



# Geraldton Port Maximisation Project

## Benthic Habitat Survey Report

### Mid West Ports Authority

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Geraldton WA 6530

Prepared by:

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## Revision Record

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0.2	30 August 2024	Dilys Zhang	Lachlan Barnes	Alysia Woodward

## Basis of Report

This report has been prepared by SLR Consulting Australia (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Mid West Ports Authority (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

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## Executive Summary

SLR Consulting (Australia) Pty Ltd (**SLR**) was engaged by Mid West Ports Authority (**MWPA**) to undertake a benthic survey within the vicinity of Geraldton Port to inform an impact assessment of the in support of a referral under Part IV of the *Environmental Protection Act 1986* with regard to the Port Maximisation Project (**PMaxP**). The PMaxP will consist of various upgrades and changes to the current configuration to facilitate the identified long-term needs of the facility. Of specific relevance to the current report is the installation of a new tug harbour to the north of the existing harbour, dredging and reclamation activities required to develop Berth 8/9 along the western edge of the existing shipping channel, and Berth 1 in the eastern end of the existing harbour. The aim of the benthic survey was to characterise the benthic communities and habitats (**BCH**) throughout the Study Area that may be potentially impacted by the proposed project activities.

Characterisation of the seabed, including the type and extent of benthic communities (e.g. seagrasses, soft sediments, rocky reef habitat) in the proposed Study Area was achieved via the use of a live feed slow tow / drop camera system deployed from a sampling vessel. The use of towed video camera images (for habitat mapping), supplemented with drop camera video (for semi-quantitative assessment purposes) provided representative coverage of benthic communities across the Study Area as well as the ability to semi-quantitatively analyse various habitat attributes.

The survey was undertaken in February 2024, with three locations within the Study Area targeted throughout the survey:

- Location 1: Northern breakwater and tug facility
- Location 2: Eastern side of existing shipping channel
- Location 3: The wider extent to the north and east of the shipping channel.

Location 1 represents an area where both direct and indirect habitat loss will occur from the installation of the northern breakwater and tug facility. Locations 2 and 3 represent potential habitat degradation / loss from indirect impacts associated with potential impacts of sediment plumes associated with the PMaxP dredging requirements.

The data collected aided in the description of benthic habitats and communities throughout the Study Area. In addition, biotic and abiotic image attributes collected during data processing from towed video transects and drop camera images, along with GPS coordinates, were transformed into point and line spatial datasets in ArcGIS to facilitate mapping of BCH throughout the Study Area.

Location 1 was characterised by soft sediment and moderately dense patchy seagrass, with sparse macroalgae interspersed throughout. Soft sediment was recorded at all sampling sites within Location 1, with an absence of hard substrate throughout this location. The dominant seagrass species in Location 1 was *Posidonia* sp. with *Halophila* sp., *Syringodium* sp. and *Amphibolis* sp. taxa also observed. Location 2 was characterised by a mosaic of low to moderate profile reef and soft sediment associated with mostly low to medium density macroalgae and seagrass. The seagrass taxa observed within Location 2 included *Halophila* sp., *Posidonia* sp., *Syringodium* sp. and *Amphibolis* sp.. The BCH throughout Location 3, north of the existing shipping channel within Champion Bay, were characterised by moderately dense seagrass meadows on soft sediment habitat, and large areas of co-dominant macroalgae and seagrass which inhabited low to moderate relief rocky reef with associated soft sediment. Dense meadows of *Posidonia* sp. and / or *Amphibolis* sp. were observed mostly in areas in Location 3 where rocky reef was absent.



A total of 7.6 ha of seagrass, 8.9 ha of macroalgae and 4.8 ha of bare soft sediment occurred within the proposed footprint for the tug harbour and Berth 8/9. The majority of seagrass and macroalgae within this proposed footprint (91% and 95%, respectively) was considered low density cover (i.e. < 25%). No seagrass or macroalgae are expected to occur in the Berth 1 and 6 proposal footprint areas.

The observations made during this study are generally consistent with those made in the study undertaken by AECOM (2020) and O2 Marine (2022) across the same area. Whilst the AECOM and O2 Marine data employed a different approach to mapping, utilising Lidar with fewer ground-truthed data points, a generally similar distribution of habitats and species within communities were observed. The three datasets are considered to provide a robust representation of the distribution of species, habitats, and communities present within the surveyed areas of Champion Bay.



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## 1.0 Introduction

SLR Consulting (Australia) Pty Ltd (**SLR**) was engaged by Mid West Ports Authority (**MWPA**) to undertake various environmental studies for the Port Maximisation Project (**PMaxP**) in Geraldton, Western Australia. As part of these studies, a benthic survey was required to inform an impact assessment in support of a referral under Part IV of the *Environmental Protection Act 1986*.

The purpose of the benthic survey is to characterise the distribution and abundance of benthic communities and habitats (**BCH**) throughout the Study Area (**Figure 1**) to aid in the provision of a cumulative loss assessment related to potential impacts to BCH from the proposed construction of a 'Tug Harbour' to the north of the existing main harbour, and associated rock walls. In addition, the areas surveyed cover BCH on the eastern side of the existing shipping channel and to the north that may be potentially affected by sediment plumes from dredging and reclamation activities associated with the PMaxP (**Figure 1**).

### 1.1 Project background

MWPA operates seven commercial berths and several critical marine and land assets at Geraldton Port, located 420 km north of Perth. The operation of the Port enables the facilitation of trade for the Mid-West region, exporting a variety of products including iron ore, grains, mineral sands, non-mineral sands and mineral concentrates. The Port also imports fuel, fertiliser and break-bulk cargo. In addition, MWPA also manages the Geraldton Fishing Boat Harbour (**FBH**), supporting the region's largest fishing industry - Western Rock Lobster, as well as several tourist-based operations.

The PMaxP is an infrastructure project aimed at modernising and optimising the capacity of the Port of Geraldton (the Port) through the upgrade of existing facilities and construction of both new and replacement facilities. The PMaxP involves dredging, land reclamation, construction of new breakwaters, and installation of new marine infrastructure.

The PMaxP will consist of various upgrades and changes to the current configuration to facilitate the identified long-term needs of the facility. Of specific relevance to this scope is the installation of a new tug harbour to the north of the existing harbour, dredging and reclamation activities required to develop Berth 8/9 along the western edge of the existing shipping channel, and Berth 1 in the eastern end of the existing harbour (**Figure 2**). It is anticipated that the installation and development of these facilities are likely to result in potential impacts to BCH within the area. The additional dredging of the existing Berth 6 pocket at the western end of the existing harbour is not expected to result in any impact to BCH so is not discussed further herein.

#### 1.1.1 Tug Harbour Facility

The construction of a new tug harbour facility to the north of the existing harbour would include the installation of a number of rock armour walls and berthing facilities specifically designed for tug use. This would include the installation of wharf infrastructure and dredging, and reclamation works to facilitate the new tug harbour (**Figure 2**).

#### 1.1.2 Berth 8/9 Dredging

It is proposed that a berthing pocket immediately to the east of the new tug harbour be dredged to aid in the facilitation of a new future berthing area for the harbour (Berth 8/9) (**Figure 2**). Berth 8/9 will involve capital dredging to -13 mCD over an approximately 2.1 ha area and future berth(s) would align with the existing shipping channel from the harbour.



### 1.1.3 Berth 1 Dredging

It is proposed that a berthing pocket in the eastern end of the existing Port harbour be dredged to -13.4 mCD to aid in the facilitation of a new future berthing area for the harbour (Berth 1) (**Figure 2**). Specific details of the new Berth 1 area are not currently available; however, it is understood the area to be dredged would be approximately 1.3 ha and would align with the existing shipping channel from the harbour.

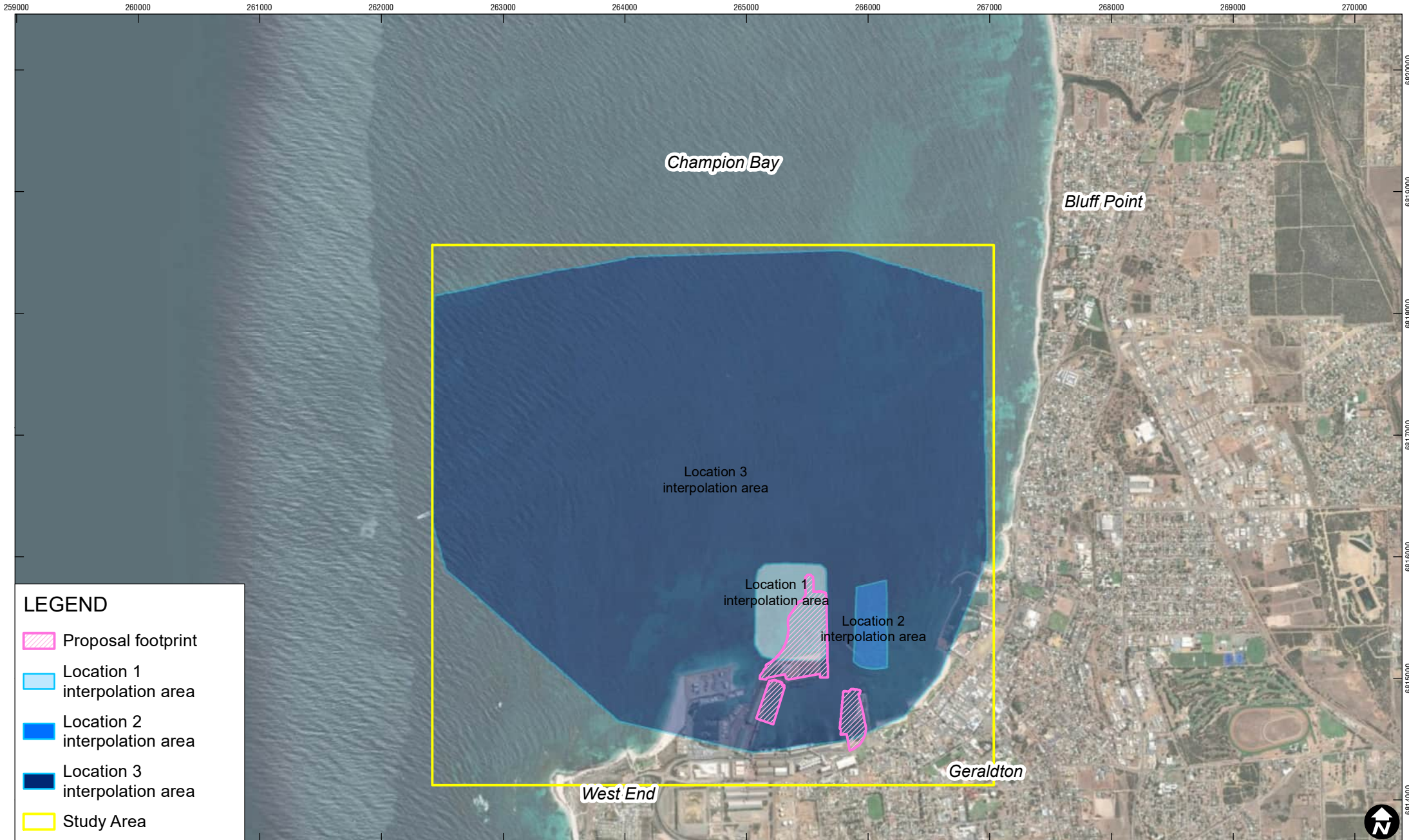
## 1.2 Aims and objectives

The aim of the benthic survey was to characterise the BCH throughout the Study Area that may be potentially impacted by the proposed project activities.

The objective of the survey was to collect sufficient data to describe and characterise the distribution of BCH throughout the Study Area (**Figure 1**). The survey would look to build upon previous mapping undertaken within the area by examining BCH characteristics at a finer scale than previously mapped.

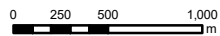
The outcomes of this assessment will be used to inform the assessment of potential impacts to BCH associated with the activities associated with the PMaxP.





**LEGEND**

- Proposal footprint
- Location 1 interpolation area
- Location 2 interpolation area
- Location 3 interpolation area
- Study Area



Scale: 1:40,000 at A4  
 Coordinate System: GDA2020 MGA Zone 50

Date Drawn: 29-Aug-2024  
 Project Number: 675.072500

Data Source:  
 Esri, Maxar, Earthstar Geographics, and the GIS User Community



**THE STUDY AREA**

**FIGURE 2**

\\AU.SLR.Local\Corporate\Projects-SLR\675-PER\675-PER\675.072500.00001 MWPA PMaxP - Marine\06 SLR Data\01 CAD\GIS\GIS\640\_30470\_F017\_StudyArea.mxd



## 2.0 Existing information

### 2.1 Environmental setting

Geraldton Port is located on Western Australia's coastline within its mid-west region in Champion Bay, approximately 420 km north of Perth. The area in and around Geraldton is considered to have a high biodiversity value in both the marine and terrestrial environments.

Over the past 150 years, the Greater Geraldton landscape has undergone significant modification due to European agriculture. As such, less than 15% of the pre-European vegetation remains. Critical areas of remaining local native vegetation are found in the Chapman and Greenough River catchments, serving as vital wildlife habitats. Additionally, the Moresby ranges contribute to the region's natural resources and are currently under consideration for conservation and community recreation.

Likewise, the marine environment surrounding Geraldton harbours valuable natural resources and significant biodiversity. The limestone substrate, which underlies the majority of Champion Bay and its surroundings, stands out as a prominent feature (AECOM 2020). This substrate plays a crucial role in shaping the bay's epibenthic communities. Factors such as the presence of limestone reefs, their relief or profile, and the depth of sand overlaying the reef all contribute to the ecological dynamics of the area. Additionally, exposure to prevailing south-westerly swells and seas significantly influences sand movement within the bay (AECOM 2020). Whether sand is deposited, eroded, or frequently resuspended due to wave and tidal water action determines the specific types of epibenthic communities that thrive in different areas. Notably, habitats with similar depths, topography, and substrate slope exhibit distinct characteristics based on their varying levels of protection from swell and waves.

### 2.2 Overview of previous benthic surveys

Previous benthic mapping undertaken within Champion Bay suggests a diverse range of habitats and benthic communities, such as seagrasses, macroalgae and filter feeding organisms exist throughout the bay and surrounding areas (AECOM 2020). Within the area to the south of the shipping channel but north of Fishing Boat Harbour, where the current proposal footprint is situated, the substrate has been described to comprised of a mixture of reef and soft sediments with mostly seagrass and macroalgae dominated benthic communities (**Figure 3**) (AECOM 2020). Seagrasses within this area consisted of low- and high-density patches of *Halophila*, *Posidonia*, *Amphibolus* and *Syringodium* species, whilst macroalgae assemblages tended to be dominated by *Sargassum* and *Ecklonia*. Depths in this area generally range between 4 m and 12 m.





**Figure 3 Previous interpolated map of benthic communities and habitats within and surrounding Champion Bay from data recorded in 2020 (source: AECOM, 2020)**



## 3.0 Methodology and Approach

### 3.1 Sampling method

Characterisation of the seabed, including the type and extent of benthic communities (e.g. seagrasses, soft sediments, rocky reef habitat) in the proposed Study Area was achieved via the use of a live feed slow tow / drop camera system deployed from a sampling vessel. The survey methodology was designed to incorporate the recommendations contained within the Technical Guidance – Protection of Benthic Communities and Habitats (EPA, 2016).

The use of towed video camera images (for habitat mapping), supplemented with drop camera video (for semi-quantitative assessment purposes) provided representative coverage of benthic communities across the Study Area as well as the ability to semi-quantitatively analyse various habitat attributes as outlined in **Section 3.6.1**.

Previous mapping undertaken in 2020 (AECOM 2020) suggests that much of the Study Area contains seagrass habitat at varying densities. As such, semi-quantitative measures of this habitat throughout the Study Area were undertaken (where feasible) to better characterise its species composition and density / cover to assist with the impact assessment component of the PMaxP.

### 3.2 Survey timing

The survey was undertaken over three days between 20 February and 22 February 2024. This period is generally within the peak growing period for many benthic communities, including seagrasses, and provides an ideal window to examine distribution and abundance patterns with regards to BCH.

### 3.3 Survey locations

The following three survey locations were defined within the Study Area while multiple sampling sites were distributed within each Location (**Figure 1**):

- Location 1: Northern breakwater and tug facility
- Location 2: Eastern side of existing shipping channel
- Location 3: The wider extent to the north and east of the shipping channel.

Location 1 represents an area where both direct and indirect habitat loss will occur from the installation of the northern breakwater and tug facility.

Locations 2 and 3 represent potential habitat degradation / loss from indirect impacts associated with potential impacts of sediment plumes associated with the PMaxP dredging requirements.

Location 2 is situated closer to the proposed dredging pockets (Berths 1 and 8) and was therefore examined at a finer scale compared with Location 3. The purpose of sampling within Location 3 was to provide a wider context of BCH distribution within the Study Area and was not designed to be extensively mapped compared to Location 1 and Location 2.

#### 3.3.1 Sampling locations

##### 3.3.1.1 Slow tow camera transects

Slow tow camera transects were used mostly for mapping purposes to provide a good coverage and assessment of the distribution of BCH throughout the Study Area. A total of 12 transects were surveyed throughout Location 1, six transects surveyed throughout Location 2 and five long transects throughout Location 3 (**Figure 4**). Transects were



separated by between 50 m to 60 m within Locations 1 and 2, which was considered appropriate to provide desired coverage and understanding of BCH across these two survey locations. Within Location 3, longer transects were separated by larger distances which allowed a greater area to be covered per unit time and facilitated the collection of data at a resolution that was considered appropriate to achieve the survey objective.

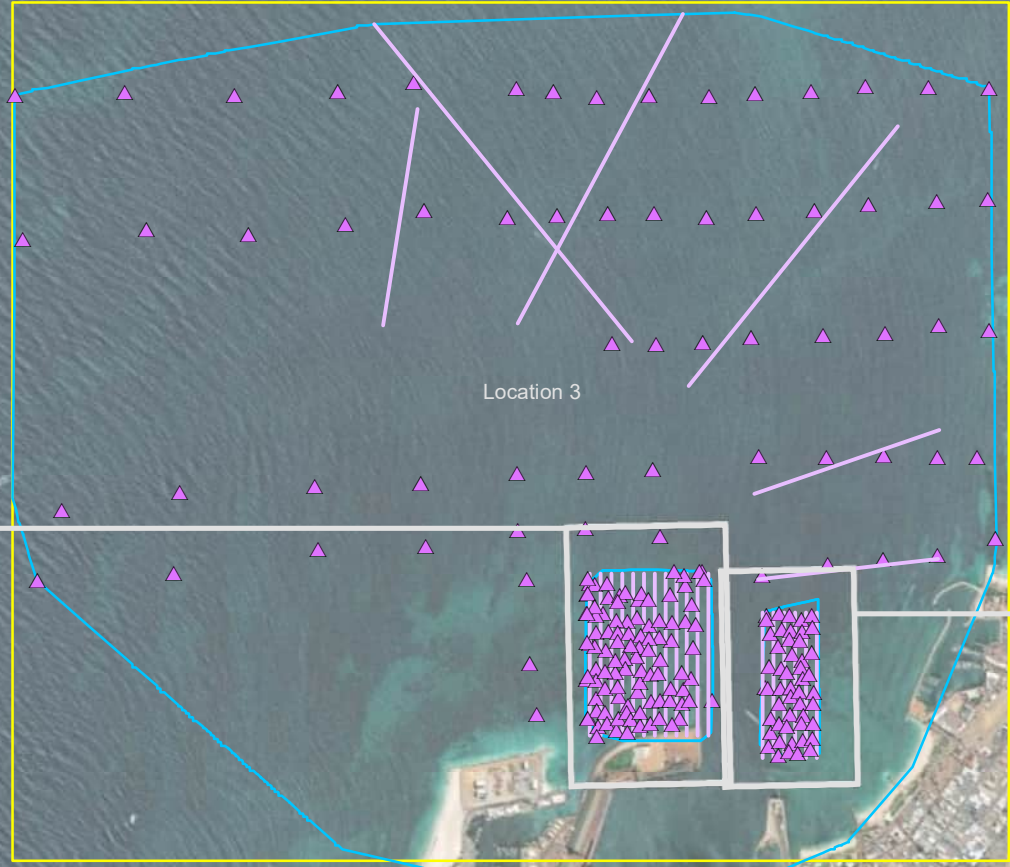
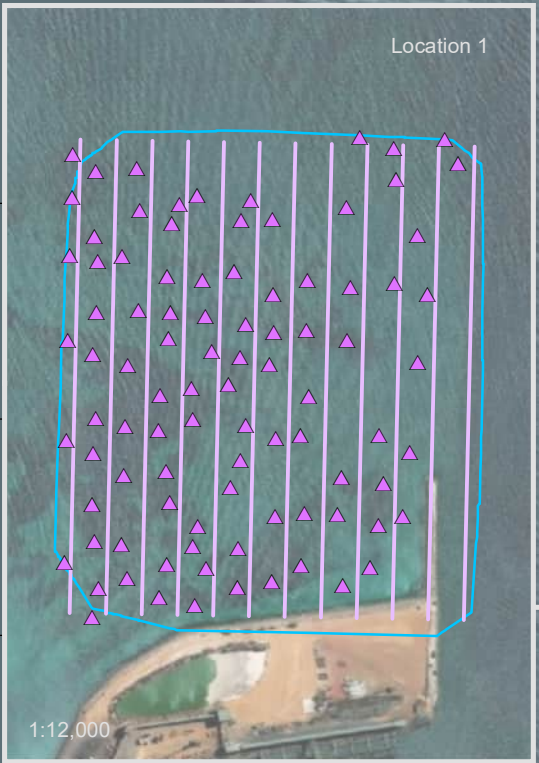
### 3.3.1.2 Drop camera sampling sites

Drop camera sampling sites for each location (92 for Location 1, 48 for Location 2 and 65 for Location 3) are shown in **Figure 4**. The location of these sites is based on previous mapping and recent aerial imagery and helped to better locate and describe various habitats encountered throughout the Study Area. Images collected by use of a drop camera (in a frame) were utilised to semi-quantitatively sample and describe benthic habitats, such as seagrasses, to better understand their density / cover across the Study Area.

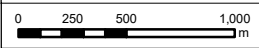


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6818000  
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6815000  
6814000



- LEGEND**
- ▲ Drop camera sites
  - Transects
  - Study Area
  - Interpolation areas



Scale: 1:35,000 at A4  
Coordinate System: GDA2020 MGA Zone 50

Date Drawn: 29-Aug-2024  
Project Number: 675.072500



Data Source:  
GeoOceans, 2020  
Esri, Maxar, Earthstar Geographics, and the GIS User Community



**LOCATION OF TRANSECTS AND  
DROP CAMERA SAMPLING POINTS**

**FIGURE 4**

### 3.4 Weather conditions

Prior to the field campaign, predicted weather conditions (based on the Bureau of Meteorology (BoM) data) were reviewed and documented as required. Tide heights and times were also reviewed and extracted from the Geraldton tide charts for 2024. **Table 1** describes the weather conditions and tides for the week that the survey was carried out.

**Table 1 Weather observations for the days in the field**

Date	Temperature (°C)	Rainfall (mm)	Wind direction	Max wind speed (km/h)	Underwater visibility	High tide (Height)	Low tide (Height)
20/2/2024	38	0	SW	28	10m	1854 (0.97m)	0442 (0.30m)
21/2/2024	30	0	SW	27	10m	1938 (0.97m)	0459 (0.31m)
22/2/2024	32	0	SSE	39	10m	2028 (0.97m)	0457 (0.33m)

### 3.5 Sampling equipment

Both the slow tow and drop camera techniques were carried out using a SpotX custom-built underwater camera (see SAQP for specifications (SLR 2024)) mounted to a tow-wing and a custom-built camera frame, and a topside GPS and depth tracker. Underwater lights attached to the camera frame were used when required based on the conditions. The SpotX custom-built underwater camera is operated from a topside control centre using QGroundControl.

*In situ* logging of information, other than GPS locations, was completed in ESRI Field Maps on a field tablet.

#### 3.5.1 Slow tow / drop camera deployment and retrieval

When using the drop camera technique (for semi-quantitative sampling purposes), the vessel navigated to each sampling site, based on the GPS locations provided to the vessel operator and crew. When the vessel reached a sample site, the camera was deployed by lowering it to the seabed, with the camera remaining stationary for a period of 3 seconds. The camera was set to record, with lights turned on if required. Field personnel reviewed the live topside feed during this process to provide instruction on the timing and angle of the drop. Each sampling location was recorded by the topside GPS while the camera frame was on the seabed.

Where the SpotX camera was deployed for slow tows (for habitat mapping purposes), the SpotX camera body in the tow-wing was suspended slightly off the seabed to allow the unit to move without coming into contact with the seabed. The vessel was in motion (as slow as possible) to capture video footage of the seabed along defined transects. GPS coordinates were taken at the start and finish of each transect and a track along the transect recorded. Deployment and length of slow tows were dependent on sea conditions, depth and water visibility.

During image / video capture, staff reviewing the live topside feed, assigned a qualitative benthic category at various points along each transect or at each drop camera point to assist with post processing of images where possible (see **Section 3.6.1** for benthic categories). *In situ* processing of images / video was dependent on the water clarity, heterogeneity of habitats and / or speed of tow.



### 3.5.2 Quality Assurance / Quality Control

A quality assurance / quality control (**QA/QC**) check of the data collected on each sampling day was undertaken and confirmed at the end of the day. This included the download and brief review of the image and / or video to determine quality (i.e. analysis suitability), confirmation of sites sampled for both camera operations, and review of all GPS records. The vessel's GPS and depth logs were provided by the vessel operator where applicable.

## 3.6 Image processing and analysis

### 3.6.1 Data processing

Each drop camera image and slow tow video were reviewed in detail following the field campaign. The following attributes (similar to the classification system outlined in Geo Oceans 2020) were collected for each drop camera image and at numerous points along each slow tow transect:

- Substrate type
  - Unconsolidated soft sediment e.g. sand, mud, gravel etc. (USS)
  - Consolidated hard surfaces e.g. rock, boulder, cobble etc. (CHS)
- Estimated per cent cover (**% cover**) of each habitat-forming taxa to the nearest 5% using the following categorisation:
  - Seagrass (SG)
  - Macroalgae (MA)
  - Soft corals (SC)
  - Filter feeders (FF)
  - Hard corals (Scleractinian corals) (HC)
- General comments about the condition of habitat-forming species or abiotic habitat
- Habitat complexity of reef habitats, where possible, in the following categories:
  1. High (>1 m high relief complex habitat, includes consolidated or boulder reef with/without macroalgae and corals)
  2. Medium (0.5-1 m medium relief complex habitat, includes consolidated or boulder reef with/without macroalgae and corals)
  3. Low (<0.5 m low relief reef with/without macroalgae and corals).

With respect to seagrass habitat, drop camera images were used to semi-quantitatively sample percent cover of each species throughout the Study Area using globally standardised protocols outlined in McKenzie et al (2003). Processing was undertaken by inspecting each image and assigning a total percent cover measure of seagrass, in addition to a percent cover measure for each species of seagrass as per methods outlined in McKenzie et al (2003). This data was recorded and tabulated for further analysis.

### 3.6.2 Data analysis and mapping

Biotic and abiotic image attributes collected during data processing from towed video transects and drop camera images, along with GPS coordinates, were transformed into point and line spatial datasets in ArcGIS to facilitate mapping of BCH throughout the Study Area. The use of recent aerial imagery was also used to augment this process. In addition, data collected by Geo Oceans in 2020 and O2 Marine in 2022 was used to supplement the data collected during the current survey and to aid with the interpolation process for benthic map



production. The interpolation excluded the shoreline (digitised at 1:2000 from aerial imagery dated 2 May 2023) and the area inside the shipping channel (mapped by O2 Marine; see **Figure 3**). The area inside the shipping channel was not considered to be a viable habitat for hard substratum benthic communities (i.e. macroalgae and hard corals) due to the 2022 maintenance dredging campaign and subsequent vessel disturbance and BCH data were excluded from within. Any macroalgae or hard coral that may be recorded within the shipping channel are likely to be small fragments transported by currents and unlikely to form viable reefs. *Halophila* spp. was recorded along the edge of the shipping channel during SLR's 2024 survey. This species is known to be a pioneering species with natural seasonal growth and decline in disturbed areas. Thus, soft sediment BCH may have the potential to occur along the edges of the shipping channel where it is contiguous with similar BCH.

Using the data, an interpolated map was generated to predict the distribution of BCH by building and customising an appropriate interpolation model (e.g. Natural Neighbour) across the Study Area using ArcGIS. To better examine the distribution and percent cover of seagrasses and macroalgae (the two dominant taxa identified during image processing) within the Study Area, separate maps of each were produced and presented in this report.

The mean ( $\pm$  standard error) percentage cover (abundance) for each broad taxonomic group at each location within the Study Area was also calculated.

There is an associated level of uncertainty in areas where there is no ground-truthed data. We assume the sampling effort described here provides a sufficient overview of the BCH within Location 1 and Location 2 and is broadly representative of the distribution and characterisation of BCH within Location 3 throughout the Study Area.

### 3.6.3 Data QA/QC procedure

Two internal (SLR) reviews took place following data processing and data analysis. Results at both stages was reviewed by a SLR Principle Marine Scientist before being incorporated into the report.

## 3.7 Limitations

It is acknowledged that there are various limitations associated with describing the distribution of BCH within the survey areas. The following limitations should be considered when interpreting the results presented herein:

- Spatial distribution and intensity of sampling effort
- Absence of BCH at any given sampling locations during the sampling period does not mean is not currently present
- Absence of BCH cannot be assumed from any area that has not been sampled.



## 4.0 Results

### 4.1 Benthic Communities and Habitats

#### 4.1.1 Location 1

Location 1 was characterised by soft sediment and moderately dense patchy seagrass, with sparse macroalgae interspersed throughout. Soft sediment was recorded at all sampling sites within Location 1, with an absence of hard substrate throughout this location. Of the 92 sites sampled within Location 1, bare unconsolidated sediment was observed at 36% of these sites, with the remaining 64% having seagrass and / or macroalgae coverage (**Figure 5**). Seagrass and macroalgae were observed together at 10% of the sites sampled.

Seagrass was observed at 45% of sites throughout Location 1, with most of these sites located to the west of the proposal footprint. The seagrass taxa observed included *Halophila sp.*, *Syringodium sp.* and *Amphibolis sp.*, although *Posidonia sp.* was clearly the dominant species present throughout Location 1. The mean % cover of seagrass at sites where it was observed was 51% ( $\pm 3.6$  SE). Macroalgae was observed at 28% of the sites sampled and were generally interspersed throughout much of Location 1 with no apparent spatial pattern (**Figure 5**). Based on the natural neighbour interpolation model output, seagrass coverage and the density of seagrass was highest in the southwest portion of Location 1 (**Figure 6**). Very little seagrass was observed around the existing break wall and shipping channel, and mostly sparse cover of seagrass was present within the proposal footprint for the tug harbour and Berth 8/9. Similarly, seagrass was absent or observed at low density in the northern portion of Location 1.

Macroalgae was observed at sparser densities compared to seagrass within Location 1 (**Figure 7**), with a mean % cover of 37% ( $\pm 3.6$  SE) at the sites where it was observed. The macroalgae taxa within Location 1 included mostly *Sargassum sp.* with some unidentified filamentous brown algae. Results from the interpolation model indicates that macroalgae cover was mostly sparse throughout Location 1 with several small denser patches (25%-50% cover) observed within the southern extent of the location and near the northwest and northeast corners of the study area. Some areas of macroalgae throughout Location 1 were present as 'drift' algae which was not attached to the seabed, although it was often difficult to discern between attached and drift macroalgae from the images collected. Where possible, however, only macroalgae that was deemed to be attached to the seabed was included in the analyses.

##### 4.1.1.1 Location 1 - Calculated area of BCH within proposal footprint

**Table 2** presents the estimated area of different BCH within Location 1 based on the output of the interpolated model that exists within the proposal footprint. These values have been calculated by overlaying the proposal footprint over the interpolated BCH distribution within Location 1 and determining the area of each habitat category that may be directly impacted by the implementation of the PMaxP.

A total of 7.6 ha of seagrass<sup>1</sup>, 8.9 ha of macroalgae<sup>2</sup> and 4.8 ha of bare soft sediment occurred within the proposed footprint for the tug harbour and Berth 8/9. The majority of seagrass and macroalgae within this proposed footprint (91% of seagrass and 95% of macroalgae, respectively) was considered low density cover (i.e. < 25%). No seagrass or macroalgae are expected to occur in the Berth 1 and 6 proposal footprint areas.

<sup>1</sup> This includes seagrass only and seagrass and macroalgae patches.

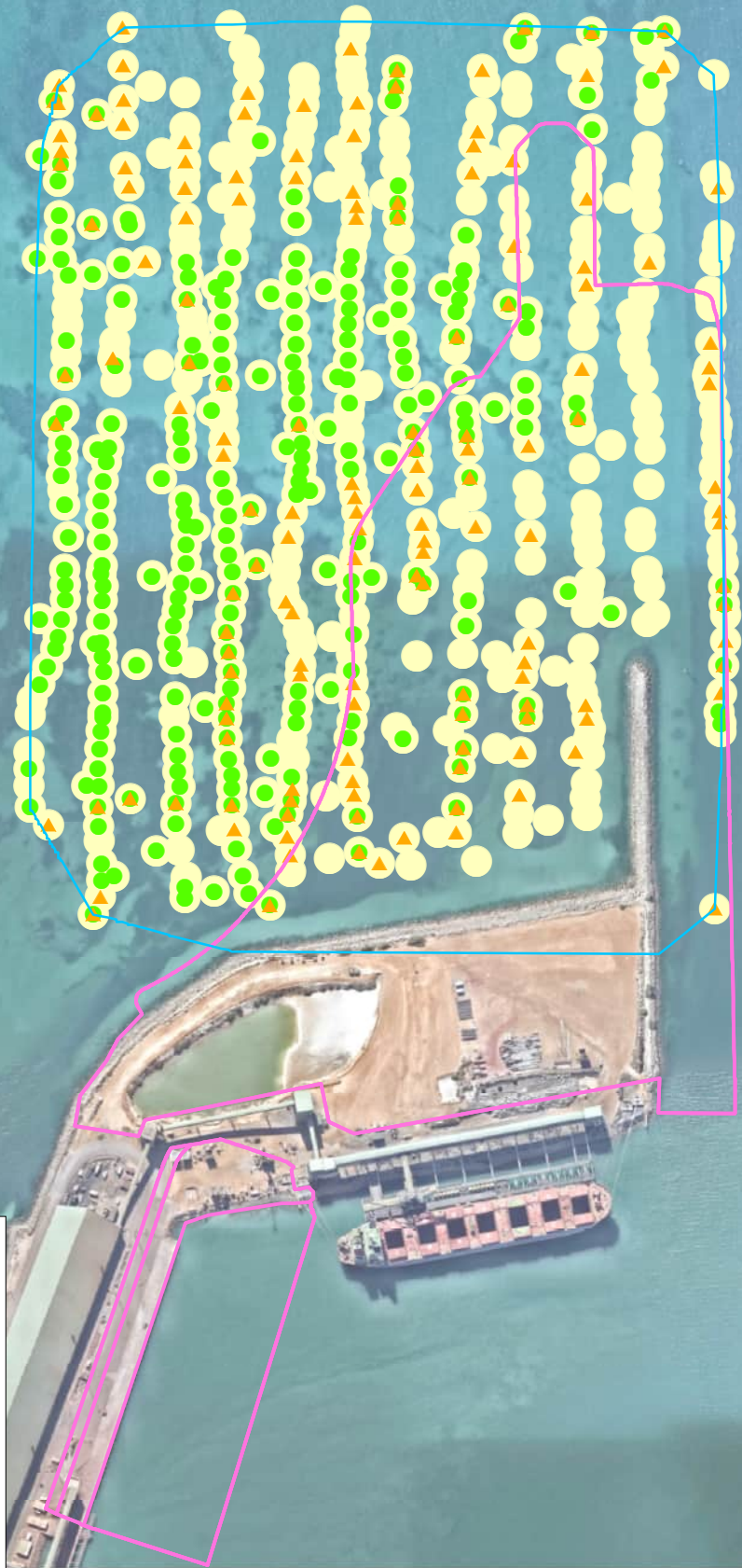
<sup>2</sup> This includes macroalgae only and seagrass and macroalgae patches.



**Table 2 Calculated area of directly impacted BCH within the proposal footprint (Tug Harbour and Berth 8/9)**

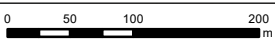
<b>Proposal footprint (ha)</b>	<b>Seagrass only (ha)</b>	<b>Macroalgae only (ha)</b>	<b>Seagrass and Macroalgae (ha)</b>	<b>Bare Soft Sediment (ha)</b>
37.6	2.5	3.8	5.1	4.8





**LEGEND**

- Proposal footprint
- Location 1 interpolation area
- Benthic communities**
- ▲ Macroalgae present
- Seagrass present
- Benthic habitat**
- Unconsolidated sediment



Scale: 1:6,000 at A4  
 Coordinate System: GDA2020 MGA Zone 50

Date Drawn: 29-Aug-2024  
 Project Number: 675.072500

Data Source:  
 Nearmap, 2 May 2023

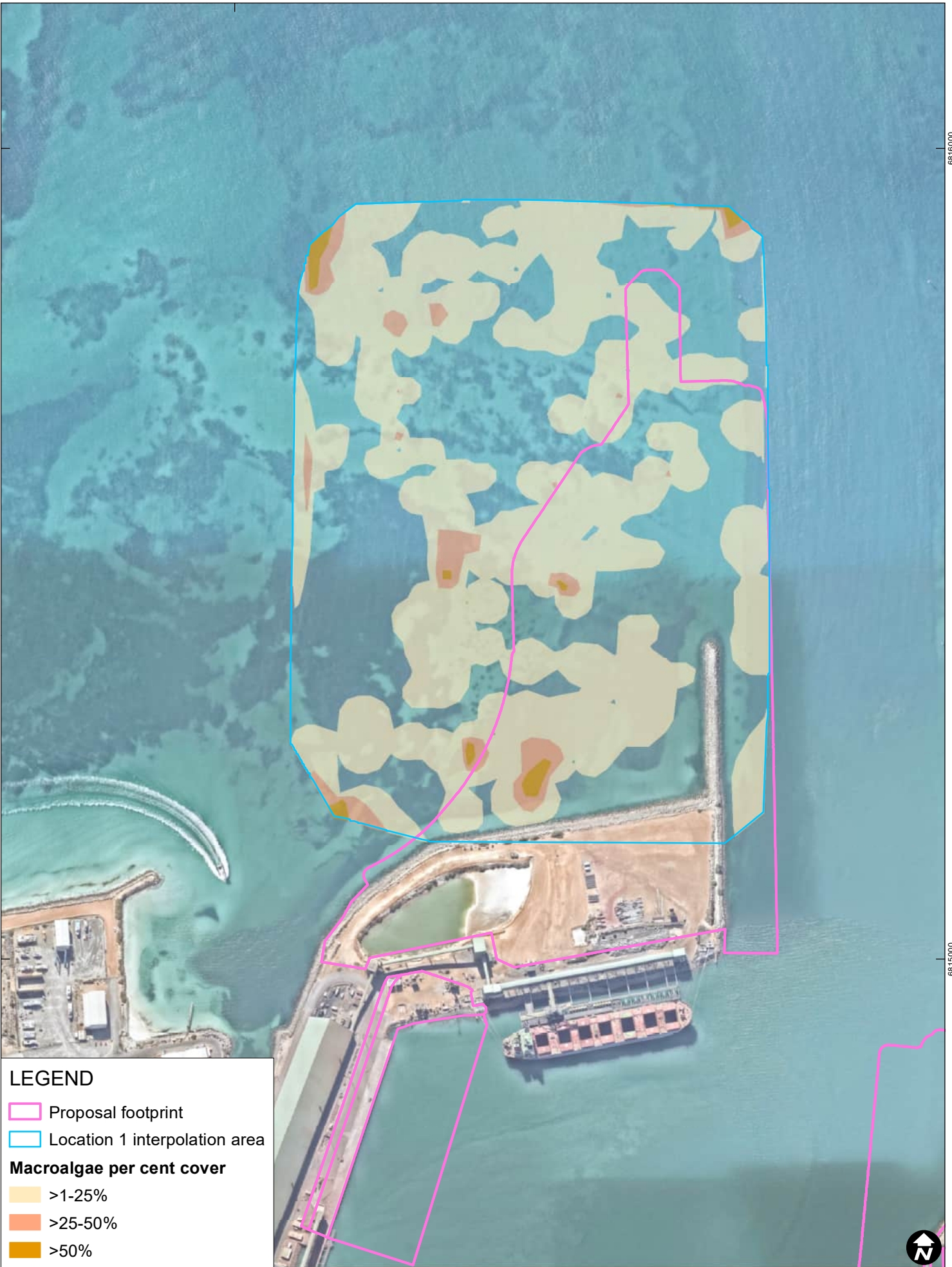


**BCH RECORDED WITHIN  
 LOCATION 1**



**FIGURE 5**






I:\AU\_SLR\_Local\Corporate\Projects-SLR\675-PER\675-PER\675-PER\675-072500\_00001\_MWPA\_PMap\_P\_Marine\06\_SLR\_Data\01\_CAD\GIS\GIS\640\_30470\_F005\_Loc1MACover.mxd

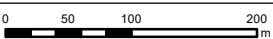


**LEGEND**

-  Proposal footprint
-  Location 1 interpolation area

**Macroalgae per cent cover**

-  >1-25%
-  >25-50%
-  >50%



Scale: 1:6,000 at A4  
Coordinate System: GDA2020 MGA Zone 50

Date Drawn: 29-Aug-2024  
Project Number: 675.072500

Data Source:  
Nearmap, 2 May 2023



**INTERPOLATED DISTRIBUTION  
AND PER CENT COVER OF  
MACROALGAE WITHIN LOCATION 1**

**FIGURE 7**

#### 4.1.2 Location 2

Location 2 was characterised by a mosaic of low to moderate profile reef and soft sediment associated with mostly low to medium density macroalgae and seagrass (**Figure 8**). Soft sediment was observed across 99% of sites, whilst rocky reef occurred at 37% of sites sampled (**Figure 8**). Seagrass was present at 83% of sites sampled whilst macroalgae was observed at 69% of sites. Seagrass and macroalgae occurred together at 61% of sites sampled in Location 2 (**Figure 8**). Bare soft sediment was observed at only 6% of sites throughout Location 2. Where rocky reef was observed it was always associated with the presence of macroalgae.

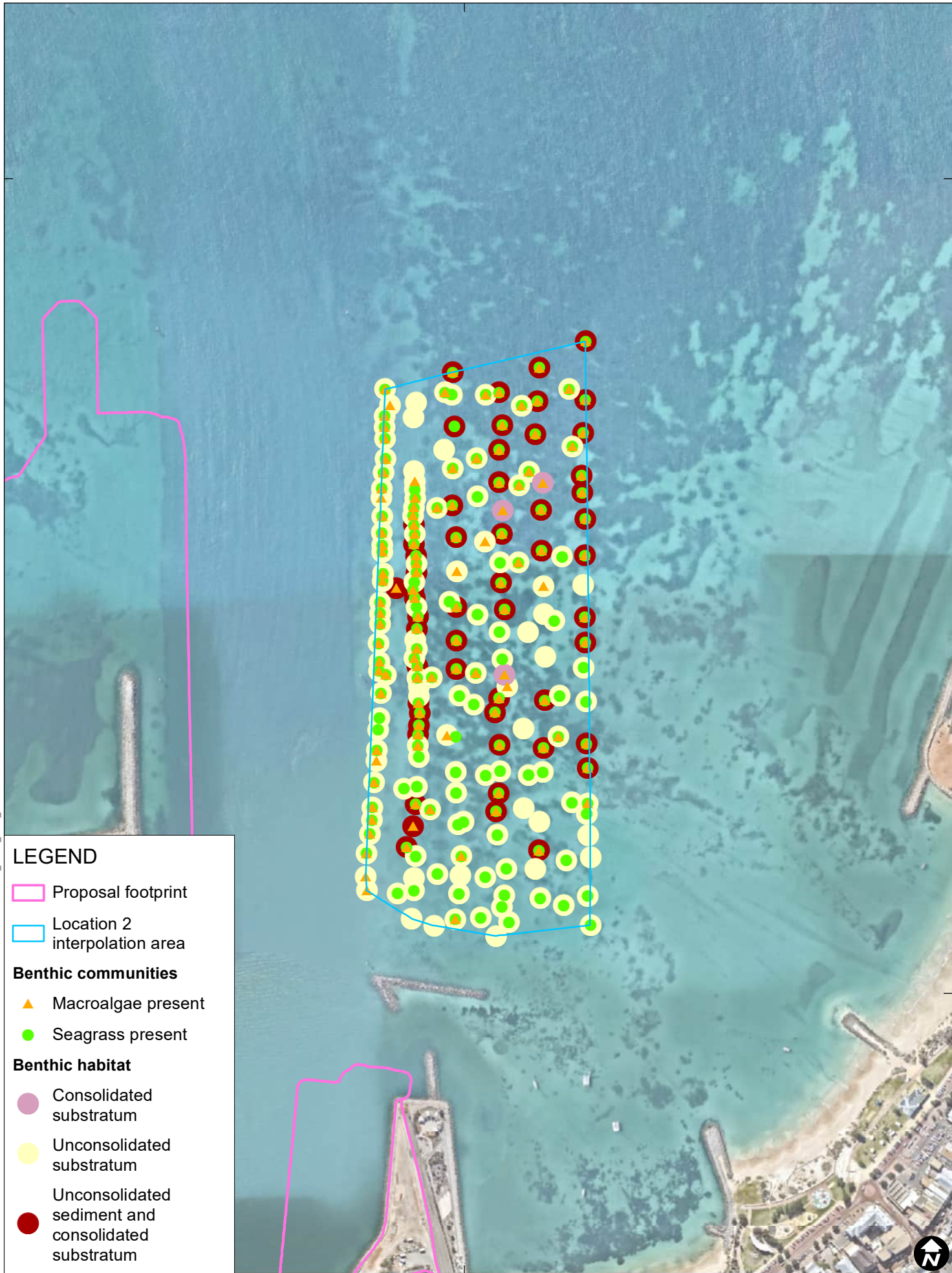
Seagrass and macroalgae were generally co-dominant across Location 2 (**Figure 9** and **Figure 10**). The mean % cover of seagrass at sites where it was observed was 35% ( $\pm 3.0$  SE). Interpolation model results indicate that low density seagrass is distributed throughout the most of Location 2 with denser patches tending to be located more in the southern portion (**Figure 9**). The seagrass taxa observed included *Halophila* sp., *Posidonia* sp., *Syringodium* sp. and *Amphibolis* sp..

Macroalgae was observed at similar densities to those recorded for seagrass throughout Location 2, with a mean % cover of 45% ( $\pm 3.4$  SE) at the sites where it was observed. A patchy mosaic of macroalgae was distributed throughout much of Location 2, although these patches tended to have greater density in the northern portion (**Figure 10**). The macroalgae taxa within Location 2 was more diverse than Location 1 and consisted of mainly *Ecklonia* sp. and *Sargassum* sp., as well as *Padina* sp., coralline algae and filamentous brown and green algae. In addition, macroalgae was present throughout the location as mostly attached to the seabed.

A few small individual hard and soft corals were also observed throughout this survey area whilst moving between transects and sampling points, although these were not sampled during image processing.

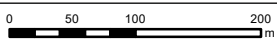


I:\AU\_SLR\_Local\Corporate\Projects-SLR\675-PER\675-PER\675-072500\_00001\_MWPA\_P\MapP-Marine\06\_SLR\_Data\01\_CADGIS\GIS\640\_30470\_F007\_Loc2SitesPA.mxd



**LEGEND**

- Proposal footprint
- Location 2 interpolation area
- Benthic communities**
- ▲ Macroalgae present
- Seagrass present
- Benthic habitat**
- Consolidated substratum
- Unconsolidated substratum
- Unconsolidated sediment and consolidated substratum



Scale: 1:6,000 at A4  
Coordinate System: GDA2020 MGA Zone 50

Date Drawn: 29-Aug-2024  
Project Number: 675.072500

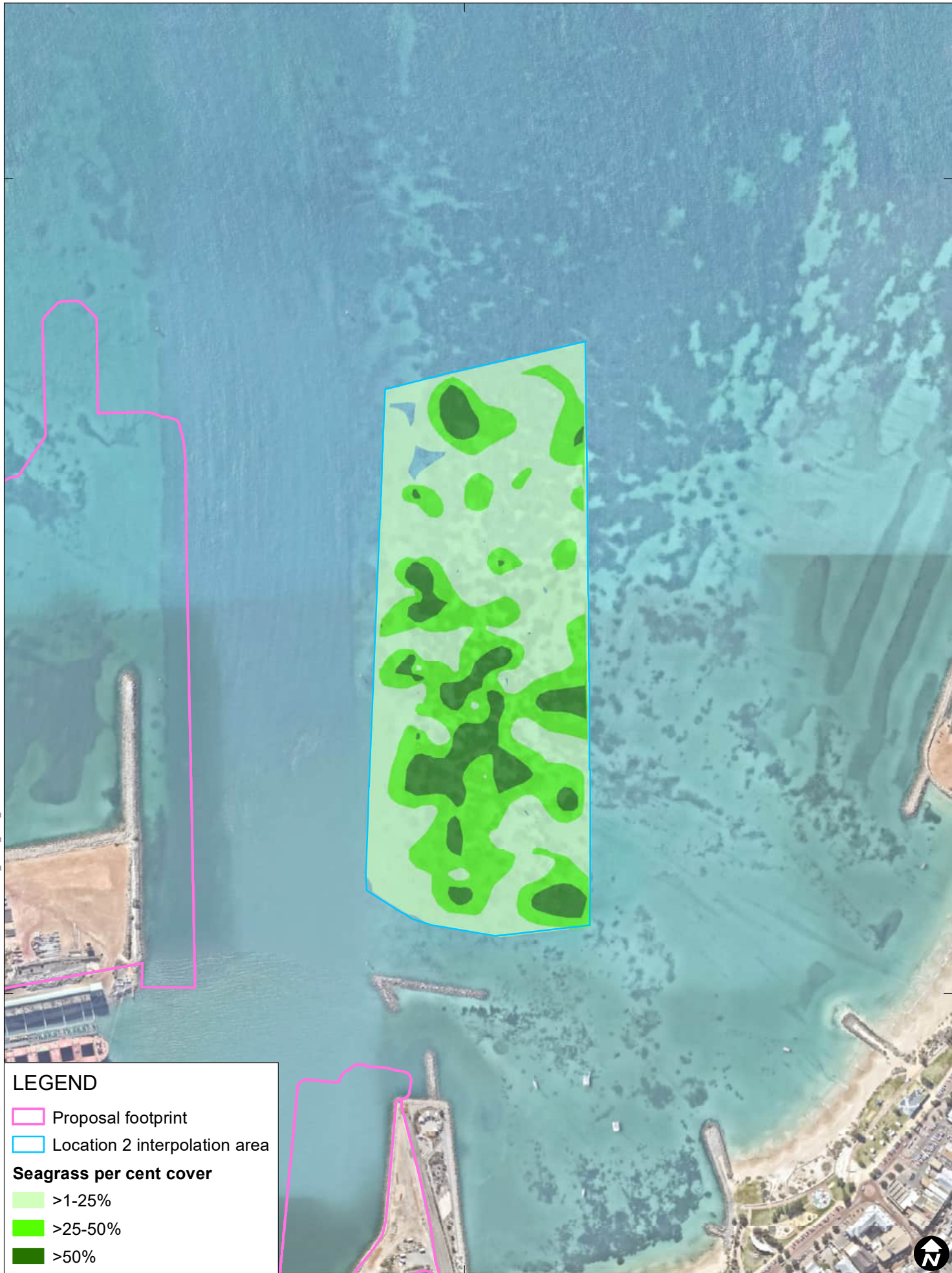
Data Source:  
Nearmap, 2 May 2023



**BCH RECORDED WITHIN  
LOCATION 2**

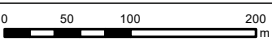
**FIGURE 8**

I:\AU\_SLR\_Local\Corporate\Projects-SLR\675-PER\675-PER\675-PER\675-072500\_00001\_MWPA\_P\MapP\_Marine\06\_SLR\_Data\01\_CAD\GIS\GIS\640\_30470\_F010\_Loc2SSCover.mxd



**LEGEND**

- Proposal footprint
  - Location 2 interpolation area
- Seagrass per cent cover**
- >1-25%
  - >25-50%
  - >50%



Scale: 1:6,000 at A4  
 Coordinate System: GDA2020 MGA Zone 50

Date Drawn: 29-Aug-2024  
 Project Number: 675.072500



Data Source:  
 Nearmap, 2 May 2023

**INTERPOLATED DISTRIBUTION  
 AND PER CENT COVER OF  
 SEAGRASSES WITHIN LOCATION 2**

**FIGURE 9**



### 4.1.3 Location 3

The BCH throughout Location 3, north of the existing shipping channel within Champion Bay, were mostly characterised by large areas of co-dominant macroalgae and seagrass which inhabited low to moderate relief rocky reef with associated soft sediment (**Figure 11** to **Figure 13**). Soft sediment was observed across 62% of sites, whilst low to moderate relief rocky reef occurred at only 3% of sites sampled (**Figure 11**). The remaining 35% of sites contained a mixture of both soft sediment and rocky reef habitat.

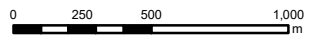
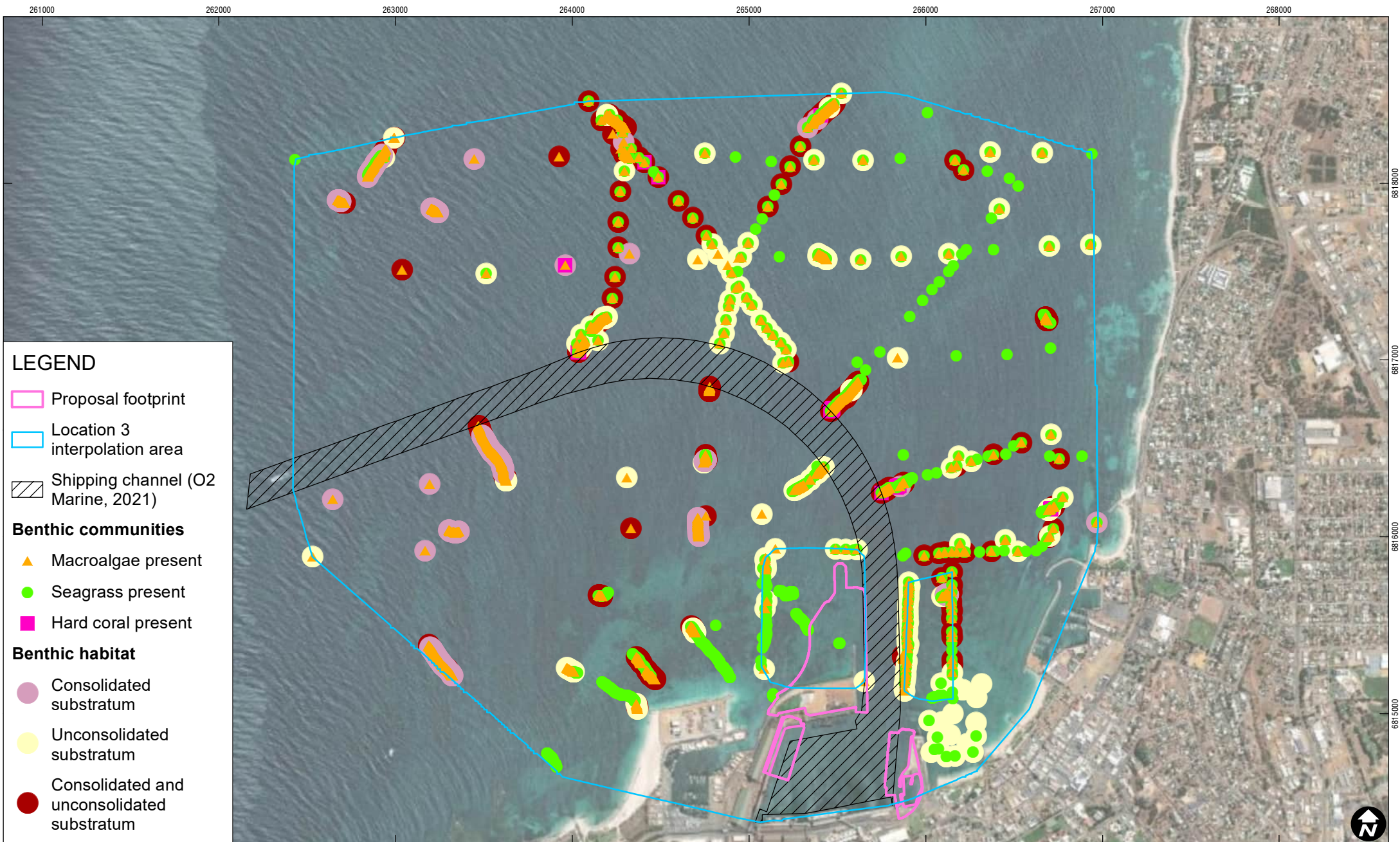
Rocky reef (consolidated substrate) tended to be observed further offshore, whilst unconsolidated soft sediment occurred closer to shore. Seagrass was present at 90% of sites sampled, with macroalgae observed at 68% of sites. Seagrass and macroalgae were recorded together at 63% of sites across Location 3. There was very little bare soft sediment observed throughout Location 3, observed at only 2% of sites sampled. Rocky reef was always observed with macroalgae present.

The mean % cover of seagrass at sites where it was observed was 48% ( $\pm 3.07$  SE). Dense meadows of *Posidonia* sp. and / or *Amphibolis* sp. were observed mostly in areas where rocky reef was absent. Seagrass tended to be more abundant in the soft sediment habitat closer to shore and further to the north and east of the location and at relatively high density at some sites (**Figure 12**), whilst rocky reef and macroalgae became more prevalent further from shore throughout the centre and western areas of Location 3 (**Figure 13**).

Macroalgae was observed at similar densities to seagrass within Location 3 (**Figure 13**), with a mean % cover of 45% ( $\pm 4.0$  SE) at the sites where it was observed. The macroalgae taxa within Location 3 was more diverse than that observed within Locations 1 and 2, and consisted of *Ecklonia* sp., *Sargassum* sp., *Padina* sp., coralline algae and a variety of filamentous brown and green algae. Very little drift algae were observed throughout Location 3, with most macroalgae observed was attached to the recorded substrate.

Some areas of low density hard coral cover (<25%) were also observed within Location 3 (**Figure 11** and **Figure 14**), and usually occurred as isolated corals within seagrass and macroalgae communities. These occurred to the north of the shipping channel (**Figure 14**). From the video footage collected, it was difficult to identify these corals, although most were likely to be from the genus *Montipora* and / or *Acropora*.





Scale: 1:27,500 at A4  
 Coordinate System: GDA2020 MGA Zone 50

Date Drawn: 29-Aug-2024  
 Project Number: 675.072500

Data Source:  
 Esri, Maxar, Earthstar Geographics, and the GIS User Community



**BCH RECORDED WITHIN  
 LOCATION 3**

**FIGURE 11**

261000 262000 263000 264000 265000 266000 267000 268000

6816000

6817000

6818000

6819000



**LEGEND**

Proposal footprint

Location 3 interpolation area

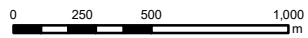
Shipping channel (O2 Marine, 2021)

**Seagrass per cent cover**

>1-25%

>25-50%

>50%



Scale: 1:27,500 at A4  
Coordinate System: GDA2020 MGA Zone 50

Date Drawn: 29-Aug-2024  
Project Number: 675.072500



Data Source:  
Esri, Maxar, Earthstar Geographics, and the GIS User Community



**INTERPOLATED DISTRIBUTION AND PER CENT COVER OF SEAGRASSES WITHIN LOCATION 3**

**FIGURE 12**

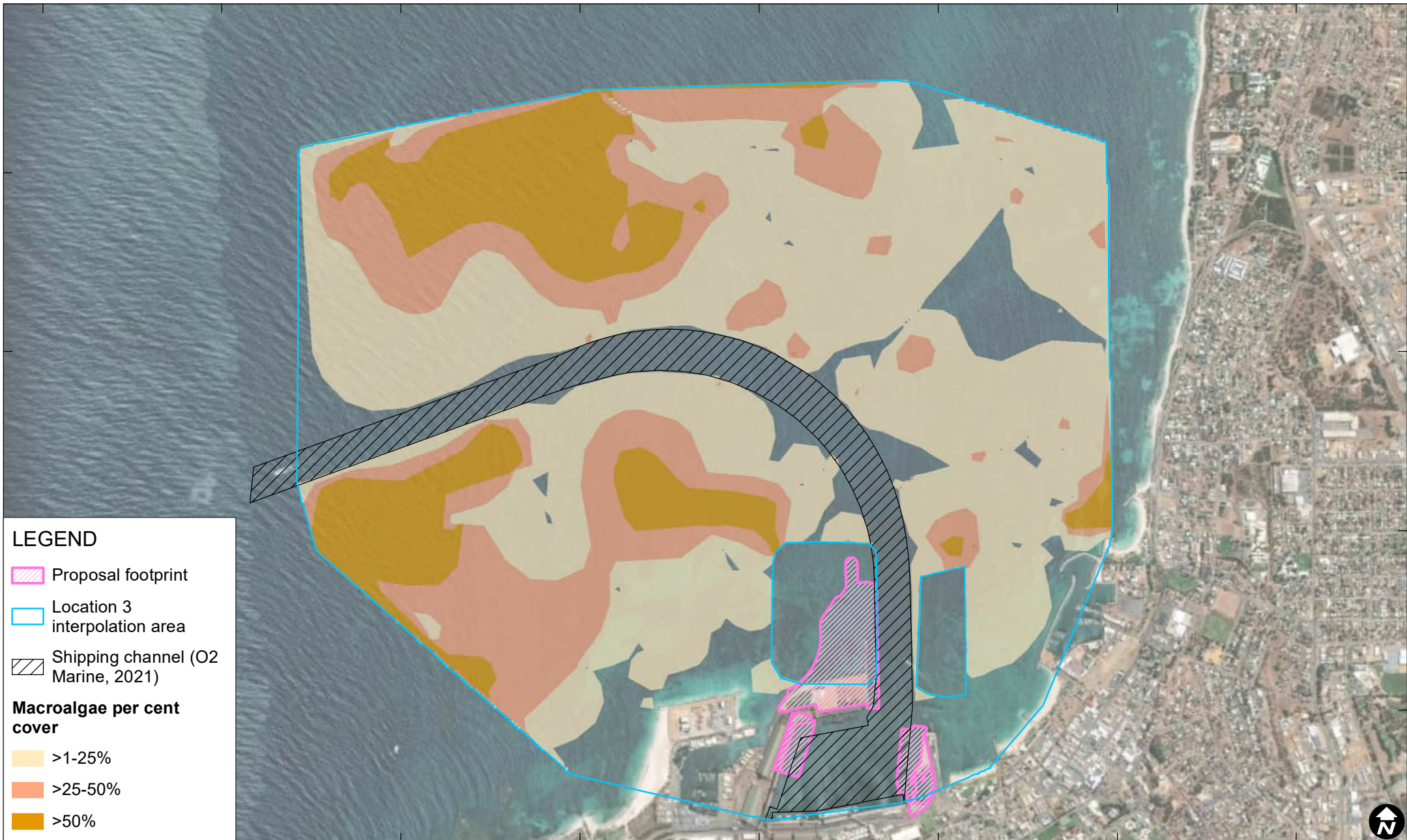
261000 262000 263000 264000 265000 266000 267000 268000

6816000


6817000


6818000


6819000




**LEGEND**


 Proposal footprint

 Location 3 interpolation area

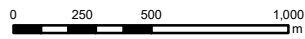
 Shipping channel (O2 Marine, 2021)

**Macroalgae per cent cover**

 >1-25%

 >25-50%

 >50%



Scale: 1:27,500 at A4  
Coordinate System: GDA2020 MGA Zone 50

Date Drawn: 29-Aug-2024  
Project Number: 675.072500



Data Source:  
Esri, Maxar, Earthstar Geographics, and the GIS User Community



**INTERPOLATED DISTRIBUTION AND PER CENT COVER OF MACROALGAE WITHIN LOCATION 3**

**FIGURE 13**

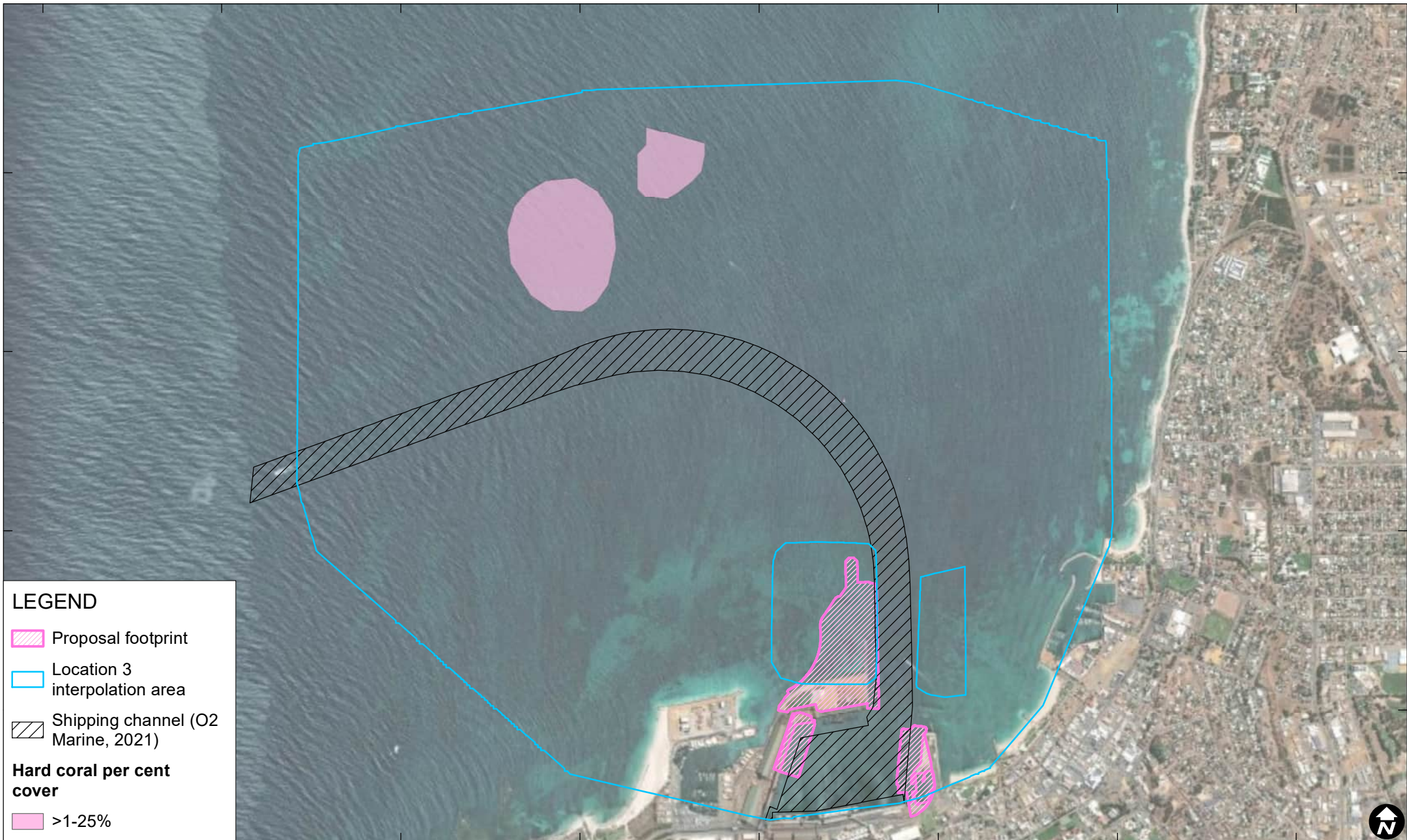
261000 262000 263000 264000 265000 266000 267000 268000

6816000


6817000


6818000


6819000




**LEGEND**

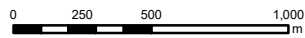
 Proposal footprint

 Location 3 interpolation area

 Shipping channel (O2 Marine, 2021)

**Hard coral per cent cover**

 >1-25%



Scale: 1:27,500 at A4  
Coordinate System: GDA2020 MGA Zone 50

Date Drawn: 29-Aug-2024  
Project Number: 675.072500



Data Source:  
Esri, Maxar, Earthstar Geographics, and the GIS User Community

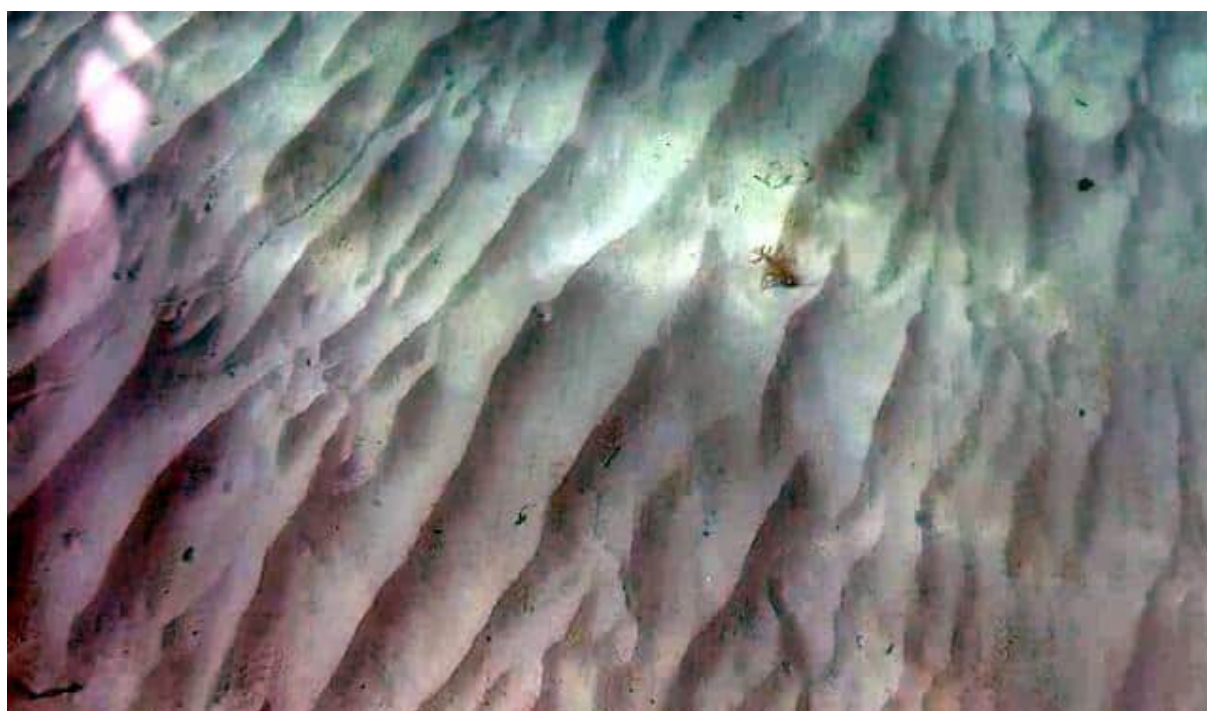


**INTERPOLATED DISTRIBUTION AND PER CENT COVER OF HARD CORAL WITHIN LOCATION 3**

**FIGURE 14**

## 4.2 Representative Images

**Plate 1** to **Plate 4** show examples of the dominant BCH categories observed throughout the three Locations within the Study Area during the survey.



**Plate 1** (Top) High density bed of seagrass (*Posidonia* sp.) within Location 1.  
(Bottom) Bare soft sediment within Location 1.





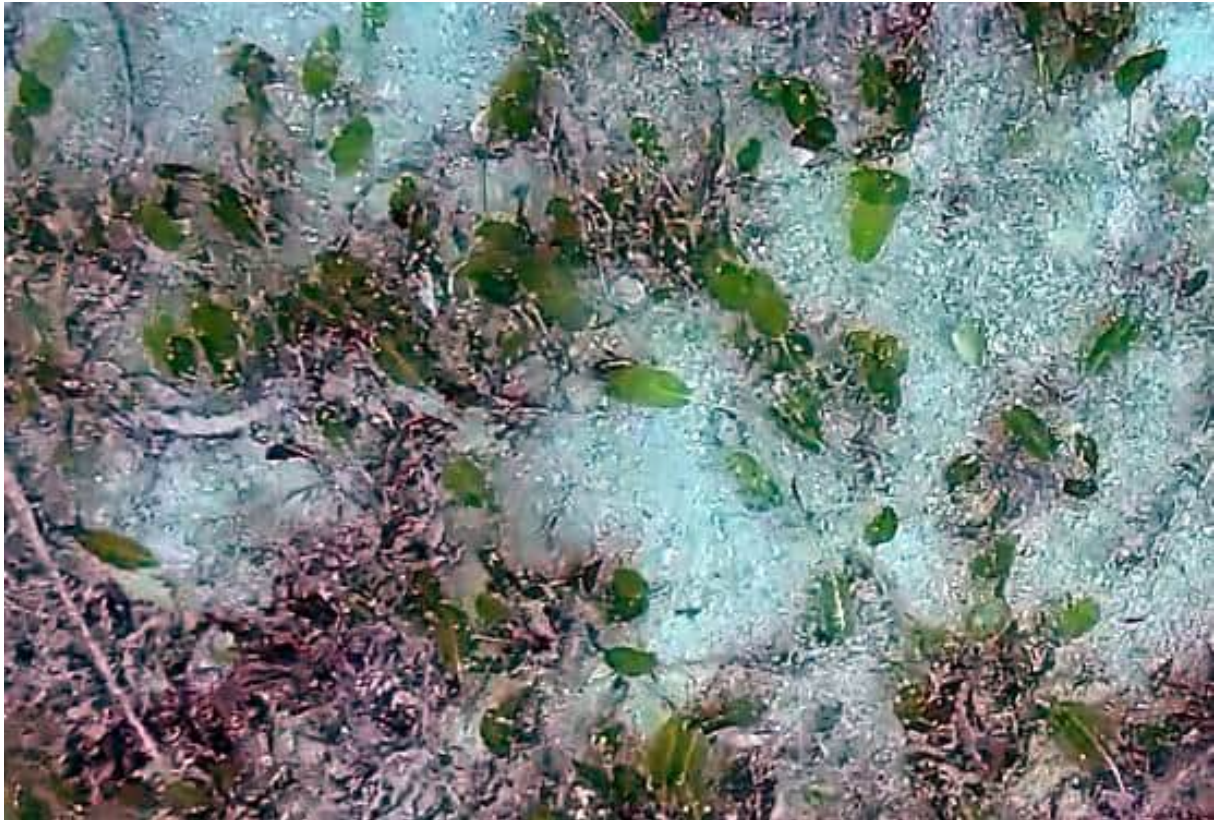
**Plate 2** (Top) Medium profile reef habitat with macroalgae and seagrass (*Halophila* sp.) within Location 2. (Bottom) High density seagrass (*Posidonia* sp.) patch within Location 2.





**Plate 3 (Top) Low profile reef habitat with macroalgae within Location 3. (Bottom) Co-dominant seagrass (*Amphibolis* sp.) and macroalgae within Location 3.**





**Plate 4** Low to medium density seagrass (*Halophila* sp.) within Location 3.



## 5.0 Discussion

The seabed throughout the Study Area was generally characterised by both sandy, unconsolidated soft sediments and patches of low-profile reef. Seagrass communities throughout the Study Area were dominated by *Posidonia* sp., *Halophila* sp. and *Amphibolis* sp., whilst macroalgae communities were dominated by *Sargassum* sp. and *Ecklonia* sp..

Location 1 consisted of large areas of bare soft sediment habitat, particularly in areas closer to the existing shipping channel near the eastern boundary of the location and within the proposal footprint. Seagrass was observed in moderate to high density towards the western side of Location 1, where it was dominated by *Posidonia* sp. and *Halophila* sp.. The main bed of moderate to high density seagrass is outside of the proposal footprint. Macroalgae was observed in mostly low density throughout Location 1 and consisted of sparse patches of *Sargassum* sp.. A total of 7.6ha of seagrass, 8.9ha of macroalgae and 4.8 ha of bare soft sediment occur within the proposed footprint for the tug harbour and Berth 8/9. The majority of seagrass and macroalgae within this proposed footprint (91% of seagrass and 95% of macroalgae, respectively) was considered low density cover (i.e. < 25%). No seagrass or macroalgae are expected to occur in the Berth 1 and 6 proposal footprint areas.

Reef habitat became more prevalent with distance from shore in both Locations 2 and 3. Very little bare soft sediment habitat was observed within these locations and a more diverse assemblage of both seagrass and macroalgae was observed compared to within Location 1. Soft sediment was dominated by moderate density cover of *Halophila* sp., *Posidonia* sp., *Syringodium* sp. and *Amphibolis* sp., whilst rocky reef was generally dominated by *Ecklonia* sp. and *Sargassum* sp., as well as *Padina* sp., coralline algae as well as filamentous brown and green algae. Macroalgae and seagrass were co-dominant throughout most of Location 2.

Location 3 was sampled at a lower resolution and spanned a much wider area compared to Locations 1 and 2. Despite this, sufficient data was captured to adequately characterise the benthic communities and habitats in this area. Reef habitat was more prevalent within Location 3 compared to the other locations, with the highest density of macroalgae observed with greater distance from shore. Layers of soft sediment across the reef made it viable habitat for seagrass to also inhabit. Seagrass was observed at moderate densities across most of Location 3, where it was dominated by *Posidonia* sp. and *Amphibolis* sp., although the area in the southwest portion of this Location was dominated by consolidated reef habitat and macroalgae. Both species of seagrass were observed in meadows as a single species but tended to occur together with moderate density macroalgae across most of Location 3. The macroalgae observed within Location 3 was more diverse than that observed in the other areas surveyed and consisted of *Ecklonia* sp., *Sargassum* sp., *Padina* sp., coralline algae and a variety of filamentous brown and green algae. A few individual observations of both hard corals were observed within Location 3.

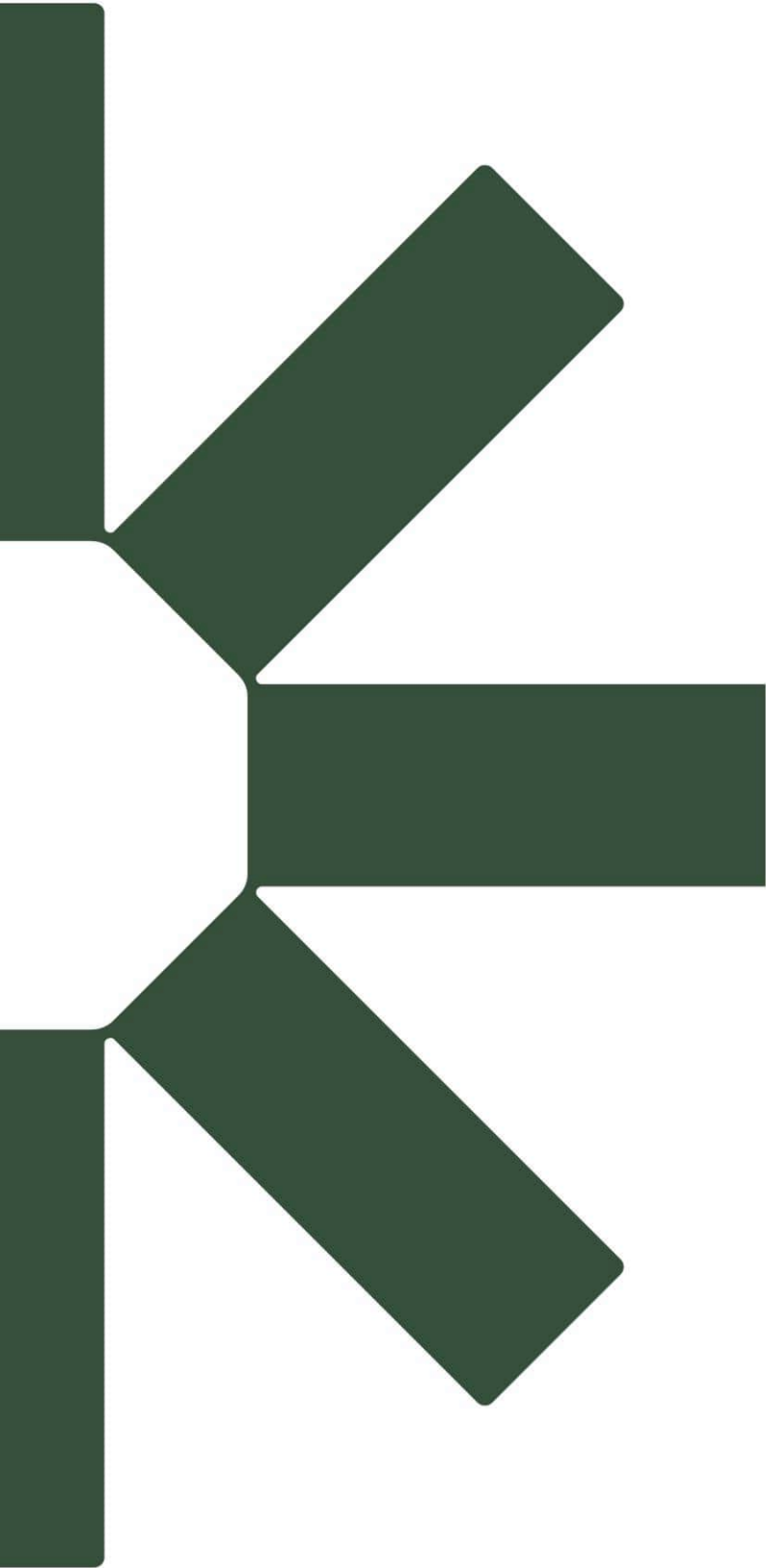
The observations made during this study are generally consistent with those made in the study undertaken by AECOM (2020) across the same area. Whilst the AECOM data employed a different approach to mapping, utilising Lidar with fewer ground-truthed data points, a generally similar distribution of habitats and species within communities were observed. These results indicate that the benthic habitats and communities observed in the area are well established, with little change taking place over the last two years. The two datasets are considered to provide a robust representation of the distribution of species, habitats and communities present within Champion Bay.



## 6.0 References

- AECOM (2020). Benthic Habitat Mapping – Champion Bay and Surrounds. Doc No. R1889/M&C4168. For Mid West Ports Authority Pty Ltd.
- EPA (Environmental Protection Authority) (2016). Technical Guidance: Protection of Benthic Communities and Habitats. Environmental Protection Authority of Western Australia.
- Geo Oceans (2020). Port of Geraldton Marine Habitat Mapping - Towed Camera Survey : May 2020. Doc Ref: VER-30139-REP-001.
- McKenzie, L.J., Campbell, S.J., Roder, C.A. (2003). Seagrass-Watch: Manual for Mapping & Monitoring Seagrass Resources (2nd ed.). Cairns: QFS, NFC.
- O2 Marine (2022). Benthic Communities and Habitat Assessment: MWPA Tourist Jetty. Mid West Ports Authority
- SLR Consulting Australia Pty Ltd (SLR) (2024). Port Maximisation Project (PMaxP) - Sampling and Analysis Quality Plan – Benthic Survey. SLR Project No.: 675.V65255.00006. For Mid West Ports Authority.





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