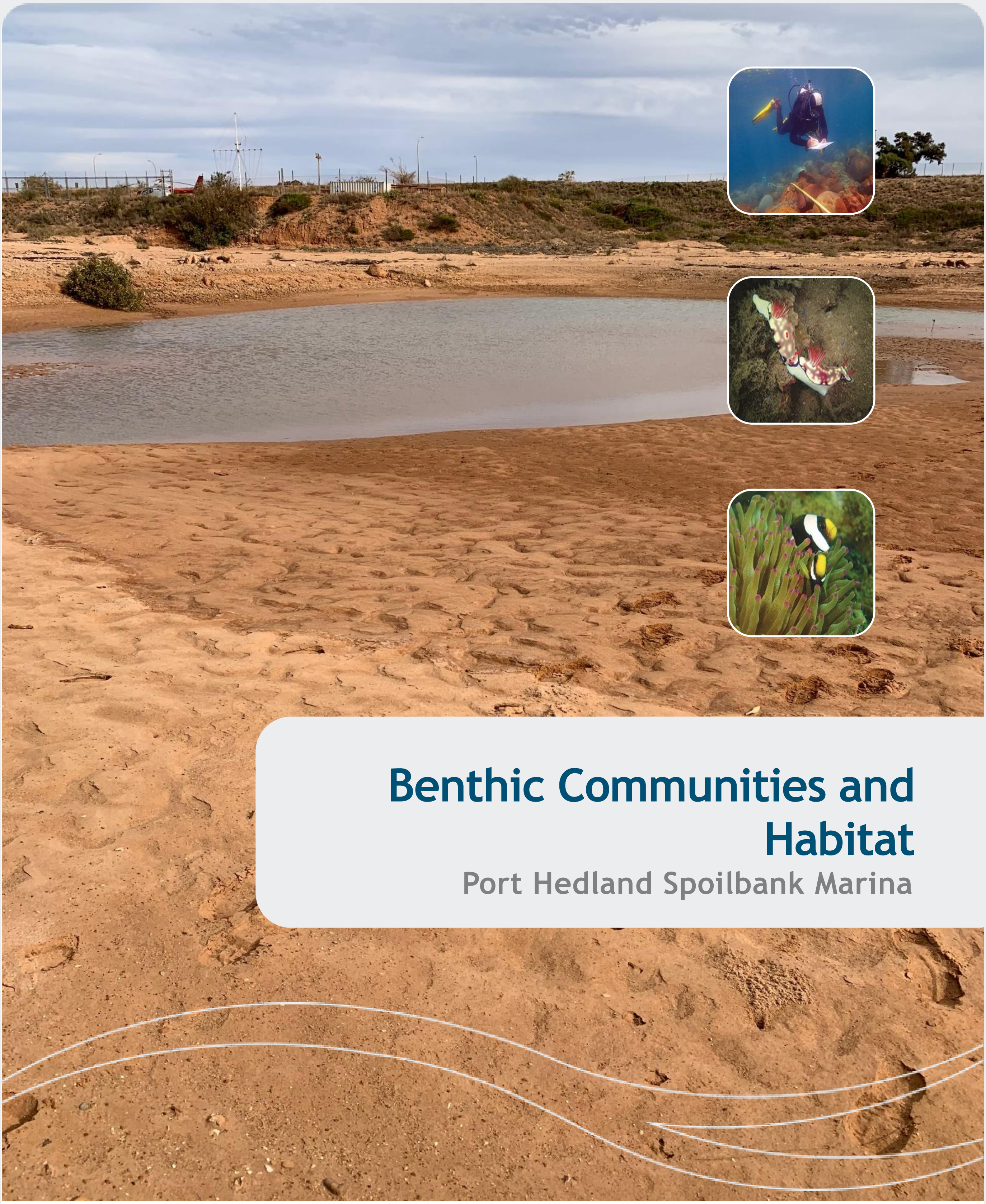


Benthic Communities and Habitat

Port Hedland Spoilbank Marina

CLIENT: Department of Transport

STATUS: E **REPORT No.:** R190211

ISSUE DATE: 09 Dec 2019

O2 MARINE

TEAL SOLUTIONS
environmental advisory

Important Note

This report and all its components (including images, audio, video, text) is copyright. Apart from fair dealing for the purposes of private study, research, criticism or review as permitted under the Copyright Act 1968, no part may be reproduced, copied, transmitted in any form or by any means (electronic, mechanical or graphic) without the prior written permission of O2 Marine and Teal Solutions.

This report has been prepared by O2 Marine in collaboration with Teal Solutions for the sole use of the **Department of Transport** (herein, ‘the client’), for a specific site (herein ‘the site’, the specific purpose specified in Section 1 of this report (herein ‘the purpose’). This report is strictly limited for use by the client, to the purpose and site and may not be used for any other purposes.

Third parties, excluding regulatory agencies assessing an application in relation to the purpose, may not rely on this report. O2 Marine and Teal Solutions waives all liability to any third-party loss, damage, liability or claim arising out of or incidental to a third-party publishing, using or relying on the facts, content, opinions or subject matter contained in this report.

O2 Marine and Teal Solution waives all responsibility for loss or damage where the accuracy and effectiveness of information provided by the Client or other third parties was inaccurate or not up to date and was relied upon, wholly or in part in reporting.

WA Marine Pty Ltd t/as O2 Marine

ACN 168 014 819

Originating Office – Southwest

Suite 5, 18 Griffin Drive, Dunsborough WA 6281

T 1300 739 447 | info@o2marine.com.au

Version Register

Version	Status	Author	Reviewer	Change from Previous Version	Authorised for Release (signed and dated)
Draft	A	C Del Deo	B Hegge		C Lane
Rev B	B	C Del Deo	B Hegge		
Rev C	C	C Del Deo	B Hegge		
Rev D	D	C Del Deo	M Spencer		B Hegge
Rev E	E	C Del Deo	M Spencer		B Hegge

Transmission Register

Controlled copies of this document are issued to the persons/companies listed below. Any copy of this report held by persons not listed in this register is deemed uncontrolled. Updated versions of this report if issued will be released to all parties listed below via the email address listed.

Name	Email Address
Bradford Jason	Jason.Bradford@transport.wa.gov.au
Matthew Spence	Matthew.Spense@transport.wa.gov.au

Acronyms and Abbreviations

Acronyms/Abbreviation	Description
BCH	Benthic Communities and Habitats
CALM	Conservation and Land Management
DSN	Dredging Science Node
EIA	Environmental Impact Assessment
EPA	Environmental Protection Authority
GIS	Geographic information system
ha	Hectares
km	kilometres
LAT	Lowest Astronomical Tide
LAU	Local assessment unit
m	Meter
m3	Cubic Meter
Pty Ltd	Proprietary Limited
WA	Western Australia
WAMSI	Western Australian Marine Science Institution

Table of Contents

Figures

Tables

Appendices

1. Introduction

1.1. Background

The Town of Port Hedland, together with LandCorp and the Pilbara Development Commission, are planning for the development of a marina in Port Hedland. The Spoilbank Marina (the Marina) will be located on the western side of the Spoilbank, adjacent to the Port Hedland Yacht Club and will include a four-lane boat ramp, up to 80 boat pens and a ~1 km channel to provide access to the Port Hedland Outer Channel (Figure 1-1).

The Department of Transport (DoT) are coordinating the design and environmental referral for the proposed marina. Teal Solutions, together with O2 Marine (Teal/O2), have been engaged to undertake the following work elements:

1. Sediment Quality Investigation;
2. Benthic Communities & Habitat (BCH) Survey (including cumulative loss assessment);
3. Prepare a Dredge and Disposal Management Plan; and
4. Develop a Marine Environmental Quality Plan.

These work elements will be used to assist the DoT prepare an environmental impact assessment and project referral to the Environmental Protection Authority (EPA).

This document presents the results of the Benthic Communities and Habitat Survey.

1.2. Project Description

The Port Hedland Spoilbank Marina development (the Marina) is located on Lot 5751 and Lot 5550 on a site commonly known as the 'Spoilbank' (Town of Port Hedland 2019). The Spoilbank is an artificial coastal landform created in the late-1960s/early-1970s from the disposal of material dredged from Port Hedland's inner harbour and shipping channel. The Project will replace the existing Richardson Street boat ramp (which will be closed) and redirect boating activities away from the commercial operations of Port Hedland's inner harbour and navigation channel.

The Marina will include a four lane boat ramps, 80 boat pens, 208 trailers parking, 86 parking bays, dry dock area for commercial vessels, public and pen holder amenities, public open space, and recreation and event space (Town of Port Hedland 2019). The concept design is presented in Table 1-1 and Figure 1-1.

Table 1-1 Summary of the Proposal

Port Hedland Spoilbank Marina	
Proponent Name	Department of Transport (WA)
Short Description	Construction of the Port Hedland Spoilbank Marina includes the following works[1]: • Dry-land excavation (332,000 m^3) of the marina basin (5.7 ha) to a design depth -2 m CD (Chart Datum) • Dredging (108,500 m^3) of access channel (2.75 ha) to a design depth of -2 m CD • Dredging (217,000 m^3) to -2 m CD to enable placement of footings for breakwaters and revetment wall (4.5 ha) structures • Excavation of sand trap (6.9 ha; 100,000 m^3) to the north of the Marina entrance • Construction of breakwaters and revetment walls (sourced from local quarries) • Disposal of all dredge material to land adjacent to the Marina as fill material to raise the finished ground level to +10 m CD prior to landscaping Ongoing management and maintenance of the Marina will also be required.

[1] *The concept design for the Marina is still under development and these quantities are subject to change*

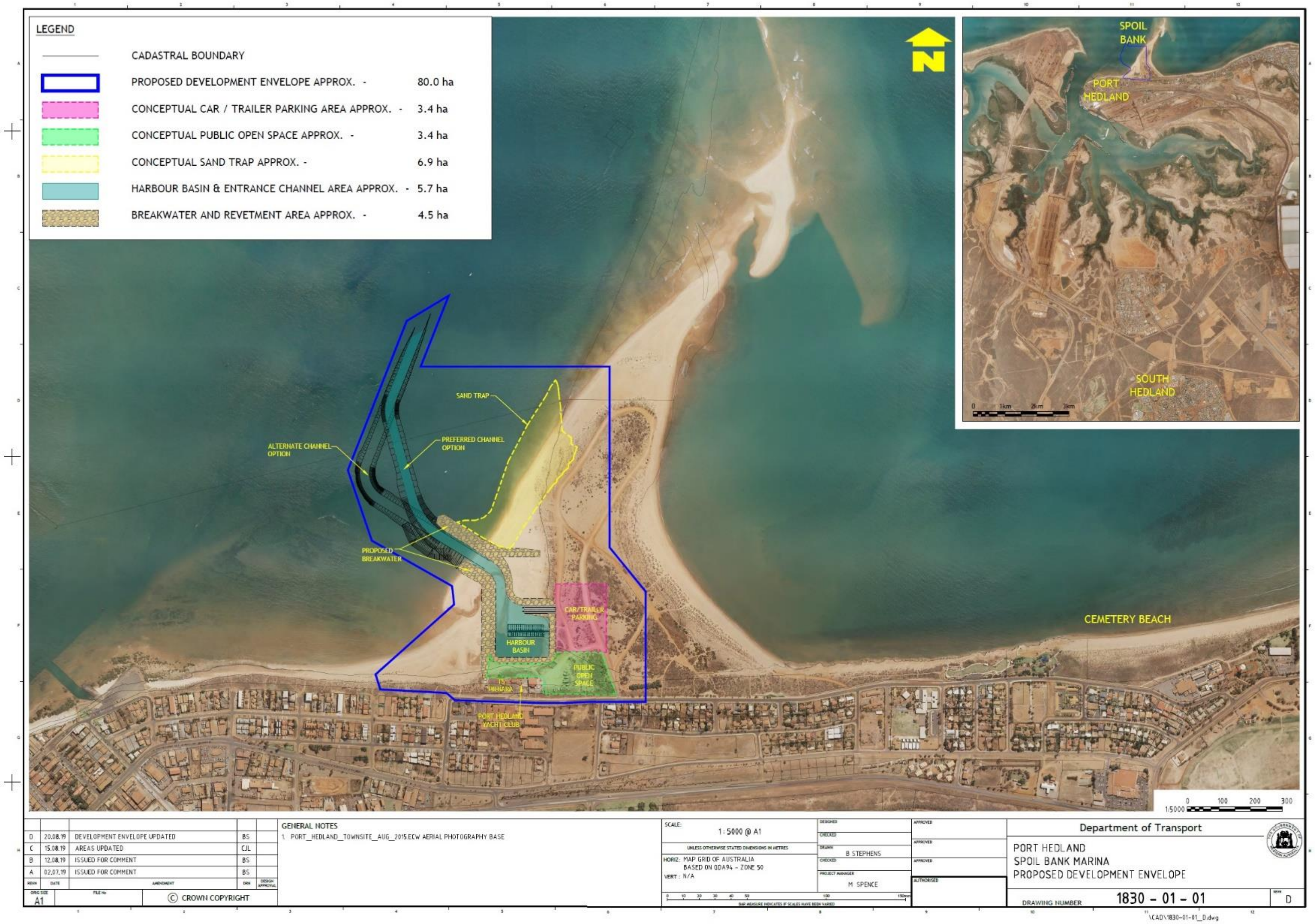


Figure 1-1 Spoilbank Marina concept design

1.3. Scope and Objectives

This report presents a description of the subtidal Benthic Habitat Communities (BCH) of the project area based on a desktop review and targeted site survey. The Report provides a basis for the BCH cumulative loss assessment and includes:

- Definition of the Local Assessment Unit (LAU)
- Summary of field methods used for validation and ground truthing;
- Characterisation of the subtidal BCH across the LAU;
- Detailed BCH map of the area immediately adjacent to the proposed Marina; and
- Review of any relevant tenure, conservation, ecological or social values relating to the BCH of the project area.

1.4. Legislation and Guidelines

This study has been aligned with relevant state and federal legislation and technical guidance relevant to BCH in the Project area, including:

- Commonwealth Environmental Protection and Biodiversity Act 1999;
- Western Australian Environmental Protection Act 1986 (EP Act);
- Western Australian Biodiversity Conservation Act 2016; and
- Western Australian Conservation and Land Management Act 1982.

The EPA provides guidance regarding the Environmental Impact Assessment process which includes the definition of environmental principles, factors and associated objectives (Statement of Environmental Principles, Factors and Objectives EPA 2018) as the basis for assessing whether a proposal's impact on the environment will be considered acceptable.

1.4.1. Environmental Principles

The object of the EP Act is to protect the environment of the State and identifies five environmental Principles. The third Principle notes that 'the conservation of biological diversity and ecological integrity should be a fundamental consideration' and this is directly relevant for the assessment of subtidal BCH impacts.

1.4.2. Environmental Factors and Objectives

The EPA has defined 13 environmental factors which are separated into five themes: Sea, Land, Water, Air and People. The environmental factors define those parts of the environment that may be impacted by a proposal. For each environmental factor, the EPA defines an environmental objective and will provide advice on whether these objectives may or may not be met for each factor when considering the impacts of a proposal. The environmental factor for 'benthic communities and habitats' is a key factor for the Marina proposal and the EPA's objective for this factor is 'to protect benthic communities and habitats so that biological diversity and ecological integrity are maintained'. The EPA have issued a number of guidelines relating to the consideration of BCH impacts, including:

- Technical Guidance – Protection of Benthic Communities and Habitats (EPA 2016a); Environmental Factor Guideline – Benthic Communities and Habitats (EPA 2016b); and
- Technical Guidance – Environmental Impact Assessment of Marine Dredging Proposals (EPA 2016c).

1.4.3. Local Assessment Unit (LAU)

The Local Assessment Unit (LAU) is the area within which to cumulative losses of Benthic Habitat Communities are calculate in accordance with the EPA's guidelines (EPA 2016b). The size and dimensions of the LAU are determined on a case-by-case basis and should take into account aspects of the local marine environment (EPA 2016a). A Project specific LAU was defined in accordance with EPA guidance to assess the loss of BCH as part of the Benthic Communities and Habitat Survey Plan (O2M/Teal 2019) provided in Appendix A.

2. Existing Environment

2.1. Overview

Port Hedland is located on the Northwest Shelf of Australia approximately 190 km east-northeast of Karratha and 460 km Southwest of Broome. Port Hedland is in the North-West Shelf marine region and around the midpoint of the Pilbara coast (BHP 2011). The marine environment is connected to the wider Indo-Pacific biogeographic region through the Leeuwin and Holloway Currents (BHP 2011). The nearshore and inshore environments are characterised by low relief, medium to coarse-grained shell fragments, strong tidal currents and turbid waters. Exposed limestone outcrops have resulted in the development of protected embayments, wide salt flats and several offshore islands with associated reef communities. The closest marine conservation areas are the Rowley Shoals Marine Park (300 km offshore to the north) and Eighty Mile Beach Marine Park (100 km east).

2.2. Climate and Oceanography

The Wet Season (October to April) very hot, with average monthly maximum temperature of 36.1°C (Bureau of Meteorology, 2019). During the Dry Season (May to September) the average monthly maximum temperature is 28.8°C. North-westerly winds prevail during the Wet Season and a strong south-easterly wind regime dominates during the Dry Season. The mean annual rainfall is 318 mm of which 79% falls during the Wet Season and is typically associated with scattered thunderstorms frequent cyclone events, including moderate to severe events every 5 to 10 years which cause extreme event winds, waves, water levels, currents and sediment transport that can be significantly higher than during ambient conditions (Baird 2019).

The passage of thunderstorms can also result in water level surges and localised flooding. The Pilbara coastline is also the most cyclone-prone area within Australia. Since 1910, Port Hedland has been impacted by 49 cyclones which are often associated with elevated water levels, high wave energy and widespread flooding (BOM 2019a). The nearshore waters of Port Hedland range in temperature from ~30.1°C (in March) to ~23.2°C (in August) and generally have a low nutrient level (Seatemperature.org 2019).

Port Hedland experiences large, semi-diurnal tides with a Spring tide range of 7.9 m and a Neap tide range of 1.5 m. Flood tide currents have a maximum speed of 1.5 kn and flow in an easterly direction, ebb tides are directed to the north-west (PPA 2019).

2.3. Geomorphology

The Pilbara coast has a relatively wide continental shelf with a low relief slope between the shoreline and the edge of the shelf approximately 200 km offshore which has a water depth of ~150 m (RPS 2014 and Jones 1973). Across the coastal platform shallow sandbars, platforms, reefs and ridges are common. Occasional flooding causes the erosion and the dispersal of terrestrial sediment across the nearshore and the development of silty tidal flats (RPS Cooke Point Prelim Assessment).

2.4. Marine Water Quality

Waters within Port Hedland harbour and nearshore are typically well mixed (Halpern Glick Maunsell 1997). Substantial variation in water quality within the Harbour can occur following rainfall events and inflow from five shallow creek systems which discharge into the harbour (BHP 2011).

2.5. Benthic Communities and Habitats

Subtidal reef areas occur along the Port Hedland shoreline and are typically associated with low rocky cliffs and sandy beaches with rocky intertidal platforms. The low-profile reef areas support a mixed benthic community including hard corals, macroalgae, soft corals and other sessile filter feeding organisms classified in previous habitat mapping studies as mixed assemblage habitats (Figure **2-1** and Figure 2-2). The diversity and abundance of biota in these habitats is highly variable as these areas are occasional covered by sand due to seasonal changes in the metocean conditions and intermittent storm and cyclone events (BHP 2011).

The areas surrounding the Spoilbank is characterised by low profile reefs supporting hard coral, macroalgae and sponges, patches of very sparse sponges are also found on bare sediment substrate within the subtidal zone whereas the intertidal zone is manly composed of bare sediment or bare limestone (Figure 2-3).

The intertidal communities adjacent to Finucane Island predominantly composed of macroalgae and corals, with coral cover ~10% typically dominated by large bombies of Porites spp. with surrounding smaller colonies Dendrophyllidae and Faviidae corals (URS 2005, SKM 2011) (Figure 2-4). These shore-attached platforms are common in the nearshore area and support a range of biotic assemblages with different species distributions depending on the water depth across the intertidal zone (BHP 2011):

- Lower Intertidal — Mixed benthic primary producers (mainly macroalgae and hard corals) and other benthic invertebrates including echinoderms, molluscs and polychaetes. Serpulid worm casings are often prominent.

- Central Zone — Macroalgae (*Caulerpa*, *Halimeda*, *Neomeris* & *Sargassam* spp.) in submerged rock pools.

- Upper Intertidal— Predominantly turf algae on the flats and macroalgae in rivulets running perpendicular to the shoreline.

Seagrass patches from the nearshore have been recorded east of Cooke Point and north of Finucane Island. Seagrass in these areas are very sparse and comprised of only one species: *Halodule uninervis* (Worley Parsons 2012).

.

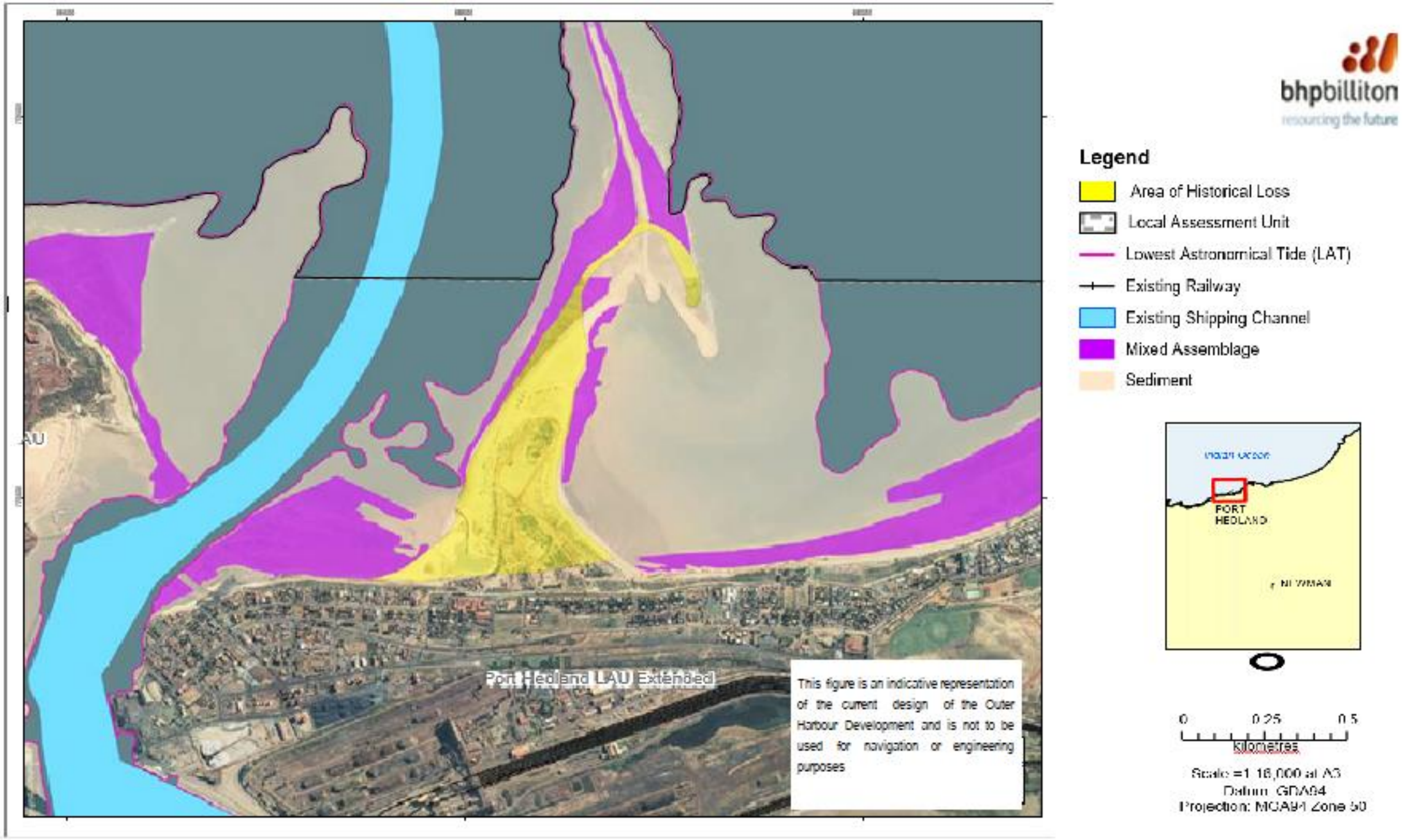


Figure 2-1 Benthic communities and habitats adjacent to the Spoilbank (Source: BHP 2011)

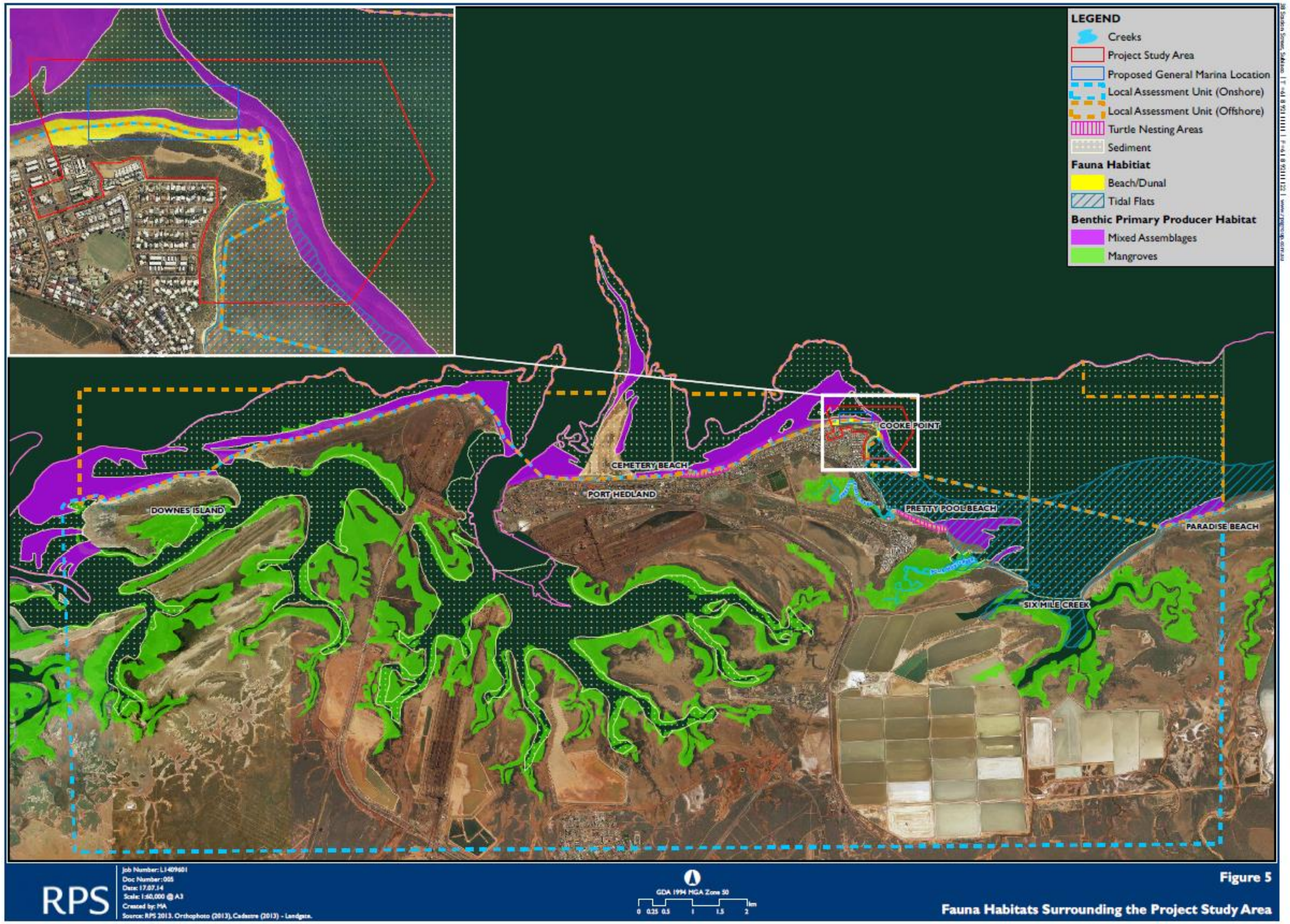


Figure 2-2 Port Hedland intertidal benthic habitat map (Source RPS 2014)

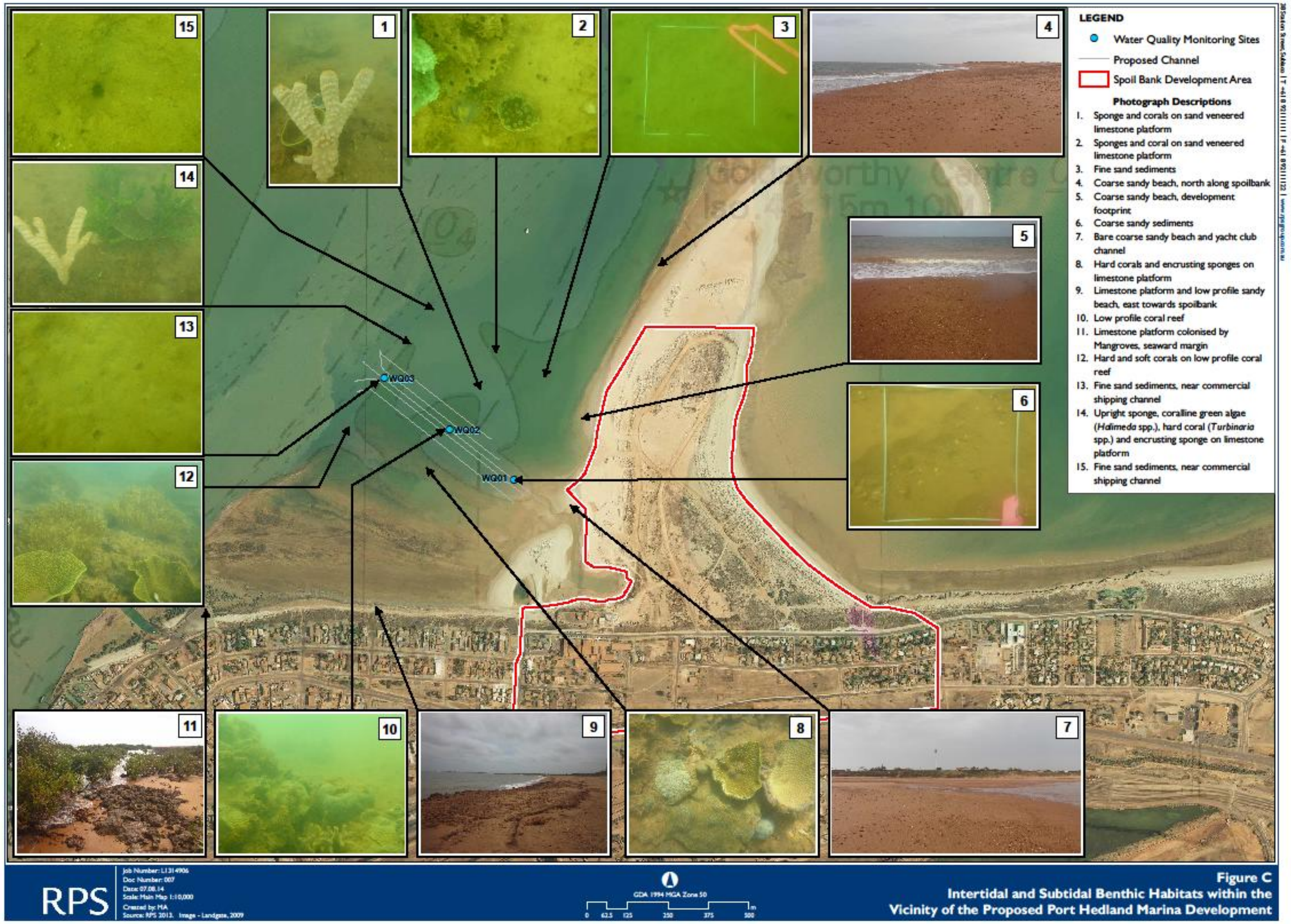


Figure 2-3 Intertidal and subtidal benthic habitats in proximity of the project area (Source RPS 2014)

Figure 6.8 Intertidal Habitat on Finucane Island Platform

Figure 2-4 Intertidal habitat on Finucane Island platform (Source SKM 2011)

3. Methods

3.1. Study Area

The benthic habitat mapping survey was undertaken across two areas: 1) Detailed Mapping Zone immediately adjacent to the proposed Spoilbank Marina (Figure 3-1); and 2) Local Assessment Unit (LAU) where broadscale groundtruthing was undertaken to validate the existing mapping (Figure 3-2).

The Detailed Mapping Zone is located immediately adjacent to the site of the proposed Marina and entrance channel and has an area of 115 ha (Figure 3-1). Mapping in this area was undertaken using a combination of side scan sonar and drop camera. This was supplemented with diver observations obtained during the sediment sampling survey[2].

Mapping across the Local Assessment Unite was based on a desktop review of previous habitat mapping which was groundtruthed with drop camera footage at 40 locations: 30 chosen to confirm the existing BCH classes, and 10 chosen at random locations across the LAU (these sites are labelled with 'R') (Figure 3-2).

---

[2] The sediment sampling survey is documented in a separate report

Figure 3-1 Mapping effort across the Detailed Mapping Zone

Figure 3-2 Local Assessment Unit and drop camera locations

3.2. Field Survey

The field survey was conducted from 23 to 30 September 2019 by qualified and experienced marine scientists from O2 Marine.

3.2.1. Drop Camera Survey

A Spot X Pro Squid camera system with real-time video streaming was used to record the drop camera footage(Figure 3-3a). At each location the seabed was surveyed until the benthic habitat could be determined with confidence. All footage was recorded to a mini SD card that was backed-up to a computer daily. At each drop camera location, the following data was manually recorded: coordinates (using Garmin GPSMAP 60CSx Handheld GPS Navigator time, water depth and any incidental observations.

Two primary benthic habitat types (mixed assemblage and bare sand) were defined for the classification of the drop camera footage to enable comparison to previous studies in the area (BHP 2011 and RPS 2014d). The mixed assemblage habitat included macroalgae, sponges and hard and soft corals. However, during the field survey several areas with ephemeral seagrass were observed and a new category of 'mixed assemblage with seagrass' was defined. The benthic habitat classifications for each drop camera site were entered directly into the Global Mapper V12 GIS in the field.

3.2.2. Side Scan Sonar Survey

The side scan sonar survey was undertaken using a dual channel 450 kHz Tritech Starfish 452F system (Figure 3-3b). This unit was operated through a topside control unit coupled to Scanline V2.1 acquisition software. Geographic positioning of the side scan sonar data was acquired using a Starfish GPS with an accuracy of ±2 m (GPS/NAVISTAR 2008). The side scan sonar was towed behind the vessel at a speed of ~4 kn and captured a swath width of four to five times the water depth. Coverage of the Detailed Mapping Zone was completed using series of parallel transects spaced ~40 m apart (Figure 3-1). The side scan sonar enables the capture of backscatter data which was groundtruthed using drop camera footing to validate the benthic features identified.

a) b)

Figure 3-3 Survey Equipment a) Spot X drop camera b) Starfish 450 Khz side scan sonar

3.3. Data Analysis

3.3.1. Drop Camera Footage

Drop camera footage was obtained from 30 locations across the Detailed Mapping Area and a further 40 locations across the LAU (Figure 3-1**Error! Reference source not found.** and Figure 3-2). This footage was reviewed to validate and update the BCH classification noted in the field. The validated BCH classifications were also used to assist with the classification of the sidescan sonar data across the Detailed Mapping Zone.

3.3.2. Side Scan Sonar

Acoustic images of the seabed were collected along 27 transects (totalling ~25 km) within the Detailed Mapping Zone (Figure 3-1). This data was analysed using Sonarwiz.7.2 software for the seabed characterisation process using a square window algorithm (Cochrane 2002). Habitat classes were then assigned using an acoustic supervised classification method (MESH 2009) based on the available drop camera imagery.

4. Results

4.1. Benthic Communities Habitat Classification

Six BCH sub-classes were identified during the field survey based on the relative species density and substrate (Table 4-1). To facilitate comparison with previous habitat mapping, these sub-classes were combined into three BCH classes. The 'Bare sand' and 'Mixed assemblage' classes were defined in previous mapping in the area (Figure **2-1** &Figure 2-2). Areas of ephemeral seagrass were observed in the present field survey and were classified as 'mix assemblage with seagrass'. In previous mapping this habitat type is likely to have been classified as 'mixed assemblage'[3]. The locations of these habitats across the Detailed Mapping area and LAU are shown in Figure 4-1 and Figure 4-2, respectively.

Table 4-1 BCH Classifications

BCH Class	Sub-class & Description	Example Image
Bare Substrate Comprises 90.5% of the LAU	**Bare sand - coarse** Coarse sand with no BCH or occasional isolated sparse macroalgae with traces of shell grit and rubbles.	 **Site BCH25**
	Bare sand - fine Fine sand/silt with no BCH or occasional isolated sparse macroalgae. Silt areas often bioturbated	 **Site BCH17**

[3] *Seagrass was not mapped on previous benthic habitat maps for this area (SKM 2011). However, the Marine Costal Intertidal Benthic Habitats Impact Assessment Report, page 14 (SKM 2011) describes two seagrass species, Thalassia hemprichii and Halophila uninervis, observed around the Finucane Island platform in low densities and of very limited areal coverage (less than or equivalent to 5 m2)'.*

BCH Class	Sub-class & Description	Example Image
Mixed assemblage Comprises 8.2% of the LAU	**Mixed assemblage – medium density** Low relief limestone reef and rubble substrate which supports medium density coral cover of diverse coral species, including *Faviidae, Mussidae, Portitidae*, and soft corals. Macroalgae, sponges and hydrozoan also present.	 **Mixed Assemblage at Spoilbank location Drop Camera Site DC04**
	Mixed assemblage - low density Flat rocky relief and rubble with low to very low cover of macroalgae, and sparse soft and hard corals, including *Faviidae, Mussidae and Turbinaria*. Generally observed close to ~~the~~ the coast in 1–5 m water depth	 **Site BCH3**
Mixed assemblage with seagrass Comprises 1.3% of the LAU	**Low density mixed assemblage with seagrass on sand** Flat substrate constituting either fine to coarse sands and occasional shell grit. Sparse Macroalgae, corals hydrozoan and sponge species are equally dispersed throughout this habitat although benthic cover is low occasional very sparse isolated leaves of *halodule sp*. seagrass was also observed at some locations.	 **Site BCH10**
	Low density mixed assemblage with very sparse seagrass on sand This habitat class occurs on patches of fine to coarse sands with sparse bioturbated bedforms. Seagrass (*Halodula* sp) present in very sparse groups (1–4 leaves). Scattered and Isolated macroalgae, and filter-feeders also occasionally present.	 **Site R32**

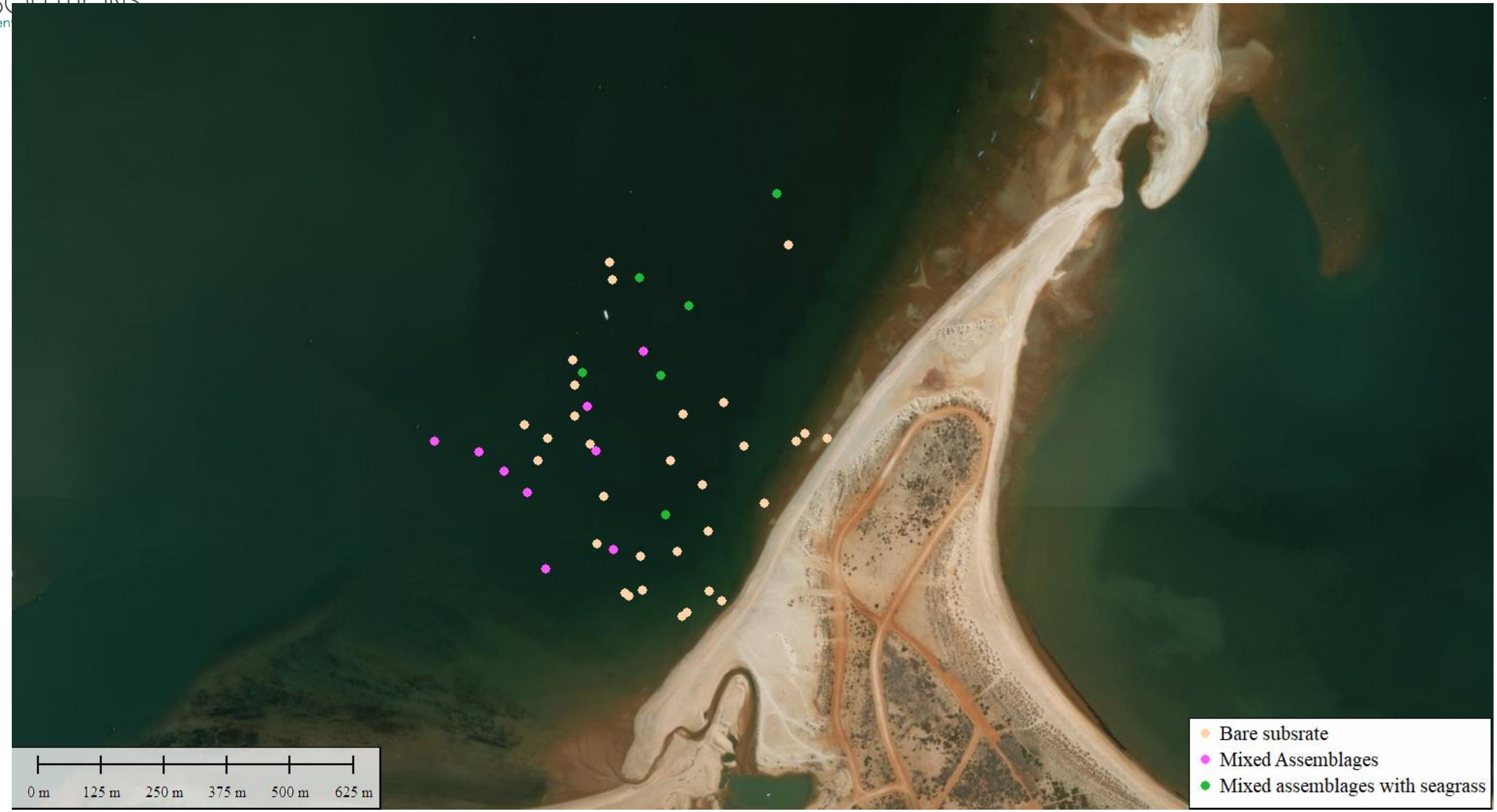


Figure 4-1 BCH classified from drop camera within the Detailed Mapping Zone

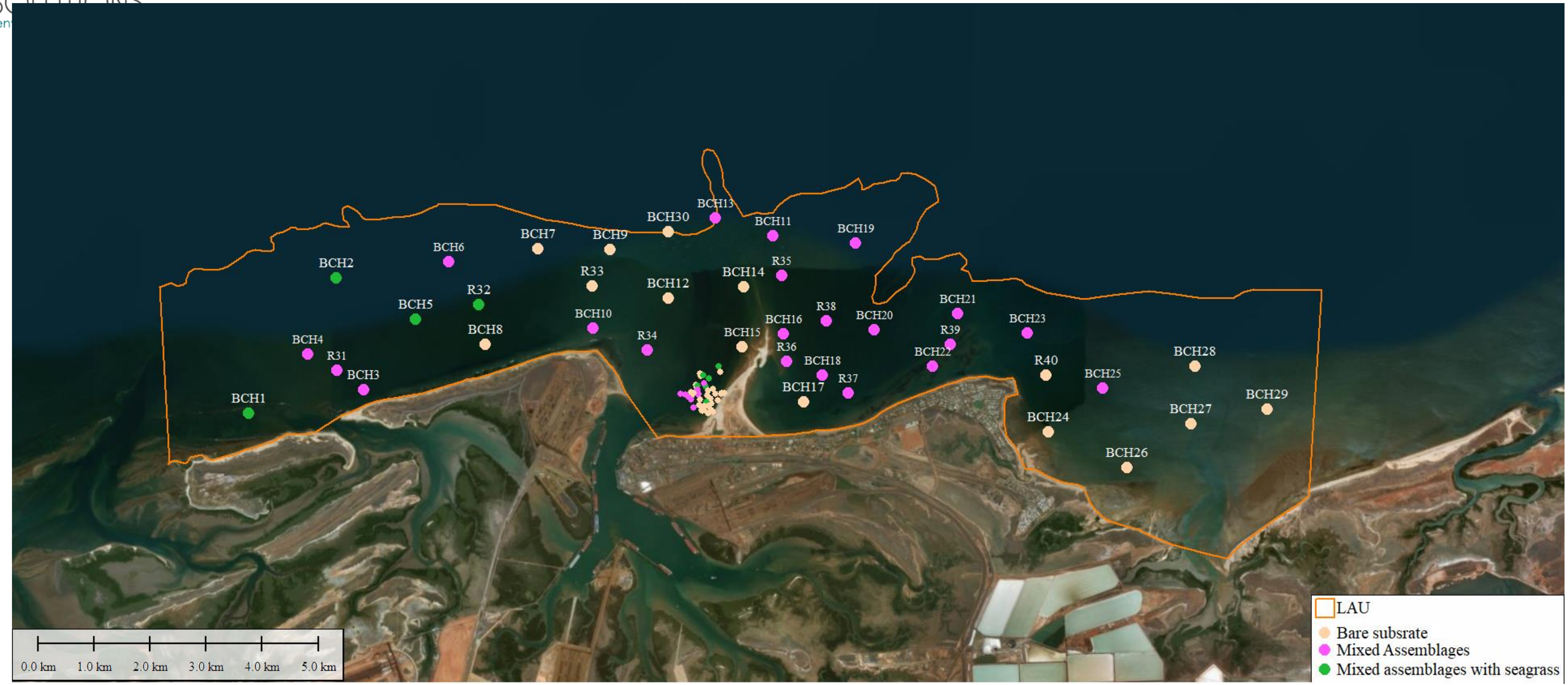


Figure 4-2 BCH classified from drop camera within the LAU

4.2. Habitat Mapping

Habitat mapping of the three BCH classes was completed for the Detailed Mapping Zone (Figure 4-3) and the LAU (Figure 4-4). The assumptions in generating these habitat maps are based on technical guidance provided in EPA (2016a, 2016b) and recommendations within documents published by the Western Australian Marine Science Institution Dredging Science Node (WAMSI DSN) and are outlined in Table 4-2.

Table 4-2 BCH Mapping Assumptions

Assumption	Application to Project
Mapping the area of habitat that supports, or has the potential to support, benthic communities (EPA 2016a).	Areas which support or have the potential to support different BCH types were primarily distinguished based on substrate type. BCH was always associated with hard moderate relief substrate such as rock or exposed limestone veneer.
Consideration of the uniformity (or heterogeneity) of biological communities (EPA 2016b).	The heterogeneity of BCH has been considered by grouping the community types which form the major components of the habitat.
The map should be produced with little regard for the relative quality of the benthic community (i.e. at the time of preparing the map), although should consider the functional ecological value of the BCH (EPA 2016a).	The three mapped BCH classes were derived from six sub-classes based on a consideration of the relative benthic cover of each BCH class. In the case of the 'Mixed Assemblage BCH, the relative dominance of the taxa is considered in the subclass, but not in the primary class to account for the fact that the BCH may have been at varying stages of recovery from natural effects at the time of preparing the map.
Identification of BCH that are not well represented locally and regionally (EPA 2016a).	All BCH classes identified during field surveys were considered to be well represented on both local and regional scales.
Differentiate between areas of habitat that are 'vegetated' or 'inhabited' by benthic communities and areas of habitat that are not (i.e. 'bare' or 'unvegetated' substrate) (EPA 2016a).	'Bare' areas were designated where benthic cover was absent or very sparse (<1%). Within the LAU, 'bare' areas were always associated with low relief, fine sand/silt bedform, often with evidence of bioturbation.
Consideration of how uncertainty associated with mapping BCH can be reduced (EPA 2016a).	Given the absence of any regionally significant BCH within the mapped area survey effort was focused on reducing uncertainty in areas where direct and indirect impacts are most likely to occur. This will enable accurate loss assessment of subtidal BCH in the context of BCH types which are known to be well represented both locally and regionally.
Characterise historical seagrass distribution as potential seagrass habitat by overlaying all seagrass observations to produce a layer which defines the potential habitat in which low biomass seagrass can grow (McMahon *et al.* 2017).	Only low biomass seagrass areas was observed within the mapped area of LAU. Seagrass was always observed in sparse to low densities as a sub-dominant taxa to either macroalgae or filter feeder species. Therefore, all areas mapped as the 'Mixed Assemblage BCH could possibly support seagrass regardless of whether it was observed during the survey.

Figure 4-3 Benthic habitats within the Detailed Mapping Zone

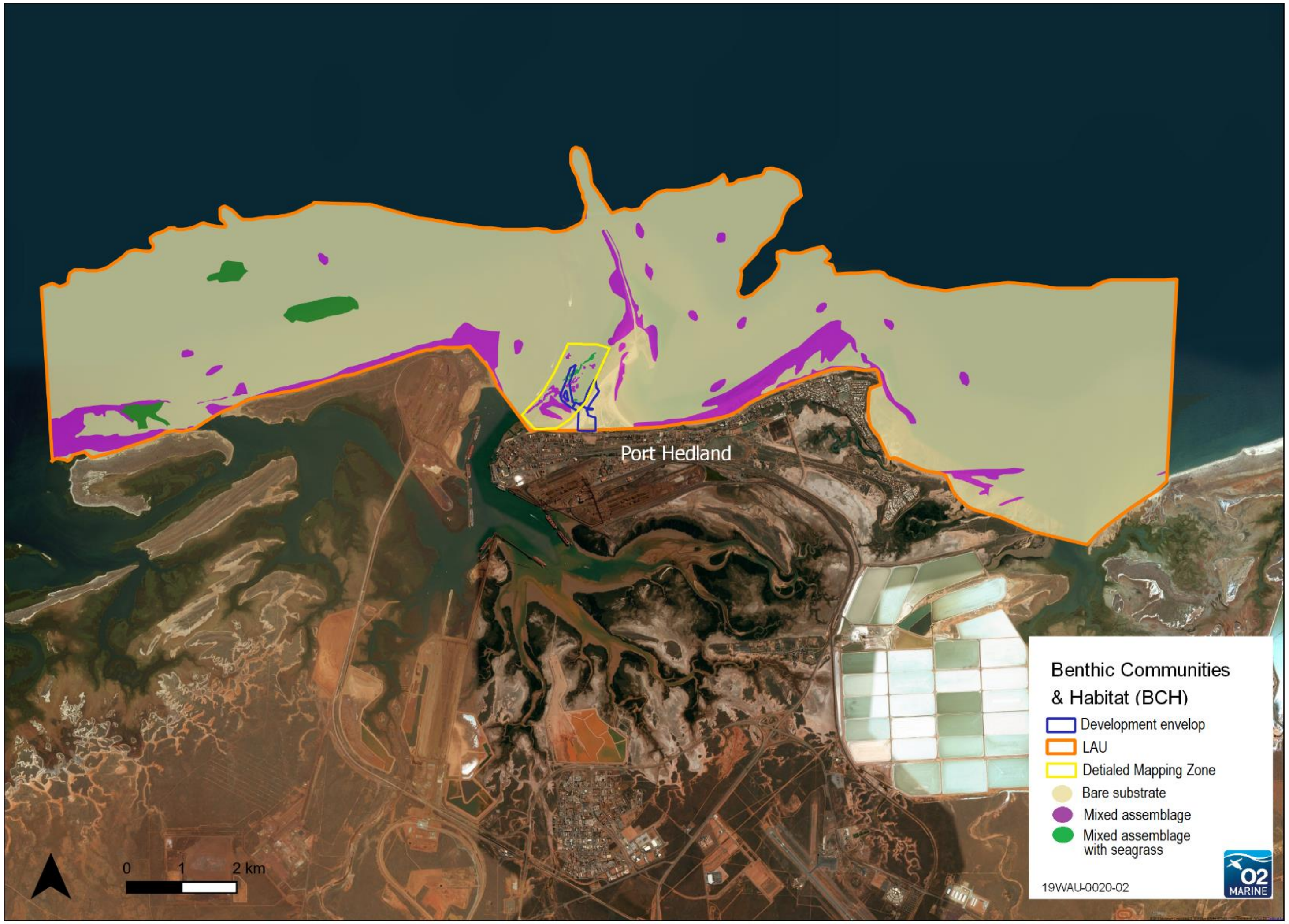


Figure 4-4 Benthic habitats across the LAU

Over 90% of the habitat across the LAU was bare sand habitat. Small areas of low to medium-density mixed assemblage habitat were typically found on consolidated or semi-consolidated substrate generally in shallow water and/or in the intertidal zone and mostly along the shoreline (Table 4-3). Areas of mixed assemblage with seagrass were found in slightly deeper water (>3 m) generally in areas with coarse sediment substrate. In the vicinity of the Marina mixed assemblage habitat were present on low profile reefs and patches of very sparse ephemeral seagrass on sand were also observed.

Table 4-3 BCH coverage across the LAU

Class	Cover (ha)	%
Bare sand	6413.7	90.4
Mixed assemblage	587.9	8.3
Mixed assemblage with seagrass	90.0	1.3

5. Functional Ecological Value

The functional ecological value of the three benthic habitats are described below.

5.1. Bare Sand

The bare sand habitat can support microphytobenthic algal communities and benthic infauna. It is also likely that some areas of bare or unvegetated substrate will support more complex ephemeral BCH at different times, particularly in shallow water areas where the benthos is constantly changing in response to physical disturbance from wave mobilisation of sediments, storm events and sedimentation following large runoff events.

5.2. Mixed Assemblage

The mixed assemblage benthic habitat includes corals, macroalgae, sponges and other species of filter-feeders present with different percentage coverage. Corals are particularly important as benthic primary producer, providing habitat and a food source for a wide variety of marine species (Moberg and Folke 1999), moreover corals perform an important role as nutrient recycler. The associated macroalgae are also an important component of tropical reef ecosystems as they contribute to the productivity of a system as a food source, provide habitat for a range of economically and ecologically important species, contribute to local sediments and play an important role in the nutrient cycle from decomposition (Kendrick & Olsen 2017). The mixed assemblage habitat were found predominantly on hard substrate along the shoreline and represented less than 9% of the LAU and generally had a low level of biodiversity. Therefore the likely contribution of these coral communities to local and regional ecosystem is considered to be limited.

5.3. Mixed assemblage with seagrass

The mixed assemblage with seagrass benthic habitat includes mixed communities with sparse seagrass mixed at corals, macroalgae and other filter feeders, as well as sparse to very sparse seagrass on bare sand substrate. Seagrasses are known to provide an important role within the marine ecosystem providing carbon storage, filtering nutrients and particles from the water column, stabilising sediments and providing high primary productivity (McKenzie et al. 2006). Seagrass can also provide an important source of foraging habitat for dugong, turtles and commercially fisheries, such as prawns. However, the limited distribution and low cover of seagrasses observed within the LAU suggests that their contribution to ecosystem services in a regional context is limited.

6. Conservation and Social Value

The proposed Marina will be located in State Waters within the harbour limits of the Port Hedland port. The conservation of ecologically significant marine, estuarine or terrestrial ecosystems is managed through the Conservation and Land Management Act. The subtidal habitats within the Project area have not been identified as containing significant ecological communities requiring protection through the introduction of marine conservation reserves. The nearest Marine Park is the Eighty Mile Beach Marine Park, which is located ~ 100 km east of Port Hedland. No Listed Threatened Ecological Communities are known to occur within the LAU.

7. Conclusions

Three benthic habitats were observed in the vicinity of the Project area:

- Bare Sand;
- Mixed assemblage; and
- Mixed assemblage with seagrass.

The benthic cover was generally sparse to low across more than 95% of the study area. All habitats identified within LAU are considered to be widespread across the turbid nearshore environments of the Pilbara region and as such do not represent habitats of particular regional or conservation significance.

Sparse seagrass communities were observed in the vicinity of the Project area, and in the LAU to the west. Corals were also observed in proximity of the project area.

8. References

BHP Billiton. 2011. Proposed Outer Harbour Development, Port Hedland: Public Environmental Review / Draft Environmental Impact Statement. Perth: Western Australia.

Bureau of Meterology (BOM). 2019. Climate Statistics for Port Hedland. Accessed on 10th of October 2019. http://www.bom.gov.au/climate/averages/tables/cw_004032.shtml

Bureau of Meterology (BOM). 2019a. Tropical Cyclones Affecting Port Hedland. Accessed on 10th of October 2019. http://www.bom.gov.au/cyclone/history/wa/pthed.shtml

Cardno. 2011. *Port Hedland Coastal Vulnerability Study*. Perth: Western Australia.

Cochrane, G.R., & Lafferty, K.D., 2002. Use of acoustic classification of sidescan sonar data for mapping benthic habitat in the Northern Channel Islands, California. Continental Shelf Research 22, 683-690.

Department of Environment 2006. *Pilbara Coastal Water Quality Consultation Outcomes — Environmental Values and Environmental Quality Objectives*, Department of Environment, Government of Western Australia, Marine Series Report No. 1.

Eliot I, Gozzard B, Eliot M, Stul T and McCormack G. 2013. *Geology, Geomorphology & Vulnerability of the Pilbara Coast*, *In the Shires of Ashburton, East Pilbara and Roebourne, and the Town of Port Hedland, Western Australia*. Damara WA Pty Ltd and Geological Survey of Western Australia, Innaloo, Western Australia.

EPA 2009. Environmental Assessment Guidelines No. 3: Protection of Environmental Factors Benthic Primary Producer Habitats in Western Australia's Marine Environment. Environmental Protection Authority, Perth, Western Australia.

Global Positioning System (GPS) 2008. Global Positioning System Standard Positioning Service Performance Standard , 4th Edition September 2008

Jones, H.A., 1973. Marine geology of the northwest Australian continental shelf. Bur. Min.Res. Geol. Geophys., Bull., 136, 102pp.

Kendrick, G and Olsen, Y. 2017. Characterising macroalgal communities of the Pilbara. Macrophyte interactions. CSIRO.

McKenzie, L.J., Erftemeijer, P and Coles, R. 2006. Seagrass ecosystems of Papua.The Ecology of Papua (Volume I & II), Chapter:5.3 (Voll II). Periplus Editions (Singapore), pp. 800-823. Research Gate, https://www. reaserchgate.net/publication/283043957

Moberg, F and Folke, F. 1999. Ecological goods and services of coral reef ecosystems. Ecological Economics 29: 215-233.

O2 Marine/Teal 2019. Port Hedland Spoilbank Marina: Benthic Communities and Habitat Survey Plan. Report prepared for Department of Transport.

Pilbara Ports Authority. 2019. *Weather and Tides*. Accessed 10th of October 2019. https://www.pilbaraports.com.au/Port-of-Port-Hedland/Port-operations/Weather-and-tides

RPS. 2014. *Preliminary Environmental Assessment Report.* Cooke Point Marina, Port Hedland. RPS Environment and Planning

Seatemperature.org, 2019. Port Hedland average sea temperature https://www.seatemperature.org/australia-pacific/australia/port-hedland.htm

SKM. 2011. *Port Hedland Outer Harbour Development: Marine Costal Intertidal Benthic Habitats Impact Assessment. Report prepared for* BHP Billiton Iron Ore by Sinclair Knight Merz, Perth Western Australia, April 2011.

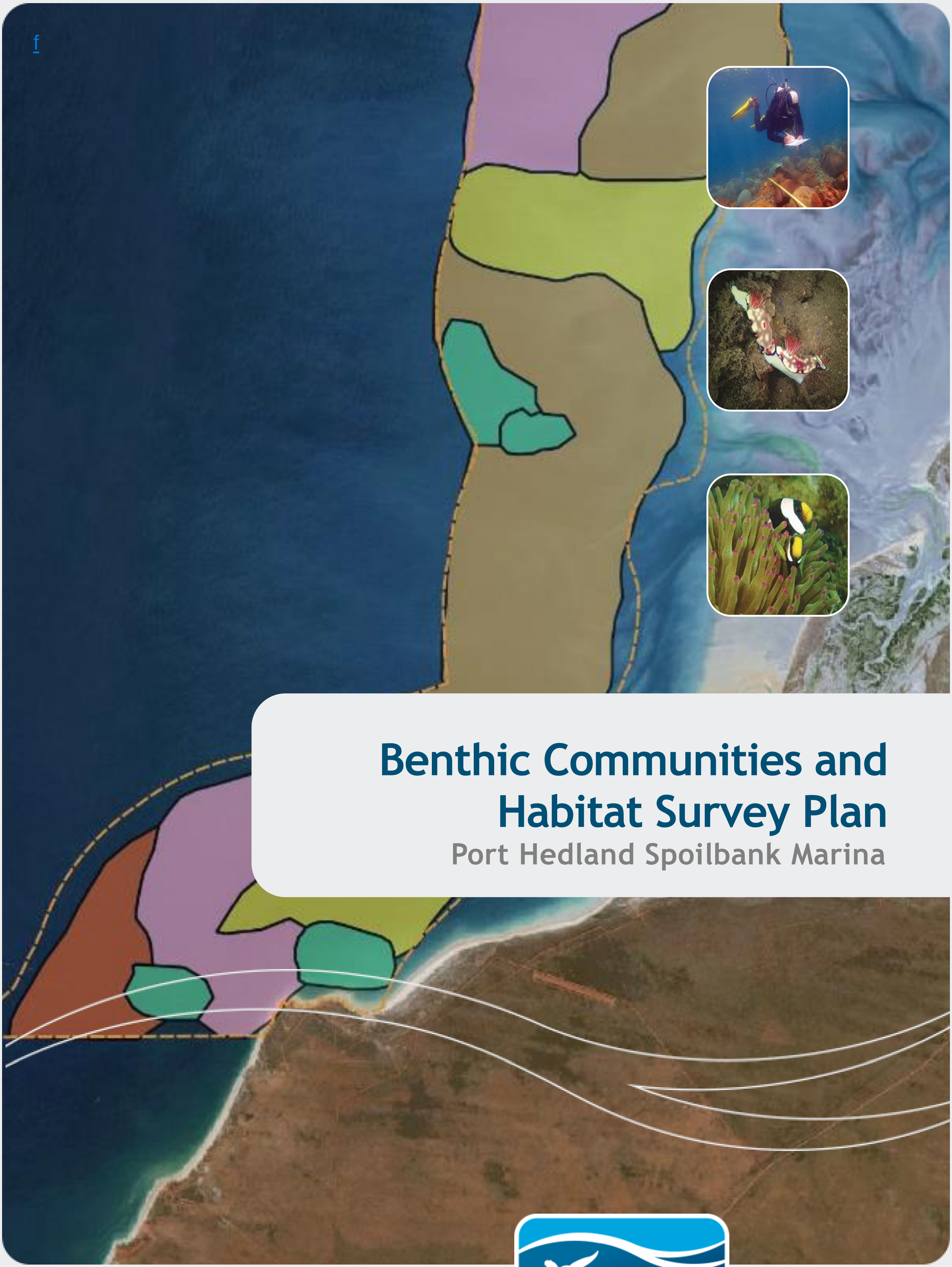
SKM 2009. *Port Hedland Outer Harbour Development: Spoil Ground Selection Study*. Report prepared for BHP Billiton Iron Ore by Sinclair Knight Merz, Perth Western Australia, July 2009.

Town of Port Hedland 2019. Draft Port Hedland Marina and Waterfront Masterplan. Town of Port Hedland 1 November 2019.

URS 2005. Maintenance Dredging Campaign: Environmental Monitoring 2004. Prepared for Port Hedland Port Authority

Appendix A Benthic Communities and Habitat Survey Plan (O2M/Teal 2019)

f



Benthic Communities and Habitat Survey Plan

Port Hedland Spoilbank Marina

CLIENT: Department of Transport

STATUS: Rev 0 **REPORT No.:** R190189

ISSUE DATE: 9/09/2019

Important Note

This report and all its components (including images, audio, video, text) is copyright. Apart from fair dealing for the purposes of private study, research, criticism or review as permitted under the Copyright Act 1968, no part may be reproduced, copied, transmitted in any form or by any means (electronic, mechanical or graphic) without the prior written permission of O2 Marine and Teal Solutions.

This report has been prepared for the sole use of the **Department of Transport** (herein, 'the client'), for a specific site (herein 'the site', the specific purpose specified in Section 1 of this report (herein 'the purpose'). This report is strictly limited for use by the client, to the purpose and site and may not be used for any other purposes.

Third parties, excluding regulatory agencies assessing an application in relation to the purpose, may not rely on this report. O2 Marine and Teal Solutions waive all liability to any third-party loss, damage, liability or claim arising out of or incidental to a third-party publishing, using or relying on the facts, content, opinions or subject matter contained in this report.

O2 Marine and Teal Solutions waive all responsibility for loss or damage where the accuracy and effectiveness of information provided by the Client or other third parties was inaccurate or not up to date and was relied upon, wholly or in part in reporting.

Report prepared on behalf of the Department of Transport by O2 Marine in collaboration with Teal Solutions

WA Marine Pty Ltd t/as O2 Marine
ACN 168 014 819
Originating Office – Fremantle
11 Mews Road Fremantle WA 6160
T 1300 739 447 | info@o2marine.com.au

Version Register

Version	Status	Author	Reviewer	Change from Previous Version	Authorised for Release (signed and dated)
Draft	A	J.Abbott	C.Del Deo	Minor Edits	
Final	0	C.Del Deo	Bruce Hegge		Bruce Hegge Chris Lane

Transmission Register

Controlled copies of this document are issued to the persons/companies listed below. Any copy of this report held by persons not listed in this register is deemed uncontrolled. Updated versions of this report if issued will be released to all parties listed below via the email address listed.

Name	Email Address
Bradford Jason	Jason.Bradford@transport.wa.gov.au
Matthew Spence	Matthew.Spence@transport.wa.gov.au

Table of Contents

Figures

Appendices

1. Introduction

1.1. Project Background

The Town of Port Hedland, together with LandCorp and the Pilbara Development Commission, are planning for the development of a marina in Port Hedland. A concept design has been developed for the Spoilbank Marina, to be located on the western side of the Spoilbank, adjacent to the Port Hedland Yacht Club (Figure 1-1). The Spoilbank Marina will include a four-lane boat ramp, up to 80 boat pens and a ~1 km channel to provide access to the Port Hedland Outer Channel (Figure 1-1). The Project will require dredging and onshore disposal of approximately 850,000 m^3 of material.

Figure 1-1 Proposed Spoilbank Marina Development in Port Hedland

The Department of Transport (DoT) are coordinating the design and environmental approvals application for the proposed marina. Teal Solutions, together with O2 Marine (Teal/O2), have been engaged to undertake the following work elements:

1. Sediment Quality Investigation;
2. Benthic Communities & Habitat (BCH) Survey (including cumulative loss assessment);
3. Development of a Dredge and Disposal Management Plan; and

4. Develop a Marine Environmental Quality Plan.

These work elements will be used to assist the DoT prepare an environmental impact assessment and project referral to the Environmental Protection Authority (EPA).

The present document outlines the methods to be used to undertake the Benthic Communities and Habitat Survey (including cumulative loss assessment).

1.2. Objectives

The objective of the Benthic Communities and Habitat Survey plan is to:

- Define the survey area that sufficiently represent the zone of potential impact for the development;
- Characterise the Local Assessment Unit (LAU) via desktop review studies;
- Outline the methods and equipment used to undertake the field surveys to validate the BCH in the LAU; and
- Outline the project deliverables for the BCH surveys.

2. Existing BCH Environment

Benthic communities are biological communities that inhabit the seabed and are important for primary or secondary production. Benthic habitats are areas of seabed that do or 'can' support these communities. The term 'seabed', when used in the context of the definition for BCH above, includes seabed substrates in the intertidal and subtidal zones of WA's coastal waters.

Several previous studies have been undertaken for both the marine and terrestrial environments associated with the proposed Port Hedland Marina which was to be located at the same site as the Spoilbank Marina, including: acid sulfate soils (RPS, 2014a), soil and sediment contamination assessment (RPS, 2014b), marine water quality (RPS, 2014c). Previous benthic habitat mapping investigations show that the area adjacent to the proposed Spoilbank Marina consists of mixed assemblage and bare sand (RPS, 2014d and BHP, 2011). The mixed assemblage included macroalgae, sponges and hard and soft corals (Figure 2-1 and Figure 2-2). It should be noted that while bare sand areas are relatively inconspicuous and lack three dimensional structure, they can be significant contributors to overall benthic primary productivity, and can provide habitat for short range endemic fauna (EPA 2016).

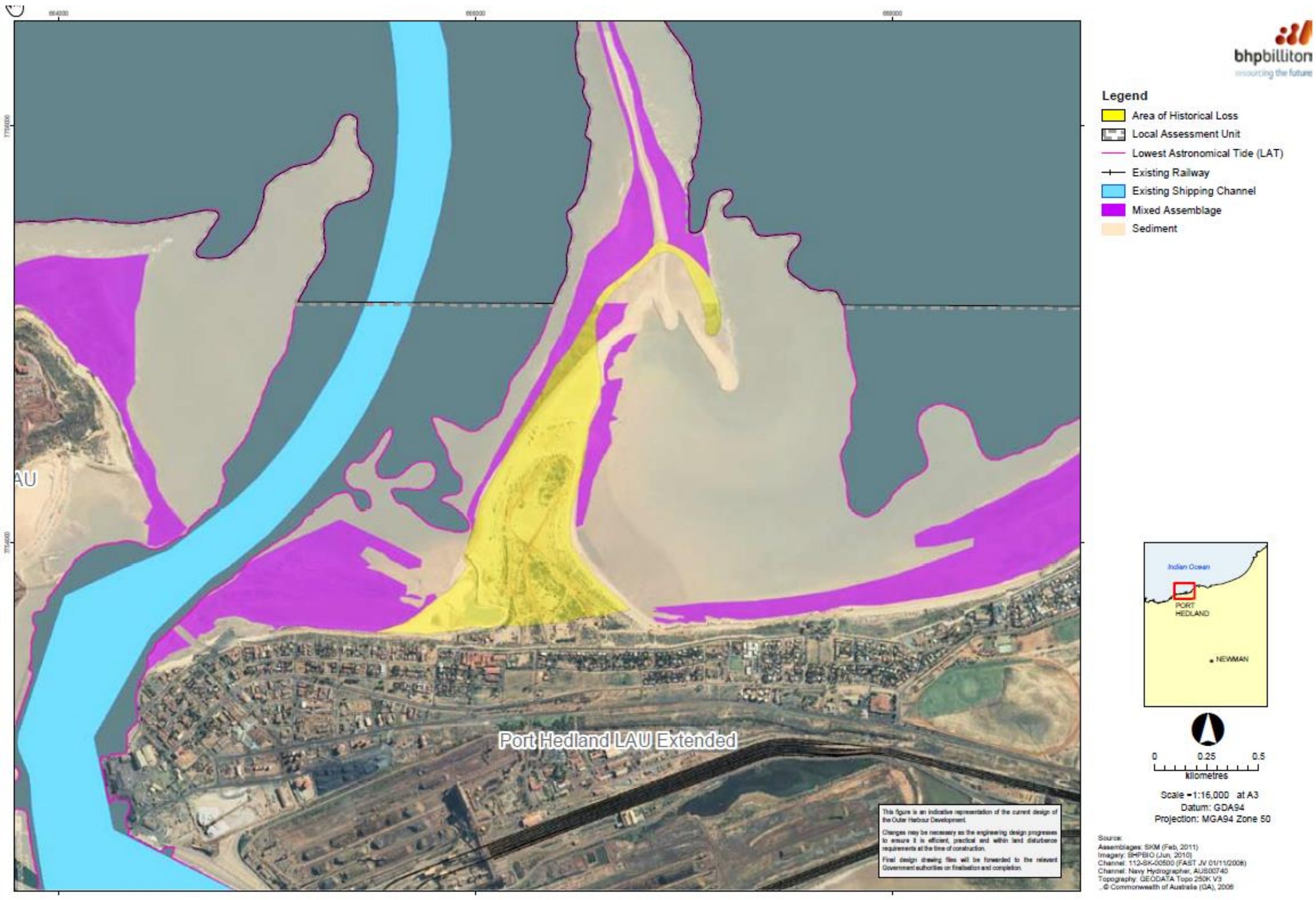


Figure 2-1 Benthic habitats mapped as part of the Outer Harbour investigations (BHP 2011)

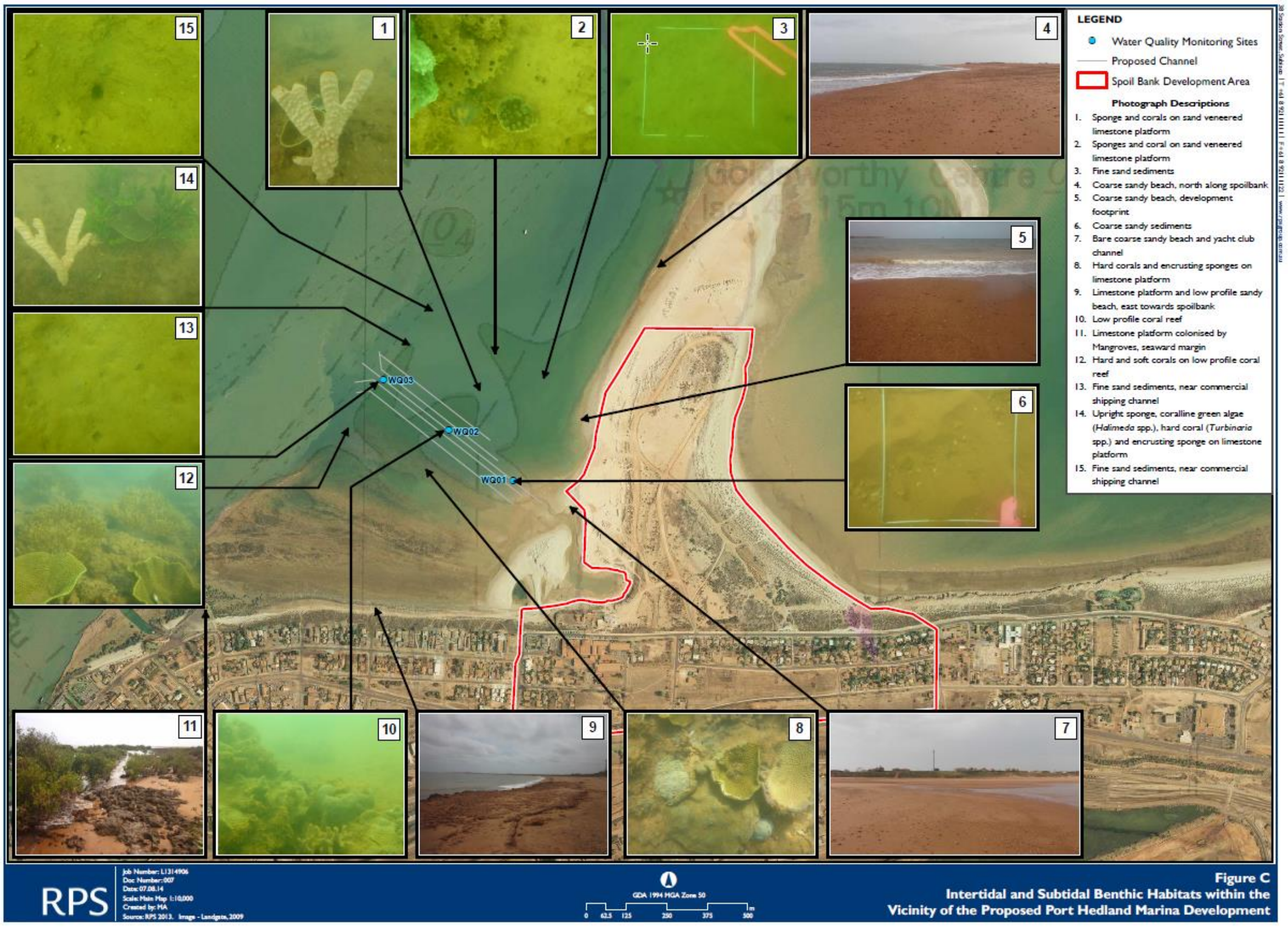


Figure 2-2 Benthic habitats mapped as part of the Port Hedland Marina investigations (SKM 2014d)

In the shallow (<2m) nearshore area of the spoil bank benthic habitats were predominantly coarse sandy sediments with shell and rock grit and these soft sediments transition to reef platform with increasing depth (Figure 2-2). The reef platform is inhabited by low to medium cover of benthic organisms including soft and hard corals, sponges, algae and ascidians. Bleaching of some corals and sponges were noted (RPS, 2014d). Towards the Port Hedland commercial shipping channel the reef platform drops away to soft silty bioturbated sandy sediments with sparse cover of benthic organisms (RPS, 2014d).

Worley (2012) found four (4) key categories of BCH within near shore LAU, these are shaded in Figure 2-3 below. Sandy benthic macro algae habitat (shaded yellow), Coral (shaded red), Reef habitat (shaded pink) and Canopy algae (shaded brown)..

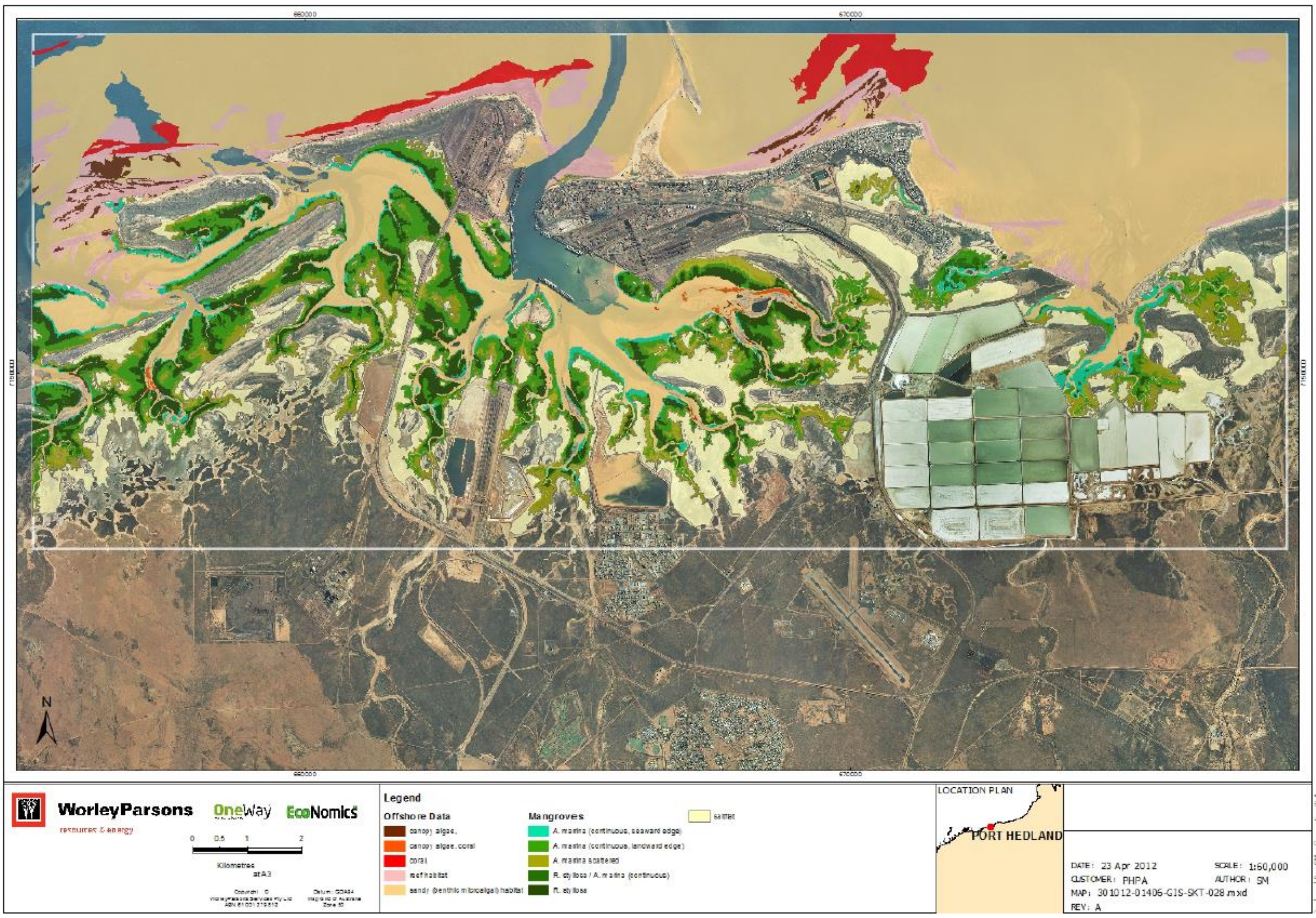


Figure 2-3 Distribution of subtidal and intertidal BPPH in the inner harbour of Port Hedland (Worley Parsons 2012b)

2.1. Local Assessment Unit (LAU)

To assess the loss of benthic habitats the EPA guidance (*Technical Guidance, Protection of Benthic Communities and Habitats* (2016) specifies the determination of a Local Assessment Unit (LAU) within which cumulative losses of benthic habitat types may be determined. The EPAs guidance suggests that the LAU is defined with reference to the local geomorphology and biophysical characteristics of the area and should typically cover an area of ~50 km^2; larger or smaller LAUs will be considered if well justified. The EPA guidance includes a figure defining the LAU for Port Hedland (EPA, 2016; Figure 1) however this LAU was to enable assessment of benthic habitat changes in the inner harbour and does not include the Spoilbank site (Figure 2-4).

Figure 2-4 **Local assessment unit (LAU) for the Port Hedland inner harbour specified in EPA guidelines (EPA, 2016)**

Two studies have defined LAUs which cover the area of the proposed Spoilbank Marina:

- BHP Outer Harbour Development Environmental Impact Assessment (BHP, 2011)
    - Five separate LAUs were defined, the LAU covering the Spoilbank area was based on the inner harbour LAU (as shown in EPA, 2016), but extended offshore in parts track the shoreline or cut across embayments (Figure 2-5).
- Cooke Point Marina, Port Hedland – Preliminary Environmental Assessment Report (RPS, 2014)
    - Similar to the BHP (2011) LAU (see (Figure 2-5) but separated into an 'onshore' and 'offshore' LAU (Figure 2-6). The northern boundary of the 'offshore' generally followed the LAT level and therefore excludes areas of subtidal BCH and the landward boundary did not include Pretty Pool Beach which represents an important costal habitat in the area.

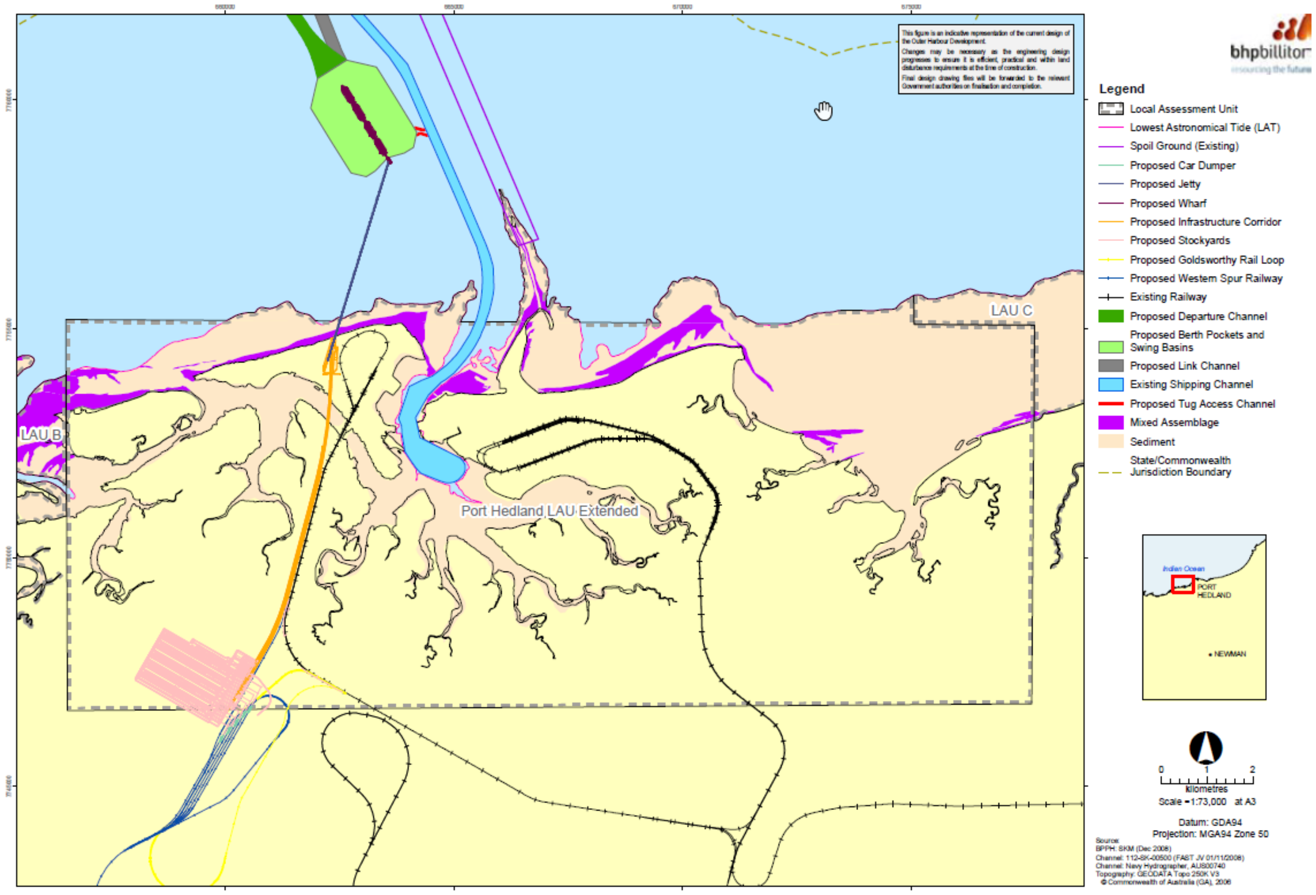


Figure 2-5 Local assessment unit used for the Outer Harbour Development (BHP 2011)

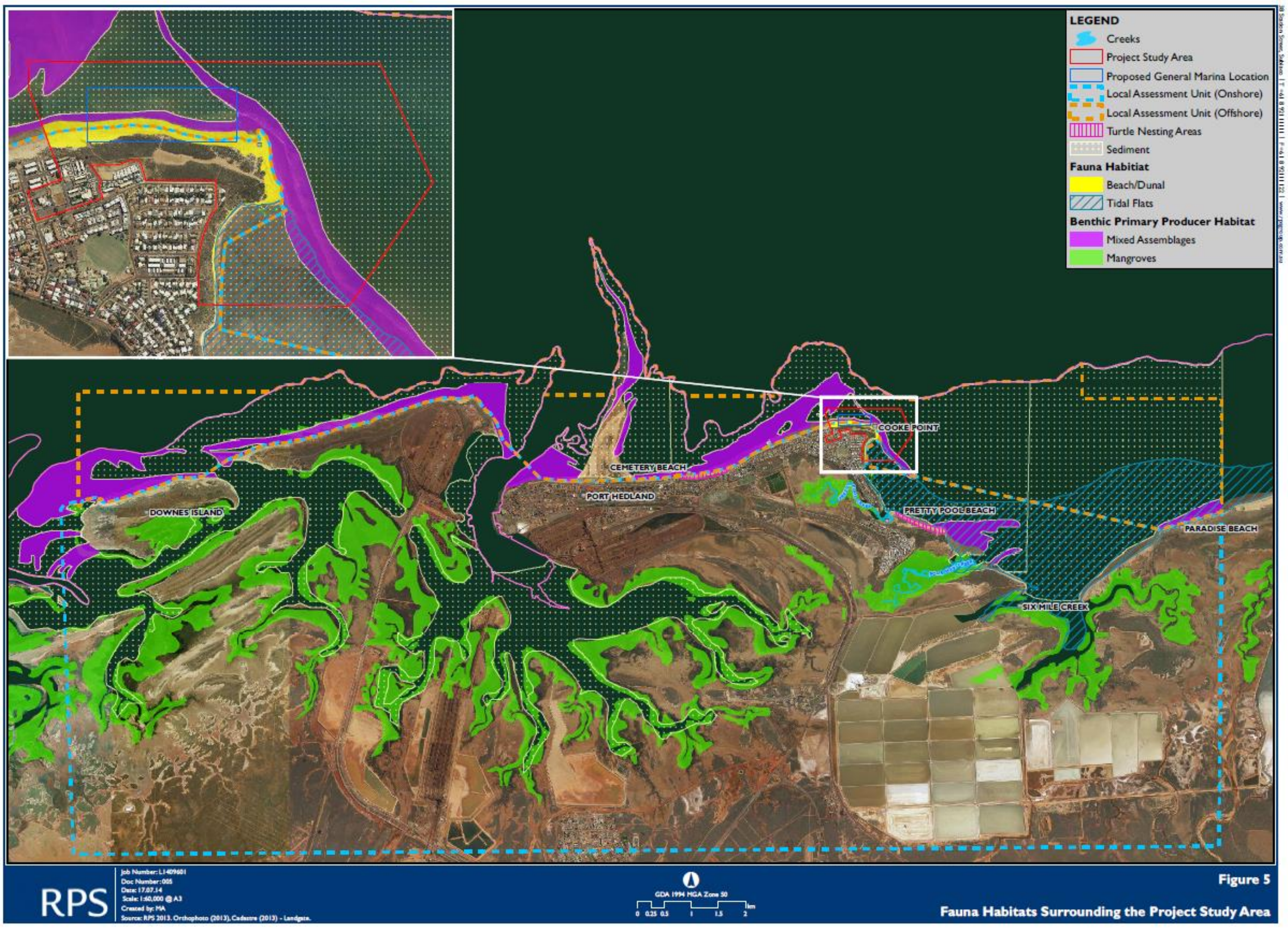


Figure 2-6 Local assessment unit proposed for the Cooke Point Marina (RPS, 2014)

For assessment of the Spoilbank Marina we propose to use a modified version of the ‘offshore’ LAU defined for Cooke Point (Figure 2-6).

The offshore boundary of the Cooke Point Marina LAU was (for most of its length) only extended to the 0m LAT, hence only representative of the intertidal habitat. To ensure that the new proposed LAU is representative of subtidal habitat, and enable assessment of potential impacts from channel construction, the offshore boundary of this LAU was extended to the -2m LAT and the landward boundary generally follows the shoreline and includes Pretty Pool Beach (Figure 2-7). This LAU covers an area of 71.2 km2 and will be used to assess the cumulative impacts to marine coastal intertidal and subtidal benthic habitats resulting from:

- Historical losses;
- Direct losses due to construction footprint of Spoilbank Marina; and
- Indirect losses arising during construction of the Spoilbank Marina (e.g. dredge plume impacts).

Figure 2-7 Proposed Local Assessment Unit for the Spoilbank Marina

3. Survey Locations

Benthic habitat mapping survey will cover two areas: 1) detailed mapping in the area immediately adjacent to the proposed Spoilbank Marina where impacts most likely to occur (Figure 3-1); and 2) broadscale groundtruthing to valid existing mapping across the larger area of the LAU (**Error! Reference source not found.**). The detailed mapping zone covers an area of ~0.91 km^2 and survey of this area will be undertaken using acoustic side scan and drop camera. Across the broadscale mapping zone selected areas will be targeted for groundtruthing with drop camera to validate the existing habitat mapping for this area.

Figure 3-1 Notional boundary of detailed BCH mapping zone

4. Methods

4.1. Data Collection

The vessel ‘Freedom 2’ (owned and operated by O2 Marine; see Appendix A for specifications) will be used to undertake the BCH surveys and shall be launched from the Port Hedland Boat Ramp (~1.2 km from the project site). Three days have been allowed to undertake the field survey: one day to cover the detailed mapping zone and two days to complete the broadscale mapping zone. Relatively quiescent sea conditions are required to collect accurate side scan data so the specific timing of this survey method will be governed by weather conditions. Prior to mobilisation, predicted weather and tides conditions for Port Hedland will be monitored to ensure suitability for the proposed field operations. Two suitably qualified O2 Marine scientists (at least one holding a Coxswain Grade 2 certificate) will undertake the surveys within daylight hours.

4.1.1. Detailed Mapping Zone

Side scan sonar imagery of the detailed mapping zone shall be obtained using a StarFish 452F high-definition side scan sonar (Figure 4-1a). The swath width of the StarFish 452F varies between 40 m (at ~10 m depth) to 10 m (at ~2 m depth) technical specifications of side scan sonar is provided in Appendix A. The sonar shall be towed in a grid pattern behind the vessel at a speed no greater than 4 knots to provide 100% survey coverage of the area. The backscatter data from the side scan sonar will be used to identify key ecological features which will then be targeted with a drop camera to verify benthic composition. The drop camera to be used will be a Spot X system (Figure 4-1b), which has been fitted with top side control unit to allow the operator to assess the seabed in real-time. High-definition video will be recorded to an external hard drive at 1080p resolution.

a) b)

Figure 4-1 Survey Equipment a) StarFish 450F b) Spot X drop camera

Visual observations from divers undertaking sediment investigations (for more information refer to the Spoilbank Marina Sediment Sampling and Analysis Plan (O2 Marine, 2019)) will also be available to supplement the BCH survey data. The collated data will be processed and analysed to produce a benthic habitat map of the Project Area.

4.1.2. Broadscale Mapping Zone

A targeted drop camera survey will be undertaken to validate the existing BCH information across the broadscale mapping zone. This groundtruthing will be implemented using the drop camera at 30 locations which have been selected to confirm the extent and distribution of the BCH across this area. An additional 10 random drop camera locations shall be distributed across the LAU to increase the accuracy of the proposed mapping methodology. Targeted locations and random locations selected for the survey are depicted respectively in red and yellow in Figure 4-2. During the survey a qualified marine scientist will review the footage in real time and assign and record the observed habitat types using the field laptop with interfaced GIS software and GPS antenna.

Figure 4-2 Proposed drop camera survey locations

4.2. Data Processing

Following collection, the drop camera footage will be analysed by an experienced marine scientist to review and confirm the benthic classification for each survey location. This information will be reviewed together with the existing BCH mapping to produce an updated BCH across the LAU. The side scan sonar backscatter data shall be analysed (using Sonarwiz.5 software) to determine a series of seabed classes which will be assigned to a habitat classification using 'acoustic supervised classification' with reference to the drop camera footage (Figure 4-3).

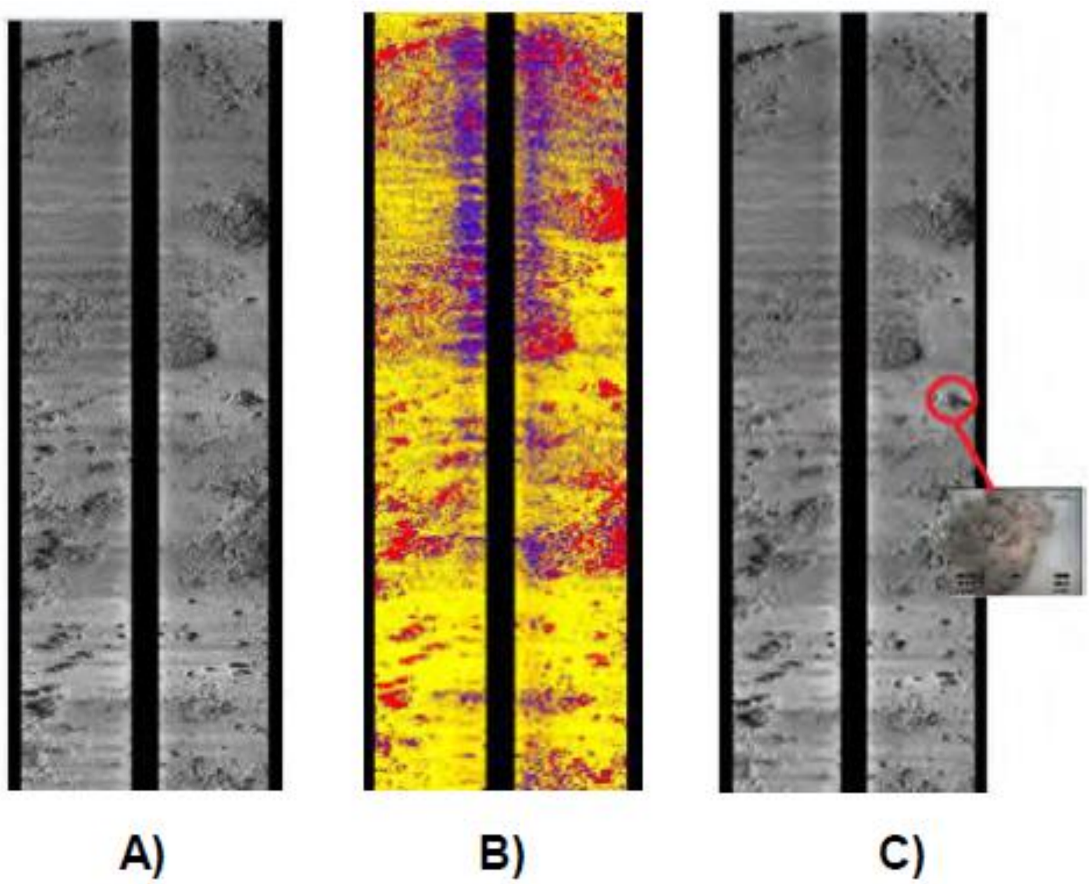


Figure 4-3 Example of side scan data processing: (A) backscatter image of seabed B) classified acoustic image C) validation of target via drop camera)

5. Deliverables

Following completion of the BCH surveys, Teal/O2 Marine will produce a Benthic Communities & Habitat Analysis Report which will include:

1. Literature review
2. Description of methods used
3. BCH map of the detailed mapping area;
4. BCH map of the LAU;
5. Descriptions of substrate, bedforms, habitat and species observed;

6. Reference List

EPA (2016). Technical Guidance. Protection of Benthic Communities and Habitats. Environmental Protection Authority. Western Australia.

O2 Marine (2019). Port Hedland Spoilbank Marina, Sediment Sampling and Analysis Plan. O2 Marine Report Number R190188. Perth, Western Australia

RPS (2014). Water Quality Report. Proposed Port Hedland Marina Development. RPS Environment and Planning Pty Ltd. Report Number L1314906. Perth, Western Australia.

RPS (2014b). Preliminary Environmental Assessment Report. Cooke Point Marine, Port Hedland. Western Australia.

BHP (2011). Outer Harbour Development, Public Environmental Review/Draft Environmental Impact Statement, Section 10, Marine Impacts and Management. Western Australia.

Worley Parsons (2012). South West Creek Dredging and Reclamation Project. Benthic Primary Producer Habitat Survey and Cumulative Loss Assessment: Port Hedland Local Assessment Unit.

Appendix A Technical Specification - Starfish 452 Side Scan Sonar

StarFish

452F TOWED SIDESCAN SYSTEM

Outstanding Performance

The StarFish 452F brings even higher definition imagery to your PC. With half the horizontal beam angle (for twice the resolution) of our popular 450F design, and our advanced digital CHIRP acoustic technology developed from the professional underwater survey industry, StarFish 452F produces crisper and cleaner imagery at ranges of up to 100 metres on each channel (200m total swathe coverage). It competes with many larger commercial systems producing spectacular images of the seabed, and includes intuitive software with a variety of data export options.

Portable System

Measuring less than 15 inches long the StarFish 452F sonar is small enough to be transported in your rucksack. Lightweight and quick to deploy by hand, the 452F towed system is independent of the boat requiring no fixed installation which makes it easy to transport and operate from any vessel. The StarFish Peli Case provides a rugged and watertight method for transporting and storing your StarFish system.

Advanced Design

The compact hydrodynamic full body three-fin design improves stability of the sonar while it's being towed which in-turn helps improve the quality of images it produces. The sonar also incorporates an inline connector to allow the cable to be swapped or replaced on site. Additional cable lengths are also available to help you choose the best towing solution for your needs.

Designed to be 'Plug and Play', connecting to your Windows PC or laptop via a USB connection, the StarFish 452F comes with software to allow the capture and recording real-time images from the seafloor below, making seabed imaging easy for everyone.

StarFish 452F
Towed Sonar Head

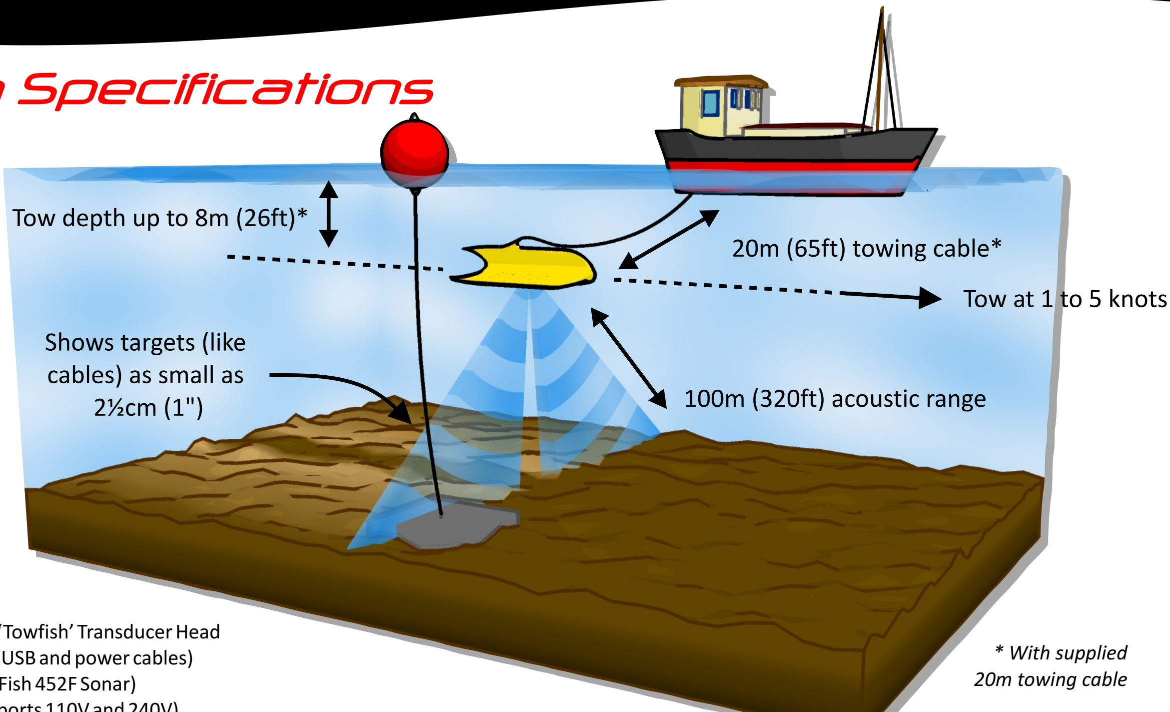
StarFish 450 Series Electronics Top Box
(compatible with 450F sonar heads)

- **The smallest towed side scan sonar available.**
- **0.8° horizontal beam width with up to 100m acoustic range per channel.**
- **Easily transportable - fits in your rucksack.**
- **Easily powered from almost any source.**
- **Plug & play USB interface to any PC, with simple & intuitive software.**
- **High visibility yellow colour to aid location & tracking..**

P/N: BP00211.1

452F TOWED SIDESCAN SYSTEM

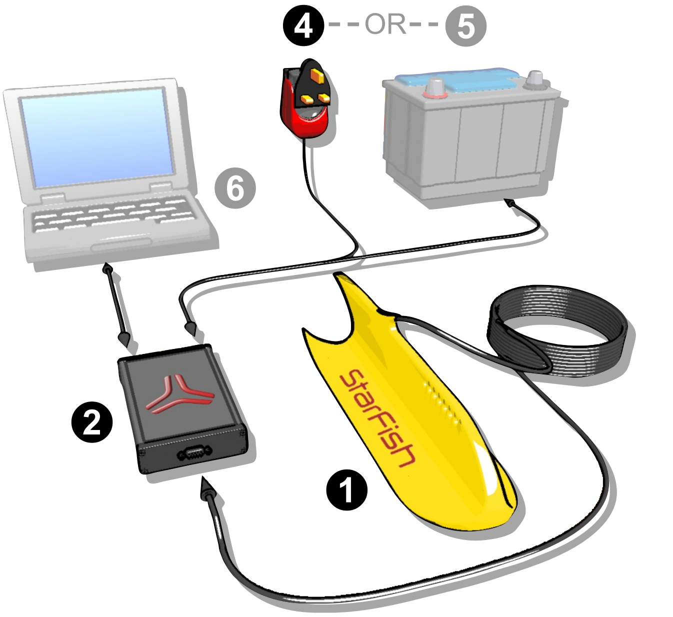
Operating Specifications



** With supplied 20m towing cable*

The Sonar connects to the Top Box. The Top Box then connects to the power source and any Windows based PC or Laptop via a USB connection to display, record and playback digital sonar images using StarFish Scanline software.

1. Starfish 452F Side Scan Sonar 'Towfish' Transducer Head
2. Starfish 450 Top Box (includes USB and power cables)
3. 20m cable (included with StarFish 452F Sonar)
4. AC Mains power adapter (supports 110V and 240V)
5. Customer supplied DC power supply 9V-28V (i.e. battery)
6. Customer supplied PC or Laptop (with at least 1 free USB port and Windows XP, Windows Vista or Windows 7)



TOP BOX SPECIFICATIONS

Dimensions	Length	166mm (6.54").
	Width	106mm (4.17").
	Height	34mm (1.34").
Weight	In Air	Approx 0.4kg (0.88lb).
Power	Supply Voltage	90-264V AC, 47-63Hz with Mains adaptor. 9-28V DC supply.
	Consumption	2.4W (200mA @ 12V) approx when idle. 6W (500mA @ 12V) approx when scanning.
Interfaces	Power	2.1mm DC jack socket.
	Data	USB B-Type connector.
	Acoustic	9-Way Female D-Type socket.
Environmental	Temperature Range	-5°C to +40°C (23°F to 104°F).
	IP Rating	IP50 (Protected against ingress of dust, no protection against ingress of liquids).

SONAR HEAD SPECIFICATIONS

Dimensions	Length	378mm (14.88").
	Width	110mm (4.33").
	Height	97mm (3.81").
Weight	In Air	Approx 2.0kg (4.4lb).
	In Fresh Water	Approx 1.0kg (2.2lb).
Body	Costruction	Reinforced yellow polyurethane rubber.
	Depth Rating	50m (164ft).
Towing Cable	Length	20m (65.6 ft) supplied - 50m (164ft) available.
	Breaking Strain	>150kg (330.7lb).
	Construction	Black polyurethane jacketed with internal Kevlar reinforcing (strain) member.
	Min Bend Radius	30mm (1.2").
Transducer	Arrangement	Dual fin mounted transducers, with 30° down angle from the horizontal.
	Vertical Beam	60° nominal width (@ -3dB signal level).
	Horizontal Beam	0.8° nominal width (@ -3dB signal level).
Acoustic	Frequency	450kHz nominal.
	Range	1m up to 100m (3ft to 320ft) on each channel providing max 200m (640ft) total coverage.
	Mode	CHIRP pulse compression.
	Pulse Length	400µs typical.
	Transmit Source Power Level	<210dB re 1Pa @ 1m.

SYSTEM SPECIFICATIONS

System Parts	Sonar	StarFish 452F Sonar Head (with 20m tow cable). StarFish 450 Top-Box (with USB interface cable).
	Power Supplies	Universal AC mains to DC power-supply (with international AC adaptors). 2m cigar-plug DC power lead. Crocodile-clip to cigar-socket DC adaptor.
	Software	StarFish Scanline interface software CD and drivers.
	Documentation	User manual, Scanline Manual, Quick start guide.
	Included Accessories	Rugged Peli™ Transport & Storage Case StarFish GPS (SiRF III) StarFish pole mounting bracket
Available Accessories		50m towing cable
Compliances	RoHS	Full compliance to the 2002/95/EC directives
	WEEE	Full EN50419 compliance

Please Note: All specifications are subject to change in line with Tritech's policy of continual product development.
For the latest news, details, mechanical drawings, applications information and evaluation software, visit www.starfishsonar.com

+44 (0)1224 746979
www.starfishsonar.com