



Pilbara Ports Authority (**PPA**) is the proponent for the Dampier Cargo Wharf Extension and Landside Redevelopment Project at the Port of Dampier, WA (**Project**).

PPA is planning to construct and operate a southern wharf extension to the Dampier Cargo Wharf. The Project incorporates the development of a new (adjoining) southern section of wharf and associated mooring dolphin, wharf connecting structure, dredged berth pocket and vessel manoeuvring area.

As part of PPA's referral of the Project to the Commonwealth Department of Climate Change, Energy, the Environment and Water under the *Environmental Protection and Biodiversity Conservation Act 1999* (Cth), PPA welcomes public comment on the preliminary documentation for the Project.

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Dampier Cargo Wharf Extension and Landside Redevelopment Project

Marine Fauna Desktop Study



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Transmission Register

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Acronyms and Abbreviations

Acronyms and Abbreviations	Description
BIA	Biologically Important Area
BC Act	Biodiversity Conservation Act 2016
BCH	Benthic Communities and Habitat
CALM Act	Conservation and Land Management Act
CAMBA	China-Australia Migratory Bird Agreement
CITES	Convention on International Trade in Endangered Species
Cth	Commonwealth
CR	Critically Endangered
DAWE	Department of Agriculture, Water and Environment
DBCA	Department of Biodiversity, Conservation and Attractions
DCW	Dampier Cargo Wharf
DE	Development Envelope
DoE	Department of Environment
DPIRD	Department of Primary Industry and Regional Development
DWER	Department of Water and Environmental Regulation
EIA	Environmental Impact Assessment
EN	Endangered
EP Act	Environmental Protection Act 1986
EPA	Environmental Protection Authority
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
ESD	Environmental Scoping Document
FRM Act	Fish Resources Management Act
ha	Hectare
IF	Infrastructure footprint
IMCRA	Interim Marine and Coastal Regionalisation
IMMA	Important Marine Mammal Area



Acronyms and Abbreviations	Description
IMS	Invasive Marine Species
IUCN	International Union for the Conservation of Nature
JAMBA	Japan-Australia Migratory Bird Agreement
KAMBA	Korea-Australia Migratory Bird Agreement
Km	Kilometre
LAT	Lowest Astronomical Tide
m	metre
MI	Migratory
MFO	Marine Fauna Observer
MNES	Matters of National Environmental Significance
NPMF	Nickol Bay Prawn Managed Fishery
OS	Other Species Protected
PDSF	Pilbara demersal scale fish fishery
PIN	Pilbara Nearshore
PMST	Protected Matters Search Tool
PON	Pilbara offshore
PPA	Pilbara Port Authority
VU	Vulnerable
WA	Western Australia
WAFIC	Western Australian Fishing Industries Council

Glossary of Terms

Term	Definition
Abundance	The total number of individuals of a taxon or taxa in an area, population, or community.
Area of interest Marine fauna search area	Spatial extent considered in marine fauna desktop and impact assessment as informed by modelling for relevant potential project stressors.
Baseline	A starting or reference point, such as collecting baseline data where no data has been collected previously.
Benthic	Pertaining to the substrate (and/or organisms) at, or associated with, the bottom of a water body.
Biodiversity	The variability within and among genes, species and ecosystems. It includes marine, terrestrial, subterranean and aquatic life and implies a highly complex system of interacting entities that occur over a range of temporal and geographic (from local to global) scales.
Bioregion	Marine and terrestrial regions defined by similar types of physical, biological and environmental attributes.
Biota	All living things present in an area.
By-catch	The part of the fishing catch that is not the target species and which is discarded or excluded.
Conservation	The protection, maintenance, management, sustainable use, restoration and enhancement of the natural environment.
Development Envelope	The maximum area within which the Project Footprint will be located.
Ecosystems	Communities of organisms interacting with one another and their non-living environment. Incorporates the physical, chemical and biological processes inherent in that interaction and the environment in which they live.
Fishery	The collective enterprise of taking fish, usually with reference to the species, year or area involved.
Project Footprint	The location where the physical proposal elements occur.
Habitat	A specific type of place within an ecosystem occupied by an organism, population or community that contains all the requirements to support their life cycles.
Impact	To have an effect upon.
Impact (indirect)	Impacts which are not a direct result of the project, often produced away from or as a result of a complex impact pathway. These include 'downwind', 'downstream', 'upstream' and 'facilitated impacts'.

Term	Definition
Impact (cumulative)	Cumulative environmental impacts are the successive, incremental and interactive impacts on the environment of a proposal with one or more past, present and reasonably foreseeable future activities.
Marine management area	A formal integrated management framework for waters that have high conservation value and intensive multiple uses. These areas are selected primarily on the basis of their biological and recreational values.
Population	A group of individuals of the same species, occupying a defined area, and usually isolated to some degree from other similar groups. Populations can be relatively reproductively isolated and adapted to local environments.
Resource (fisheries)	A stock or reserve that can be drawn upon.

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1. Introduction

1.1. Project Description

Pilbara Ports Authority (PPA) is the proponent for the Dampier Cargo Wharf Extension and Landside Redevelopment Project (**the Project**). PPA is proposing to construct and operate a land-backed wharf extension to the Dampier Cargo Wharf (**DCW**) at the Port of Dampier (**the Port**). The ultimate scope of the Project incorporates the development of a new (adjoining) southern section of wharf and associated mooring dolphin, wharf connecting structure, dredged berth pocket and vessel manoeuvring area (Figure 1). The design of the wharf structure is yet to be finalised; however, key construction elements of the Project may include pile driving works, stabilisation of the shoreline via construction of rock revetment or a retaining wall and construction of a concrete deck.

Up to 380,000 m³ of capital dredging will be undertaken to establish a new berth pocket and associated manoeuvring basin to design depths of -13.2 m (Chart Datum (**CD**)) and -11.0 m (CD) respectively (note that up to 1m of over-dredging may be required to achieve these depths). This volume includes an estimated 100,000m³ of underlying and surface granophyre rock at the south-east end of the dredging footprint. To undertake dredging of this material it must be broken up first using drilling and blasting techniques. Dredging will be undertaken using either a cutter suction or backactor dredge. Material dredged as part of the Project is proposed to be placed within the three established spoil grounds within the Port depending on the type of material to be disposed. These spoil grounds are named East Lewis Island Spoil Ground (**ELI**), Spoil Ground A/B and Spoil Ground 2B (locations displayed in Figure 2). Suitable rock material may be beneficially reused for other approved Port projects and / or be placed within established Spoil Grounds within the Port. Where possible, PPA will seek to place rock material in such a way within ELI Spoil Ground that it can be colonised by corals.

The Project Footprint includes highly modified seabed environments the majority of which has undergone previous capital dredging and are subject to ongoing maintenance dredging in accordance with PPA’s Commonwealth 5-year Sea Dumping Permit (**SDP**) (SD2019/3962) and approved Long-Term Dredge Management Plan. The Development Envelope (**DE**) and Project Footprint (Figure 1) also include developed and operational port infrastructure, including laydown areas, coastal revetments, an existing mooring dolphin associated with the DCW and two wharf facilities: the Heavy Load Out Facility (**HLOF**) and Alternative Load-Out Facility (**ALOF**).

A summary of the Project is provided in Table 1. The physical, construction and operational elements of the Project are provided in Table 2. The final design and construction details of the Project at this stage are not known. The construction elements detailed within this report represent the “worst case” proposed design. The number of piles and volumes of blasting may decrease (but will not increase) when finalising the Project design and construction details. The proposed DE and Project Footprint are presented in Figure 2.

Table 1 General Project description

Project title	
Dampier Cargo Wharf Extension and Landside Redevelopment Project	
Proponent name	Pilbara Ports Authority

Short description	The Project is for the construction and operation of a land-backed wharf extension to the DCW at the Port. The Project incorporates the development of a new (adjoining) southern section of wharf, dredged berth pocket and vessel manoeuvring area. The Project will enable larger vessels (up to Panamax class) to access the terminal and facilitate new trades and products being handled at the Port.
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Table 2 Proposal content elements

Proposal element	Location / description	Maximum extent, capacity or range
Physical elements		
Land-backed wharf Extension	Figure 1	325 m wharf face with a wharf connecting structure.
Berth pocket and vessel manoeuvring area	Figure 1	<ul style="list-style-type: none"> Total dredge footprint of 8.4 hectares (ha). Berth pocket to design depth of -13.2 m CD. Vessel manoeuvring area to design depth of -11 m CD. (Note that up to 1m of over-dredge may be required to achieve these design depths)
Construction elements		
Construction of the DCW Extension Project	Figure 1	<ul style="list-style-type: none"> Pile driving works (approx.) 470 steel piles of up to 1800 mm diameter and potential installation of a suspended wharf deck. Construction of rock revetment and installation to form the wharf deck and associated mooring dolphin.
Capital Dredging	Figure 1	<ul style="list-style-type: none"> Up to 380,000 m³ (including up to 1m of over-dredge) of capital dredging will be undertaken using a backactor or cutter suction dredge.
Drilling and blasting	Figure 1	<ul style="list-style-type: none"> Approximately 100,000 m³ of granophyre rock material to the south and east of the Project dredging area will be broken up using drilling and blasting techniques.
Disposal of material	Figure 2	<ul style="list-style-type: none"> Dredge spoil, including blasted rock material to be placed at established spoil grounds located in Port waters including Spoil Ground 2B, Spoil Ground A/B and East Lewis Island Spoil Ground (Spoil Ground ELI). Suitable rock material may be beneficially reused for other approved Port projects and / or within established Spoil Grounds within the Port. Where possible, PPA will seek to place rock material in such a way within ELI Spoil Ground that it can be colonised by corals.
Operational elements		
Vessels and wharf	Figure 1	<ul style="list-style-type: none"> Enable larger vessels (Panamax class) to access the terminal and facilitate new trades and products being handled at the Port.

Ongoing maintenance dredging	Figure 1	<ul style="list-style-type: none"> In accordance with PPA’s 5-year SDP for maintenance dredging (SD2019/3962) or subsequent revisions.
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1.2. Location

The Port is located approximately 1,540 kilometres (by road) north of Perth, WA and 260 kilometres (by road) west of Port Hedland. The Port is located on the western side of Murujuga on the Pilbara coastline (Figure 2), approximately 20 km west of Karratha.

The Port extends out into Mermaid Sound and the Indian Ocean beyond the limits of State Waters (3 nautical miles) and incorporates the waters surrounding Murujuga and some waters of the Dampier Archipelago.

1.3. Objectives

This report presents the outcomes of a marine fauna desktop study that will be used to inform environmental impact assessment (EIA) of the Project and formulation of related management measures.

The objectives were to:

- Identify marine fauna species that are conservation significant, specially protected or are commercially valued that may occur within the vicinity of the DE (Figure 1)
- Evaluate which species have the greatest potential to be impacted by the Project (i.e., ‘key’ species for EIA and management consideration)
- Summarise key species’ ecological characteristics (i.e., population, distribution, habitat use and life history)
- Characterise potential impacts in relation to known threats to EPBC listed species existing conservation management actions that are needed to undertake EIA and devise appropriate management strategies.

Identifying key species facilitates the correct proportionality of information to be provided for given species, as it relates to the nature and risk of potentially significant impacts. This report should be read in conjunction with the Underwater Noise Modelling Report (Talis 2022).

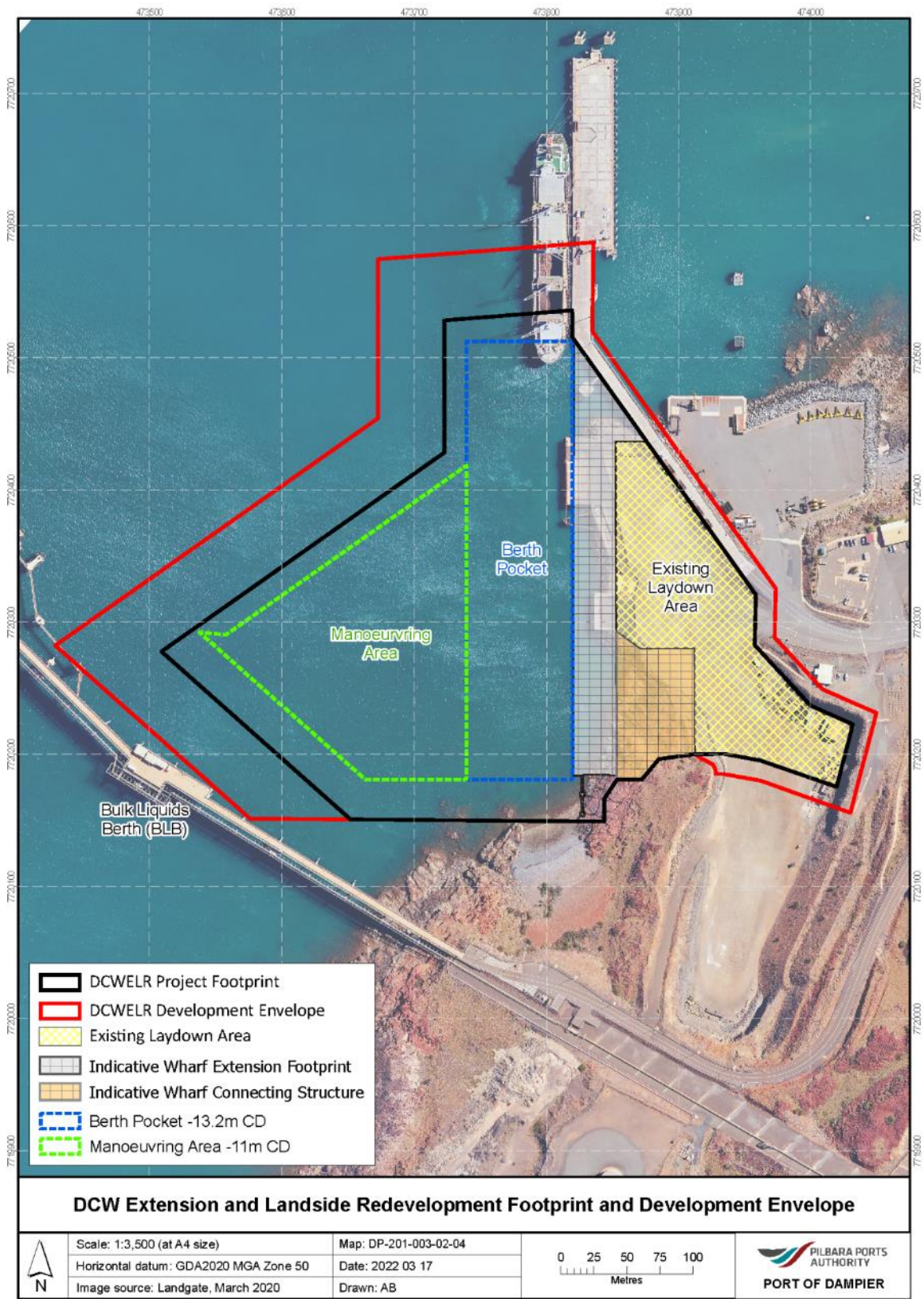


Figure 1 Project DE and Footprint.

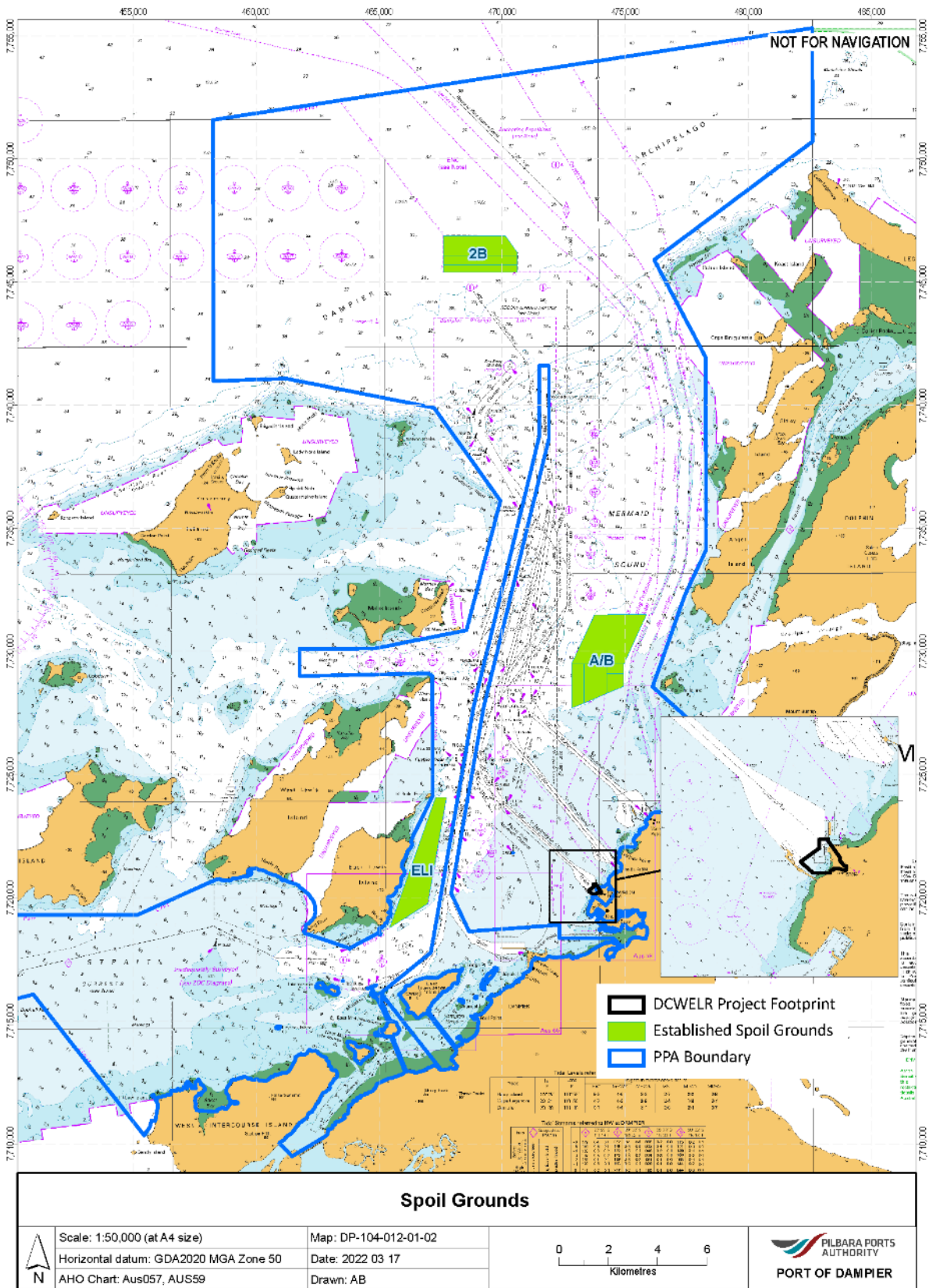


Figure 2 Project location and Port of Dampier boundary and established spoil grounds.

2. Relevant Marine Fauna Legislation

Key legislation governing the protection of marine fauna and their habitats in WA are:

- Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act (Cth))
- Environmental Protection Act 1986 (EP Act (WA))
- Biodiversity Conservation Act 2016 (BC Act (WA))
- Conservation and Land Management Act 1984 (CALM Act (WA))
- Fish Resources Management Act 1994 (FRM Act (WA)):

The EPBC Act and EP Act aim to support environmentally sustainable development while protecting environmental values, including biodiversity. Projects referred under the EPBC Act are assessed by DAWE. Projects referred under the EP Act are assessed by the WA EPA.

2.1. EPBC Act

The EPBC Act lists ‘nationally significant’ animals, plants, habitats and places as Matters of National Environmental Significance (**MNES**) and aims to ensure that potential negative impacts on them are carefully considered before changes in land use or new developments are approved.

Numerous marine fauna species trigger the EPBC Act as MNES during EIA, dependant on whether they are listed as threatened or migratory species. Significant impact criteria have been devised for each group (DoE 2013). Recovery Plans for threatened species and ecological communities are to be recognised during the EIA process as they stipulate research and management actions for species or communities’ survival.

The EPBC Act is Australia’s primary legislation for meeting international conservation commitments, including those related to International Union’s Conservation of Nature (IUCN) Red List of Threatened Species, various conventions protecting migratory species and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (**CITES**). In addition, Australia is signatory to three international agreements that protect and recognise the importance of conserving migratory birds and their habitats. These are the Japan-Australia Migratory Bird Agreement (**JAMBA**), China-Australia Migratory Bird agreement (**CAMBA**) and the Republic of Korea-Australia Migratory Bird agreement (**KAMBA**). Species of migratory birds that occur in Australia, Japan, China and the Republic of Korea are listed under the three agreements. Birds listed on these agreements must also be placed on the migratory species list under the EPBC Act through the Wildlife Conservation Plan for Migratory Shorebirds. The EPBC Act provides for protection of migratory species as a matter of national environmental significance.

Other species are also protected under the EPBC Act as ‘cetaceans’ or ‘marine’. Commonwealth waters from the three nautical mile state waters limit out to the boundary of the Exclusive Economic Zone (i.e., out to 200 nautical miles and further in some places) have been designated as ‘The Australian Whale Sanctuary’. Within the sanctuary, it is an offence to kill, injure or interfere with a cetacean.

2.2. EP Act

Governed by the EP Act, the EPA uses environmental principles, factors and associated objectives as the basis for assessing whether a proposal's impact on the environment is acceptable. These principles, factors and objectives therefore underpin the EIA process.

The EP Act's objective is to protect WA's environment and identifies five environmental principles. The third principle of the conservation of biological diversity and ecological integrity is directly relevant to Marine Fauna. Marine Fauna are defined as "Animals that live in the ocean or rely on the ocean for all or part of their lives" (EPA 2018). The EPA's objective for Marine Fauna is: 'To protect Marine Fauna so that biological diversity and ecological integrity are maintained'. Within EIA, the EPA gives special attention to species that are iconic or of social, cultural, economic or ecosystem value. Animals such as sponges and corals that are attached to the seabed are typically considered under the environmental factor of Benthic Communities and Habitats (BCH).

2.3. BC Act (WA)

The objects of this BC Act (WA) are to conserve and protect the State's biodiversity and promote the ecologically sustainable use of State's biodiversity components (i.e., species, habitats, ecological communities, genes, ecosystems and ecological processes). This includes provisions to prevent harassment or disturbance of fauna. It classifies native species, subspecies and populations as Specially Protected, Threatened (Critically Endangered, Endangered or Vulnerable) or Extinct. Priorities of 1, 2 or 3 (ranked in order of priority for survey and evaluation of conservation status) are assigned to possibly threatened species that do not meet survey criteria or are data deficient. Priority 4 species are those that are adequately known and rare, but not threatened.

2.4. CALM Act (WA)

The CALM Act (WA) details the Department of Biodiversity, Conservation and Attractions (DBCA) role as WA's management agency for the State's conservation estate. In doing so, it facilitates the protection of some Marine Fauna habitat through the gazettal and management of marine protected areas. Australia provides critical habitat for millions of migratory birds each year and Australia is responsible for conserving migratory bird populations and their habitats. Habitats for migratory shorebirds include those for waterbirds, shorebirds and seabirds.

The Project DE does not spatially overlap, with any Marine Park, Marine Nature Reserve or Marine Management Area, however, 25 of the Dampier Archipelago's islands are incorporated into four nature reserves managed by the DBCA.

2.5. FRM Act (WA)

The FRM Act (WA) is the principal act that regulates the management, utilisation and conservation of fish (i.e., all aquatic organisms except reptiles, birds, mammals, amphibians) and their habitat in WA. This includes the management of biosecurity risks from the introduction and/or spread of invasive marine species (IMS). The FRM Act is administered by the Department of Primary Industries and Regional Development (DPIRD). DPIRD provides advice to the EPA and DAWE on the potential for proposed actions to have significant impact on fish

or fish habitat in WA. Projects likely to have a significant impact on fish or fish habitat in WA State waters must be assessed by the EPA; and by DAWE in Commonwealth waters (between three and 200 nautical miles off the WA coast). Published guidance is currently available for seismic activities, with plans for guidance on drilling activities, dredging programs, and oil spill impacts and monitoring yet to be published.

3. Methods

3.1. Habitat Description

Marine elements of the Project are located on the coast and within the relatively flat and shallow waters, up to 10 m deep, of the Pilbara (nearshore) WA (PIN) Integrated Marine and Coastal Regionalisation (IMCRA) meso-scale region (IMCRA 1998; DCLM 2005), within the broader North-west Marine Region (Figure 5) (DSEWPac 2012). The western Pilbara coastline is characterised by mangrove communities, supratidal flats behind the mangroves, intertidal creeks and mudflats, sandy flat habitats, a large tidal range, highly turbid water and the occurrence of fringing coral reefs around some of the islands (IMCRA 1998). Habitats of the Project Area are widespread and typical of the broader region (IMCRA 1998).

The North-west region is characterised by shallow-water tropical marine ecosystems, less than 200 m deep for more than 40 percent of the region with strong surface currents (DSEWPC 2012). The region is dominated by the Indonesian Throughflow, which is a key link in the global exchange of water and heat between ocean basins and a significant element of the global climate system (DSWEPC 2012a). It brings warm, low-nutrient (oligotrophic), low-salinity water from the western Pacific Ocean through the Indonesian archipelago to the Indian Ocean (DSWEPC 2012). It is the primary driver of the oceanographic and ecological processes in the region (DSWEPC 2012a).

The Project is situated within the Dampier Archipelago which is a chain of 12 major islands and 30 smaller islands, islets and rocks (Morris 1990) covering 400 kilometres (Woodside 2018; DCLM 2005). It contains a wide diversity of marine habitats including soft and hard coral reefs, mangroves, salt marshes, inter-tidal rocky shore, sands and mudflats, inter-tidal reef platforms, beaches, rocky shores, bare sediment, shallow subtidal rocky shore, sponge, rubble, seagrasses beds, macroalgae beds and mixed communities comprising soft coral and sponge habitats (MScience 2018; Woodside 2018; MMPATF 2021b; Worley Parsons 2009; DCLM 2005).

PPA undertook a review of publicly available reports and papers on the Dampier Archipelago including the Port of Dampier (MScience, 2014) which identified five key benthic communities and habitat (BCH) likely to be present, including hard corals, macroalgae, mangroves, seagrass and mixed communities. These significant marine habitats of the Dampier Archipelago are shown in Figure 3.

Twenty-five of the islands are protected as a Nature Reserve (Dampier Archipelago Nature Reserve) (Woodside 2018).

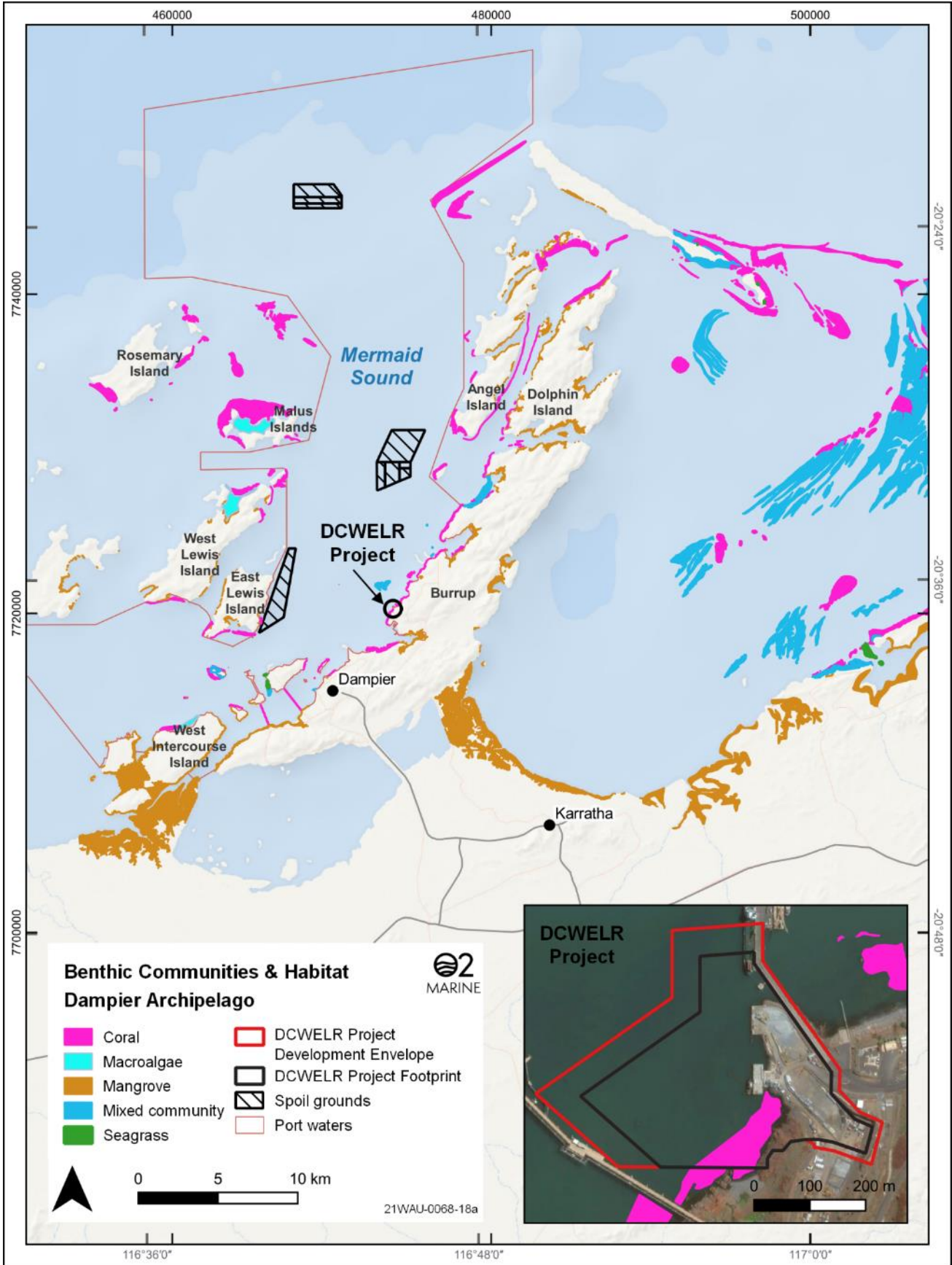


Figure 3 Significant marine habitats of the Dampier Archipelago (Source: PPA 2021).

3.1.1. Intertidal

Important ecological communities found within the intertidal areas of the Dampier Archipelago include mangroves, sand, mudflats and coral reefs (DCLM 2005).

Intertidal sand and mudflat communities occur in sheltered, relatively low energy marine environments and occur along most of the coastline in the area (DCLM 2005). A high diversity of infauna live within the substrate of these habitats, and although typically bare of vegetation, these areas are covered with a surface film of micro-organisms that are a rich source of food for a high diversity of invertebrates they support and in turn provide a valuable food source for larger fish and organisms which swim over the area at high tide, as well as resident and migratory shorebirds (DCLM 2005).

Structurally complex mangals are a common feature of the mainland shore with smaller systems around many of the islands and are generally fronted by intertidal sand and mudflats (DCLM 2005). Mangals are very important primary producers and are of ecological and economic importance (DCLM 2005). Mangals provide habitat for many gastropods, other invertebrates, are an important habitat for birds and provide a nursery for a variety of species including sawfish, marine turtles, and a variety of fish and prawn species which are targeted commercially (DCLM 2005). Corals are important primary producers, and they provide food, substrate and shelter for a wide variety of marine life including sponges, sea stars, sea urchins, molluscs, gastropods, worms and fishes, some of which are targeted by recreational commercial fishers (DCLM 2005).

Six species of mangrove occur in the region and are generally considered to be in pristine condition. Mangrove areas are afforded a high conservation value and the EPA (2001) recommends the impacts of development on mangrove habitat and ecological function of the mangroves should be reduced to the minimum practicable level. As indicated in the *Guidance Statement for Protection of Tropical Arid Zone Mangroves Along the Pilbara Coastline* (EPA 2001), the Project DE is situated within the EPA designated regionally significant mangrove management area that is inside designated industrial and associated port areas: Dampier Archipelago Area. All other mangroves areas of high conservation value that are outside of these areas are also found within the Project area.

3.1.2. Subtidal

The nearshore area of the Project is mainly mudflat habitat, whilst further offshore is predominately silt habitat (DCLM 2005). Extensive sand and silt substrates that exist in the area support a variety of invertebrate species both in and on sediments (DCLM 2005). These communities are typically bare but may have seasonal vegetation or permanent patches of seagrass or macroalgae (DCLM 2005). Silt habitats occur in the sheltered areas of the nearshore region of the Archipelago, while sand occurs more offshore (DCLM 2005). Soft-bottom communities often support a rich variety of infauna that live in the substrate and in turn support surface dwellers that live above or on the substrate (DCLM 2005). Subtidal habitats of ecological importance that exist within the Dampier Archipelago include coral reef systems, macroalgal and seagrass (DCLM 2005). Macroalgae (seaweeds) dominate submerged limestone reefs and also grow on stable rubble and boulder surfaces in the Dampier Archipelago region (DCLM 2005). These communities are most commonly found on shallow limestone pavement in depths less than 10 m (DCLM 2005). Seagrass occurs in the large bays and shelter flats (DCLM 2005). Seagrass do not form extensive meadows in the Dampier Archipelago, but rather form

interspersed sparse, low abundant seagrass/macroalgae beds on shallow sandy sediments and interspersed with other BCH (Woodside 2018; DCLM 2005). Macroalgae and seagrass are important primary producers, they provide refuge and habitat and nursery grounds for juvenile fish and are a food source for marine turtles and dugongs (DCLM 2005).

Table 3 Spatial overlap between marine Project elements, aspects, and habitats.

Project element / aspect	Intertidal	Nearshore	Offshore	Islands
Land-backed wharf extension (Piled wharf and connecting structure)	Yes	Yes	No	No
Mooring dolphin	Yes	Yes	No	No
Berth pocket and vessel manoeuvring area	Yes	Yes	No	No
Underwater noise	Yes	Yes	No	No
Dredge plume	Yes	Yes	No	No
Spoil disposal ground	No	No	Yes	No

3.1.3. Key Ecological Features

There are no Project elements that overlap with Key Ecological Features (Figure 4).

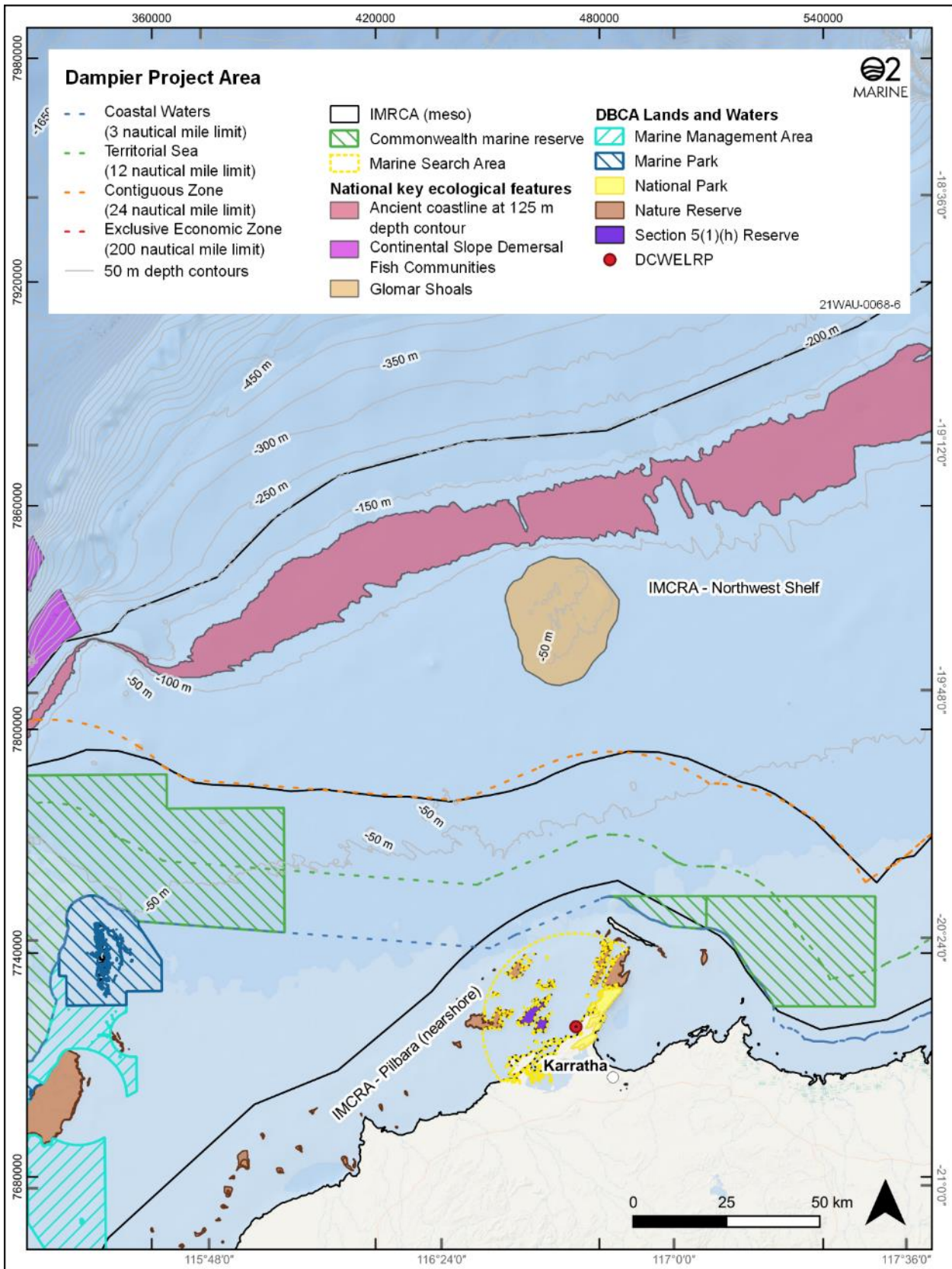


Figure 4 Bioregional setting.

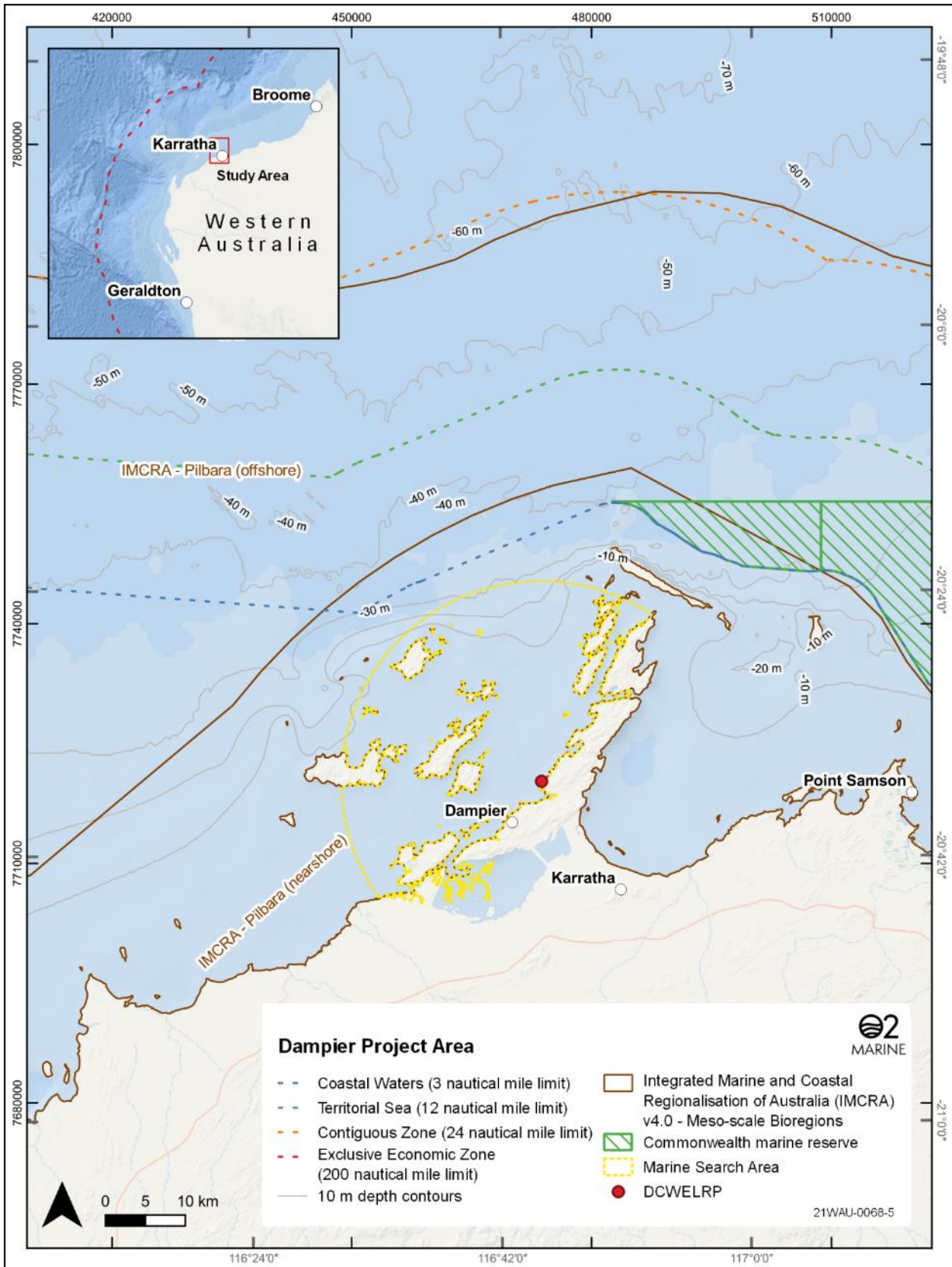


Figure 5 Marine Fauna Search Area.

3.2. Database and Report Searches

A search of several databases undertaken in November 2021 and literature for marine fauna species in and around the Project DE was undertaken (Table 4). A search of the broader area (here in “Marine Fauna Search Area”), within a 25 km buffer, included all project elements, including varying bathymetry of the surrounding area which have the potential to influence the occurrence of highly mobile marine fauna species. Point data from marine fauna surveys and BIA data within the broader region have been included in this assessment to further gauge the potential of species and their occurrence in the region.

Table 4 Databases and reports.

Target	Database / report	Organisation	Citation
Conservation significant species ¹	Commonwealth Protected Matters Search (PMST) ³	DAWE	DAWE 2021a
Conservation significant species ²	DBCA threatened species database ⁴	DBCA	DBCA 2021a
Commercially important fish species	State of fisheries report	DPIRD	DPIRD, 2019
Recreationally important fish species	State-wide recreational fishing survey	DPIRD	DPIRD, 2019a

¹ Species listed as threatened, or other MNES under the EPBC Act (Cth)

² Species listed as threatened or priority under the BC Act (WA)

Protected Matters Search Tool (PMST)

The Protected Matters Search Tool (PMST) is a platform provided by DAWE to identify MNES within a given area of interest. Listed species and communities shown to have a ‘moderate potential to occur’ has been informed by broad species ranges, bioclimatic modelling and scientific expert advice.

The type and probability of species presence, including a ranked order, is also provided by the PMST search which has been used for this study.

Department of Biodiversity, Conservation and Attractions (DBCA) Threatened Species Database

The Western Australian Department of Biodiversity, Conservation and Attractions (DBCA) provides a database search service for the identification of threatened and priority plants, animals or ecological communities at or near an area of interest.

Threatened species are reported with the following categories:

- CR: Critically Endangered
- EN: Endangered
- VU: Vulnerable

Specially protected species are reported with the following categories:

- MI: Migratory
- OS: Other Specially Protected

Priority species range from P1 – P4. They include possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora. Priority 4 species are those in need of further monitoring – they are adequately known but are somewhat rare.

Fisheries Reports

Commercial and recreational fisheries were identified using the most current relevant reports available. The State of the fisheries report (DPIRD 2019) was initially viewed to identify the fisheries in the region. Data provided by data.wa.gov.au further identified whether these fisheries overlap with the Project Area.

3.3. Likelihood of Occurrence and Identification of Key Species

Key species were identified for targeted EIA and management planning. This approach facilitates the correct proportionality of information to be provided for given species, as it relates to the nature and risk of potentially significant impacts. Further, identified key species are effectively ‘umbrella’ species – when they are protected, others will be indirectly protected.

Key species were defined as those with:

- a high conservation status under the EPBC Act as MNES, or the BC Act as threatened or priority species; or
- target commercial or recreational fish species; and
- a high likelihood of occurrence within the DE.

Likelihood of occurrence within Project DE was determined following the definitions presented in Table 5. These definitions involve occurrence frequency. Many threatened and migratory marine fauna species are large and highly mobile, meaning they can move through areas that may not be of particular importance.

Table 5 Species likelihood of occurrence definitions.

Likelihood	Definition
High	Individuals of the species have been repeatedly recorded in the DEs and / or surrounding habitat. The DEs are within the species’ known range and surrounding habitat is expected to support populations of the species.
Medium	Individuals of the species have been infrequently recorded in the DEs and / or surrounding habitat. The high likelihood of occurrence criteria has not been met, however suitable (not necessarily preferred) habitat may occur within the DE, or nearby. The surrounding habitat may support individuals or populations of the species.
Low	The DEs are well outside of the species’ range, or the species has not been recorded there. Suitable habitat is not likely to be present.

Previous Field Studies

The likelihood of occurrence assessment has been informed by a number of field studies have been undertaken at the Project site (Table 6).

Table 6 Studies undertaken at the Project location.

Study	Source
Dampier Archipelago Humpback Whale Project – boat-based population estimate study	Jenner and Jenner (1991)
Pendoley Turtle Perdaman Urea project: Marine Fauna Desktop Assessment	Pendoley Environmental (2019)
Dolphin and dugong sightings recorded during dolphin aerial surveys undertaken in 2015, 2016 and 2017	Department of Biodiversity, Conservation and Attractions (DBCA 2021b)
Dolphin sightings recorded during boat-based dolphin surveys undertaken in 2015 and 2019	Department of Biodiversity, Conservation and Attractions (DBCA 2021c)
A review of the spatial distribution of marine turtle nesting and foraging areas in Western Australia	Waayers (2014)
Using aerial photogrammetry to assess stock-wide marine turtle nesting distribution, abundance and cumulative exposure to industrial activity	Fossette et al. (2021)

3.4. Literature Review

A targeted literature review was undertaken for key species. For conservation significant species, parameters were aligned to the EPBC Act Significant Impact Criteria for Threatened and Migratory species (DoE, 2013), and the EPA’s Environmental Factor Guideline for Marine Fauna (EPA 2016) (Table 7).

Table 7 Literature review parameters for key conservation significant species.

Topic	Parameters
Population	Abundance Trends
Distribution	Range and area of occupancy (State, regional and local) Local patterns Animal movement Temporal occurrence
Habitat use and life history	Longevity and fecundity Breeding

Topic	Parameters
	Foraging Ecological windows Critical habitat Biologically important areas Habitat availability
Conservation management	Relevant pressures and threats (direct and indirect) (ref) Recovery plans and conservation actions

4. Results

4.1. Conservation Significant Marine Fauna

Table 8 Summary of conservation significant marine fauna species listed by database searches (na: Not Applicable).

Fauna group	BC Act	EPBC Act			
	Threatened, Priority or other	Threatened	Migratory	Marine	Cetacean
Mammals	4	3	12	13	12
Reptiles	7	7	6	23	na
Birds	12	10	54	60	na
Fish	5	7	11	34	na

Table 9 Marine mammal species listed by database searches and their likelihood of occurrence within Project DE to potential impact (IN: Intertidal; NS: Nearshore, OS: Offshore; IS: Islands) that overlap with Project elements and aspects.

Species		BC Act	EPBC Act	PMST rank			Occurrence likelihood	Group	
Common Name	Scientific Name		Threatened Category	Migratory	Marine	Cetacean			
Dugong	<i>Dugong dugon</i>	OS	-	Yes	Yes	-	Known	High- (NS)	Key ⁴
Humpback whale	<i>Megaptera novaeangliae</i>	CD	-	Yes	Yes	Yes	Known	High- (NS, OS)	Key
Australian humpback dolphin	<i>Sousa sahalensis</i>	P4	-	Yes	Yes	Yes	Known	High- (NS)	Key
Indo-Pacific bottlenose dolphin	<i>Tursiops aduncus</i>	-	-	Yes	Yes	Yes	Known	High- (NS)	Key
Minke whale	<i>Balaenoptera acutorostrata</i>	-	-	Yes	Yes	Yes	May	Low	Other
Bryde's whale	<i>Balaenoptera edeni</i>	-	-	Yes	Yes	Yes	May	Low	Other
Common dolphin,	<i>Delphinus delphis</i>	-	-	Yes	Yes	Yes	May	Low	Other
Risso's dolphin	<i>Grampus griseus</i>	-	-	Yes	Yes	Yes	May	Low	Other
Killer whale	<i>Orcinus orca</i>	-	-	Yes	Yes	Yes	May	Low	Other
Spotted dolphin	<i>Stenella attenuata</i>	-	-	Yes	Yes	Yes	May	Low	Other

Species		BC Act	EPBC Act				PMST rank	Occurrence likelihood	Group
Bottlenose dolphin	<i>Tursiops truncatus s. str.</i>	-	-	Yes	Yes	Yes	May	High (OS)	Other
Pygmy blue whale	<i>Balaenoptera musculus breviceuda</i>	EN	EN	Yes	Yes	Yes	May	Medium (OS)	Other
Spinner dolphin	<i>Stenella longirostris</i>	-	-	-	Yes	Yes	-	Low	Other

Table 10 Seabird and shorebird species listed by database searches and their likelihood of occurrence within Project DE to potential impact (IN: Intertidal; NS: Nearshore, OS: Offshore; IS: Islands) that overlap with Project elements and aspects.

Species		BC Act	EPBC Act				PMST rank	Occurrence likelihood	Group
Common Name	Scientific Name		Threatened Category	Migratory	Marine	Cetacean			
Curlew sandpiper	<i>Calidris ferruginea</i>	CR	CR	Yes	Yes	-	Known	High (IN)	Key ⁵
Northern siberian bar-tailed godwit	<i>Limosa lapponica menzbieri</i>	CR	CR	Yes	Yes	-	Known	High (IN, IS)	Key
Eastern curlew	<i>Numenius madagascariensis</i>	CR	CR	Yes	Yes	-	Known	High (IN, IS)	Key
Red knot	<i>Calidris canutus</i>	EN	EN	Yes	Yes	-	Known	High (IN, IS)	Key
Greater sand plover, large sand plover	<i>Charadrius leschenaultii</i>	VU	-	Yes	Yes	-	Known	High (IN, IS)	Key
Lesser sand plover, Mongolian plover	<i>Charadrius mongolus</i>	EN	EN	Yes	Yes	-	Known	High (IN, IS)	Key
Fairy tern	<i>Sternula nereis</i>	VU	VU	-	Yes	-	Known	High (IN, IS)	Key
Australian fairy tern	<i>Sternula nereis nereis</i>	VU	VU	-	-	-	Known	High (IN, IS)	Key
Great knot	<i>Calidris tenuirostris</i>	CR	CR	Yes	Yes	-	Known	High (IN, IS)	Key

Species		BC Act	EPBC Act				PMST rank	Occurrence likelihood	Group
Common greenshank	<i>Tringa nebularia</i>	-	-	Yes	Yes	-	Known	High (IN, I)	Other
Common sandpiper	<i>Actitis hypoleucos</i>	-	-	Yes	Yes	-	Known	High (IN)	Other
Marsh sandpiper, little greenshank	<i>Tringa stagnatilis</i>	-	-	Yes	Yes	-	Known	High (IN)	Other
Common redshank, redshank	<i>Tringa totanus</i>	-	-	Yes	Yes	-	Known	High (IN)	Other
Pacific golden plover	<i>Pluvialis fulva</i>	-	-	Yes	Yes	-	Known	High (IN)	Other
Australian pratincole	<i>Stiltia isabella</i>	-	-	Yes	Yes	-	Known	High (IN)	Other
Pied stilt, black-winged stilt	<i>Himantopus himantopus</i>	-	-	Yes	Yes	-	Known	High (IN)	Other
Red-necked avocet	<i>Recurvirostra novaehollandiae</i>	-	-	Yes	Yes	-	Known	High (IN)	Other
Ruddy turnstone	<i>Arenaria interpres</i>	-	-	Yes	Yes	-	Known	High (IN)	Other
Wedge-tailed shearwater	<i>Ardenna pacifica</i>	-	-	Yes	Yes	-	Known	High (IN)	Other
Silver gull	<i>Chroicocephalus novaehollandiae</i>	-	-	-	Yes	-	Known	High (IN)	Other

Species		BC Act	EPBC Act				PMST rank	Occurrence likelihood	Group
Terek sandpiper	<i>Xenus cinereus</i>	-	-	Yes	Yes	-	Known	High (IN)	Other
Lesser frigatebird	<i>Fregata ariel</i>	-	-	Yes	Yes	-	Known	High (IN)	Other
White-bellied sea-eagle	<i>Haliaeetus leucogaster</i>	-	-	-	Yes	-	Known	High (IN)	Other
Caspian tern	<i>Hydroprogne caspia</i>	-	-	Yes	Yes	-	Known	High (IN)	Other
Bridled tern	<i>Onychoprion anaethetus</i>	-	-	Yes	Yes	-	Known	High (IN)	Other
Osprey	<i>Pandion haliaetus</i>	-	-	Yes	Yes	-	Known	High (IN)	Other
Greater crested tern	<i>Thalasseus bergii</i>	-	-	Yes	Yes	-	Known	High (IN)	Other
Grey-tailed tattler	<i>Tringa brevipes</i>	-	-	Yes	Yes	-	Known	High (IN)	Other
Whimbrel	<i>Numenius phaeopus</i>	-	-	Yes	Yes	-	Known	High (IN)	Other
Red-necked phalarope	<i>Phalaropus lobatus</i>	-	-	Yes	Yes	-	Known	High (IN)	Other
Black-tailed godwit	<i>Limosa limosa</i>	-	-	Yes	Yes	-	Known	High (IN)	Other
Broad-billed sandpiper	<i>Limicola falcinellus</i>	-	-	Yes	Yes	-	Known	High (IN)	Other
Sanderling	<i>Calidris alba</i>	-	-	Yes	Yes	-	Known	High (IN)	Other

Species		BC Act	EPBC Act				PMST rank	Occurrence likelihood	Group
Red-capped plover	<i>Charadrius ruficapillus</i>	-	-	-	Yes	-	Known	High (IN)	Other
Grey plover	<i>Pluvialis squatarola</i>	-	-	Yes	Yes	-	Known	High (IN)	Other
Red-necked stint	<i>Calidris ruficollis</i>	-	-	Yes	Yes	-	Known	High (IN)	Other
Long-toed stint	<i>Calidris subminuta</i>	-	-	Yes	Yes	-	Known	High (IN)	Other
Fork-tailed swift	<i>Apus pacificus</i>	-	-	Yes	Yes	-	Likely	High (IN)	Other
Sharp-tailed sandpiper	<i>Calidris acuminata</i>	-	-	Yes	Yes	-	Known	High (IN)	Other
Streaked shearwater	<i>Calonectris leucomelas</i>	-	-	Yes	Yes	-	Likely	Low (IN)	Other
Black-eared cuckoo	<i>Chalcites osculans</i>	-	-	-	Yes	-	Likely	Low (IN)	Other
Roseate tern	<i>Sterna dougallii</i>	-	-	Yes	Yes	-	Likely	Low (IN)	Other
Common noddy	<i>Anous stolidus</i>	-	-	Yes	Yes	-	May	Low (IN)	Other
Pectoral sandpiper	<i>Calidris melanotos</i>	-	-	Yes	Yes	-	May	Low (IN)	Other
Oriental plover, oriental dotterel	<i>Charadrius veredus</i>	-	-	Yes	Yes	-	Known	High (IN)	Other

Species		BC Act	EPBC Act				PMST rank	Occurrence likelihood	Group
Oriental pratincole	<i>Glareola maldivarum</i>	-	-	Yes	Yes	-	Known	High (IN)	Other
Southern giant-petrel	<i>Macronectes giganteus</i>	P4	EN	Yes	Yes	-	May	Moderate (OS)	Other
Cattle egret	<i>Bubulcus ibis</i>	-	-	-	Yes	-	May	Low	Other
Australian painted snipe	<i>Rostratula australis</i>	EN	EN	-	Yes	-	May	Low	Other
Asian dowitcher	<i>Limnodromus semipalmatus</i>	-	-	Yes	Yes	-	May	Low	Other
White-winged tern	<i>Chlidonias leucopterus</i>	-	-	Yes	Yes	-	-	Low	Other
Peregrine falcon	<i>Falco peregrinus</i>	OS	-	-	-	-	-	Low	Other
Gull-billed tern	<i>Gelochelidon nilotica</i>	-	-	Yes	Yes	-	-	Low	Other
Little curlew	<i>Numenius minutus</i>	-	-	Yes	Yes	-	-	Low	Other
Wilson's storm-petrel	<i>Oceanites oceanicus</i>	-	-	Yes	Yes	-	-	Low	Other
Osprey, eastern osprey	<i>Pandion cristatus</i>	-	-	-	-	-	-	Low	Other
Glossy Ibis	<i>Plegadis falcinellus</i>	-	-	Yes	Yes	-	-	Low	Other

Species		BC Act	EPBC Act	PMST rank				Occurrence likelihood	Group
Common tern	<i>Sterna hirundo</i>	-	-	Yes	Yes	-	-	Low	Other
Little tern	<i>Sterna albifrons</i>	-	-	Yes	Yes	-	-	Low	Other
Brown booby	<i>Sula leucogaster</i>	-	-	Yes	Yes	-	-	Low	Other
Wood sandpiper	<i>Tringa glareola</i>	-	-	Yes	Yes	-	-	Low	Other

Table 11 Marine reptile species listed by database searches and their likelihood of occurrence within Project DE to potential impact (IN: Intertidal; NS: Nearshore, OS: Offshore; IS: Islands) that overlap with Project elements and aspects.

Species		BC Act	EPBC Act				PMST rank	Occurrence likelihood	Group
Common Name	Scientific Name		Threatened Category	Migratory	Marine	Cetacean			
Loggerhead turtle	<i>Caretta caretta</i>	EN	EN	Yes	Yes	-	Known	High (NS, OS, IS)	Key ⁶
Green turtle	<i>Chelonia mydas</i>	VU	VU	Yes	Yes	-	Known	High (NS, OS, IS)	Key
Hawksbill turtle	<i>Eretmochelys imbricata</i>	VU	VU	Yes	Yes	-	Known	High (NS, OS, IS)	Key
Flatback turtle	<i>Natator depressus</i>	VU	VU	Yes	Yes	-	Known	High (NS, OS, IS)	Key
Leaf-scaled sea snake	<i>Aipysurus foliosquama</i>	CR	CR	Yes	Yes	-	Known	High (NS, OS, IS)	Key
Short-nosed seasnake	<i>Aipysurus apraefrontalis</i>	CR	CR	-	Yes		Likely	Moderate (IS, NS)	Other
Leatherback turtle	<i>Dermochelys coriacea</i>	VU	EN	Yes	Yes	-	Likely	Moderate (NS, OS)	Other
Horned seasnake	<i>Acalyptophis peronii</i>	-	-	-	Yes	-	May	Low	Other
Dubois' seasnake	<i>Aipysurus duboisii</i>	-	-	-	Yes	-	May	Low	Other
Spine-tailed seasnake	<i>Aipysurus eydouxii</i>	-	-	-	Yes	-	May	Low	Other
Olive seasnake	<i>Aipysurus laevis</i>	-	-	-	Yes	-	May	Low	Other

Species		BC Act	EPBC Act			PMST rank	Occurrence likelihood	Group	
Brown-lined seasnake	<i>Aipysurus tenuis</i>	-	-	-	Yes	-	May	Low	Other
Stokes' seasnake	<i>Astrotia stokesii</i>	-	-	-	Yes	-	May	Low	Other
Spotted seasnake	<i>Chitulia ornata</i>	-	-	-	Yes	-	May	Low	Other
Spectacled seasnake	<i>Disteira kingii</i>	-	-	-	Yes	-	May	Low	Other
Olive-headed seasnake	<i>Disteira major</i>	-	-	-	Yes	-	May	Low	Other
Turtle-headed seasnake	<i>Mesocephalic annulatus</i>	-	-	-	Yes	-	May	Low	Other
North-western mangrove seasnake	<i>Ephalophis greyi</i>	-	-	-	Yes	-	May	Low	Other
Black-ringed seasnake	<i>Hydrelaps darwiniensis</i>	-	-	-	Yes	-	May	Low	Other
Elegant seasnake	<i>Hydrophis elegans</i>	-	-	-	Yes	-	May	Low	Other
Small-headed seasnake	<i>Hydrophis macdowellii</i>	-	-	-	Yes	-	May	Low	Other
Fine-spined seasnake	<i>Leioselasma czeblukovi</i>	-	-	-	Yes	-	May	Low	Other
Yellow-bellied seasnake	<i>Pelamis platurus</i>	-	-	-	Yes	-	May	Low	Other

Table12 Fish species listed by database searches and their likelihood of occurrence within Project DE to potential impact (IN: Intertidal; NS: Nearshore, OS: Offshore.) that overlap with Project elements and aspects.

Species		BC Act	EPBC Act	PMST rank		Occurrence likelihood	Group	
Common Name	Scientific Name		Threatened Category	Migratory	Marine			
Green sawfish	<i>Pristis zijsron</i>	VU	VU	Yes	Yes	Known	High (NS)	Key ⁷
Dwarf sawfish	<i>Pristis clavata</i>	P1	VU	Yes	Yes	Known	High (NS)	Key
Reef manta ray	<i>Mobula alfredi</i>	-	-	Yes	-	Known	High (NS, OS)	Other
Narrow sawfish	<i>Anoxypristis cuspidata</i>	-	-	Yes	-	Likely	Low	Other
Scalloped hammerhead	<i>Sphyrna lewini</i>	-	CD	Yes	-	Likely	Low	Other
Grey nurse shark (west coast population)	<i>Carcharias taurus</i> (west coast population)	VU	VU	Yes	Yes	Likely	Low	Other
Oceanic whitetip shark	<i>Carcharhinus longimanus</i>	-	-	Yes	Yes	Likely	Low	Other
Southern bluefin tuna	<i>Thunnus maccoyii</i>	-	CD	Yes	Yes	Likely	Low	Other
White shark, great white shark	<i>Carcharodon carcharias</i>	VU	VU	Yes	Yes	May	Low	Other
Whale shark	<i>Rhincodon typus</i>	OS	VU	Yes	Yes	May	Low	Other

Species	BC Act	EPBC Act	PMST rank	Occurrence likelihood	Group		
Giant manta Ray <i>Mobula birostris</i>	-	-	Yes	-	Likely	Low	Other
Braun's pughead pipefish, pug-headed pipefish <i>Bulbonaricus brauni</i>	-	-	-	Yes	May	Low	Other
Three-keel pipefish <i>Campichthys tricarinatus</i>	-	-	-	Yes	May	Low	Other
Pacific short-bodied pipefish <i>Choeroichthys brachysoma</i>	-	-	-	Yes	May	Low	Other
Pig-snouted pipefish <i>Choeroichthys suillus</i>	-	-	-	Yes	May	Low	Other
Cleaner pipefish <i>Doryrhamphus janssi</i>	-	-	-	Yes	May	Low	Other
Flagtail pipefish <i>Doryrhamphus negrosensis</i>	-	-	-	Yes	May	Low	Other
Ladder pipefish <i>Festucalex scalaris</i>	-	-	-	Yes	May	Low	Other
Tiger pipefish <i>Filicampus tigris</i>	-	-	-	Yes	May	Low	Other
Brock's pipefish <i>Halicampus brocki</i>	-	-	-	Yes	May	Low	Other
Mud pipefish <i>Halicampus grayi</i>	-	-	-	Yes	May	Low	Other
Glittering pipefish <i>Halicampus nitidus</i>	-	-	-	Yes	May	Low	Other

Species		BC Act	EPBC Act			PMST rank	Occurrence likelihood	Group
Spiny-snout pipefish	<i>Halicampus spirostris</i>	-	-	-	Yes	May	Low	Other
Ribboned pipehorse	<i>Haliichthys taeniophorus</i>	-	-	-	Yes	May	Low	Other
Beady pipefish	<i>Hippichthys penicillus</i>	-	-	-	Yes	May	Low	Other
Western spiny seahorse	<i>Hippocampus angustus</i>	-	-	-	Yes	May	Low	Other
Spiny seahorse	<i>Hippocampus histrix</i>	-	-	-	Yes	May	Low	Other
Spotted seahorse	<i>Hippocampus kuda</i>	-	-	-	Yes	May	Low	Other
Flat-face seahorse	<i>Hippocampus planifrons</i>	-	-	-	Yes	May	Low	Other
Three-spot seahorse	<i>Hippocampus trimaculatus</i>	-	-	-	Yes	May	Low	Other
Flat-faced seahorse	<i>Hippocampus planifrons</i>	-	-	-	Yes	May	Low	Other
Tidepool pipefish	<i>Micrognathus micronotopterus</i>	-	-	-	Yes	May	Low	Other
Pallid pipehorse	<i>Solegnathus hardwickii</i>	-	-	-	Yes	May	Low	Other
Gunther's pipehorse	<i>Solegnathus lettiensis</i>	-	-	-	Yes	May	Low	Other

Species		BC Act	EPBC Act			PMST rank	Occurrence likelihood	Group
Robust ghostpipefish	<i>Solenostomus cyanopterus</i>	-	-	-	Yes	May	Low	Other
Double-end pipehorse	<i>Syngnathoides biaculeatus</i>	-	-	-	Yes	May	Low	Other
Bentstick pipefish	<i>Trachyrhamphus bicoarctatus</i>	-	-	-	Yes	May	Low	Other
Straightstick pipefish	<i>Trachyrhamphus longirostris</i>	-	-	-	Yes	May	Low	Other

⁷Species names formatted as bold are considered key species.

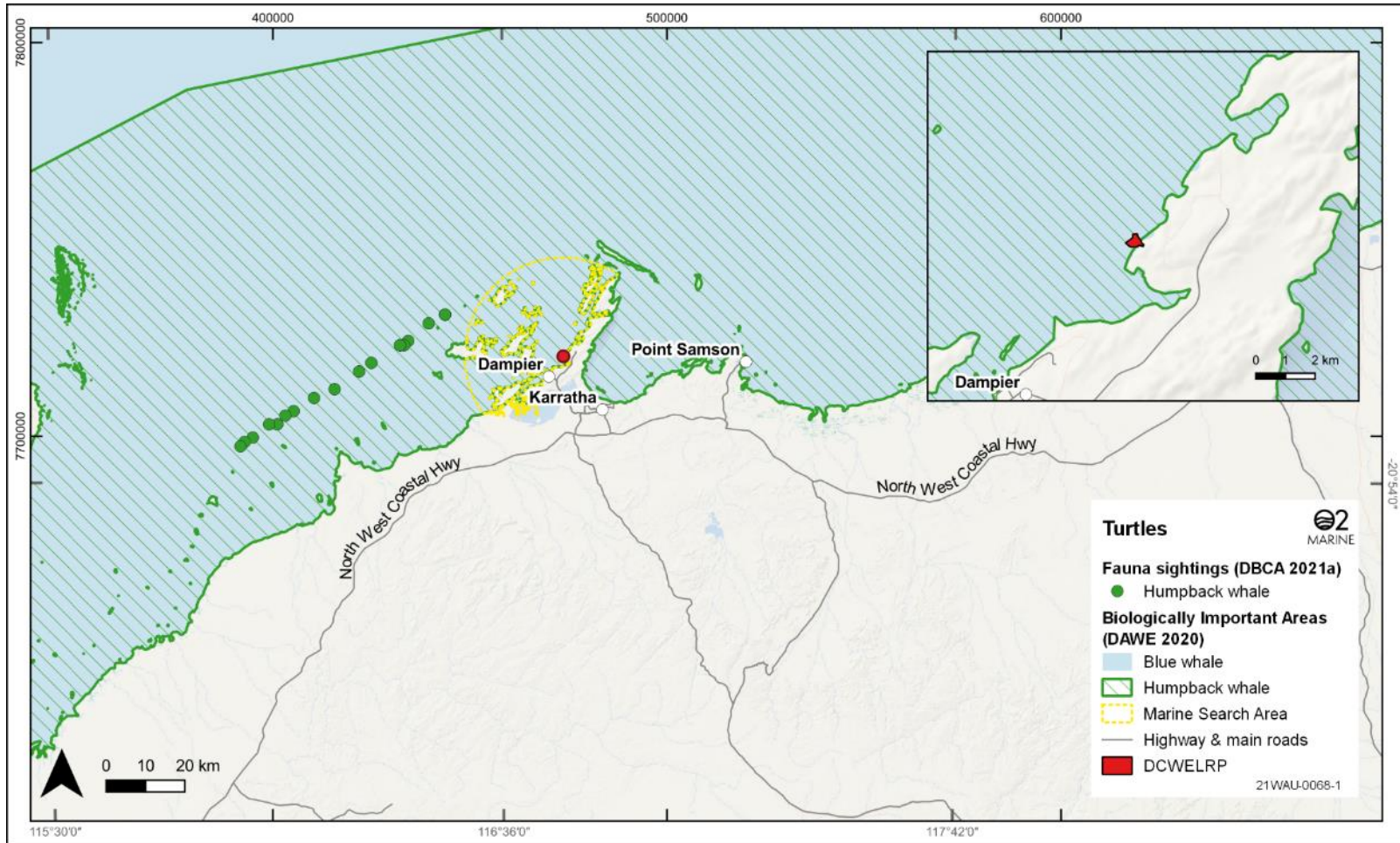


Figure 6 Whale sightings within the Marine Fauna Search Area and regionally.

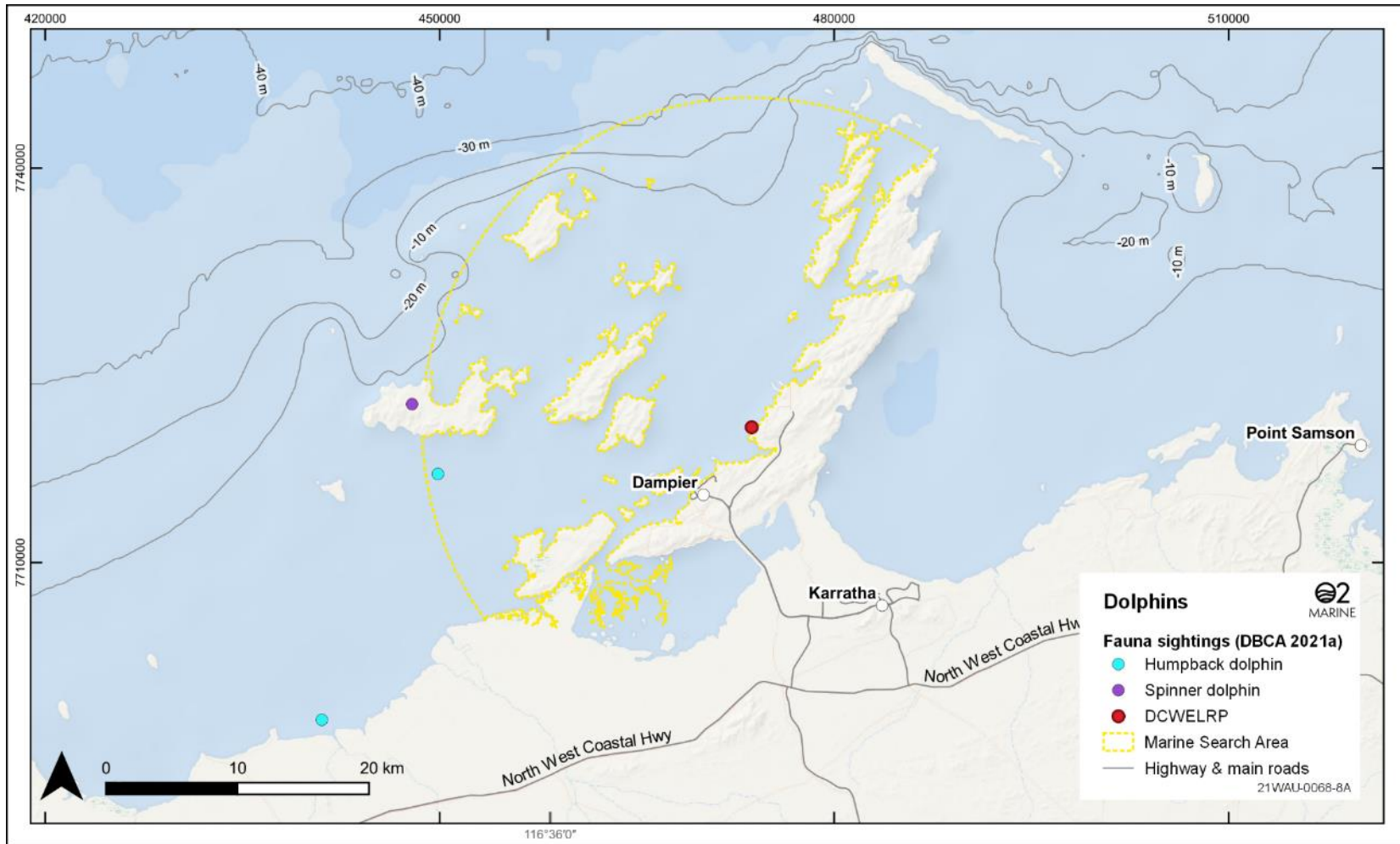


Figure 7 Dolphin sightings within the Marine Fauna Search Area and regionally from the DBCA Fauna and Threatened Species Search (Source: DBCA 2021a).

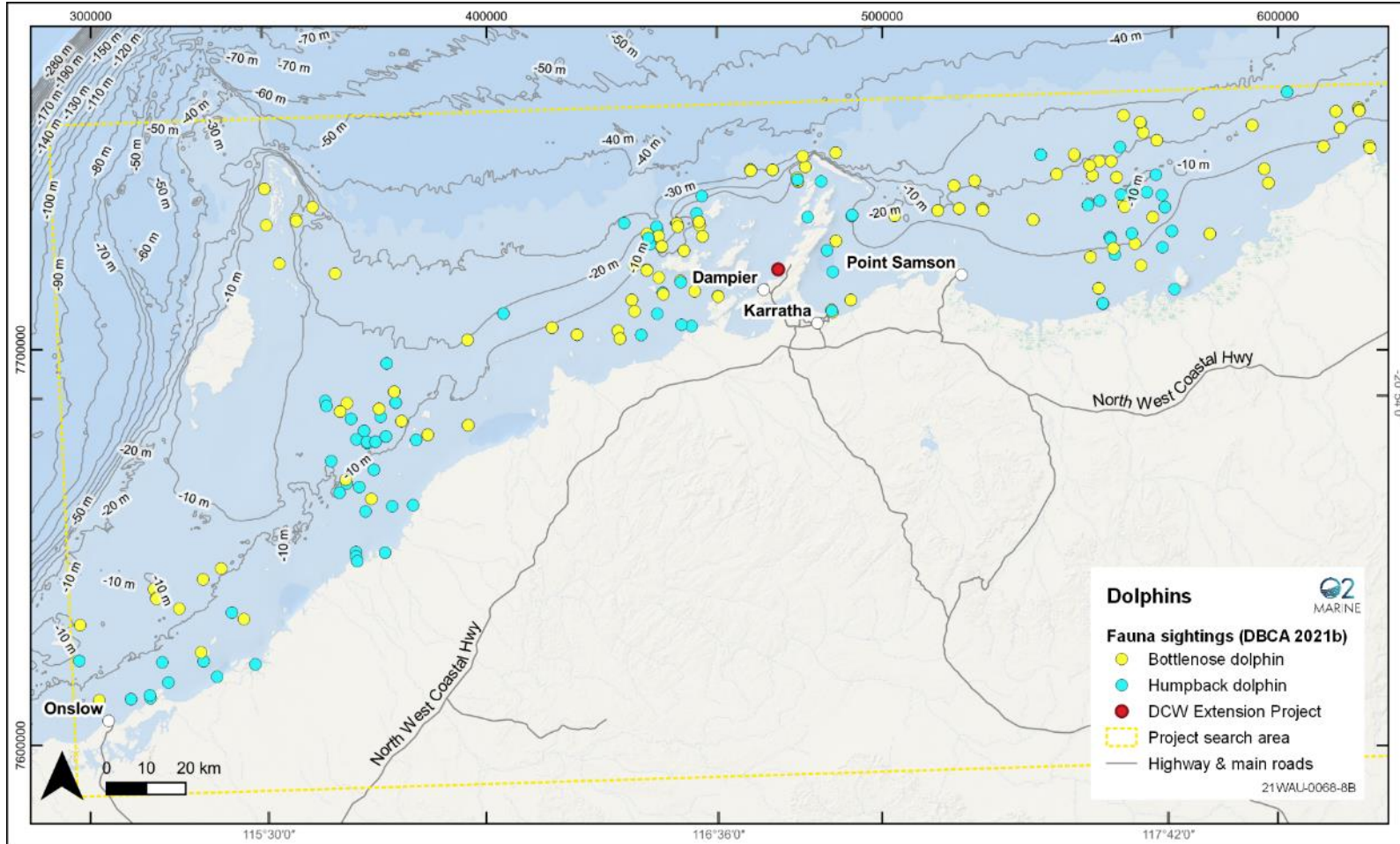


Figure 8 Dolphin sightings within the Marine Fauna Search Area and regionally (DBCA aerial Survey) (Source: DBCA 2021b).

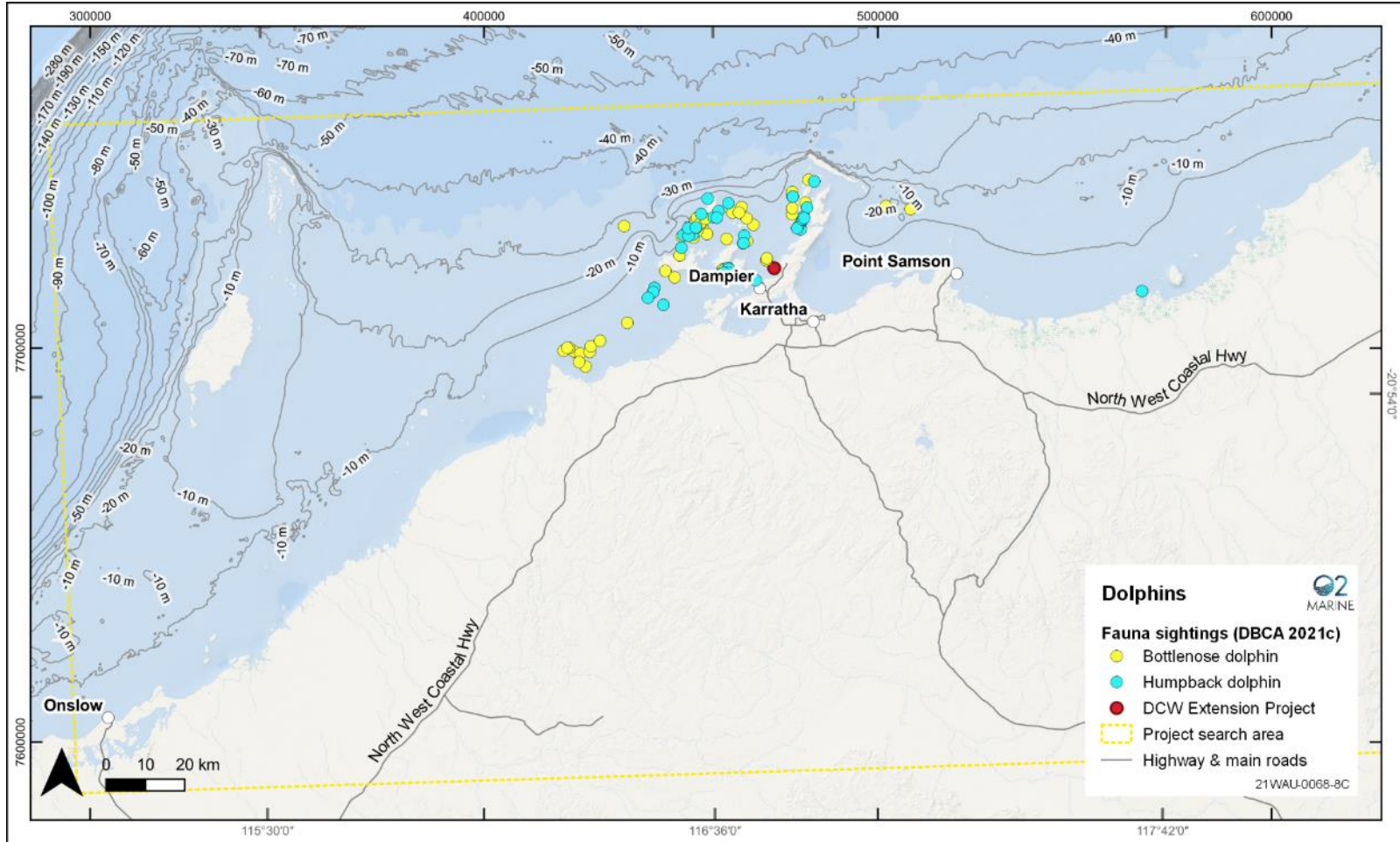


Figure 9 Dolphin sightings within the Marine Fauna Search Area and regionally (DBCA Vessel survey) (Source: DBCA 2021c).

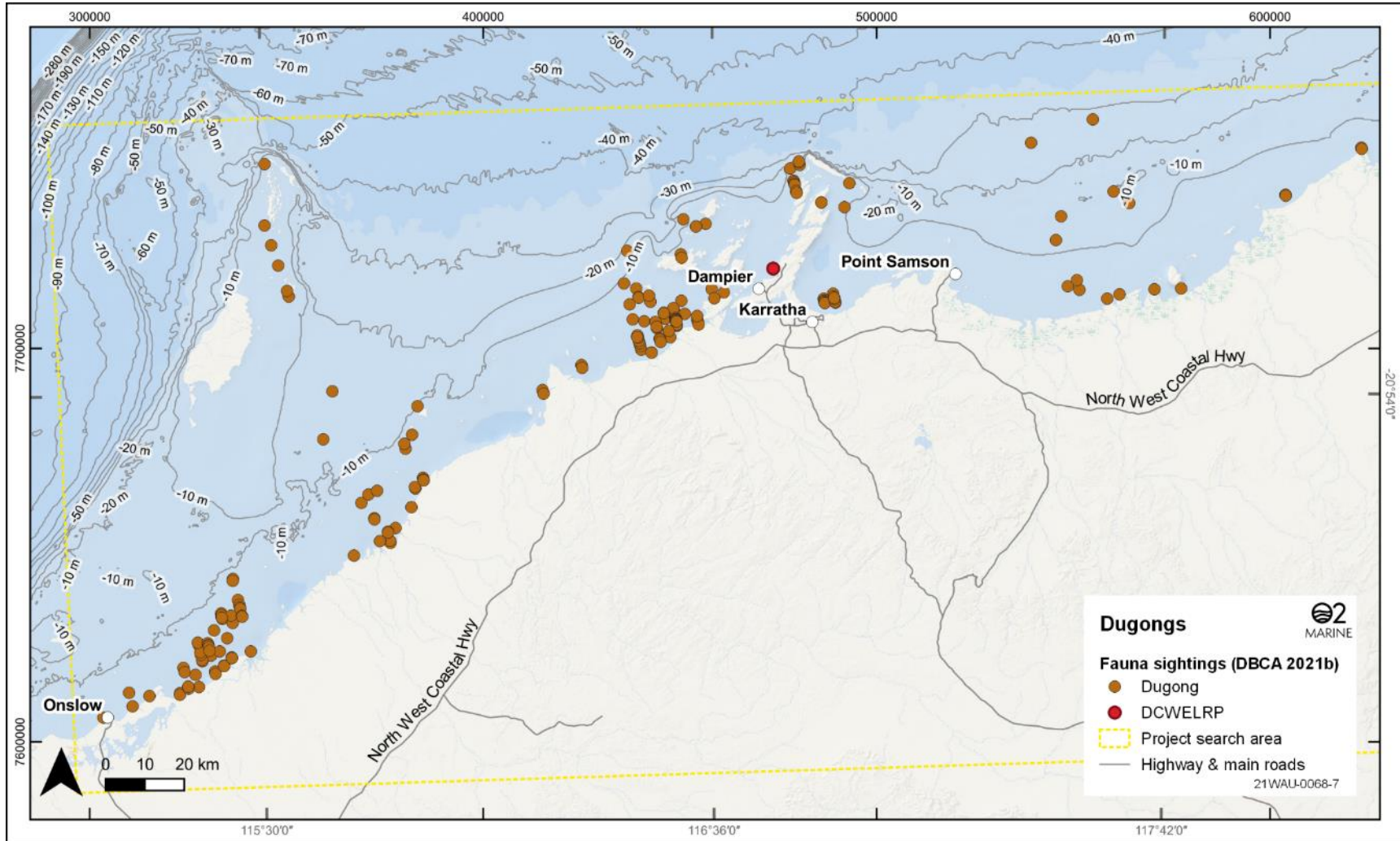


Figure 10 Dugong sightings within the Marine Fauna Search Area and regionally. (Source: DBCWA 2021b).

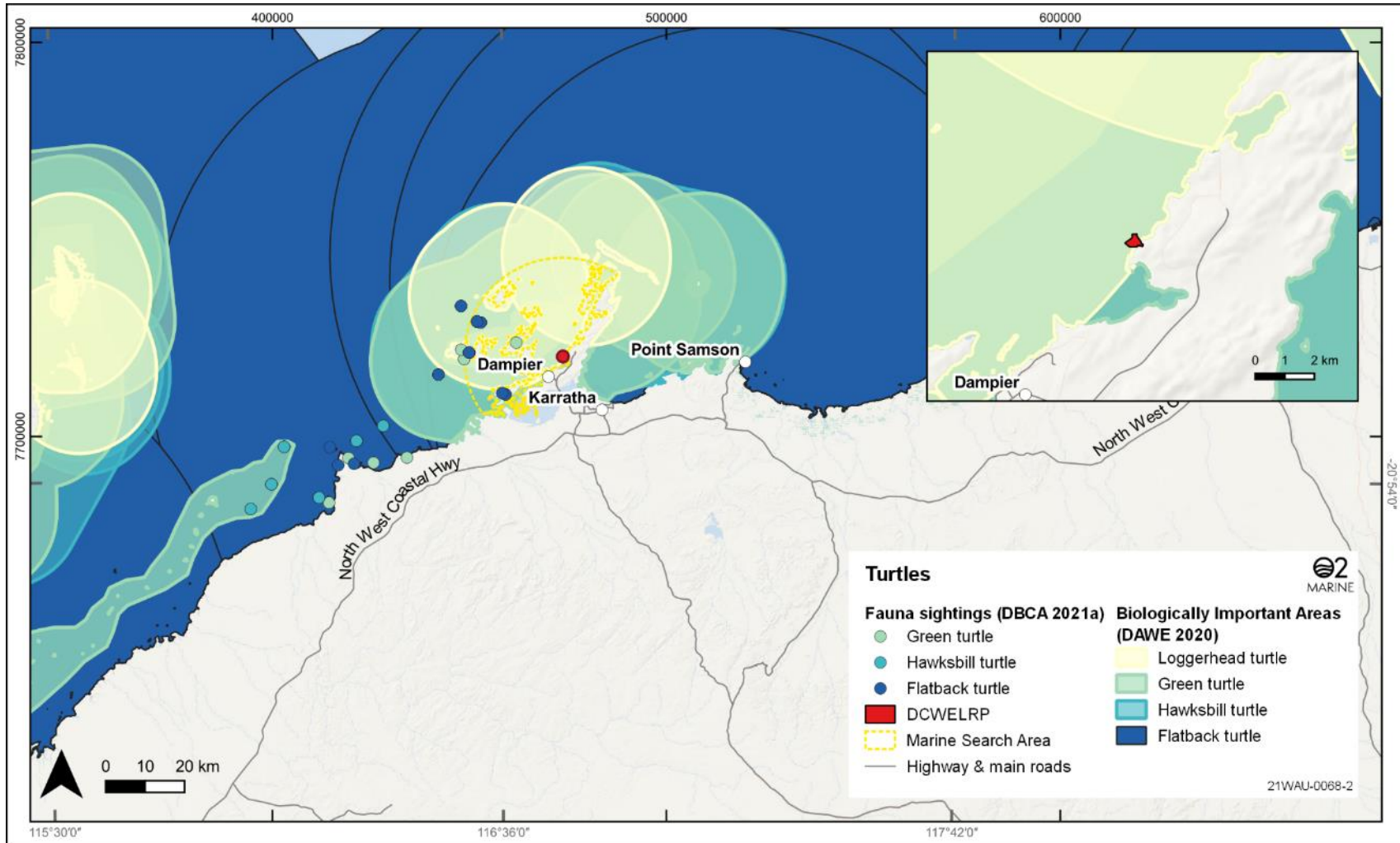


Figure 11 Turtle sightings within the Marine Fauna Search Area and regionally (Source: DBCA 2021a and DAWE 2020).

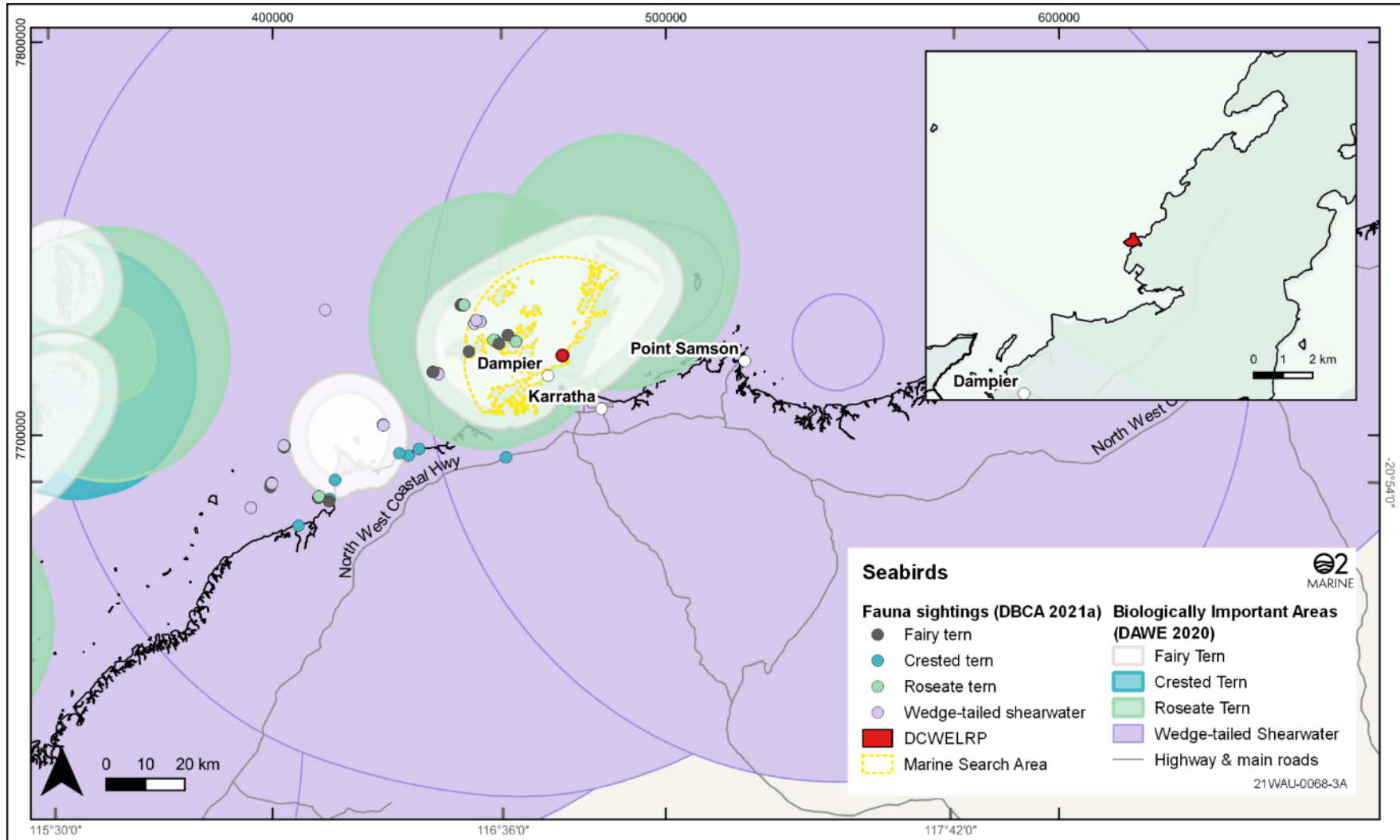


Figure 12 Seabird sightings within the Marine Fauna Search Area and regionally. (Source: DBCA 2021a and DAWE 2020).

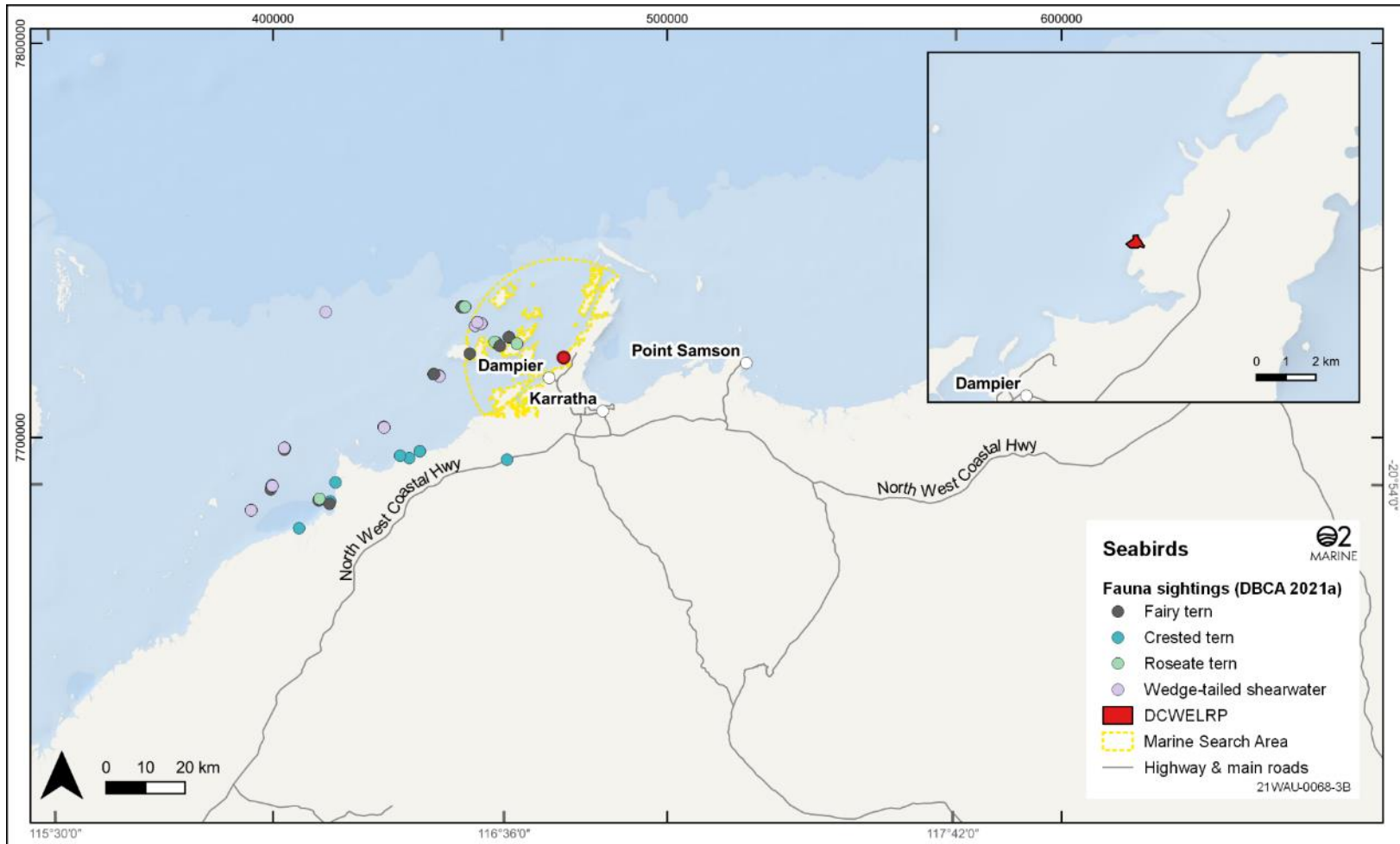


Figure 13 Shorebird sightings within the Marine Fauna Search Area and regionally. (Source: DBCA 2021a).

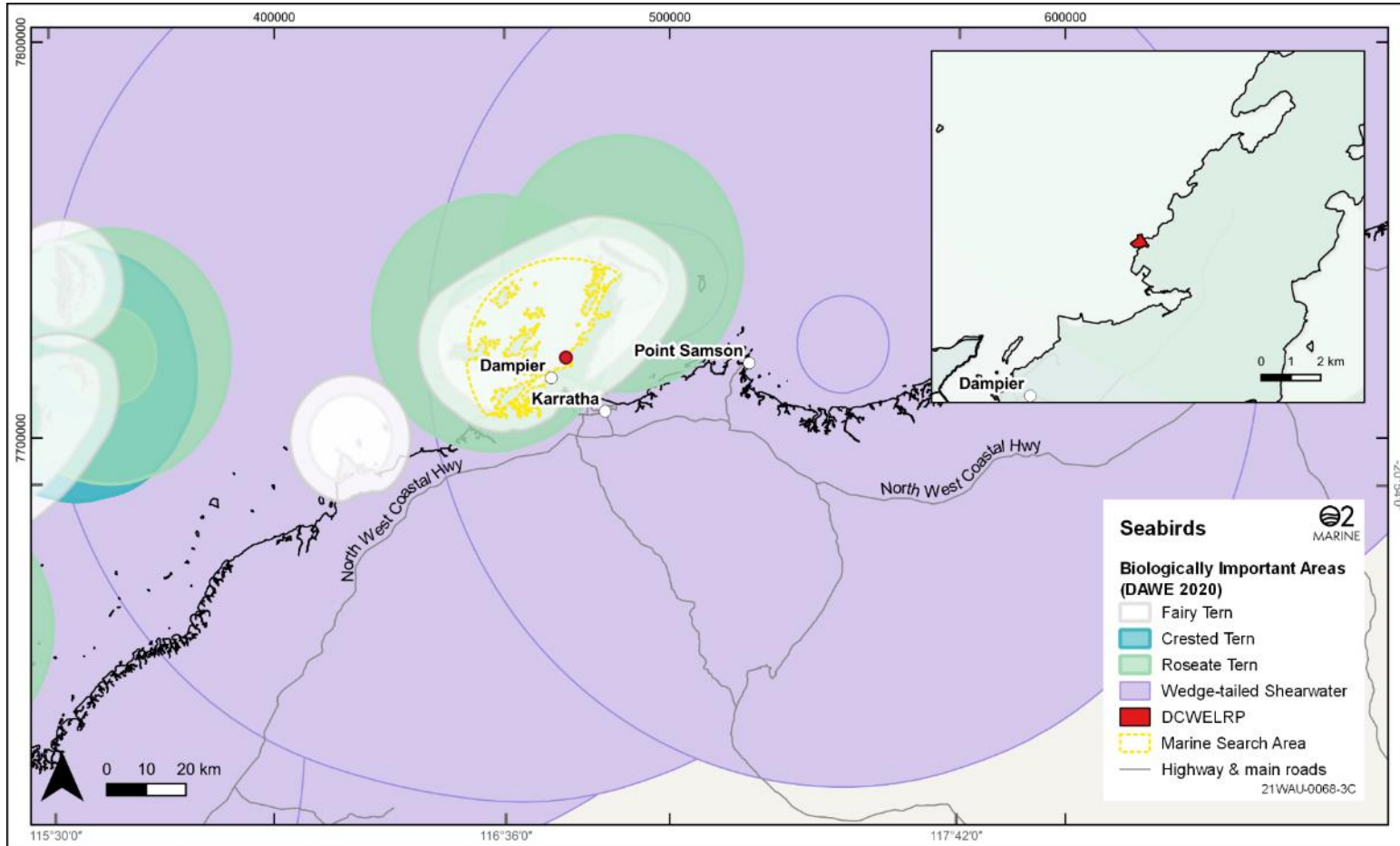


Figure 14 Seabird BIAs that overlap with API and Marine Fauna Search Area and regionally. (Source: DAWE 2020).

5. Discussion

5.1. Mammals

5.1.1. Humpback whale

Population

Off the west coast of Australia, a population of 33,000 humpback whales (at a minimum) are known to migrate annually (Jenner *et al.* 2018). This population was decimated during the whaling era but is recovering strongly at an estimated rate of over 11% per annum (Jenner *et al.* 2018). A boat-based population estimate study conducted by Jenner and Jenner (1991) within the Dampier Archipelago over a five-year period (1990 to 1994) in the months June to October, to determine the size of the southern Hemisphere Group IV humpback whale stock, recorded the peak number of whales in the month of August.

Distribution

The WA coastline is a known migration route for the humpback whale population IV (IWC breeding stock D), whereby humpback whales are known to migrate annually, between low-latitude winter breeding and calving grounds in the Kimberley and high-latitude summer feeding areas in the Antarctic (MMPATF 2021a; Jenner *et al.* 2018). Humpback whales have been identified as occurring in the waters around the Dampier Archipelago (Morris 1990) and includes several protected bays that are used as resting or standing areas on the southern migration (MMPATF 2021b) and are listed as a qualifying species that reside within the Dampier Archipelago Important Marine Mammal Area (IMMA) (MMPATF 2021a) (Figure 6).

Habitat use and life history

A review of the DAWE *National Conservation Values Atlas* interactive online tool (DAWE 2020) identified the Project Area as a Biologically Important Area Migration for the humpback whale. They undergo seasonal migrations between summer foraging grounds in cold productive waters to winter breeding grounds in warm waters of low latitudes. Breeding Stock D whales migrate annually from the southern Antarctic feeding grounds to the north entering the North-west Marine Region waters around June to breed and give birth to calves until later returning to the southern waters of the Antarctic around October (MMPATF 2021a). Humpback whales are primarily a coastal species when migrating and the migration typically occurs within the 200 m bathymetry from the coastline (MMPATF 2021a). The migration route encompasses many different habitat types (e.g., seagrass, rocky seabed, sand) (MMPATF 2021a). Humpback whales migrate north to the warm tropical waters off the Pilbara and Kimberley in June and July to give birth and suckle their young (DCLM 2005). Humpback whales live to around 48 years old, with a mean sexual maturity age of five years. Females occasionally give birth in the waters of the Dampier Archipelago, although the main calving area is further north (DCLM 2005). Adult humpback whales and their young also frequent the Archipelago on their southern migrations in early spring, and the Mermaid Sound (area of water between the western coastline of the Burrup Peninsula to the east of the Dampier Port, and Dampier Archipelago to the west) is a significant resting area for females with calves (MMPATF 2021b; DCLM 2005; Morris 1990).

Conservation management

Humpback whales are listed as Vulnerable, Migratory, Marine and Cetacean under the EPBC Act and as Conservation Dependant fauna under the BC Act. Their global (non-statutory) listing by the IUCN is Least Concern.

The greatest threats to humpback whales in WA are from human-made underwater noise (resulting in hearing impairment, organ damage, communication interference, elevated stress levels and/or avoidance of important habitat), vessel strike and entanglement in lobster pot lines and marine debris (Threatened Species Scientific Committee 2015).

There is no current Recovery Plan for the species.

5.1.2. Coastal dolphins

Population

Humpback dolphins typically occur in small populations of approximately 50-150 individuals (Hanf et al. 2016). Abundance estimates for humpback dolphin populations in WA do not exist (Hanf et al. 2016). A biopsy survey conducted by Allen et al. (2012) between the 31st March and 31st July 2010 by boat collected the highest rates of biopsy samples (approachable dolphin groups) per hour of effort for the Australian humpback dolphin and Indo-Pacific bottlenose dolphin at survey sites within the Dampier Archipelago and off Onslow and Port Hedland compared to other surveyed locations including Coral Bay, Eco Beach, the North West Cape and Cable Beach/ Roebuck Bay.

One individual snubfin dolphin has been observed near Angel Island in the Dampier Archipelago on the 21st May 2010 (Allen et al. 2012). There is currently scant information on the abundance of Australian snubfin dolphins throughout much of their geographical range, and especially within the Kimberley region of northern WA (Bouchet et al. 2021). Roebuck Bay is the only known areas where relatively large numbers of Australian snubfins congregate (DSEWPaC 2012b). Australian snubfin dolphins are generally found in very low numbers within a fragmented coastal distribution (Thiele 2005 in DSEWPaC 2012b). Bedjer et al. (2012) suggests in WA the total numbers are likely to be in the low thousands of individuals (i.e., < 5,000).

Distribution

The Australian humpback dolphin exhibit relatively small home ranges (<300 km²) and high site fidelity (Hanf et al. 2016). The species is limited to the shallow (< 30 m deep) tropical/subtropical coastal waters of the Sahul shelf of northern Australia and the southern waters of Papua New Guinea (Raudino et al. 2018; Hanf et al. 2016; Allen et al. 2012). In Australia, the species' range extends from Shark Bay in Western Australia north and east to southern Queensland (Raudino et al. 2018; Allen et al. 2012). In the Pilbara, they have been recorded up to 50 km from the mainland, but possibly associated with offshore islands (Hanf et al. 2015; Hanf et al. 2021). Australian humpback dolphins do not appear to undergo large-scale seasonal migrations, although seasonal shifts in abundance have been observed (Parra & Cagnazzi 2016). A biopsy survey conducted by Allen et al.

(2012) between the March and July 2010 by boat identified Australian humpback dolphins at all surveyed sites within the Dampier Archipelago (Figure 7; Figure 8 and Figure 9).

Allen et al. (2012). Identified the occurrence of the Australian humpback dolphins and Indo-Pacific bottlenose dolphins in the coastal waters adjacent to each coastal township of north-western Australia, including: Coral Bay and North West Cape (Exmouth) in the northern Gascoyne region, north-east across the Pilbara coast (Onslow, Dampier and Port Hedland) to Cable Beach and Roebuck Bay (Broome) in the Western Kimberley.

Indo-Pacific bottlenose dolphins occur in tropical and sub-tropical, shallow waters from South Africa to the Red Sea and eastwards to the Arabian Gulf, India, China and Japan, southwards to Indonesia and New Guinea, and New Caledonia. They have recently been re-listed as Near Threatened by the IUCN (Braulik et al. 2019). Their shallow coastal habitats overlap with human activity and coastal development which exposes them to repeated and cumulative stressors that have potential to disrupt and displace individuals (Bejder et al. 2006; Smith et al. 2017). Within Australia the species is restricted to inshore areas such as bays and estuaries, nearshore waters, open coast environments, and shallow offshore waters, around the whole Australian coast (Allen et al. 2012). Indo-Pacific bottlenose dolphins have been recorded throughout nearshore waters of the region, including the Project area (Hanf et al 2017; Allen et al. 2012; Hanf et al. 2021). Preliminary distribution models suggest that there could be habitat partitioning between Indo-Pacific bottlenose and humpback dolphins (Hanf et al. 2021).

Snubfin dolphins are found in the North-west Marine Region in nearshore state waters along the coast from Cape Londonderry south to Roebuck Bay, with records of vagrants as far south as Exmouth Gulf (DSEWPaC 2012b). They have been recorded within the Dampier Archipelago, Port Hedland, Cable Beach and Roebuck Bay from the Montebello Islands, Exmouth Gulf and the North West Cape (Allen et al. 2012; DSEWPaC 2012b).

Habitat use and life history

Australian humpback and Indo-Pacific bottlenose dolphins are both found throughout the study area. They share similar behavioural activities, with some degree of spatial overlap. At a regional scale, there may be some partitioning between the species with bottlenose dolphins preferring deeper waters close to sloping bathymetry (Hanf et al. 2017; Hanf et al. 2021). Finer scale studies support this, with significant differences in habitat use and fine-scale habitat selection (e.g., Hunt et al. 2017). Humpback dolphins are opportunistic, generalist feeders, that prey on a wide variety of both schooling, bottom dwelling and pelagic fish and cephalopods that are generally associated with mangroves, seagrass, sandy bottom or rocky coral reefs in shallow coastal waters and estuaries of tropical regions (Parra and Jedensjö 2013). Humpback dolphins inhabit shallow, coastal waters; typically, within 20 km of land and in water depths of less than 20 m (Parra, and Jedensjö 2013; Hanf et al. 2015; Hanf et al. 2021; Hunt et al. 2018). Both species have regularly been encountered in diverse habitats, from the clear waters over Ningaloo Reef to the often-turbid waters around the Dampier Archipelago, Port Hedland and Cable Beach (Allen et al. 2012).

No Biologically Important Areas (BIAs) have been recognised in Dampier Archipelago for the Australian humpback dolphin, Indo-Pacific bottlenose dolphin or the Snubfin dolphin. This probably reflects the paucity of data for the species and the need to update publicly available government datasets (Hanf et al. 2016).

Humpback dolphins may be present in the Marine Fauna Search Area and Project DE at any time through the year, with no ecological windows having been identified.

Conservation management

Australian humpback and Indo-Pacific bottlenose dolphins are listed as Migratory, Marine and Cetacean under the EPBC Act, and humpback dolphins are listed as P4 fauna under the BC Act. In addition to potential direct impact from vessel strike, humpback dolphins are at high risk from sub-lethal effects of habitat disturbance due to their high site fidelity and small, discrete populations that spatially overlap with human activity (i.e., coastal development; petroleum exploration; commercial fishing; recreational boating) (Allen et al. 2012; Hanf et al. 2016). Underwater noise has the potential to cause direct harm, or effect hearing through masking and hinder communication ability which is important for maintain social structure and natural behaviours.

There is no adopted or made Recovery Plan for either species.

5.1.3. Dugong

Population

Current dugong distributions are believed to represent relict populations separated by large areas where they are either extinct or close to extinction (DSEWPC 2012b). Specific areas supporting dugongs in WA include Shark Bay, Ningaloo and Exmouth Gulf and the Pilbara coast. The largest population is in Shark Bay, WA, which has an estimated population of around 10 000 individuals followed by Exmouth Gulf, south of the Project Area (DSEWPC 2012b). Small numbers of dugongs have been sighted in shallow, warm waters in bays and between islands, including at East Lewis Island, Cape Preston, Regnard Bay, Nickol Bay and west of Keast Island (MMPATF 2021b; DCLM 2005). Current knowledge on the size of the population of the Dampier Archipelago/ Cape Preston area for dugongs is limited (MMPATF 2021b).

Distribution

Dugongs range extends from east Africa to the western Pacific (Groom et al. 2017; DCLM 2005). In Australia, dugong distribution and abundance vary along the northern coastline from Shark Bay in WA, into Northern Territory and to Moreton Bay near Brisbane, Queensland (DSEWPC 2012b; Groom et al. 2017; Holley & Prince 2008). Dugongs are found in coastal waters adjacent to the North-west marine region, including Shark Bay, Exmouth Gulf and offshore on the Northwest Shelf, in and adjacent to Ningaloo Reef, in coastal waters close to Broome and along the Kimberley coast, and on the edge of the continental shelf at Ashmore Reef (DSEWPC 2012b). Dugongs have also been identified as occurring in the waters around the Dampier Archipelago which is a part of the North-west Marine Region (Morris 1990) and are known to reside in the Dampier Archipelago IMMA (MMPATF 2021b) and sightings identified in the Marine Fauna Search Area (Figure 10).

From satellite tracking of individuals and aerial surveys it appears that dugongs, like many other marine mammals, can move long distances, but the timing and length of movements vary individually. Gales et al. (2004) found a regional shift of dugongs from Exmouth Gulf and Ningaloo Reef to Shark Bay in response to large scale seagrass damage from a tropical cyclone.

Habitat use and life history

Dugongs are resident in coastal waters of the Pilbara coast and are sighted year-round, having a strong association with seagrass habitat in coastal waters, estuarine creeks or streams (MMPATF 2021b; DSEWPC 2012b; DCLM 2005). Seagrass beds are found throughout Nickol Bay and around many of the islands (Worley Parsons 2009a). Dugongs are migratory, which is believed to be related to their search for suitable seagrass beds or warmer waters (DSEWPC 2012b). Many of the shallow bays and areas between islands are used by the Dugong for feeding on sea grasses (Morris 1990). Seagrass is the preferred food for dugongs, but they are also known to eat algae and macroinvertebrates (DSWEPC 2012b).

The dugong's life history renders it vulnerable to potential impacts (Marsh et al. 2011). They are long lived with a very slow and highly inconsistent reproductive rate. Population simulations indicate that even with the most optimistic combinations of life-history parameters (e.g., low natural mortality and no human-induced mortality) a dugong population is unlikely to increase more than 5% per year (Marsh et al. 1999).

Dugongs can weigh over 400 kg, due to their heavy bones, believed to help act as a ballast, helping them remain suspended as they consume seagrass. However, this also makes them relatively slow moving and difficult to detect which renders them susceptible to potential vessel strike.

Conservation management

The dugong is the only species of its genus and its family Dugongidae (i.e., it is monospecific). Dugongs are listed as Migratory and Marine under the EPBC Act and as Other Protected Fauna under the BC Act (WA). Their global (non-statutory) listing by the IUCN is Near Threatened. Dugongs are species of high cultural and conservation significance in Australia and many other coastal regions globally.

Vessel strike, habitat loss and habitat degradation have been identified as key threatening processes for dugongs and require special management considerations during coastal development and port expansion (DSEWPaC 2012b).

Australia has no adopted or made Recovery Plan for dugongs.

5.2. Birds

The Pilbara coast and islands, provide various habitats as important refuge for shorebirds and seabirds. Seabirds and shorebirds are more likely to be vulnerable to indirect impacts (e.g., light pollution or hydrocarbon spill), rather than direct impacts. One hundred and two species of bird have been recorded in the Dampier Archipelago (Morris 1990). Sixteen species of seabird and 10 shore-bird species nests on the islands (Morris1990).

5.2.1. Seabirds

Seabirds, including terns and shearwaters, nest on the islands. They often congregate in large flocks along the coastline and alongside shorebirds. However, they forage at sea, feed upon fish and squid, only coming ashore to roost and nest. Island habitats are important for seabirds such as terns and wedge-tailed shearwaters as they provide relatively undisturbed roosting and nesting habitats close to coastal oceanic foraging grounds. Sea birds have relatively long-life spans, delayed breeding and few offspring into which they invest

considerable effort over time. These characteristics plus threats posed by fisheries bycatch and introduced predator species have led to global population declines. They are typically apex-predators within the oceanic food chain and, consequently, key indicators of wider marine health.

Seabirds are a taxonomically varied group that depend on the marine environment for at least part of their life cycle. Species identified by the PMST represent the following families:

- > ‘True’ petrels and shearwaters;
- > Frigatebirds; and
- > Gulls and terns.

The fairy tern and the Australian fairy tern were identified as a key species (Table 13).

Table 13 Summary of key seabird species population, distribution and habitat preference.

Species	Population	Distribution	Habitat
Fairy tern (see below)	(see below)	(see below)	(see below)
Australian fairy tern	In decline due to habitat disturbance and predation.	Within Australia, the Fairy Tern occurs along the coasts of Victoria, Tasmania, South Australia and Western Australia; occurring as far north as the Dampier Archipelago near Karratha.	Nests on sheltered sandy beaches, spits and banks above the high tide line and below vegetation. Feeds almost entirely on fish. Fairy Terns catch fish by plunging in shallow water most often from heights of about 3 m - 10 m above the sea surface.

5.2.2. Shorebirds

Shorebirds are mostly associated with wetland and coastal habitats where they wade in shallow water and feed along the shore. This group includes plovers, sandpipers, stints, curlews, knots, godwits and oystercatchers. Some shorebirds spend their entire lives in Australia (resident), while others travel long distances between their feeding and breeding grounds each year (migratory). Migratory shorebirds use sandy spits, sandbars, rocky shores, sandy beaches, salt marshes, intertidal flats and mangroves as important feeding and resting habitat during spring and summer, when the birds escape the harsh winter of their northern hemisphere breeding grounds. Islands support resident shorebirds, including oystercatchers and beach stone-curlews, and provide undisturbed nesting.

Table 14 Summary of key shorebirds species population, distribution and (local) habitat preference.

Species	Population	Distribution	Habitat
Curlew sandpiper	In decline. Approximately 13% of the global population (1,350,000) occurs in the East Asian-Australasian Flyway.	Breeding grounds in Siberia and migrate through southeast Asia. They are a passage migrant through Europe, north Africa, Kazakhstan, west and south-central Siberia, Ussuri land, China, Taiwan, Japan, the Philippines, west Melanesia, Wallacea and New Guinea.	Intertidal mudflats of estuaries, lagoons, mangroves, as well as beaches and rocky shores. This species forages mainly on invertebrates, including worms, molluscs, crustaceans, and insects, as well as seeds.
Northern Siberian bar tailed godwit	An estimated 325 000 Bar-tailed Godwits occupy the East Asian-Australasian Flyway. During the non-breeding season 88% of the East Asian-Australasian Flyway population occurs in Australia and New Zealand.	Recorded in the coastal areas of all Australian states. Breeds in the north of Scandinavia, Russia and north-west Alaska.	Estuarine mudflats, beaches and mangroves.
Eastern curlew	In decline. The number of mature individuals in Australia was estimated at 28 000 in 2008.	Breed in eastern Russia. Recorded in the coastal areas of all Australian states. They have a continuous distribution from Barrow Island and Dampier Archipelago, Western Australia, through the Kimberley and along the Northern Territory, Queensland, and NSW coasts and the islands of Torres Strait. Area of occupancy is decreasing.	Intertidal mudflats and sandflats, often with beds of seagrass and on sheltered coasts.
Red knot	The number of mature individuals in Australia was estimated at 68	The red knot breeds in the northern hemisphere and undertakes migrations along the East Asian-Australasian Flyway (EAAF) to spend the	The red knot does not breed in Australia (TSSC 2016). During the non-breeding season in Australasia, the red knot mainly inhabit intertidal mudflats, sandflats and sandy beaches of sheltered coasts and

Species	Population	Distribution	Habitat
	000 in 2011 (Garnett et al. 2011) but has declined since (TSSC 2016).	boreal winter in Australasia (TSSC 2016). The vast majority of the population is considered to spend the non-breeding period in Australia (Bamford et al. 2008). The red knot is common in all the main suitable habitats around the coast of Australia (Barrett et al. 2002).	sometimes on sandy ocean beaches or shallow pools on exposed rock platforms. They are occasionally seen on terrestrial saline wetlands near the coast and on sewage ponds and saltworks (Higgins & Davies 1996). Usually forages in soft substrate near the water edge on intertidal mudflats or sandflats exposed by low tide. At high tide they may feed at nearby lakes, sewage ponds and floodwaters (Higgins & Davies 1996).
Greater sand plover	110 000 birds are estimated to be present in the East Asian-Australasian Flyway (Stewart et al. 2007).	In Australia, the Greater Sand Plover occurs in coastal areas in all states, though the greatest numbers occur in northern Australia, especially the north-west (Marchant & Higgins 1993; Minton et al. 2006).	In the non-breeding grounds in Australasia, the species is almost entirely coastal, inhabiting littoral and estuarine habitats. They mainly occur on sheltered sandy, shelly or muddy beaches with large intertidal mudflats or sandbanks, as well as sandy estuarine lagoons and inshore reefs, rock platforms, small rocky islands or sand cays on coral reefs.
Lesser sand plover	130 000–140 000 birds are estimated to be present in the East Asian-Australasian Flyway. At eighty-mile beach 1575 have been recorded.	Within Australia, the Lesser Sand-Plover is widespread in coastal regions and has been recorded in all states.	In non-breeding grounds in Australia, this species usually occurs in coastal littoral and estuarine environments. It inhabits large intertidal sandflats or mudflats in sheltered bays, harbours and estuaries, and occasionally sandy ocean beaches, coral reefs, wave-cut rock platforms and rocky outcrops. It also sometime occurs in short saltmarsh or among mangroves. The species also inhabits saltworks and near-coastal saltpans, brackish swamps and sandy or silt islands in riverbeds.
Great knot	The number utilising the East Asian-Australasian Flyway is approximately 425 000.	Recorded around the entirety of the Australian coast. Common on the coasts of the Pilbara and Kimberley, from the Dampier Archipelago to the Northern Territory.	Typically prefers sheltered coastal habitats, with large intertidal mudflats or sandflats. This includes inlets, bays, harbours, estuaries and lagoons. They are occasionally found on exposed reefs or rock platforms, shorelines with mangrove vegetation, ponds in saltworks, at swamps near the coast, salt lakes and non-tidal lagoons.

A review of the DAWE *National Conservation Values Atlas* interactive online tool (DAWE 2020) identified spatial overlap between the DE and breeding BIA for the fairy tern, roseate tern and wedge-tailed shearwater. The area is also recognised as a Biologically Important Foraging Area for the wedge-tailed shearwater. The fairy tern is only present in the archipelago during their breeding season (Morris 1990). The islands provide important undisturbed nesting and refuge sites for several marine species (Morris 1990). Most species breed during the winter months, however throughout the year there is at least one species nesting at any one time (Morris 1990). The Dampier Archipelago region is a significant rookery for a variety of seabird species, with a significant wedge-tailed shearwater rookery in the area, and the proposed reserves are considered to provide important feeding and nesting ground for migratory species (DCLM 2005).

Conservation management

The curlew sandpiper, Northern Siberian bar tailed godwit and great knot are all listed as Critically Endangered under the EPBC Act and BC Act. The red knot and lesser sand plover are listed as Endangered under the EPBC and BC Act, whilst the greater sand plover, fairy tern and Australian fairy tern are listed as Vulnerable under both the EPBC and BC Acts. The life histories of sea birds, including long life spans, delayed reproduction and small numbers of young each year, make them vulnerable to a range of pressures in the marine environment (DSEWPC 2012d). Migratory shorebirds face similar threats to seabirds in the marine environment and have a tendency to site fidelity (DSEWPC 2012d). In relation to coastal development, key threats to seabirds and migratory shorebirds include noise pollution from vessels and onshore activities, direct habitat removal, degradation of breeding and foraging areas, oil pollution and general marine debris.

5.2.3. Turtles

Population and distribution

Six of the world's seven species of marine turtles occur in Australian waters and all six are known to occur in the Pilbara region (DoEE 2017). Of the six species of marine turtle known to occur in the region, five have been recorded in the Dampier Archipelago, these being green, hawksbill, loggerhead, flatback and leatherback, although the leatherback turtle is not known to nest in the area (DCLM 2005; Prince 1993; Morris 1990). In Australia, genetic stocks have been identified through genetic analyses (DoEE 2017). They are separated through differential preferences in nesting habitat. The abundance and distribution of each stock relevant to the Dampier Archipelago and Project DE is presented in Table 15.

Table 15 Summary of key turtle species population and distribution (DoEE 2017).

Species	Genetic stock	Habitat Critical for Species Survival	BIAs	Population trend	Distribution/ Nesting Location	Temporal Occurrence
Loggerhead turtle	Western Australia	There is no habitat critical to the survival of this species that overlaps the Project DE.	Dampier Archipelago and coastal island interesting buffers overlaps with the Project DE.	Stable The Western Australian loggerhead turtle stock is one of the largest in the world.	Major: Dirt Hartog Island, South Murion Island, North West Cape, Gnarlou Bay. Minor: Mainland from Shark Bay to southern North-West Shelf (Northern end Ningaloo Marine Park).	Mating: Unknown Nesting: Nov-Mar (peak Jan) Hatching: Jan-May
Flatback turtle	Pilbara coast (F-Pil)	Dampier Archipelago an coastal island interesting buffers overlaps with the Project DE.	Interesting buffer overlaps with Project DE.	Unknown	Major: Barrow Island, Mundabullangana Station, Delambre Island. Minor: Thevanard, Varanus, Muiron Islands, Montebello Group, Cemetery Beach.	Mating: Sep-Jan. Nesting: Oct-Mar (peak: Nov-Jan). Hatching: Feb-Mar.
Hawksbill turtle	Western Australia (H-WA)	Dampier Archipelago interesting buffer overlaps with the Project DE.	Interesting buffer overlaps with spoil disposal sites.	Unknown	Major: Dampier Archipelago (Including Rosemary Island and Delambre Island), Montebello Islands. Minor: Ah Chong Island, South East Island and Trimouille Island), Lowendal Islands, Sholl Island.	Mating: Sep-Jan. Nesting: Oct-Mar (peak: Nov-Jan). Hatching: Feb-Mar.

Species	Genetic stock	Habitat Critical for Species Survival	BIAs	Population trend	Distribution/ Nesting Location	Temporal Occurrence
Green turtle	North west Shelf (G-NWS)	Dampier Archipelago interesting buffer overlaps with the Project DE.	Internesting buffer overlaps with spoil disposal sites.	Stable. One of the largest green turtle stocks in the world; largest in the Indian Ocean.	Major: Lacepedes, Montebello, Barrow, Muiron, Browse Islands and Northwest Cape. Minor: Boodie, Middle, Serrurier, Thevenard, Lowendal, Rosemary, Legendre, Delambre Islands and various mainland beaches, Shark Bay to Ningaloo and Kimberley Coast.	Mating: Sep–Dec. Nesting: Nov–Mar (peak: Dec–Feb). Hatching: Jan–May (peak: Feb–Mar).

Habitat and life history

Important turtle habitats are areas used for breeding (mating, nesting and inter-nesting), foraging, resting, and migration. The waters of the Dampier Archipelago are used for breeding while the sandy beaches are regularly used for nesting by green, hawksbill and flatback turtles and occasionally by loggerhead turtles (DCLM 2005). Onshore nesting and offshore inter-nesting (i.e., the period between successive nesting events) habitat that is considered to be critical for the survival of the species. Internesting habitats are located immediately seaward of designated nesting habitat critical to the survival of turtle species, using a 20 m buffer for green and hawksbill turtles and a 60 m buffer for flatback turtles. They are broad areas, having been agreed upon by an expert panel. The purpose of these defined areas is “To ensure maintenance of genetic diversity, habitat critical to the survival of marine turtles”.

Nesting

Sea turtles have high nesting beach fidelity, returning to the same beach from where they were born to lay their eggs. Nesting sites are selected carefully as nests can be disrupted by flooding or erosion (as well as feral animals such as cats and foxes). After a period of incubation (in which time sand temperature will influence the male-female sex ratio), hatchlings will emerge and head to the open ocean using natural navigation cues. It is at this time where turtles are at their most vulnerable, with high levels of predation by native (e.g., sea birds, goannas, sharks) and introduced (e.g., cats, foxes) animals. Should they become disorientated, their

path to the ocean will become less direct, which increases predation risk, or they may not be able to find the ocean at all. Many aspects of the post-hatchling period are unknown.

Flatback turtles

A review of the DAWE *National Conservation Values Atlas* interactive online tool (DAWE 2020) identified the Project Development Area as a Critical Nesting Habitat for the flatback turtle as well as a Nesting BIA. The flatback turtle utilise the beaches of the Dampier Archipelago for nesting during the summer months (October to March) with peak nesting in November to January (DoEE 2017; DCLM 2005; Morris 1990). There are significant rookeries centred on Dampier Archipelago (DoEE 2017; Limpus 2007). Delambre Island, Enderby Island, Hauy Island, Keast Island and Legendre Island have records of moderate nesting (Pendoley 2019). Delmbre Island has been recognised as the largest flatback turtle rookery in Australia with an estimated 3500 nesting females per year (Pendoley 2019).

Green turtles

A review of the DAWE *National Conservation Values Atlas* interactive online tool (DAWE 2020) identified the Project DE as a Critical Nesting Habitat for the green turtle as well as a Nesting BIA. The green turtle utilise the beaches of the Dampier Archipelago for nesting during the summer months (November – March) with peak nesting between December to February (DoEE 2017; DCLM 2005; Morris 1990).

Green turtle nesting has been identified on the islands within the Dampier Archipelago, some of which have been identified as principal near-coastal rookeries for the species (DoEE 2017; Waayers et al. 2014). Angel Island, Cohen Island, Delambre Island, Dolphin Island, Eaglehawk Island, Enderby Island, Goodwyn Island, Hauy Island, Keast Island, Lady Nora Island, Legendre Island, Malus Island, Rosemary Island, and West Lewis Island have records nesting for this species (Pendoley 2019).

Hawksbill turtles

A review of the DAWE *National Conservation Values Atlas* interactive online tool (DAWE 2020) identified the Project DE as Critical Nesting Habitat and Nesting BIA for the hawksbill turtle. The hawksbill turtle utilise the beaches of the Dampier Archipelago for nesting during the summer months (October – February) with peak nesting in October to January, however, are known to nest all year round in the region (DoEE 2017; DSEWPC 2012d; DCLM 2005; Prince 1993; Morris 1990). Hawksbill nesting in WA is centred on the Pilbara (Dampier Archipelago) (Whiting et al. 2018; Waayers et al. 2014; Limpus 2002). Rosemary Island in the Dampier Archipelago is considered a significant breeding area, supporting the most significant hawksbill turtle rookery in the Western Australian region and one of the largest in the Indian Ocean; tens to hundreds of animals nest on the island annually, more than any other Western Australian rookery, with approximately 1000 nesting females nesting per year (Pendoley Environmental 2019; DoEE 2017; DSEWPC 2012d). Angel Island, Delambre Island, Dolphin Island, Eaglehawk Island, Enderby Island, Goodwyn Island, Malus Island and Rosemary Island have records of moderate nesting (Pendoley 2019).

Inter-nesting

During the inter-nesting period, green turtles appear to remain within shallow nearshore waters (<20 m). Juvenile and adult turtles are regularly seen foraging and resting in coastal and offshore waters of the Pilbara. Mating occurs in nearshore waters relatively close to nesting beaches.

Flatback turtles

A review of the DAWE *National Conservation Values Atlas* interactive online tool (DAWE 2020) identified the Project DE as Interesting BIA for the flatback turtle. The hatchling period is known between February to March (DoEE 2017). The waters of the Dampier Archipelago have been identified as a foraging area for Flatback turtles (Waayers et al. 2014). The interesting buffer for the flatback turtles is within a 60 km radius from their nesting location, primarily in a longshore direction or from islands towards the mainland (Pendoley 2019; DoEE 2017). Post-nesting satellite tracking indicates foraging occurs along the Western Australian coast in water shallower than 130 m and within 315 km of shore with many areas located in 50 m water depth and 66 km from shore (Pendoley 2019; DoEE 2017). Other studies have showed that flatback turtles travelled at least 26 km and up to 48 km in all directions from nesting beaches on the Lacepede Islands during interesting (Waayers et al. 2011 in Pendoley 2019). Foraging habitat for post-hatchling/young juveniles is unknown, however likely to remain in waters over the Australian continental shelf (DoEE 2017). Juvenile-adult flatback turtles are known to favour soft sediment habitats that support benthic invertebrates (DoEE 2017). Their main diet comprises algae, squid, invertebrates, and molluscs (Pendoley 2019).

Green turtles

A review of the DAWE *National Conservation Values Atlas* interactive online tool (DAWE 2020) identified the Project Area as a Interesting BIA for the green turtle. The hatchling period is known between January to May (peak February to March) (DoEE 2017). The interesting buffer for the green turtles is within a 20 km radius from their nesting location (DoEE 2017). In a 2005 turtle tracking survey conducted by Pendoley (2019), female green turtles travelled up to 5 km from nesting beaches in the Dampier Archipelago, remaining within shallow, nearshore waters between 0 and 10 m deep. They have been observed basking on the beaches of Rosemary Island (Limpus 2002). The waters of the Dampier Archipelago have been identified as a foraging area for green turtles (Waayers et al. 2014). During non-breeding, green turtles typically occupy nearshore, coastal bays, feeding on seagrasses and macroalgae (Pendoley 2019). They are herbivorous for the majority of their life history; however, post-hatchling green turtles are omnivorous in their pelagic stage, and recent findings point to an oceanic diet including sea jellies for some populations (Pendoley 2019). Tracking data from a survey conducted by Pendoley in 2005 did not identify and foraging grounds for green turtles within the Dampier Archipelago (Pendoley 2019).

Hawksbill turtles

A review of the DAWE *National Conservation Values Atlas* interactive online tool (DAWE 2020) identified the Project Area as a Interesting BIA for the hawksbill turtle. The hatchling period is all year with a peak in December to February (DoEE 2017). Individuals may migrate up to 2400 kilometres between their nesting and

foraging grounds (DSWEPC 2012d). On Rosemary Island, the re-nesting period for hawksbill turtles is generally three years (DSWEPC 2012d). The interesting buffer for the hawksbill turtles is within a 20 km radius from their nesting location (DoEE 2017). Details from a turtle tracking survey conducted by Pendoley in 2005 (2019) indicate that nesting female hawksbill turtles remained within 1 km of nesting beaches on Rosemary Island. Foraging habitat for post-hatchling/young juveniles is unknown (DoEE 2017). Foraging habitat identified for juvenile-adult hawksbill turtles include tidal and sub-tidal coral and rocky reef habitats where they feed on algae, sponges and soft corals but will also consume shrimp, squid, anemones, algae, seagrass, sea cucumber and soft corals (Pendoley 2019; DoEE 2017). Hawksbill turtles can be found in clear or turbid water, within rock and reef habitats, algal and seagrass meadows, soft-bottom habitats, coastal areas and lagoons (Pendoley 2019; DoEE 2017). Tracking data from a survey conducted by Pendoley in 2005 did not identify foraging grounds for hawksbills within the Dampier Archipelago (Pendoley 2019).

Loggerhead turtles

A review of the DAWE *National Conservation Values Atlas* interactive online tool (DAWE 2020) identified the Project Development Area as a Interesting BIA for the loggerhead turtle. Foraging habitat for post-hatchling/young juveniles is unknown, however likely to disperse through waters of the Indian Ocean (DoEE 2017). Foraging habitat identified for juvenile-adult hawksbill turtles include tidal and sub-tidal habitats with hard and soft substrates including rocky and coral reefs, muddy bays, sand flats, estuaries and seagrass meadows (DoEE 2017). A proportion of turtles may also remain resident in the open ocean (DoEE 2017). They feed on benthic invertebrates including molluscs and crustaceans (Pendoley 2019). Loggerhead turtles are infrequently recorded in the area during nesting season. Loggerhead turtles primarily nest south of the Pilbara region and as such are much less abundant, with their distribution around Dampier Archipelago unclear. They are a nearshore species who prefer warm, shallow continental shelves and coastal bay and estuaries (Pendoley 2019).

Table 16 Generalised diets of turtle species (DoEE 2017).

Species	Generalised diet	Foraging habitat
Flatback turtle	Primarily carnivorous, feeding on soft-bodied invertebrates. Juveniles eat gastropod molluscs, squid, siphonophores. Limited data indicate that cuttlefish, hydroids, soft corals, crinoids, molluscs and jellyfish are also eaten.	Soft sediment habitats that support benthic invertebrates.
Green turtle	Primarily herbivorous, foraging on algae, seagrass and mangroves. In their pelagic juvenile stage, they feed on algae, pelagic crustaceans and molluscs.	Tidal/sub-tidal habitats with coral reef, mangrove, sand, rocky reefs and mudflats.
Hawksbill turtle	Omnivorous, feeding on algae, sponges, soft corals and other soft-bodied invertebrates.	Tidal and sub-tidal coral and rocky reef habitats.
Loggerhead turtles	Carnivorous, feeding predominately on benthic invertebrates in habitats ranging from near shore to 55 m. During their post-hatchling stage, they feed on algae, pelagic crustaceans and molluscs.	Tidal and sub-tidal habitats with hard and soft substrates including rocky and coral reefs, muddy bays, sand flats, estuaries and seagrass meadows. A proportion of turtles also remain resident in the open ocean.

Mating

Flatback turtles

A review of the DAWE *National Conservation Values Atlas* interactive online tool (DAWE 2020) identified the Project DE as a Mating BIA for the flatback turtle. The mating period however is unknown (DoEE 2017).

Conservation management

Flatback, green and hawksbill turtles are all listed as Vulnerable, Migratory and Marine under the EPBC Act and Vulnerable under the BC Act. At the international level flatback turtles are Data Deficient, green turtles are Endangered and hawksbill turtles are Critically Endangered. In relation to coastal development, key threats to turtles are light pollution (i.e., disturbance to nesting behaviour and misorientation of turtle hatchlings), direct habitat removal, degradation of nesting and foraging areas, vessel strike, underwater noise and entrainment from dredgers.

Their conservation is managed under the Recovery Plan for Marine Turtles in Australia (DoEE 2017).

5.3. Sharks and Rays

5.3.1. Green Sawfish

Population

The green sawfish is one of five species of sawfish have been identified in Australia, however little is known about the ecology of these species due to their rarity (Morgan 2017; Bradshaw et al. 2008). The green sawfish have suffered severe global declines since the late 1960s and are considered to be locally extinct throughout much of their former range (DoE 2015). Australia probably represents the last secure population of green sawfish across the species global range (DoE 2015). Green sawfish populations are genetically structured in northern Australian waters (DoE 2015). Distinct green sawfish populations have been identified from the west coast, the Gulf of Carpentaria and the east coast (DoE 2015).

Distribution

The known distribution of the green sawfish is from the Whitsundays in Queensland across northern Australian waters to Shark Bay in WA (DoE 2015). However, their distribution is not clearly defined due to confusion with other members of the genus (Thorburn et al. 2008). They are known to primarily occur in inshore coastal and offshore marine waters, including river mouths, shallow estuarine waters, embayment's and along sandy and muddy beaches, however, does not penetrate freshwater, spending much of their lives in estuarine and inshore areas (DoE 2015; Stevens et al. 2015; Poulakis et al. 2010; Compagno 1990). Short-term tracking has shown that green sawfish appear to have limited movements that are tidally influenced, and they are likely to occupy a restricted range of only a few square kilometres within the coastal fringe, with a strong association with mangroves and adjacent mudflats (DSEWPC 2012e; DoE 2015; Stevens et al. 2008). Adult/juveniles are known to occur nearshore from the Project Area, whilst only adults are known to occur further offshore (DoE 2015; Stevens et al. 2005). They have been recorded in very shallow water (less than one metre) and in offshore trawl grounds in over 70 m of water (Stevens et al. 2005). A movement study with acoustic telemetry further south of the Project Area, near the town of Onslow, tracked individuals and found they occupied shallow depths up to two metres, moving up to 10 km during each tidal cycle (Morgan et al. 2017). Individuals often returned to within 100 m of previous high tide resting sites, demonstrating the repeated use of habitat (Stevens et al. 2008). They moved towards the shore on the rising tide and away from the shore on the falling tide but remaining in water mostly less than one and a half metres deep.

Habitat use and life history

Pupping is known to occur in the Pilbara region for green sawfish and has been identified as likely to occur in the Project DE (DoE 2015). Sawfish pupping occurs after the wet season in northern WA, generally from late October to April. A study by Morgan (2017), found juveniles have a high site fidelity for at least three to six months and remain in their chosen nursery for at least three to four years later migrating into nearshore marine waters after the wet season. Sawfish return to the estuaries to breed during the following wet season. They are relatively long lived with the green sawfish believed to live up to 50 years (Morgan 2017).

Sawfish foraging areas include shallow, sandy substrate during high and low tides. In general mangrove habitat provides shelter and protection for sawfish. The habitat to which adult and juvenile sawfish are found

differs slightly and therefore for some species, adults and juveniles may only occur in fresh or marine habitats dependant on their lifecycle stages (Harrison and Dulvy 2014; Compagno 1990). Little is known about adult habitat use for any of the species (DoE 2015). They are considered to be top predators and their diet consists mostly of a variety of fish and crustaceans (Stevens et al. 2005). It is presumed that green sawfish are slow growing, long lived, late to maturity and have low fecundity (DoE 2015).

No BIAs have been identified for sawfish around the Project DE.

5.3.2. Dwarf Sawfish

Population

The dwarf sawfish is possibly restricted to Australia representing the last secure population of the species across its global range (DoE 2015).

Distribution

Distinct dwarf sawfish populations have been identified from the west coast of Australia, the Gulf of Carpentaria and the east coast of Australia (DoE 2015). Distinct dwarf sawfish populations are thought to occur on the west coast of Australia, the north coast of Australia and the Gulf of Carpentaria, with no migration between these locations (Phillips et al. 2011; Phillips, 2012).

Habitat use and life history

The species inhabit inshore coastal areas including rivers and estuaries, spending much of their lives in estuarine and inshore areas (DoE 2015). Dwarf sawfish usually inhabit shallow (two to three metres) coastal waters and estuarine habitats, almost into freshwater (Thorburn et al. 2007; Last and Stevens 2009). A study in north-western Western Australia found that estuarine habitats are used as nursery areas, with juveniles remaining in these areas up until three years of age (DoE 2015). Pupping is not known or unlikely to occur in the Project Area, however Adult/juvenile sawfish are known to occur, whilst adults occur further offshore, although unconfirmed (DoE 2015). Little is known about adult habitat use for the species (DoE 2015). Adults are thought to occupy a range within the coastal fringe of only a few square kilometres and show site fidelity (Stevens et al. 2008). They are considered to be top predators and their diet consists mostly of a variety of fish and crustaceans (Stevens et al. 2005). The approximate age of maturity of the species is estimated to be between 8-10 years old (Peverell 2008). Peverell (2008) estimated longevity of 34 years for dwarf sawfish. It is presumed that dwarf sawfish are slow growing, late to maturity and have low fecundity (DoE 2015; Harrison and Dulvy 2014).

Conservation management

Globally, overfishing and habitat alteration have caused major declines in sawfish populations. In relation to coastal development, key threats to sawfish include habitat degradation from changes to coastal processes and reduction in water quality (DoE 2015; DSWEPC 2012e).

Green and dwarf sawfish are all listed as Vulnerable and Migratory and marine under the EPBC Act. Under the BC Act, green sawfish is listed as Vulnerable and dwarf sawfish are Priority 1. At the international level dwarf

sawfish are listed as Endangered and green Critically Endangered. Their conservation is managed under the Sawfish and River Sharks Multispecies Recovery Plan (DoE 2015).

6. Fin fish

The Project DE falls within the North Coast Bioregion (DPIRD 2019). Given the location of the Project Development Area, the only relevant captured species suite are those that are found in the inshore and offshore demersal waters aquatic zone (DPIRD 2019). The Southern Bluefin Tuna (*Thunnus maccoyii*) was the only captured fish species identified from the PMST search as likely to occur within the Marine Fauna Search Area and listed as a (protected) Conservation Dependant species under the EPBC Act. Given its likelihood of occurrence this species has not been considered a key species for the purpose of this assessment.

Five resources have been identified within the North Coast Bioregion (DPIRD 2019). Of these, one commercially important fish resource overlaps with the Project DE and is further detailed within Table 17.

Table 17 Fishery resource, catch type, captured species and significance in relation to Project DE for commercial fisheries that overlap with the Project DE.

Resource	Fishery	Catch type	Captured Species	Significance of Project DE	Aquatic zone/habitat
Northern Demersal Scalefish	Pilbara Fish Trawl (Interim) Managed Fishery	Commercial	Finfish – tropical demersal scale fish suite (Emperors, snappers, cods)	Fishery closed within Project DE.	Inshore and Offshore demersal

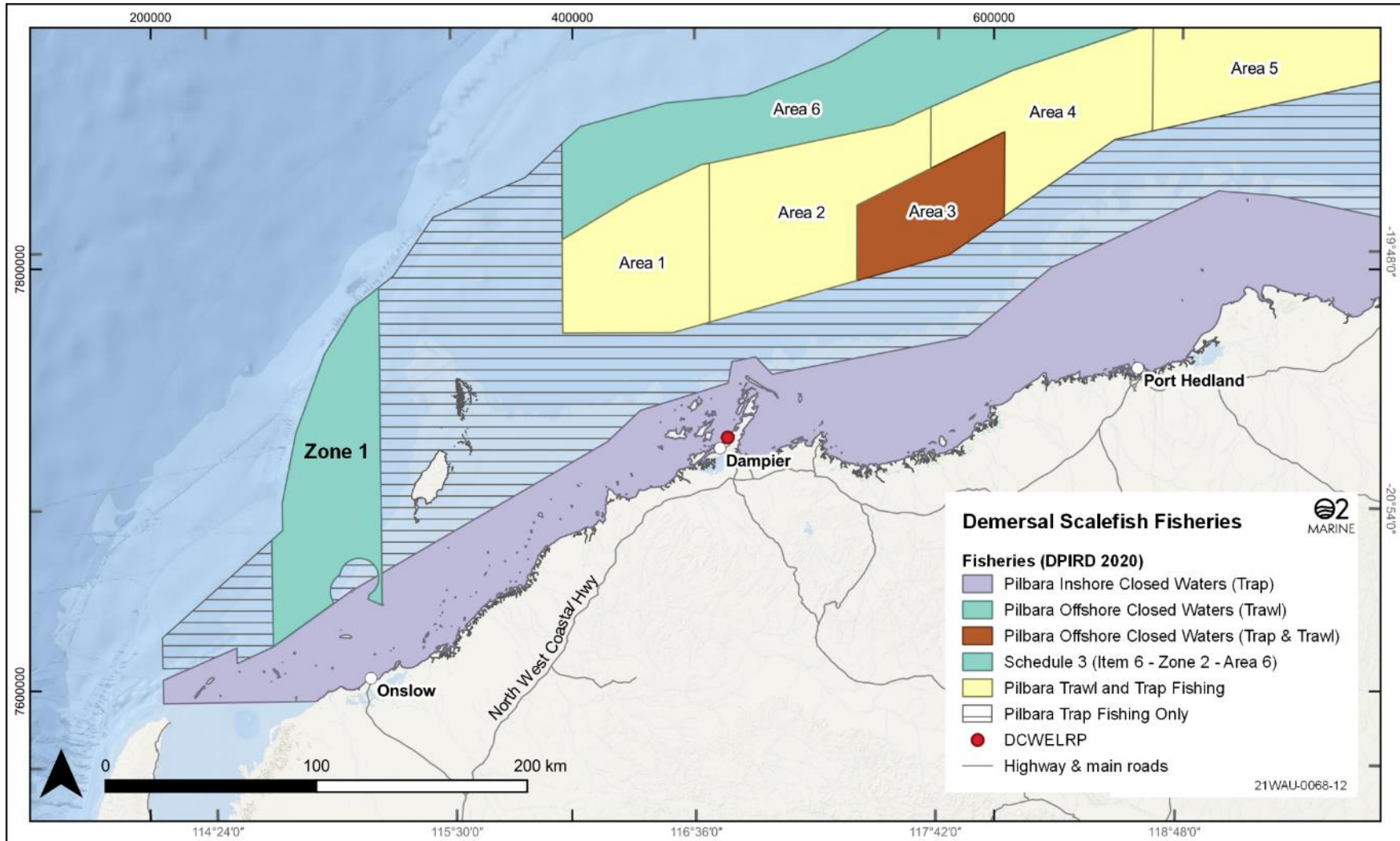


Figure 15 Demersal Scalefish Fisheries.

The principal fisheries in the North Coast Bioregion focus on tropical finfish (DPIRD 2019). Fish stocks in the North Coast Bioregion are entirely tropical, with most having an Indo-Pacific distribution extending eastward through Indonesia to the Indian subcontinent and Arabian Gulf regions (DPIRD 2019).

Recreational fishing in the North Coast Bioregion has a distinct seasonal peak in winter when the population is increased by significant numbers of intra-state and inter-state tourists travelling through the area visiting the Dampier Archipelago (DPIRD 2019). Much of the angling activity is boat-based, with beach fishing limited to periods of flood tides and high water (DPIRD 2019).

The numerous creek systems, mangroves, rivers and beaches provide shore and small boat fishing (DPIRD 2019). Species that utilise these habitats include barramundi, tropical emperors, mangrove jack, trevallies, sooty grunter, threadfin, cods and catfish, and invertebrate species including blue swimmer crabs, mud crabs and squid (DPIRD 2019).

Offshore islands, coral reef systems and continental shelf waters provide recreational fishing opportunities for species including tropical snappers, cods, coral and coronation trout, sharks, trevally, tusk fish, tunas, mackerels and billfish (DPIRD 2019).

Threats

Potential threats include loss or contamination of marine habitats as a result of dredging and sea dumping, oil spills, interactions between vessels and listed species and the introduction of marine pests (DPIRD 2019).

7. Invertebrates

The intertidal zone of the Dampier Archipelago is characterised by wide sandflats, mudflats, rocky shores, coral reefs and mangals, all of which support an extremely abundant and diverse invertebrate fauna (Morris 1990). In the Pilbara including around the Project DE, the intertidal sand and mud flats support a diverse assemblage of invertebrates including molluscs, polychaetes, echinoderms and crustaceans (Wilson 2013). These faunal assemblages include a high proportion of regionally endemic species (Wilson 2013). Sandflats and mangals are not identified as occurring within the Project DE and therefore intertidal faunal species associated with these habitats are unlikely to occur within the Project DE Area. Coral habitat occurs within the Project DE, as well as the broader Dampier Archipelago area, fringing islands and the mainland (Figure 3), and therefore, it is unlikely associated invertebrate faunal species would be restricted to the Project Area. Five resources have been identified within the North Coast Bioregion (DPIRD 2019). Of these, four commercially important invertebrate resource overlaps with the Project DE and is further detailed within Table 18.

Threats

Potential threats include loss or contamination of marine habitats as a result of dredging and sea dumping, oil spills and introduction of marine pests (DPIRD 2019).

Table 18 Fishery resource, breeding stock status and catch effort ranges for commercial fisheries that overlap with the Project DE.

Resource	Fishery	Catch type	Captured Species	Significance of Project DE	Aquatic zone/habitat
Northern Invertebrates	Onslow Prawn Managed Fishery	Commercial	Banana prawn, brown tiger prawn, Western king prawns, endeavour prawn, coral prawn	Fishery activities overlap with Project DE (Figure 16)	Inshore Mud, sand
	Nickol Bay Prawn Managed Fishery	Commercial	Banana prawn, brown tiger prawn, Western king prawns, endeavour prawn, coral prawn	Fishery closed in part of Project DE. Other area trawled.	Inshore Mud, sand
Pearl Oyster (<i>P. maxima</i>)	Pearl Oyster Wildstock Fishery	Commercial	Pearl oyster (Invertebrate (mollusc))	Fishery activities overlap with Project DE (Figure 17)	Nearshore
Statewide marine aquarium fish and hermit resources	Hermit Crab Managed Fishery	Commercial and recreational	Invertebrate (Australian hermit crab)	Fishery activities overlap with Project DE (Figure 19)	Nearshore
North coast crab resource	Pilbara Managed Crab Fishery	Commercial and recreational	Invertebrate (Pilbara blue swimmer crab and Kimberley mud crab)	Fishery activities are prohibited within Project DE (Figure 18)	Estuarine/nearshore

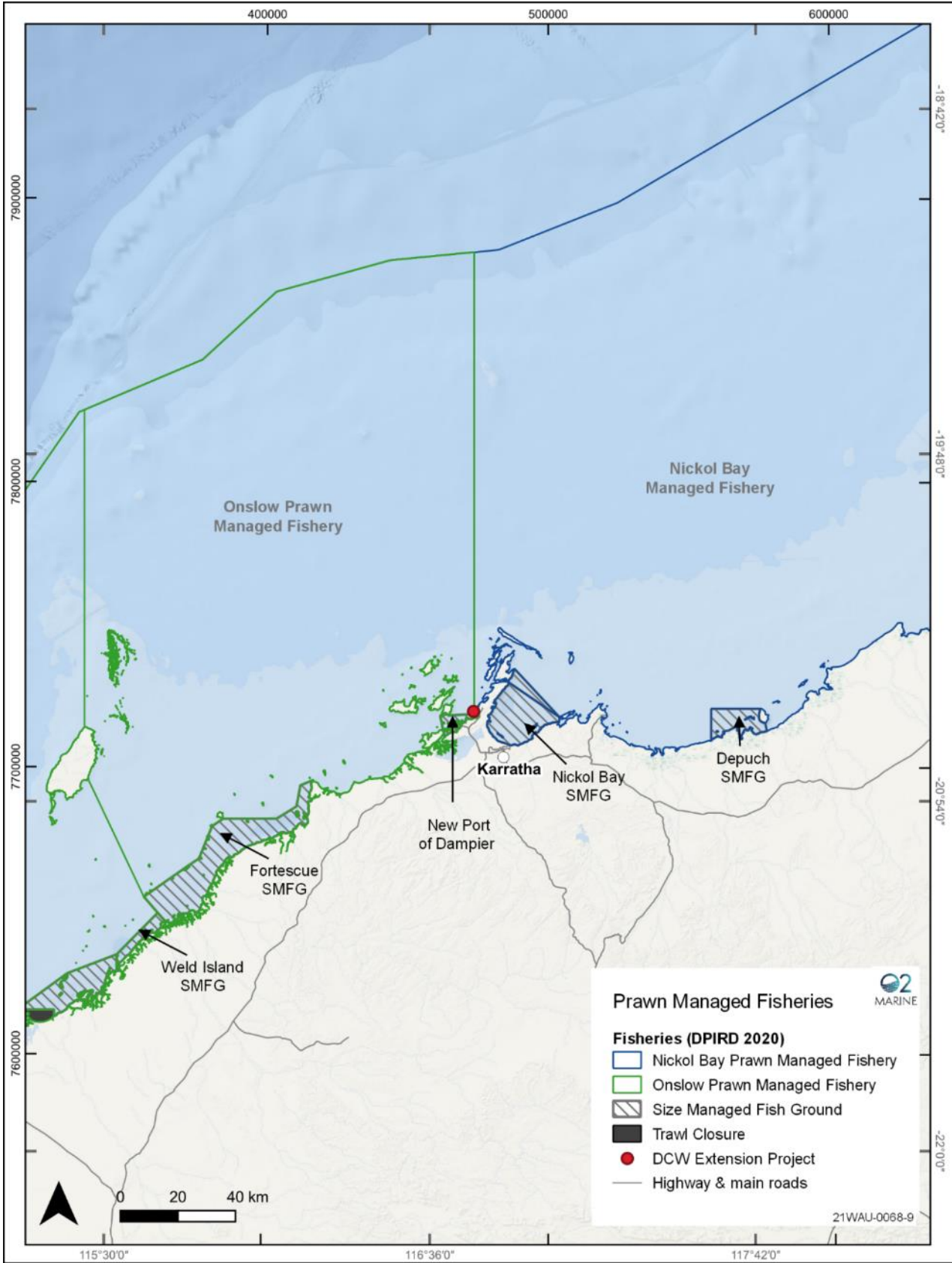


Figure 16 Prawn Managed Fisheries.

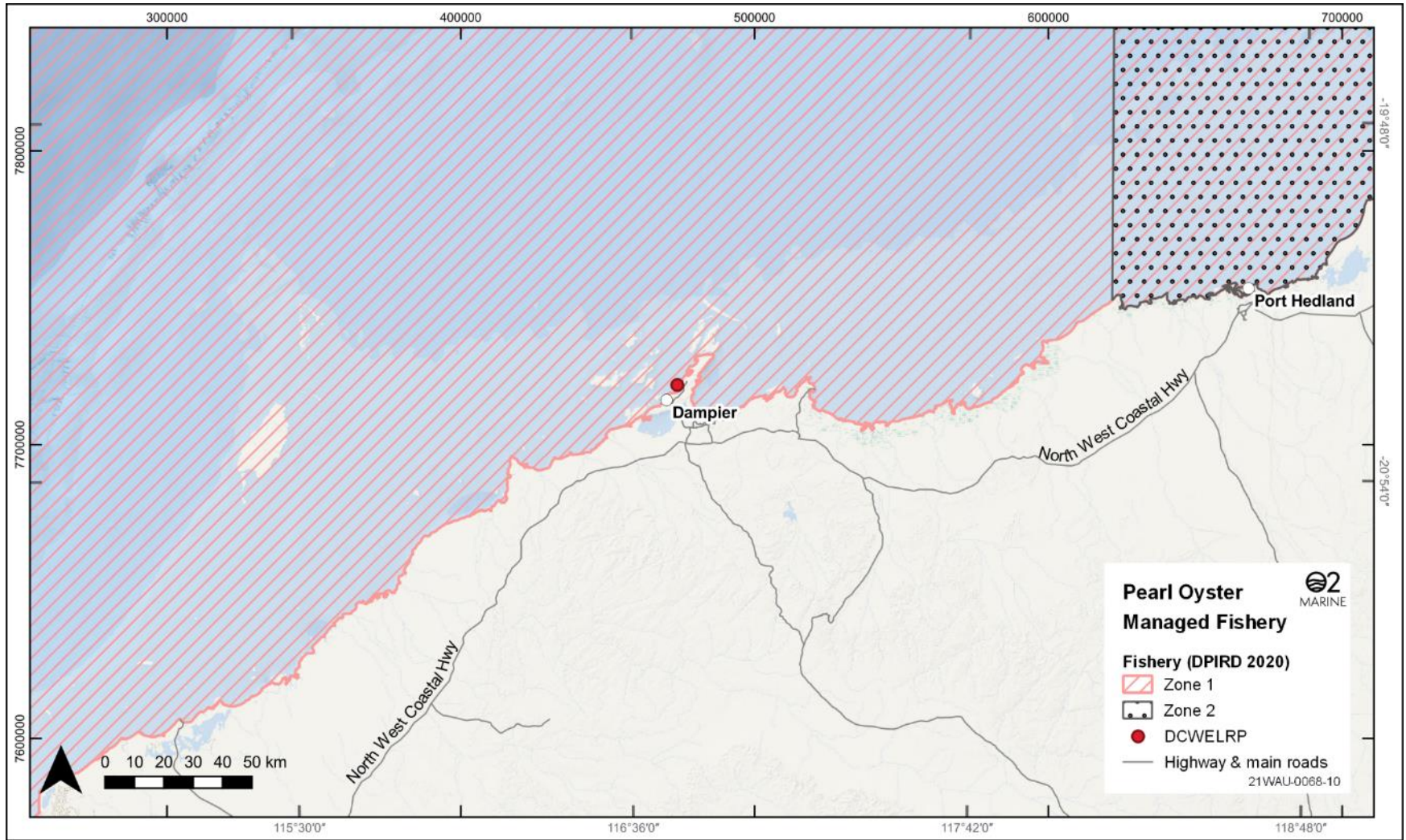


Figure 17 Pearl Oyster Managed Fishery.

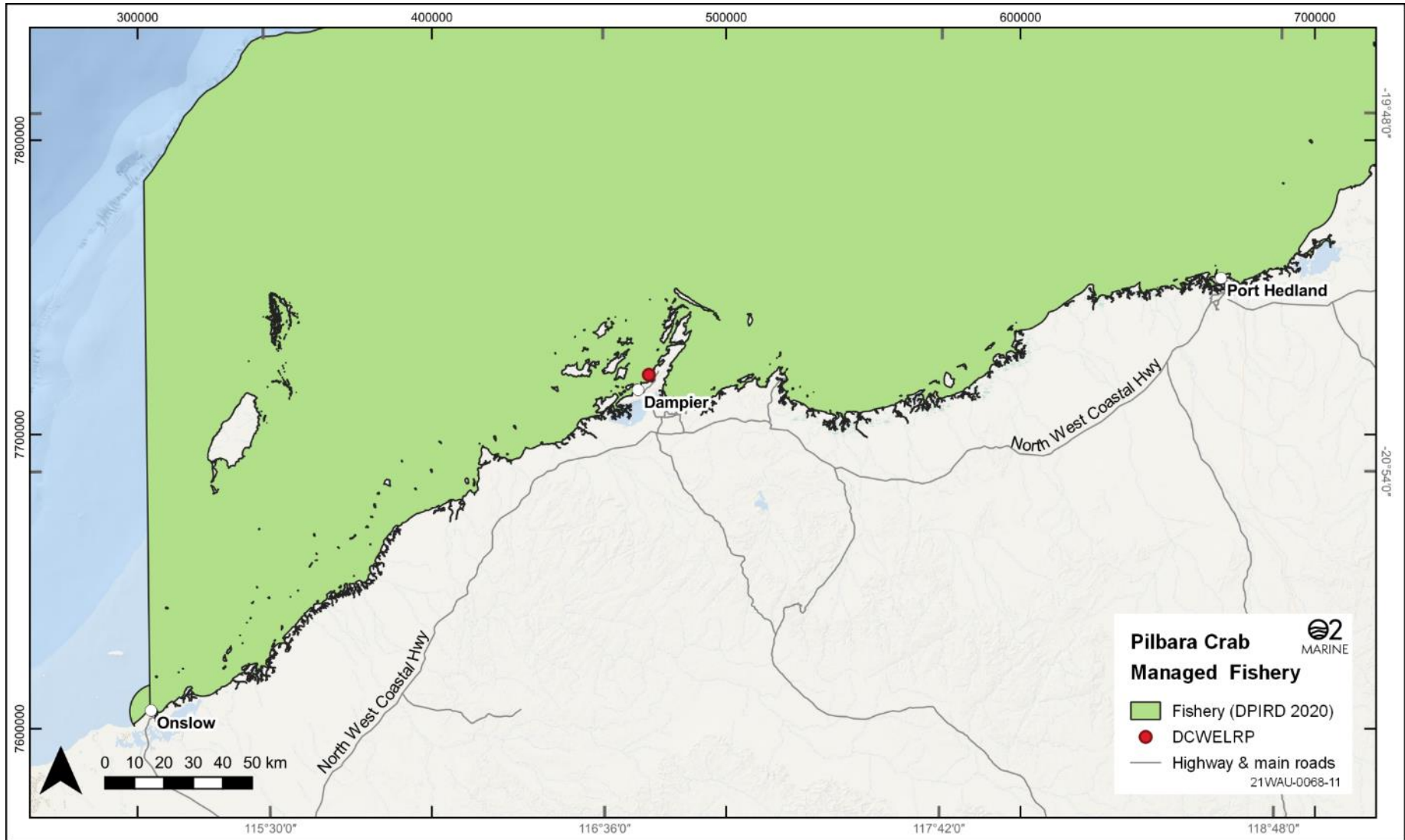


Figure 18 Pilbara Crab Managed Fishery.

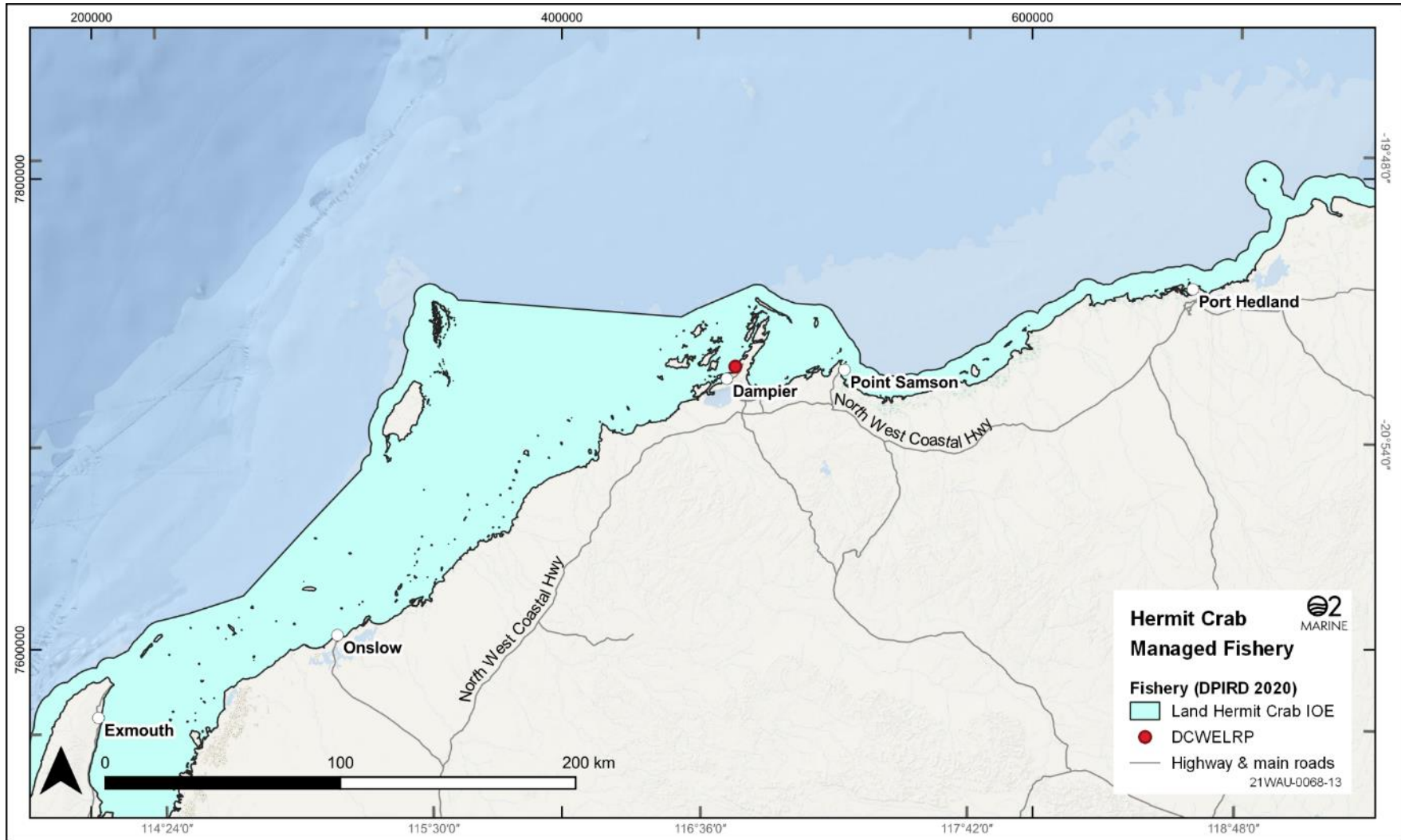


Figure 19 Hermit Crab Managed Fishery.

8. Summary and Conclusion

Key species were identified so that the correct proportionality of information is considered when assessing the nature and risk of potentially significant impacts. Key species were defined as those with:

- > A high conservation status under the EPBC Act as MNES, or the BC Act as threatened or priority species; or
- > Target commercial or recreational fish species; and
- > A high likelihood of occurrence within the Project DE or Potential Area of Impact.

Key mammal species are the humpback whale, dugong, Australian humpback dolphin and Indo-Pacific bottlenose dolphin. Key marine reptile species are the green turtle, flatback turtle and hawksbill turtle. The key fish species is the green sawfish and dwarf sawfish. Information on seabirds and shorebirds has been presented to support the assessment of indirect impacts.

1. Humpback whale (Migratory)

Humpback whales would likely to be seen 25 km offshore Project Development Area and during their annual migration north to breed and give birth to calves in the Kimberley (~ late May to August). They occur closer to the shore in shallow water depths (<30 m) from ~August to October when they migrate south to feeding grounds in the Antarctic. Known threats to humpback whales include underwater noise pollution and collision with vessels.

2. Australian humpback and Indo-Pacific bottlenose dolphins (Migratory)

Australian humpback and Indo-Pacific bottlenose dolphins are both found throughout the Marine Fauna Search Area. Threats are not listed for the Australian humpback dolphin in the North-west bioregional plan, however known threats to the Indo-Pacific bottlenose dolphin that have the potential to arise as a result of the Project include marine debris, noise pollution and collision with vessels. With application of appropriate management and mitigation measures including the use of MFO's, exclusion zones, noise dampening measures and waste management procedures, the indirect and direct impacts to both dolphin species as a result of the Project both during construction and operation is unlikely.

3. Dugong (Threatened and Migratory)

Dugongs may be present in the Project DE and surrounds at any time through the year, with no ecological windows having been identified. Threats relative to the Project on dugongs as described in the North-west bioregional plan include marine debris, physical habitat modification, collision with vessels and invasive species. With the application of appropriate management and mitigation measures including the use of MFO's, exclusion zones, waste management procedures, the indirect and direct impacts to dugongs as a result of the Project both during construction and operation is unlikely.

4. Flatback, green and hawksbill turtles (Threatened and Migratory)

The flatback turtle, green turtle and hawksbill turtle occur in or nearby the Project DE during all life-history phases (i.e., mating, nesting and inter-nesting) with likely year-round presence. The Project is located within a biologically important area for the flatback turtle and hawksbill turtle and overlaps with critical habitat for

nesting and inter-nesting for the flatback and green turtles and hawksbill turtle. Green turtles are likely to use the area during inter-nesting periods, remaining within shallow nearshore waters (<20 m). Threats relative to all species include marine debris, noise pollution, light pollution, physical habitat modification. Threats specific to the green turtles include changes in turbidity. Green and flatback turtles are also subject to human presence at sensitive sites and invasive species, whilst green and hawksbill turtles are subject to collision with vessels. With application of appropriate management and mitigation measures including the use of MFO's, exclusion zones, noise dampening measures, lighting management and waste management procedures, the indirect and direct impacts to turtles as a result of the Project both during construction and operation is unlikely.

5. Seabirds and shorebirds

The Pilbara coast and islands such as that of the Dampier Archipelago, provide various habitats as important refuge for shorebirds and seabirds. Seabirds and shorebirds could be vulnerable to indirect impacts (e.g., light pollution), rather than direct impacts. With application of appropriate management and mitigation measures including best practice lighting, waste and biosecurity management procedures, the indirect impacts to birds as a result of the Project Activities both during construction and operation is unlikely.

6. Green sawfish and dwarf (Threatened)

Sawfish have been recorded in freshwater rivers, lakes and coastal marine environments. The key ecological window for sawfish pupping in the region occurs after the wet season, generally from late October to April. Threats relative to the Project on green sawfish as described in the North-west bioregional plan include marine debris. This threat is indirect and will be appropriately managed through a waste management procedure and therefore the Project is not expected to have a significant impact on this species.

7. Other species

The species considered as "other" possess similar biological and ecological characteristics to the "key" species groups and therefore the same management and mitigation measures can be applied to these "other" species groups. Seabirds have been considered as "other" as a precautionary measure and have considered within this impact assessment due to their vulnerability to light pollution.

Important commercial and recreational fisheries exist in the area. However, due to port zoning, access is prohibited to nearshore Project DE.

Areas overlapping with the Project DE do not support restricted populations or habitats of conservation significant or commercially important marine fauna species. Habitats that are present are widespread and well represented throughout the region.

Biologically important areas

BIAs are spatially defined zones where aggregations of individuals of a species are known to display biologically important behaviours such as breeding, foraging, resting or migration (DAWE 2021). BIAs were first identified on a regional basis as they were developed as part of the Commonwealth Marine Bioregional Plans and have been identified using expert scientific knowledge about species' distribution, abundance, and behaviour in the region to inform decisions made under the EPBC Act 1999. They are important components of Species' Recovery Plans, where those plans exist. A summary of BIAs around the DEs is presented in Table 19.

Table 19 BIAs that spatially overlap with the Project DE or Potential Area of Impact.

Species	Behaviour	Description
Humpback whale	Migration (north and south)	BIA extends from coast to ~90 km offshore. Mother-calf pairs closer to shore during southern migration. Migrate from Antarctica to Kimberley region of north WA.
Pygmy blue whale	Distribution	BIA extends from coast to ~367 km offshore. Migrate from Antarctica to Indonesia.
Wedge-tailed shearwater	Breeding	BIA extends from coast to ~130 km offshore, on vegetated islands.
Roseate tern	Breeding	BIA extends from coast to ~50 km offshore. On vegetated islands.
Fairy tern	Breeding	BIA extends from coast to ~32 km offshore. In colonies on coral shingle on continental islands, or coral cays, on sandy islands and open sandy beaches.
Loggerhead turtle	Internesting	BIA extends from coast ~44 km offshore.
Green turtle	Foraging	~ 70 km south and ~ 40 km north of Project DE.
	Internesting	20 km buffer around Dampier Archipelago. BIA extends from coast ~40 km offshore.
	Migration corridor	Broad: minimal area of the North West Shelf stock dispersal is between Perth, Cocos (Keeling) Island and Papua New Guinea.
	Nesting	~6 km from Project DE, extending out to 18 km from Project DE. On islands of the Dampier Archipelago.
Hawksbill turtle	Foraging	~42 km north and ~ 70 km south from Project DE. Feed between 50 km and 450 km from nesting beaches.
	Internesting	20 km buffer around Dampier Archipelago. BIA extends from coast to ~45 km offshore.
	Mating	Breeding male and female hawksbills move from feeding grounds to areas near nesting beaches for mating.
	Migration corridor	Migrates up to 2,400 km between foraging areas and nesting beaches.

Species	Behaviour	Description
	Nesting	~6km offshore from Project DE on Dampier Archipelago islands. BIA extends from coast ~25 km offshore.
Flatback turtle	Foraging	~70 km south of Project DE.
	Interesting	BIA extends from coast to ~90 km offshore
	Mating	~5.9 km from Project DE. BIA extends from coast out to ~19 km.
	Migration corridor	Restricted to the continental shelf. The WA stock is restricted to the Pilbara.
	Nesting	~10 km south from Project DE at West Intercourse Island.

Critical habitat areas

The Recovery Plan for Marine Turtles in Australian 2017-2027 (DoEE 2017) identifies habitat critical for the survival of turtle species, in relation to the various stocks (Table 20). These areas have been identified by consensus of a panel of experts in marine turtle biology. They are not on the Register of Critical Habitat under the EPBC Act, but they are relevant when applying the significant impact criteria.

Table 20 Critical Habitat Areas that spatially overlap with the Project DE or Potential Area of Impact.

Species	Behaviour	DE	Timing
Flatback turtle	Nesting	~10 km south from Project DE at West Intercourse Island.	Oct – Mar (peak: Nov-Jan)
Green turtle	Nesting	~6 km from Project Area, extending out to 18 km from Project DE. On islands of the Dampier Archipelago.	Nov – Mar (peak: Dec – Feb)
Hawksbill turtle	Nesting	~6 km offshore from Project DE on Dampier Archipelago islands. BIA extends from coast ~25 km offshore.	Peak: Oct -Jan

Ecological windows

Table 21 Key species' ecological windows.

Species presence	J	F	M	A	M	J	J	A	S	O	N	D
Humpback whale												
- Northward migration												
- Southward migration												
Dugong												
Australian humpback dolphin												
Indo-Pacific bottlenose dolphin												
Flatback turtle												

- Foraging												
- Nesting and internesting												
Green turtle												
- Foraging												
- Nesting and internesting												
Hawksbill turtle												
- Foraging												
- Nesting and internesting												
Green sawfish												
- Pupping												
Planned construction activities												

Potential stressors

DSEWPaC (2012a) outline sensitivities to conservation significant marine fauna species in the North West Bioregion (Table 22) that should be considered when assessing the significance of impacts from PPA activities.

Direct impact may arise from:

- > Underwater noise from piling, rock blasting and dredging (injury or mortality)
- > Vessel movements (risk of strike)

Indirect impacts may arise from:

- > Underwater noise from piling, rock blasting and dredging (behavioural change)
- > Light pollution
- > Temporary, localised increase in turbidity from dredging
- > Introduction of marine pest species from project vessels.

Table 22 Matrix of the vulnerability of marine fauna to PPA project risks (C=Concern (Red), PC=Potential Concern (Gold), LC=Less Concern (Green), NC=Not of Concern (Grey), DD=Data Deficient (White)) (adapted from DEWPaC 2011)

Marine fauna	Underwater Noise	Habitat Modification	Human Presence	Change Hydrology	Increased Turbidity ¹	Nutrient Pollution	Vessel Strike	Dredge Entrainment	Chemical Spills	Litter/Debris	Light Pollution	Invasive Species
Humpback whale	PC	NC	NC	NC	NC	NC	PC	NC	LC	LC	NC	NC
Dolphins	PC	PC	PC	PC	DD	PC	LC	NC	PC	PC	NC	DD
Dugong	LC	C	LC	NC	PC	NC	PC	NC	LC	PC	DD	PC
Turtles	PC	C	C	LC	PC	LC	PC	PC	LC	C	C	C
Sea snakes	DD	PC	NC	NC	DD	DD	LC	LC	PC	DD	NC	DD
Seabirds & shorebirds	NC	PC	PC	LC	PC	NC	NC	NC	PC	LC	PC	PC
Sawfish	DD	C	LC	C	NC	LC	LC	LC	LC	PC	NC	LC
Other Sharks & Rays	DD	LC	NC	NC	DD	LC	NC	LC	PC	DD	NC	LC
Finfish	DD	PC	DD	PC	DD	LC	NC	PC	PC	LC	NC	LC

9. Reference List

- Allen, S.J., Cagnazzi, D.D., Hodgson, A.J., Loneragan, N.R. and Bejder, L. (2012). Tropical inshore dolphins of north-western Australia: Unknown populations in a rapidly changing region. *Pacific Conservation Biology*. Vol. 18: 56-63. Surrey Beatty & Sons, Sydney. 2012.
- Armstrong, A.J., Armstrong, A.O., McGregor, F., Richardson, A.J., Bennett, M.B., Townsend, KA., Hays, G.C., Van Keulen, M., Smith, J and Dudgeon, C.L. (2020). Satellite tagging and photographic identification reveal connectivity between two UNESCO World Heritage Areas for Reef Manta Rays. *Front. Mar. Sci.*, 28 August 2020. <https://doi.org/10.3389/fmars.2020.00725>.
- Bamford M., D. Watkins, W. Bancroft, G. Tischler & J. Wahl. (2008). Migratory Shorebirds of the East Asian - Australasian Flyway: Population estimates and internationally important sites. [Online]. Canberra, ACT: Department of the Environment, Water, Heritage and the Arts, Wetlands International-Oceania. Available from: <http://www.environment.gov.au/biodiversity/migratory/publications/shorebirds-east-asia.html>.
- Barrett, G., A. Silcocks, S. Barry, R. Poulter & R. Cunningham. (2002). Australian Bird Atlas 1998-2001 Main Report To Environment Australia. Melbourne: Birds Australia.
- Bejder, L., Samuels, A., Whitehead, H., Gales, N., Mann, J., Connor, R., Heithaus, M.R., Watson-Capps, J., Flaherty, C. and Krützen, M. (2006). Decline in relative abundance of bottlenose dolphins exposed to long-term disturbance, *Conservation Biology* 20(6): 1791-1798.
- Bejder, L., Hodgson, A., Loneragan, N and Allen, S. (2012). Coastal dolphins in north-western Australia: The need for re-evaluation of species listings and short-comings in the Environmental Impact Assessment process. *Pacific Conservation Biology*. DOI:10.1071/PC120022.
- Bouchet, P.J., Thiele, D., Marley, S.A., Waples, K., Weisenberger, F., Rangers, B., Balangarra Rangers., Bardi Jawi Rangers., Dambimangari Rangers., Nyamba Buru Yawuru Rangers, Nyul Nyul Rangers., Uunguu Rangers and Raudino, H. (2021). Regional Assessment of the Conservation Status of Snubfin Dolphins (*Orcaella heinsohni*) in the Kimberley Region, Western Australia. *Frontiers in Marine Science*. <https://doi.org/10.3389/fmars.2020.614852>.
- Bradshaw, C.J.A., Buckworth, R.C., Charters, R., Field, I.C. and Meekan, M.G. (2008). Distribution and abundance of Glyphis and sawfishes in northern Australia and their potential interactions with commercial fisheries. Final Report. Department of the Environment, Water, Heritage and the Arts.
- Braulik, G., Natoli, A., Kiszka, J., Parra, G., Plon, S and Smith, B.D. (2019). *Tursiops aduncus*, Indo-Pacific Bottlenose Dolphin. The IUCN red list of threatened species 2019: e.T41714A50381127. <http://dx.doi.org/10.2305/IUCN.UK.2019-3.RLTS.T41714A50381127.en>.
- Compagno, L.J.V. (1990). Alternative life-history styles of cartilaginous fishes in time and space. *Environmental Biology of fishes*. 28:33-37.

- Couturier, L.I.E., Dudgeon, C.L., Pollock, K.H., Jaine, F.R.A., Bennett, M.B., Townsend, K.A., Weeks, S.J. and Richardson, A.J. (2014). Population dynamics of the reef manta ray *Manta alfredi* in eastern Australia. *Coral Reefs* 33, 329–342 (2014). <https://doi.org/10.1007/s00338-014-1126-5>.
- D’Anastasi, B.R., Herwerden, L.v., Hobbs, J.A., Simpfendorfer, C.A. and Lukoschek, V. (2016). New range and habitat records for threatened Australian sea snakes raise challenges for conservation. *Biological Conservation*. 194 (2016) 66-70. <http://dx.doi.org/10.1016/j.biocon.2015.11.032>.
- Department of Agriculture, Water and the Environment (DAWE). (2020). National Conservation Values Atlas. Commonwealth of Australia. [National Conservation Values Atlas: Interactive Map \(environment.gov.au\)](#). Accessed on the 8th November 2021.
- Department of Agriculture, Water and the Environment (DAWE). (2021). Biologically important areas of regionally significant marine species. [Biologically important areas of regionally significant marine species - DAWE](#). Accessed on the 10th December 2021.
- Department of Agriculture, Water and the Environment (DAWE). (2021a). Protected Matters Search Tool. [Protected Matters Search Tool - DAWE](#).
- Department of Agriculture, Water and the Environment (DAWE). (2022a). *Stenella longirostris* – Long-snouted Spinner Dolphin. [Stenella longirostris — Long-snouted Spinner Dolphin \(environment.gov.au\)](#). Assessed on the 6th January 2022.
- Department of Biodiversity, Conservation and Attractions (DBCA). (2021a). Threatened and Priority Fauna Database Search for Dampier accessed on the November. Prepared by the Species and Communities Program for O2Marine for the purpose of environmental assessment.
- Department of Biodiversity, Conservation and Attractions (DBCA). (2021b). Dolphin and dugong sightings recorded during dolphin aerial surveys undertaken in 2015, 2016 and 2017 within the vicinity of the Dampier Archipelago, Western Australia. Unpublished data shared by the Marine Science Branch for O2 Marine for the purpose of environmental assessment.
- Department of Biodiversity, Conservation and Attractions. (2021c). Dolphin sightings recorded during boat-based dolphin surveys undertaken in 2015 and 2019 within the vicinity of the Dampier Archipelago, Western Australia. Unpublished data shared by the Marine Science Branch for O2 Marine for the purpose of environmental assessment.
- Department of Conservation and Land Management (DCLM). (2005). Indicative Management Plan for the proposed Dampier Archipelago Marine Park and Cape Preston Marine Management Area.
- Department of the Environment (DoE). (2013). Matters of National Environmental Significance. Significant impact guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999.
- Department of the Environment (DoE). (2015). Sawfish and River Sharks multispecies Recovery Plan. Commonwealth of Australia.
- Department of the Environment and Energy (DoEE). (2017). Recovery Plan for Marine Turtles in Australia 2017-2027. Commonwealth of Australia 2017.
- Department of Primary Industries and Regional Development (DPIRD). (2019). Status of the fisheries and aquatic resources of Western Australia 2019/20 State of the fisheries.

- Department of Primary Industries and Regional Development (DPIRD). (2019a). State-wide survey of boat-based recreational fishing in Western Australia 2017/2018. Fisheries Research Report No. 297.
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPC). (2012a). Marine bioregional plan for the North-west Marine Region. Prepared under the Environment Protection and Biodiversity Conservation Act 1999. Commonwealth of Australia.
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPC). (2012b). Species group report card - dugongs. Supporting the marine bioregional plan for the North-west Marine Region. Prepared under the *Environment Protection and Biodiversity Conservation Act 1999*. Commonwealth of Australia.
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPC). (2012c). Species group report card - cetaceans. Supporting the marine bioregional plan for the North-west Marine Region. Prepared under the *Environment Protection and Biodiversity Conservation Act 1999*. Commonwealth of Australia.
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPC). (2012d). Species group report card – marine reptiles. Supporting the marine bioregional plan for the North-west Marine Region. Prepared under the *Environment Protection and Biodiversity Conservation Act 1999*. Commonwealth of Australia.
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPC). (2012e). Species group report card – sharks and sawfishes. Supporting the marine bioregional plan for the North-west Marine Region. Prepared under the *Environment Protection and Biodiversity Conservation Act 1999*. Commonwealth of Australia.
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPC). (2012d). Species group report card – seabirds and migratory shorebirds. Supporting the marine bioregional plan for the North-west Marine Region. Prepared under the *Environment Protection and Biodiversity Conservation Act 1999*. Commonwealth of Australia.
- Environmental Protection Authority (EPA). (2001). EPA Advice: Protection of Tropical Arid Zone Mangroves Along the Pilbara Coastline. In accordance with section 16 (j) of the Environmental Protection Act 1986. EPA, Western Australia.
- Environmental Protection Authority (EPA). (2016a). Environmental Factor Guideline. Marine Fauna.
- Environmental Protection Authority (EPA). (2016b). Environmental Factor Guideline. Protection of Benthic Communities and Habitats.
- Fossette, S., Loewenthal, G, Peel, L.R., Vitenbergs, A., Hamel, M.A., Douglas, C., Tucker, A.D., Mayer, F and Whiting, S.D. (2021). Using aerial photogrammetry to assess stock-wide marine turtle nesting distribution, abundance and cumulative exposure to industrial activity. *Remote Sensing*, 2021, 13, 1116. <https://doi.org/10.3390/rs13061116>.
- Gales, N., McCauley, R.D., Lanyon, J and Holley, D. (2004). Change in abundance of dugongs in Shark Bay, Ningaloo and Exmouth Gulf, Western Australia: evidence for large-scale migration. *Wildlife Research*, 2004, 31, 283-290. CSIRO Publishing.

- Garnett, S., J. Szabo & G. Dutson. (2011). The Action Plan for Australian Birds 2010. CSIRO Publishing.
- Groom, R.A., Dunshea, G.J., Griffiths, A.D. and Mackarous, K. (2017). The distribution and abundance of Dugong and other marine megafauna in northern Territory, November 2015. Department of Environment and Natural Resources, Darwin.
- Hanf, D.M. (2015). Species distribution modelling of Western Pilbara Inshore dolphins. Thesis. Murdoch University. Cetacean research unit.
- Hanf, D.M., Hunt, T and Parra, G.J. (2016). Humpback Dolphins of Western Australia: A review of Current knowledge and Recommendations for future management. *Advances in Marine Biology*, Volume 73. ISSN 00656-2881. <http://dx.doi.org/10.1016/bs.amb.2015.07.004>.
- Hanf, D., Hodgson, A.J., Kobryn, H., Bejder, L and Smith, J.N. (2021). Dolphin Distribution and Habitat Suitability in North Western Australia: Applications and Implications of a Broad-Scale, Non-targeted Dataset. *Front. Mar. Sci.* 8:733841. doi: 10.3389/fmars.2021.733841.
- Harrison, L.R. and Dulvy, N.K. (2014). Sawfish: A global strategy for conservation. IUCN species commission's shark specialist group, Vancouver, Canada.
- Higgins, P.J. & S.J.J.F. Davies, eds. (1996). *Handbook of Australian, New Zealand and Antarctic Birds. Volume Three - Snipe to Pigeons*. Melbourne, Victoria: Oxford University Press.
- Holley, D.K and Prince, R.I.T. (2008). Historical datasets of Dugong (*Dugong dugon*) observations in the Kimberley region of Western Australia – data report – report No. 2008-03. Edith Cowan University. Research Online. ECU Publications Pre. 2011.
- Hunt, T., Bejder, L., Allen, S. A., Rankin, R. W., Hanf, D., Parra, G. J. (2017). Demographic characteristics of Australian humpback dolphins reveal important habitat toward the southwestern limit of their range. *Endangered Species Research*. 32: 71-88.
- Interim Marine and Coastal Regionalisation for Australia (IMCRA) Technical Group. (1998). *Interim Marine and Coastal Regionalisation for Australia: An ecosystem-based classification for marine and coastal environments. Version 3.3*. Environment Australia, Commonwealth Department of the Environment.
- Jenner, C and Jenner, M.N. (1991). Dampier Archipelago Humpback Whale Project. Western Australia. Season Report 1991. Unpubl. Report to the International Whaling Commission Sc/44/ o 8. Centre for whale research.
- Jenner, C., Meekan, M., Salgado-Kent, C., Thums, M and Waples, K. (2018). Humpback whale use of the Kimberley: understanding and monitoring spatial distribution. WAMSI Kimberley Marine Research Program. KMRP Report. Project 1.2.1.
- Last, P. R, and Stevens, J. D. (2009). *Sharks and rays of Australia. second edition*. Commonwealth Scientific and Industrial Research Organisation (CSIRO). Australia.
- Limpus, C.J. (2002). *Western Australian Marine Turtle Review*. Queensland Environmental Protection Agency. Department of Conservation and Land Management.
- Limpus, C.J. (2007). A biological review of Australian marine turtles. 5. Flatback Turtle *Natator depressus* (Garman). Freshwater and Marine Sciences Unit Environmental Sciences Division. Queensland Government Environmental Protection Agency.

- Lourie, S.A., S.J. Foster, E.W.T. Cooper & A.C.J. Vincent. (2004). A guide to the identification of seahorses. Washington, D.C., University of British Columbia and World Wildlife Fund. Available from: http://www.traffic.org/species-reports/traffic_species_fish29.pdf.
- Marchant, S. & P.J. Higgins, eds. (1993). Handbook of Australian, New Zealand and Antarctic Birds. Volume 2 - Raptors to Lapwings. Melbourne, Victoria: Oxford University Press.
- Marine Mammal Protected Areas Task Force (MMPATF). (2021a). Western Australian Humpback Whale Migration Route IMMA. IMMA e-Atlas - Marine Mammal Protected Areas Task Force (marinemammalhabitat.org). Accessed on the 8th November 2021.
- Marine Mammal Protected Areas Task Force (MMPATF). (2021b). Dampier Archipelago IMMA. [Dampier Archipelago IMMA - Marine Mammal Protected Areas Task Force \(marinemammalhabitat.org\)](http://marinemammalhabitat.org). Accessed on the 8th November 2021.
- Marshall, A.D., Compagno, L.J.V., Bennett, M.B. (2009). Redescription of the genus *Manta* with resurrection of *Manta alfredi* (Krefft, 1968) (Chondrichthyes: Myliobatoidei: Mobulidae). *Zootaxa* 2301:1-28.
- Marsh, H. (1999). Reproduction in sirenians. In: Boyd, I.L., C. Lockyer and H.D. Marsh. Chapter 6: Reproduction in Marine Mammals. In: Reynolds, J.E. and J.R. Twiss (eds). *Marine Mammals*. Smithsonian Institution Press, Washington DC. pp. 243-256.
- Marsh, H., Thomas, J.O and Reynolds III, J.E. (2011). Ecology and Conservation of the Sirenia. Dugongs and Manatees. *Conservation Biology* 18. Cambridge.
- Minton, C., J. Wahl, R. Jessop, C. Hassell, P. Collins & H. Gibbs. (2006). Migration routes of waders which spend the non-breeding season in Australia. *Stilt*. 50:135-157.
- Morgan, D.L., Ebner, B.C., Allen, M.G., Gleiss, A.C., Beatty, S.J. and Whitty, J.M. (2017). Habitat use and site fidelity of neonate and juvenile green sawfish *Pristis zijsron* in a nursery area in Western Australia. *Endangered Species Research*, 34, pp.235-249.
- Morris, K. (1990). Dampier Archipelago Nature Reserves. Management Plan 1990-2000. Management Plan No 18. Department of Conservation and Land Management.
- MScience. (2018). Marine habitat mapping. Dampier and Cape Lambert 2017. Report prepared for Rio Tinto.
- Parra, G.J., & M. Jedensjö. (2013). Stomach contents of Australian snubfin (*Orcaella heinsohni*) and Indo-Pacific humpback dolphins (*Sousa chinensis*). *Marine Mammal Science*. 30:1184-1198.
- Pendoley Environmental. (2019). Perdaman Urea project: Marine Fauna Desktop Assessment. Prepared for Cardni Inc.
- Peeverell, S. C. (2008). Sawfish (Pristidae) of the Gulf of Carpentaria, Queensland, Australia. School of Marine Biology, James Cook University.
- Phillips, N., Chaplin, J. A., Morgan, D. L. & Peeverell, S. C. (2011). Population genetic structure and genetic diversity of three critically endangered *Pristis* sawfishes in Australian waters. *Marine Biology* 158, 903–915.
- Phillips, N. (2012). Conservation genetics of *Pristis* sawfishes in Australian waters. PhD Thesis. Murdoch University. 247 pp.

- Poulakis, G.R., Stevens, P.W., Timmers, A.A., Stafford, C.J., Curtis, C., Tringali, M.D and Bakenhaster, M.D. (2010). Distribution, habitat use, and movements of juvenile smalltooth sawfish, *Pristis pectinate*, in the Charlotte Harbor estuarine system, Florida. Florida Fish and Wildlife Conservation Commission.
- Prince, R.I.T. (1993). Western Australian Marine Turtle Conservation Project: An Outline of Scope and an Invitation to Participate. *Marine Turtle Newsletter* 60:8-14.
- Raudino, H.C., Hunt, T.N and Waples, K.A. (2018). Records of Australian humpback dolphins (*Sousa sahalensis*) from an offshore island group in Western Australia. *Marine Biodiversity Records* (2018) 11:14 <https://doi.org/10.1186/s41200-018-0147-0>.
- Smith, J., Brown, A.M., Salgado Kent, C., Marley, S., Simon, J.A., Thiele, D., Bedjer, L., Erbe, C and Chabanne, D. (2017). Relative abundance, population genetic structure and passive acoustic monitoring of Australian snubfin and humpback dolphins in regions within the Kimberley. Report of Project 1.2.4 prepared for the Kimberley marine Research Program. Final Report. Project 1.2.4.
- Stevens, J. D., Pillans, R. D. & Salini, J. P. (2005). Conservation assessment of *Glyphis glyphis* (spartooth shark), *Glyphis garicki* (northern river shark), *Pristis microdon* (freshwater sawfish) and *Pristis zijsron* (green sawfish). Report to Department of Environment and Heritage. Canberra. Australia. 84 pp. Available on the internet at: <http://www.environment.gov.au/resource/conservation-assessment-glyphis-sp-spartooth-shark-glyphis-sp-cnorthern-river-shark>.
- Stevens, J.D., Simpfendorfer, C.A., Pillans, R.D., McAuley, R.B. (2008). Spatial Distribution and habitat utilisation of sawfish (*Pristis* spp) in relation to fishing in northern Australia. Report prepared for Department of the Environment, Water, Heritage and the Arts.
- Thorburn, D.C., Morgan, D.L., Rowland, A.J and Gill, H.S. (2007). Freshwater Sawfish *Pristis microdon* Latham, 1794 (Chondrichthyes: Pristidae) in the Kimberley region of Western Australia. *Zootaxa* 1471: 27-41.
- Thorburn, D.C., Morgan, D.L., Rowland, A.J., Gill, H.S. and Palling. (2008). Life history notes of the critically endangered dwarf sawfish, *Pristis clavata*, Garman 1906 from the Kimberley region of Western Australia. *Environmental Biology of fishes* 83: 139-145.
- Threatened Species Scientific Committee (TSSC). (2015). Conservation Advice *Megaptera novaengliae* humpback whale. Canberra: Department of the Environment. Available from: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/38-conservation-advice-10102015.pdf>. In effect under the EPBC Act from 01-Oct-2015.
- Threatened Species Scientific Committee (TSSC). (2016). Conservation Advice *Calidris canutus* Red Knot. Canberra: Department of the Environment. Available from: [855 - Conservation Advice *Calidris canutus* - Red knot - approved 5 May 2016 \(environment.gov.au\)](http://www.environment.gov.au/biodiversity/threatened/species/pubs/38-conservation-advice-10102015.pdf). In effect under the EPBC Act from 05-May-2016.
- Waayers, D., Mau, R., Mueller, A., Smith, J and Pet-Soede, L. (2014). A review of the spatial distribution of marine turtle nesting and foraging areas in Western Australia. Proceedings of the Second Australian and Second Australian Marine Turtle Symposia. Perth 25-27.
- Whiting, S., Tucker, T., Pendoley, K., Mitchell, N., Bentley, B., Berry, O., FitzSimmons, N. (2018). Final Report of Project 1.2.2 prepared for the Kimberley Marine Research Program, Western Australian Marine Science Institution, Perth, Western Australia, 146 pp.

- Wilson, B. (2013). The biogeography of the Australian North West Shelf: Environmental Change and Life's Response. First edition. San Diego, CA. Elsevier.
- Woodside. (2018). Scarborough Project Nearshore Component. Referral Supplementary Report Part A.
- Worley Parsons. (2009a). Benthic Habitat Report. Dampier Marine Service Facility. Prepared for Dampier Port Authority. Perth, WA.
- Worley Parsons. (2009b). Dampier Marine Services Facility. Preliminary site investigation sampling and analysis plan implementation report. Prepared for Dampier Port Authority. Perth, WA.