Introduced Marine Pest Management Plan

Mardie Project

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Acronyms and Abbreviations

Term	Full term
°C	Degrees Celsius
AFC	Anti-fouling coating
ALARP	As Low as Reasonably Practicable
ANZECC	Australian and New Zealand and Environment and Conservation Council
APMPL	Australian Priority Marine Pest List
BC Act	*Biodiversity Conservation Act 2016* (WA)
BCH	Benthic Communities and Habitat
BCHMMP	Benthic Communities and Habitat Monitoring and Management Plan
BCI	BCI Minerals Ltd
BOLD	Barcode of Life Database
BoM	Bureau of Meteorology
BWMP	Ballast Water Management Plan
CC	Closed canopy
CCIMPE	Consultative Committee on Introduced Marine Pest Emergencies
Cth	Commonwealth
DAFF	Department of Agriculture, Fisheries and Forestry
DCCEEW	Department of Climate Change, Energy, the Environment and Water (Cth)
DE	Development Envelope
DMPA4	Dredge Material Placement Area 4
DPIRD	Department of Primary Industries and Development
DSDMP	Dredge Spoil Disposal Management Plan
DWER	Department of Water and Environmental Regulation
eDNA	Environmental DNA
EEPL	Exotic Environmental Pests, Weeds and Diseases
EP Act	*Environmental Protection Act 1986* (WA)
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
EPOs	Environmental Protection Outcomes
ha	hectares
IMO	International Maritime Organisation
IMP	Introduced marine pests
IMPMP	Introduced Marine Pest Management Plan

Term	Full term
IMS	Introduced marine species
km	kilometre
LAT	Lowest astronomical tide
LAU	Local Assessment Unit
LEP	Level of Ecological Protection
m	metres
MARS	Marine Arrivals Reporting System
MDET	Monitoring Design Excel Template
mm	millimetres
MPSC	Marine Pest Sectoral Committee
MS	Ministerial Statement
MSC	Marine Stewardship Council
NEBRA	National Environmental Biosecurity Response Agreement
NIMPCG	National Introduced Marine Pest Coordination Group
NIMPIS	National Introduced Marine Pest Information System
NTU	Nephelometric Turbidity Units
OGV	Ocean-going vessel
PAR	Pre -arrival report
ppt	Parts per thousand
PVC	Polyvinyl Chloride
SAP	Sampling Analysis Plan
SME	Subject Matter Expert
SoP	Sulphate of potash
SOP	Standard operating procedure
SWASP	State Wide Array Surveillance Program
TSV	Transshipment Vessel
WA	Western Australia

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1. Introduction

1.1. Project description

BCI Minerals Ltd (BCI) has been granted approval for the Mardie Project, a greenfields high quality salt and sulphate of potash (SoP) project and an associated transhipment export facility at Mardie, approximately 80 km south-west of Karratha, in the Pilbara region of Western Australia (WA) (Figure 1).

The Original Proposal was assessed by the WA Environmental Protection Authority (EPA) under Part IV of the *Environmental Protection Act 1986* (WA) (EP Act) and approved by the WA Minister for Environment via Ministerial Statement (MS) 1175 on 24 November 2021. Environmental approval was also granted by the Department of Climate Change, Energy, the Environment and Water (DCCEEW) under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) on 12 January 2020 via EPBC 2018/8236. Mardie Minerals has since revised the project design, referred to as the Optimised Mardie Project (the Project) which was approved via MS 1211 (which superseded MS1175) on 19 October 2023 and via EPBC 2022/9169 on 9 September 2024. The EPBC 2018/8236 conditions were varied on 9 October 2024 to mirror the EPBC 2022/9169 approval. Dredging is required for the construction of the export facility, and the addition of offshore disposal of dredged material is currently under assessment by the EPA via s40AA for a significant amendment to MS 1211, and by DCCEEW via EPBC 2024/10054.

The Project is designed to use solar and wind evaporation to concentrate seawater, enabling the sustainable production of approximately 5.35 million tonnes per year of high-grade sodium chloride (NaCl) and around 140,000 tonnes annually of sulphate of potash (SoP) fertiliser. These products will support the expanding needs of the chemical and agricultural sectors, with operations expected to continue for more than 60 years. The Project commenced operations on the 10th of September 2024, marked by the filling of Pond 1.

The Project involves capital dredging of an estimated 355,000 m^3 design volume (including 10% over-dredging volume) to ensure sufficient depth for the transhipper berth pocket at the end of the trestle jetty, as well as along an approximately 4.9 km long channel out to deeper water. Disposal of the dredge material will be offshore at proposed Dredge Management Placement Area 4 (DMPA4), located approximately 25 km (14 nautical miles) north-northwest of the dredging location (Figure 2).

Maintenance dredging volumes on average are expected to be up to 50,000 m^3 annually to maintain sufficient depths for the project operations (Preston Consulting 2025). However, based on similar channels in the Pilbara, it is not expected that maintenance dredging will need to be undertaken every year. Channel maintenance will be related to annual variability in the sedimentation rate at the dredge site dependent on a range of environmental factors (e.g. wave action, tidal currents and severe weather events (cyclones) impacting the site). Maintenance dredging is more likely to be every 2-4 years (Preston Consulting 2025).

Salt, fertiliser grade SoP, and potentially other commercial by-products will be transported from the stockpile areas to the barge-loading facility on the trestle jetty. The final salt and SOP product will be exported from the 2.4 km trestle jetty and loaded onto the transhipment vessel. Transhipment vessels

(TSVs) will travel offshore to dock with Ocean Going Vessels (OGV)and transfer product into OGV's for overseas export (Figure 3).

The Development Envelope (DE) shown in Figure 2 and Port of Cape Preston West proposed anchorage locations are presented in Figure 3.

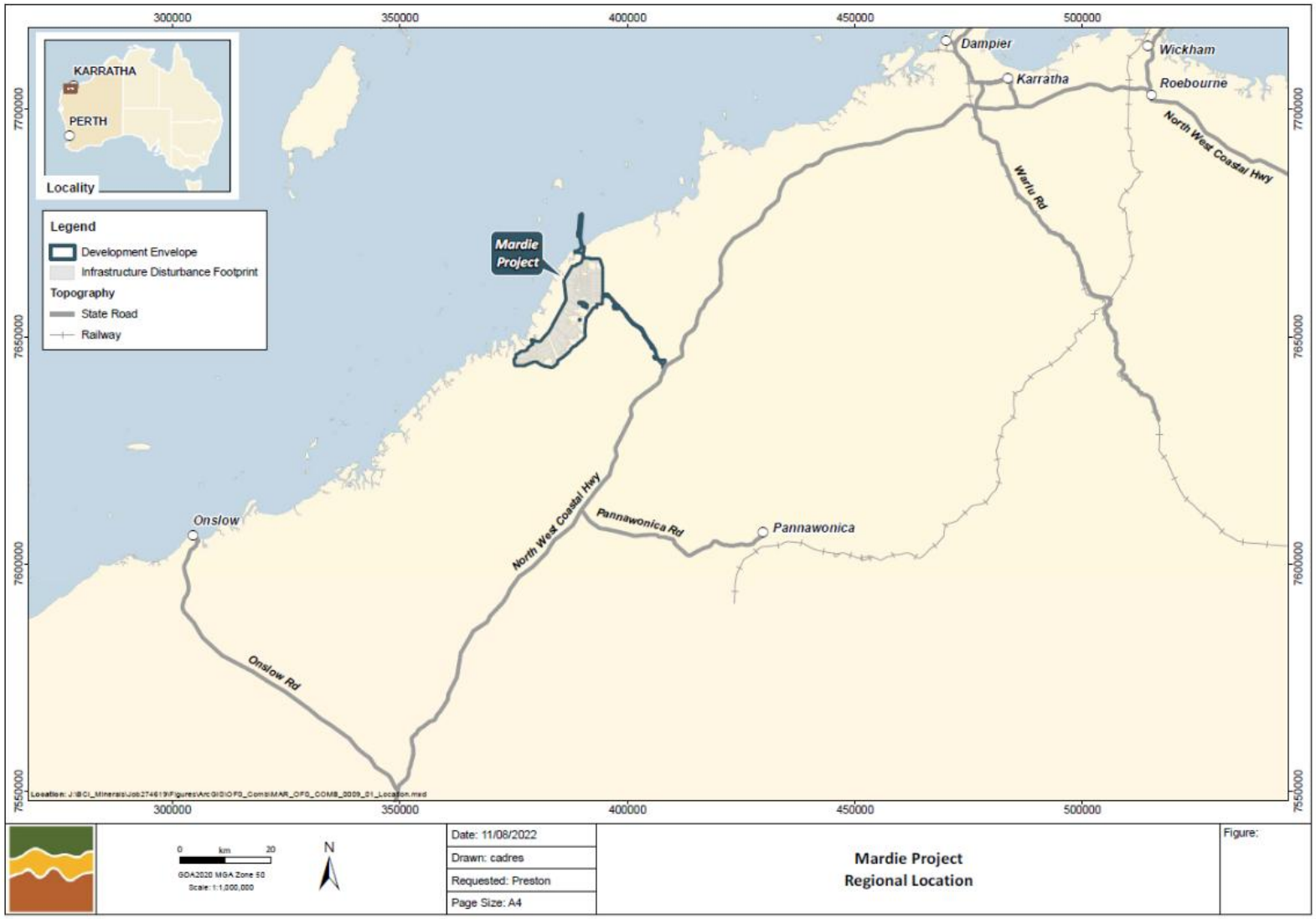

Figure 1: Regional location of the Project

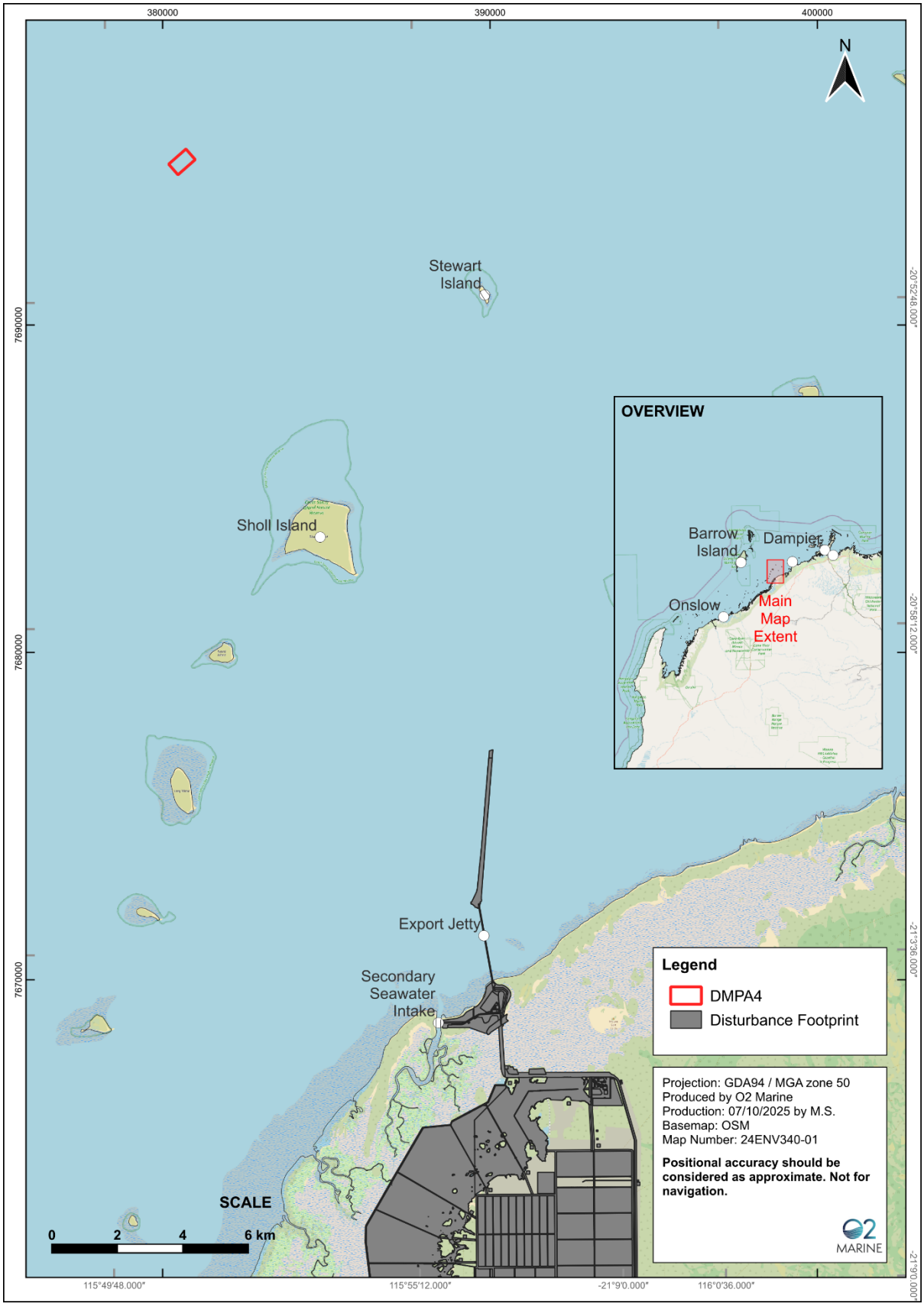

Figure 2: Approved Project area and proposed offshore disposal site (DMPA4)

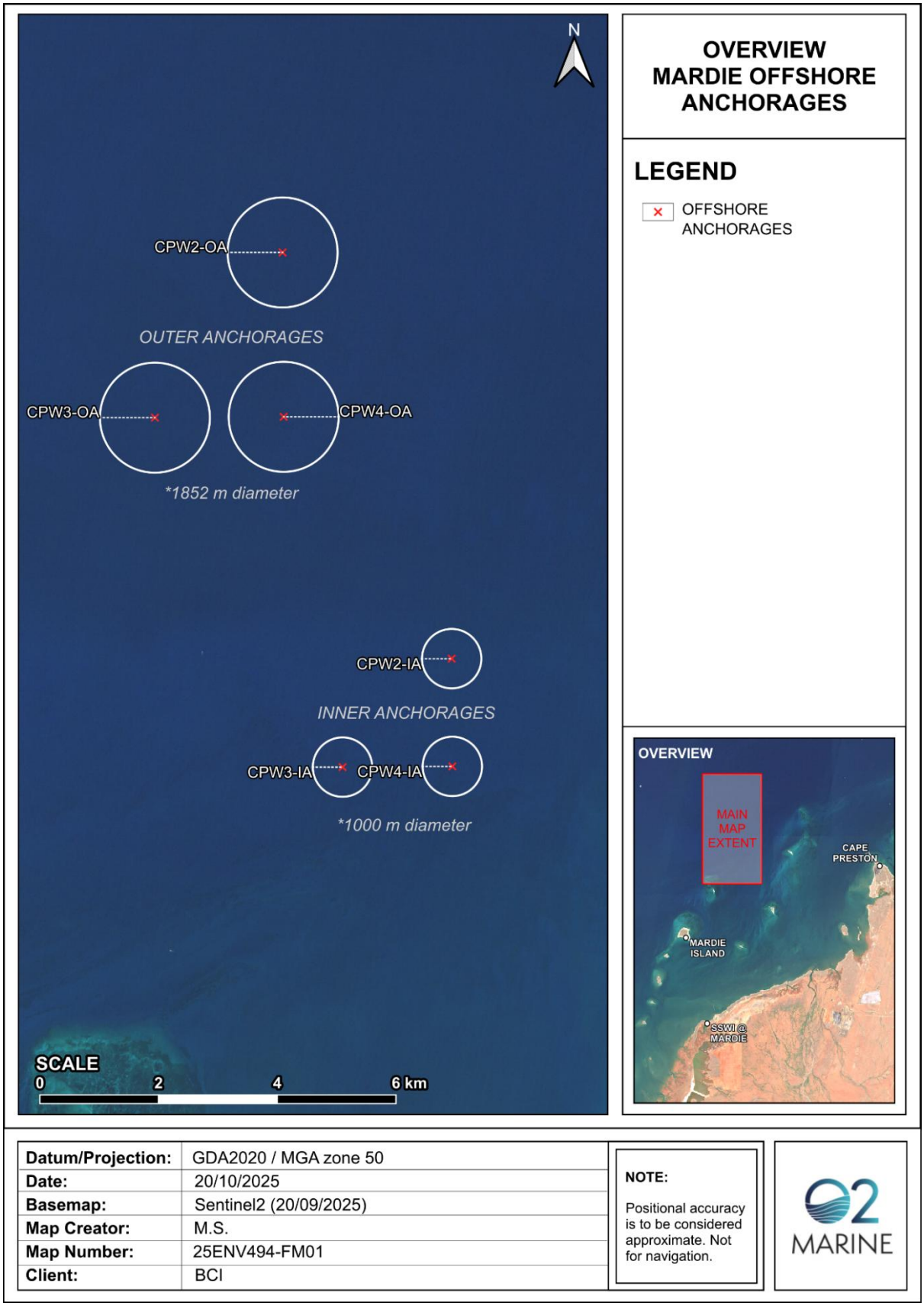

Figure 3: Port of Cape Preston West proposed anchorage locations to be used by the Project

1.2. Purpose

The intention of this Introduced Marine Pest Management Plan (IMPMP) is to replace the existing Marine Pest Management Procedure (O2 Marine 2022; 21WAU-0060-08/T210234) and revise the risk assessment to ensure risk associated with the changes with dredging and offshore disposal have been appropriately considered.

The purpose of the IMPMP is to incorporate the existing risk assessment and the approved Marine Pest Management Procedure to develop a management plan that satisfies MS 1211 Condition B2-2, C1-1 and C4-1 (See Section 0). Specifically, this plan includes the following key elements:

- Analysis of risk and likelihood of introduction of introduced marine pests (IMPs) during the construction phase and operational life of the Project through vessel movements and activities.
- Identification of IMP transfer risk species for the Project area using the National System Monitoring Design Excel Template (MDET).
- Risk assessment of IMP translocation due to the Project and identification of relevant management controls to reduce risk.
- Define detailed management and monitoring actions to ensure the Project's Environmental Protection Outcomes (EPOs) are achieved.
- Define and detail IMP monitoring requirements for construction and operations.

1.3. Objectives

The objective of this IMPMP is to identify IMPs of potential risk and to assign appropriate management actions and mitigation measures, where necessary, to ensure that the EPO of no introduction or establishment of marine pests in the State Waters as a result of the Project in line with Condition B2-1(1) of the MS1222.

1.4. Project conditions

This IMPMP is developed to meet Ministerial Statement 1211 conditions B2, C1-1 and C4 and comply with condition 74 of the EPBC 2018/8236 and EPBC 2022/9169 approvals, as outlined in Table 1 and Table 2. At the time of writing this plan there is a pending assessment in which BCI are proposing to revise the proposal. This is documented in the EPA assessment number 2500 and associated EPA report 1795. Whilst the outcomes of the assessment may change implementation conditions related to the disposal of dredge spoil it is unlikely to affect those relating to IMP and thus this plan is considered appropriate to meet the intent the existing (MS1211) and proposed (outlined in EPA report 1795) conditions. The IMPMP will replace the approved Marine Pest Management Procedure and form the basis for IMP management for the Project.

Table 1: Relevant Ministerial Statement 1211 approval conditions

Condition	Requirements	Section of this Plan
B2 Marine Pests		
B2-1	The proponent must ensure the implementation of the proposal achieves the following environmental outcomes:	Section 7 Section 8

Condition	Requirements	Section of this Plan
	1. No introduction or establishment of marine pests in the State Waters as a result of the proposal	
B2-2	The proponent must implement the Marine Pest Management Procedure (Rev 1, dated 1 September 2022) environmental management plan, with the purpose of ensuring the environmental outcomes in Condition B1-1 (the benthic community and habitat) and B2-1 are achieved, monitored and substantiated.	Section 7 Section 8
C1 Environmental Management Plans: Conditions Related to Commencement of Implementation of the Proposal		
C1-1	The proponent must not undertake: 5. Marine construction or operations associated with the Mardie Project until the CEO has confirmed in writing that the environmental management plan required by condition B2-2 meets the requirements of that condition and Condition C4.	Section 7 Section 8
C4 Environmental Management Plans: Conditions Relating to Monitoring and Adaptive Management for Outcomes Based Conditions		
C4-1	The environmental management plans required under condition B1-4, condition B2-2, condition B3-2, condition B4-3, condition B5-3, condition B5-4, condition B6-4, condition B6-6 and condition B8-3 must contain provisions which enable the substantiation of whether the relevant outcomes of those conditions are met, and must include: 1. threshold criteria that provide a limit beyond which the environmental outcomes are not achieved 2. trigger criteria that will provide an early warning that the environmental outcomes are not likely to be met 3. monitoring parameters, sites, control/reference sites, methodology, timing and frequencies which will be used to measure threshold criteria and trigger criteria. Include methodology for determining alternative monitoring sites as a contingency if proposed sites are not suitable in the future 4. baseline data 5. data collection and analysis methodologies 6. adaptive management methodology 7. contingency measures which will be implemented if threshold criteria or trigger criteria are met 8. reporting requirements.	Section 7 Section 8

Table 2: Relevant EPBC 2022/9169 and EPBC 2018/8236 approval conditions

Condition	Requirement	Section of this Plan
Marine Pest Prevention Plan		
74	To avoid and mitigate harm to marine fauna and their habitats from marine pests, the approval holder must: a. comply with conditions B2-1 and B2-2 of the WA Approval; and b. implement the Marine Pest Management Procedure until the expiry date of this approval.	Section 7 Section 8

2. Regulations, Guidelines and Management for Introduced Marine Species

2.1. Introduced Marine Pests Definition

Introduced Marine Species (IMS) are animals, plants, algae and other biota existing in a region beyond their natural geographical range, to which they have generally been translocated by human activity (DAWR 2018). Australia currently has over 250 known IMS but only a small proportion have become IMPs. IMPs are IMS that harm the marine environment, social amenity or industries that use the marine environment, or have the potential to do so if they were to be introduced, established, or spread in Australia's marine environment (DAWR 2018). Some examples of the impacts of IMPs include:

- Competition with native species for resources
- Predation on native species
- Alteration of trophic interactions and food webs
- Loss of commercial and recreational fisheries harvest
- Reduced coastal aesthetics.
- Damage to marine and industrial infrastructure.
- Reduced aquaculture productivity.

2.2. Laws, Guidelines, and Policies

Several Commonwealth and State Regulations and Guidelines are used within Commonwealth and state waters (within three nautical miles) to enforce biosecurity. Australia has committed to International Maritime Organisation (IMO) Conventions and a significant amount of leadership in the form of legislative instruments and guidance is provided at the Commonwealth level by the Department of Agriculture, Fisheries and Forestry (DAFF). Relevant laws, guidelines and policies enforced by the Commonwealth include:

- *Biosecurity Act (2015) and Biosecurity Regulations* (2016)
- *Biosecurity Amendment (Ballast Water and Other Measures) Act 2017* (Amendment Act)
- Biosecurity Amendment (Biofouling Management) Regulations 2021
- Biosecurity (Ballast Water and Sediments) Determination 2017
- Australian Ballast Water Management Requirements (DAWE 2020)
- Australian Biofouling Management Requirements (2023)
- National Biofouling Management Guidelines:
    - National Biofouling Management Guidelines for Commercial Vessels (MSPC 2018a)
    - National Biofouling Management Guidelines for Non-Trading Vessels (MSPC 2018b)
    - National Biofouling Management Guidelines for Recreational Vessels (MSPC 2018c).

Within WA, the Department of Primary Industries and Regional Development (DPIRD) is the lead agency responsible for developing and implementing the necessary management arrangements and biosecurity control activities to restrict the introduction and translocation of invasive marine and

freshwater species in the WA aquatic environment. Relevant laws, guidelines and policies are listed by State include:

- *Fish Resources Management Act (1994)* and Regulations (1995)
- *Pearling Act (1990)*
- *Ports Authority Act (1999)* and Regulations (2001)
- *Biodiversity Conservation Act (2016)* (BC Act)
- Environmental Protection Act (1986) (EP Act)
- *Biosecurity and Agricultural Management Act (2007).*

2.3. National Approach to IMP Management

Following a series of high-profile marine pest detections in Australia in the 1980s and 1990s, the National Introduced Marine Pest Coordination Group (NIMPCG), established in 2000, developed the National System. The National System proposed a suite of detailed biosecurity reform measures intended for development and implementation by Australian governments, industry, and research organisations.

In 2011, the Marine Pest Sectoral Committee (MPSC) replaced the NIMPCG as the lead government body coordinating Australia's marine pest risk management. The MPSC leads a national approach to marine pest biosecurity, aiming to prevent the spread of marine pests. Its membership includes representatives from the Australian, State and Territory governments, the New Zealand Government, and technical experts, with shared responsibilities across national and local agencies, and active involvement from industry groups. The first national strategic plan, Marine Pest Plan 2018–2023, significantly enhanced Australia's marine pest biosecurity system. A successor plan is currently being developed following the 2018–2023 plan's conclusion in June 2023 (MPSC 2025).

The National Priority List of Exotic Environmental Pests, Weeds and Diseases (EEPL) was released in November 2020. The purpose of the EEPL was to strengthen Australia's environmental biosecurity and develop a national approach to address biosecurity risk to Australia's environment. EEPL is reported and maintained by DAFF in collaboration with other environmental and biosecurity agencies. The list contains 168 exotic species, categorised into eight biological groups (DAFF 2025):

- Aquatic animal diseases
- Freshwater invertebrates
- Marine pests
- Native animal diseases (wildlife diseases)
- Plant diseases
- Terrestrial invertebrates
- Vertebrates
- Weeds and freshwater algae.

Of the 168 exotic species, this IMPMP will only consider the marine pests listed, which have been identified within Appendix A.1 (DAFF 2025).

2.4. National Introduce Marine Pest Coordination Group

NIMPCG (National Introduced Marine Pest Coordination Group) created a database of introduced marine species worldwide, which identified 55 species considered to present the greatest threat to the Australian marine environment (Appendix A.2). This database considered species from existing introduced marine species lists shown below.

- A list of species for which domestic ballast water management would be required
- The priority pest list (domestic list) in National Priority Pests: Part II. Ranking of Australian Marine Pests. Final Report for the Department of Environment and Heritage (Hayes et al. 2005).
- The priority pest list (international list) in National Priority Pests: Part II. Ranking of Australian Marine Pests. Final Report for the Department of Environment and Heritage (Hayes et al. 2005).
- The Trigger List of IMPs used in emergency management by the Consultative Committee on Introduced Marine Pest Emergencies (CCIMPE trigger list) - further superseded by the Australian Priority Marine Pest List.

The salinity and temperature tolerance range for these species was included with the intention that designers of monitoring programs could refine their target species list to the environmental conditions at the site of interest. This is completed using the Monitoring Design Excel Template (MDET) which was originally developed in line with the Australian Marine Pest Monitoring Guidelines (DAFF 2010).

3. Existing Environment

The description of the existing environment for the Project is presented in Appendix B. Identifying the environmental conditions and habitat type at the Project area (i.e. Mardie) provides valuable information on the suitability of the conditions for potential IMP introduction, survival, translocation and reproduction. These environmental factors will be utilised in Appendix C to determine which IMP trigger list species are compatible to the Project region as a suitable receiving environment and the level of associated risk.

4. Introduced Marine Species and Pests in Western Australian

4.1. Australian Priority Marine Pest List

The Australian Priority Marine Pest List (APMPL) superseded the CCIMPE trigger list. The APMPL identifies 10 of Australia's significant marine pests. This list includes three established and seven exotic species, namely:

Established:

- European shore crab (*Carcinus maenas*)
- Japanese kelp (*Undaria pinnatifida*)
- Northern Pacific seastar (*Asterias amurensis*).

Exotic:

- Asian green mussel (*Perna viridis*)

- Black striped false mussel (*Mytilopsis sallei*)
- Brown mussel (*Perna perna*)
- Charru mussel (*Mytella strigata*)
- Chinese mitten crab (*Eriocheir sinensis*)
- Harris' mud crab (*Rhithropanopeus harrisi*)
- New Zealand green-lipped mussel (*Perna canaliculus*).

To decide on the priority pests, species were determined if nationally significant, able to be identified in the marine environment and able to be eradicated.

4.2. Within Western Australia

A search of the DPIRD- Fisheries online Biosecurity alerts portal [https://biosecurity.awe.gov.au] identified ten marine pest alerts for WA were current at the time of this report (DPIRD 2025), with observations of:

- Asian green mussel (*P. viridis*) on a vessel at Barrow Island and at Henderson in 2013
- Asian paddle crab (*Charybdis japonica*) in Perth and Mandurah
- Black-striped mussel (*M. sallei*)[1]
- Carpet sea squirt (*D. vexillum*)
- European green crab (*Carcinus maenas*)
- Freshwater gold clam (*Corbicula fluminea*)
- Indistinct river shrimp (*Caridina indistincta*)
- Japanese kelp (*U. pinnatifida*)[2]
- Northern pacific seastar (*A. amurensis*)[2]
- Redclaw crayfish (*Cherax quadricarinatus*).

None of these pest species are known to have established self-sustaining populations in WA waters but all represent a serious threat. Five of these species (*P. virdis, M. sallei, Carcinus maenas, U. pinnatifida, A. amurensis)* are listed on the APMPL. The five species (*Carcinus maenas, Charybdis japonica, M. sallei, P. virdis, U. pinnatifida*) on the APMPL are also listed on the NIMPCG list (2009a, b).

From previous unpublished survey records of WA ports and unpublished reports in 2008, Huisman et al. (2008) identified 102 known introduced marine and estuarine species in WA. Of these species, 60 species were considered to have been introduced by anthropogenic activity. Of the 102, three species were listed on the Australian National IMP list at the time (NIMPCG 2009a,b): the dinoflagellate *Alexandrium minutum*, the bivalve *Musculista senhousia* and the polychaete *Sabella spallanzanii* (Wells 2018).

4.3. Within the Pilbara Region

A comprehensive review by Huisman et al. (2008) found that 15 introduced marine species (Table 3) have been previously identified as present in the Pilbara but have not established self-sustaining populations, except for *Didemnum perlucidum*. None of the other species are on the NIMPCG list or the

[1] Exotic Priority pest on APMPL
[2] Established Priority pest on APMPL

APMPL. However, while *D. perlucidum* is the only IMS known to have been introduced into the Pilbara, the presence of 15 other introduced marine species (Huisman et al. 2008), demonstrates that the mechanisms for introduction of IMS are present.

The invasive ascidian *D. perlucidum* was first recorded in the Fremantle marine area in 2010 (Smale and Childs 2011). Following the initial report *D. perlucidum* was rapidly found throughout WA from Esperance on the southeast coast, along the west coast, to the Kimberley in the northeast and in Darwin, Northern Territory (NT).

Table 3: IMPs identified in the Pilbara (adapted from Huisman et al. 2008)

Group	Species	Onslow	Barrow Island	Dampier	Port Hedland
Bryozoans	*Amathia distans*				×
	Amathia vidovici				×
	Bowerbankia gracilis				×
	Bugula neritina			×	×
	Bugula stolonifera				×
	Savignyella lafonti		×		×
	Tricellaria occidentalis		×		
	Zoobotryon verticillatum				×
Crustaceans	*Amphibalanus amphitrite*			×	×
	Amphibalanus reticulata		×	×	×
	Megabalanus ajax		×	×	
	Megabalanus rosa		×	×	×
	Megabalanus tintinnabulum	×	×	×	×
Hydroids	*Antenella secundaria*				×
Ascidians	*Didemnum perlucidum*		×	×	

5. Risk Assessment

An IMP risk assessment was completed for the Mardie Project (Introduced Marine Pest Risk Assessment (O2 Marine Report No. R190001)) in 2020. To ensure IMP risk species and vectors are still relevant and suitable for the Project (including change to offshore dredge spoil disposal), a revised assessment has been completed and is presented in Appendix C.

The key nodes of IMP translocation and introduction for the Project are:

- Jetty construction and new infrastructure in the intertidal and sub-tidal zones (trestle jetty 2.4 km)
- Substrate surrounding and below the trestle jetty
- Outfall and intake pipelines in the intertidal and sub-tidal zones
- Capital dredging (355,000 m^3) and offshore dredge spoil disposal at DMPA4
- Maintenance dredging and offshore dredge spoil disposal at DMPA4
- Anchorage at transhipment area (six anchorage sites, three inner anchorages and three outer anchorages; OGVs at anchor)
- Transhipment vessels (TSVs)
- Transhipment channel with increased/deeper area of soft bottom substrate and reduced coverage of existing BCH
- Export vessels/ocean going vessels
- Support vessels
- Immersible equipment.

The assessment identified 46 possible species were identified as having potential to establish within the surrounding Project waters (Table 4; for methods see Appendix C).

Table 4: NIMPCG (2009a;2009b) listed IMP species that are at risk of translocation within the Project area.

Species phylum/ class	Species Name	Common Name	Hard substrate	Soft substrate (epifauna)	Plankton/ pelagic	Soft substrate (infauna)	Source
Ballast Water							
Bacillophyta/ diatoms	*Chaetoceros concavicornis*	-			X		NIMPCG (MDET)
	Chaetoceros convolutus	Centric Diatom			X		NIMPCG (MDET)
Cnidaria	*Blackfordia virginica*	-			X		NIMPCG (MDET)
Ctenophore	*Beroe ovata*	-			X		NIMPCG (MDET)
Dinophyceae	*Alexandrium monilatum*	Toxic dinoflagellate			X	X	NIMPCG (MDET)
Ballast Water and Hull Fouling							
Annelida	*Hydroides dianthus*	Serpulid tube worm	X		X		NIMPCG (MDET)
	Sabella spallanzanii	Mediterranean fanworm			X		NIMPCG (MDET)
Ascidiacea	*Didemnum spp.*	Colonial sea squirt			X		NIMPCG (MDET); Huisman et al. 2009
	Didemnum perlucidum	White sea squirt	X	X		X	NIMPIS
Chlorophyta	*Caulerpa racemosa*	Sea grapes	X	X	X		NIMPCG (MDET)
	Caulerpa taxifolia	Aquarium weed	X	X			NIMPCG (MDET)
Crustacea/ Brachyura	*Carcinus maenas*	European green crab			X		NIMPCG (MDET); APMPL
	Charybdis japonica	Asian paddle crab		X	X		NIMPCG (MDET)
	Hemigrapsus sanguineus	Asian shore crab			X		NIMPCG (MDET)
	Hemigrapsus takanoi/penicillatus	Brush-clawed shore crab/hairy-clawed shore crab	X	X	X		NIMPCG (MDET)
	Rhithropanopeus harrisii	Harris mud crab	X	X	X		NIMPCG (MDET); APMPL
	Eriocheir sinensis	Chinese mitten crab		X		X	APMPL
Crustacea/ Cirripedia	*Balanus eburneus*	Ivory barnacle	X		X		NIMPCG (MDET)
Crustacea/ Copepoda	*Tortanus dextrilobatus*	-			X		NIMPCG (MDET)
Dinophyceae	*Alexandrium catenella*	Toxic dinoflagellate			X	X	NIMPCG (MDET)
	Alexandrium minutum	Toxic dinoflagellate			X	X	NIMPCG (MDET)
	Alexandrium tamarense	Toxic dinoflagellate				X	NIMPCG (MDET)

Species phylum/ class	Species Name	Common Name	Hard substrate	Soft substrate (epifauna)	Plankton/ pelagic	Soft substrate (infauna)	Source
	Dinophysis norvegica	Toxic dinoflagellate				X	NIMPCG (MDET)
	Gymnodinium catenatum	-			X	X	NIMPCG (MDET)
	Pfiesteria piscicida	Toxic dinoflagellate			X	X	NIMPCG (MDET)
Echinodemata	*Asterias amurensis*	Northern Pacific seastar			X		NIMPCG (MDET); APMPL
Mollusca/Bivalvia	*Corbula amurensis*	overbite clam			X		NIMPCG (MDET)
	Crassostrea gigas	Giant oyster			X		NIMPCG (MDET)
	Ensis directus	Jack-knife clam			X	X	NIMPCG (MDET)
	Musculista senhousia	Asian bag mussel	X	X	X		NIMPCG (MDET)
	Mytilopsis sallei	Black-striped mussel	X	X	X		NIMPCG (MDET); APMPL
	Perna perna	Brown mussel	X		X		NIMPCG (MDET); APMPL
	Perna viridis	Asian green mussel	X		X		NIMPCG (MDET); APMPL
	Varicorbula gibba	Common basket-shell			X		NIMPCG (MDET)
	Mytella strigata	Charru mussel	X	X		X	APMPL
	Perna canaliculus	New Zealand green-lipped mussel	X				APMPL
Mollusca/ gastropoda	*Crepidula fornicata*	Slipper limpet			X		NIMPCG (MDET)
	Rapana venosa	Asian rapa whelk	X	X	X		NIMPCG (MDET)
Phaeophyta	*Sargassum muticum*	Japanese wireweed			X		NIMPCG (MDET)
	Undaria pinnatifida	Wakame			X		NIMPCG (MDET); APMPL
Pisces	*Siganus luridus*	Dusky spinefoot	X		X		NIMPCG (MDET)
	Siganus rivulatus	Marbled spinefoot	X		X		NIMPCG (MDET)
	Tridentiger barbatus	Shokihaze goby			X		NIMPCG (MDET)
	Tridentiger bifasciatus	Shimofuri goby			X		NIMPCG (MDET)
Rhodophyta	*Bonnemaisonia hamifera*	Bonnemaison's hook weed	X	X	X		NIMPCG (MDET)
	Grateloupia turuturu	Devil's tongue weed	X		X		NIMPCG (MDET)

A summary of the risk assessment is presented in Table 5. The residual risks are manageable; however, it is important to emphasise:

- The sea squirt (*D. perlucidum*) is already known to be established in the region (Bridgwood and McDonald 2014; DPIRD 2017) increasing the likelihood of further spread despite mitigation efforts.
- The potential interaction between TSVs and OGVs during the operational phase introduces risk vector outside of the defined Project DE, which may transport species back to the Project DE.

Table 5: Summary of risk assessment for IMPs (See Appendix B.4. for full assessment)

Activity or Element with Potential Impacts on the Environment	Inherent risk	Residual risk
Construction		
Increase the spread of IMP throughout the region through general movement of support vessels or other construction vessels.	Medium	Low
Increase the spread of IMP throughout the region by disturbing and modifying the natural substrate – dredging and disposal.	High	Medium
Use of immersible construction materials (pylons, pipework, jetty)	Low	Low
Anchoring/mooring/berthing of Construction Vessels	Medium	Low
Operations		
Anchoring of Operational Vessels.	Medium	Low
Increase the spread of IMP throughout the region through the frequent movement of transhipper vessels and general support vessels.	Medium	Low
Increase the spread of IMP throughout the region by disturbing and modifying the natural substrate – maintenance dredging.	High	Medium
Increase the spread of IMP throughout the region with TSV movements and interactions with OGVs.	High	Medium
Use of immersible equipment (anchors, mooring, ropes, etc.)	Low	Low
De-ballasting of Operational vessels (TSV deballast).	Medium	Low

6. Roles and responsibilities

The roles and responsibilities for the implementation of this IMPMP are summarised in Table 6.

Table 6: Roles and responsibilities of the IMPMP implementation

Position	Responsibility
Proponent/BCI (as Principal)	• Overall responsibility for implementation of this IMPMP • Overall responsibility for complying with all relevant legislation, standards and guidelines • Reports on environmental performance for the project to relevant decision making authorities and to the key stakeholders • Responsible for the implementation of the environmental monitoring programs and inspections • Prepares environmental monitoring reports • Responsible for environmental compliance reporting in accordance with State and Commonwealth approvals • Responsible for reporting all environmental non-compliance incidents in accordance with State and Commonwealth approvals.
Vessel contractors/vessel masters	• Implements the management actions of the IMPMP • Ensure that vessels comply with all State and Commonwealth biofouling and ballast water requirements prior to arrival to WA waters and the Project site • All vessel operators are required to accurately report information in accordance with Section 193 of the *Biosecurity Act* 2015 • Ensure all equipment is adequately maintained and correctly operated • Ensuring that anti-fouling coatings (AFC) are appropriate, complying with relevant requirements under IMO • Ensuring vessels are appropriately cleaned and inspected • Daily inspections of marine equipment • Responsible for reporting all environmental incidents and potential IMP detections to the Proponents Environmental Advisor notified to BCI immediately to meet regulatory reporting requirements.
All persons involved with the Project	• Comply with the requirements of this IMPMP • Comply with all legal requirements under the State and Commonwealth approvals and relevant Acts • Exercise a Duty of Care to the environment at all times. • Report all environmental incidents and possible IMPs or excessive biofouling to the relevant supervisor.
Manager Port Development / Operations	• Comply with the requirements set out in this IMPMP and other relevant plans • Liaise with contractors to ensure communication and understanding of environmental requirements as outlined in this IMPMP • Ensure all site personnel are aware of their responsibilities set out in relevant management plans and procedures • Oversee management of inspections, audits and investigations.

7. Management Measures Port Development/Operations

The introduction of an IMP may occur regardless of the assessed risk level. Therefore, to mitigate the risks posed by IMPs during both the construction and operational phases of the Project, each phase has been assigned monitoring and management actions to measure compliance against the EPOs (Table 7) and management targets these are presented in Table 8 and Table 9, respectively. To ensure the conditions in Section 0 are met.

In additional to these tables, the management strategies for project vessels have been separated into three components:

- Ballast Water Exchange (Section 7.3)
- Vessel Hull Biofouling (Section 7.4)
- In-water cleaning (Section 7.5).

BCI must ensure compliance with established management targets through the implementation of risk controls in accordance with this IMPMP, and any advice from DPIRD on best practice to manage IMPs.

The management measures presented in the sections below outline the responsibilities of the Project aspects managed by BCI as specified within the MS1211 conditions. The relevant Project aspects include the infrastructure (export jetty), the dredge footprint (navigational channel) and offshore disposal (at DMPA4). The transhipping and loading of OGVs is managed under the jurisdiction of Pilbara Ports and falls within the Port of Cape Preston West waters.

Table 7: Management Targets

EPA Factor	EPA Objective	Potential Environmental Impact pathways	Environmental protection outcome (EPO)	Management Target	Risk Management Strategy
Marine Fauna	To protect marine fauna so that biological diversity and ecological integrity are maintained	Introduced Marine Pests (IMP) translocation from construction or operational vessels.	No introduction or establishment of marine pests in State Waters as a result of the Project.	Manage construction vessels activities to prevent IMP impacts on the environment. Manage dredging and disposal activities to prevent IMP impacts on the environment. No introduction or establishment of marine pests into the state or within the state as a result of the Project. No introduction of IMP from outside of the Pilbara region to the nearshore Project area.	Table 8 Table 9
BCH	To maintain the structure, function, diversity, distribution and viability of benthic communities and habitats at local and regional scales	Indirect impact to BCH health due to Introduced Marine Pests (IMP). Introduction of marine pests/other marine species due to vessel movements from other locations.	No introduction or establishment of marine pests in State Waters as a result of the Project		Table 8 Table 9
MEQ	To maintain the quality of water, sediment and biota so that the environmental values, both	Introduction of marine pests/other marine species due to vessel movements from other locations, resulting in	No introduction or establishment of marine pests in State Waters as a result of the Project		Table 8 Table 9

EPA Factor	EPA Objective	Potential Environmental Impact pathways	Environmental protection outcome (EPO)	Management Target	Risk Management Strategy
	ecological and social, are protected.	indirect impacts to environmental quality.		Manage maintenance dredging activities to prevent IMP impacts on the environment. No introduction of marine pests that results in a loss of BCH outside the Project DE	

7.1. Construction

Management actions proposed to minimise potential impacts on the environment from IMPs during construction (namely capital dredging) are presented in Table 8.

Table 8: Construction management actions to minimise the risk of IMP impacts

Management			Environmental Performance				
Targets	Actions	Trigger	Trigger Action	Responsibility	Reporting/Evidence	Timing	Contingency
No introduction or establishment of marine pests into the state or within the State waters as a result of the Project. Manage construction vessels activities to prevent IMP impacts on the environment as a result of the Project.	• All relevant vessels should comply with ballast water exchange and vessel hull biofouling management outlined in Australian Ballast Water Management Requirements (DAWE 2020) (Section 7.3), and the Australian Biofouling Management Requirements (DAFF 2023) (Section 7.4.). • All vessels mobilised to site to have an effective biofouling management plan and record book. • If vessels come from interstate or international waters vessels are required to complete the Maritime and Aircraft Reporting System (MARS) and be in accordance with the pre-arrival conditions within the Australian Biofouling Management Requirements (DAFF 2023) and supply supporting documentation, including anti-foul certificates and inspection reports.	Vessel mobilising to site. Vessel does not meet MARs acceptable requirements or documentation is not suitable for mobilisation.	• Complete MARS and ensure that has met the DAFF and DPIRD requirements. • Undertake mitigation to reduce vessel to acceptable risk before approving mobilisation.	• Contractor • Vessel operator	• Vessel management procedures • Completed MARS for vessels originating outside WA or Australian waters.	• Throughout construction operations • Prior to vessel arriving at the site and prior to mobilisation from outside State waters.	• Vessels are not to mobilise to Project unless the Procedures are to be utilised • Notification to DAFF and the DPIRD if an IMP species is identified • International vessel not to mobilise to site without completed MARS.
Manage dredging and disposal activities to prevent IMP impacts on the environment as a result of the Project.	• All relevant vessels should comply with ballast water exchange and vessel hull biofouling management outlined in Australian Ballast Water Management Requirements (DAWE 2020) (Section 7.3), and the Australian Biofouling Management Requirements (DAFF 2023) (Section 7.4.) • Implement the Mardie Project Dredge and Spoil Disposal Management Plan (DSDMP) (O2 Marine 2025a).	IMP detection.	• Verification of information regarding IMP detection.	• Dredge contractor • BCI	• Vessel management procedures • Report any IMPs to DPIRD (see Section 9).	• Throughout dredging.	• Vessels are not to mobilise to project site without approved IMP documentation • If IMPs are detected follow reactive monitoring advice provided by DPIRD.
	• Implemented the IMP monitoring prior to the commencement of capital dredging Section 8.	IMP detection.	• Verification of information regarding IMP detection and monitoring as per Section 8.	• BCI.	• See Section 8 • Report any IMPs to DPIRD (see Section 9).	• Prior to dredging.	• If IMPs are detected follow reactive monitoring advice provided by DPIRD.
	• If vessels come from interstate or international waters vessels are required to complete the Maritime and Aircraft Reporting System (MARS) and are in accordance with the pre-arrival conditions within the Australian Biofouling Management Requirements (DAFF 2023) and supply supporting documentation, including anti-foul certificates and inspection reports.	High risk vessel from outside of WA waters.	• Undertake mitigation to reduce vessel to acceptable risk before approving mobilisation.	• Vessel operator.	• Completed MARS for vessels originating outside WA or Australian waters.	• Prior to vessel arriving at the site.	• International vessel not to mobilise to site without completed MARS.
No introduction of marine pests that results in a loss of BCH outside the Project DE as a result of the Project	• Implement the BCH monitoring program as outlined within the Maride Project DSDMP (O2 Marine 2025).	Detection of IMP during BCH surveys.	• See Section 8.8.	• BCI.	• BCH Assessment Report including data (photographs).	• Quarterly during baseline period (12 months).	• If IMPs or possible IMP is detected, BCI to follow procedures outlined in Section 8.6 and follow DPIRD requirements.

7.2. Operations

Management proposed to minimise potential impacts on the environment from IMPs during operations are presented in Table 9.

Table 9: Construction management actions to minimise the risk of IMP impacts

Management			Environmental Performance				
Targets	Actions	Trigger	Trigger Action	Responsibility	Reporting/Evidence	Timing	Contingency
No introduction of IMP into the State waters as a result of the Project. **No introduction of IMP from outside of the Pilbara region to the nearshore Project area.**	Implement ballast water management (Refer to Section 7.3): • All vessels to comply with directives from Pilbara Ports, as will be prescribed in the Port Handbook for Port of Cape Preston West (Pilbara Ports, *in prep*). • Project support vessels (i.e. transhippers) are to either manage ballast water or receive a low risk exemption from the department (DPIRD and/or DCCEEW) prior to discharge. • Discharge of ballast water for any vessel mobilised during the lifetime of the Project shall be managed in accordance with the mandatory requirements of the Australian Ballast Water Requirements (DAWE 2020). • All vessels arriving to the Project site from international waters and international vessels are to submit a Ballast Water Report through the MARS. • Ensure all vessel operations are recorded in the Ballast Water Record System and vessel >400gross tonnes must have a ballast water management plan and a ballast water management certificate.	Non-compliant ballast water exchanges within the Port of Cape Preston West waters.	• Investigate ballast water exchange.	• All vessel Operators • BCI.	• DAFF • International vessels that are intending to discharge internationally sourced ballast water must submit a Ballast Water Report through MARS at least 12 hours prior to arrival, but no later than 96 hours.	• Before entering Australian waters or the Project area	• If ballast water does not meet DAFF Biosecurity requirements, discharge shall not occur in State waters. • Identify suitable open ocean contingency for emergency ballast discharge for pre-entry clearance to avoid impacts on operational vessel arrivals.
	Adhere to the National biofouling management guidelines for vessels (MSPC 2018a,b) and the Australian biofouling management requirements (2023) (see Section 7.4) including for the TSVs: • Hull inspections • Inspections of internal seawater systems • Demonstrate proactive management (i.e. implement an effective biofouling management plan and keep a biofouling record book.	Vessel mobilisation to the Project site.	• Vessels requiring biofouling management prior to mobilising to Project area.	• All vessel operators • BCI.	• Biofouling management record book • Vessel inspections and maintenance.	• Throughout the lifespan of the Project • 5-yearly dry-dock inspections of TSV.	• Source from Australian waters where possible • Industry-specific vessel appraisal prior to entering Project site. Undertake in/out of water inspection where required for risk management. No sediments to be transferred to site • Consider use of passive or active monitoring at site to demonstrate efficacy of management measure application.
	• Relevant vessels used throughout the Project area when mobilising to site will comply with Australian anti-fouling and in-water cleaning guidelines (DAFF 2024) (See Section 7.5) • All vessels to comply with directives from Pilbara Ports, as will be prescribed in the Port Handbook for Port of Cape Preston West (Pilbara Ports, *in prep*).	Vessel mobilisation to the Project site.	• Vessels requiring anti-fouling management prior to mobilising to Project area.	• All vessel operators • BCI.	• BCI and vessel operators must obtain an anti-fouling system certificate or declaration on anti-fouling system.	• Vessel mobilisation throughout lifespan of Project.	• Source all vessels from Australian waters where possible. • Industry-specific vessel appraisal prior to entering Project site. Undertake in/out of water inspection where required for risk management. No sediments to be transferred to site • Consider use of passive or active monitoring at site to demonstrate efficacy of management measure application • Where anti-fouling paint is damaged as a result of grounding, collision or

Management			Environmental Performance				
Targets	Actions	Trigger	Trigger Action	Responsibility	Reporting/Evidence	Timing	Contingency
							mechanical impact, in-water repair of the paint system should be considered for the area of damage even if the area of damage is relatively minor as recommended in the National Biofouling guidelines for commercial vessels (MPSC 2018b).
	Biofouling management of submersible equipment and vessels including: • Regular inspections of AFC • Ensure all anchors and cables are cleaned after use • Remove any obvious biofouling from berthing lines (by hand and/or high-pressure wash). If in-water cleaning is required for the transhipper must be completed in line with (Section 7.5): • Australian and New Zealand and Environment and Conservation Council (ANZECC) Antifouling In-water hull cleaning guidelines (DAFF 2024). • Directives from Pilbara Ports, as will be prescribed in the Port Handbook for Port of Cape Preston West (Pilbara Ports, *in prep*).	Excessive biofouling.	• Implement cleaning procedures for vessel.	• BCI • Vessel operator.	• Vessel's biofouling management procedures • Approval from DPIRD.	• As required.	• If suspected IMP is detected, follow the requirements in Section 8.6 • If in water cleaning not approved by DPIRD, cleaning to be completed via dry docking or via alternative methods.
	• Implement ongoing monitoring outlined in Section 8.	IMP detection.	• Confirmation of IMP detection follow DPIRD or regulator instructions.	• BCI.	• Annual report • See Section 8 and 9.	• Biannually sampling (see Section 8).	• Following the first full year of the IMP Operations monitoring the methods and procedures are to be reviewed by DPIRD, Pilbara Ports, and any other key stakeholders to ensure they are effective and follow best practice.
Manage maintenance dredging activities to prevent IMP impacts on the environment.	• Source dredge from WA waters where possible.	Dredge mobilising to site with a last Port of call outside State waters.	• Complete a Ballast Water Management Requirements, PAR, and MARS.	• BCI • Dredge contractor.	• MARS report.	• MARs to be completed at least 12hours, but no earlier than 96 hours before arriving in Australian waters.	• If vessel has been cleaned of all biofouling within 30 days of arrival, vessel master must provide the cleaning report and supporting photographs and/or video that all that meet the DCCEEW requirements as outlined in Australian biofouling management requirements (DAFF 2023).
	• Continue to implement ongoing IMP monitoring (refer to Section 8) • Implement the DSDMP (O2 Marine 2025a).	IMP detection.	• Confirmation of IMP detection follow DPIRD or regulator instructions.	• BCI.	• Report any IMPs to DPIRD (see Section 9) • Required vessel forms and management plans to be kept on file for auditing by BCI.	• Biannual monitoring during operations (See Section 8).	• Vessels are not to mobilise to project site without approved IMP documentation • Refer to Mardie Project: DSDMP (O2 Marine 2025).
No introduction of marine pests that results in a loss of BCH outside the Project DE	• Implement the Benthic Communities and Habitat Monitoring and Management Plan (BCHMMP) (O2 Marine 2023a,b). • Implement the DSDMP (O2 Marine 2025a).	IMP detection.	• Follow reactive monitoring advice from DPIRD if pest is detected • See Section 8.8.	• BCI.	• BCH Assessment Report including data (photographs).	Biannually ongoing BCH monitoring unless impacts are detected (See BCHMMP O2 Marine 2023a,b).	• If IMPs or possible IMP is detected, BCI to follow procedures outlined in Section 8.6 and follow DPIRD requirements • If IMP are detected implement a BCH assessment and review of the results from the most recent BCHMMP survey.

7.3. Ballast Water Exchange

The discharge of ballast water for any vessel mobilised during the Project shall be managed consistently with the mandatory requirements of DAFF and the Australian Ballast Water Management Requirements (DAWE 2020; australian-ballast-water-management-requirements.pdf)

Ballast water that does not meet DAFF biosecurity requirements shall not be discharged within State waters. Confirmation of exchange at sea, treatment or other risk management measure application required prior to site entry.

In addition, the MARS requires pre-arrival reporting of ballast water biosecurity. All vessels arriving internationally are required to use MARS prior to arrival on site (pre-arrival inline with MARS 96 to 12 hours prior to arrival in Australian waters) and domestic vessels are also encouraged to participate in this program.

All vessels to comply with directives from Pilbara Ports, as will be prescribed in the Port Handbook for Port of Cape Preston West waters (Pilbara Ports, *in prep*).

Accidental or incidental discharge of ballast water within the Project waters is to be reported as outlined in Section 9.

7.4. Vessel Hull Biofouling Management

A ship's biofouling may contain marine organisms that are pests and have the potential to be transferred long distances through transport via the vessel hull or any other external part of the ship including the rudders, propellers and other hull appendages, internal seawater systems (e.g. sea chests and engine cooling pipes), or any equipment attached to or on board the ship (e.g. anchor chains). Biofouling organisms can reproduce or be dislodged within standard operating conditions.

Non-trading vessels, such as dredge vessels, are highlighted as a high-risk item as they are slow moving, generally spend substantial lengths of time in coastal waters and have numerous hull niches to transport marine organisms.

All Project related vessels may be subject to biofouling, these include vessels that are sourced and operate exclusively within the Pilbara region and vessels that transit into and outside of the Pilbara region. Furthermore, vessel biofouling management measures relate to both the introduction of new IMP from outside of the Pilbara region, and the facilitation of extending the range of an IMP that is within the Pilbara region.

Figure 4 illustrates an approach undertaken prior to vessel mobilisation. Vessel operations within the Project waters shall be consistent with the following relevant mandatory biofouling requirements:

- Anti-Fouling and In-Water Cleaning Guidelines (DAFF 2024)
- Australian Ballast Water Management Requirements (DAWE 2020)
- *Commonwealth Biosecurity Act 2015*
- National Biofouling Management Guidance for Non-Trading Vessels (MSPC 2018a)
- National Biofouling Management Guidelines for Commercial Vessels (MSPC 2018b).

Any activity that has the potential to disturb or dislodge biofouling on a ship and/or the ship's AFC should be prohibited and only undertaken following consultation and endorsement with DPIRD and

the local authority (i.e. Pilbara Ports) through an application process. Such activities include (but are not limited to):

- Cleaning of internal seawater systems (including sea-chests and engine cooling pipes)
- Propeller 'polishing' (cleaning)
- Careening (i.e. the practice of beaching ships for hull cleaning and anti-fouling removal).

In-water cleaning may consider such activities in exceptional circumstances, such as where a net environmental benefit or immediate safety risk can be demonstrated. Such applications should be directed to DPIRD. All in-water cleaning in Port of Cape Preston West waters to comply with directives from Pilbara Ports, as will be prescribed in the Port Handbook for Port of Cape Preston West waters (Pilbara Ports, *in prep*).

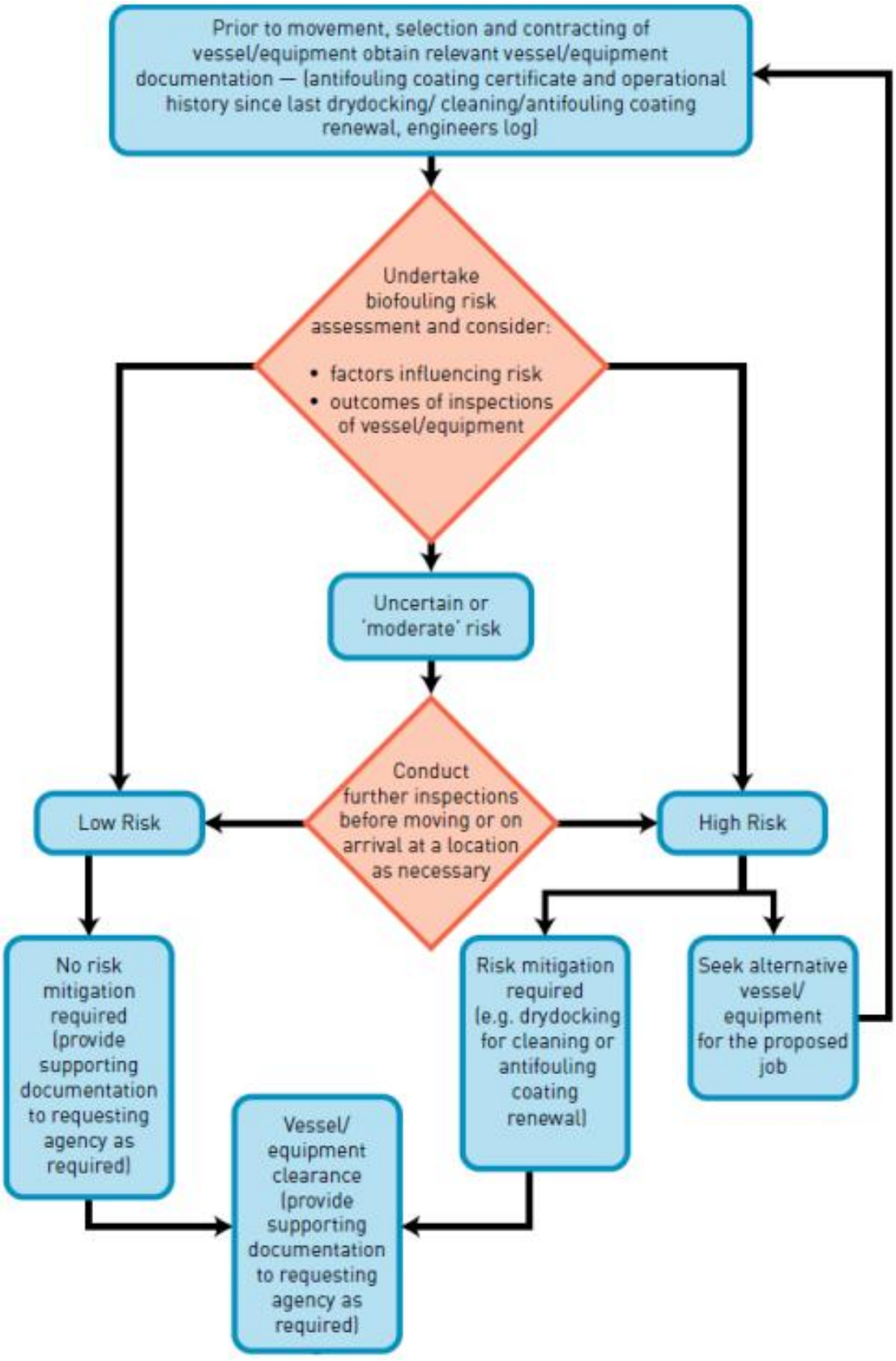

Figure 4: Generic approach to biofouling risk assessment

7.5. In-water cleaning guidelines

In-water cleaning can manage biofouling on vessels; however, it can also physically damage AFCs, shorten the coating service life and release a pulse of biocide into the environment (DAFF 2024). In-water cleaning can also facilitate release of invasive aquatic pests into the surrounding environment. Therefore, vessels must follow the Australian anti-fouling and in-water cleaning guidelines requiring (DAFF 2024):

- The in-water cleaning operator holds evidence that documentary requirements are met prior to commencing in-water cleaning of a vessel
- The in-water cleaning operator holds all necessary approvals to conduct in-water cleaning at the proposed cleaning location
- The in-water cleaning operator produces an in-water cleaning report, accompanied by images and video, detailing at a minimum:
    - The surfaces of the vessel that were cleaned
    - The biofouling type and percent cover pre-clean and post-clean
    - The cleaning method(s) used to in-water clean the vessel complies with Australian anti-fouling and in-water cleaning guidelines: exposure draft DAFF 18
    - The method of collection and disposal of any debris in compliance with the relevant regulator(s).
- The in-water cleaning operator holds copies (may be digital) of documents for a period of 3 years.

Following these requirements, some vessel will require further inspection for IMP management assurance.

All in-water cleaning to comply with directives from Pilbara Ports, as will be prescribed in the Port Handbook for Port of Cape Preston West waters (Pilbara Ports, *in prep*).

8. Monitoring

Early detection of IMPs is the most cost-effective way to minimise the risk of IMPs establishing, as once established IMPs are notoriously difficult to eradicate (McDonald et al. 2020). As proposed by McDonald et al. (2020) successful management of IMPs relies on the following key factors:

- Identification of vectors and risk pathways, and alignment with measures to reduce IMP introduction likelihood
- Awareness, by all, of the potential risk of incursions, and appropriate protocols and surveillance for early detection and identification of IMP showing pest-like characteristics
- Rapid response following the detection of potential IMP
- Support and cooperation between stakeholders (e.g. industry, public) and regulatory agencies in the response process (Piola and McDonald 2012; McDonald et al. 2020).

The risk assessment presented in Appendix C outlines the potential vectors and risk pathways for IMPs in relation to the Project. The mitigation and management measures for how to reduce the likelihood

of introduction have been presented within Section 7. The following sections outline the proposed monitoring methods to ensure appropriate surveillance and early detection of IMPs for the Project.

Given the Projects location in the Pilbara and the Pilbara Ports waters, these procedures will be reviewed and endorsed by both DPIRD and Pilbara Ports to ensure that the proposed methods are appropriate, feasible and best practice at the time of implementation. BCI commits to collaborate with both DPIRD and Pilbara Ports (when required) in the instances when potential pests are detected to develop appropriate reactive monitoring.

8.1. Monitoring Program

Monitoring to identify any IMPs, attributable to the Project, will be implemented during the Project to allow BCI to rapidly identify and respond to a potential marine pest invasion. A monitoring program that aligns with the IMP risks presented by the project will be designed in collaboration with DPIRD and implemented during the Project. A summary of the monitoring program is presented in Table 10 and a flow chart on the current best practice approach (SWASP) which this program is based on is presented in Figure 5.

Table 10: Summary of monitoring program

Construction (capital dredging[3])					
Site	Sampling methods	Timing and frequency	Analysis	IMP Detection	Rationale
Dredge footprint	Passive eDNA array sampling (see Section 8.3). Biofouling scrapes from existing infrastructure and/or settlement array (see Section 8.4 and Section 8.5.1).	Pre-dredging.	See Section 8.3.2.	See Section 8.6.	Snapshot survey to determine the presence of any marine pest prior to dredging (e.g. presence of sea squirt (*D. perlucidum*), which may already be present and not as a result of dredging). Sampling methods will be in line with best-practice approach informed by a review from DPIRD or an appropriate subject matter expert.
Operations					
Site	Sampling methods	Timing and frequency	Analysis	IMP Detection	Rationale
Jetty	Settlement array (see Section 8.5.1 and Figure 5) and/or passive eDNA array (see Section 8.3).	Biannually, summer and winter.	See Section 8.5.2 and Figure 5.	See Section 8.6.	The piles for the jetty provide a new niche for IMPs to establish and suitable substrate is present surrounding and below the trestle jetty. The TSVs interact with the OGVs and pests could be translocated to the site from their interaction at the anchorage sites. The sampling methods will be in line with DPIRDs best practice sampling methods, and could include the standard settlement arrays and/or eDNA passive arrays. The proposed sampling methods will be reviewed by DPIRD or an appropriate subject matter expert.
Shoreline	Shoreline survey (see Section 8.7 and Figure 5).	Annually.[4]	See Section 8.7 and Figure 5.	See Section 8.6.	The surveys will target the high-risk areas for the Project, such as the shoreline adjacent to the loading jetty and Secondary seawater intake where marine infrastructure is present and where pests could establish. The point of these surveys is to detect species that may not be detected within the eDNA suite via the settlement array/eDNA passive array sampling.

[3] Monitoring is not required for maintenance dredging as the operational IMP monitoring will already be underway
[4] Timing/frequency of monitoring to align with best practice as advised by DPIRD

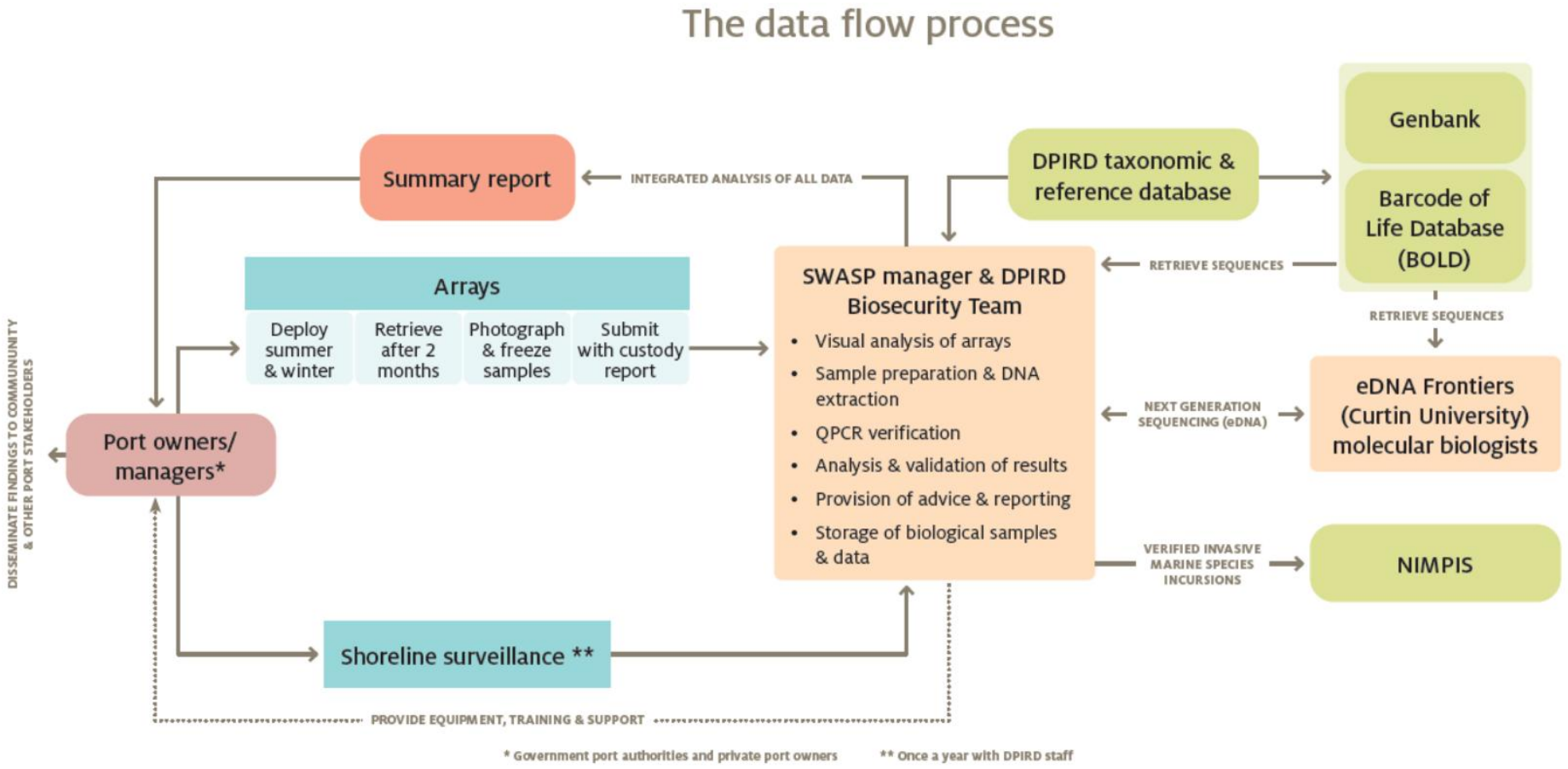

Figure 5: SWASP monitoring approach and methods (DPIRD n.d.)

QPCR - real-time Polymerase Chain Reaction is the method of molecular testing and is used to identify species within the samples

Barcode of Life Database – is a system which supports in the generation and application of DNA barcode data and is used to complete genetic analysis

8.2. Monitoring sites

Based off the risk assessment (refer to Section 5), the following key locations/vectors have been identified as key areas where IMPs are most likely to be introduced and/or could be established:

- Dredge footprint- due to direct contact with seabed
- Loading jetty – new niche and interaction with TSVs
- Shoreline and intake – new niche and interaction marine infrastructure.

Indicative monitoring locations are presented in Figure 6, exact monitoring locations will be confirmed following site access and logistics, and GPS locations will be recorded during sampling.

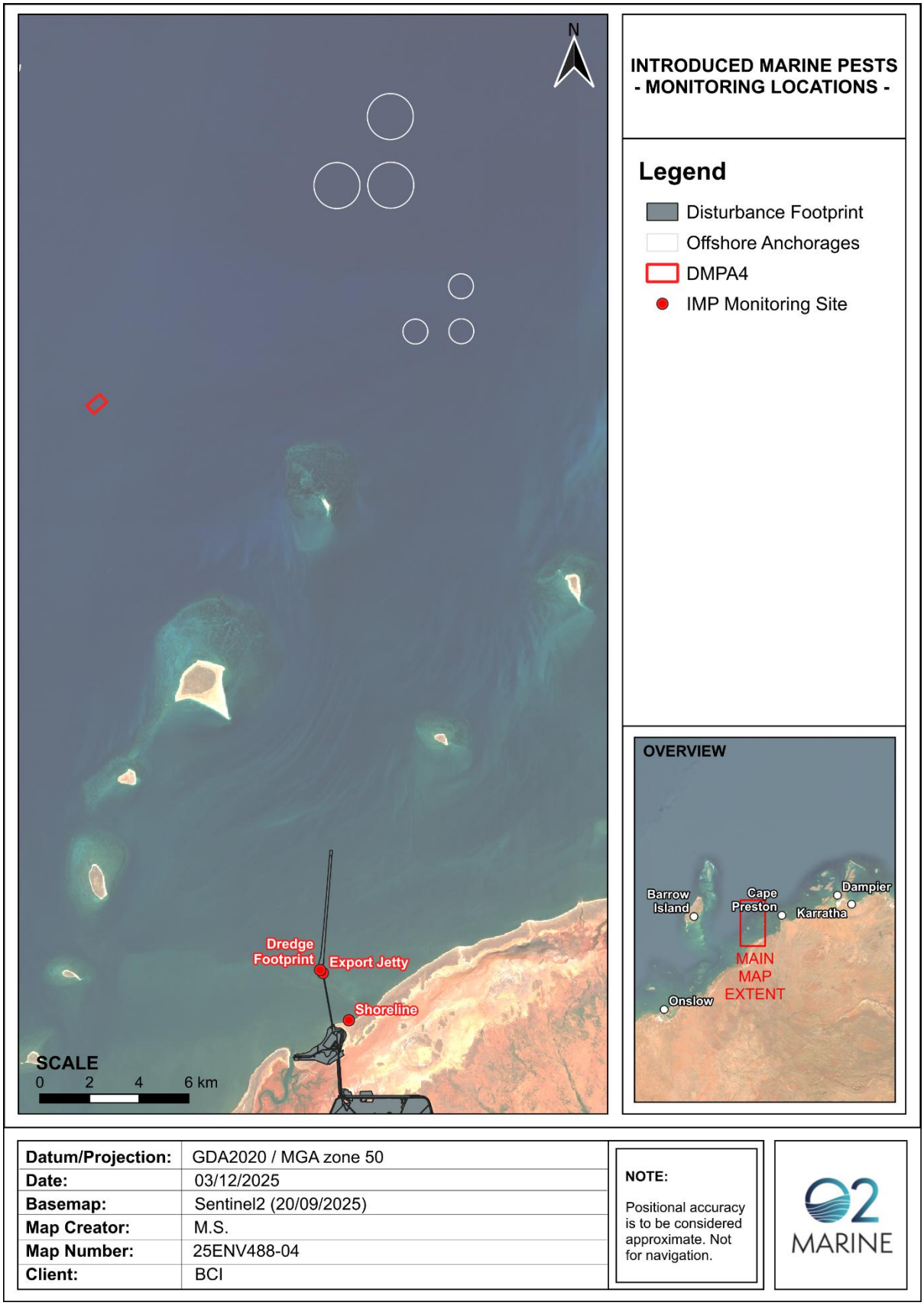

Figure 6: Indicative monitoring locations

8.3. eDNA passive arrays

eDNA passive arrays will be deployed during the pre-dredging and may be deployed with the settlement arrays or replace the settlement arrays.

Passive arrays are an emerging monitoring technique that require a shorter deployment time and provide an alternative to the current settlement arrays, while still allowing for timely detections, which provides a critical framework for follow up surveys and potential eradication programs.

8.3.1. Sampling methods

Deployment: At least three replicates collected at least two sites[5], of the passive eDNA arrays (Figure 7) are to be deployed at the jetty infrastructure or at a suitable location adjacent to the dredge footprint/channel. The eDNA passive arrays are to be deployed following a standard operating procedures (SOP) and a sampling analysis plan (SAP) that will be developed in consultation with eDNA experts at the eDNA Frontiers Lab – Curtin University and DPIRD or an appropriate subject matter expert (SME). The passive eDNA arrays are to be deployed for 2-weeks.

Retrieval: following the 2-week deployment, the eDNA passive array samples are to be collected following the SOP and SAP. Samples are to be stored following standard procedures.

8.3.2. Reporting and analysis

The eDNA passive arrays are to be analysed by a certified laboratory, such as eDNA Frontiers, Curtin University, where they will be processed using a metabarcoding analysis and results reported to BCI.

[5] single site may have unique characteristics that enhance or prevent IMS from depositing, such as wind direction, boat turbulence, heat/sunshine or resident biology

Figure 7: Example of the eDNA passive arrays - sample kit bag (LHS) and the pieces individually (RHS)

8.4. Biofouling scrapes

In conjunction with the passive arrays, biofouling is to be scraped from the pile structures prior to dredging. Samples are to be collected following a SOP and SAP, which will be developed in consultation with the required DPIRD personnel or marine pest expert and at least three samples are to be collected. Samples to be frozen and sent to certified laboratory, such as eDNA Frontiers, Curtin University, where they will be processed using a metabarcoding analysis and results reported to BCI.

8.5. Settlement array

Deployment of settlement arrays is considered current best practice to monitor for IMPs around port infrastructure. These arrays provide an early warning system for the detection of any fouling populations of introduced marine species (DPIRD n.d). However, eDNA passive sampling arrays are an emerging sampling technique for eDNA. Settlement and/or eDNA passive sampling arrays (see Section 8.3) are to be used for the biannually sampling for operational monitoring for the Project. Sampling method used (i.e. settlement array or eDNA passive array) to be endorsed by DPIRD to align with the SWASP program.

8.5.1. Sampling methods

The settlement arrays should be constructed with both horizontal and vertical PVC plates which provide a clean 'competition free' substrate for any marine larvae to settle on. The array should consist of a minimum of 3 plates (up to 10) and be configured so the plates are continuously suspended approximately 1 m below the surface. Arrays are anchored to the bottom with sufficient weight to ensure it will not be displaced by environmental factors. A crab habitat trap may be incorporated into the anchoring system. A SOP and SAP will be developed in consultation with the required DPIRD personnel or SME.

Arrays are soaked for approximately 2-months prior to collection. The accumulated biofouling is collected and submitted for analyses. Metabarcoding screens for approximately 80 species of IMP.

Deployment: at least one settlement array (Figure 8) is to be deployed at the end on the Mardie Loading Jetty. The location must be sufficiently deep such that the array does not dry out on low tides. Factors such as tidal flow, wave action, and prop wash should be considered to ensure the array does not come into contact with other infrastructure.

Retrieval: settlement arrays are to be retrieved from the water following a 2-month soak period. The frames are to be collected following a SOP and SAP, which will be developed in consultation with the required DPIRD personnel or marine pest expert. Once out of the water all PVC plates are to be photographed, samples scraped and packaged, and frozen.

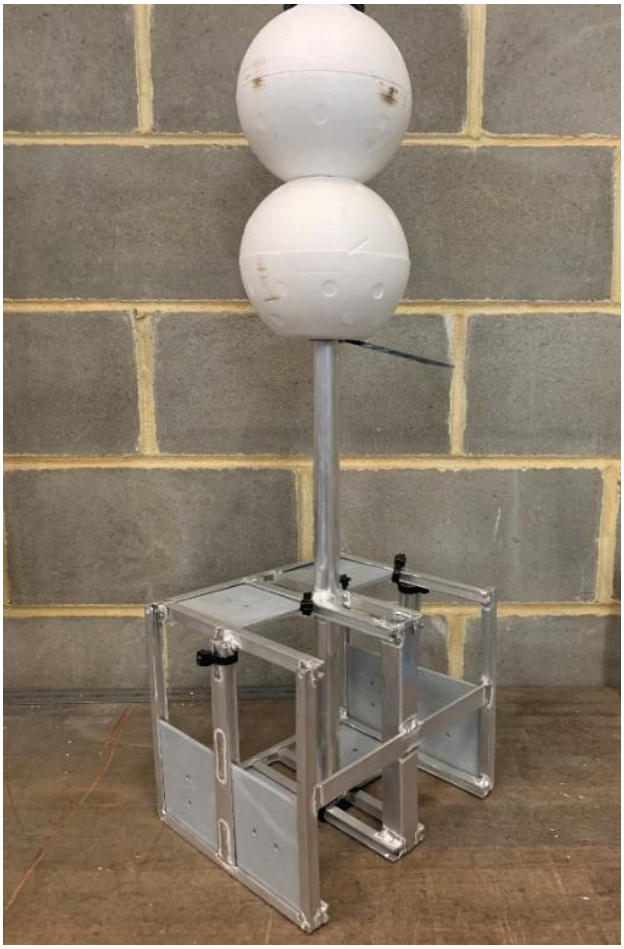

Figure 8: Potential IMP array (DPIRD n.d.)

8.5.2. Analysis and reporting

Following the 2-month deployment the settlement arrays are to be photographed and processed following a DPIRD approved method. Samples are then to be frozen for transport to certified laboratory. Samples will then be prepared by the laboratory and undergo DNA extraction. The samples will be tested for invasive pests using metabarcoding analysis.

8.6. Reactive monitoring

If IMPs are detected during any surveys (e.g. IMP monitoring or BCH surveys), a report will be submitted to DPIRD (see Section 9). BCI will engage with DPIRD and any relevant stakeholders (e.g. Pilbara Ports during operations) to develop and implement a reactive management approach depending on the species detected (once confirmed).

8.7. Shoreline monitoring

Shoreline monitoring is an important supplement to settlement arrays. There are several target species unlikely to be detected by the SWASPs. Further, the scrapings from the panels are only analysed for the targeted suite of species. There are many species with the potential to invade the Pilbara coastline that are not included on the target list. Shoreline surveys represent an effective opportunity to detect such species.

There is potential IMP surveying will be incorporated into the statewide system currently overseen by DPIRD. Pilbara Ports supports this program by providing personnel to conduct shoreline surveys. An alternative is for shoreline surveys to be conducted in-house, or by a contractor.

Shoreline surveys should be undertaken adjacent to the loading jetty, and beside the pond water intake. Surveys should be conducted at low tide and consist of a 100m transect walked along the waterline, and return via the wrack deposited at the high tide mark. Actions are dependent on the experience of the person conducting the survey. The surveyor should be alert for any species displaying invasive characteristics, any unfamiliar species, or any species on the alert list. Any such detections should be photographed, and if possible captured and frozen in a snap lock bag. Images are subsequently sent to IMS specialists to determine if further investigation is warranted. Shoreline surveys should be conducted in concert with collection of SWASPs.

8.8. Benthic communities and habitat monitoring

To meet MS 1211 Condition B2-2 monitoring of BCH, a BCH monitoring has been developed within the DSDMP (O2 Marine 2025a), and monitoring is also being completed under the approved BCH Monitoring and Management Plan (BCHMMP) which is the requirement of MS 1211 condition B1-4 (O2 Marine 2023a,b).

The DSDMP and the BCHMMP both detail the monitoring locations, timing and frequency. During these surveys if IMPs are identified, they will be reported in line with Section 9 of this IMPMP.

8.9. Eradication

Eradication of marine pests is often extremely difficult. Eradication is only possible in extremely unusual circumstances where the population can be effectively isolated (Wittenberg and Cock 2001). The management procedures (which will be informed by DPIRD) following a possible detection of a marine pest will aim to isolate transport vectors to reduce spread and establishment in the receiving environment.

8.10. Adaptive Management

BCI is committed to improving environmental results and management practices throughout the implementation of the Project and therefore will use an adaptive management approach for this IMPMP. Adaptive management practices will include:

- Following the first year of operations of the TSVs/OGVs and of IMPMP monitoring, BCI will review of the monitoring program, along with DPIRD and Pilbara Ports. The review will focus on the effectiveness of the Port Operations IMP monitoring procedures in Section 8. This will be reviewed to determine and evaluate the efficiency of the IMP management measures in Table 9 and monitoring program. Any changes required will be completed in line with Section 10.
- Following detection/establishment of an IMP, BCI will review the management actions in consultation with DPIRD, and identify potential new management measures, methodologies, and technologies that may be more effective.

9. Reporting Requirements

BCI IMP reporting requirements for the Project are summarised in Table 11.

Table 11: IMP reporting requirements

Report	Content	Timeframe	Responsibility	Recipient
Presence of IMP or Potential IMP	Report any identification of IMP or Potential IMPs as per procedure.	• Within 24 hours of being made aware of identification of potential IMP is suspected or subsequently confirmed.	• Vessel operators • BCI.	• DPIRD • Pilbara Ports • FishWatch (1800 815 507) aquatic.biosecurity@dpird.wa.gov.au • or Biosecurity Section via 08 6551 4444
Capital Dredging report	Summary of sampling methods and results from pre-dredge survey.	• Final report provided within 2-months of the completion of capital dredging.	• BCI.	• DPIRD • DCCEEW • DWER • Pilbara Ports.
Annual IMP report	Summary of all monitoring implemented, including but not limited to: • Monitoring methods • Report eDNA extraction result. • Identification of any risk species • Summary report.	• Annual report in accordance with BCI annual environmental reporting requirements	• BCI.	• DPIRD • DCCEEW • DWER • Pilbara Ports.
International Vessels	All vessel operators entering Australian territory waters must complete mandatory PAR through MARs (DAWE 2022).	• Prior to entering Australia waters	• Vessel operators.	• Pilbara Ports • MARs.
Accidental ballast water discharge	Accidental discharge of high-risk ballast water (sourced from international waters) within the waters of the Project area. Report to include date, location, volume.	• As soon as possible, within 72 hours.	• Vessel operators • Contractor • BCI.	Maritime National Coordination Centre: • Email: maritimeNCC@awe.gov.au • Phone: 1300 004 605 Fax: 1300 005 882

9.1. IMP Detection Reporting Procedures

If a possible risk species is identified within the Project area, immediate notification is to be made to BCI who will notify to Pilbara Ports, DPIRD, and DAFF. Notification must be sent within 24 hours, adhering to the reporting requirements in Section 9. Given it is difficult to attribute the source of an incursion BCI will follow directives from DPIRD and work with the relevant authorities to undertake investigation if required.

To meet the National Environmental Biosecurity Response Agreement (NEBRA) cost sharing requirements it is essential for BCI to notify other potentially relevant parties if a potential species on NIMPCG list (Section 2.4) is identified.

While waiting on confirmation of possible risk species, BCI will implement the following steps to limit the spread of possible risk species:

- Initiating voluntary restrictions on affected vectors (vectors depend on the species but could include submersible equipment, vessels etc.)
- Notifying relevant agencies if necessary (refer to Table 11)
- Investigate if the suspected species is listed on the Australian Priority Marine Pest List (Appendix A).

In the case that a possible IMP risk species is identified during the construction and operation phase of the Project the detections must be reported to DPIRD within 24 hours. All notifications are to include the following information as per the requirements of how to report an aquatic pest on the DPIRD website (Report an aquatic pest | Department of Primary Industries and Regional Development) and presented in Table 12.

Table 12: IMP detection procedures and requirements

Steps	Requirements
1. Record The detection of a possible IMP is to be reported by the contractor, vessel manager or any BCI staff. The record must include the following information which BCI are to report via the BCI Site Environmental Manager to DPIRD.	• Location (GPS coordinates, address, or nearest landmark) • Date and time of detection • Size of possible IMP detected • Colour of IMP detected • Water depth where the species was detected • Environment/BCH (i.e. beach, sand, rock pool, in weed, water, river, attached to structure).
2. Photograph The record must also include a photograph of the IMP detected to be completed as early as possible and ideally within the environment where it was found, with photograph being completed prior to preserving or refrigeration of sample	• Photograph must include entire sample undisturbed and include surroundings (if possible) • Close up of IMP with scale for reference (ruler, coin, thumb etc.) • Close up of any characteristic marks or colours • Photos to be checked for clarity and glare.
3. Collect Complete recording and photographing IMP before collecting specimen. Specimen/s are to be collected and stored in a Ziplock plastic bag or plastic container.	• Label using a pencil Ziplock bag or container with date, collectors name and contact details, GPS coordinate of location and any other details listed above in Step 1. Record it) and place it in the bag with the sample. • Store the sample in a cold esky or fridge. Do not freeze it (unless there is no other way to preserve it). • FishWatch will advise where you can drop off your sample - usually your local DPIRD office.

10. Document Review

BCI is committed to continual improvement and will conduct regular review of the content and implementation of this IMPMP.

This IMPMP will be reviewed as required in response to monitoring IMP data, and every five years during operations. The IMPMP will be updated based on review outcomes. The review will take into account whether best practice and management targets are being achieved or are likely to be achieved and will identify any updates required to reach the targets.

The guidelines and procedures for managing IMPs are currently being reviewed and revised by the relevant State and Commonwealth departments, this IMPMP should be updated to reflect any changes in IMP management from the publication any new State or Commonwealth IMP guidelines or procedures. This IMPMP is a living document and will be reviewed in accordance with Table 13. Any significant changes must be documented and reported to appropriate agencies as per MS 1211 Condition C2, and EPBC 2022/9169 Condition 84 to 86.

Table 13: Audit and review requirements for the IMPMP

Timing	Rationale
Any time operational activities significantly alter.	Operational changes to the Project may result in an altered risk profile. Therefore, the IMPMP will require a review to ensure that it remains fit-for-purpose for altered operational conditions.
Following any significant incidents (i.e. detection of IMPs).	To ensure that the management actions and controls in place are adequate to ensure no IMP introduction or non-compliances.
Following any update to any National or State legislation or regulation regarding IMP, as well as new IMP guidelines determined by Pilbara Ports.	To ensure this management plan follows all legislations, regulations, or guidelines applicable to the Project area.
Feedback from DPIRD or Pilbara Ports on updated IMPs requirements.	To ensure this management plan is consistent with measures being implemented in the surrounding Pilbara waters.
When directed by the CEO of the EPA.	In line with MS 1211 Condition C2-2(2).

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Appendix A. Australian Marine Pest lists

Appendix A.1. National Priority List of Exotic Environmental Pests, Weeds and Diseases

Of the 168 exotic species, this report will only consider the marine pests listed (DAFF 2025). The following marine species are:

- Asian brackish-water clam/Overbite clam (*Potamocorbula amurensis*)
- Asian green mussel (*Perna viridis*)
- Atlantic oyster drill (*Urosalpinx cinerea*)
- Black-striped false mussel (*Mytilopsis sallei*)
- Brown mussel (*Perna perna*)
- Brush-clawed shore crab (*Hemigrapsus takanoi*)
- Carpet sea squirt (*Didemnum vexillum*)
- Centric diatom (*Chaetoceros concavicornis*)
- Chinese mitten crab (*Eriocheir sinensis*)
- Comb jelly (*Mnemiopsis leidyi*)
- Harris' mud crab (*Rhithropanopeus harrisi*)
- Japanese shore crab (*Hemigrapsus sanguineus*)
- Japanese skeleton shrimp (*Caprella mutica*)
- Japanese wireweed (*Sargassum muticum*)
- *Lady crab / Asian paddle crab (*Charybdis japonica*)
- New Zealand green-lipped mussel (*Perna canaliculus*)
- Rapa whelk (*Rapana venosa*)
- Red-gilled mudworm (*Marenzelleria neglecta*)
- Soft shelled clam (*Mya arenaria*)
- Toxic dinoflagellate (*Dinophysis norvegica*).

Appendix A.2. National Introduced Marine Pests Coordination Group's Monitoring Design Excel Table

The NIMPCG developed the Monitoring Design Excel Template (MDET) which originally considered the salinity and temperature tolerance range for invasive marine species with the intention that designers of monitoring programs could refine their target species list to the environmental conditions at the site. MDET was originally developed in line with the Australian Marine Pest Monitoring Guidelines (CoA 2010).

Search criteria

The user guide for the MDET suggests including the species where one of the life stages is excluded by narrowly exceeding the thresholds. For example, *Crepidula fornicate larvae* has an undefined threshold, but the adult's salinity threshold is 40 parts per thousand (ppt) which is equivalent to background salinity at Locker Point. Therefore, the larvae can be introduced and are able to survive in the conditions and the adult could potentially establish within the salinity range in the region. The thresholds used

with the MDET may be based on limited data (DAFF 2010). Therefore, species which narrowly (±3 °C/ppt buffer) exceed the temperature or salinity thresholds are included within the risk species list. If one of the species life-stages was found not to tolerate the conditions, all life stages for that species were excluded from the table due to the inability for it to reproduce (in line with Wells 2018).

The BCH at the Project area is predominantly soft substrate with potential seagrass present, although hard substrate of macroalgae dominated reef, and macroalgae and sparse coral reef is also found in the area. The Project will also contribute to additional hard substrate (e.g. jetty piles) available that can support the introduction of IMP. Therefore, the habitats found within the Project area have the potential to support all NIMPCG trigger list species identified from environmental tolerances. We acknowledge the NIMPCG has been superseded at the federal level by the Marine Pest Sectoral Committee (MPSC) as the government body responsible for coordination of Australia's marine pest risk management arrangements. The MPSC coordinates a national approach to marine pest biosecurity to stop the spread of marine pests and provide expert scientific, technical and policy advice on marine pest related biosecurity issues to the National Biosecurity Committee (DAWR 2018).

Appendix Table A-1: NIMPCG list species (NIMPCG 2009a, b)

Species Phylum	Species Name
Crustacea/Copepoda	*Acartia tonsa*
Dinophyceae	*Alexandrium catenella*
Dinophyceae	*Alexandrium minutum*
Dinophyceae	*Alexandrium monilatum*
Dinophyceae	*Alexandrium tamarense*
Echinodemata	*Asterias amurensis*
Crustacea/Cirripedia	*Balanus eburneus*
Crustacea/Cirripedia	*Balanus improvisus*
Ctenophore	*Beroe ovata*
Cnidaria	*Blackfordia virginica*
Rhodophyta	*Bonnemaisonia hamifera*
Crustacea/Brachyura	*Callinectes sapidus*
Crustacea/Brachyura	*Carcinus maenas*
Chlorophyta	*Caulerpa racemosa*
Chlorophyta	*Caulerpa taxifolia*
Bacillophyta/diatoms	*Chaetoceros concavicornis*
Bacillophyta/diatoms	*Chaetoceros convolutus*
Crustacea/Brachyura	*Charybdis japonica*
Chlorophyta	*Codium fragile spp. tomentosoides*
Mollusca/Bivalvia	*Corbula amurensis*
Mollusca/Bivalvia	*Crassostrea gigas*
Mollusca/gastropoda	*Crepidula fornicata*

Species Phylum	Species Name
Ascidiacea	*Didemnum spp.*
Dinophyceae	*Dinophysis norvegica*
Mollusca/Bivalvia	*Ensis directus*
Crustacea/Brachyura	*Eriocheir sinensis*
Rhodophyta	*Grateloupia turuturu*
Dinophyceae	*Gymnodinium catenatum*
Crustacea/Brachyura	*Hemigrapsus sanguineus*
Crustacea/Brachyura	*Hemigrapsus takanoi/penicillatus*
Annelida	*Hydroides dianthus*
Mollusca/Bivalvia	*Limnoperna fortunei*
Annelida	*Marenzelleria spp.*
Ctenophore	*Mnemiopsis leidyi*
Mollusca/Bivalvia	*Musculista senhousia*
Mollusca/Bivalvia	*Mya arenaria*
Mollusca/Bivalvia	*Mytilopsis sallei*
Mollusca/Bivalvia	*Perna perna*
Mollusca/Bivalvia	*Perna viridis*
Dinophyceae	*Pfiesteria piscicida*
Crustacea/Copepoda	*Pseudodiaptomus marinus*
Bacillophyta/diatoms	*Pseudo-nitzschia seriata*
Mollusca/gastropoda	*Rapana venosa*
Crustacea/Brachyura	*Rhithropanopeus harrisii*
Annelida	*Sabella spallanzanii*
Phaeophyta	*Sargassum muticum*
Pisces	*Siganus luridus*
Pisces	*Siganus rivulatus*
Crustacea/Copepoda	*Tortanus dextrilobatus*
Pisces	*Tridentiger barbatus*
Pisces	*Tridentiger bifasciatus*
Phaeophyta	*Undaria pinnatifida*
Mollusca/Bivalvia	*Varicorbula gibba*
Rhodophyta	*Womersleyella setacea*

Appendix B. Existing Environment

Appendix B.1. Benthic Communities and Habitat

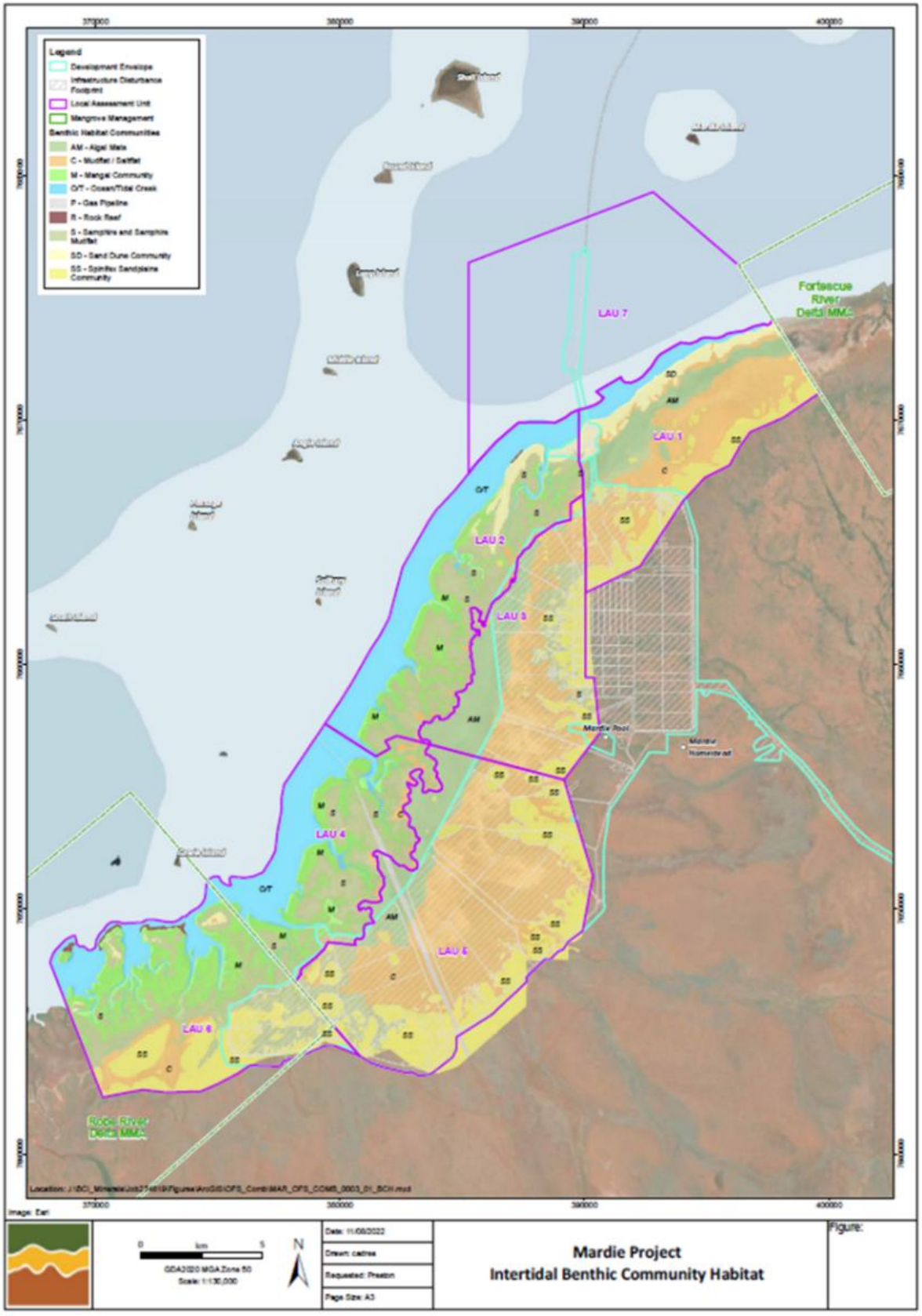
As part of project assessments, O2 Marine (2019c, 2019d) undertook subtidal and intertidal benthic communities and habitat (BCH) investigations which identified the following key classes occurring within the wider Project area:

- Mangroves
- Samphire/samphire mudflats
- Foreshore mudflats/tidal creeks
- Rocky and sandy shorelines
- Bare sand
- Filter feeder/macroalgae/seagrass
- Coral/macroalgae.

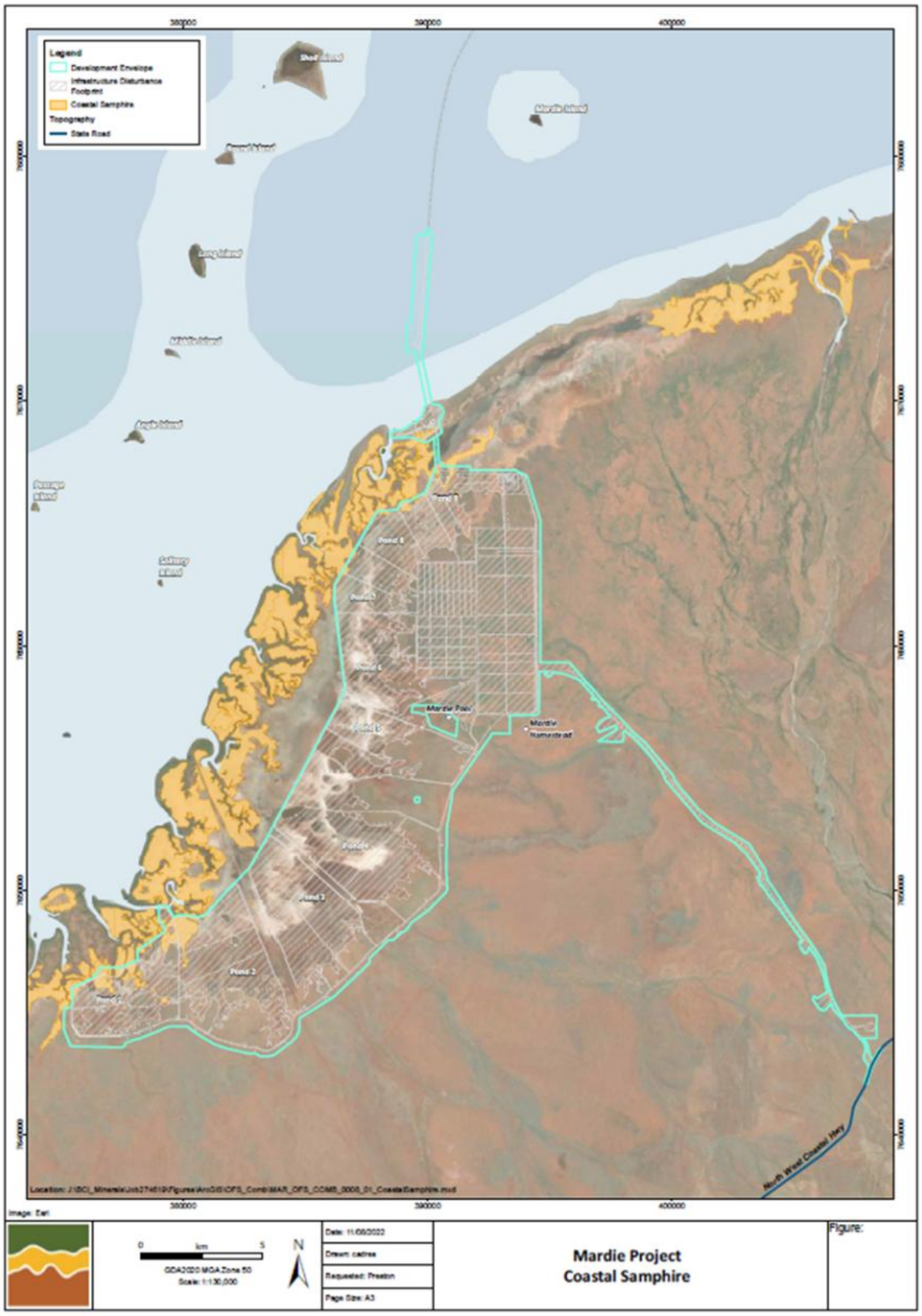
Surveys conducted by O2 Marine (2019c, 2019d) of the proposed development site have demonstrated the major subtidal habitat types to mainly consist of fine sands and silt that are largely devoid of biotic cover aside from occasional macroalgae, coral, filter feeder, seagrass and crab burrows (bioturbation). Shallow areas just below the intertidal zone had a slightly higher cover of macroalgae and some loose rocky rubble substrate and limestone pavement was also recorded. Some localised patches of soft and hard corals have also been found with a mixture of macroalgae, sponge and hydroid communities.

Eight broad intertidal BCH classes were identified and mapped within the Study Area (DE and surrounds), as shown in and include the following habitat classes (see O2 Marine 2019c,d) for more detail):

- Algal mat
- Closed Canopy (CC) seaward mangroves
- Scattered (SC) landward mangroves
- Samphire/samphire mudflats
- Foreshore mudflat/tidal creek
- Rocky shoreline
- Mudflats/saltflats
- Sandy beaches.



Appendix Figure B-1:Intertidal BCH within the LAUs 1 to 6



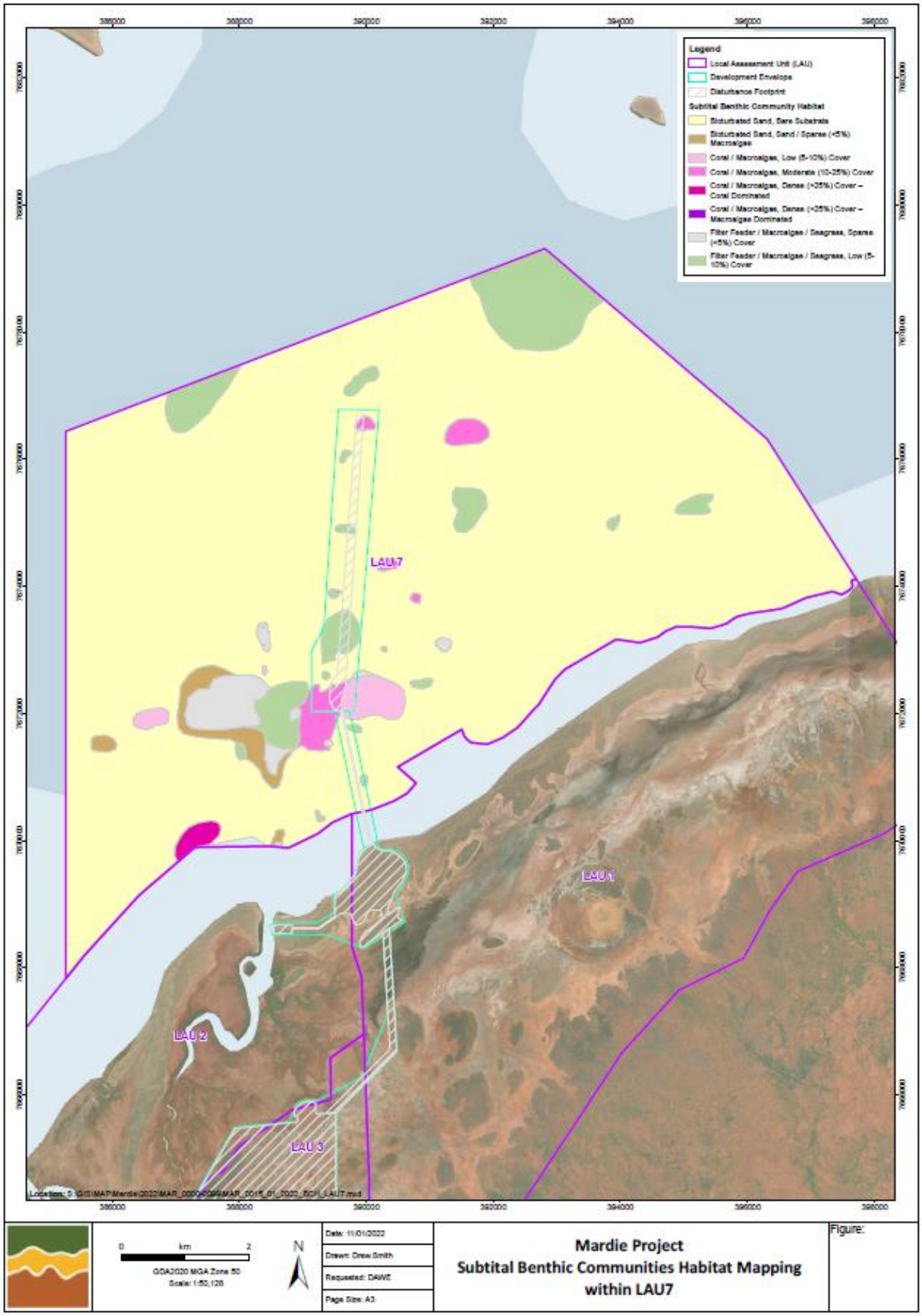
Appendix Figure B-2: Coastal Samphire BCH

Appendix B.2. Subtidal BCH

During the subtidal habitat mapping phase of the investigations, three broad subtidal BCH classes were identified within LAU7 (O2 Marine 2020b). Within those three broad classes (bare sand, filter feeder/macroalgae/seagrasses and coral/macroalgae), eight BCH subclasses were distinguished based on varying levels of benthic cover and dominant taxa. These classes and subclasses are mapped in Appendix Figure B-3 and are (See O2 Marine 2020b for more detail):

- Bare sand (bare silt/sand)
- Filter feeder/macroalgae/seagrass (Sand/Sparse (<5%) Filter Feeders, Low (5-10%) Cover Macroalgae/Filter Feeders)
- Coral/macroalgae (Low (5-10%) Cover Coral, Moderate (10-25%) Cover Coral/Macroalgae/Seagrass)
- Coral/Macroalgae (Dense (>25%) Cover Macroalgae/Coral/Filter Feeders, Dense (>25%) Cover Coral Dominated).

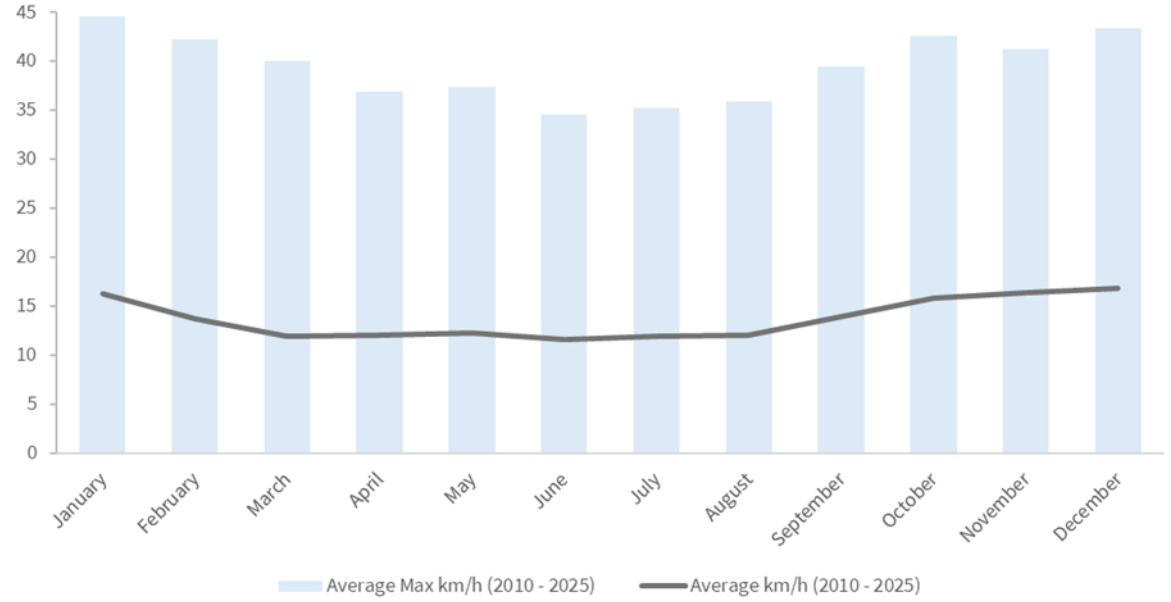
Subsequent to mapping, further pilot studies were undertaken to refine the subtidal BCH health monitoring program and create baseline data. These surveys found ephemeral seagrasses dominate nearshore areas of the foreshore mudflats (i.e. around depths of lowest astronomical tide (LAT)), recording seagrass cover up to nearly 60% at one site. These areas were not mapped initially as the risk to these areas from marine related activities (e.g. dredging and bitterns discharges) was considered low. However, monitoring sites have been established in nearshore seagrass habitat to monitor for potential changes to surface water, groundwater and tidal regimes.



Appendix Figure B-3: Subtidal BCH within LAU 7

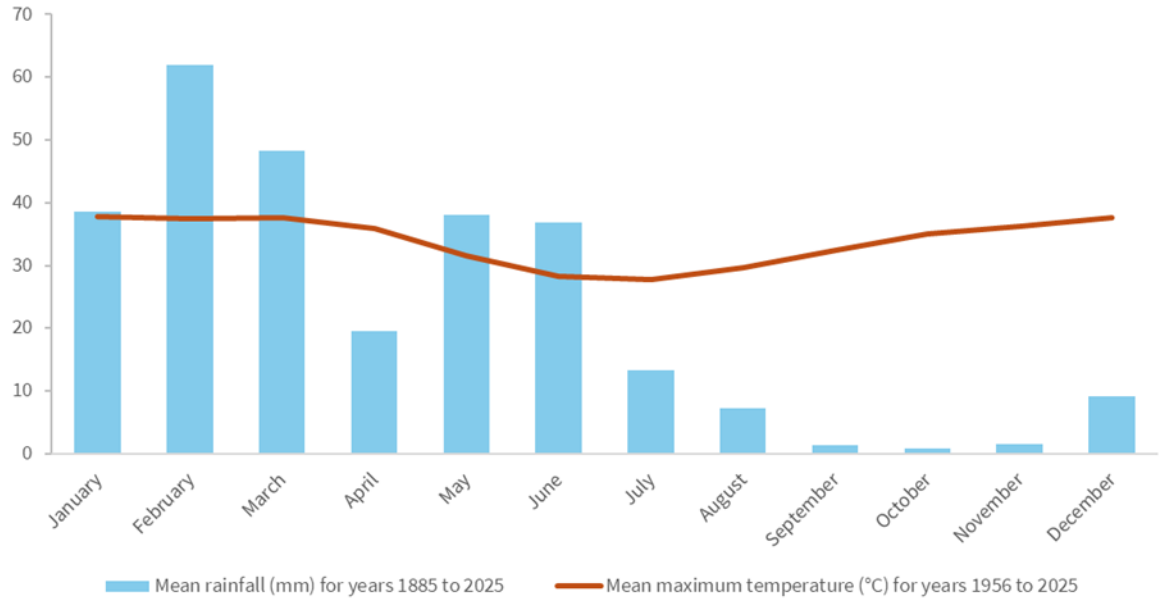
Appendix B.3. Climate

The southern Pilbara region has a tropical monsoon climate with distinct wet and dry seasons. The dry season extends from May to October, and is characterised by warm to hot temperatures, easterly to southeasterly winds from the continental landmass, clear and stable conditions as the subtropical high-pressure ridge migrates over this area. In the afternoon, the wind direction shifts to north-westerly, particularly later in the dry season, associated with the onset of the land sea breeze as the temperature difference between the continent and the ocean increases throughout the day. In the wet season the wind climate is dominated by westerly and north-westerly winds. Average wind speeds are presented in Appendix Figure B-4 based on analysis of the measured wind records from Mardie Airport over the period 2010 – 2025.



Appendix Figure B-4: Wind statistics from Mardie (BoM).

Climate statistics for the town of Mardie are presented in Appendix Figure B-5 from the BoM site which is approximately 16 km inland. Maximum daily temperatures at Mardie average 34°C throughout the year, peaking at 37.8°C in January and falling to 27.8°C in July. The Pilbara is influenced by northern rainfall systems of tropical origin. These systems are responsible for heavy falls during the summer months, while the southern low-pressure systems sometimes bring limited winter rains. The annual average rainfall is only 138 mm, and the mean monthly rainfall has a bimodal distribution, peaking in January to March and also May to June, with very little rainfall from July to December. Daily rainfall can reach over 330 mm during extreme events that may occur one to two times per decade. Evaporation rates in the region are high, estimated to exceed by ten times the annual rainfall.



Appendix Figure B-5: Climate statistics from Mardie (BoM).

The Australian cyclone season extends from November through to April with an average of 10 cyclones per year, although not all make landfall. Tropical cyclone winds can generate extreme coastal water levels through storm surge and these systems are frequently associated with heavy rainfall that can cause significant flooding. The Pilbara region of WA has a high exposure to tropical cyclone events, with a typical cyclone track recurving and making landfall on the coastline between Broome and Exmouth. The season typically runs from mid-December to April, peaking in February and March. The Karratha to Onslow coastline is the most-cyclone prone section of the Australian coast, typically experiencing one landfalling event every two years. The northwestern coastline of Western Australia is highly vulnerable to the occurrence of storm surge. This is due to the frequency of tropical cyclones, the wide continental shelf and relatively shallow ocean floor over the North West Shelf, as well as the low-lying nature of much of the coastline. In addition, tropical cyclone events are strongly associated with flooding due to widespread heavy rainfall. Historical events of significance impacting between Karratha and Onslow include: Trixie 1975, Chloe 1984, Orson 1989, Olivia 1996, John 1999, Monty 2004, Clare 2006 and Glenda 2006, Damien (2020), and Ilsa (2023).

As reported by the Bureau of Meteorology (2025a), the 2024/25 wet season was characterised by above-average temperatures and rainfall across the Pilbara region. Mean maximum and minimum temperatures ranked in the top 10% of all wet seasons since 1910–11, with record-breaking daily minimum temperatures in parts of the Pilbara (e.g. Mardie station: 34.7–45.8°C; BoM 2025a). Twelve tropical cyclones formed in the northern Australian region, more than any season since 2005/06 and above the post-2000 average of nine. Rainfall was similarly elevated. The Pilbara recorded its highest February rainfall on record due to Severe Tropical Cyclone Zelia, contributing significantly to seasonal totals (BoM 2025b).

Appendix B.4. Geology and geomorphology

In the Pilbara the coastal zone incorporates coastal waters out to 30 m depth contour and associated coastal islands. The seafloor in this zone is virtually flat with the exception of small nearshore islands. Further offshore the substrate become steeper and therefore influences the type of benthic communities that exist here. The coastal platform generally slopes seaward with turbid waters (particularly to 10 m and deeper in the north) and increasing tidal influence from south to north. Shallow sandbars, platforms, reefs and ridges are common in the Pilbara and constitute the substrate types found at Mardie.

The Mardie coastline is characterised by tidal creeks which have generally evolved in response to the ongoing tidal current forcing. Rainfall in this environment is highly intermittent and it is likely that rainfall runoff occurs as sheet flow over the local drainage catchments that have relatively small catchment areas towards the tidal creek drainage network. Sediment is delivered periodically to the coast through networks of rivers and streams. Extreme water levels and waves and associated rainfall and runoff under cyclonic conditions would be a significant driver of geomorphic changes along the coast, leading to erosion and enhanced sediment transport processes (Eliot et al. 2013).

The primary mechanism for sediment transport in nearshore areas appears to be the tidal flows. The measured data from inshore shows a marginally stronger flood magnitude compared with the ebb, likely due to the shallow water and complex bathymetry which funnels water in on the flood tide between the reefs and islands. Based on measured data from inshore, the depth averaged velocity in spring tides is in the range of 0.3 m/s to 0.5 m/s, whilst on the neaps the current speed is 0.2 m/s to 0.3 m/s. Whilst the site is generally protected by swells, the sea waves and swell will contribute to nearshore and shoreline sediment transport processes

Sediment samples from the nearshore areas around the Project site collected in 2018 and 2019 confirm the seabed composition is made up of predominantly sand fractions with varying degrees of fines (O2 Marine 2019a). The samples collected from the seabed in the proposed berth pocket and entrance channel showed fine fractions (silt and clay) of 20 % to 30 %. Further offshore (approximately 5 km) the sediment sampling indicated the fine fractions reduced to less than 5% of the sample with the composition of the seabed sediment dominated by sand fractions.

Appendix B.5. Water conditions

A risk assessment of IMP species can be informed by identifying the physical water characteristics at the project area. Water quality (including salinity, temperature and turbidity) of the receiving environment has a notable influence on the survivorship of marine species, including IMPs. If the range of tolerance to each of the water quality factors are known for each potential IMP, the likelihood of survival at the project site can be calculated. A summary is in Appendix Table B-1.

Appendix Table B-1: Summary of water conditions at the Project area

Parameter	Summary
Salinity	In the west Pilbara nearshore waters have variable salinity (Pearce et al. 2003)). In the summer monsoonal season, and salinity may be impacted by freshwater flows from nearby Fortescue River, Robe River and local watercourses. O2 Marine (2019b) identified high

Parameter	Summary
	nearshore salinities within the study area, ranging between 34-46 ppt over an annual period, with an annual median of 39.3 ppt. Freshwater flow from nearby watercourses during the summer monsoon season or large tropical lows have the potential to reduce nearshore salinity. However, rapid mixing with offshore marine waters is likely to occur due to the strong mixing processes in the area.
Temperature	Studies in the area have demonstrated higher temperatures in inshore waters than offshore during summer, while the inverse is correct during winter (Pearce et al. 2003). O2 Marine (2019b) identified a temperature range between 18-33 °C at the study area, whilst nearby water quality studies (i.e. Cape Preston) have identified temperatures that range between 18 °C in winter to 31.5°C in the summer (CALM 2005). With a wide temperature range, some IMP species may be unable to survive or reproduce successfully.
Turbidity	Nearshore waters are often more turbid than deeper offshore waters at Mardie due to a variety of factors. Turbidity also varies temporally and at smaller localised scales. Tide is particularly influential on turbidity, which is naturally higher during spring than neap tides, due to increased current velocities (Jones et al. 2015). Large inshore areas of shallow, flat bathymetry are affected by wind driven waves and currents which easily resuspend fine sediments in the area. In addition, blooms of the cyanobacteria *Trichodesmium* spp. occur commonly in the area which increases the turbidity of surface waters (Maunsell 2006; RPS 2008). Turbidity data collected by O2 Marine (2019b) identified high levels (i.e. Mean 15.2 NTU) in the inshore areas surrounding the proposed Mardie Port, with much lower turbidity levels (i.e. Mean 2.2 NTU) observed further offshore surrounding the Passage Islands.

Appendix B.6. Marine Fauna

O2 Marine conducted a prior assessment of the likelihood of occurrence of conservation significant marine fauna species within the vicinity of the Mardie Project area (2020). The following key marine fauna species were identified which are either known to occur or have a high likelihood of occurring in the vicinity of the Project:

- Humpback whale (*Megaptera novaeangliae*)
- Dugong (*Dugong dugong*)
- Australian humpback dolphin *(Sousa sahulensis*)
- Loggerhead turtle (*Caretta caretta*)
- Green turtle (*Chelonia mydas*)
- Flatback turtle (*Eretmochelys imbricate*)
- Hawksbill turtle (*Eretmochelys imbricata*)
- Short-nosed sea snake (*Aipysurus apraefrontalis*)
- Green sawfish (*Pristis zijsron*)
- Reef mantra ray (*Mobula alfredi*).

In addition to these, further key marine fauna have been identified for the offshore disposal area DMPA4 based on a new search of the Protected Matters Search Tool (PMST) (20 km buffer) and literature review. These additional key marine fauna are:

- Indo-pacific/spotted bottlenose dolphin (*Tursiops aduncus*)
- Leaf-scaled sea snake (*Aipysurus foliosquama*)
- Narrow sawfish (Anoxypristis cuspidate)

- Dwarf sawfish (*Pristis clavata*).

Furthermore, marine fauna ecological windows are presented in Appendix Table B-2 for key species. These results are based on a recent O2 Marine report for BCI Minerals (O2 Marine 2025). The results from the literature review key species present in the Mardie area, EPBC listing, and the behaviour of the fauna during that time (if known) (Jenner et al. 2010; Jenner and Jenner 2010; D'Anastasi et al. 2016 Bayliss and Hutton 2017; DoEE 2017; Morgan et al. 2017; Raudino et al. 2018; Irvine et al.2018; O2 Marine 2023; Peel et al. 2024; Morgan et al. 2015; Lear and Morgan 2022; Lear et al. 2023; DoE 2025).

Appendix Table B-2: Ecological windows of marine fauna species known to be present in the Project area throughout the year (Dark blue represents full duration of presence, light blue represents timing of specific behaviour)

Species	Listing	Behaviour	Ecological Window											
			J	F	M	A	M	J	J	A	S	O	N	D
Indo-Pacific bottlenose dolphin	EPBC Act: Migratory BC Act: Migratory	*Presence*												
Australian humpback dolphin	EPBC Act: Vulnerable, Migratory BC Act: P4, Migratory	*Presence*												
Dugong	EPBC Act: Migratory BC Act: Migratory	*Presence*												
Humpback whale	EPBC Act: Migratory, Cetacean BC Act: CD, Migratory	*Northern migration*												
		Southern migration												
Australian snubfin dolphin	EPBC Act: Vulnerable, Migratory BC Act: P4, Migratory	*Presences (noting not likely to be present)*												
Blue whale (*Balaenoptera musculus*) Pygmy blue whale (*B. m. brevicauda*)	EPBC Act: Endangered, Migratory, Cetacean BC Act: Endangered	*Northern migration*												
		Southern migration												

Species	Listing	Behaviour	Ecological Window											
			J	F	M	A	M	J	J	A	S	O	N	D
Green turtle	EPBC Act: Vulnerable, Migratory, Marine BC Act: Vulnerable	*Foraging*												
		Nesting and inter-nesting												
		Peak nesting												
		Hatchlings												
Hawksbill turtle	EPBC Act: Vulnerable, Migratory, Marine BC Act: Vulnerable	*Foraging*												
		Nesting and inter-nesting												
		Peak nesting												
		Peak hatchlings												
Flatback turtle	EPBC Act: Vulnerable, Migratory, Marine BC Act: Vulnerable	*Foraging*												
		Nesting and inter-nesting												
		Peak nesting												
		Hatchlings												
Loggerhead turtle	EPBC Act: Endangered, Migratory, Marine BCT Act: Endangered	*Foraging*												
		Nesting and inter-nesting												
		Peak nesting												
		Hatchlings												
Leatherback turtle	EPBC Act: Endangered, Migratory, Marine BC Act: Vulnerable	*Foraging(noting not expected to be present)*												

Species	Listing	Behaviour	Ecological Window											
			J	F	M	A	M	J	J	A	S	O	N	D
Short-nosed sea snake	EPBC Act: Critically Endangered, Marine BC Act: Critically Endangered	*Presence*												
Leaf-scaled sea snake	EPBC Act: Critically Endangered, Marine BC Act: Critically Endangered	*Presence*												
Green sawfish	EPBC Act: Endangered, Marine BC Act: Vulnerable	*Foraging and/or migration*												
		Pupping												
Narrow sawfish	EPBC Act: Migratory BC Act: Migratory	*Foraging*												
		Pupping												
Dwarf sawfish	EPBC Act: Vulnerable, Migratory BC Act: P1, Migratory	*Presences*												
		Pupping												
Scalloped hammerhead	EPBC Act: CD BC Act: Not listed	*Presences*												
		Pupping												
White shark	EPBC Act: Vulnerable, Migratory BC Act: Vulnerable	*Presences (noting not likely to be present)*												

Species	Listing	Behaviour	Ecological Window											
			J	F	M	A	M	J	J	A	S	O	N	D
Grey nurse shark	EPBC Act: Vulnerable BC Act: Vulnerable	*Presences (noting not likely to be present)*												
Reef manta ray	EPBC Act: Migratory BC Act: Migratory	*Presences (noting not likely to be present)*												
Giant manta ray	EPBC Act: Migratory BC Act: Migratory	*Presence*												

Appendix B.7. Aquatic Resources and Fisheries

The aquatic resources that overlap with the Project area are identified in Appendix Table B-3. The fisheries and indicator species that are managed within these aquatic resources are also identified in this table and a summary of these resources is presented below. Further information on these resources are found can be found in the O2 Marine's Fish and Fisheries Impact Assessment (O2 Marine 2025b).

Appendix Table B-3: Aquatic resources, fisheries and key indicator species found near the Project area (Newman et al. 2024)

Aquatic Resource	Fisheries	Indicator species
North coast bioregion		

Northern Demersal Scalefish Resource	Commercial
	• Northern Demersal Scalefish Managed Fishery (operational area does not overlap with the Mardie Project dredge footprint and DMPA4)
	  • Pilbara Demersal Scalefish Fisheries
	  • Pilbara Trap Managed Fishery
	  • Pilbara Fish Trawl (Interim) Managed Fishery
	  • Pilbara Line Fishery
	Recreational
		• Red emperor
		• Rankin cod
		• Bluespotted emperor
		• Goldband snapper (Kimberley region)

Northern Invertebrates Resource	Commercial • Onslow Prawn Managed Fishery • Nickol Bay Prawn Managed Fishery • Broome Prawn Managed Fishery • Kimberley Prawn Managed Fishery	• Banana prawn • Western king prawn • Brown tiger prawn
North Coast Crab Resource	Commercial • Pilbara Crab Managed Fishery • Exmouth Gulf Developing Crab Fishery • Kimberly Crab Managed Fishery Recreational Customary	• Blue swimmer crabs
Pearl Oyster Resource	Commercial • Pearl Oyster Managed Fishery (MSC*) • Customary	• Silver lipped pearl oyster
Statewide bioregion		
Statewide Hand Collection Resource	Commercial • Western Australian Sea Cucumber Fishery (MSC*) Customary	• Sandfish • Redfish
Statewide Large Pelagic Finfish Resource	Commercial • Mackerel Managed Fishery Recreational	• Spanish mackerel • Grey mackerel
Statewide Marine Aquarium Fish and	Commercial • Marine Aquarium Fish Managed Fishery	• Syngnathids • Invertebrates

Aquatic Resource	Fisheries	Indicator species
Hermit Crab Resource	• Hermit Crab Managed Fishery	• Hard coral • Soft coral • Living rock • Living sand • Sponges • Algae/Seagrasses • Hermit crab
Statewide Specimen Shell Resource	Commercial • Specimen Shell Managed Fishery	• Shells
Statewide Abalone Resource	Commercial • Abalone (Roe's) Managed Fishery • Abalone (Greenlip/Brownlip) Managed Fishery (MSC*) Recreational	• Roe's abalone • Greenlip abalone • Brownlip abalone
**Some fisheries within the aquatic resources are also certified fisheries by the Marine Stewardship Council (MSC), which means the fisheries have been independently certified as being sustainable*		

Appendix C. Risk Assessment

Appendix C.1. Identification of Risks and Risk Assessment

The North-west bioregional plan has identified the introduction of a known or potential pest or invasive species as a pressure that is likely to cause substantial impact on conservation values in the area (DSEWPaC 2012). Shallow and inshore areas, especially Ports and sites of infrastructure development, have the highest risk of establishing marine pests. However, some species have the potential to establish or expand into deeper waters (DSEWPaC 2012).

Appendix C.2. Resources at Risk

The establishment of a marine pest can occur rapidly, they can out-compete native species, alter the structural integrity such as loss of habitats (e.g. seagrass and sandy soft bottom areas), and can alter the ecological balance on coastlines (DSEWPaC 2012). The consequences/level of impact of IMP translocation is dependent on the value and sensitivity of the receiving environment and the value and susceptibilities of the Projects assets.

C.2.1. Natural Resources

The Project site is adjacent to areas of conservation significance such as mangroves and coral reef ecosystems. Mangroves are present along the coastline of Mardie and coral reefs are found around the Passage Islands, the closest of which is 6.5 km from the proposed transhipment dredge channel. Some of these ecosystems have a formal level of protection including terrestrial parks or proposed state marine parks. These include the Marine Park and Marine Management Area at Barrow Island (>25km from DMPA4) and the Pilbara Inshore Islands Nature Reserve (Great Sandy Island Nature Reserve) (~10km from DMPA4).

The *Pilbara Coastal Water Quality Outcomes* (DoE 2006) report designated the region with a High Level of Ecological Protection (LEP), with mangrove areas receiving a Maximum LEP. This status was reaffirmed in a 2019 update, which confirmed that approximately 18% of the region retains a high to maximum LEP. However, these protected areas do not include zones identified for industrial infrastructure development under current government-endorsed land-use plans. Despite this, the areas designated for development are acknowledged to hold significant socio-economic, environmental, and cultural values, identified through extensive stakeholder consultation. Additionally, the region supports mangrove communities of regional significance (EPA 2001).

Significant loss of habitat due to IMP could potentially impact marine fauna during different life stages. These consequences could include loss of nursery habitat from IMP competition or degradation, competition for resources, avoidances of breeding habitats (e.g. nesting, pupping, spawning), loss of local biodiversity and/or changes in marine fauna communities and fish stocks. The most significant consequence is loss or avoidance of critical habitat (e.g. one used for feeding, breeding, or nursery habitat) by a large proportion of the population which could have far-reach effects. Conservation significant marine species likely to occur in the area (refer to Appendix B.5) are also at risk of harm by IMP.

IMP presents significant risks to port operations, including physical damage to infrastructure, reputational harm, and increased regulatory obligations. IMP can impair critical infrastructure such as vessels, seawater intakes, and port equipment through fouling and biofouling, resulting in reduced operational efficiency. If an IMP incursion occurs, port activities may be substantially affected by regulatory responses, which can include changes to shipping operations, implementation of eradication measures, and long-term environmental monitoring. Certain pest species may also necessitate frequent dry-docking of vessels for inspection and cleaning to maintain or restore functionality.

C.2.2. Regional economic consequences

The introduction of IMP in the Pilbara region of Western may cause significant economic consequences posing damage to the region's key industries such as shipping, oil and gas, and mining. IMP can damage critical marine infrastructure, disrupt local ecosystems, and reduce biodiversity, ultimately affecting commercial fisheries. Commercial implications because of IMP introduction would be substantial, including physical detriment to assets, damage to business reputation, and increased regulatory requirements. Damage to, or inhibition of infrastructure functionality by IMP, such as the fouling of vessels, seawater intake and equipment, is likely to result in reduced efficiency and an eradication program would be required as recommended in Muñoz and McDonald (2014).

Appendix C.3. Risk Factors

There is a diverse range of factors that may affect the likelihood of an IMP arriving and establishing within the Project area. For a successful marine pest introduction to take place, they need to be transported from a location where the pest species is known to occur and transported to a receiving environment that is suitable for their survival.

C.3.1. IMP Vectors

Vectors are the mechanism by which a potential marine pest can be translocated from donor to receiving node. Primary vectors of concern include biofouling on vessel hulls and other surfaces, ballast water, or other internal water or sediment carried by a vessel or marine equipment. The most common transportation vectors for the introduction of IMP are biofouling on vessels, debris, and submersible equipment, or in ballast water/sediment and seacocks/sea strainers. Marine pests can also be introduced and spread by fisheries, aquaculture, ornamental trade and natural dispersal (i.e. currents) (MPSC 2024). There has been reports of approximately 250 non-indigenous marine species in Australian waters, and of these reports 75% have been introduced via biofouling (McDonald et al. 2015).

The assumption with IMP introduction is that the likelihood of them occurring within an area is related to the number of vessels that visit the area from a high risk location. The likelihood of translocation is dependent upon the following factors to determine a vessels risk (modified from McDonald et al. 2015):

- Frequency and duration of vessel visits (assumption greater duration of stay, greater potential of transfer)
- Vessel operating speeds (e.g. stationary, or slow- moving vessels in port areas allow fouling pests to attach, while transit times between ports will affect survivorship in ballast water)

- Type of vessel operations (i.e. direct contact with seabed brings higher risk of pest transfer and settlement)
- Vessel origin (i.e. outside of Pilbara, WA, or international)
- Level of hull biofouling and prevention (AFCs)
- Capacity and use of ballast water throughout journey.
- Presence and size of internal vessel areas such as sea chests, anchor cable lockers, propeller shafts (more niches greater potential for transfer)
- Size of vessel and corresponding size of hull wetted area
- Frequency/rigour of inspection of internal areas and treatment systems used.
- Dry docking - duration since the last dry-docking or removal from the water
- Maintenance constraints (assumption structural profiles that inhibit effective maintenance the greater the potential for pests to settle on hull).

C.3.2. Project Risk Areas

Construction of the project will alter the habitat available for marine pest settlement. Dredging of up to 355,000 m^3 for the transhipping channel will remove existing soft substrate and create deeper areas of new soft substrate, creating a potential niche environment that was not previously available. These disturbed areas have potential to be colonised by opportunistic marine pests. In addition, trestle jetty pylons and outfall/intake pipelines will create new areas of hard substrate that were not previously available to sessile/sedentary marine species. Vessel movements, as well as marine and coastal development, are primary and secondary pathways for the introduction of marine pests (DAWR 2018). Vessel movements into new development areas provide the opportunity for marine pest species to establish in new habitats or increase the existing distribution extent (DAWR 2018). The expansion of the marine and coastal infrastructure in WA has increased likelihood of marine pest translocation (DAWR 2018).

The Project will involve the use of transhipment barges that will travel offshore to load product onto OGVs (bulk carrier vessels) for overseas export.

The key nodes of IMP translocation and introduction for the Project are:

- Jetty construction and new infrastructure in the intertidal and sub-tidal zones
- Substrate surrounding and below the trestle jetty
- Outfall and intake pipelines in the intertidal and sub-tidal zones
- Dredging (355,000 m^3) and disposal at DMPA4 (using barges)
- Maintenance dredging and disposal at DMPA4
- Anchorage at transhipment area
- TSVs vessels
- Transhipment channel with increased/deeper area of soft bottom substrate and reduced coverage of existing BCH
- Export vessels/ocean going vessels
- Support vessels
- Immersible equipment.

Potential Invasive Species

The Mardie area has not been surveyed specifically for IMPs, however BCH community surveys by O2 Marine have not identified any to date (O2 Marine 2019d). Additionally, nearby at Cape Preston (~37km from the Mardie export jetty), URS conducted an IMP survey and found no marine pest species listed by the National IMP Coordination Group (URS 2009).

Regionally, the IMP species *Didemnum perlucidum* is found at Barrow Island, ~50km to the north-west of the project site at Mardie. This species is listed as an IMP by NIMPCG (2009a, 2009b), which indicates that is has potential to cause harm to the environment it is introduced to, however has been widely found in marine industrial area across WA.

Considering the Project area has not specifically been surveyed for IMPs, this section identifies marine species which are most likely to be introduced to the Project area. Temperature and salinity thresholds could enable or limit the translocation and spread of the pests from the Project site. Therefore, species thresholds were considered in the evaluation. The species were identified using a combination of the following sources:

- National Introduced Marine Pests Coordination Group (NIMPCG) (Appendix A.1)
- Australian Priority Marine Pest List (APMPL) (Section 4.1)
- National Priority list of Exotic Environmental Pests Weeds and Diseases (EEPL) (DAFF 2025) (Appendix A.1)
- Western Australian Prevention List for Introduced Marine Pests (DPIRD 2016) (Section 4.1)

Known environmental conditions at the Project location were used to refine the marine pest species.

IMP Risk Species for Mardie

This section identifies marine pest species which are most likely to be introduced to Mardie as a result of the Project. This is based on the Australian National priority trigger list for marine pests that are considered to be at risk of introduction and causing harm in Australian waters (NIMPCG, 2009a; 2009b). The approach utilises the National Monitoring Design Excel Template (MDET) v2.5 (DAWR 2018) which provides environmental tolerance ranges for each of the 54 species on the national list. The environmental conditions at Mardie are detailed in Appendix B If one of the species life-stages was found not to tolerate the conditions, all life stages for that species were excluded from the table due to the inability for it to reproduce (in line with Wells 2018). Following this methodology, 48 possible species were identified as having potential to establish within the surrounding Project waters (Table 5). Of these species, 41 have a planktonic life history stage which enables the potential for transfer through vessel ballast water during either the construction and/or operational phases of the Project.

The habitat composition at the Mardie Project site is predominantly soft substrate, however hard substrate (coral reefs, rocky rubble, limestone pavement) is also found in localised areas (See Appendix B for further details). Habitats available at Mardie, therefore, have potential to support all of the NIMPCG trigger list species identified from environmental tolerances. This is particularly the case for species that have life stages relevant to soft substrate. The construction of anchorage sites will also provide new settlement locations for the species that have life-stages that require hard substrate due to habitats in

the offshore area dominated by deep water sparse assemblage on sand/low profile reef, and low-density mixed assemblage habitat.

Six high risk species have potential of being introduced and surviving are *Rhithropanopeus harrisii, Mytilopsis sallei, Perna perna, Perna viridis, Undaria pinnatifida and Carcinus maenas* (NIMPCG list). These species have planktonic life stage history stage, which can be transferred through vessel ballast water during either the construction and/or operational phases of the Project. They also have the potential to establish at the secondary nodes; however, all potential hard substrates are secondary nodes and have a lower risk of IMP translocation. Controls to mitigate risk of these taxa being introduced and secondarily transferred have been identified in Section 7. Controls to mitigate risk of these taxa being introduced and secondarily transferred include regular dry dock maintenance of AFCs across vessel hulls and all niche environments (e.g. sea chests/strainers) and use of passive monitoring (eDNA sampling) to enable early warning of any introductions of species of concern.

Appendix C.4. Risk Assessment

This report determines the hazards, likelihood and scale of potential consequences and suggests controls regarding introduction of marine pests to Mardie due to the progression of construction and operations of the 'Optimised Mardie Project' in the Pilbara. This section details the methodology used, which is consistent with the Australian and New Zealand Standard for Risk Management (AS/NZS ISO 31000:2018).

C.4.1. IMP Risk Assessment Procedures

Within the overarching framework, various methodologies, and factors to consider for risk assessment of marine biosecurity have been discussed and implemented in the past. These include focus on environmental matching between donor and recipient ports (ICES 1996; Hilliard and Raaymakers 1997), species-specific assessments (Carlton et al. 1995; Hayes and Hewitt 1998) or Quantitative Import Risk Assessments (Kellar 1993; Morley 1993) among others. At a basic level, species-specific assessment requires identification of environmental conditions and infection status at donor and recipient ports for each species.

Pilbara Ports recently discontinued the Vessel Biofouling Risk Assessment and Management Procedure (Pilbara Ports 2023) due to the termination of 'Vessel Check' portal (online integrated biofouling risk assessment and management tool which is jointly managed by DPIRD and DHI). However, Pilbara Ports strongly encourages compliance with Commonwealth Government and International Maritime Organization (IMO) requirements and guidance measures in place for the management of biofouling and in water cleaning with support by DPIRD. Updated policies and procedures are currently in development by Pilbara Ports.

C.4.2. Risk Assessment Methodology

The approach utilised in this risk assessment aims to rank the likelihood and consequence associated with different hazards at a scale using best-of-knowledge estimates. Appendix Figure C-1 illustrates the process providing an overarching methodology overview. Activities that present hazards or key risk activities associated with the Project were identified. Construction and operation phases were assessed

independently, as well as activities conducted in nearshore and offshore locations within the Project area.

Appendix Figure C-1: IMP risk management process

As part of the IMP risk assessment process, the following steps were undertaken to ensure effective management and mitigation. After a thorough review of marine pests known to Australia, WA, and the Pilbara, further resources at risk to the Project were identified. Furthermore, environmental and economic resources at risk were identified, along with potential vectors for the introduction of IMPs. Potential vulnerable or high-risk sites within the project location are identified.

Determining the level of risk by assessing both the likelihood of pest occurrence and the potential consequences by identifying activities that present hazards or key risk activities associated with the Project. These activities were divided into the different phases of the project: construction and operation. Each of the hazards was rated independently based on the consequences resulting from translocation of selected IMP species (Section 4) on the values at the site (Section Appendix C.2). This is also considered the availability of suitable habitat for the IMP species considered most likely to be encountered. The likelihood of successful IMP translocation arising from each of the hazardous activities estimated using Appendix Table C-1. This considered IMP translocation risk rating based on vessel type (i.e. vector), node of introduction and phase of works. An activity's risk was defined using the grading matrix (Appendix Table C-4). The risks associated with each activity were independently rated based on the:

- Likelihood of occurrence (Appendix Table C-2), which also considered the vessel type risk rating
- Consequences to the identified resources at risk (Appendix Table C-3).

The risk grading determined the level of management and mitigation needed to be taken for each hazardous activity. After careful risk analysis, grading and determining levels of acceptability, matters that were deemed to have all relevant controls or treatments applied are provided with a risk ranking of As Low as Reasonably Practicable (ALARP). Thus, the development of targeted risk mitigation strategies and a comprehensive marine pest management plan to guide implementation and ongoing monitoring.

Appendix Table C-1: Risk grading matrix

		Consequence				
		Catastrophic	Major	Moderate	Minor	Negligible
LIKELIHOOD	*Almost certain*	Extreme	Extreme	High	High	Medium
	Likely	Extreme	High	High	Medium	Medium
	Possible	High	High	Medium	Medium	Low
	Unlikely	High	Medium	Medium	Low	Low
	Rare	Medium	Medium	Low	Low	Low

Appendix Table C-2: Likelihood of Occurrence definitions relating to IMPs

Likelihood	Frequency	Probability
Almost certain	Expected to occur continuously	95-100 % chance of occurring
Likely	Expected to occur at least once a year	71-95 % chance of occurring
Possible	Expected to occur at least once in a 10-year timeframe	31-70 % chance of occurring
Unlikely	Expected to occur at least once in the lifespan of the Project	5-30 % chance of occurring
Rare	Unlikely to occur throughout the lifespan of the Project	0-5 % chance of occurring

Appendix Table C-3: Consequence ratings for assessment of hazardous activities relating to IMPs.

	Negligible	Minor	Moderate	Major	Catastrophic
Environment-ecosystem	No detection of an IMP, or no IMP introduction that impacts the overall condition of the ecosystem.	The range of an IMP already known to occur in Pilbara waters spreads to include waters within the Project area. The impact is present but not to the extent that it would impair the overall condition of the ecosystem, sensitive population or community in the long term.	The range of an IMP already known to occur in Pilbara waters spreads to include waters within AND outside the Project area. Recovery periods of 5 - 10 years are anticipated.	The introduction of a new IMP is not currently known to occur within Pilbara waters. This may include an IMP from another port with Australian waters. The impact is significant at either a local or wider level or to a sensitive population or community. Recovery periods of 10 - 20 years are likely.	The introduction of a new IMP that is not currently known to occur within Australian waters. The impact affects the nature of the ecosystem over a wide area OR the impact is catastrophic and possibly irreversible over a small area or to a sensitive population or community. Recovery periods of greater than 20 years likely OR condition of an affected part of the ecosystem irretrievably compromised.
Environment perception	No media attention	Individual complaints.	Negative regional media attention and regional group campaign.	Negative national media attention and national campaign	Negative and extensive national media attention and national campaigns.

Appendix Table C-4: Risk grading levels and their relative 'tolerance' including guidance on risk mitigation.

Grade	Risk Grading Levels and Mitigation Actions
Low	Activities which present a low risk are acceptable to proceed with caution with existing controls, management measures and monitoring. All IMP detections must be reported to the Pilbara Ports and DPIRD regardless of an activity risk rating.
Medium	Activities with a medium risk rating are accepted to proceed once BCI (manager/director level) and/or designated sub-contractor (if relevant) have demonstrated management and mitigation actions that will be used to reduce the likelihood and/ or consequences of the identified activities. All IMP detections must be reported to the Pilbara Ports and DPIRD regardless of an activity risk rating.
High	Activities with a high risk are not acceptable. Additional mitigation and management actions are required that are very reliable and should be approved by DPIRD and Pilbara Ports before activities can commence. All IMP detections must be reported to the Pilbara Ports and DPIRD regardless of an activity risk rating.
Extreme	Activities with extreme risk should be avoided and terminated. This is because risk events graded at this level have the potential to cause serious and ongoing damage to the environment, the community and the organisation. All emerging or continuing extreme risk exposures are to be reported to BCI, Pilbara Ports and DPIRD. All IMP detections must be reported to the Pilbara Ports and DPIRD regardless of an activity risk rating.

C.4.3. Risk Assessment Results

Results of the IMP Risk Assessment for the Project are summarised below in Appendix Table C-5. The construction and operational phases are assessed separately as they will involve different vessels and

utilise nearshore and offshore areas with different frequencies. For example, dredging during the construction phase is a slow-moving vessel and makes direct contact with the substrate, presenting a High risk of the likelihood of IMP translocation to the Project area. Whereas the operational phase will utilise barges, which have an inherent high risk due to its slow moving and stationary nature, allowing ease of IMP translocation. The slow speed and time spent moored in high-risk ports can create a higher likelihood of IMP colonisation. The operational phase will involve different vessels, potentially sourced from different locations.

Appendix Table C-5: IMP Risk assessment results

Initial Risk					Residual Risk			
Activity or Element with Potential Impacts on the Environment	Marine Pest Pathway	Consequence	Likelihood	Risk Level	Existing Controls and management measures	Consequence	Likelihood	Risk Level
Construction Phase								
Increase the spread of IMP throughout the region through general support vessels or other construction vessels.	• Ballast water exchange • Translocation of biofouling onto other vessels (i.e. transhippers) • Ships transiting from outside of the Pilbara region.	Moderate	Possible	Medium	• Non-specific commercial vessels used for the Project during the construction phase are likely to be sourced locally. • Where not locally sourced, refer to DAFF protocols • Antifoulant coating on vessel hulls (refer to Section 7.5).	Moderate	Rare	Low
Increase the spread of IMP throughout the region by disturbing and modifying the natural substrate – capital dredging	• Direct contact with the seabed • Slow moving, number of hull niches, and spending substantial time in coastal waters • Dredge pocket - Ideal receiving environment for the survival and reproduction of IMPs.	Major	Likely	High	• State Wide Array Surveillance Program (SWASP – refer to Section 8).	Moderate	Rare	Medium
Use of immersible construction materials (pylons, pipework, jetty)	• Introduction of biofouling IMP through dislodgement or direct introduction.	Moderate	Rare	Low	• Review supporting documentation of equipment prior to construction works to identify operational history and fouling management. Construction materials and equipment to be kept dry (above	Moderate	Rare	Low

Initial Risk					Residual Risk			
Activity or Element with Potential Impacts on the Environment	Marine Pest Pathway	Consequence	Likelihood	Risk Level	Existing Controls and management measures	Consequence	Likelihood	Risk Level
					waterline) at last port of call.			
Anchoring/mooring/berthing of Construction Vessels	• Introduction of IMP via dislodgment of bioufouling.	Moderate	Unlikely	Medium	• Antifoulant coating on vessel hulls • Industry-specific vessel appraisal prior to entering Project site. Undertake in/out of water inspection where required for risk management. • Suggest AFC requirements (age, type etc) during vessel tender process. Consider use of passive or active monitoring at site to demonstrate efficacy of management measure application.	Moderate	Rare	Low
Operations Phase								
Anchoring of Operational Vessels	• Ballast water exchange • Translocation of biofouling onto other vessels (i.e. transhippers)	Moderate	Possible	Medium	• Anchorage is restricted to offshore within Port of Cape Preston West waters managed by Pilbara Ports.	Moderate	Rare	Low

Initial Risk					Residual Risk			
Activity or Element with Potential Impacts on the Environment	Marine Pest Pathway	Consequence	Likelihood	Risk Level	Existing Controls and management measures	Consequence	Likelihood	Risk Level
	• Ships transiting from outside of the Pilbara region.				• *Biosecurity Act 2015*, Ballast Water Management Requirements, Pre-Arrival Reports (PAR), Maritime Arrivals Reporting System (MARS) • Antifoulant coating on vessel hull (refer to Section 7.4 and 7.5).			
Increase the spread of IMP throughout the region through the frequent movement of TSVs and general support vessels	• Dislodgement of biofouling • Release of propagules from mature organisms present in biofouling communities • Introduction of IMP through transfer from bulk carriers (i.e. OGVs) or biofouling.	Moderate	Possible	Medium	• Antifoulant coating on vessel hulls (refer to Section refer to Section 7.4 and 7.5).	Moderate	Rare	Low
Increase the spread of IMP throughout the region by disturbing and modifying the natural substrate – maintenance dredging	• Direct contact with the seabed • Slow moving, number of hull niches, and spending substantial time in coastal waters • Dredge pocket - Ideal receiving environment for the survival and reproduction of IMPs.	Major	Likely	High	• SWASP – refer to Section 8 • Vessels arriving from outside Australian water to comply with the *Biosecurity Act 2015*, Ballast Water Management Requirements, PAR, and MARS. • Implement the DSDMP (O2 Marine 2025)	Major	Rare	Medium

Initial Risk					Residual Risk			
Activity or Element with Potential Impacts on the Environment	Marine Pest Pathway	Consequence	Likelihood	Risk Level	Existing Controls and management measures	Consequence	Likelihood	Risk Level
					• Source dredge from Australian waters where possible			
Increase the spread of IMP throughout the region with operational TSVs	• Dislodgement of Biofouling • Slow moving, number of hull niches, and spending substantial time in coastal waters.	Major	Likely	High	• Non-specific commercial vessels used for the Project during the operational phase are likely to be sourced locally. • Where not locally sourced, refer to DAFF protocols • Antifoulant coating on vessel hulls.	Moderate	Rare	Medium
Use of immersible equipment (anchors, mooring, ropes, etc.)	• Introduction of biofouling IMP through dislodgement or direct introduction.	Moderate	Rare	Low	• Replace equipment suspected of IMP attachment.	Moderate	Rare	Low
De-ballasting of Operational vessels	• Introduction of IMP via ballast water.	Moderate	Unlikely	Medium	• Ballast exchange to occur in accordance with current legislation • Confirmation of exchange at sea, treatment or other risk management measure application prior to site entry	Moderate	Rare	Low

Initial Risk					Residual Risk			
Activity or Element with Potential Impacts on the Environment	Marine Pest Pathway	Consequence	Likelihood	Risk Level	Existing Controls and management measures	Consequence	Likelihood	Risk Level
					• Maintain passive monitoring at the Project site to demonstrate efficacy of management measures (SWASP).			

Appendix D. Appendix References

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