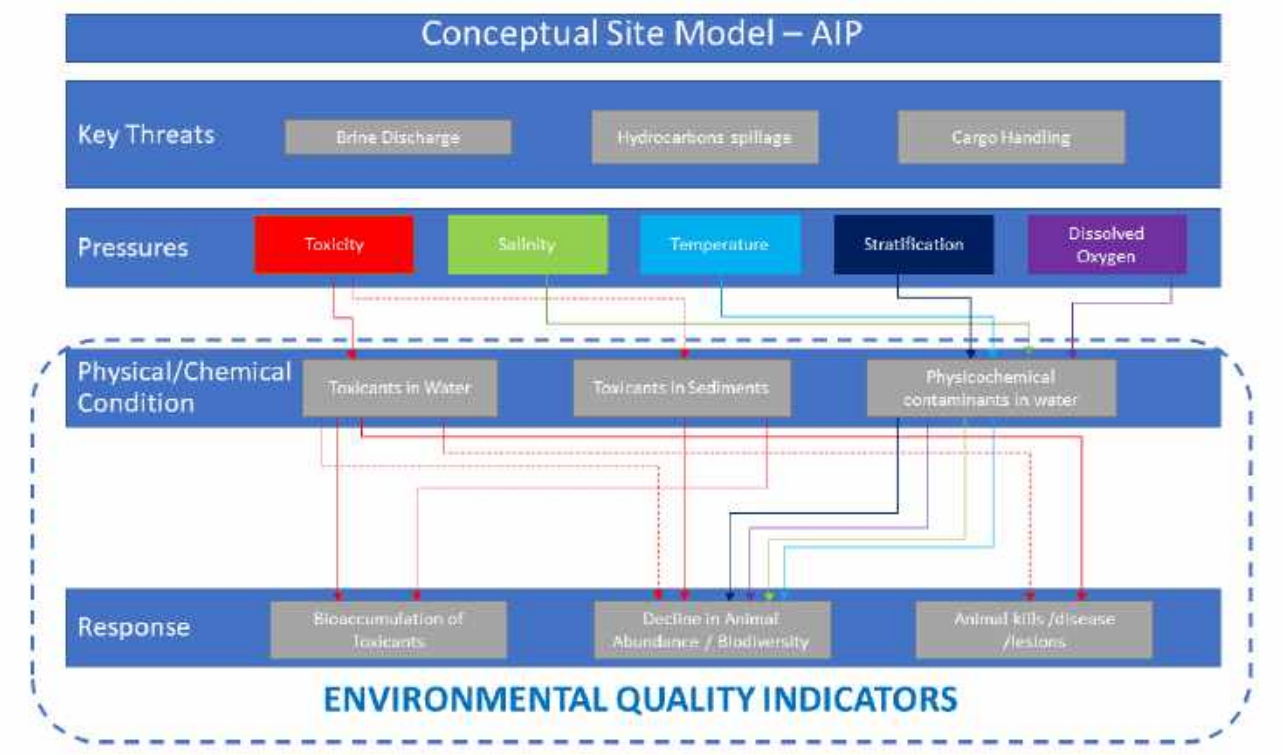

Figure 5 AIP Conceptual Site Model of Key Threats and Pressures to Marine Environmental Quality

5.6. Environmental Quality Indicators

EQIs are measurable parameters selected to monitor changes in each EQO. The EQIs for the AIP are listed in **Table 8**.

Table 8 Environmental Quality Indicators selected for the AIP

Pressures	**Environmental Quality Indicators**[1]	
	Ecosystem Health (EQO1)	Recreation and Aesthetics (EQ04; EQO6)
< Physicochemical constituents, particularly: o salinity o dissolved oxygen o water temperature < Toxicants	< Physicochemical constituents in water < Toxicants in water < Toxicants in sediment < Benthic infauna community health < Fauna disease or death	< Physicochemical constituents in water < Toxicants in water < Fauna disease or death

[1] EQO2, EQO3, EQO5, EQO7 and EQO8 are considered met, if EQO1 is satisfied

6. Monitoring and Management Summary

To ensure that defined EVs and EQOs are not compromised through operational activities associated with the AIP, a comprehensive monitoring and management program is proposed. An overview is presented in **Table 9** and **Table 10,** with detailed descriptions of relevant management actions provided in **Sections 7** and **8.**

Table 9 Performance monitoring and management proposed to be undertaken during the brine discharge validation phase of AIP.

Monitoring Program			Performance Target	Management Response	Reporting
Rationale	**Approach**	**Timing / Frequency**	**/EQG**		
Whole of effluent toxicity (WET) of final brine product is required to confirm the number of dilutions of brine required to achieve 90% and 99% Species Protection Level (SPL) at the Low Ecological Protection Area (LEPA)/Moderate Ecological Protection Area (MEPA) and MEPA/High Ecological Protection Area (HEPA) boundary.	Undertake WET testing to confirm toxicity of raw brine and calculate dilution factors for species protection.	Following seawater desalination plant (SDP) completion, as soon as brine sample is available. AND Whenever composition of brine has been permanently changed.	Minimum level of dilution as defined by WET testing to achieve a 90% and 99% SPL at the LEPA/MEPA and MEPA/HEPA boundary (refer to Performance Target 3 in **Section 7.2.2**)	If the Performance Target is not achieved, then the management response will include, but should not necessarily be limited to: > Investigate the potential sources of higher than predicted toxicity (i.e., chemicals) > As required review and adjust desalination process to reduce brine toxicity > Increase the dilution ratio of brine water prior to discharge > Adjust discharge regime (e.g., timing, flow rate, volume, diffuser configuration) as required.	WET testing results will be included and discussed in the commissioning assessment report, which will be completed within two months following completion of commissioning.
Brine dispersion modelling and plant performance requires validation during the commissioning phase to determine the optimum outfall discharge operations required to achieve the specified number of dilutions at LEPA/MEPA and MEPA/HEPA boundary.	Measurement of water temperature and salinity of brine prior to release and discharge flow rate. AND In-situ measurement of salinity and temperature near the seabed at the LEPA/MEPA boundary. AND Transects of water column profiles of temperature and salinity radiating outwards from the outfall.	Program will be implemented during commissioning and will include: > Measurements prior to release daily for 12-months > In-situ measurements at the seabed once every hour for 12-months. > Water column profiles are required to be taken monthly over the 12-month validation period, to ensure a range of metocean conditions are achieved.	Prior to Release > Brine physical properties and flow rates to be advised based on plant engineering specification (refer to Performance Targets 1 & 2 in **Section 7.2.2**) LEPA/MEPA Boundary > Impact median between reference 5th and 95th percentiles for selected EQGs (refer to Performance Target 4 in **Section 7.2.2**)	If the Performance Target(s) are not achieved, then the management response will include, but should not necessarily be limited to: > Investigate the cause of exceedance > Undertake equipment inspection, maintenance and calibration as required > Adjust dilution ratio of brine water prior to discharge > Adjust discharge regime (e.g., timing, flow rate, volume, diffuser configuration) as required.	Monitoring results will be included and discussed in the commissioning assessment report, which will be completed within two months following completion of commissioning.

Table 10 Monitoring and management proposed to mitigate impacts on marine environmental quality from operational brine discharge and cargo handling

Pressure (Indicator)	Monitoring Program		Performance Target (EQG)	Trigger Exceedance Response	Performance Threshold (EQS)	Threshold Exceedance Response	Reporting
	Approach	**Timing/ Frequency**					
Physical constituents in water Toxicants in Water	Routine - Brine Measurement of outfall brine salinity and temperature prior to release together with measurement of discharge flow rate. Reactive Measurement of salinity in transects radiating out rom diffusers and static locations presented in Figure 6.	Routine - Brine At least daily throughout operations. Reactive Initiated within 5 days following a confirmed Performance Target exceedance.	Routine – Brine Prior to Release - Brine physical properties and flow rates (Refer to Performance Targets 1 & 2 presented in Section 8.2) Reactive median data point for each site which is compared directly against Performance Target 3 (Refer to Performance Target 3 presented in Section 8.2)	In the event of EQG exceedance, management response may include, but should not necessarily be limited to: Investigative Monitoring Conduct investigative monitoring program (benthic infauna – refer Section 8.3.5) within 4 weeks of confirmed EQG exceedance from reactive monitoring program. Plant Operations Investigate the cause of exceedance. > Undertake asset performance monitoring, maintenance and calibration as required. > Adjust dilution ratio of brine water prior to discharge. > Adjust discharge regime (e.g., timing, flow rate, volume, diffuser configuration) where possible.	Performance Threshold 1 is based on final EQS[1] (Refer to Section 8.2). Investigative monitoring data collected is to be compared against EQS.	In the event of EQS exceedance, management responses will include, but not be limited to: Investigate the cause of exceedance. > Review and adjust desalination process to reduce brine toxicity; > Undertake equipment inspection, maintenance and calibration as required; > Increase the dilution ratio of brine water prior to discharge; > Adjust discharge regime (e.g., timing, flow rate, volume, diffuser configuration) as required.	Routine/Reactive > Monitoring results to be included in routine operational reports. > Operational reports to be included with annual compliance report. > An EQG investigation report will be prepared within 30 days of an EQG exceedance. Investigative > DWER CEO will be notified within 24 hours of confirmation of an EQS exceedance. > DCCEEW will also be informed of exceedance > An EQS investigation report will be prepared and issued to the DWER CEO within 3 months of an EQS exceedance. > Investigation report will also be given to DCCEEW
Toxicants in Sediments	Routine Collection of sediment samples from all sites presented in Figure 7 and Figure 8. Raw metals results are compared to the EQGs. Reactive EQG exceedance triggers elutriate and bioavailability testing. These results are compared against the EQGs.	Sediment samples collected annually for three years following commissioning and then five yearly thereafter.	Routine Performance Target 3 (Section 8.2) requires pooled raw metals and normalized hydrocarbon data to be compared against the EQGs which are the ANZG (2018) default guideline values. Reactive Performance Target 3 (Section8.2) requires elutriate and bioavailability data to be compared against the EQGs which are the ANZG (2018) default guideline values.	In the event of EQG exceedance, management response may include, but should not necessarily be limited to: Investigative Monitoring Conduct investigative monitoring for benthic infauna within 4 weeks of confirmed EQG exceedance from reactive monitoring program. Cargo Handling Operations > Conduct operational audit to ensure compliance with document processes; > Conduct facility inspection; > Review cargo handling loading parameters (weather, load rates, dust suppression, product moisture etc);	Performance Threshold 1 is based on final EQS[1] (Refer to Section 8.2). Investigative monitoring data collected is to be compared against EQS.	In the event of EQS exceedance, management responses will include, but not be limited to: > Investigate the cause of exceedance. > Review cargo handling loading parameters (weather, load rates, dust suppression, product moisture etc); > Conduct operational audit to ensure compliance with document processes; > Conduct facility inspection;	Routine/Reactive - EQG > Annual or five yearly sampling summary report to be completed within 3 months of field sampling activities. > An EQG investigation report will be prepared within 30 days of an EQG exceedance. Investigative - EQS > DWER CEO will be notified within 24 hours of confirmation of an EQS exceedance. > DCCEEW will be informed of an EQS exceedance > An EQS investigation report will be prepared and issued to the DWER CEO within 3 months of an EQS exceedance.

[1]: EQS are to be determined in accordance with scheduled revision of this Plan defined within **Section8.2** based on final design specifications.

7. Brine Discharge Commissioning and Validation

7.1. Rationale

To determine the actual impacts from brine discharge a MEQ validation monitoring and management program has been designed. This program is divided into several components which each have specific objectives and methodologies:

- Whole Effluent Toxicity (WET) testing to determine actual brine discharge toxicity and confirm the dilution required to achieve ecological protection at LEP boundaries; and
- MEQ validation program of the discharge characteristics (flow rate and brine properties) and receiving environment monitoring at strategically positioned impact and reference locations surrounding the discharge to allow an assessment against defined site specific EQC.

Management during validation is focused on ensuring that predicted impacts are consistent with actual impacts within the respective spatial LEPs, therefore protecting the associated EVs and EQOs. Where desired levels are not achieved, contingency actions will be implemented thus ensuring the brine discharge and associated engineering design are optimised for routine operations to protect MEQ within the defined LEPs.

The designated validation period is 12 months, through which time a thorough assessment of the discharge against the defined performance targets will have been achieved. If the performance targets are still not being achieved by this time, validation sampling will continue until all engineering solutions have been applied to rectify the exceedances. This is considered unlikely based on the ongoing contingency measures applied during this period to rectify any potential impacts which will be applied during commissioning and validation.

Once the 12-month validation period has been completed, then this section of the program will be considered complete and the project will move to the 'Operational Phase' as described in **Section 8**.

7.2. EQC and Performance Targets and Thresholds

7.2.1. Environmental Quality Criteria

The purpose of this phase is to validate predictive modelling, determining final toxicity and dilution factors required to protect MEQ at LEP boundaries, hence only EQGs are applicable to this phase. There are no EQS associated with this phase as this component is focused on ensuring that MEQ within the LEPs are met during the initial Project set-up and commissioning, and therefore the routine operational discharges will not impact the EQOs and EVs will be achieved.

The preliminary EQGs are presented in **Table 11**. Note that for validation purposes only the LEPA/MEPA boundary is required to be assessed as the high LEP, based on predicted dilution contours, occurs well within the MEPA (O2 Metocean 2021) and therefore, only moderate LEP EQGs are applied.

Table 11 Preliminary EQGs for Marine Environmental Quality Validation

EQI	Units	EQG Moderate
Salinity	ppt	Impact site median > reference 95th percentiles
Temperature	°C	Impact site median not between reference 5th and 95th percentiles
pH	-	
Dissolved Oxygen	% Saturation	Impact site median > reference 95th percentiles

7.2.2. Performance Targets and Thresholds

To achieve the purpose, Performance Targets have been established which will inform management when contingency measures need to be actioned. Contingency measures are presented in **Section 7.4** and are typically based upon causal investigation and implementing appropriate corrective actions to eliminate or reduce re-occurrence and thereby ensure effective operation of the AIP.

No Performance Threshold apply during this phase.

Performance Target 1

Performance Target 1 will be based upon the maximum instantaneous or averaged flow rate (daily or hourly) to be determined based upon final engineering design of the desalination plant. Performance Target 1 will be exceeded if the assigned performance measure is exceeded, thus enacting contingency management as presented below**.**

Performance Target 2

Performance Target 2 is based upon maximum discharge concentrations of physical parameters within the brine to be determined by final engineering design. Performance Target 2 will be exceeded if the brine physical parameters exceed the maximum concentrations, thus enacting contingency management as presented below**.**

Performance Target 3

Performance Target 3 is based on meeting the minimum number of dilutions defined by WET testing to achieve 90% and 99% species protection levels at the LEPA/MEPA and MEPA/HEPA boundary, respectively. Performance Target 3 will be exceeded if WET testing identifies that the minimum number of dilutions are not being achieved within defined LEP boundaries (**Figure 4**), thus enacting contingency management as presented below

Performance Target 4

Performance Target 4 is defined as the EQCs and are based upon assessment against physicochemical parameters collected at the LEPA/MEPA and MEPA/HEPA boundaries. MEQ samples collected from designated sample locations are to be assessed against the EQCs (see

Table 11). Where an exceedance of any of the EQCs occur contingency management as described in the following sections will be required.

7.3. Whole Effluent Toxicity Testing

7.3.1. Purpose

The purpose of WET testing is to identify the specific toxicity of the brine wastewater under accredited laboratory conditions, using species selected to be representative of those on site. WET testing results will provide an assessment of the dilution factors required to be achieved on brine outfall wastewater to achieve the SPLs applicable within the LEP areas presented in **Figure 4**.

7.3.2. Sampling Design

WET testing will be undertaken as soon as the water quality of the brine discharge is considered to be within design specifications and therefore representative of brine characteristics during routine operations. WET testing will be conducted from samples taken directly from the raw brine and the results will be analysed in accordance with ANZG (2018) toxicity sampling and testing protocols.

Additional WET testing will also be required at any time during which the desalination process is altered, or if constituents of the brine are expected to have changed, thus potentially altering the toxicity within the discharge stream.

In accordance with ANZG (2018), toxicity testing is proposed to be undertaken on a minimum of six (6) locally relevant species from five (5) taxonomic groups[1]. Testing will be in accordance with laboratory NATA accredited methodologies and in accordance with ANZG (2018) toxicity sampling and testing protocols, including the preferred use of 'chronic' over 'acute' testing. Suggested tests (based on those currently available) for WET testing are listed below:

- 48-hour larval development test: Milky oyster *Saccostrea echinata* (ESA SOP 106)
- 8-day Sea anemone pedal lacerate development test: *Aiptasia pulchella* (ESA SOP 128)
- Sea urchin larval development test: *Echinometra mathaei* (APHA and ASTM protocols)
- Fish larvae development bioassays: Kingfish *Seriola lalandi* (USEPA Method 1001.0)
- 72-hr marine algal growth test: *Nitzschia Closterium* (ESA SOP 110 (ESA 2016))
- Copepod Larval development Bioassay: *Gladioferens imparipes* (ISO 16778 (2015)

The WET tests will be confirmed closer to the time in collaboration with the preferred laboratory to ensure appropriateness of the selected tests and to determine availability of the selected species.

7.3.3. Sampling Methodology

Samples for WET testing will be collected directly from the raw brine prior to any dilutions at the point directly before it enters the discharge pipe. Samples will be collected in laboratory supplied sample containers and in accordance with sampling instructions and ANZG (2018) protocols. Typically, this involves filling plastic sample bottles (~2.5 L) from the brine sump once normal operational

[1] Tests should avoid using salinity-tolerant euryhaline species (e.g., Barramundi).

processes are established and normal discharges are occurring. Samples are typically required to be chilled and transported to the laboratory within stipulated timeframes. Diluent water will be collected from a source within the HEPA that has been determined to have no impacts from the outfall discharge (i.e., through interpreting modelling results) from a depth equal to the outfall diffuser. Samples will be transported directly to the laboratory to ensure ecotoxicity testing can occur as soon as practicable after sample collection.

7.3.4. Data Assessment and Reporting

Ecotoxicity testing results will be entered into a software program (i.e., Burrlioz) to calculate the value required to achieve a 90% SPL at the boundary of the LEPA/MEPA and a 99% SPL at the boundary of the MEPA/HEPA. WET testing results will be assessed against predicted dilution contours to ensure that actual dilution contours required to achieve the 90% and 99% SPLs are being achieved. These results will be used to validate, or as a basis for review and refinement of operational parameter for the reverse osmosis plant.

At the completion of each round of WET testing a validated laboratory report and summary report will be compiled which will include, but not be limited to:

Summary of the methods applied and any deviations from the methods proposed herein;

- A table summarising laboratory results;
- An interpretation of the raw data from the software program used (i.e., Burrlioz);
- Analysis of results against predictive modelling with respect to dilution contour modelling and spatial allocation of LEPs with the mixing zone boundary required to meet the 90% SPL; and
- Any actions or recommendations arising.

7.4. Brine Effluent MEQ Validation Monitoring

7.4.1. Purpose

The purpose of the brine effluent MEQ validation is to provide an assessment of environmental performance to identify if the defined EQCs are being achieved within their respective LEPs. Results will also be assessed to determine if the predicted model dilution factors are being achieved at the LEPA/MEPA boundary. Brine discharge validation testing will also provide an indication of the level of variability of the brine constituents, thus allowing a definitive prediction of the levels of impacts from routine discharges to be predicted.

These results will be interpreted along with revised dilution factors from WET testing (**Section 7.3**) to further define and revise the EQCs for ongoing operational performance assessment (**Section 8.2**).

7.4.2. Sampling Design

The brine discharge validation monitoring period will be undertaken as soon as the water quality of the discharge is considered to be within design specifications and therefore representative of brine effluent characteristics during routine operations. Brine discharge validation monitoring will be undertaken until the Performance Targets are achieved, or for a minimum of 12-months if they are consistently achieved.

This will require the following sampling programs:

- Continuous in-line flow rate monitoring;
- Continuous monitoring of salinity and temperature of the raw brine effluent;
- Physico-chemical water column profiling conducted on two occasions; and
- Continuous in-situ water quality data logging.

Continuous monitoring sites are placed to ensure potential impacts are monitored (impact sites) and compared with suitable offsite locations (reference sites). There are four in total with impacts sites position based on modelled plume dispersion outputs (O2 Metocean 2021). No sites are included on the MEPA/HEPA or MEPA/XEPA boundaries as there is a very low risk of impacts from brine discharge at this distance for the diffuser.

Physicochemical water column profiling will also be conducted at each of the locations along with radial transects from the source to determine exactly where diffuser dilutions are occurring for validation against predictions.

Details of the monitoring locations and associated sampling tasks to be completed at each location are presented in **Table 12**. In-situ data logging and water column profiling static sample locations are presented in **Figure 6**.

Table 12 Marine Environmental Quality Monitoring Locations and Associated Routine Sampling Tasks for MEQ Validation

Site Name	Site Reference	LEP	Easting (GDA94 MGA50)	Northing (GDA94 MGA50)	Monitoring Tasks		
					Physical observations	Water column Profiling	In-Situ data logging
AIP1 AIP2	These sites are located on the LEPA/MEPA boundary. Their specific locations are positioned where the modelled outfall plume predict the farthest extent from the diffuser and therefore would represent the worst-case scenario for an exceedance of the performance targets (O2 Metocean 2021) to ensure impacts are within the predictions and the LEP. They also represent potential impact boundaries from the Offshore Shipping Facility	Moderate	294387 294309	7600864 7600857	X	X	X
REF1	This site is located adjacent to the operational area in the High LEP area to provide reference site data for comparison to impacts. The site will also ensure there are no impacts occurring within the HEPA.	High	295328	7601498	X	X	X

Site Name	Site Reference	LEP	Easting (GDA94 MGA50)	Northing (GDA94 MGA50)	Monitoring Tasks		
					Physical observations	Water column Profiling	In-Situ data logging
REF2	This site is located adjacent to the operational area in the Maximum LEP area to provide reference site data for comparison to impacts. The site is also strategically positioned within the Ashburton River Delta regionally significant mangrove management area (as defined by EPA 2001) will also ensure there are no impacts occurring within the HEPA.	Maximum	292837	7601553	X	X	X

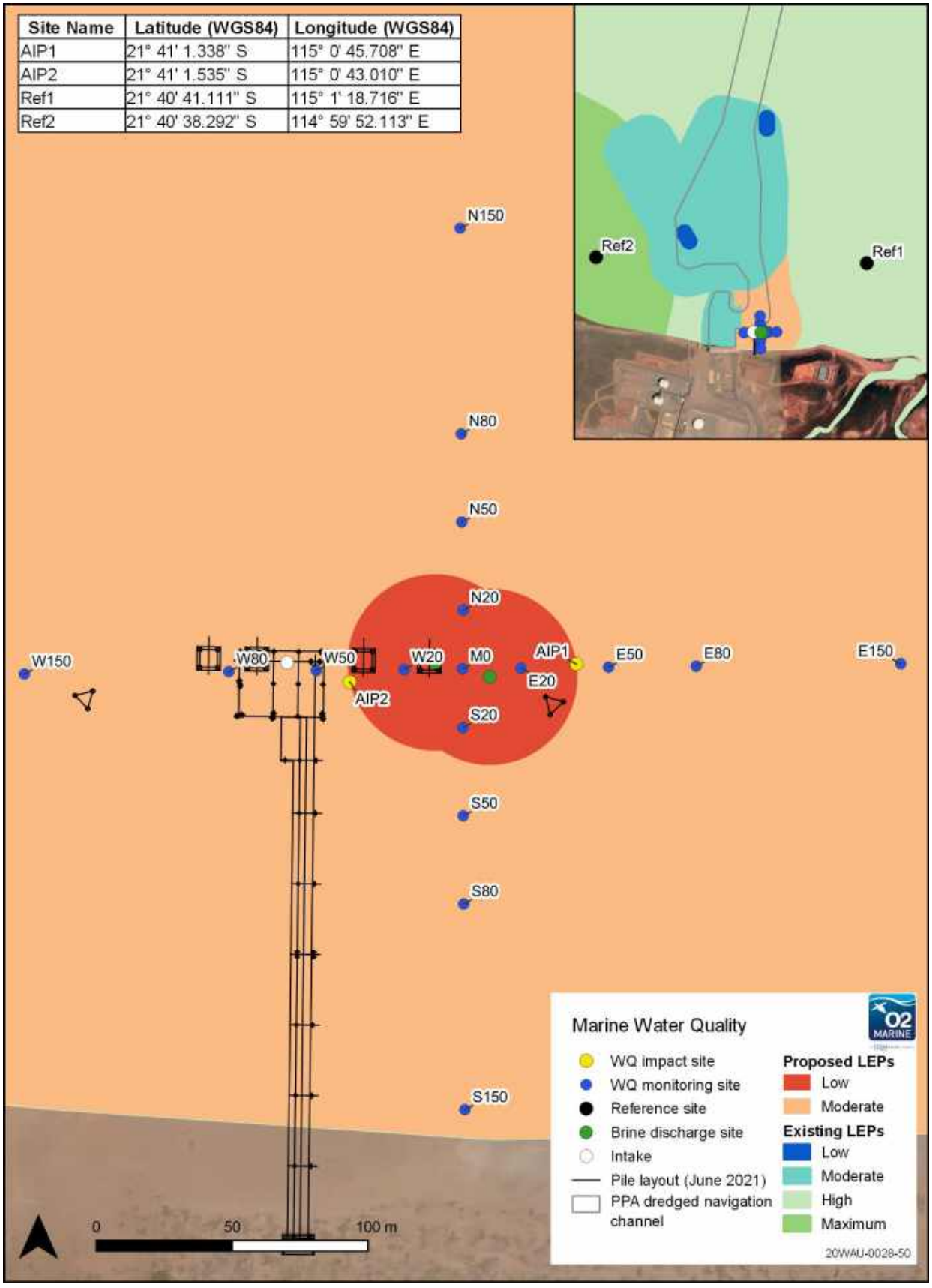

Figure 6 Marine water quality monitoring locations

Brine Discharge and Flow Rate Monitoring

Daily measurements of temperature and salinity will be collected over the 12-month validation period. Measurements will be obtained from the brine prior to release using a pre-calibrated water quality meter or appropriate inline sensor.

A flow rate sensor, or similar, will be installed to monitor hourly flow rates to collect data representative of the diffuser outfall. Sampling will be conducted daily for the 12-month validation period.

Physicochemical Water Column Profiling

Monthly during the 12-months of the brine validation phase, water column profiles (measurements at 0.5m depth increments) of temperature, salinity, pH and dissolved oxygen will be collected along four transects (i.e., north, east, south & west – may be adapted to suit accessibility) radiating outwards from the diffusers at the following intervals: 0 m, 20 m, 50 m, 80m, 150 m; and at the four sites presented in Figure 6.

Water quality instrument calibration will be performed in accordance with manufacturer specifications and appropriate QA/QC protocols.

In-situ physicochemical monitoring

Measurements of temperature, salinity, pH and dissolved oxygen will be collected hourly over a designated 12-month period during the brine discharge validation phase. In-situ loggers attached to seabed frames designed to stand upright on the seabed, while maintaining the instruments at approximately 0.3 m above the seafloor, will be used to collect the in-situ measurements. Data collection will be undertaken at four sites as presented in **Figure 6**.

Water quality instrument maintenance and calibration will be performed prior to the deployment in accordance with manufacturer specifications and appropriate QA/QC protocols. Any maintenance visits will involve retrieval of the instrument frame, maintenance and then re-deployment, typically within a 24-hr period.

7.4.3. Data Assessment and Reporting

All data is required to be validated prior to the release of any monitoring reports to confirm that data has been analysed correctly. Data analysis is to be checked and verified against raw data logs by an independent person.

Compliance with the Performance Targets will be conducted as follows:

- Flow rates sensor measurements compared directly against Performance Target 1;
- Brine physical properties as sampled will be compared directly with Performance Target 2; and
- Water column profiles will be interrogated to collect a median data point for each site which is compared directly against the Performance Target 4.

In-situ data assessment will include:

- Calculation of the 5th and 95th percentiles (as applicable) from data pooled from the two reference sites; and
- Calculation of a daily median from impact sites which will be compared directly against Performance Target 4.

A comprehensive report will be compiled at the completion of the validation phase which will include, but not be limited to:

Summary of the methods applied and any deviations the method presented herein;

- Timeseries graphs and tables of physicochemical parameters;
- An assessment of daily data collected against Performance Targets;
- A review of Performance Target exceedances investigations and remedial actions implemented; and
- Any actions or recommendations arising.

7.4.4. Contingency Management

If the Performance Targets are not achieved, then the management response will include, but will not necessarily be limited to:

- Investigate the cause of the exceedance or potential sources of higher than predicted toxicity (i.e., chemicals);
- As required, review and adjust desalination process to reduce brine toxicity;
- Undertake equipment inspection, maintenance and calibration as required;
- Increase the dilution ratio of brine water prior to discharge; and
- Adjust discharge regime (e.g., timing, flow rate, volume, diffuser configuration) as required.

Management response actions are required to be implemented with 7 days of notification of a performance target exceedance.

8. Routine MEQ Monitoring

8.1. Rationale

Once the validation phase is completed the routine operations phase is designed to manage and monitor the MEQ of the AIP. This phase comprises the following two components:

1. Ongoing assessment of brine discharge quality against design specifications; and
2. Ongoing MEQ monitoring to ensure that potential impacts from operational activities are occurring within the limits of allocated within each spatial LEP.

Management during ongoing operations will be focused on ensuring that the validated levels of impact within the defined spatial LEPs continue to be achieved, therefore protecting the associated EVs and EQOs. Where desired levels are not being achieved contingency actions will be implemented to ensure the impacts are restricted, investigated and remediated. At this stage compliance reporting requirements will also be stipulated, with outcomes from monitoring programs reported against their objectives and criteria and submitted, as required, to the regulator.

8.2. EQC and Performance Targets and Thresholds

8.2.1. Environmental Quality Criteria

At this stage the EQGs and EQSs presented below are preliminary and subject to review as engineering design is finalised and over the course of the Project implementation as new data or information relevant to the protection of MEQ comes available. EQGs are established for toxicants in sediments (**Table 13**), and physical properties and toxicants in water (**Table 14**). EQS are established for benthic infauna and physicochemical parameters associated with brine discharge (**Table 15**).

Table 13 Environmental Quality Guidelines for toxicants in sediments

EQI	Units	EQG			
		Low	Moderate	High	Maximum
Aluminum	mg/kg	<6150	<4100	<4100	No detectable change from natural background (i.e., reference site)
Arsenic	mg/kg	<20	<20	<20	
Cadmium	mg/kg	<1.5	<1.5	<1.5	
Copper	mg/kg	<65	<65	<65	
Iron	mg/kg	Double the median of the reference sites			
Lead	mg/kg	<50	<50	<50	
Mercury	mg/kg	<0.15	<0.15	<0.15	
Nickel	mg/kg	<21	<21	<21	
Vanadium	mg/kg	<54	<36	<36	
Zinc	mg/kg	<200	<200	<200	

EQI	Units	EQG			
		Low	Moderate	High	Maximum
TRH Total C6-C14 C15-C36	mg/kg	 <250 <25 <100	 <250 <25 <100	 <250 <25 <100	
TPH	mg/kg	<280	<280	<280	
BTEXN - Benzene - Toluene - Ethylbenzene - Xylene - Napthalene	mg/kg	<Laboratory Limit of Reporting (LoR) or Practical Quantitation Limit (PQL)			

Table 14 Environmental Quality Guidelines for physical properties in water and sediment elutriate toxicants

Environmental Quality Indicators	Environmental Quality Guidelines					
	Constituents	Units	Low LEP	Moderate LEP	High LEP	Maximum LEP
Physicochemical Constituents in Water	Salinity	PSU	No EQG apply	<95th percentile of reference sites	<80th percentile of reference sites	No detectable change from natural background (reference sites) for Physicochemical parameters or toxicants in water
	Dissolved oxygen	% Saturation		>5th percentile of reference sites	>20th percentile of reference sites	
	pH	-		Between 5th - 95th percentile of reference sites	Between 20th - 80th percentile of reference sites	
	Temperature	°C		Between 5th - 95th percentile of reference sites	Between 20th - 80th percentile of reference sites	
	Elutriate Metals					

Environmental Quality Indicators	Environmental Quality Guidelines					
	Constituents	**Units**	**Low LEP**	**Moderate LEP**	**High LEP**	**Maximum LEP**
Toxicants in Water	Arsenic	(µg/L)	<99th percentile of reference sites		95th percentile of background	
	Cadmium	(µg/L)	<36	<14	<0.7	
	Copper	(µg/L)	<8	<3	<0.3	
	Lead	(µg/L)	<12	<6.6	<2.2	
	Mercury	(µg/L)	<1.4	<0.7	<0.1	
	Vanadium	(µg/L)	<280	<160	<50	
	Zinc	(µg/L)	<43	<23	<7	
	Elutriate BTEXN					
	Benzene	(µg/L)	<1300	<900	<500	
	Tolulene	(µg/L)	<330	<110	<50	
	Ethylbenzene	(µg/L)	<160	<110	<50	
	m-Xylene	(µg/L)	<150	<100	<50	
	Napthalene	(µg/L)	<120	<90	<50	
	Elutriate Total Recoverable Hydrocarbons & Total Petroleum Hydrocarbons					
	TRH C6-C14	(µg/L)	<25			
	TRH C15-C36	(µg/L)	<100			
	TPH C6-C36	(µg/L)	<99th percentile of background		<95th percentile of background	

Table 15 Environmental Quality Standards for routine operational operations

EQI	EQS	
	Moderate	High
Salinity in brine Key toxicants in brine	Dilutions meet 90% SPL as determined by WET testing	Dilutions meet 99% SPL as determined by WET testing
Toxicants in Sediment	No loss or decline within benthic fauna communities greater than 95% percentile of natural conditions	No change in benthic fauna community composition as compared to natural conditions
	No reports of animal disease or deaths attributable to the Project	
Physicochemical stressors in water	No loss or decline within benthic fauna communities greater than 95% percentile of natural conditions	No change in benthic fauna communities from natural conditions
	No reports of animal disease or deaths attributable to the Project	

8.2.2. Performance Targets and Thresholds

To achieve the purpose, Performance Targets have been established which will inform management when contingency measures need to be actioned. Contingency measures are typically based upon causal investigation and implementing appropriate corrective actions to eliminate or reduce re-occurrence and thereby ensure effective operation of the AIP.

Performance Targets are based upon instantaneous flow rates, the maximum predicted design concentration for constituents within the raw brine discharge and the EQC defined within **Table 13** and **Table 14** for the constituents being monitored.

A Performance Threshold is defined based upon the EQS and identifies the point where the EQOs may not be met and the EVs are considered at risk from AIP operational activities. Where these are exceeded compliance investigation and reporting are required as detailed below.

The Performance Targets and Performance Threshold are detailed below.

Performance Target 1

Performance Target 1 will be based upon the maximum instantaneous or averaged flow rate (daily or hourly) to be determined during the validation period. Performance Target 1 will be exceeded if the assigned performance measure is exceeded for more than seven consecutive days, thus enacting contingency management as presented below.

Performance Target 2

Performance Target 2 is based upon maximum discharge concentrations of salinity within the brine to be determined by during the validation period. Performance Target 2 will be exceeded if the maximum concentration within the raw brine is exceeded for more than seven consecutive days, thus enacting contingency management as presented below.

Performance Target 3

Performance Target 3 is defined as the EQGs and are based upon assessment against MEQ samples and data collected at the LEPA/MEPA or MEPA/HEPA boundaries or within the LEPs. MEQ samples and data collected from designated sampling locations are to be assessed against the defined EQGs as identified in **Table 13** and **Table 14**. Where any EQGs are exceeded contingency management actions as detailed below are required.

Performance Threshold

The Performance Threshold is defined as the EQSs and are based upon assessment against MEQ samples and data collected at the LEPA/MEPA or MEPA/HEPA boundaries or within the LEPs. MEQ samples and data collected from designated sampling locations are to be assessed against the defined EQGs as identified in **Table 15**. Where an exceedance of any of the EQSs occur and investigation, contingency management and compliance reporting will be required.

8.3. Brine Discharge Monitoring

8.3.1. Purpose

The purpose of the brine discharge monitoring program is to ensure that ongoing operational brine discharges are representative of results obtained during the validation program, including seasonal variability. Therefore, an annual program has been designed to ensure operational discharges continue to meet the EQOs and thus protect the EVs.

8.3.2. Sampling Design

Brine outfall monitoring will commence immediately following the completion of the brine outfall validation phase. This program will require:

Routine Monitoring:

- Continuous in-line flow rate monitoring; and
- Continuous monitoring of salinity and temperature of the raw brine effluent.

Reactive Monitoring:

- Physicochemical water column profiling.
- Benthic infauna sampling

Water column profiling sample locations are presented in **Figure 6**.

8.3.3. Routine Monitoring

Brine Discharge and Flow Rate Monitoring

Daily measurements of temperature and salinity will be collected throughout operations. Measurements will be obtained from the brine prior to release using a pre-calibrated water quality meter or appropriate inline sensor.

A flow rate sensor, or similar, will be installed to monitor hourly flow rates of the diffuser outfall. Data will collect daily for the lifetime of discharge operations.

Flow rate and brine physicochemical monitoring will be required for the first 12 months, whereby upon a review of performance, this may be adjusted to a less intensive frequency (i.e., one daily measurement collected per month).

8.3.4. Reactive Monitoring

Physicochemical Water Column Profiling

Water column profiles (measurements at 0.5m depth increments) of temperature, salinity, pH and dissolved oxygen will be collected in accordance with the methods presented in **Section 7.4**. Reactive monitoring will be conducted within five days of an EQG exceedance.

8.3.5. Investigative Monitoring

Benthic Infauna Sampling

Procedure

Investigative monitoring of benthic infauna will be conducted in the event that reactive monitoring program, identifies an exceedance against Performance Target 3.

Sediment samples for benthic infauna analysis will be collected at suitable impact and reference site locations as required by the severity of the exceedance. Benthic infauna samples will be collected from a vessel using a sediment grab sampler such as a Van-Veen grab or similar. Three (3) replicate samples will be collected at each location to provide statistical replication required for adequate analysis of benthic infauna.

The following sample process/collection steps will occur:

1. Once the sample has been recovered it will be released from the grab sampler into a suitable collection tray;
2. Weigh the sediment sample and record for post sampling data analysis purposes;
3. Sieve the sediment through a 500 µm sieve using either the saltwater deck wash to remove fine sediment; and
4. All material retained on the sieve, such as coarse sediment and benthic infauna, will be carefully rinsed into suitable pre-labelled containers and preserved with 95-100% ethanol solution.

This process will be replicated to ensure three (3) individual sediment samples are collected from each location to provide sufficient statistical data to allow assessment of variability within each sample location.

Laboratory Analysis

Laboratory picking is conducted under a dissecting-microscope, with all benthic infauna being removed from the sediment. Picking quality assurance checks are done on 10% of the total samples, with a 5% picking error rate. If the picking error is above 5% then previous samples are checked, until a satisfactory error rate is met. All picked benthic infauna will be stored in separate sample vials with 70% ethanol. Macroinvertebrates will be identified to Family taxonomic level using a compound microscope.

8.3.6. Data Assessment and Reporting

Data Assessment

All data is required to be validated prior to the release of any monitoring reports to confirm that data has been analysed correctly. Data analysis is to be checked and verified against raw data logs through an internal peer review process.

Compliance with the Performance Targets will be conducted as follows:

- Flow rates will be averaged hourly over a 24-hour period and compared directly with Performance Target 1; and
- Brine physical properties as sampled will be compared directly with Performance Target 2.

Where an exceedance of Performance Targets 1 or 2 occurs, the reactive sampling component of physicochemical water column profiling will be enacted within five days. Data assessment for the reactive monitoring program will include:

- Water column profiles will be interrogated to calculate the median data point for each site which is compared directly against Performance Target 3.

Where an exceedance of Performance Target 3 occurs for reactive monitoring, benthic infauna sampling will be conducted. Results from this reactive sampling component will be compared against the Performance Threshold.

Reporting

Routine Reporting

Routine brine discharge and flow rate monitoring results are to be presented with an assessment against Performance Targets within monthly operational reports.

A summary of results recorded annually including assessment against the Performance Targets will be included within the Annual Compliance Report and submitted to the CEO of DWER and DCCEEW.

Performance Target Exceedance Reporting

A Performance Target exceedance investigation report will be prepared within 10 days of confirming any exceedance in accordance with MinRes. The investigation report will include, but not be limited to;

- A summary of the exceedance;
- A summary of the investigation findings and outcomes; and
- A summary of preventative and/or corrective actions implemented, including identification that reactive monitoring has or will be undertaken to confirm potential for impacts to occur.

Any exceedance of the Performance Threshold will require the following:

1. Notification to CEO of DWER with 24 hours of identification of exceedance; and
2. Exceedance investigation report will be submitted to the CEO of DWER and DCCEEW within three months of the reported exceedance, including;
    a. a summary of the exceedance
    b. a summary of the investigation findings and outcomes
    c. a summary of preventative and/or corrective actions implemented, including identification that reactive monitoring has or will be undertaken to confirm potential for impacts to occur.

8.3.7. Contingency Management

If the Performance Targets or Performance Threshold are not achieved, then the management response will include, but should not necessarily be limited to:

- Investigate the cause of the exceedance or potential sources of higher than predicted toxicity (i.e., chemicals);
- As required , review and adjust desalination process to reduce brine toxicity;
- Undertake equipment inspection, maintenance and calibration as required;
- Increase the dilution ratio of brine water prior to discharge; and
- Adjust discharge regime (e.g., timing, flow rate, volume) as required.

8.4. Ongoing MEQ Monitoring

8.4.1. Purpose

The purpose of the ongoing MEQ monitoring program is to collect quantitative data, to assess against Performance Targets and ensure that impacts from operational activities do not impact MEQ outside the limits of acceptable ecological change for each LEP.

8.4.2. Sampling Design

Procedure

Ongoing marine sediment quality monitoring will commence following the completion of the brine outfall validation phase as well as WET testing when the first brine is available from the RO plant. Surface sediment samples will be collected annually for a three-year period from three (3) sites in the berth pocket and ten (10) sites at the proposed anchorage area and two inshore and four offshore reference sites (**Figure 7** and **Figure 8**). Proposed locations have been selected to ensure potential impacts from cargo handling within the Berth Pocket and at the Offshore Anchorages are identified through the sampling program. Any revision to sampling sites will be based on revised cargo activities (i.e., reduced, or increased anchorages, increased volumes etc.) or during implementation of monitoring activities and will be updated within future versions of this Plan.

Following the initial three-year period of annual sampling, if no impacts to sediment quality are shown, the frequency of sediment sampling will revert to five-yearly throughout the remainder of the AIP operational life. Where impacts are identified (exceedance of Performance Threshold) then sediment sampling will remain annually until no impacts are identified based on successful implementation of contingency actions.

Sampling will involve the collection of sediment using a Van-Veen grab or similar. The grab, plastic tray and other equipment in contact with the sediment will be rinsed with Decon solution and seawater prior to sampling each site to reduce potential for contamination. Where insufficient sediment is collected (i.e., less than 1/3rd of grab volume), the grab will be redeployed. Estimate and record the volume of sediment collected and empty the grab into a plastic tray to mix and homogenise the sediment. Photograph each sample once emptied into the plastic tray. Place sample into appropriate sample jars/containers provided by laboratory. Containers will be refrigerated or placed into an esky with ice bricks before frozen at the completion of each sampling day and sent to a NATA approved laboratory.

An appropriate number of sediment samples will be collected for laboratory analysis of both routine (metals and hydrocarbons) and reactive samples (elutriate and bioavailability, including elutriate waters). Reactive sample analysis only required as defined in **Section 8.4.5**.

All sample containers will be marked with a unique identifier, the date/time and the sampler's name and clarification that the samples are *marine sediment* using a 'wet-write' permanent maker. All samples will then be listed on a chain of custody (CoC) form which will accompany the samples sent to the laboratories.

Sediment quality monitoring sites are placed to ensure potential impacts are monitored (impact sites) and compared with suitable offsite locations (reference sites). There are nineteen in total with nearshore impact sites located within berthing pockets adjacent to product handling operations where impacts, such as spillage, are most likely to occur. The offshore impact sites located within the vicinity of proposed transhipping anchorages where spillages or other impacts are possible.

Details of the monitoring locations are presented in **Table 16**. Sediment sample locations are presented in **Figure 7** and **Figure 8**.

Table 16 Marine Environmental Quality Sampling Monitoring Locations

Site Name	Site Reference	LEP	Easting (GDA94 MGA50)	Northing (GDA94 MGA50)
Nearshore Sediment Sampling Locations (Figure 7)				
SS1-SS3	These have been placed within the berthing pocket adjacent to the offloading facility where impacts are most likely to occur. Berth pockets is also the deepest section of the dredged area and therefore likely to act as a sink for any contaminants.	Moderate	292837	7601553
			294223	7600890
			294288	7600891
REF1	This site is located adjacent to the operational area in the High LEP area to provide reference site data for comparison to impacts. The site will also ensure there are no impacts occurring within the HEPA.	High	295328	7601498
REF2	This site is located adjacent to the operational area in the Maximum LEP area to provide reference site data for comparison to impacts. The site is also strategically positioned within the Ashburton River Delta regionally significant mangrove management area (as defined by EPA 2001) will also ensure there are no impacts occurring within the HEPA.	Maximum	292837	7601553

Site Name	Site Reference	LEP	Easting (GDA94 MGA50)	Northing (GDA94 MGA50)
Offshore Sediment Sampling Locations (Figure 8)				
SS4-SS13	Sites are positioned within each of proposed offshore transhipping anchorages where spillage or other operational impacts are possible.	Moderate	277110	7631017
			276774	7632130
			278801	7634462
			280142	7635163
			282108	7638348
			281743	7637068
			279929	7636946
			278710	7637555
			276927	7635071
			276332	7634111
REF3-REF6	Reference sites are proposed to be positioned within similar benthic habitat areas at similar depths. Reference sites are positioned adjacent to operation, but at a sufficient distance so as not to be impacted by transhipping operations. Data will be used to inform and assist interpretation of data from the Impact sites.	High	274473	7630865
			273467	7629341
			282520	7639826
			284532	7640588

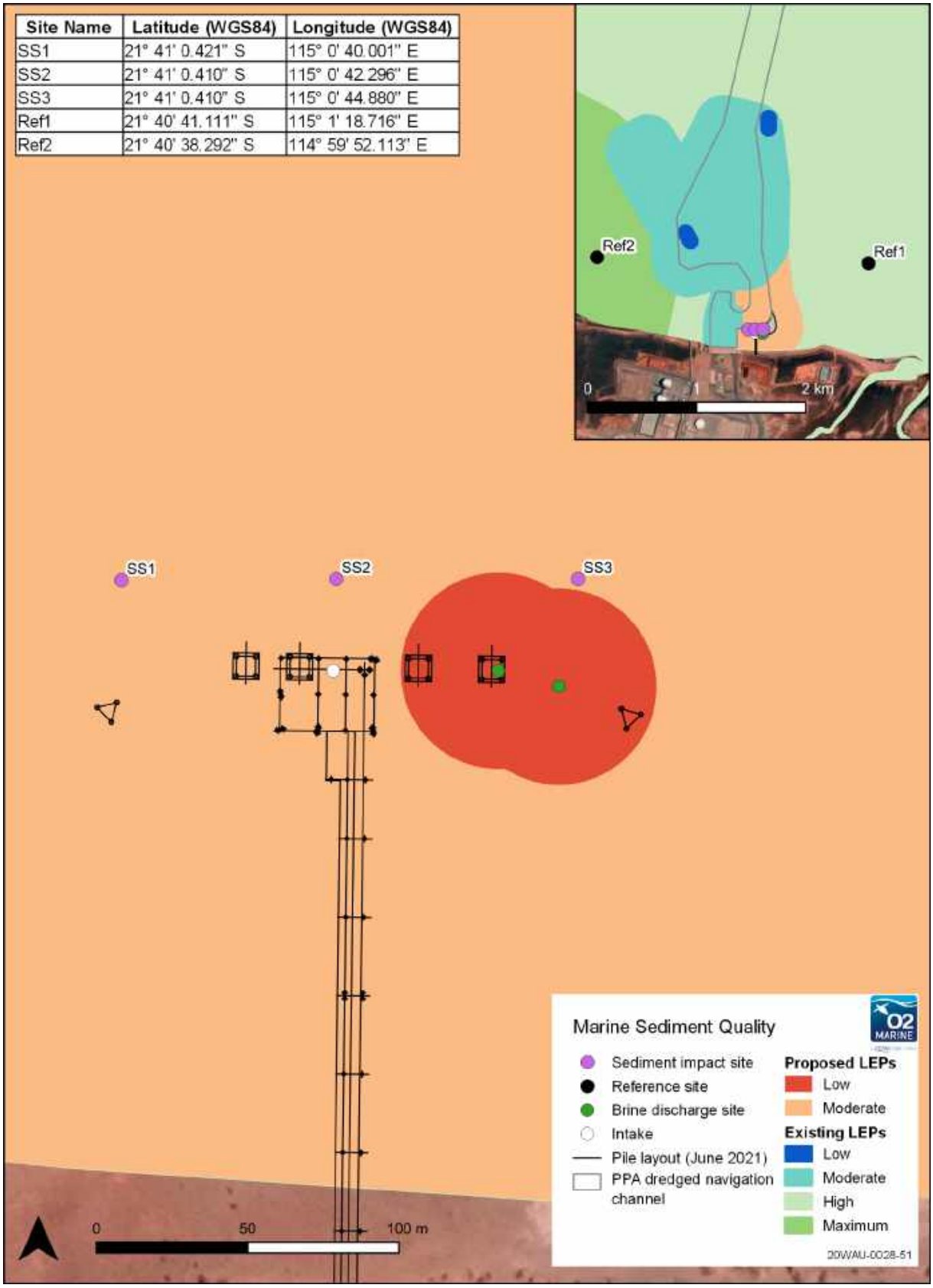

Figure 7 Proposed nearshore sediment quality sampling locations

Site Name	Latitude (WGS84)	Longitude (WGS84)
SS4	21° 24' 33.753" S	114° 50' 59.316" E
SS5	21° 23' 57.443" S	114° 50' 48.208" E
SS6	21° 22' 42.552" S	114° 51' 59.658" E
SS7	21° 22' 20.355" S	114° 52' 46.527" E
SS9	21° 20' 37.680" S	114° 53' 56.227" E
SS8	21° 21' 19.133" S	114° 53' 42.943" E
SS10	21° 21' 22.303" S	114° 52' 39.959" E
SS11	21° 21' 1.952" S	114° 51' 57.942" E
SS12	21° 22' 21.907" S	114° 50' 54.896" E
SS13	21° 22' 52.849" S	114° 50' 33.813" E
Ref3	21° 24' 37.525" S	114° 49' 27.729" E
Ref4	21° 25' 26.605" S	114° 48' 52.080" E
Ref5	21° 19' 49.807" S	114° 54' 11.187" E

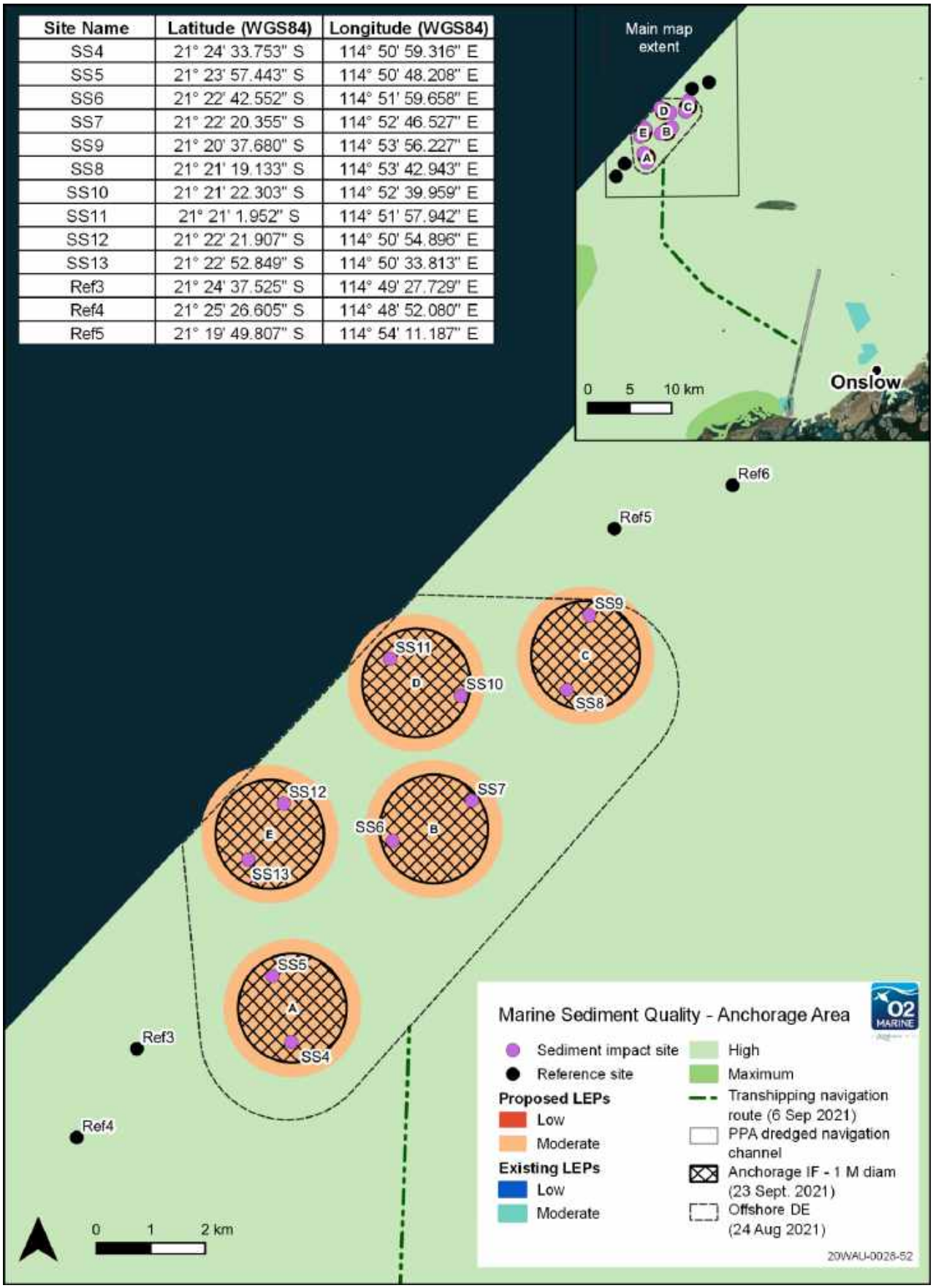

Figure 8 Proposed offshore sediment quality sampling locations

8.4.3. Laboratory Analysis

Sediment quality sample analysis will be performed on samples collected from all monitoring locations**.** These samples will be analysed by a NATA-accredited laboratory for the following analytical suite:

- Particle size distribution (PSD);
- Total organic carbon (TOC);
- Moisture;
- Metals (Al, As, Cd, Cu, Fe, Hg, Pb, Ni, Zn, V);
- Hydrocarbons (TRH and BTEXN).

Elutriate and dilute acid extraction (0.1 M HCL) analysis will also be required where the EQGs for particular analytes are exceeded.

8.4.4. Field Quality Assurance & Quality Control

All water quality meters are to be in calibration. If monitoring equipment is hired, calibration certificates are to be provided from the supplier. Calibration records are to be saved and attached as an appendix to compliance reports.

The following Quality Assurance & Quality Control (QA/QC) Samples shall be collected as described below:

- A ***duplicate sample*** is to be collected at the same site as two (2) of the primary monitoring samples. The purpose of the sample is to confirm that the primary laboratory is able to produce consistent results when analysing the same sample.
- A ***field triplicate sample*** is collected at one site. The purpose of this sample is to confirm physical and chemical variability of the sediments.
- A ***rinsate sample*** is collected to confirm that cross contamination doesn't occur during the sampling processes in the field.

8.4.5. Data Assessment and reporting

Data Assessment

All data are required to be validated prior to the release of any monitoring reports to confirm that data has been analysed correctly. Data analysis is to be checked and verified against raw data logs through an internal peer review process.

An assessment of quality control data needs to be undertaken and included in all reports including:

- Assessment of field contamination (rinsate);
- Assessment of field variability (triplicate);
- Assessment of lab variability (inter-laboratory duplicates); and
- Laboratory QA/QC results.

Analytical results for each site will be compared against Performance Target 3 as follows:

- Raw metals and hydrocarbon results (normalised to 1% TOC) will be pooled based on spatial location (i.e., offshore and nearshore) with the 95% upper confidence levels of the means compared to the EQGs presented in **Table 13**;
- If the preliminary EQGs are exceeded, then elutriate and bioavailability testing will be conducted by the laboratory:
    1. Bioavailability testing results are compared to the EQGs presented in **Table 13;** and
    2. Elutriate results are compared to the EQGs presented in **Table 14.**

Where an exceedance of Performance Target 3 occurs, benthic infauna sampling will be conducted. Results from this reactive sampling component will be compared against Performance Threshold 1.

Reporting

An environmental summary report will be developed at the completion of each monitoring period which will include, but not be limited to:

- Summary of the methods applied and any deviations from this MOEMMP;
- A table summarising laboratory analysis results;
- Timeseries graphs of laboratory analysis results;
- An assessment of all data collected against Performance Targets;
- A review of Performance Target exceedances investigations and remedial actions implemented; and
- Any actions or recommendations required as a result of field implementation of the MOEMMP and assessment of monitoring data.

An investigation report will be compiled for any elevated results which requires investigation. Any EQS exceedance reports will be submitted to the CEO of DWER within three months of the reported exceedance, including associated monitoring program and results.

8.4.6. Contingency Management

Where Performance Targets are, or the performance threshold exceeded then an investigation into the cause will be undertaken.

Where the cause is able to be identified, cargo handling and relevant operation procedures and practices will be amended accordingly to ensure that the likelihood of any re-occurrence is reduced. Some of the contingency actions which may be able to be revised include:

- Conduct operational audits to ensure compliance with document processes;
- Conduct facility inspections to ensure all equipment and vessels are operating as per manufacturer specifications;
- Ensure quality of the cargo meets handling process requirements (moisture levels)
- Review cargo handling loading parameters (wind, sea state tides);
- Modification to loading facilities to increase environmental performance (inclusion of barriers, sumps, collection points, dust suppression etc.); and
- Revise the anchorage positions if sea-state cannot be achieved.

8.5. Avoidance of marine fauna during vessel operation

To minimize the risk of vessel strike during vessel operations, the following management measures have been developed. These measures focus on species particularly at risk who bask/ rest on the surface and/ or are air breathers but will be implemented for other marine fauna species if observed. Trained MFO is a crew member trained in marine fauna species observations and mitigation measures, consistent with Project environment management plans. The trained MFO will be on duty on Project vessels during construction and operations and may have other vessel duties. There will be at least one Trained MFO on duty at all times during construction and operations. The Trained MFO will be on marine fauna observation/mitigation measure duties only

Measure – 1

Vessels engaged in MinRes operations will comply with PPA speed limits, 9 knots, within the Port boundary in the event a vessel engaged in MinRes operations strikes a conservation significant marine fauna an incident investigation will be undertaken to determine if speeds limits need to be adjusted to reduce the risk of repeated vessel strikes. The results of this risk incident investigation, including any management actions, will be made available to DCCEEW. In the event a vessel strike occurs at night and this strike results in severe injury or fatality to a conservation significant marine fauna species then, night-time speed limits will be temporarily reduced to under 10 knots in areas considered to be high-risk areas on the advice of the dedicated marine fauna observer (Laist et al, 2014). The need for this reduced night-time speed limit to continue will be reviewed once the results of the incident investigation are known. The results of this review will be made available to DCCEEW.

Measure – 2

All vessel crews engaged in MinRes marine operations will attend a minimum of one marine fauna induction to become familiar with the range of conservation significant marine fauna that could be present in the operational area and the risks MinRes operations may present to this fauna. All commitments made by MinRes to manage vessel interactions with conservation significant marine fauna will be included in the induction. The content of the induction will be updated as required to ensure it remains current and reflects the marine fauna being observed in the operational area and any vessel interactions with these fauna that have occurred. This marine fauna induction can be combined with other crew inductions that may be required.

Measure – 3

At least one member of the crew on each vessel undertaking operational activities will be trained in marine fauna observations and mitigation measures, including the requirements of the Wildlife Conservation (Closed Season for Marine Mammals) Notice 1998, as amended or replaced from time to time, and maintain a log of fauna observed during vessel transit consisting of: GPS coordinates; species (if known); and behaviour. Logs are to be submitted to the DEC on an annual basis at the same time as submitting the compliance assessment report required by condition 4-6 to the CEO. These crew members will have other vessel tasks, when the vessel is not in transit, or have the ability to undertake tasks while performing quality observations (e.g. vessel watchman, skipper).

This will be reviewed after 6 months of marine operations, informed by the number of actual vessel fauna interactions that have resulted in serious injury or fatality to conservation significant marine fauna. The results of this review will be made available to DCCEEW for comment.

Measure – 4

Lighting on all vessels engaged in MinRes operations and MinRes marine infrastructure will be kept to the minimum that is required for safe operation for the vessels and infrastructure.

Measure – 5

Vessels under the control of MinRes and which enter the operational area from high-risk areas will undergo a desktop risk assessment to determine the likelihood of the introduction of marine pests. The risk assessment tool will be consistent with the DCCEEWs guidelines on managing marine pests. This risk assessment tool will be provided to DCCEEW for their review and comment prior to implementation.

8.6. Underwater noise from operational vessels

Acoustic stress to marine fauna is a threat posed by vessel operations. Noise created by industrial operations, can often form localised noise sources. If sufficiently loud, these sources may be detrimental to certain marine species by resulting in Temporary Threshold Shift (TTS) or Permanent Threshold Shift (PTS) in marine fauna hearing (Talis Consultants, 2022). Exceeding these noise thresholds can put undue stress on marine fauna, create disorientation and therefore alter life history strategies. In extreme cases, if PTS are reached then hearing may be permanently damaged for marine fauna. Project TSVs and OGVs do not have the ability to exhibit sound readings that exceed limits for the Projects (Talis Consultants, 2022). By abiding by vessel strike management measures there is also a further reduced spatial risk of interference between marine fauna and sources of localised industrial noise and therefore reducing risk of exceeding EPBC listed species TTS or PTS. Irrespective the following management measure will be followed:

- Project vessels will be maintained in accordance with their maintenance system to avoid increasing noise transference into the water.

By following guidance for applying levels of ecological protection under the EPA guidelines for marine environmental quality, the factor of marine fauna is largely addressed by establishing management measures for marine environmental quality. By abiding by these MEQ management measures, EPBC listed marine fauna are indirectly protected, as the risk of harm or exceeding biological thresholds is reduced from exposure to brine wastewater discharge from the Project operations.

9. Review

This MOEMMP is a dynamic document and will be regularly reviewed in accordance with **Table 17** to ensure it remains relevant to the Project and aligns with industry best practice.

Table 17 MOEMMP review timeframes for the Project lifecycle

Timing	Rationale
Scheduled Review	
Upon receipt of Approval Conditions	Ministerial Statement approval conditions obtained will necessitate a comprehensive review of this MOEMMP to ensure all relevant aspects are covered within this Plan to ensure compliance.
Upon Completion of Validation assessment	A comprehensive review of the LEPs and EQC will be required based upon data obtained during this phase. A comprehensive review of the entire MOEMMP will be required to ensure adequacy for management of the ongoing MEQ with respect to the final operational Processing Facility.
Annually during routine operations	At the completion of annual reporting requirements any recommendations for alteration of the MOEMMP will need to be incorporated into a revised version suitable for the next 12 months of operations.
Ad-Hoc Review	
Any time operational activities significantly alter	Operational changes to the project may result in an altered risk profile. Therefore, the MOEMMP will require a review to ensure that it remains fit-for-purpose for altered operational conditions.
Any time brine discharge quality or regime alters	Process or design alterations changes to the brine discharge may result in an altered risk profile. Therefore, the MOEMMP will require a review to ensure that it remains fit-for-purpose for altered operational conditions.

During review of the MOEMMP consideration will be given to (but not limited to):

- Overall effectiveness of the Plan;
- Appropriateness of EVs, EQO and LEPs;
- To refine EQC with compiled baseline data set;
- New threats to MEQ that may be identified;
- Lessons learned during sampling or analysis;
- Changes in industry best practice;
- Changes in environmental risk; and
- Any changes in methodology or equipment used.

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Appendix A. Risk Assessment

A Risk Assessment has been undertaking using the guidelines provided by the Australian Department of Environment (DoE, 2014)

The objectives of the risk assessment are:

- Provide a consistent, qualitative and systematic process to screen and rate potential impacts in terms of likelihood and consequence;
- Identify those risks of greater likelihood of occurrence and consequence to support the development and implementation of appropriate mitigation measures; and
- Identify those risk of low likelihood of occurrence and consequence to allow for an appropriate level of management focus.

This risk assessment was undertaken whereby each potential environmental impact was given a risk rating in terms of likelihood and consequence using the definitions in **Table A-18** and **Table A-19** below. These definitions are provided in *Environmental Management Plan Guidelines, Commonwealth of Australia 2014*.

Table A-18 Likelihood Definitions

Qualitative measure of likelihood (how likely is it that this event/issue will occur after control strategies have been put in place)	
Highly likely	Is expected to occur in most circumstances
Likely	Will probably occur during the life of the project
Possible	Might occur during the life of the project
Unlikely	Could occur but considered unlikely or doubtful
Rare	May occur in exceptional circumstances

Table A-19 Consequence Definitions

Qualitative measure of consequences (what will be the consequence/result if this issue does occur rating)	
Minor	Minor incident of environmental damage that can be reversed
Moderate	Isolated but substantial instances of environmental damage that could be reversed with intensive efforts
High	Substantial instances of environmental damage that could be reversed with intensive efforts
Major	Major loss of environmental amenity and real danger of continuing
Critical	Severe widespread loss of environmental amenity and irrecoverable environmental damage

Risk rating for Likelihood and Consequence have been combined using the Risk Matrix presented in **Table A-20** below to determine final risk ratings (low, medium, high, or severe).

Table A-20 Risk Matrix used to determine final risk ratings

	Consequence				
	Minor	Moderate	High	Major	Critical
Highly Likely	Medium	High	High	Severe	Severe
Likely	Low	Medium	High	High	Severe
Possible	Low	Medium	Medium	High	Severe
Unlikely	Low	Low	Medium	High	High
Rare	Low	Low	Low	Medium	High

Appendix B. Existing Environment

This section describes the existing environment at the site of the AIP and surrounding waters. The description of the existing environment is based on a desktop review of historical information and investigations currently conducted as part of the environmental impact assessment process.

Water Quality

The area around Onslow is characterised by relatively turbid inshore/nearshore waters that are subject to moderate tidal and residual flows (non-harmonic currents driven primarily by meteorological forcing, generally in the longshore direction over a period of days or weeks) and episodic highly turbid runoff from the Ashburton River. The mid and outer waters are generally clear (Chevron Australia 2010). The coastal waters generally have very low levels of anthropogenic contamination (Wenziker et al. 2006) and are oligotrophic with low availability of nitrogen limiting rates of primary production. However, on occasions blooms within the water column of nitrogen-fixing cyanobacteria such as *Trichodesmium* spp. or associated with tidal flats surrounding mangrove communities may contribute significant amounts of nutrients into the marine environment. High spatial and seasonal variability has previously been recorded in nutrient and chlorophyll-a concentrations within the Dampier Archipelago (Pearce et al. 2003; Buchan et al. 2003). Baseline nitrogen and phosphorus concentrations in the marine waters around Onslow occasionally exceeded the default trigger values of 100 µg/L total nitrogen (Ntot) and 15 µg/L total phosphorus (Ptot) specified by ANZECC & ARMCANZ (2000), with concentrations approaching 350 µg/L and 18 µg/L, respectively for Ntot and Ptot (Chevron Australia 2010).

Baseline water quality values were collected as part of the EIS/ERMP for the Wheatstone Project. Two separate monitoring programs provide relevant baseline values to characterise the existing environment:

1. A regional monitoring program of water quality in the area near the proposed turning basins along the proposed trunkline adjacent to Bessieres and Thevenard Island (MScience 2011), and
2. A localised monitoring program focussed on the water quality around the proposed nearshore outfall approximately 0.5-1.0 km from the shoreline (MScience 2013).

The baseline water quality conditions and results of these monitoring programs are presented below in terms of the concentrations of:

1. Toxicants
2. Other Physical and Chemical Parameters
3. Biological Parameters.

Potential pressures on water quality are discharge of pollutants (nutrients and toxicants) into the water, construction activities, maintenance dredging and bypassing works generating elevated turbidity and suspended sediment, disturbance of acid sulphate soils and the risk of accidental spillage of toxicants and nutrients. Waste discharges also occur from the Wheatstone LNG facility and the Onlsow Salt waste brine outfall.

In accordance with the State Water Quality Management Strategy Environmental Quality Management Framework (EQMF), the Department of Environment (DoE) consulted with relevant stakeholder groups across the Pilbara in 2006 to establish Environmental Values (EVs) and Environmental Quality Objectives (EQOs) and assign appropriate Levels of Ecological Protection for Pilbara Coastal Waters. This process has since been refined and described in EPA's Technical Guidance *for Protecting the Marine Environmental Quality of Western Australia* (EPA 2016). Marine coastal waters in the Project are assigned a High LEP or Maximum LEP to the West of the ACW in waters adjacent to the Ashburton regionally significant mangrove area. A Moderate LEP is assigned to the ACW and offshore dredge material disposal areas, with a Low LEP assigned to the mixing zone immediately surrounding outfall discharges.

Toxicants

The results of the monitoring programs provide baseline concentrations and indicate the ANZECC & ARMCANZ (2000) guideline values for toxicants generally provide appropriate concentrations for protecting the environmental values of the nearshore waters. Baseline concentrations occasionally exceeded the lower reporting limit although these concentrations typically varied between surveys.

The baseline 95th percentile concentrations of cadmium, chromium, manganese, molybdenum, nickel, vanadium and mercury were always below the ANZECC & ARMCANZ (2000) guideline values for 99% or 90% species protection. The concentrations of arsenic, copper, lead, aluminium and selenium were always below the reporting limit and/or the ANZECC & ARMCANZ (2000) guideline values for 99% or 90% species protection. However, the Limit of Reporting (LOR) for these elements was, at times, above the guideline or low reliability guideline value. There are no published guideline values for iron. The 95th percentile concentration of zinc exceeded the guideline value for 99% species protection (High LEP) but not 90% species protection (Moderate LEP). A high reliability guideline concentration for aluminium is not available; the low reliability ANZECC & ARMCANZ (2000) guideline value is 0.5 µg/L and was exceeded. This published guideline for aluminium has been calculated from limited data and is provided as an indicative value only.

Oil and Grease, Total Solvent Extractable (O&G TSE) was rarely detectable and median concentration was usually below 5 mg/L. The test for chlorine was not sensitive enough to detect if chlorine concentrations approached the low reliability ANZECC & ARMCANZ (2000) guideline value. Under such circumstances a more sensitive method combined with comparison to reference sites will be used for monitoring purposes. Overall, the results indicate that the water quality guidelines for 99% and 90% species protection for all elements are suitable for application to the water around Onslow, notwithstanding the effects of potentially elevated background concentrations for constituents where guidelines values were below the LOR and periodic nitrogen and phosphorous excursions.

Other Physical and Chemical Parameters

The results of the monitoring programs indicate that the water quality guidelines recommended in ANZECC & ARMCANZ (2000) for other physical and chemical parameters are generally not suitable for protecting the environmental values of the nearshore waters around Onslow.

For nitrogen-based water quality parameters (Ntot, nitrates + nitrites) baseline median concentrations in MScience (2013) were above the recommended guidelines specified in ANZECC

& ARMCANZ (2000). The median concentrations for both Ptot and filterable reactive phosphorus in MScience (2013) were below the ANZECC & ARMCANZ (2000) default guideline values although Ptot did, at times, exceed the guideline value. Further from shore, Ntot exceeded guideline values, but nitrate + nitrite, ammonia, Ptot and filterable reactive phosphorus did not (MScience 2011). Monitoring undertaken in the specific area of interest therefore provides the most appropriate values for calculation of locally relevant triggers for nitrogen and phosphorus compounds as recommended by ANZECC & ARMCANZ (2000).

Most of the remaining other chemical and physical parameters, particularly turbidity, temperature and salinity (shown TDS), exhibit high natural variability. This has been well demonstrated in the regional monitoring of these parameters over a 2-year baseline period (SKM 2013). A review of regional water quality indicated that the regional median turbidity was usually <1 Nephelometric Turbidity Units (NTU) and the 80th percentile was <3 NTU during non-cyclonic periods (MScience 2009).

Across 30 sites daily median turbidity ranged from <1 NTU during winter up to 6 NTU during non-cyclonic periods in summer. Discharge from the Ashburton River during inland rainfall is the primary source for input of terrestrial sediments to the nearshore waters. These events can cause large-scale turbidity elevations in nearshore waters over a period of months. Spring and summer are times of the year when there are persistent westerly winds and increased runoff from rainfall as well as periodic cyclones.

The influence of cyclonic activity on turbidity is strong. During the passage of Tropical Cyclone (TC) Dominic in January 2009, daily median turbidity increased to approximately 80 NTU and remained above 20 NTU for at least ten days. Offshore waters in general tend to have lower turbidity levels. Turbidity levels in the week following TC Iggy peaked at approximately 100 NTU at inshore and some eastern mid-shore sites; and 80 and 60 NTU at western mid-shore and offshore sites, respectively (SKM 2012).

During the January – March 2012 monitoring period, median daily photosynthetically active radiation (PAR) showed a general pattern of greater PAR at offshore sites than inshore and mid-shore sites. PAR also varies seasonally in waters off Onslow. The median total daily PAR across sites ranged from 1.8 to 16 mole/m^2/day in summer and 3.0 to 11.4 mole/m^2/day in winter (SKM 2012). Daily PAR decreased to 0.0 mole/m^2/day after the passing of TC Iggy. The return to normal PAR levels following this event was quicker at offshore sites (SKM 2012). Most monitoring sites showed a response to spring tides, with the added water depth resulting in reduced PAR.

Sediment re-suspension, mainly due to wind-driven waves, is common in the area immediately seaward of the intertidal zone and can lead to considerable turbidity (Forde 1985). This was evident in the January to March 2012 monitoring period and may be related to the generally smaller particle sizes that were found at the inshore sites (SKM 2012). Resuspension further offshore is mainly due to internal or subsurface waves (Heywood *et al*. 2006).

Water temperature and salinity were similar across all sites during January to March 2012, indicating that the waters were well mixed.

Biological Parameters

The ANZECC & ARMCANZ (2000) guideline values for biological parameters generally provide appropriate concentrations for protecting the aesthetics and for primary and secondary contact purposes for protecting the environmental values of the nearshore waters around Onslow. Total coliforms measured were well below guideline values for recreational water use.

Sediment Quality

The marine sediments in the region mainly consist of silt and sand sheets of varying thickness overlying Pleistocene limestone. Near the Ashburton Delta, sediments are generally fine silts and clays with high silica content (Chevron 2013).

Two broad types of sediments occur within the area: sands intermixed with variable fractions of clays, silts and or gravels, and; rock (siltstone, claystone and sandstone) that is generally weathered and weak. The proportion of the two soil types changes with increasing distance from the shore. In the ACW and PLF basin the material to be dredged consists of 75% sand and 25% weak rock. In the PLF approach channel the material is 60% sand and 40% weak rock. In both cases, sand is assumed to overlay the rock. Sediments become increasingly coarse and increase in calcium carbonate content with distance offshore, due to decreasing input of terrigenous silts and clays from river runoff and coastal erosion (Coffey 2009).

The chemical characteristics of marine sediments in the vicinity of the Ashburton North Site has been assessed on two previous occasions; once in 2005 by the DEC (2006) and by URS in the Wheatstone dredging area (URS 2009).

The DEC (2006) study recorded no discernible anthropogenic enrichment of contaminants (e.g., organotins, hydrocarbons, organochlorine pesticides and polychlorinated biphenyls) in sediments offshore of the Ashburton River mouth. The study also measured natural background concentrations of trace metals in the marine sediments, noting that, with the exception of arsenic, natural background concentrations of all metals were below the relevant Australia and New Zealand Environment and Conservation Council/Agricultural and Resource Management Council of Australia and New Zealand (ANZECC/ARMCANZ) (2000) screening levels (DEC 2006).

During the URS (2009) survey, marine surface sediments and deep cores were sampled within and near the proposed dredging area and grab samples from the proposed nearshore disposal grounds. The study recorded concentrations of all contaminants and trace metals as being below the laboratory limit-of reporting (LOR) or below the relevant National Assessment Guidelines for Dredging (NAGD) (Commonwealth of Australia 2009d) screening levels, with the exception of arsenic and nickel (URS 2009).

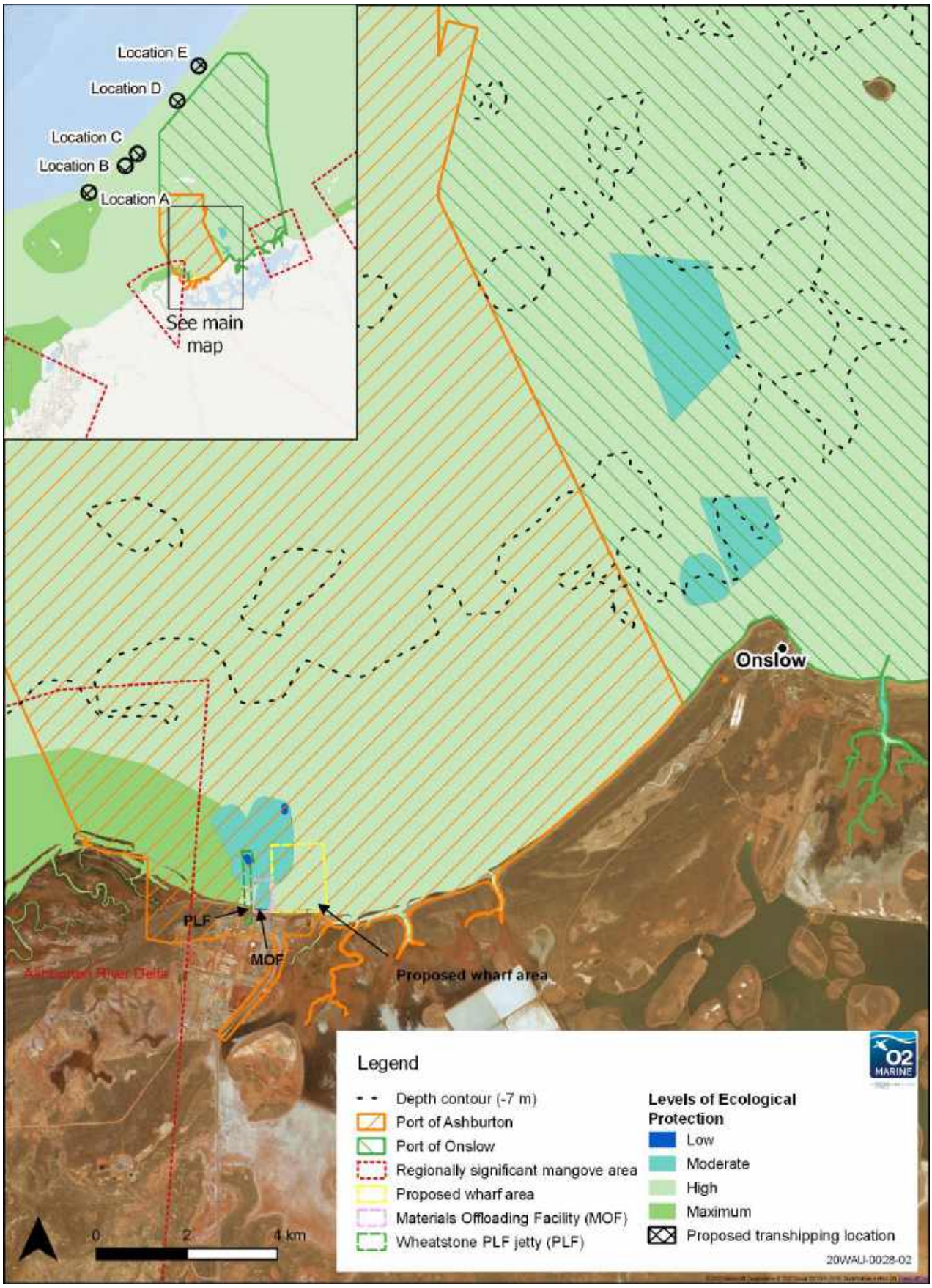

Figure A - 1 Levels of Ecological Protection for the AIP

The current major pressure on sediment quality in the vicinity of the AIP is from shipping activity, pollution and mobilisation of contaminated sediments through maintenance dredging and waste discharges (i.e., Wheatstone and Onslow Salt).

A geochemical assessment of the sediment was undertaken for the Wheatstone Project to determine whether the potential for acid sulfate soils (ASS) to develop exists. A total of 72 samples were collected from 15 deep core borehole locations at varying depths along the length of the navigation channel, turning basin and ACW. The investigation concludes that the likelihood of encountering PASS or AASS material from collected samples of the area is low. This was indicated by a negligible acid generating capacity of the sediment encountered during the field sampling program. Where PASS was encountered, typically in the superficial sediment profile close to the coastline, based on laboratory results it is considered that the sediments have sufficient available carbonate buffering capacity to negate any potential acidity for material that may be placed onshore. However, given the requirements outlined in DER (2015), it is likely that management options in the form of an acid sulfate soils management plan (ASSMP) will be required if onshore placement of material is undertaken of the dredge material.