MID WEST PORTS

Maintenance dredging

2020 BENTHIC HABITAT MAPPING REPORT - CHAMPION BAY & SURROUNDS

Prepared by AECOM

Purpose

The report describes the marine habitats located in Champion Bay, Port Grey, Geelvink Channel and Oakajee. The report includes Benthic Habitat Maps and is supported with videos and photography.

Linkages

- Beneficial Use Assessment
- Environmental Impact Assessment

Benefits & Opportunities

- Powerful visual aid with maps, video and photography of marine habitats.
- Sites are geo-referenced, providing quantitative baseline assessments.
- Valuable data set of habitats.
- Data is easily transferrable.
- Inform future projects.

BASELINE DATA

- ✓ **Benthic habitat mapping**
- Seagrass health assessment
- ✓ **Hydrographic surveys**
- Sediment characterisation
- **Water quality and light data**
- Wind, waves, currents

Importance

This report helped to inform the environmental impact assessments and dredge plume modelling through:

- Identification of marine environments which could be susceptible to potential impacts from dredging activities,
- Identification of potential dredge material placement locations, and
- Supports the dredge environmental monitoring and management plans

Conclusions

Fourteen (14) different habitat types have been mapped within Champion Bay.

- The different marine habitats such as reefs, sand and limestone pavement influence the type of benthic communities that exist in the bay and surrounding areas.
- Exposure from prevailing south westerly swell and seas is also a key factor to the type of communities present as swells and waves play a pivotal role in the movement and dispersal of sand around the bay.
- Deposition, erosion or frequent resuspension of sand due to wave and tidal water movement greatly influences the type of seagrass, macroalgae or coral communities that will colonise certain areas in the bay.

AECOM Imagine it. Delivered.

Marine Habitat Assessment of Champion Bay & Surrounds
Mid West Ports Authority Pty Ltd
01-Sep-2020
Doc No. R1889/M&C4168

Benthic Habitat Mapping Report

Champion Bay & Surrounds

Benthic Habitat Mapping Report

Champion Bay & Surrounds

Client: Mid West Ports Authority Pty Ltd

ABN: 73 384 989 178

Prepared by

AECOM Australia Pty Ltd
Level 3, 181 Adelaide Terrace, Perth WA 6004, GPO Box B59, Perth WA 6849, Australia
T +61 8 6230 5600 www.aecom.com
ABN 20 093 846 925

01-Sep-2020

Job No.: 60626486

AECOM in Australia and New Zealand is certified to ISO9001, ISO14001 AS/NZS4801 and OHSAS18001.

Quality Information

Document	Benthic Habitat Mapping Report
Ref	60626486
Date	01-Sep-2020
Prepared by	Marthin Slabber
Reviewed by	Ian Baxter

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
A	27-Jul-2020	Final	Peter Young Associate Director - Marine Science	
0	01-Sep-2020	Final	Peter Young Associate Director - Marine Science	

Table of Contents

List of Figures

List of Plates

1.0 Introduction

1.1 Background

Mid West Ports Authority (MWPA), formerly Geraldton Port Authority, administers the Port of Geraldton which is located approximately 430 km north of Perth in the Mid West region of Western Australia. The port is the only large-scale commercial port in the region and consists of a seven-berth inner harbour, large fishing boat harbour, tug boat harbour and associated infrastructure.

MWPA intends to carry out maintenance dredging of the shipping channel and commercial port in 2021 to maintain safe navigable depths in these areas and continued safe access to the Port. As part of the preparation for this dredging, and in support of the development of the MWPA's long-term dredging strategy for the region, updated benthic habitat maps of the areas of potential impact are required to meet EPA guidelines on the Environmental Impact Assessment of Marine Dredging Proposals (EPA 2016).

AECOM has been engaged by MWPA to undertake a detailed benthic habitat assessment of communities in Champion Bay, Port Grey and Geelvink Channel. Figure 1 presents an overview of the survey area and regional bathymetry for Champion Bay and surrounds.

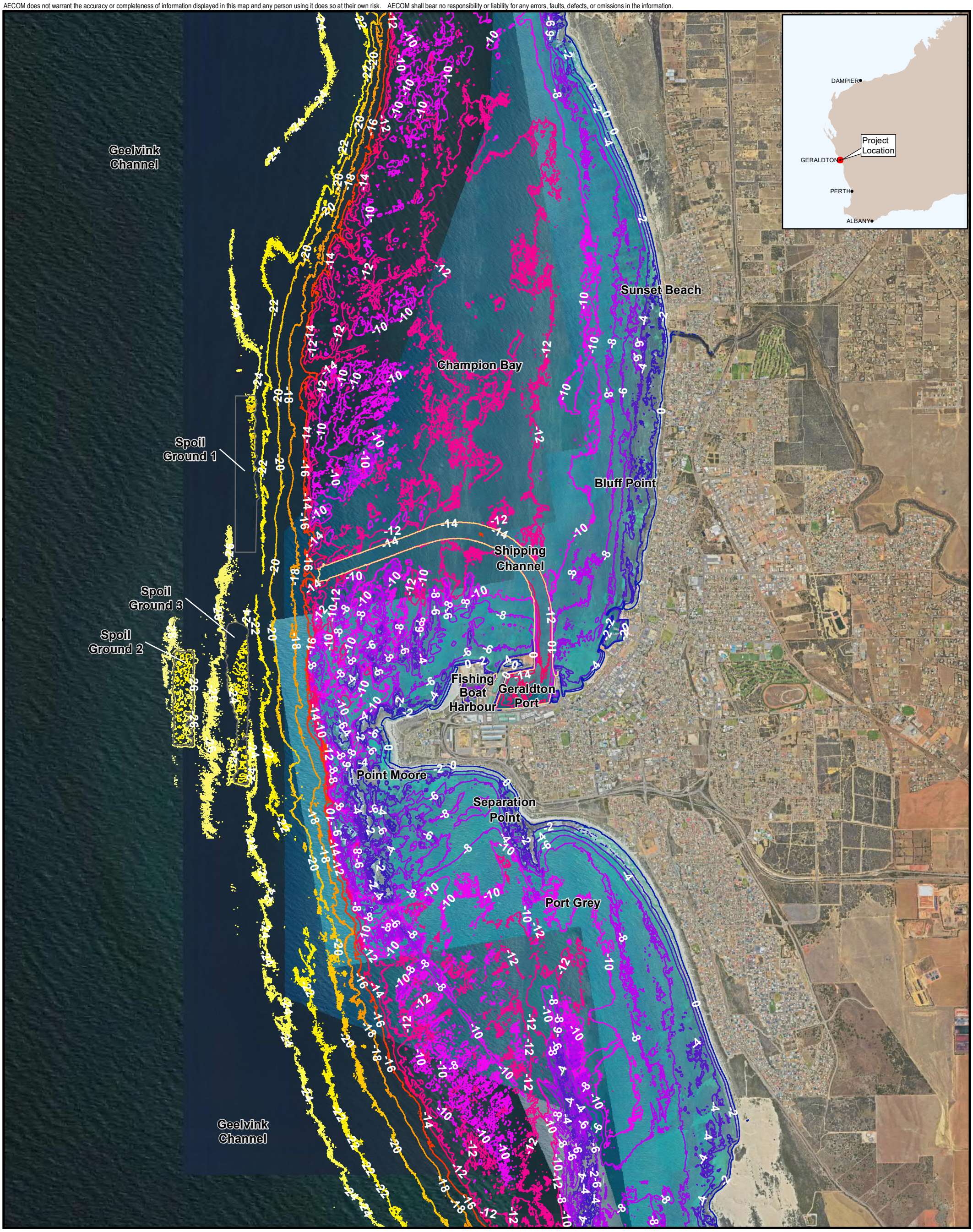
MWPA also requested a detailed assessment of benthic habitats in the Oakajee marine area. Oakajee has previously been identified as a potential location for a new large-scale commercial port to accommodate the growing demand for mining and agricultural export services in the region. An overview of the Oakajee survey area and bathymetry is presented in Figure 2.

1.2 Objectives

The objectives of this study were to:

- Implement a suitable benthic habitat assessment survey across the areas of interest including Champion Bay, Port Grey, Geelvink Channel and the Oakajee marine area.
- Generate benthic habitat maps for the areas of interest which have suitable detail to meet the requirements of environmental approvals processes.
- Produce spatial data and technical reports (this report) to describe the benthic habitats mapped and the methods employed to generate the final habitat maps.

This report details the outcomes of the habitat survey and provides a description of the habitats identified as well as the methodology employed during the data gathering and habitat mapping process.



PROJECT ID	60626486
CREATED BY	KAI.DU
APPROVED BY	M.SLABBER
LAST MODIFIED	26 AUG 2020

AECOM
www.aecom.com

N
1:51,000
(when printed at A3)

DATUM GDA 1994 MGA Zone 50
0 400 800 1,200 1,600
Metres

Data sources: Image - Landgate

LEGEND

- Spoil Ground
- Shipping Channel

CONTOUR (m)

- -30.00 - -24.00
- -23.99 - -18.00
- -17.99 - -12.00
- -11.99 - -6.00
- -5.99 - 0.00

Champion Bay and Surrounds Survey Area

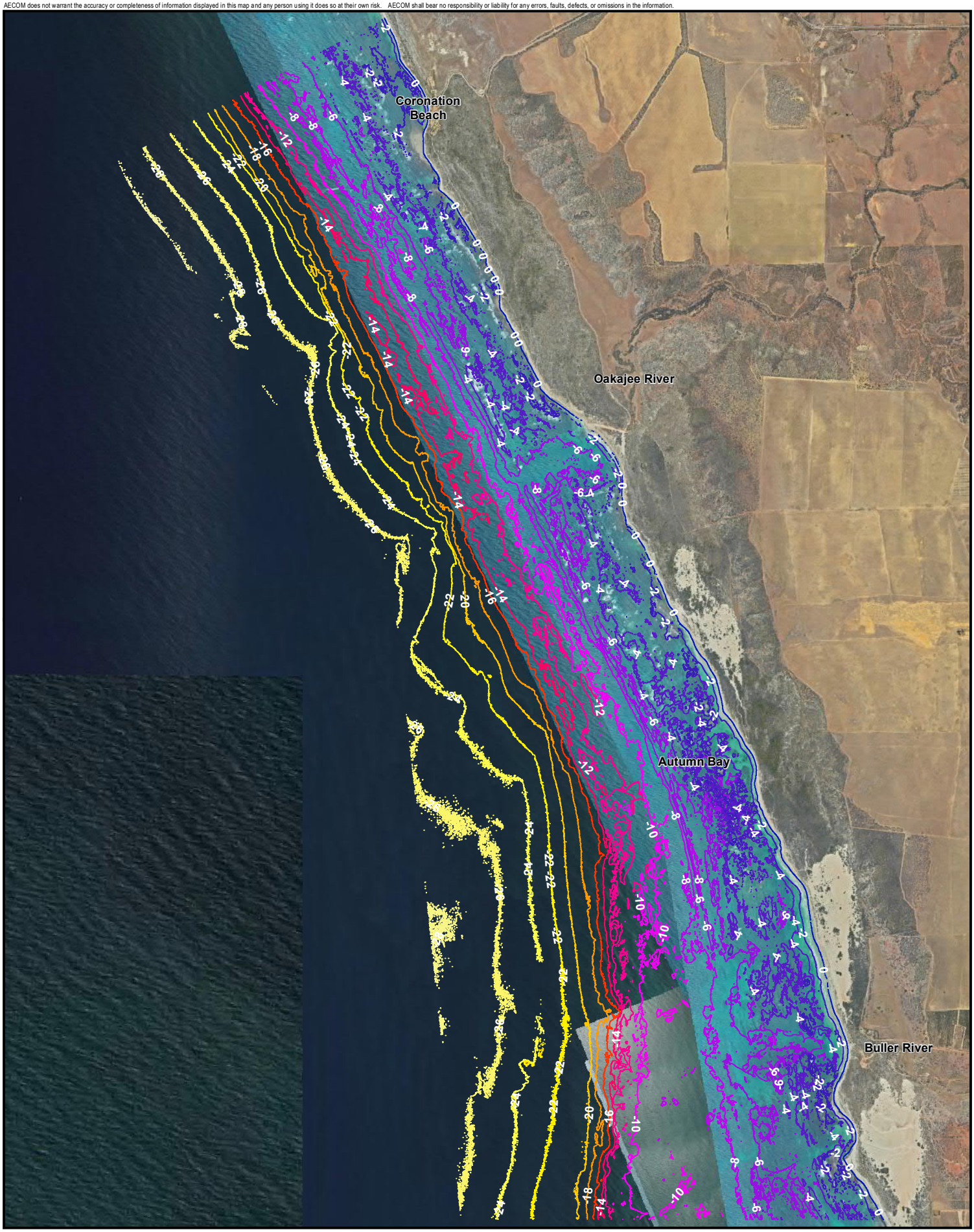
MID WEST PORTS AUTHORITY

CHAMPION BAY HABITAT ASSESSMENT

Figure 1

Map Document: \\auper1fp001\projects\606X\60626486\900_CAD_GIS\920_GIS\02_MXDs\02_AfterSurvey\Re_ClientComm\G60626486_Fig1_CamBaySurvey_v1_A3P.mxd (kai.du)

A3 size



PROJECT ID	60626486
CREATED BY	KAI.DU
APPROVED BY	M.SLABBER
LAST MODIFIED	26 AUG 2020

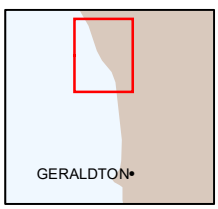
AECOM
www.aecom.com

N
DATUM GDA 1994 MGA Zone 50
1:35,000 (when printed at A3)
0 400 800 1,200 1,600
Metres

Data sources: Image - Landgate

Base Data: © Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010); Geoscience Australia; Streetpro

LEGEND
CONTOUR (m)
- -30.00 - -24.00
- -23.99 - -18.00
- -17.99 - -12.00
- -11.99 - -6.00
- -5.99 - 0.00



Oakajee Marine Survey Area

MID WEST PORTS AUTHORITY

CHAMPION BAY HABITAT ASSESSMENT

Figure 2

Map Document: \\auper1fp001\projects\606X\60626486\900_CAD_GIS\920_GIS\02_MXDs\02_AfterSurvey\Re_ClientComm\G60626486_Fig2_OakajeeSurvey_v1_A3P.mxd (kai.du)

A3 size

2.0 Methods

2.1 Pre-survey

2.1.1 Data review

Prior to the survey, a data review was conducted of previous habitat assessments and other relevant surveys in the region. This included historic habitat assessments of Champion Bay and the surrounding areas as well as those conducted for the Oakajee area. The most recent mapping of benthic habitats of Champion Bay, Geelvink Channel and Port Grey was conducted in 2001 to inform the environmental assessment requirements for the Port Enhancement Project of Geraldton Port.

The most recent mapping of marine habitats in the Oakajee area was conducted prior to 1997 as part of suite of studies to inform the Public Environmental Review for a potential new deep water industrial port at Oakajee.

The data review informed the development of the pre-survey mapping and the field survey design as well as the final benthic habitat maps.

2.1.2 Pre-survey mapping

Prior to the field survey AECOM conducted a pre-survey mapping exercise through interrogation of recent LiDAR bathymetry data collected of the Geraldton and Oakajee marine areas (Figure 3 and Figure 4) by the Western Australian Department of Transport (DoT) in 2016 (Archive 17620702 and 17620703).

The LiDAR imagery was reviewed using ArcMap software with the aim of identifying distinct substrate classes which could inform potential survey locations and provide a basis for potential habitat classes and boundaries in the final mapping. Preliminary substrate classes were mapped using the Terrain Ruggedness in Benthic Terrain Modeler tool in ArcMap. The tool completes an automated classification of the LiDAR data and assigns substrate classes predominantly based on roughness and slope. The substrate was then converted to a shapefile mapped according to the four classes listed below:

- Boulders, Cobbles, Rock
- Reef Flat/Pavement
- Sand/Mud
- Depression/Valley.

A review of the assigned classes against previous habitat maps and recent admiralty charts of the survey areas revealed a close alignment of substrate boundaries against historic benthic habitat boundaries and bathymetry contours. For example, the Boulders, Cobbles, Rock class closely aligned with areas of high profile reef previously mapped. Reef Flat/Pavement closely aligned in most areas with areas of low profile reef and reef pavement. Sand/Mud generally aligned with more low lying and topographically flat areas or areas of deep sand. Depression/Valley accounted for the offshore deeper habitats.

This mapping provided a useful basis upon which to prepare the field survey design and final habitat mapping.

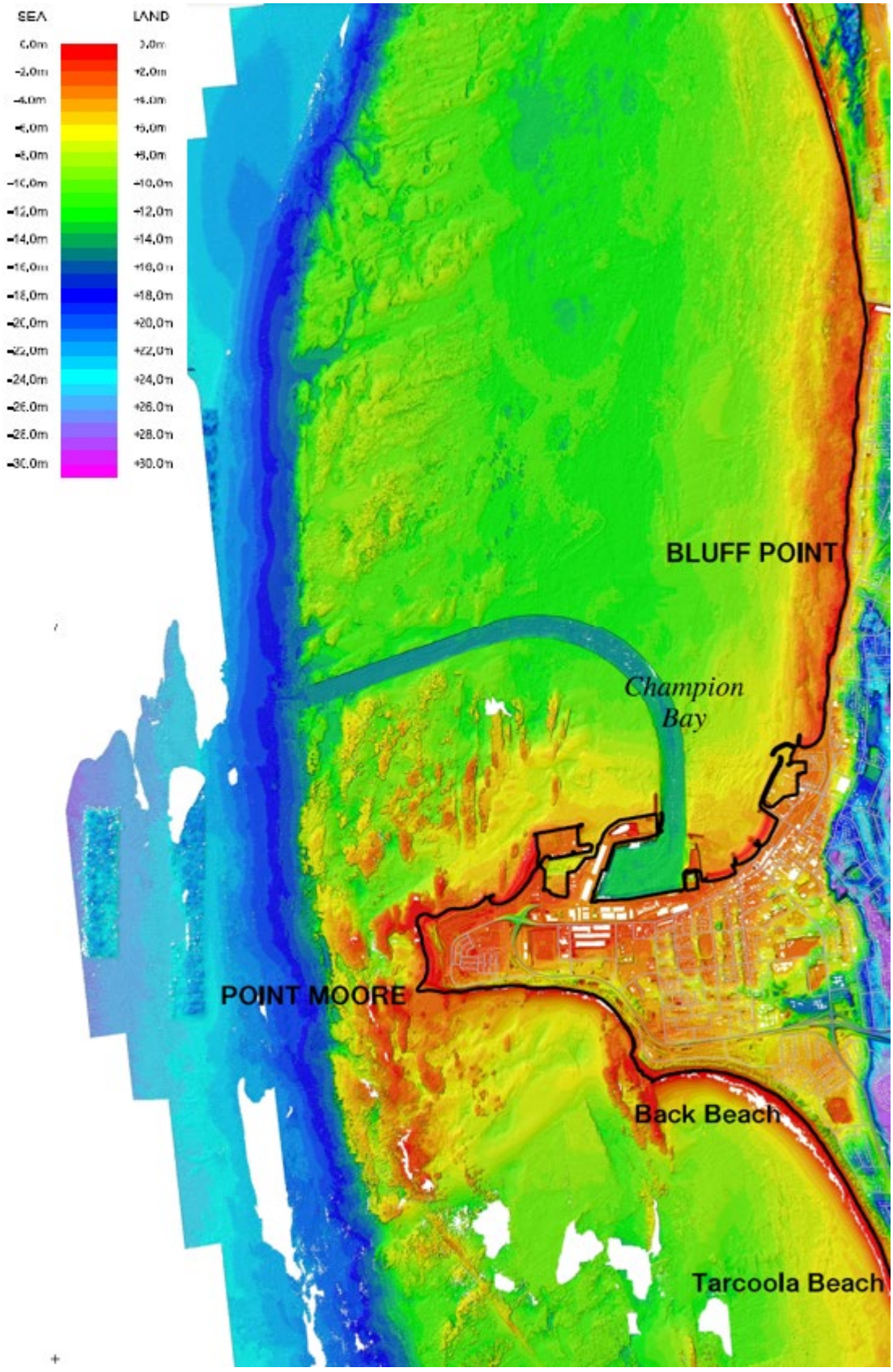


Figure 3 LiDAR bathymetry data for Champion Bay and the Geraldton area (DoT 2016)

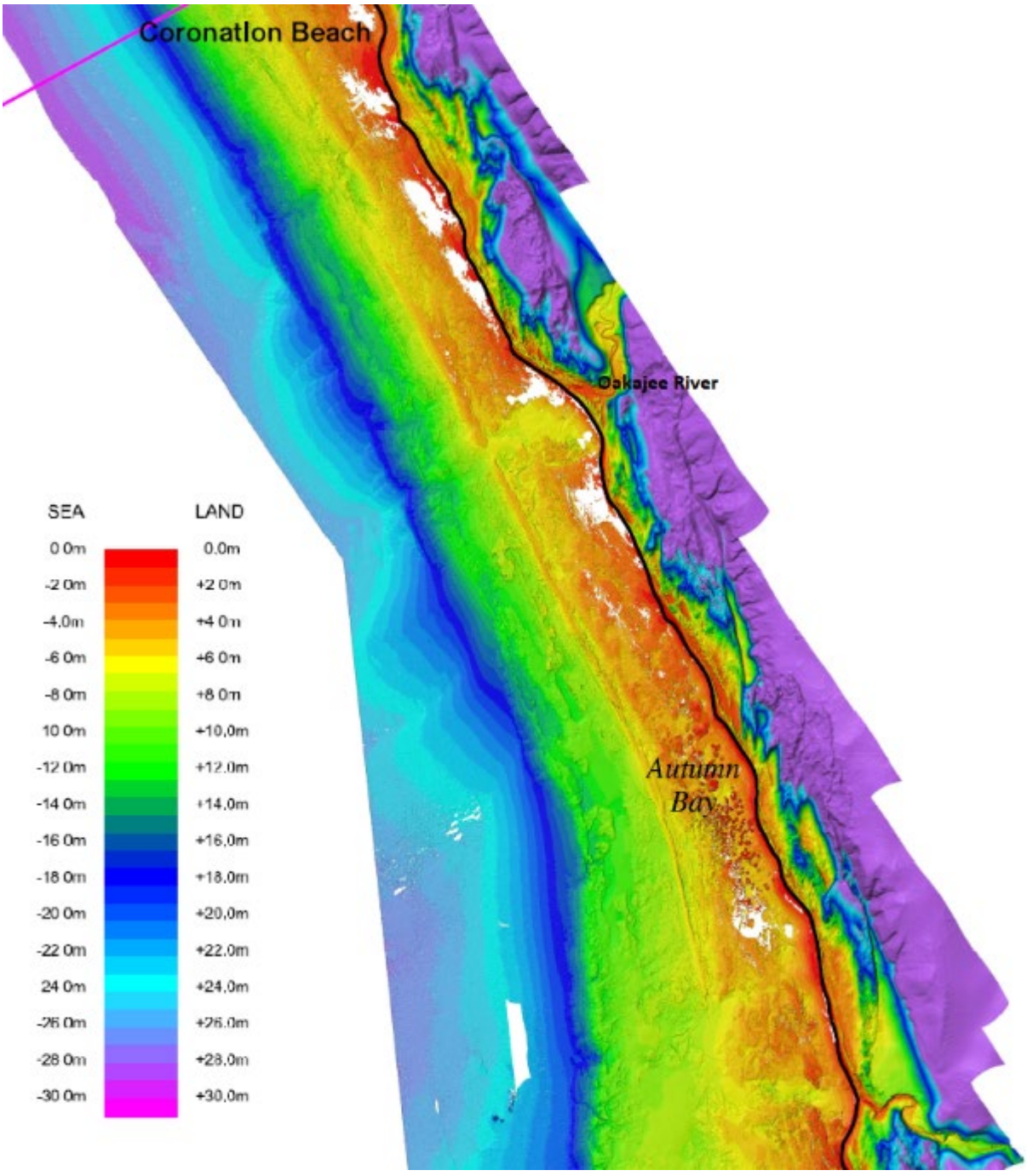


Figure 4 LiDAR bathymetry data for the Oakajee area (DoT 2016)

2.2 Field survey

The field survey component of the project was carried out by Geo Oceans. A detailed field summary report which includes a description of the field conditions, transects locations and survey methodologies, is appended as Appendix A.

2.2.1 Survey design

The field survey design was developed by Geo Oceans and AECOM with input from MWPA regarding areas of priority, with Champion Bay identified as the highest priority survey area, followed by Oakajee.

The benthic communities of Champion Bay was identified as the priority survey area, due to the upcoming plans for maintenance dredging and future maximisation of Geraldton Port. Field survey zones for Champion Bay were prioritised in the following order:

a. nearshore areas adjacent to Geraldton Port (including the fishing boat harbour);

b. benthic habitats located north to north-east of the shipping channel;

c. three (3) offshore dredge spoil grounds which were constructed during the Port Enhancement Project from 2001-2003;

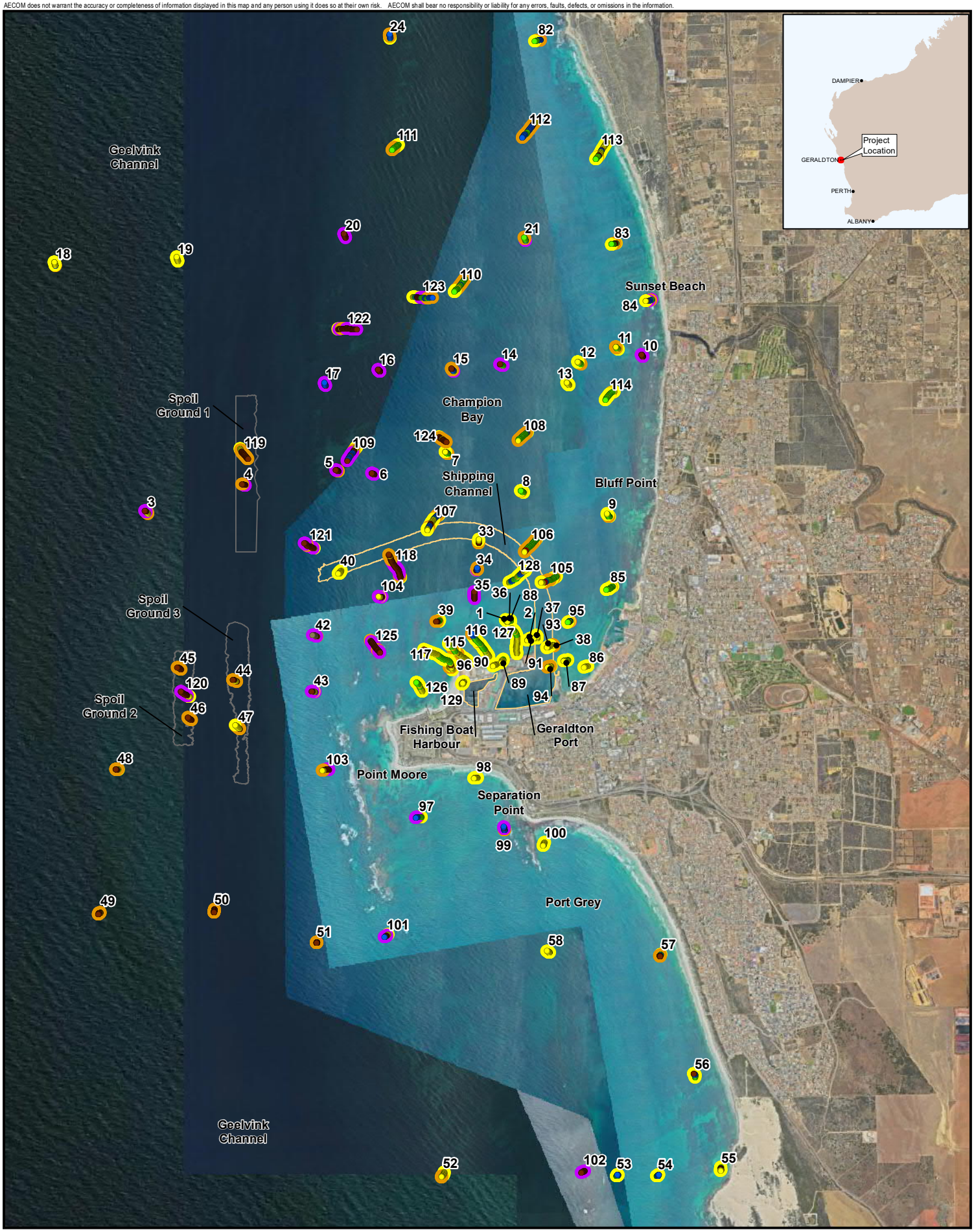
The Oakajee survey area was of lower priority as there are currently no established plans for its development. However, the MWPA requested that the area also be surveyed to establish an up-to-date data set, which provides valuable information in the event development plans for an industrial Port at Oakajee progress in the future.

Transects locations were based upon:

- areas of priority namely the nearshore areas north of the Port, the area north of the shipping channel; and the existing offshore spoil grounds;
- data from historical habitat reports; and
- the pre-survey substrate mapping discussed in Section 2.1.2.

Ninety-five (95) transect locations were initially identified prior to the survey, based upon the points mentioned previously. A further thirty-four (34) transects were added during the course of the survey based upon survey conditions and any areas of interest noted whilst in the field.

Figure 5, Figure 6 and Figure 7 show the locations of survey transects across the relevant survey areas for Champion Bay, Port Grey, Geelvink Channel and Oakajee.



PROJECT ID	60626486
CREATED BY	KAI.DU
APPROVED BY	M.SLABBER
LAST MODIFIED	26 AUG 2020

AECOM
www.aecom.com

N
1:51,000 (when printed at A3)
DATUM GDA 1994 MGA Zone 50
0 400 800 1,200 1,600
Metres

Data sources: Image - Landgate

Base Data: © Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010); Geoscience Australia; Streetpro

LEGEND

Spoil Ground
Shipping Channel

Habitat
- Seagrass
- Macroalgae
- Seagrass and Macroalgae
- Hard Coral and Macroalgae
- No Macrobiota

Substrate
- Reef
- Reef and Sediment
- Sediment

Transects in Champion Bay

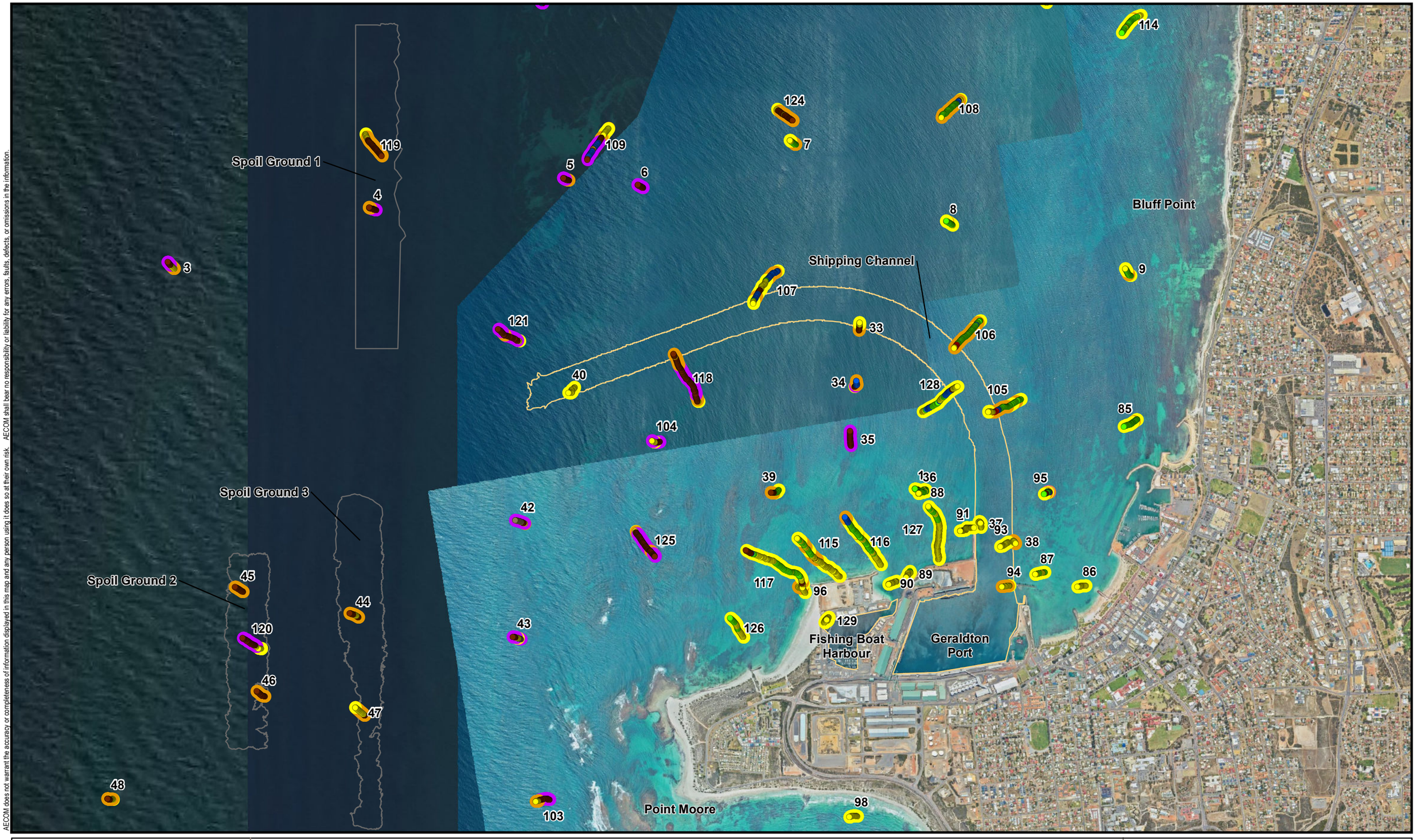
MID WEST PORTS AUTHORITY

CHAMPION BAY HABITAT ASSESSMENT

Figure 5

Map Document: \\auper1fp001\projects\606X\60626486\900_CAD_GIS\920_GIS\02_MXDs\02_AfterSurvey\Re_ClientComm\G60626486_Fig3_GeoOcean_Cham_v1_A3P.mxd (kai.du)

A3 size



PROJECT ID	60626486
CREATED BY	KAI.DU
APPROVED BY	M.SLABBER
LAST MODIFIED	26 AUG 2020

AECOM

www.aecom.com

1:25,000 (when printed at A3)

DATUM GDA 1994 MGA Zone 50

0 250 500 750 1,000

metres

Data sources: Image - Landgate

Base Data: © Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010); Geoscience Australia; Streetpro

LEGEND

Labels_Landmarks

Spoil Ground

Shipping Channel

Habitat

- Seagrass
- Macroalgae
- Seagrass and Macroalgae
- Hard Coral and Macroalgae
- No Macrobiota

Substrate

- Reef
- Reef and Sediment
- Sediment

Transects in Champion Bay Spoil Ground and Shipping Channel

MID WEST PORTS AUTHORITY

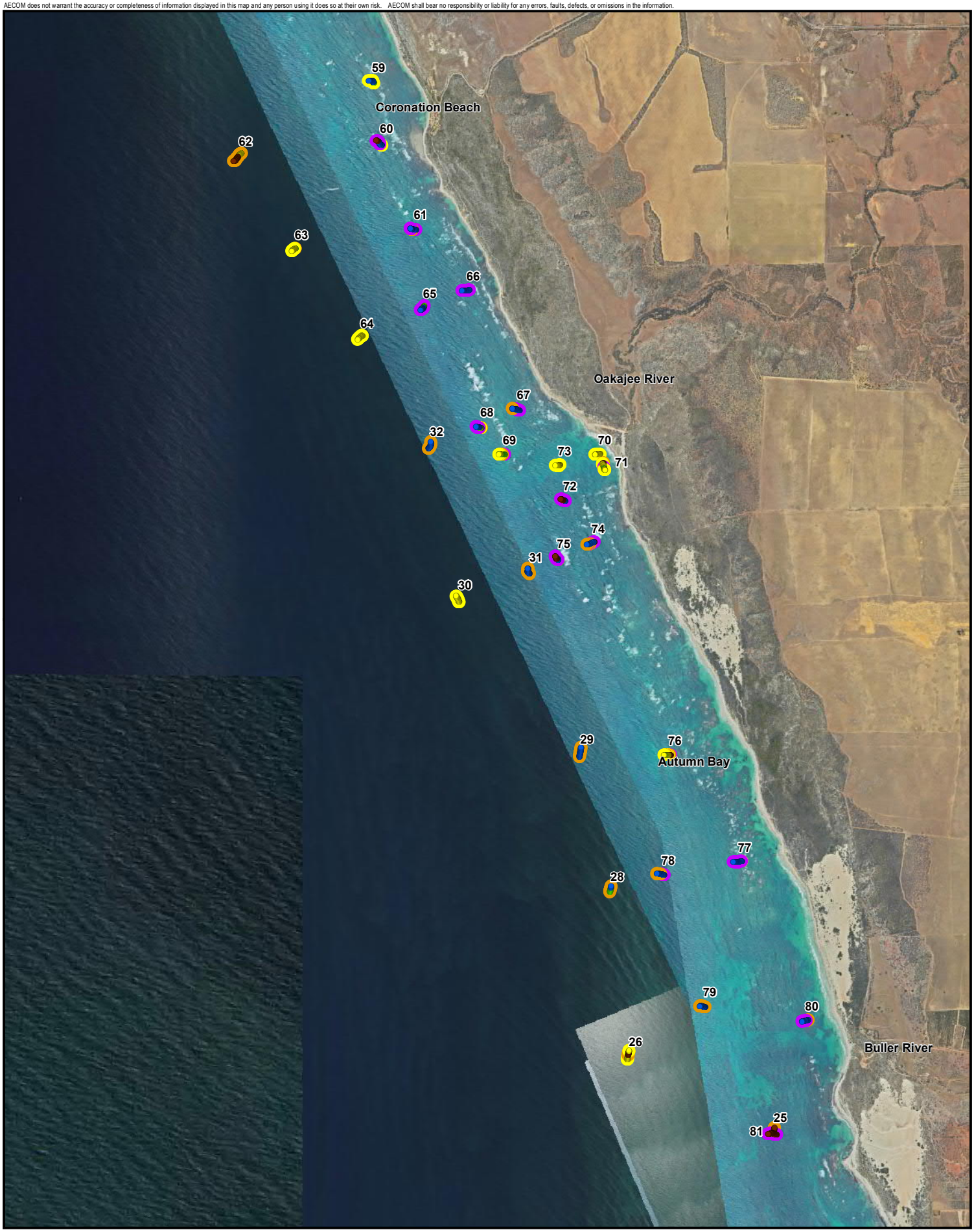
CHAMPION BAY HABITAT ASSESSMENT

Figure

6

Map Document: \\auper1fp001\projects\606X\60626486\900_CAD_GIS\920_GIS\02_MXDs\02_AfterSurvey\Re_ClientComm\G60626486_Fig4_Cham_Channel_v1_A3L.mxd (kai.du)

A3 size



PROJECT ID	60626486
CREATED BY	KAI.DU
APPROVED BY	M.SLABBER
LAST MODIFIED	31 AUG 2020

AECOM
www.aecom.com

N
DATUM GDA 1994 MGA Zone 50
0 400 800 1,200 1,600
1:35,000 (when printed at A3)
Metres

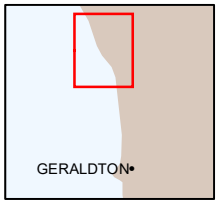
Data sources: Image - Landgate

Base Data: © Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010); Geoscience Australia; Streetpro

LEGEND

Habitat
- Seagrass
- Macroalgae
- Seagrass and Macroalgae
- No Macrobiota

Substrate
- Reef
- Reef and Sediment
- Sediment



Transects in Oakajee

MID WEST PORTS AUTHORITY

CHAMPION BAY HABITAT ASSESSMENT

Figure 7

Map Document: \\auper1fp001\projects\606X\60626486\900_CAD_GIS\920_GIS\02_MXDs\02_AfterSurvey\Re_ClientComm\G60626486_Fig5_TranOakajee_v1_A3P.mxd (kai.du)

A3 size

2.2.2 Survey dates and logistics

The field survey was undertaken between 27 April and 6 May, 2020. Field survey conditions are described in the Field Summary Report (Appendix A).

2.2.3 Data collection

2.2.3.1 Towed Video

Field data was collected primarily using a towed video set up with multiple cameras including high definition video and still images. Habitat data was recorded in real time and spatially recorded using the integrated Geo Oceans GO Visions habitat scoring and geo coding system.

2.2.3.2 Remotely Operated Vehicle

A remotely operated vehicle (ROV) was taken on the survey for a separate scope but was used to provide footage of the Seal Rocks breakwater coral habitat where tow camera use was not feasible. The ROV was also used to collect additional footage of the deeper water spoil ground areas.

A broader description of the data collection methodologies is provided in the Field Summary Report (Appendix A).

2.2.4 Habitat classification system

Habitat data collected were scored according the habitat classification scheme presented in Appendix A of the Field Summary Report (Appendix A of this report).

In summary, substrate was primarily scored for type (reef, reef and sediment, sediment), profile (<1 m, 1-4 m etc.) and structure (cobbles, unbroken rock etc.). Sediment was scored for type (gravel, sand etc), and profile (0-10 cm, 10-30 cm etc). Benthic macro-biota were scored for presence and percentage cover against five classes, with listings of taxa likely to be encountered during the survey (for example, *Amphibolis* spp. seagrass). Taxa listings were determined based upon records for the region and of taxa observed during previous surveys. The macro-biota classes were Macroalgae, Seagrass, Hard Coral, Filter Feeders and Soft Coral.

2.2.5 Data analysis and QAQC

Field data were checked for quality and accuracy at the completion of each transect and following each survey day. Additional checks were made for data packaging and file naming following the survey.

2.3 Post-survey map creation

Habitat maps were produced in ESRI ArcMap. Habitat boundaries were delineated based on a combination of LiDAR data, aerial imagery, pre-survey mapping and Geo Oceans ground truthing habitat data.

LiDAR data were captured in 2016 and were acquired from the Department of Transport. Aerial imagery was captured in 2018 and was acquired through Landgate. Although aerial imagery from 2019 and 2020 was available, 2018 imagery was used as it was a significantly clearer image captured on a calm weather day and revealed much greater benthic detail than both the 2019 and 2020 images.

In shallower areas closer to shore, habitat boundaries were delineated based upon aerial imagery. Where aerial imagery of sufficient quality was available, an automated image classification was undertaken to identify boundaries of broad benthic habitats based on image colour and texture.

The aerial image was processed in two parts (shallow and deep) to minimise the effect of water depth on the image classification process.

An Isoclass classifier was applied in ESRI ArcMap to generate a classified map image of approximately 10 classes. The classified map was then re-classified using the reclassify tool in the ArcMap Spatial Analyst toolbox to reduce the number of classes to those best resembling the benthic habitats across the region (e.g. high profile reef, pavement with sand, and seagrass habitat). A focal statistics tool with a 5 x 5 rectangular window was passed over the map with the majority value assigned to smooth the map and remove some of the results from the automated image classification process.

The raster dataset was then converted to a shapefile for manual editing and final map production. The area of each polygon was then calculated and polygons with an area of less than 10 m^2 were removed (using the Eliminate tool) to further reduce the 'noise' in the map which was a by-product of the image classification process. Manual editing of boundaries was then undertaken to fine tune the habitat boundaries to reflect the habitat classes present.

In deeper areas where aerial imagery was not usable, habitat boundaries were delineated based on LiDAR data, pre-survey mapping and ground truthing data with reference against historical map points, primarily those collected during the Port Enhancement Project habitat surveys (URS 2001). Depth contours were derived from LiDAR data and referenced against ground truthing transects and substrate classes identified in pre-survey mapping. Where ground truthing data revealed a distinct change in habitat class which corresponded with a change in depth and substrate boundary (in the pre-survey mapping), the depth contour was used to guide the habitat boundary. In areas where no ground truthing data were collected, habitat boundaries were inferred based on the substrate type, slope or elevation as mapped in the pre-survey mapping and shown in LiDAR data.

3.0 Results and Discussion

3.1 Champion Bay and Surrounds

3.1.1 Habitats Overview

The benthic habitats of Champion Bay and the surrounding area can be broken down into a range of habitats as has been identified during historical habitat surveys of the area. A key feature of the bay and the surrounding area is the limestone substrate which underlies the vast majority of the bay and surrounds (Monaghan, Rooke & Robinson 1993, 1994). Limestone reef presence, relief or reef profile, and the depth of sand overlaying reef, are key factors which influence the epibenthic communities in the bay and surrounding areas. Exposure from prevailing south westerly swell and seas is also a key factor. Such swells and waves play a pivotal role in the movement and dispersal of sand around the bay. Deposition, erosion or frequent resuspension of sand due to wave and tidal water movement greatly influences what type of epibenthic communities colonise certain areas in the bay. Key distinctions can be seen in habitats with similar depths, topography and substrate slope but with varying levels of protection from swell and waves.

With this in mind, habitats in this survey with similar substrate and water depth have been identified and described separately if distinct differences in epibenthic macrobiota have been observed. Furthermore, where possible, efforts have been made to highlight the likely key influences which distinguish each habitat.

The description of habitats identified in the Champion Bay and surrounds survey have been arranged in the context of three broad survey areas. These are:

- Champion Bay – North of the Shipping Channel and Offshore Habitats – Section 3.2
  - Deep water sand, No epibenthic macrobiota
  - Deep water pavement with sand, Macroalgae dominant
  - Spoil grounds – Gravel and rubble, Macroalgae dominant
  - Sloping pavement with sand, Low density Macroalgae and Seagrass
  - Pavement with sand, High density Seagrass
  - Pavement with shallow sand, Seagrass dominant
  - Low profile reef with sand, Macroalgae and Seagrass codominant
  - Low profile reef with deep sand, Low density Seagrass and Macroalgae
  - High profile deep reef 1-4 m, Macroalgae dominant
  - High profile shallow reef 1-4 m, Macroalgae dominant
  - Deep water reef slope, Macroalgae
  - Seal Rocks breakwater, Coral Habitat
- Champion Bay – South of the Shipping Channel - Section 3.3
  - Pavement with sand, No macrobiota
  - Pavement with sand, Low density Seagrass
  - Pavement with sand, High density Seagrass
  - Pavement with sand, Macroalgae
  - Low profile reef with sand, Seagrass and Macroalgae
  - High profile shallow reef 1-4 m, Macroalgae dominant
- South of Point Moore - Section 3.4
  - Pavement with sand, Low density Seagrass
  - Pavement with sand, High density Seagrass,

- Pavement with sand, Macroalgae
- Low profile reef with sand, Seagrass and Macroalgae
- High profile shallow reef 1-4 m, Macroalgae dominant

The benthic habitats identified in Champion Bay and the surrounding area are shown in Figure 8 and Figure 9.

3.2 Habitats of Champion Bay - North of the Shipping Channel, & Offshore habitats

The following habitats have been identified in Champion Bay, in the areas north and east of the shipping channel, and in the offshore areas (including the existing spoil grounds).

3.2.1 Deep water sand, no epibenthic macrobiota

Deep water (> 16 m) offshore habitats north west of Champion Bay were characterised by moderate to large rippled deep sand habitats supporting very little epibenthic macrobiota (Transects 18 and 19). A combination of light attenuation through the water column (leading to reduced benthic light levels) and the absence of hard substrate reduces the potential for many epibenthic macrobiota to become established.

3.2.2 Deep water pavement with sand, Macroalgae dominant

Deep water (> 16 m) offshore habitats west and south west of Champion Bay were characterised by low profile reef with interspersed sand patches on top of reef (Transects 3 and 48-51). The presence of consolidated substrate allows the establishment of greater epibenthic macrobiota, predominantly macroalgae species such as *Ecklonia* spp. and *Sargassum* spp. along with various red and brown algae species. The area would experience substantial water movement due to offshore currents and during storms which would cause regular resuspension of sand patches. This, along with the deeper water, would limit substantial seagrass colonisation although some patches of low cover *Amphibolis* and *Thalassodendron* were observed.

3.2.3 Spoil grounds - Gravel and rubble, Macroalgae dominant

All three offshore spoil grounds had similar habitats (Transects 4, 44-47, 119 and 120). The substrate consisted of largely unconsolidated mixed masses of sand, gravel, pebbles and cobbles with a moderate gradual relief of between 1–2 m across the majority of each surveyed site (Plate 1). Spoil grounds 1 and 2 consisted of a greater amount of larger material (pebbles and cobbles), whereas spoil ground 3 had more sand and gravel patches. Towards the fringe of each spoil ground a gradual transition from larger particle size material to eventual large rippled deep sand was evident.

Epibenthic biota were dominated by large (>20 cm) red and brown algae with occasional *Ecklonia* also noted. The algal assemblages varied between 10% and 70% cover, with cover generally greatest in areas with mixed sand and small to medium sized gravel and pebbles. Areas with mostly larger material, such as cobbles and rubble, had 20- 50% macroalgal over. No coral, filter feeder or seagrass communities were observed; most likely due to the unconsolidated and frequently moving substrate, water depth and strong water movement.

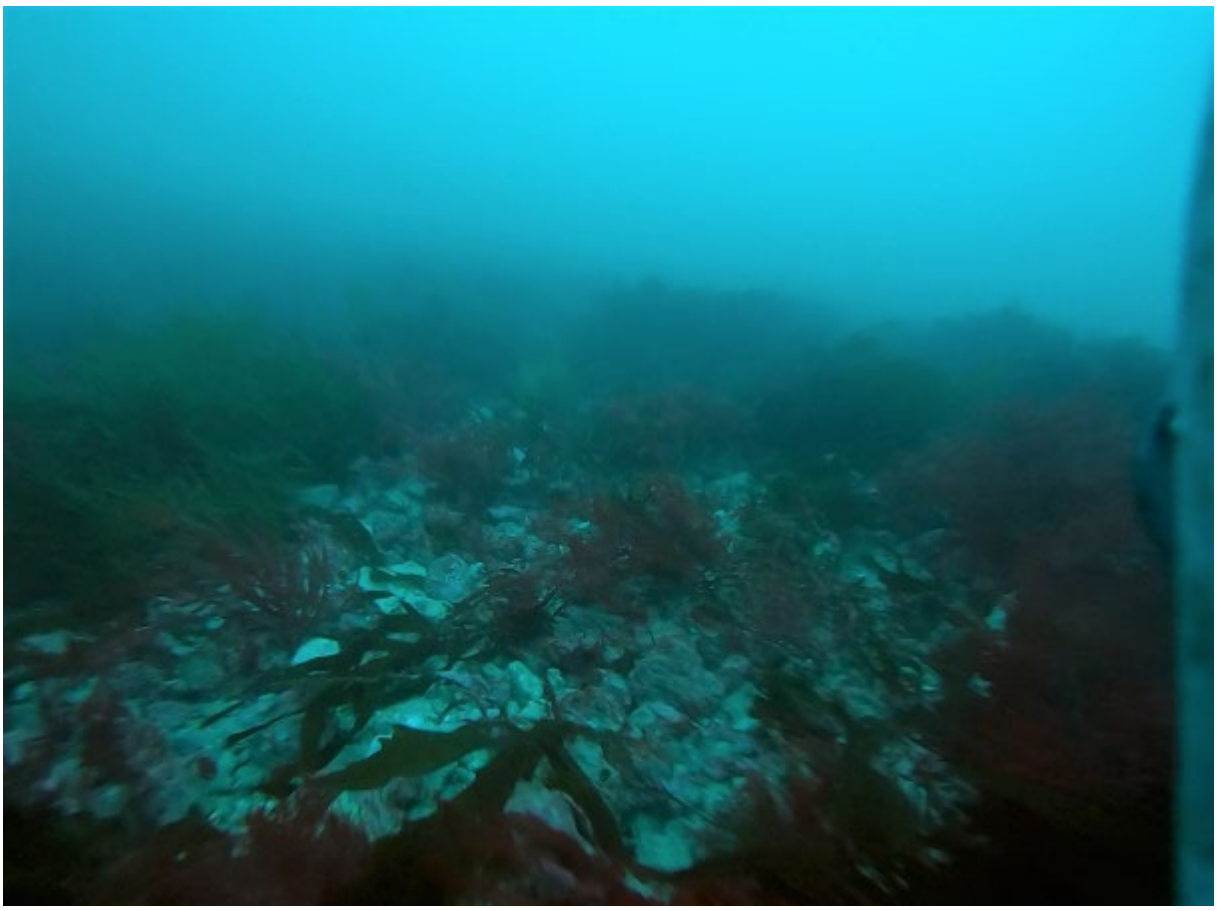


Plate 1 Spoil Ground 2 - Gravel and rubble, Macroalgae dominant (Transect 120)

3.2.4 Sloping pavement with sand, Low density Macroalgae and Seagrass

Limestone pavement, with overlying sand of varying depth which would receive regular resuspension due to waves and swell, constitutes the majority of the habitat type in the eastern side of Champion Bay. The area is characterised by gradually sloping sand veneered pavement which supports a mosaic of mixed assemblages of macroalgae and seagrass of various species interspersed with similar amounts of bare sand (Transects 11-13 and 113).

This habitat extends westwards from the shore in the north eastern portion of the bay to approximately the 12 m isobath. Approximately midway further south along the eastern shore, the pavement gives way to high profile reef areas; from here, the pavement habitat cuts inshore to the 5 m isobath and fringes the seaward margin of the high profile reef and continues in a south westerly direction towards the shipping channel. The area contains only few scattered patches of raised substrate greater than 2 m in elevation, which generally support greater densities of macroalgae than seagrass. This assertion is supported by LiDAR data which show a mostly even spacing of depth contours running parallel to the shore, with only a few raised benthic features along the 10 m isobath.

Sargassum spp. and red/brown algae are the dominant macroalgae genera, although *Ecklonia* spp. also occur in areas of exposed pavement. *Halophila* spp. and *Amphibolis* spp. are the dominant seagrasses and are found on sandy patches and sand veneered pavement areas, respectively. *Syringodium* is a subdominant seagrass which mostly occurs on areas with rougher unconsolidated substrate, such as gravel and cobbles. Although the area is colonised by equal parts seagrass habitat and macroalgae habitat, often intermixed, neither seagrass nor macroalgae were ever observed at higher than 50% cover over large distances on any of the transects completed in this area.

Despite being on the eastern side of Champion Bay, the area is too far north to receive the protection from the westerly and south westerly wave and swell impacts offered by the Point Moore headland and the high profile reef areas around the headland. As a result, considerable wave and swell

influence will likely contribute to the patchwork of seagrass, macroalgae beds and sand areas in this part of the bay (and type of habitat) due to the frequent resuspension of sand which would limit the establishment of long-term and high-cover seagrass and macroalgae beds.

3.2.5 Pavement with sand, High density Seagrass

The south eastern section of Champion Bay (Transects 9, 85, 95, 105, 106 and 114) is characterised by areas of stable sand generally overlaying pavement. The area receives some protection from large south westerly swells and waves by the Point Moore headland and consequently the area has historically supported large high-density seagrass meadows; these were also observed during this survey (Plate 2). The meadows were dominated by genera that favour low wave energy sand habitats (i.e. *Halophila, Syringodium* and *Posidonia)*. *Amphibolis*, which tends to occur more in shallower sand veneered pavements areas with higher wave energy, was also prevalent in this section of the bay, especially where the limestone pavement was exposed. Seagrass cover exceeded 50% on most transects, with over 70% cover recorded on Transect 9. A number or sponges and the occasional hard coral were also observed, especially on Transect 85.

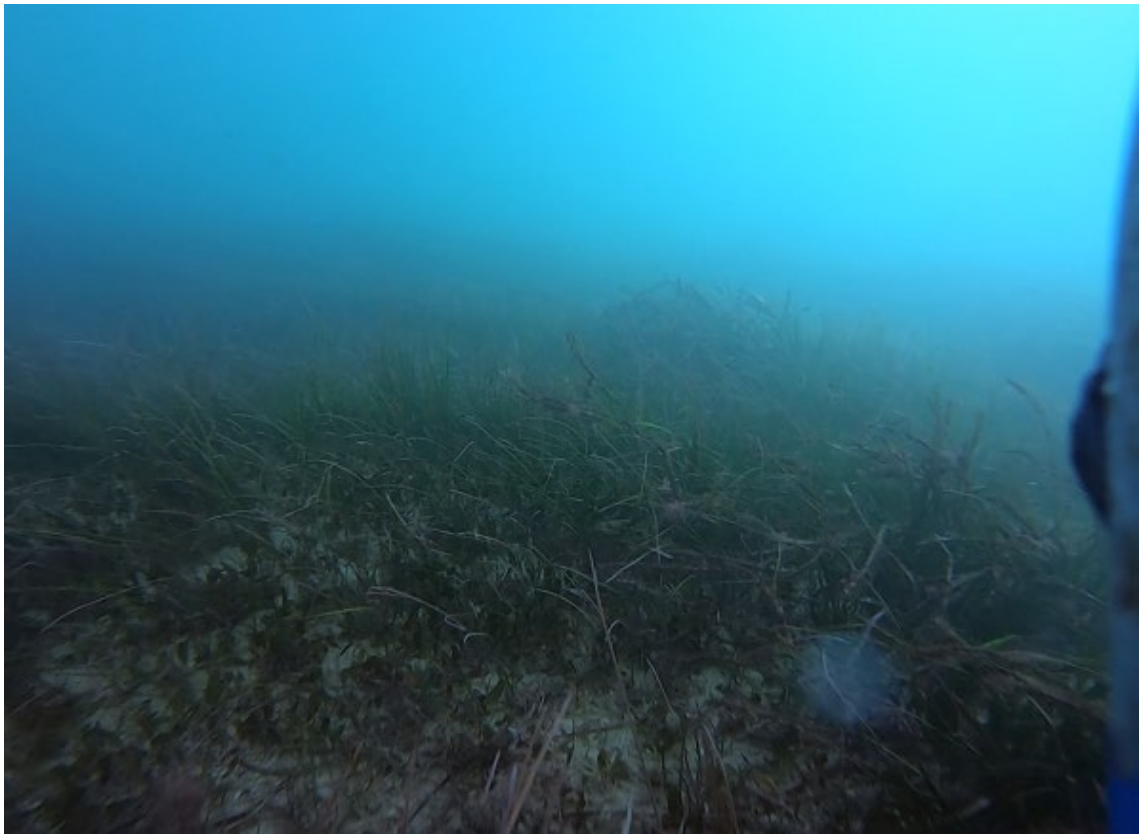


Plate 2 Pavement with sand, High density seagrass (Transect 85)

3.2.6 Pavement with shallow sand, Seagrass dominant

The seabed in the central part of Champion Bay forms a natural basin between the eastern nearshore area and the western raised reefs and is the deepest area in the bay (Transects 7, 8, 14, 21, 108, 110 and 112). Other sections towards the western reefs have deeper points, but these are generally holes or channels between raised reef areas. Despite being deeper, the central basin has a relatively flat topography (based on LiDAR data) with minimal sloping in either direction. The area is generally encircled by the 12 m isobath and borders an area of higher relief reef to the west and north, low relief sloping sand covered pavement to the east, and the shipping channel to the south.

Being deeper, and in the lee of the western high profile reefs, the area would receive some protection from oceanic swells. Most transects revealed a predominantly sand covered substrate dominated by seagrass meadows of mostly moderate to dense (up to 70% cover) *Amphibolis* (Plate 3). *Halophila* and, to a lesser extent, *Syringodium* also formed substantial meadows, mostly in the south eastern

section of this habitat, around transects 8 and 108. Low densities of small red and brown algae, *Ecklonia* and *Sargassum* were also observed on most transects. Transect 112, on the 12 m isobath with higher relief reef, had small patches of dense (up 65% cover) macroalgae beds.

Plate 3 Pavement with shallow sand, Seagrass dominant (Transect 110)

3.2.7 Low profile reef with sand, Macroalgae and Seagrass codominant

Within Champion Bay north of the shipping channel, this habitat encompasses the transition between the central basin and the high-profile deep reefs which border the entire western side of Champion Bay (Transects 14, 15, 107, 111, 122 and 123). Topographically, LiDAR data indicate the area is one of predominantly moderate profile (0-1 m) with a gradual rise of approximately 2-4 m from the border of the central basin to the base of the high-profile western deep reefs. The distinguishing feature of this habitat is the undulating, yet low profile, hard substrate in deeper water. The area supports both macroalgae and seagrass as codominant macrobiota. Macroalgae feature more on areas with higher relief, while seagrass dominates more on flatter sections which harbour sand. Both biota groups were recorded at up to 50% cover. Seagrass taxa were overwhelmingly dominated by *Amphibolis,* with occasional occurrences of *Syringodium* and *Thalassodendron. Halophila* was also common, but mostly on Transect 82 which is the most eastern extent of this habitat. Red and brown algae were the most common algal taxa and featured in all transects, while *Sargassum* with *Ecklonia* recorded the highest percentage cover, usually in areas with higher relief.

3.2.8 Low profile reef with deep sand, low density Seagrass and Macroalgae

The south eastern corner of Champion Bay is characterised by a shallow nearshore area of low profile reef consisting of rocks, cobbles and low profile limestone outcrops, surrounded by areas of mostly bare sand (Transects 38, 86 and 87). As the seabed becomes shallower towards the shoreline, progressively less limestone is exposed, and deep sand becomes more prominent. Transects revealed the reef areas to support low density small algae, with areas of sand around reef areas supporting low density *Posidonia* and *Halophila* seagrasses. Towards the western edge of this area, which borders the shipping channel, video transects revealed areas of dense seagrass wrack on bare sand.

3.2.9 High profile deep reef 1–4 m, Macroalgae dominant

The high profile deep reef habitat constitutes the high relief reefs on the western edge of Champion Bay (Transects 5, 6, 16, 17, 109, 111, 122 and 123). The area is a high energy zone which receives considerable influence from swells and waves directly from the open ocean. The area is characterised by high relief limestone rises forming a complex region of small elevated platforms and outcrops rising up to 6 m depth relative to chart datum (CD), surrounded and intersected by numerous holes, gullies and channels as deep as 12 m CD (according to LiDAR data). Due to the topographic complexity of the seabed, the area supports a diverse range of, and frequently alternating, benthic habitats within close proximity. While macroalgae in the form of red and brown algae and *Sargassum* accounts for the majority of dominant flora, transects reveal the habitat frequently alternates between dense macroalgal beds of red and brown algae, to dense patches of *Sargassum* and *Ecklonia* (Plate 4), to mixed assemblages of red and brown algae, *Sargassum,* and *Ecklonia* with a conspicuous understory of *Amphibolis* and *Thalassodendron* seagrass. Interspersed amongst these floral assemblages are substantial patches of completely bare, heavily rippled deep sand.

According to LiDAR data and supported by transect footage, the southern section of this habitat has areas of greatest relief (> 4 m) and more varied floral assemblages, while the area to the north features lower relief areas for larger distances. Notably, *Amphibolis* seagrass is much more abundant and dominant in the northern sections of this habitat compared to the macroalgae-dominated southern areas of high profile deep reef.

Plate 4 High profile deep reef, Macroalgae dominant (Transect 5)

3.2.10 High profile shallow reef 1-4 m, Macroalgae dominant

Running along the south eastern shoreline of Champion Bay from Sunset Beach southwards to Champion Bay beach, and extending approximately 400 m out from shore to approximately the 5 m isobath, is an area of dissected limestone shoreline platform with high relief at the offshore end. Transects completed in the northern section of this habitat (Transects 10 and 84) reveal an area of high relief reef face rising to a shallow shoreline platform, interspersed with numerous holes and depressions, which supports predominantly large *Ecklonia* and *Sargassum* and red and brown algae, with occasional patches of high density *Amphibolis* and *Thalassodendron* seagrass.

3.2.11 Deep water reef slope, Macroalgae

The deep water reef slope is the transition between the high profile reef line which forms the western edge of Champion Bay and the deep water offshore habitats of Geelvink Channel (Transects 20, 24, 42, 43, 103 and 121). The habitat is highly variable as it transitions from high profile macroalgae-dominated reef in relatively shallow waters (8–12 m) to the deeper (>20 m) sand and sand covered pavement offshore habitats. The area is characterised by very high profile (> 4 m) reef walls and overhangs which give way to sloping pavement into deeper water. Epibenthic biota were also highly variable. Transects 42 and 43 revealed reef covered in small red and brown algae, brown lobed algae, crustose coralline algae, and sporadic sponges and solitary hard corals including *Turbinaria*, Faviids and small *Acropora* species. On the reef walls, numerous encrusting sponges, small algae and crustose coralline algae dominate. On deeper sloping sections, undulating coralline algal-covered reef is interspersed with bare sand patches. Large *Sargassum* algae also grow on some sand-covered reef sections, albeit at low density.

Transects completed further north along the reef slope revealed lower profile sloping reef with greater sand presence which supports dense beds of *Amphibolis* seagrass in some sections (Transect 24), while other areas were more dominated by large macroalgae including *Sargassum* and *Ecklonia,* and small red and brown algae (Transect 20). Very few sponges and almost no corals were observed in the northern transects.

3.2.12 Seal Rocks Breakwater, Coral Habitat

Only two areas were identified as hard coral dominated habitat during the survey. These were the leeward sides of Seal Rocks breakwater (Plate 5) and the Eastern Rock wall. Quantitative data were not recorded for coral cover at these locations due to access restrictions; however, ROV footage of the locations revealed an area tens of meters in size with several large coral colonies (> 500 mm diameter) present. Notable genera included *Pocillopora*, *Montipora*, *Acropora* and Faviidae.

Plate 5 Coral habitat at Seal Rocks breakwater (ROV footage).

3.3 Habitats of Champion Bay - South of the Shipping Channel

The following habitats have been identified south of the shipping channel, in the area north and west of the fishing boat harbour and including the high relief reef areas offshore from Point Moore.

3.3.1 Pavement with sand, No epibenthic macrobiota

Several areas in shallow water fringing the beach front west and north of the fishing boat harbour, and north of the duck pond breakwater, consisted of deeper sand on pavement which supported little to no epibenthic macrobiota (Transects 89, 90, 96 and 115-117). Aerial imagery of the nearshore area does show darker patches in this area but transects revealed much of it to be loose seagrass and macroalgal wrack. Two areas further seaward (Transect 117) also featured sand across large areas of hundreds of meters with very little epibenthic biota. Both the nearshore and offshore areas of bare sand appeared to be areas of deeper sand on pavement. It is likely these areas are exposed to stronger tidal-forced water movement as the water makes its way through the numerous high profile reef areas. The depth of the sand, and the regular sediment resuspension and movement due to the tidal currents and wave impacts, most likely limits the establishment of seagrass or macroalgae in these areas. Notwithstanding the current survey outcomes, these areas should, however, still be viewed as potential seagrass habitats as some species, especially *Halophila,* have been known to rapidly colonise previously unvegetated sand habitats when local conditions experience change (e.g. Loneragan et al 2013).

3.3.2 Pavement with sand, Low density Seagrass

Low density seagrass meadows on sand veneered pavement accounted for a large portion of the seabed directly north of the fishing boat harbour, up to the start of the westward curve of the shipping channel. The 10 m isobath appeared to be the depth limit for seagrass dominance in this habitat. West of the fishing boat harbour, the habitat formed a band of low density meadows stretching from approximately the 4 m isobath seaward to the start of the low profile reef areas, gradually curving south towards Point Moore (Transects 1, 36, 88, 115-117, 126 and 128). Substrate in the area was characterised by moderately deeper sand veneers on pavement.

Seagrass density varied from 5% up to 50% in some parts, with *Halophila* the most common taxon. Smaller patches of low cover *Posidonia* and *Syringodium* were also observed. Notably the area envelopes smaller areas of high density (> 50% cover) seagrass meadows; this habitat is discussed in Section 3.3.3.

3.3.3 Pavement with sand, High density Seagrass

Patches of high density seagrass meadows of up to 90% coverage, dominated by *Posidonia* with a dense understory of *Halophila* (Plate 6)*,* were observed approximately 300 m offshore, directly north of the fishing boat harbour entrance (Transects 116 and 127). These areas appear as very dark patches on sand on aerial imagery, with minimal substrate elevation as informed by LiDAR data. Further areas of dense seagrass delineated through satellite imagery were also mapped west of the fishing boat harbour towards the tip of the headland. Minor patches of mixed *Syringodium* and *Amphibolis* seagrass were also noted in patches of higher density meadows, although to a far lesser extent than areas of *Halophila* and *Posidonia* dominance*.*

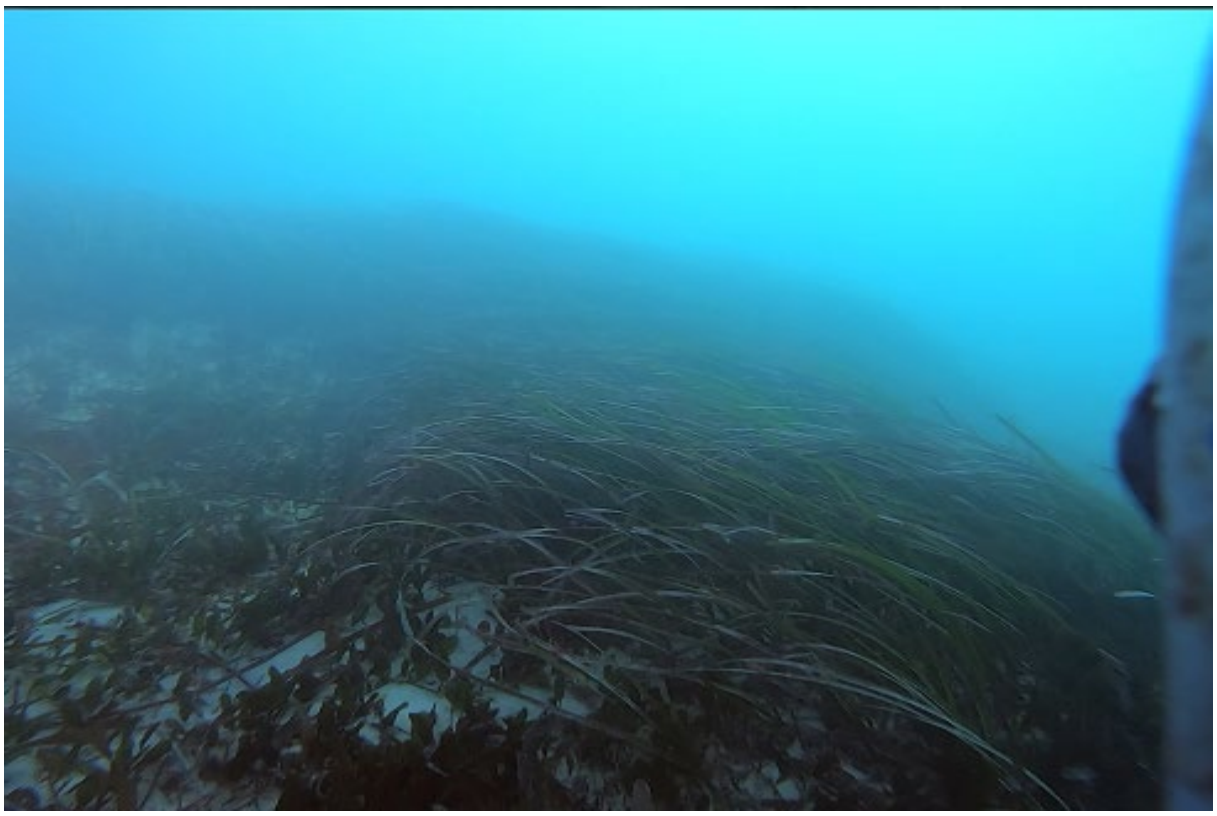


Plate 6 Pavement with sand, High density Seagrass (Transect 116)

3.3.4 Pavement with sand, Macroalgae

In deeper waters (>8 m) surrounding the high profile reef areas south of the outer section of the shipping channel, the substrate consisted of limestone pavement with shallow veneers of sand. The area supported moderate to high densities of macroalgae, with small patches of low density *Halophila* also observed. Small red and brown algae were dominant on sandier patches (generally up to 50% cover) while larger *Ecklonia* and *Sargassum* algae became dominant in areas of exposed limestone, or closer to high profile reef.

3.3.5 Low profile reef with sand, Seagrass and Macroalgae

Similar to the low profile reefs surrounding the high profile areas north of the shipping channel, those south of the shipping channel were typically areas of undulating substrate comprising a mix of low profile limestone rises predominantly colonised by macroalgae, interspersed with sand inundated deeper pockets supporting mostly seagrass (Transects 39, 103 and 116, Plate 7). Sections of higher relief with less sand inundation supported dense communities of small red and brown algae, *Ecklonia* and *Sargassum.* Sandier patches supported *Halophila* and *Posidonia* which, notably, is distinct from the northern low profile reef areas where *Amphibolis* was overwhelmingly the more dominant seagrass taxon observed. Small occurrences of *Amphibolis* mixed with *Posidonia* were also noted.

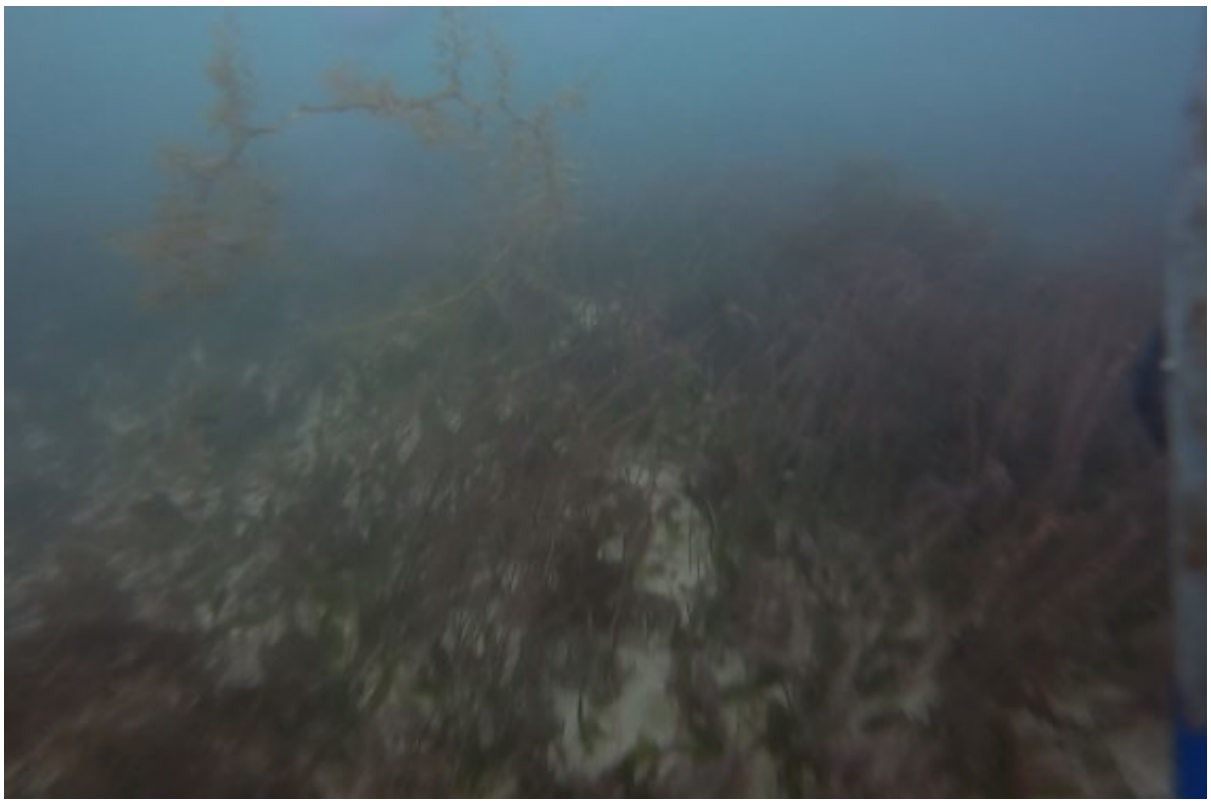


Plate 7 Low profile reef with sand, Seagrass and Macroalgae (Transect 39)

3.3.6 High profile shallow reef 1- 4 m, Macroalgae dominant

High profile shallow reef south of the shipping channel consisted of a topographically complex series of high profile (>4 m) limestone pinnacles, ridges and elevated platforms which rise from 7–10 m up to 2 m below sea level in some instances (Transects 35, 42, 43, 104, 118 and 125). Numerous caves, shelves and large overhangs were also noted. Macroalgae dominate the floral assemblages, with *Ecklonia* colonising the steeper reef sections and *Sargassum* typically occupying the flatter reef areas (Plate 8). Crustose coralline algae were also very prevalent, occupying most surfaces not covered by the larger macroalgae (Plate 9). Transects completed on the western-most reefs (Transects 42 and 43) revealed much less large macroalgae growth, with smaller *Sargassum*, red and brown algae, and crustose coralline algae occupying most reef surfaces. Isolated corals and various sponges were also noted in several places. This reduction of flora biomass can likely be attributed to the increased wave energy reaching these western reefs; this would limit the holdfast ability of larger algal species.

The areas between the raised reef sections tended to harbour sand and supported mostly smaller *Sargassum* and red and brown algae, with isolated patches of low density *Halophila* and *Posidonia* in the lee of some reefs.

LiDAR data indicated a notable difference between the shallow high profile reef areas north of the shipping channel and those in shallower water south of the channel. Those north of the channel consist of larger expansive raised platforms and shelves intersected by deep holes, gullies and channels. South of the channel, however, the reefs are further apart and can be described more as upward projections and a series of ridges from an otherwise mostly deeper surrounding seabed.

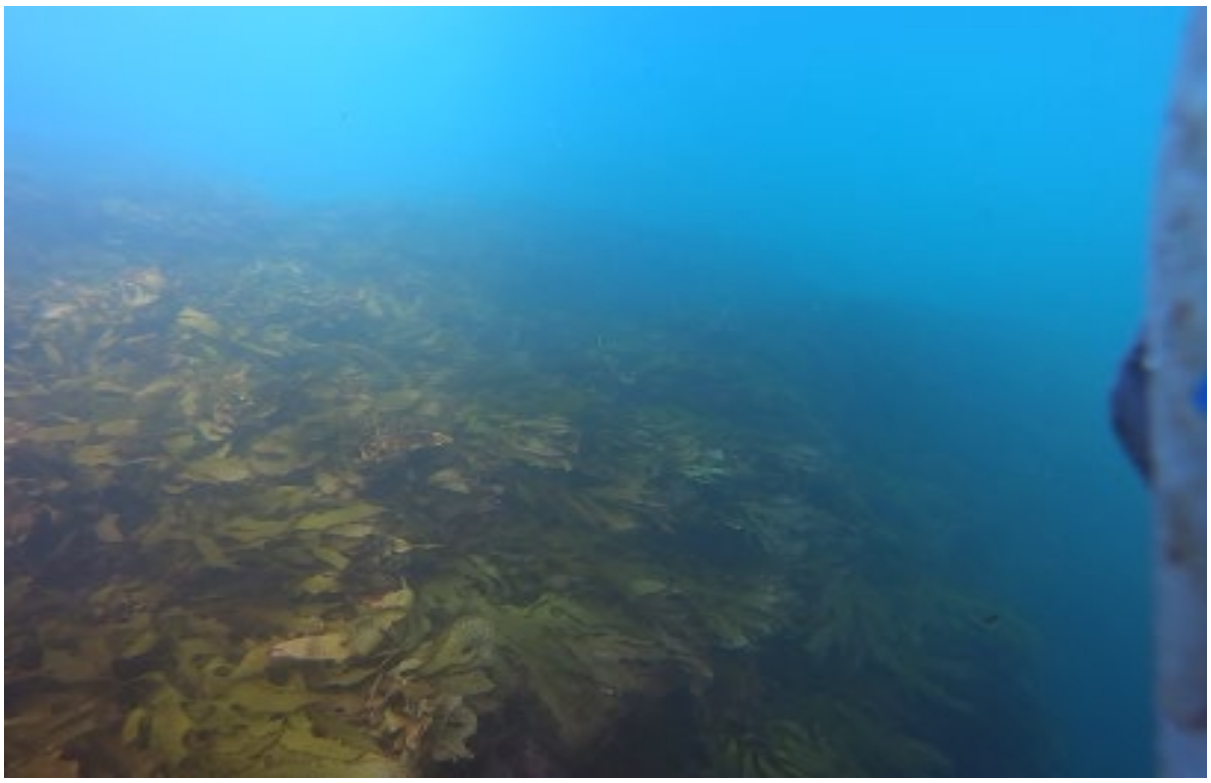


Plate 8 High profile shallow reef, Macroalgae dominant (Transect 125)

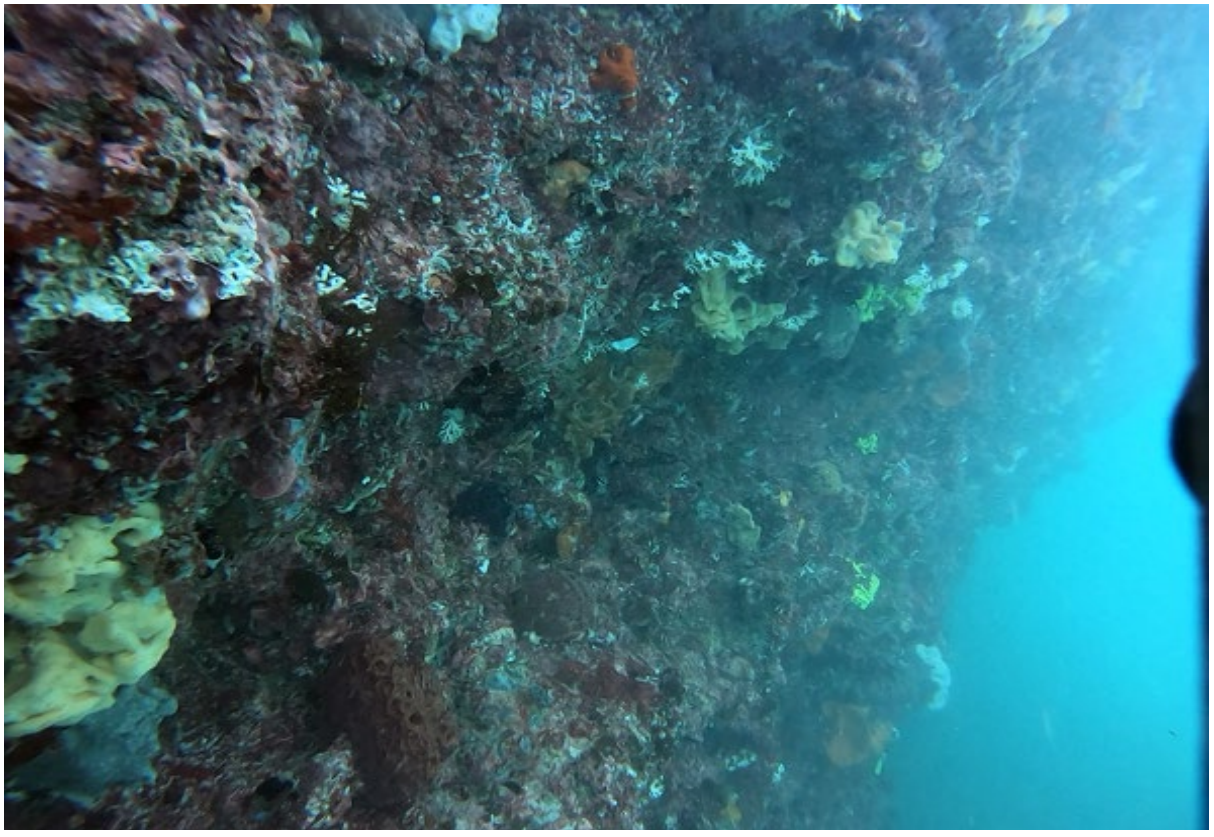


Plate 9 High profile shallow reef, Macroalgae dominant (Transect 42)

3.4 Habitats south of Point Moore

The following habitats have been identified south of Point Moore, including the area south of Port Grey and westward to the deep water drop-off.

3.4.1 Pavement with sand, Low density Seagrass

A substantial portion of the benthic habitat south of Point Moore and the greater Port Grey area consists of limestone pavement with overlaying sand of varying depths. Much of this habitat supports seagrass as the dominant flora at generally low to moderate densities of up to 50% cover (Transects 53-58, 97, 98 and 100). The habitat is similar to the habitat described north of Point Moore in Section 3.3.2 with seagrass colonising most of the sand-covered seabed between the 4 m isobath to approximately the 10 m isobath. The dominant seagrass taxa were *Halophila (*which inhabited areas of deeper sand) and *Amphibolis* which was more common on areas of shallow sand. *Posidonia* and *Syringodium* also formed subdominant meadows in areas with greater density of cover. The macroalga *Caulerpa*, which often grows in similar habitats to seagrass, was also observed at densities as high as 50% cover (Transects 54 and 56) in some areas.

It is worth noting that this habitat covers a large area with a relatively low profile (as determined from LiDAR data). Compared to the survey intensity north of Point Moore, fewer transects were completed across this large area mapped as supporting low density seagrass however, as with the low density seagrass dominated habitat on sand described north of Point Moore (Section 3.3.2), the area south of Point Moore also supports areas of high density seagrass which are described in the following section (Section 3.4.2). Therefore given this large habitat of mapped low density seagrass envelopes an area of confirmed high density seagrass (Section 3.4.2) it is possible although unlikely, that other areas within this mapped habitat may, and can potentially in future, support high density seagrass beds, even though they were not mapped during this current exercise.

3.4.2 Pavement with sand, High density seagrass

Within the area of low density seagrass (as described in Section 3.4.1) lies an area of very high density seagrass (Transects 56 and 57, Plate 10). These habitats support seagrass meadows of up to 90% cover which, along with the area surrounding Transect 116 (Section 3.3.3), was the highest density seagrass observed during the survey. Beds were dominated by a mixed assemblage of *Halophila* and *Amphibolis,* with *Syringodium* in some parts. *Caulerpa* was also prevalent and observed at up to 50% cover in places. In the highest cover areas observed on Transect 57, only *Amphibolis* accounted for the high cover, although *Halophila* may likely also have been present (the light intensity was too low to determine this). Notably, these assemblages were distinctive from the high density seagrass areas described north of Point Moore, where *Posidonia* rather than *Amphibolis* accounted for the greatest cover.

3.4.3 Pavement with sand, Macroalgae

A small area, encircled by high profile reef, of pavement with sand occurs along the western high profile reef areas south of Point Moore. Although no transect was completed in the area, it was mapped as pavement with sand based on its low profile substrate and the bare sand coloration in aerial imagery. Given its proximity to the high energy western reefs, and being encircled by high profile reef, it is most likely that the area supports small macroalgae (likely red and brown algae) as the dominant flora, with potentially low density seagrass such as *Halophila* also occurring.

Plate 10 **Pavement with sand, High density seagrass (Transect 56 - A failure with the high definition camera meant only standard definition video footage was recorded during this transect).**

3.4.4 Low profile reef with sand, Seagrass and Macroalgae

Occupying the majority of the western half of the shallow areas (<12 m CD) south of Point Moore, and landward of the drop off into the deeper waters of Geelvink Channel, lies an area of low profile reef with sand. No transects were completed in this area during this survey; however, LiDAR data indicate the area has a distinctly rough undulating substrate with numerous areas of 1 m or more relief. Surveys completed in 2001 using a RoxAnne bottom scanning echo sounder revealed the area to be a mix of sand and sand veneered pavement (URS 2001). That survey, however, only completed two transects across the area. Based on the LiDAR data and observations within reef and sand areas in the wider Port Grey and Point Moore area, it is likely this habitat consists of undulating low profile limestone bommies, outcrops and elevated platforms with varying depths of sand between raised areas and atop platform areas. Low profile reef is usually adjacent to areas of high profile reef which will influence the tidal patterns in those areas and will influence the types of epibenthic assemblages occupying the low relief areas.

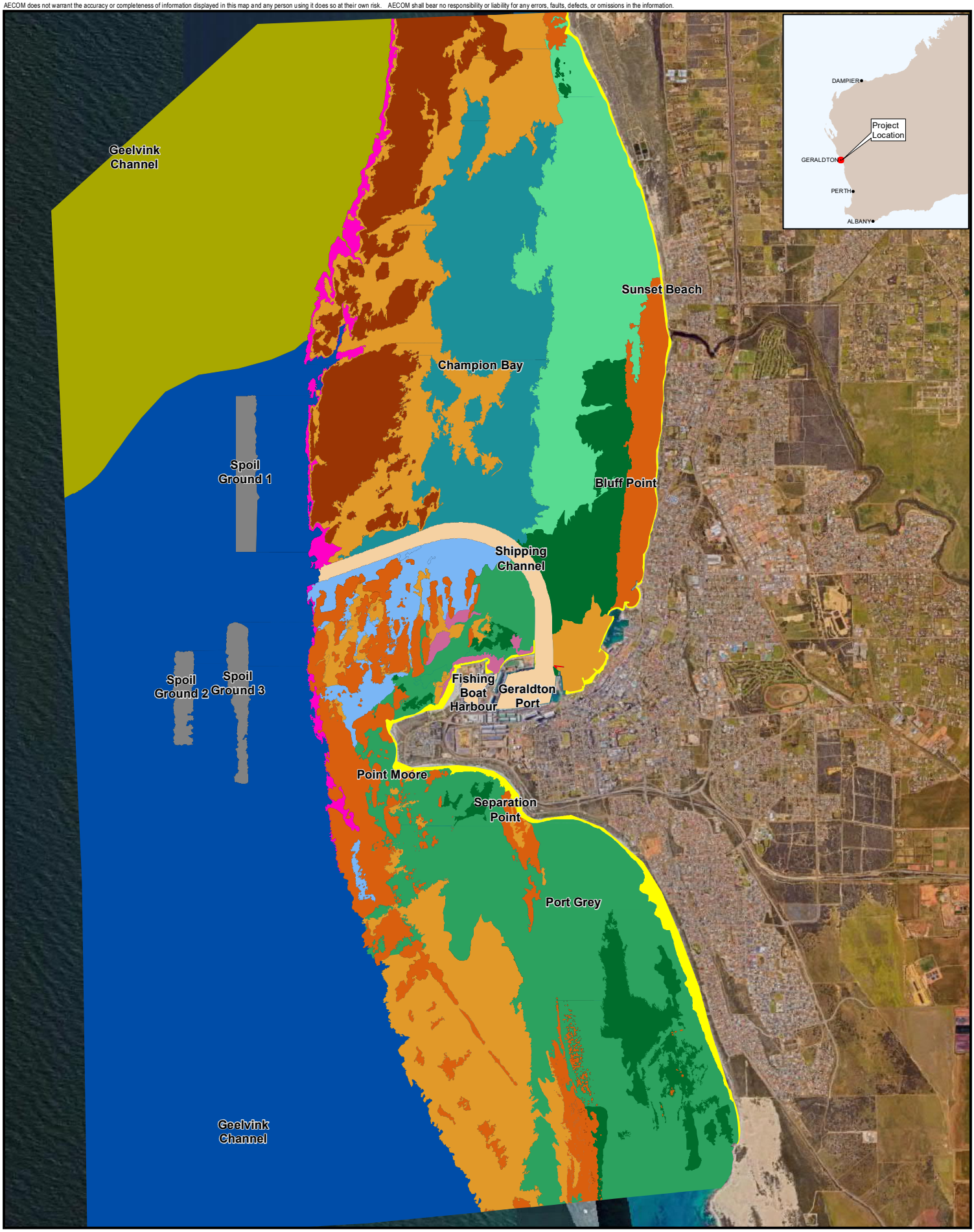
As with other low profile reef habitats described in Sections 3.2.7, 3.2.8 and 3.3.5, the area will likely support small and large macroalgae taxa such as red and brown algae, and *Sargassum* on higher relief areas, and seagrass taxa (*Amphibolis* and *Halophila)* on sand patches.

3.4.5 High profile shallow reef 1 – 4 m, Macroalgae dominant

Several high relief (1–4 m & >4 m, Plate 11) areas occur south of Point Moore and adjacent to the Port Grey area (Transects 97, 99, 102 and 107). Although numerous, the areas of high relief reef are not as large and expansive as those further north around the Point Moore headland (Section 3.3.6). According to LiDAR data, the high profile reefs further south of Point Moore do not form the high profile barrier-type banks that fringe the reef slope into Geelvink Channel (as seen around Point Moore) but rather tend to consist of either longer, narrow ridges or isolated raised platforms rising from surrounding lower profile reef (Transect 102), or as limestone platforms with a high relief seaward face protruding out from the shoreline (Transect 99).

The western high profile ridges (Transect 101) were dominated by mixed assemblages of *Sargassum*, small red and brown algae and lobed brown algae with a low cover understorey of *Amphibolis*. Small patches of *Thalassodendron* were also observed. High profile reefs further inshore (Transect 102) supported the same assemblage of macroalgae as the western ridges, with the addition of *Ecklonia* as a codominant taxon to *Sargassum.* No seagrass was observed at this location. At Transect 99, which traverses the nearshore reef extending out from the shore, *Sargassum*, small red and brown algae and lobed brown algae were codominant with *Amphibolis* which colonised the sand-inundated patches between high points.

Plate 11 High profile shallow reef, Macroalgae dominant (Transect 102)



PROJECT ID	60626486
CREATED BY	KAI.DU
APPROVED BY	M.SLABBER
LAST MODIFIED	26 AUG 2020

AECOM
www.aecom.com

N
DATUM GDA 1994 MGA Zone 50
1:51,000 (when printed at A3)
0 500 1,000 1,500 2,000
Metres

Data sources: Image - Landgate

Base Data: © Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010); Geoscience Australia; Streetpro

LEGEND

- High Profile Deep Reef 1-4 m: Macroalgae Dominant
- High Profile Shallow Reef 1-4 m: Macroalgae Dominant
- Low Profile Reef with Sand: Seagrass and Macroalgae
- Deep Water Reef Slope: Macroalgae
- Deep Pavement with Sand: Macroalgae
- Pavement with Sand: High Density Seagrass
- Pavement with Sand: Low Density Seagrass
- Pavement with Sand: Macroalgae
- Pavement with Sand: No Epibenthic Macrobiota
- Pavement with Shallow Sand: Seagrass Dominant
- Sloping Pavement with Sand: Low Density Seagrass and Macroalgae
- Deep Sand: No Epibenthic Macrobiota
- Seal Rocks Breakwater: Coral Habitat
- Spoil Ground - Gravel and Rubble: Macroalgae
- Beach/Groin/Breakwater
- Shipping Channel

Champion Bay and Surrounds

MID WEST PORTS AUTHORITY

CHAMPION BAY HABITAT ASSESSMENT

Figure 8

Map Document: \\auper1fp001\projects\606X\606626486\900_CAD_GIS\920_GIS\02_MXDs\02_AfterSurvey\Re_ClientComm\G60626486_Fig6_HabClass_v3_A3P.mxd (kai.du)

A3 size

PROJECT ID	60626486
CREATED BY	KAI.DU
APPROVED BY	M.SLABBER
LAST MODIFIED	26 AUG 2020

AECOM
www.aecom.com

N
1:18,000 (when printed at A3)
DATUM GDA 1994 MGA Zone 50
0 200 400 600 800
Metres

Data sources: Image - Landgate

LEGEND

- High Profile Deep Reef 1-4 m: Macroalgae Dominant
- High Profile Shallow Reef 1-4 m: Macroalgae Dominant
- Low Profile Reef with Sand: Seagrass and Macroalgae
- Deep Water Reef Slope: Macroalgae
- Deep Pavement with Sand: Macroalgae
- Pavement with Sand: High Density Seagrass
- Pavement with Sand: Low Density Seagrass
- Pavement with Sand: Macroalgae
- Pavement with Sand: No Epibenthic Macrobiota
- Pavement with Shallow Sand: Seagrass Dominant
- Sloping Pavement with Sand: Low Density Seagrass and Macroalgae
- Seal Rocks Breakwater: Coral Habitat
- Beach/Groin/Breakwater
- Shipping Channel

Habitats surrounding the Fishing Boat Harbour and the Port

MID WEST PORTS AUTHORITY

CHAMPION BAY HABITAT ASSESSMENT

Figure 9

Map Document: \\auper1fp001\projects\606X\60626486\900_CAD_GIS\920_GIS\02_MXDs\02_AfterSurvey\Re_ClientComm\G60626486_Fig7_HabClassCentl_v2_A3P.mxd (kai.du)

A3 size

3.5 Oakajee

3.5.1 Habitats Overview

In contrast to Champion Bay, the outermost reefs at Oakajee are in deep water and do not form an embayment. The shallow nearshore habitats are much narrower, steeper and closer to shore. Consequently, these habitats routinely experience high wave energy as they do not receive much protection from oceanic swell and waves. In waters shallower than 15 m the substrate is predominantly reef which varies from low to high profile for much of the area with only minor areas of pavement and sand on pavement. The extensive nearshore reefs limit sand movement across the shallow habitats and consequently net longshore sediment transport northwards at Oakajee is minimal compared to Champion Bay (Tingay & Associates 1997).

Low and high profile limestone reef extends in most parts directly seaward from the shoreline, remaining shallow (< 10 m) out to approximately 1 km offshore before dropping to depths beyond 15 m. A distinct wide natural channel exists approximately midway along the Oakajee coast. The channel is a remnant of the Oakajee River outlet and stretches from the shore to the deeper waters beyond the reef line.

The benthic habitats for the Oakajee survey area are identified as:

- Pavement with sand, Low density macrobiota
- Low profile reef with sand, Seagrass and Macroalgae
- High profile reef, Macroalgae
- Deep pavement with sand, Macroalgae

The benthic habitats identified in Oakajee marine area are shown in Figure 10, Figure 11 and Figure 12.

3.5.2 Pavement with sand, Low density macrobiota

From the shoreline, sand veneered pavement extends seawards between sections of exposed reef to the base of higher relief reef in shallow depths (<5 m) or into deeper water where larger channels exist between reef areas (Plate 12). Midway along the coastline at the Oakajee River outlet, a wide natural channel exists through the reef which is predominantly deep sand on pavement (Transects 70, 71 and 73). North of this channel the reef forms an almost continuous structure extending north up to Coronation Beach. South of this channel, reef areas become more broken and disjointed, forming channels of sand veneered pavement which extend from the shore into deeper waters as they cut through breaks in the reef.

This habitat predominantly supports low assemblages of epibenthic macrobiota. In several transects within the natural channel mentioned earlier, bare deep sand on pavement was recorded stretching from the shore all the way into deeper waters. Sand veneered pavement in very shallow areas fringing the beach may support denser assemblages of macrobiota; however, due to the shallow depth transects could not be completed in these areas.

3.5.3 Low profile reef with sand, Seagrass and Macroalgae

Low profile reef (<4 m relief) accounted for the vast majority of the substrate in the Oakajee survey area (Plate 13). Sections of low profile reef extended almost unbroken from Coronation Beach southward to the natural deep water channel at the Oakajee river outlet and mid-shore point along the Oakajee coast. South of here, low profile reef continues southward to the Buller River channel, although the reef becomes more broken and fragmented. The seaward extent of low profile reef stretches from the shore in most areas all the way to the 15 m isobath. Between areas of raised reef, low lying pockets, holes and gullies harbour sand of varying depth on reef.

Due to the variation in reef relief, thickness of sand on reef and water depth, this habitat supports a diverse range of epibenthic assemblages. Areas of lower relief (up to 1 m) with greater volumes of sediment support *Thalassodendron* seagrass and mixed assemblages of macroalgae including *Caulerpa, Sargassum* and various small and large red and brown algae (Transects 60 and 72).

Areas with higher relief and less sand account for the majority of the low relief areas in the Oakajee area. Shallower areas of higher relief reef tend to support greater densities of *Thalassodendron,* either as single species or mixed assemblages with *Amphibolis* (Transects 60, 61, 65-69, 71, 74, 75, 77 and 80). As depth increases, *Amphibolis* becomes more common (Transects 28, 29, 31, 32 and 68). Of the algal assemblages, red and brown algae and lobed brown algae were most common, growing on almost every surface except deep sand. Of the large macroalgae, *Sargassum* was most common, especially in areas of lower relief, or on top of elevated platforms, while *Ecklonia* dominated the edge of ledges, platforms and overhangs.

Vertical reef surfaces, underneath ledges and overhangs supported coralline algae and various sponges and ascidians.

3.5.4 High profile reef, Macroalgae

High profile reef areas occur from shore to about the 5 m isobath. In the northern parts, high profile sections occur as raised shallow platforms intersected by deep, narrow gullies and holes with numerous overhangs and caves. In the south, fragmented limestone columns and bommies rise over 4 m from the surrounding lower profile reef. *Sargassum* and red and brown algae colonise the tops of bommies and the light-receiving surfaces, while encrusting coralline algae and sponges inhabit vertical surfaces and beneath overhangs. These areas are highly complex, offering a diverse array of micro-habitats within close proximity. Where sand is present, the base of high profile areas often supports *Amphibolis* meadows.

3.5.5 Deep pavement with sand, Macroalgae

Approximately 1.5–1.8 km offshore in the northern part of the Oakajee area, there is a distinct drop-off from about 10-12 m depth to 15–16 m depth. This shallower inner shore shelf gets progressively wider further south. Seaward of this drop-off, the substrate takes on a more gradual slope into deeper water. The area is characterised by sand veneered pavement with varying depths of sand on pavement (Transects 30, 63 and 64). The area is predominantly bare sand with low densities of macroalgae and *Amphibolis* seagrass where sand on the pavement is shallow. In transects close to the drop-off, pavement under shallow sand supported denser assemblages of *Sargassum* and small red and brown algae. A number of upright sponges were also observed where sand on pavement was shallow.

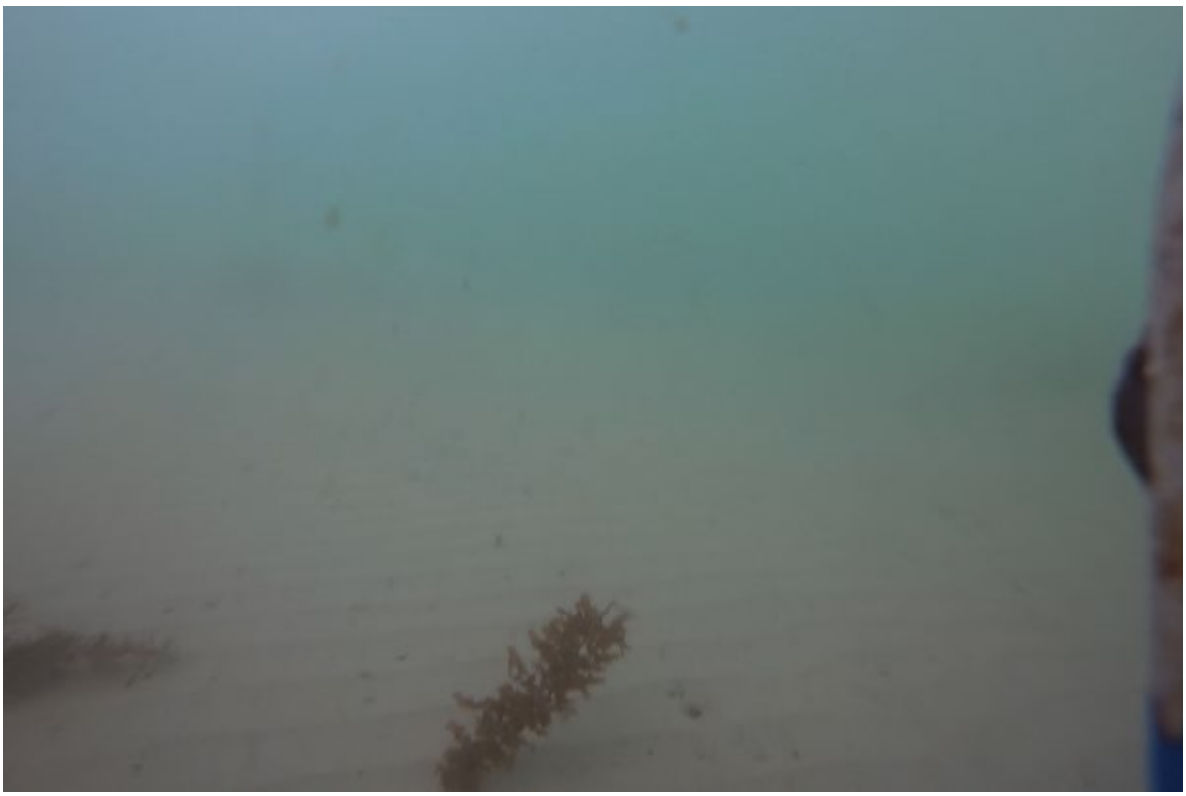
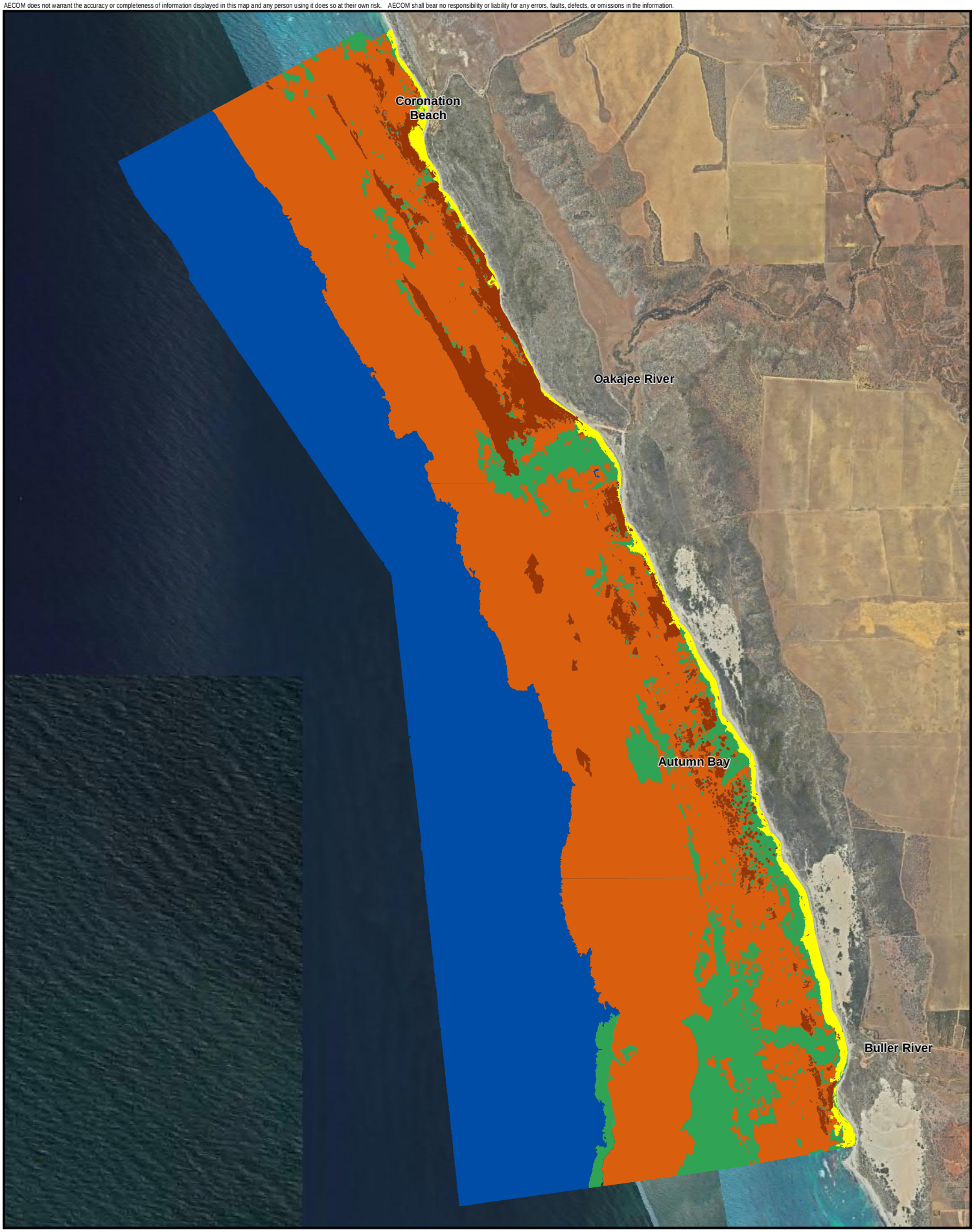


Plate 12 Pavement with sand, Low density epibenthic macrobiota (Transect 70)

Plate 13 Low profile reef with sand, Seagrass and Macroalgae (Transect 61)



PROJECT ID	60626486
CREATED BY	KAI.DU
APPROVED BY	M.SLABBER
LAST MODIFIED	26 AUG 2020

AECOM
www.aecom.com

DATUM GDA 1994 MGA Zone 50

1:35,000 (when printed at A3)

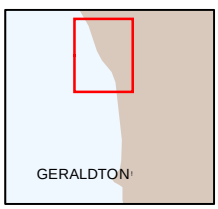
0 400 800 1,200 1,600
Metres

Data sources: Image - Landgate

Base Data: © Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010); Geoscience Australia; Streetpro

LEGEND

- High Profile Reef: Macroalgae
- Low Profile Reef with Sand: Seagrass and Macroalgae
- Pavement with Sand: Low Density Epibenthic Macrobiota
- Deep Pavement with Sand: Macroalgae
- Beach/Shore



Oakajee Benthic Habitats

MID WEST PORTS AUTHORITY

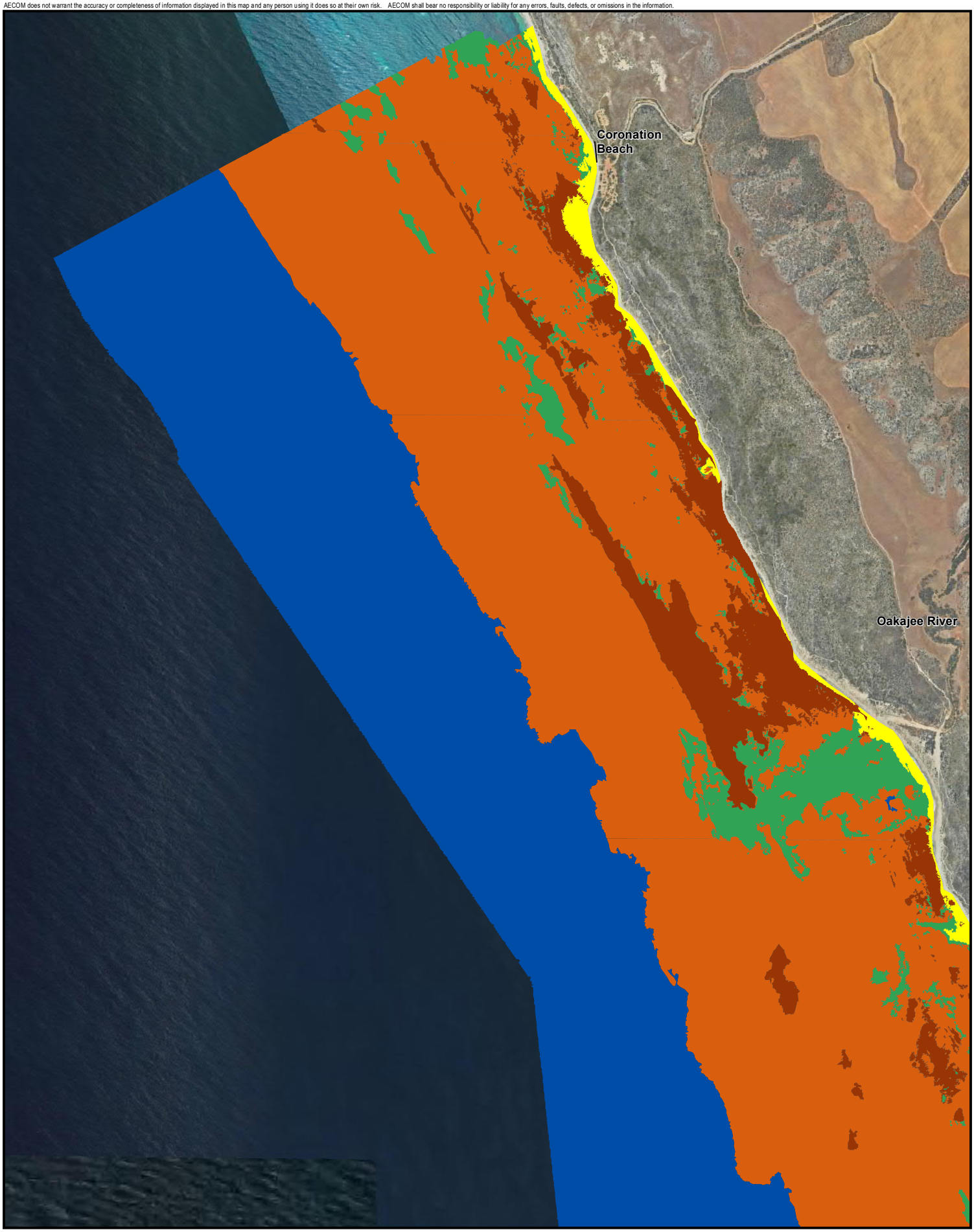
CHAMPION BAY HABITAT ASSESSMENT

Figure

10

Map Document: \\auper1fp001\projects\606X\60626486\900_CAD_GIS\920_GIS\02_MXDs\02_AfterSurvey\Re_ClientComm\G60626486_Fig8_HabClassOakajee_v1_A3P.mxd (kai.du)

A3 size



PROJECT ID	60626486
CREATED BY	KAI.DU
APPROVED BY	M.SLABBER
LAST MODIFIED	26 AUG 2020

AECOM
www.aecom.com

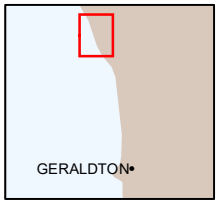
N
DATUM GDA 1994 MGA Zone 50
1:20,000 (when printed at A3)
0 200 400 600 800
Metres

Data sources: Image - Landgate

Base Data: © Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010); Geoscience Australia; Streetpro

LEGEND

- High Profile Reef: Macroalgae
- Low Profile Reef with Sand: Seagrass and Macroalgae
- Pavement with Sand: Low Density Epibenthic Macrobiota
- Deep Pavement with Sand: Macroalgae
- Beach/Shore



Northern Oakajee Benthic Habitats

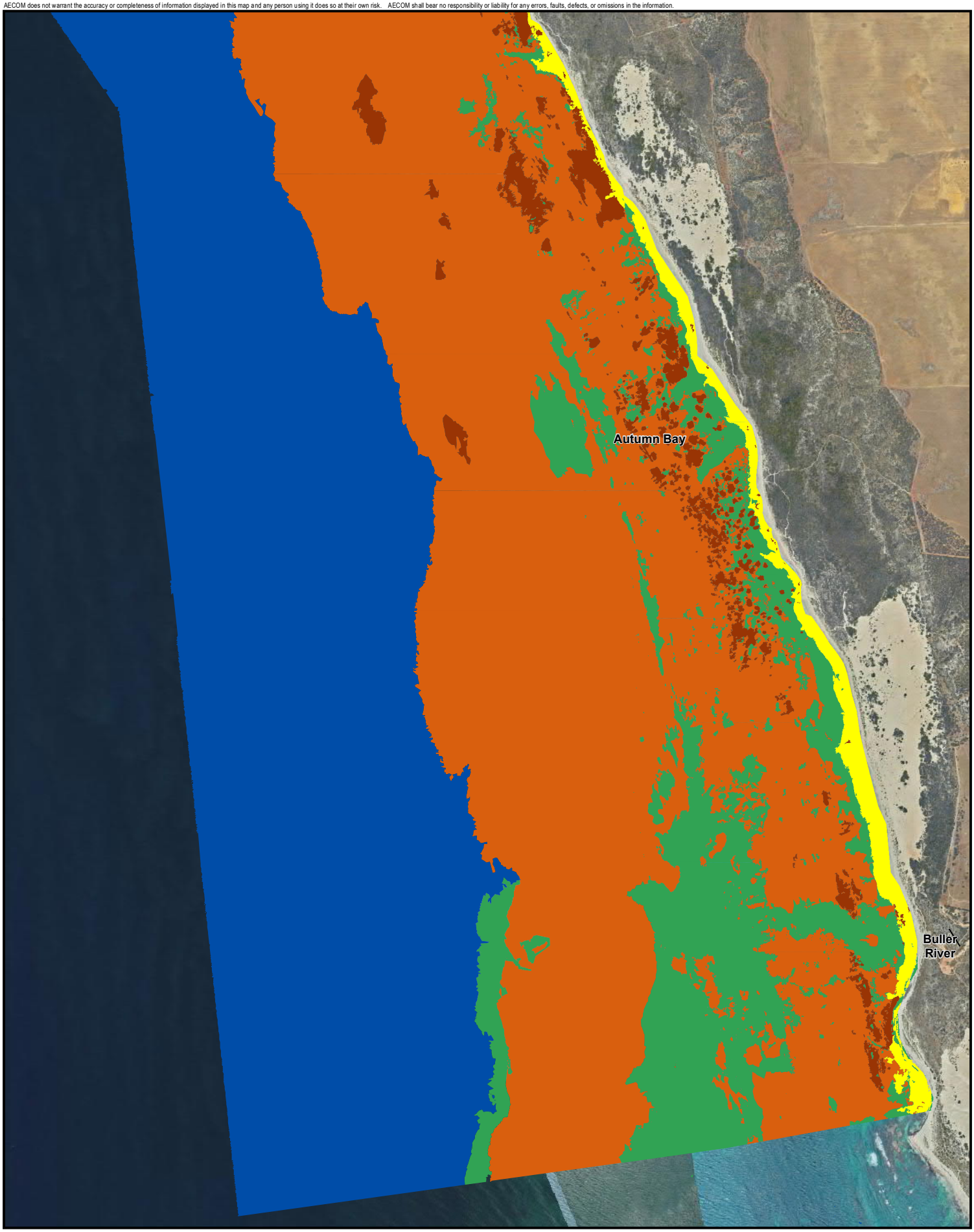
MID WEST PORTS AUTHORITY

CHAMPION BAY HABITAT ASSESSMENT

Figure 11

Map Document: \\auper1fp001\projects\606X\60626486\900_CAD_GIS\920_GIS\02_MXDs\02_AfterSurvey\Re_ClientComm\G60626486_Fig9_HabClassOakajeeNorth_v1_A3P.mxd (kai.du)

A3 size



PROJECT ID	60626486
CREATED BY	KAI.DU
APPROVED BY	M.SLABBER
LAST MODIFIED	26 AUG 2020

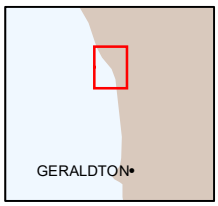
AECOM
www.aecom.com

N
1:20,000 (when printed at A3)
DATUM GDA 1994 MGA Zone 50
0 200 400 600 800
Metres

Data sources: Image - Landgate

Base Data: © Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010); Geoscience Australia; Streetpro

LEGEND
- High Profile Reef: Macroalgae
- Low Profile Reef with Sand: Seagrass and Macroalgae
- Pavement with Sand: Low Density Epibenthic Macrobiota
- Deep Pavement with Sand: Macroalgae
- Beach/Shore



Southern Oakajee Benthic Habitats

MID WEST PORTS AUTHORITY

CHAMPION BAY HABITAT ASSESSMENT

Figure 12

Map Document: \\auper1fp001\projects\606X\60626486\900_CAD_GIS\920_GIS\02_MXDs\02_AfterSurvey\Re_ClientComm\G60626486_Fig10_HabClassOakajeeSouth_v1_A3P.mxd (kai.du)

A3 size

4.0 References

Alan Tingay & Associates 1997. *Proposed Oakajee Deep Water Port Site Marine Seafloor Habitat Survey Marine Impact Assessment and Fisheries Assessment*. Report to Minister for Resources Development by Alan Tingay & Associates, Perth, Western Australia. Report No. 97/25, April 1997.

EPA 2016, *Technical Guidance – Environmental Impact Assessment of Marine Dredging Proposals*, EPA, Western Australia.

Loneragan NR, Kangas M, Haywood MDE, Kenyon RA, Caputi N, Sporer E, 2013. Impacts of cyclones and aquatic macrophytes on recruitment and landings of tiger prawns *Penaeus esculentus* in Exmouth Gulf, Western Australia. *Estuarine, Coastal and Shelf Science* 127:46-58

Monaghan, Rooke & Robinson 1993. *Marine Habitat and Seafloor Survey – Alternative Deepwater Port Sites, Geraldton Region.* In: Alan Tingay & Associates (1994). Deepwater Port at Point Moore, Public Environmental Review, Volume 2 Technical Reports. Report to Geraldton Port Authority by Alan Tingay & Associates, Perth, Western Australia, Report No. 94/6, October 1994.

Monaghan, Rooke & Robinson 1994. *Geraldton Port – Marine Environs Habitat Survey*. In: Alan Tingay & Associates (1994). Deepwater Port at Point Moore, Public Environmental Review, Volume 2 Technical Reports. Report to Geraldton Port Authority by Alan Tingay & Associates, Perth, Western Australia, Report No. 94/6, October 1994.

URS 2001. *Marine Habitats of Champion Bay, Port Grey and Geelvink Channel*. Prepared for Geraldton Port Authority by URS Australia Pty Ltd, Western Australia.

Appendix A

Geo Oceans Field Summary Report

30139 Port of Geraldton Marine Habitat Mapping

Towed Camera Survey : May 2020

Document Ref:	VER-30139-REP-001
Revision:	0
Issue Date:	08/06/2020

Controlled Document

Revision History

Rev	Date	Comment	Author	Reviewed	Approved
A	08/06/20	Internal review	S. Brekke	B. Brayford	B. Brayford
0	08/06/20	Issued for use	S. Brekke		



Contents

1 Introduction

The Port of Geraldton ('the Port') is located approximately 430 km north of Perth in the Mid-West region of Western Australia. The Port is administered by the Mid West Port Authority (MWPA) and presently consists of a shipping channel, a seven berth inner harbour (the 'harbour'), a large fishing boat harbour, a tug boat harbour and associated land-based infrastructure. The town of Geraldton has grown around the Port and the shelter of Point Moore with other major industries of the region including farming and fishing.

The MWPA is proposing to undertake maintenance dredging activities within the commercial harbour and the shipping channel in 2021 to remove accumulated sediments, returning the channel to the original designed depths, thus ensuring the safe navigability and continued use of the Port.

MWPA is developing a long-term dredge strategy outlining future options for capital and maintenance dredging works which align with the Port's Master Plan and ensures the Geraldton Port continues to operate safely to meet current and future growth opportunities.

Aecom (Primary Contractor) contracted Geo Oceans (subcontractor) on behalf of MWPA to supply remotely deployed underwater camera equipment and personnel to execute environmental surveys in the nearshore waters around the port of Geraldton, in the mid-west WA. Geo Oceans specialise in the provision of professional services using underwater robotics for inspection and marine science surveys.

The marine habitat data captured during this campaign includes high definition video and still images and semi-quantitative data that can be used to map the spatial distribution of the marine habitats. The data could be further processed to create a baseline dataset for all the dominant habitats throughout the survey area for temporal monitoring of changes over time.

2 Methods

This section describes the equipment and methodology used to execute the towed camera survey, data processing and analyses.

2.1 Survey Logistics

The survey was undertaken between 27th of April – 6th of May 2020. The winds were predominately moderate to strong (15 to 25 knots) creating periods of rough sea state during the survey period. Significant swell activity (2 to 4m) also affected the work, making some sites unreachable due to large waves breaking on the proposed transect locations (I.e. T072, T141, T151, T166 and T194). One site was unreachable due to it being in the middle of a fish farm pen (T184). The proposed transect sites that were not accessible were completed from the closest, safe position.

The towed camera operations were conducted on the *Sienna,* a 12m vessel (Figure 1). The water depth in the areas surveyed ranged from approximately -35 m to -1.5 m LAT.

Figure 1 Towed camera deployment setup aboard the Sienna

2.2 Survey Design

A detailed analysis of previous data and maps was undertaken to validate the available environmental data in the survey area. Prior to the survey, Geo Oceans plotted the location of 95 towed camera transect locations in Arc GIS software, which would form the basis for the towed camera survey. Additional transects were added in response to on-site habitat assessment and MWPA's areas of interest.

A total of 129 towed camera transects were completed covering 16.5 km of seafloor (benthic) habitat.

2.3 Towed Camera Operations

The towed camera system consisted of topside electronic technology and survey software and in-water towed camera equipment. The topside technology allowed the on-site (real-time) assessment of data and the assimilation and recording of data sets (I.e. video, still images, GPS and on-site habitat assessment).

Prior to camera deployment, the transect number and locations were confirmed and recorded within the survey system. The still, video and GPS inputs were confirmed as operational and the towed camera frame was lowered to the seafloor. The camera frame was lowered until visual confirmation was achieved that the camera was at the appropriate height for data collection, typically 1m off the seafloor. The vessel navigated from the transect start point while towing the towed camera system at a speed of approximately 1 knot.

2.3.1 Topside Control Unit

The topside component of the towed camera system combines GO Visions habitat assessment software, Arc GIS software, GPS, a Topside Control Unit (TCU), dual monitors, hard drives and a laptop interface (Figure 2).

The system is controlled through the laptop interface and coordinated through the TCU. Video footage, still images and GPS positioning data is collected through the TCU and assessed by the operator within the GO Visions software on the laptop interface. The GO Visions software is used to encode GPS data to the video footage and still images, and on-site habitat assessments are undertaken simultaneously by the operator. All data inputs are then collectively recorded through the GO Visions software and logged in an MS Access database file.

Figure 2 Towed Camera video analysis setup aboard the Sienna.

2.3.2 Towed Camera

The towed camera frame housed a low light (0.1 lux) video camera, high definition video camera (1080p) and DSLR still image camera. The towed camera frame was a hydrodynamic design to minimise the subsequent drag forces from the water. This reduces camera lag behind the vessel and the error associated with spatial positioning between the GPS receiver on the vessel and the subsea camera frame.

The video camera was mounted on a 45° forward facing angle. The digital SLR camera (DSLR) was housed inside a subsea pod and mounted to the towed camera frame on a 90° downward angle (facing the seafloor).

The Digital Single Lens Reflex (DSLR) stills camera was controlled by and displayed on the laptop interface. The DSLR was set to automatically trigger exposures at 5 second intervals.

2.3.3 Spatial Positioning

The GPS position (latitude and longitude) coordinates were acquired using a Hemisphere DGPS with an accuracy of less than 5 m (95% confidence). The GPS antennae was positioned close to the towed camera's surface tow point. To reduce the towed camera frame's drag, the vessel was operated at slow speeds (less than 1 km/hr) to minimise the camera's spatial position error relative to the GPS antennae.

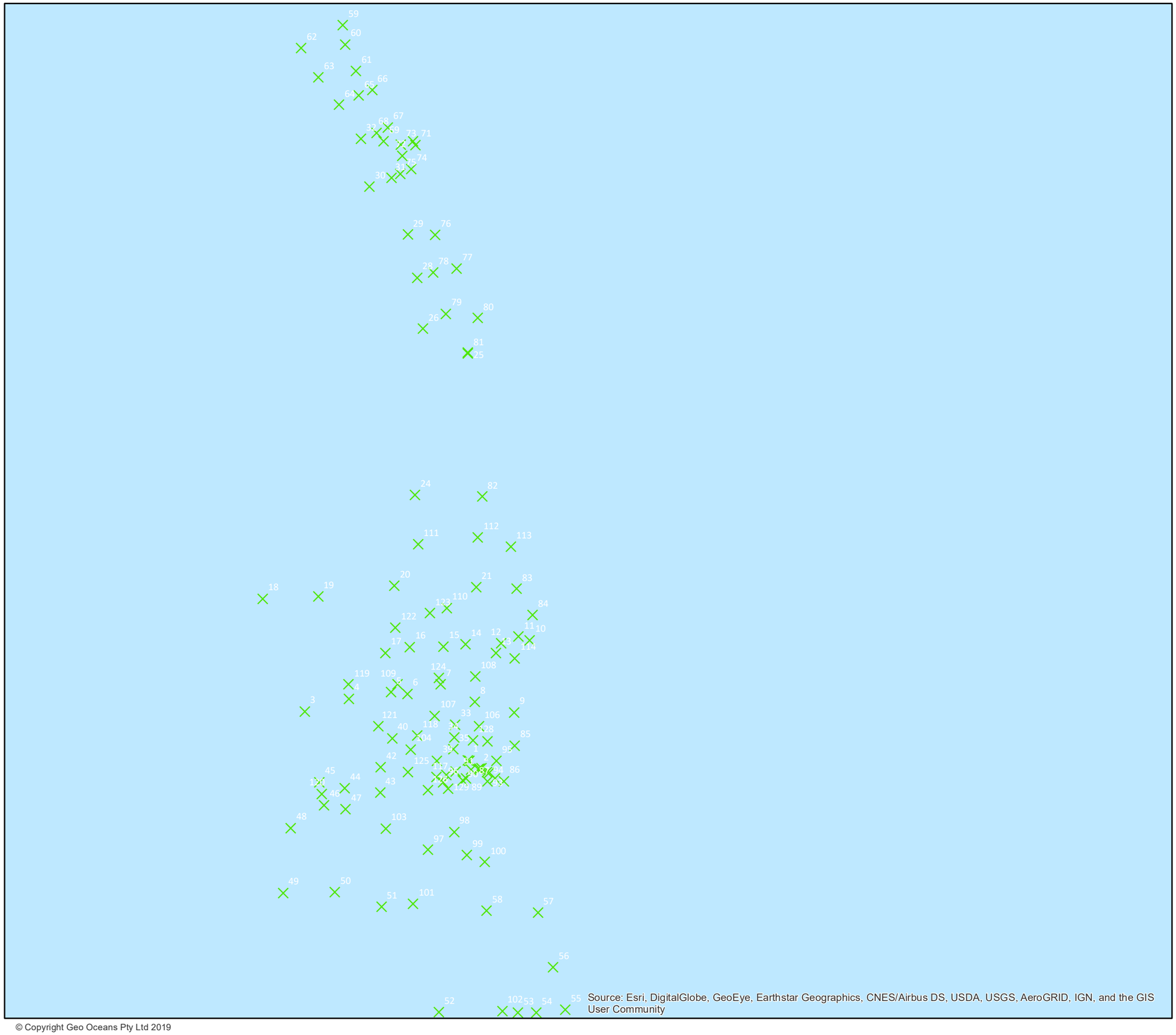
2.4 Data Analysis

The video feed was analysed in real-time, using Geo Oceans' customised software program (GO Visions^{TM}). Field scientists recorded habitat data ('Habitat Point' data), including the percent cover of five different subtidal 'Community Classes' as defined in the habitat classification scheme (Appendix A). Substrate categorisation (e.g. 'Sand' and 'Reef'), biota counts and modifiers (e.g. sediment particle size, substrate profile and biota taxonomic information) were also recorded.

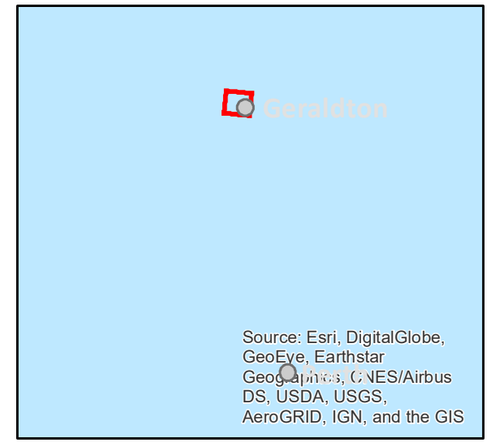
Observations were recorded and geo-referenced using GO Visions^{TM} software (e.g. 'Dead weed wrack').

2.5 Data Checking

Data were error checked in a Microsoft Access database for blank fields and erroneous GPS coordinates and habitat classifications. The data were converted into a GIS shapefile (as point data) and displayed in ArcGIS. Habitat data were symbolised to show the dominant community types (I.e. Coral, Seagrass, Filter Feeders and Macroalgae). The point data were reviewed for habitat classifications that were inconsistent with surrounding point data and satellite imagery.



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Map Legend

- Transcect Locations (mid point)

SOW Survey Areas

- Areas of Interest
- Spoil Grounds
- SOW Northern Survey Area
- SOW Southern Survey Area

Disclaimer: While all attempts have been made to ensure the accuracy of the information presented, GeoOceans does not guarantee the correctness or suitability of the information for any particular purpose.

[redacted]

30139 - MWPA - Port of Geraldton May 2020 Towed Camera Survey Transect Locations

0 4 8

Kilometers

GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

30139
3/06/2020 BB
119,518 @ A3

3 Results

A total of 10,608 points of habitat data were acquired across 129 towed camera transects (Appendix B). The transects ranged in length from 50m to 510 m and covered a total distance of 16.5 km. The habitat data was imported into ArcGIS software to display the benthic community types recorded in the survey area (Figure 4 and Figure 5).

3.1 Macroalgae, Gravel - Unconsolidated gravel dominated by macroalgae

The offshore spoil grounds (30m water depth) contained areas of unconsolidated gravel and rubble substrates with moderate to high coverage (up to 80% coverage) of macroalgae dominated by *Ecklonia spp, Sargassum spp.* with various red algae (Figure 6).

3.2 Seagrass, Sand - Unconsolidated sediment (sand/silt) with seagrass

Where epifaunal species were observed on the sand substrates they were typically dominated by seagrass with presence of macroalgae species.

The seagrass genera recorded was diverse and included Halophila (Figure 7), Amphibolis (Figure 8), Posidonia (Figure 9), Syringodium, Thalassodendron and Zostera.

3.3 Reef – Macroalgal dominated reef habitat

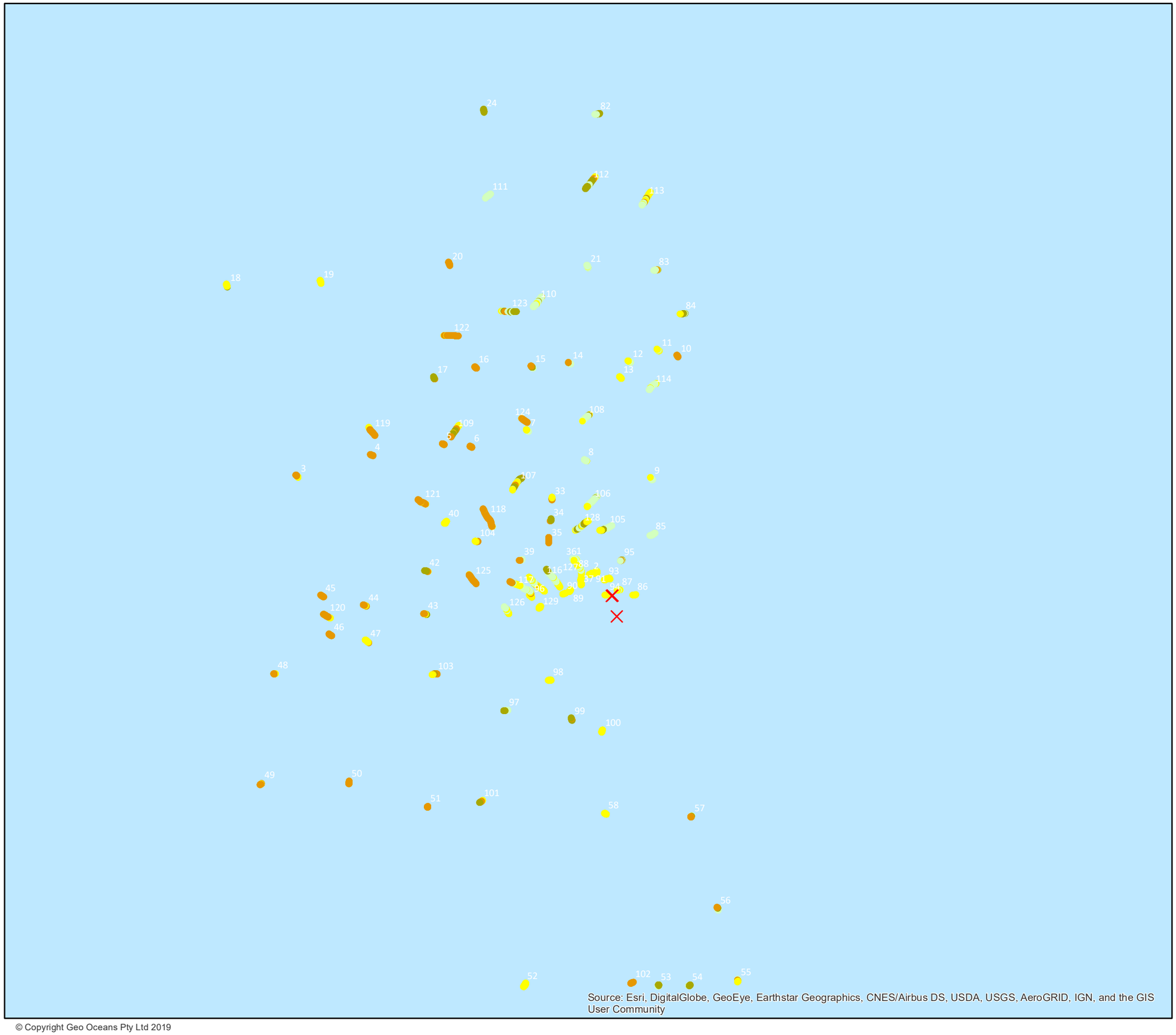
Macroalgae was the most common reef community recorded. The increased substrate stability provided by reef and gravel/pebble substrate, supported the establishment of macroalgae habitats. Macroalgae species included *Ecklonia* (Figure 10) and *Sargassum* (Figure 11). Additional species included the occasional coral and sponge species. *Sargussum* was the dominant macroalgae recorded.

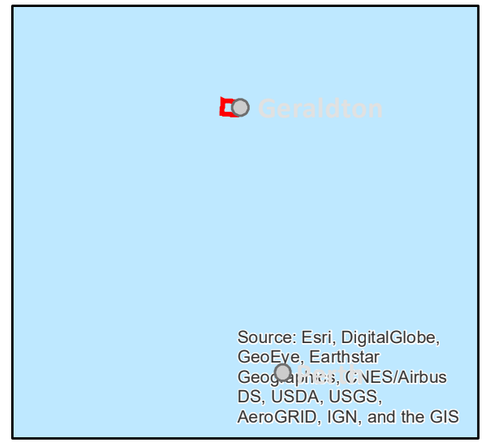
3.4 Reef – Coral dominated reef habitat

There was no coral dominated natural reefs recorded during the towed camera survey.

There were two small patches of reef that were dominated by hard corals recorded during an ROV survey on the inside of the man-made structures of Seal Rock and the Eastern Rockwall. These patches of coral were not recorded using the GO Visions towed camera and habitat assessment software because the areas were too shallow to access for the towed camera operation.

The ROV survey on the inside of Seal Rock recorded 40 minutes of high definition video footage on the leeward inner corner of the Seal Rock wall (ROV dive 35). This small patch of coral in the sheltered corner of the man-made rock wall was 10’s of meters in size and included presence of hard coral colonies larger than 500m diameter in size from the genera Pocillopora (Figure 12), Montipora (Figure 13), Acropora (Figure 14) and Favid (Figure 15).





Map Legend

Habitat Description

- Macroalgae
- Sand
- Seagrass
- Seagrass and macroalgae
- Coral Recorded - ROV Survey

SOW Survey Areas

- Areas of Interest
- Spoil Grounds
- SOW Southern Survey Area

Disclaimer: While all attempts have been made to ensure the accuracy of the information presented, GeoOceans does not guarantee the correctness or suitability of the information for any particular purpose.

[redacted]

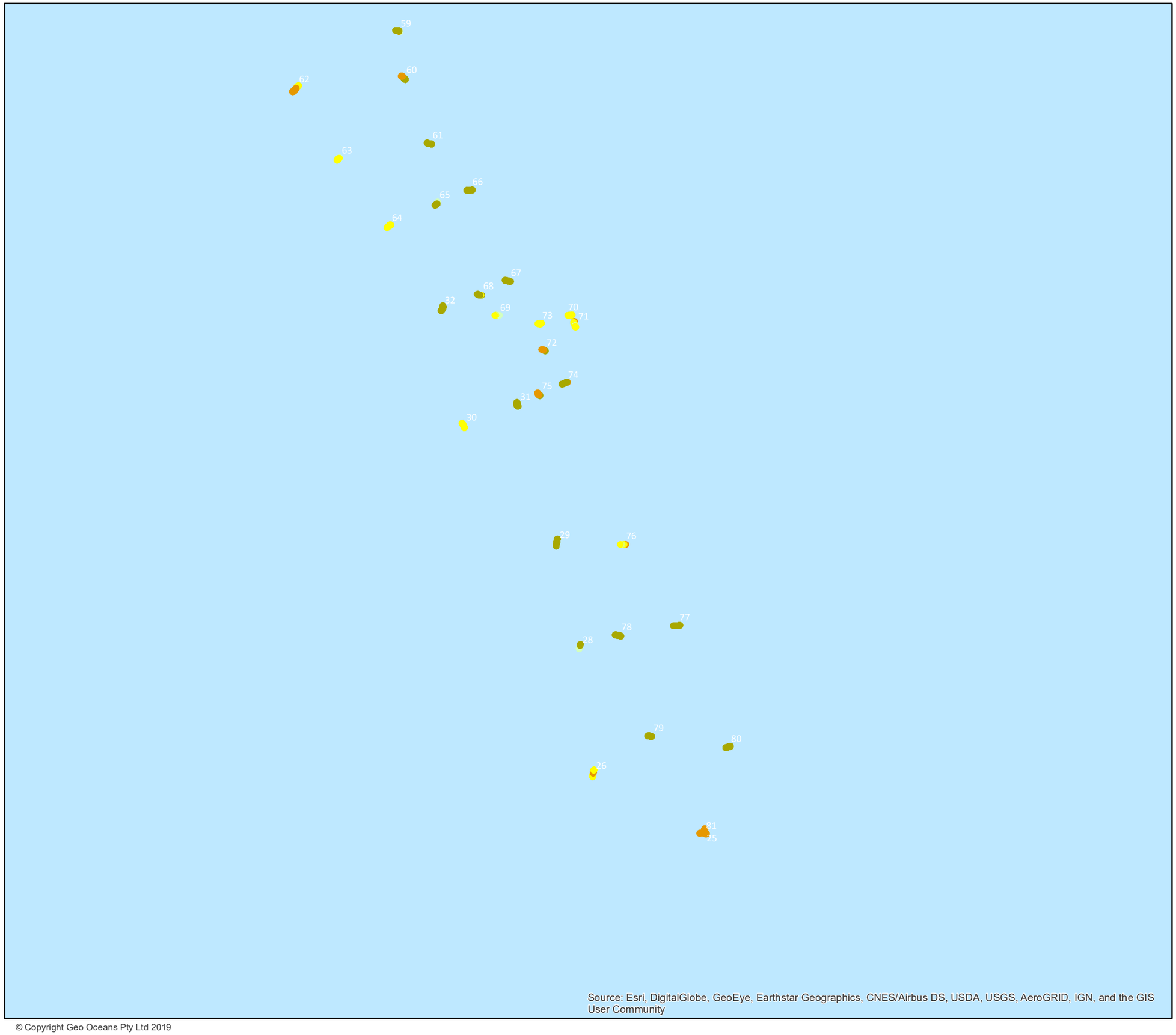
30139 - MWPA - Port of Geraldton May 2020 Towed Camera Survey Southern Area - Habitat Data

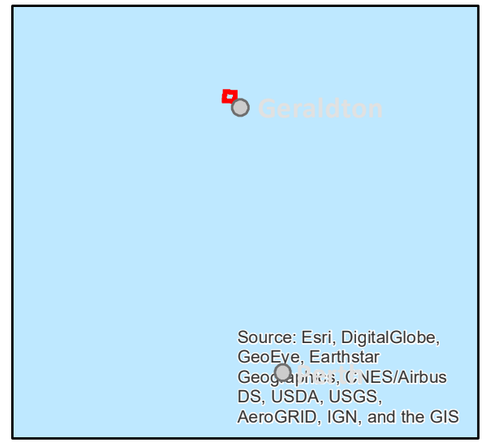
0 2.25 4.5

Kilometers

GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

30139
8/06/2020 BB
70,774 @ A3





Map Legend

Habitat Description

- Macroalgae
- Sand
- Seagrass
- Seagrass and macroalgae

SOW Survey Areas

- Areas of Interest
- SOW Northern Survey Area

Disclaimer: While all attempts have been made to ensure the accuracy of the information presented, GeoOceans does not guarantee the correctness or suitability of the information for any particular purpose.

[redacted]

30139 - MWPA - Port of Geraldton May 2020 Towed Camera Survey Northern Area - Habitat Data

0 1.5 3

Kilometers

GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

30139
3/06/2020 BB
48,917 @ A3

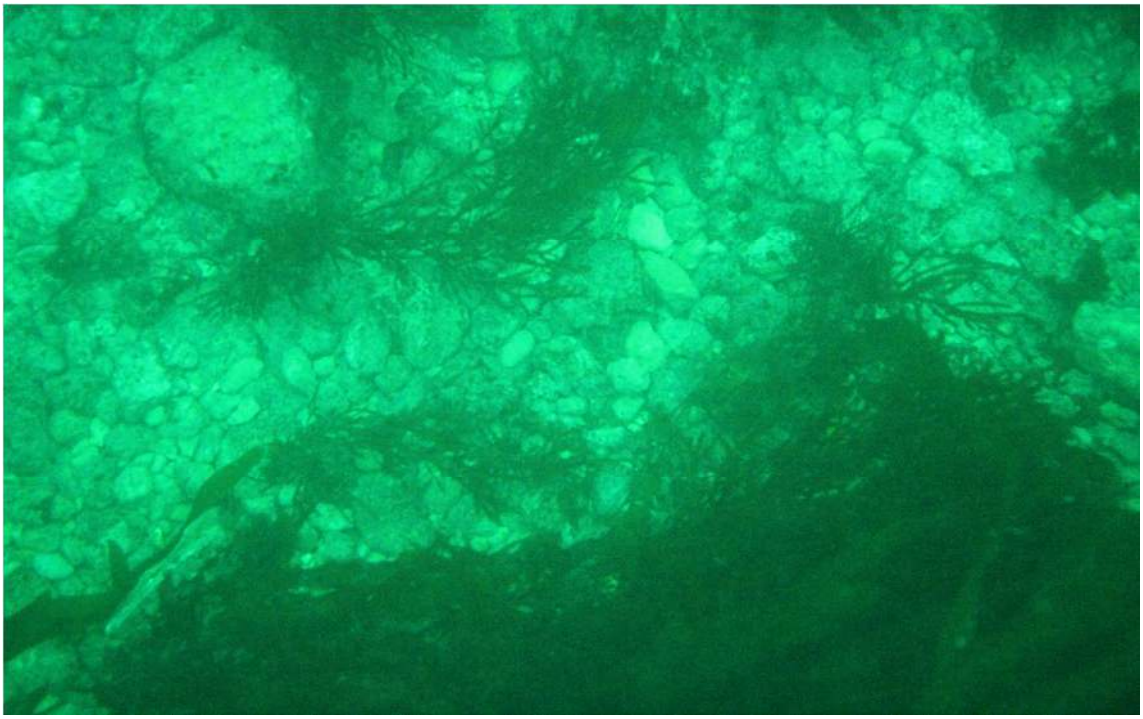


Figure 6 Unconsolidated gravel and pebble substrate containing Ecklonia spp. and other macroalgae (Transect 045; spoil ground site 2).

Figure 7 Sand with seagrass (Halophila sp.) (Transect 117)

Figure 8 100% coverage Amphibolis seagrass (Transect 114)

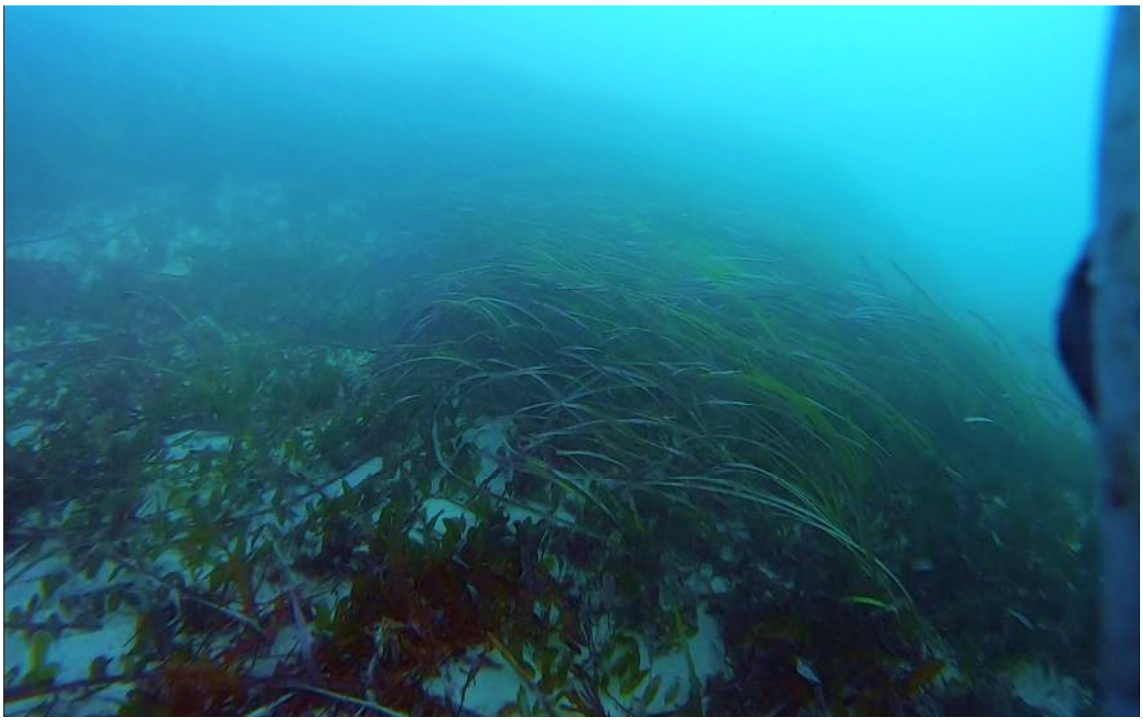


Figure 9 Mixed seagrass bed with patches Halophila and Posidonia seagrass (Transect 116)

Figure 10 Reef dominated by macroalgae Ecklonia 'Kelp' (Transect 125)

Figure 11 Reef dominated by macroalgae Sargassum sp. (Transect 121)

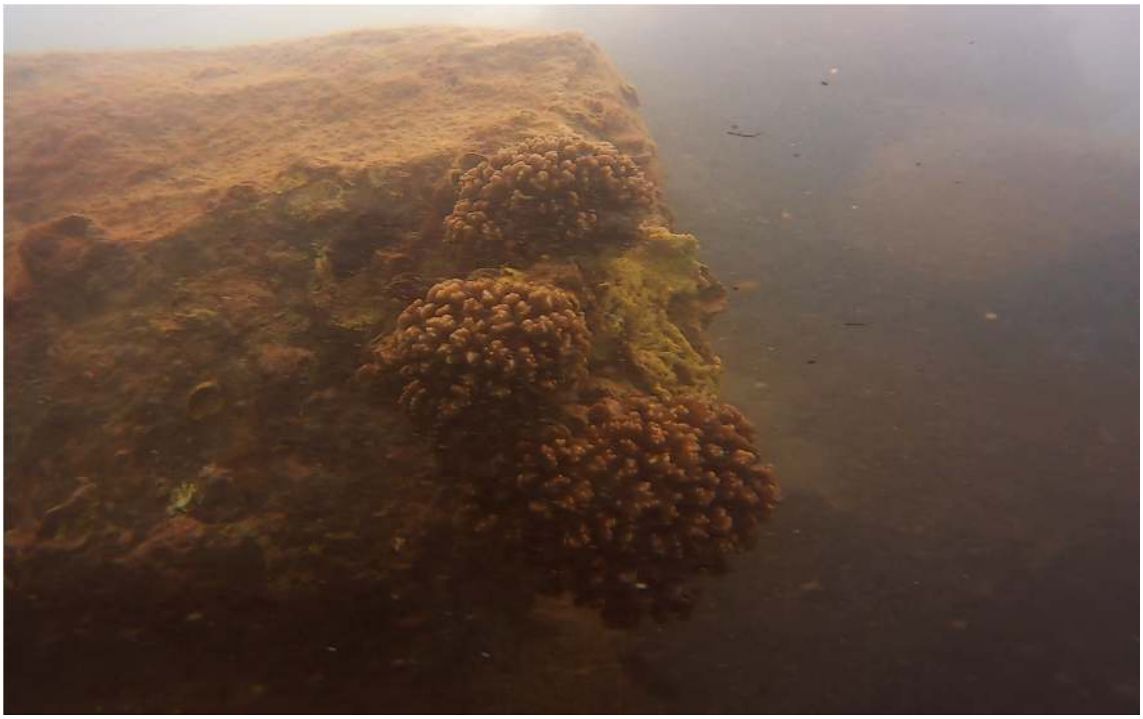


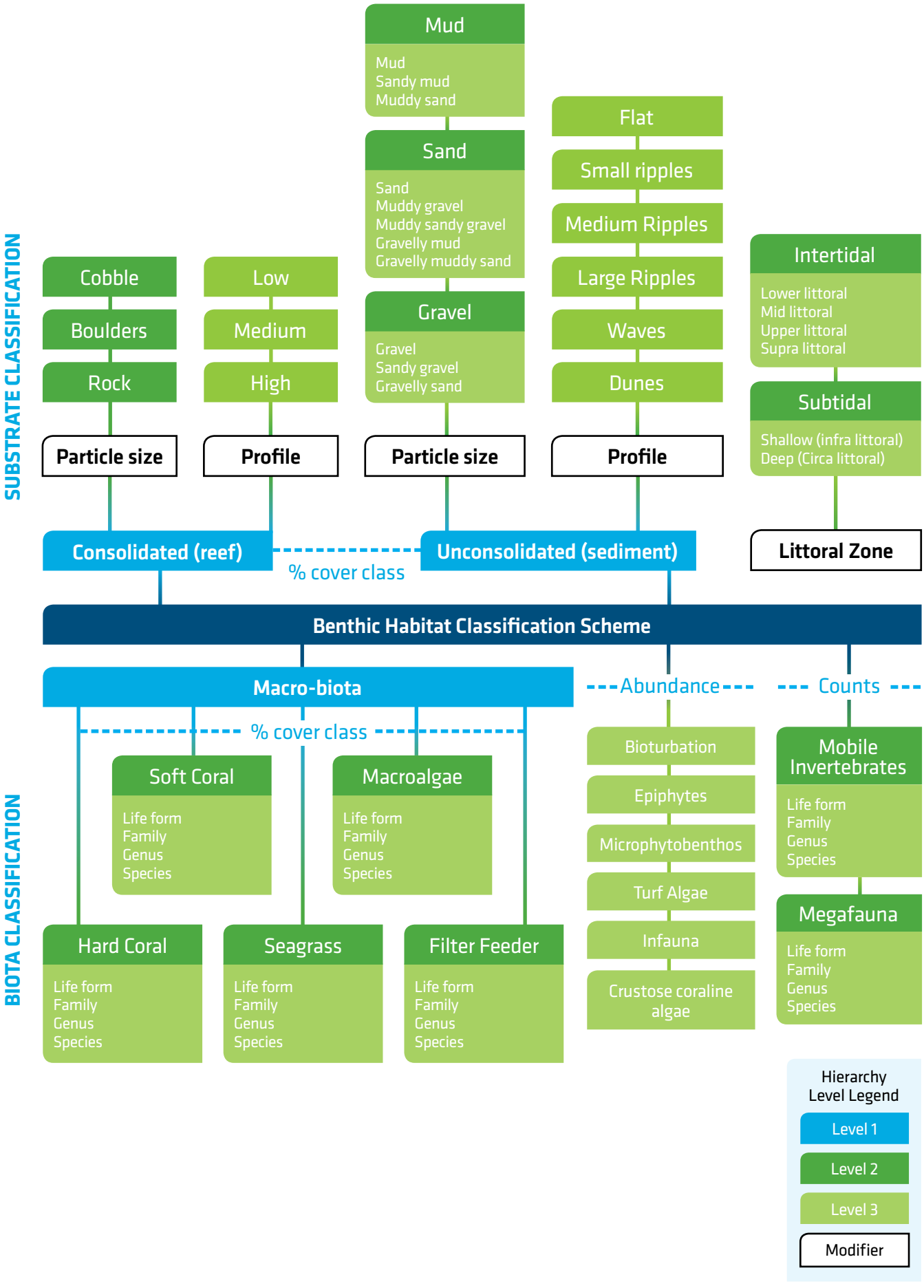
Figure 12 Seal Rock rock wall boulders with Pocillopora colonies (ROV dive 35)

Figure 13 Seal Rock rock wall boulders with plating Montipora colony (ROV dive 35)

Figure 14 Seal Rock rock wall boulders with plating Acropora colony (ROV dive 35)

Figure 15 Seal Rock rock wall boulders with a massive Favid colony (ROV dive 35)

Appendix A Habitat Classification Scheme


SUBSTRATE CLASSIFICATION
BIOTA CLASSIFICATION
Cobble
Boulders
Rock
Particle size
Low
Medium
High
Profile
Mud
Mud
Sandy mud
Muddy sand
Sand
Sand
Muddy gravel
Muddy sandy gravel
Gravelly mud
Gravelly muddy sand
Gravel
Gravel
Sandy gravel
Gravelly sand
Particle size
Flat
Small ripples
Medium Ripples
Large Ripples
Waves
Dunes
Profile
Intertidal
Lower littoral
Mid littoral
Upper littoral
Supra littoral
Subtidal
Shallow (infra littoral)
Deep (Circa littoral)
Littoral Zone
Consolidated (reef)
% cover class
Unconsolidated (sediment)
Benthic Habitat Classification Scheme
Macro-biota
% cover class
Soft Coral
Life form
Family
Genus
Species
Macroalgae
Life form
Family
Genus
Species
Hard Coral
Life form
Family
Genus
Species
Seagrass
Life form
Family
Genus
Species
Filter Feeder
Life form
Family
Genus
Species
Abundance
Bioturbation
Epiphytes
Microphytobenthos
Turf Algae
Infauna
Crustose coraline algae
Counts
Mobile Invertebrates
Life form
Family
Genus
Species
Megafauna
Life form
Family
Genus
Species
Hierarchy Level Legend
Level 1
Level 2
Level 3
Modifier

Biota Classification	Definition
Macro-biota	**Macrobenthos >20mm**
Soft Coral	Photosynthetic soft corals; Present >5% over 5m2
Hard Coral	Scleractinian corals; Present >5% over 5m2
Macroalgae	Macroalgae >20mm; Present >10% over 5m2
Filter Feeders	Non-photosynthetic benthic invertebrates; Present >10%
Seagrass	Seagrass; Present >0.5% over 5m2
Microphytobenthos (MPB)	
None	No MPB visible
Low	Slight discolouration of sediment; sediment clearly visible
Medium	Sediment is covered with a layer of MPB; sediment visible
High	No sediment visible through a thick layer of MPB
Turf algae	**Recorded when turf algae dominates the epibenthos**
None	<10% cover
Low	10-20% cover
Medium	20-50% cover
High	>50% cover
Crustose Coralline Algae (CCA)	**Recorded when CCA dominates the epibenthos**
None	<10% cover
Low	10-20% cover
Medium	20-50% cover
High	>50% cover
Epiphytes	
None	<10% cover on macrobiota
Low	10-20% cover on macrobiota
Medium	20-50% cover on macrobiota
High	>50% cover on macrobiota

Substrate Classification	Definition
Unconsolidated (Sediment)	Sediment >99% cover
Mixed sediment and reef	Reef 1–50% cover
Consolidated (Reef)	Reef >50% cover
Reef particle size	
Cobble	Particles 64–256 mm
Boulder	Particles >256 mm
Rock (unbroken)	Unbroken rock substrate
Reef profile	
High	>4 m rise over 2 m
Medium	1–4 m rise over 2 m
Low	<1 m rise over 2 m
Sediment particle size	
Pebble	Particles 4–64 mm
Gravel	Particles 2–4 mm
Sand	Particles 63 um–2 mm
Mud	Particles <63 um
Sediment profile	
Flat	No profile (undulations <1 cm)
Small ripples	Undulations 1–10 cm high
Medium ripples	Undulations 10–50 cm high
Large ripples	Undulations 50–100 cm high
Waves	Undulations 1–5 m high
Dunes	Undulations >5 m high
Bioturbation	
None	No evidence of bioturbation
Low	1–5 disturbances (e.g. burrows or mounds) per metre
Medium	5–15 disturbances per metre
High	>15 disturbances per metre

Macrobiota Classification	Taxonomy/Lifeform
Macrolagae	Other green algae small (<20cm)
	Caulerpa
	Halimeda
	Red-Brown algae small (<20cm)
	Brown lobed small (<20cm)
	Fucaceae brown algae (>20cm)
	Kelp
	Red algae large (>20cm)
	Other large algae (>20cm)
Seagrasses	Unknown seagrass
	Halophila
	Halodule / Syringodium
	Thalassia
	Other seagrass
Filter Feeders (Non BPP)	Encrusting sponge
	Upright sponge
	Soft coral (non BPP)
	Bivalves
	Gorgonian
	Sea whip
	Hydroid
	Other filter feeder
	Ascidian
Soft Coral (BPP)	Corillimorph
	Zoanthid
	Sarcophyton/Lobophytum
	Sinularia
	Other soft corals (BPP)
Hard Coral	Encrusting coral
	Upright coral
	Acropora
	Faviid
	Goniopora
	Symphyllia
	Lobophyllia
	Turbinaria
	Solitary coral
	Other coral

Appendix B Towed Camera Transect Summary

30139 - MWPA May 2020 Survey - Towed Camera Transect Summary Table

OBJECTID	ProjectNam	TransectID	LatMid	LonMid	LatStart	LonStart	LatEnd	LonEnd	AnalystNam	InterpDate	GroupMAMea	GroupMAPre	ClassCAMea	ClassCAPre	ClassSAMea	ClassSAPre	ClassSGMea	ClassSGPre	ClassHCMea	ClassHCPre	ClassFFMea	ClassFFPre	TotalPoint	MaxLeg	TransectNo	ReefCover	StartLocal	FinishLoca	StartUTCDa	FinishUTCD	TotalDistance
1	30139 - MWP	1	-28.764873	114.59504	-28.764911	114.595257	-28.764835	114.594822	Ben Piek	27/04/2020 0:00	0.0	0.0	0.0	0.0	0.0	0.0	8.6	1.0	0.0	0.0	0.0	0.0	362	0.5	170	0.0	28/04/2020 0:00	28/04/2020 0:00	27/04/2020 0:00	27/04/2020 0:00	71
2	30139 - MWP	2	-28.767563	114.598321	-28.767506	114.598589	-28.76762	114.598052	Ben Piek	27/04/2020 0:00	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	374	0.7	174	0.0	28/04/2020 0:00	28/04/2020 0:00	27/04/2020 0:00	27/04/2020 0:00	73
3	30139 - MWP	3	-28.749673	114.541239	-28.750029	114.541657	-28.749316	114.54082	Ben Piek	28/04/2020 0:00	16.8	1.0	16.8	1.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	321	1.4	163	54.6	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	132
4	30139 - MWP	4	-28.746214	114.555896	-28.746339	114.556243	-28.746089	114.555548	Ben Piek	28/04/2020 0:00	30.0	1.0	30.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	273	1.0	164	64.8	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	89
5	30139 - MWP	5	-28.744531	114.569954	-28.744611	114.570227	-28.74445	114.56968	Ben Piek	28/04/2020 0:00	67.8	1.0	65.2	1.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	259	0.7	186	65.6	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	75
6	30139 - MWP	6	-28.745108	114.575355	-28.745229	114.575599	-28.744988	114.575111	Ben Piek	28/04/2020 0:00	77.5	1.0	70.0	1.0	7.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	268	1.4	185	70.0	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	73
7	30139 - MWP	7	-28.742563	114.586539	-28.742791	114.586828	-28.742334	114.58625	Ben Piek	28/04/2020 0:00	6.0	0.0	0.0	0.0	6.0	0.0	7.4	1.0	0.0	0.0	1.0	0.0	320	0.7	184 - Moved due to fish farm	18.1	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	86
8	30139 - MWP	8	-28.747886	114.597757	-28.748073	114.598048	-28.747698	114.597465	Ben Piek	28/04/2020 0:00	3.0	0.0	0.0	0.0	3.0	0.0	19.4	1.0	0.0	0.0	3.0	0.0	260	0.9	183	0.9	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	73
9	30139 - MWP	9	-28.751218	114.610712	-28.751428	114.610971	-28.751007	114.610454	Ben Piek	28/04/2020 0:00	1.1	0.0	0.0	0.0	1.1	0.0	24.2	1.0	0.0	0.0	0.8	0.0	350	1.3	182	4.5	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	82
10	30139 - MWP	10	-28.730219	114.616304	-28.730479	114.616533	-28.729959	114.616075	Ben Piek	28/04/2020 0:00	57.5	1.0	50.0	1.0	7.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	221	0.9	194 - Moved, breaking waves	74.9	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	81
11	30139 - MWP	11	-28.729118	114.612573	-28.729419	114.612923	-28.728817	114.612222	Ben Piek	28/04/2020 0:00	0.9	0.0	0.0	0.0	0.9	0.0	3.9	1.0	0.0	0.0	0.0	0.0	216	1.7	193 - Lots of wrack/Floating weed	3.5	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	104
12	30139 - MWP	12	-28.730947	114.606821	-28.731118	114.607165	-28.730777	114.606477	Ben Piek	28/04/2020 0:00	1.7	0.0	0.8	0.0	0.9	0.0	5.2	1.0	0.0	0.0	0.0	0.0	200	1.4	191	21.6	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	80
13	30139 - MWP	13	-28.73371	114.604981	-28.733916	114.605198	-28.733504	114.604764	Ben Piek	28/04/2020 0:00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	203	0.9	192	0.0	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	65
14	30139 - MWP	14	-28.730995	114.595028	-28.731159	114.595332	-28.73083	114.594724	Ben Piek	28/04/2020 0:00	3.9	0.0	2.5	0.0	1.4	0.0	51.4	1.0	0.0	0.0	0.0	0.0	260	1.1	190	70.0	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	75
15	30139 - MWP	15	-28.731509	114.587665	-28.731741	114.587917	-28.731277	114.587414	Ben Piek	28/04/2020 0:00	18.9	1.0	4.4	0.0	14.5	1.0	22.8	1.0	0.0	0.0	0.0	0.0	252	1.7	189	56.9	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	80
16	30139 - MWP	16	-28.731405	114.576563	-28.731567	114.576754	-28.731244	114.576373	Ben Piek	28/04/2020 0:00	59.2	1.0	29.1	1.0	30.1	1.0	3.0	1.0	0.0	0.0	0.1	0.0	258	2.7	188	67.8	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	68
17	30139 - MWP	17	-28.733057	114.568398	-28.733255	114.568526	-28.732859	114.56827	Ben Piek	28/04/2020 0:00	38.9	1.0	20.2	1.0	18.8	1.0	11.3	1.0	0.0	0.0	0.0	0.0	220	0.8	187	70.0	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	64
18	30139 - MWP	18	-28.716468	114.528138	-28.716859	114.528317	-28.716078	114.527959	Ben Piek	28/04/2020 0:00	5.0	0.0	2.5	0.0	2.5	0.0	2.6	1.0	0.0	0.0	0.0	0.0	275	1.0	200	2.1	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	114
19	30139 - MWP	19	-28.716176	114.546503	-28.716591	114.546608	-28.715761	114.546397	Ben Piek	28/04/2020 0:00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	200	3.5	199	0.0	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	103
20	30139 - MWP	20	-28.713461	114.571839	-28.713867	114.572019	-28.713056	114.571658	Ben Piek	28/04/2020 0:00	54.2	1.0	40.9	1.0	13.4	1.0	0.0	0.0	0.0	0.0	0.0	0.0	210	1.7	198	90.0	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	103
21	30139 - MWP	21	-28.714381	114.598908	-28.714722	114.599034	-28.714039	114.598782	Ben Piek	28/04/2020 0:00	6.1	0.0	3.1	0.0	3.0	0.0	44.2	1.0	0.0	0.0	0.0	0.0	219	0.9	197	51.1	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	86
22	30139 - MWP	24	-28.687126	114.579195	-28.687571	114.579266	-28.686682	114.579125	Ben Piek	28/04/2020 0:00	14.6	1.0	7.1	0.0	7.5	0.0	30.0	1.0	0.0	0.0	0.1	0.0	205	1.4	202	16.5	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	106
23	30139 - MWP	25	-28.645869	114.597775	-28.646263	114.597676	-28.645475	114.597874	Ben Piek	28/04/2020 0:00	50.2	1.0	44.0	1.0	6.3	0.0	0.0	0.0	0.0	0.0	0.1	0.0	235	1.3	203	47.7	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	96
24	30139 - MWP	26	-28.638642	114.582943	-28.639125	114.58286	-28.638159	114.583026	Ben Piek	28/04/2020 0:00	12.3	1.0	0.0	0.0	12.3	1.0	0.0	0.0	0.0	0.0	0.0	0.0	303	2.6	204	20.7	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	119
25	30139 - MWP	28	-28.623609	114.581412	-28.624089	114.581295	-28.623129	114.58153	Ben Piek	28/04/2020 0:00	5.8	0.0	0.0	0.0	5.8	0.0	30.0	1.0	0.0	0.0	0.0	0.0	164	1.5	209	44.8	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	115
26	30139 - MWP	29	-28.611017	114.578581	-28.611601	114.578469	-28.610434	114.578693	Ben Piek	28/04/2020 0:00	15.0	1.0	0.0	0.0	15.0	1.0	30.0	1.0	0.0	0.0	0.0	0.0	263	0.8	No Stills	30.0	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	137
27	30139 - MWP	30	-28.596726	114.566309	-28.597057	114.56652	-28.596396	114.566099	Ben Piek	28/04/2020 0:00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	268	0.6	212	0.0	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	98
28	30139 - MWP	31	-28.594364	114.57367	-28.594679	114.573783	-28.594048	114.573558	Ben Piek	28/04/2020 0:00	27.0	1.0	0.0	0.0	27.0	1.0	18.1	1.0	0.6	0.0	0.0	0.0	362	1.4	213 - Some Coral Seen	50.0	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	117
29	30139 - MWP	32	-28.582661	114.563712	-28.583026	114.563597	-28.582295	114.563827	Ben Piek	28/04/2020 0:00	40.6	1.0	30.7	1.0	9.9	0.0	8.2	1.0	0.0	0.0	0.1	0.0	290	1.9	219	50.0	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	108
30	30139 - MWP	33	-28.754436	114.591027	-28.754788	114.591007	-28.754085	114.591047	Ben Piek	28/04/2020 0:00	34.2	1.0	22.3	1.0	11.9	1.0	0.0	0.0	0.0	0.0	0.0	0.0	182	0.7	172	25.3	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	81
31	30139 - MWP	34	-28.758146	114.590645	-28.758475	114.590566	-28.757818	114.590724	Ben Piek	28/04/2020 0:00	18.0	1.0	3.0	0.0	15.0	1.0	9.4	1.0	0.0	0.0	0.0	0.0	188	1.4	169	43.3	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	89
32	30139 - MWP	35	-28.761581	114.590237	-28.762171	114.590274	-28.760991	114.590201	Ben Piek	28/04/2020 0:00	71.7	1.0	68.7	1.0	3.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	283	2.2	173	94.2	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	138
33	30139 - MWP	36	-28.765024	114.595404	-28.764879	114.595736	-28.76517	114.595072	Ben Piek	28/04/2020 0:00	0.0	0.0	0.0	0.0	0.0	0.0	8.1	1.0	0.0	0.0	0.0	0.0	249	1.5	170	0.0	29/04/2020 0:00	29/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	81
34	30139 - MWP	37	-28.767339	114.599424	-28.767472	114.5996	-28.767207	114.599248	Ben Piek	28/04/2020 0:00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	271	0.9	174 - Repeat - Snagged Camera	0.0	29/04/2020 0:00	29/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	135
35	30139 - MWP	38	-28.768565	114.602059	-28.768632	114.602031	-28.768498	114.602087	Ben Piek	28/04/2020 0:00	3.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	125	1.9	174 - abort	30.0	29/04/2020 0:00	29/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	71
36	30139 - MWP	39	-28.764802	114.584713	-28.764711	114.585083	-28.764892	114.584343	Ben Piek	28/04/2020 0:00	15.0	1.0	3.3	0.0	11.7	1.0	19.4	1.0	0.0	0.0	0.0	0.0	276	0.8	168	14.1	29/04/2020 0:00	29/04/2020 0:00	28/04/2020 0:00	28/04/2020 0:00	89
37	30139 - MWP	40	-28.758014	114.570083	-28.757799	114.570432	-28.758228	114.569733	Ben Piek	29/04/2020 0:00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	215	1.7	165	0.0	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	113
38	30139 - MWP	42	-28.766436	114.566123	-28.766558	114.566554	-28.766313	114.565693	Ben Piek	29/04/2020 0:00	90.6	1.0	35.2	1.0	55.4	1.0	0.0	0.0	1.0	1.0	0.0	0.0	213	0.7	162 - Very High Profile - Cray Ground	97.7	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	173
39	30139 - MWP	43	-28.77388	114.565683	-28.773962	114.566031	-28.773798	114.565335	Ben Piek	29/04/2020 0:00	38.7	1.0	3.6	0.0	35.1	1.0	0.0	0.0	2.4	0.0	0.0	0.0	243	1.3	157 - High Profile	77.4	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	81
40	30139 - MWP	44	-28.772277	114.553995	-28.772514	114.554522	-28.772039	114.553468	Ben Piek	29/04/2020 0:00	17.3	1.0	3.2	0.0	14.1	1.0	0.0	0.0	0.0	0.0	0.0	0.0	246	1.3	158 - Spoil ground, sand inundated rocks	13.2	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	128
41	30139 - MWP	45	-28.770455	114.545624	-28.770698	114.546045	-28.770212	114.545204	Ben Piek	29/04/2020 0:00	27.0	1.0	15.0	1.0	12.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	202	1.6	160 - Spoil Ground, rubble and algae	50.0	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	107
42	30139 - MWP	46	-28.777196	114.547042	-28.777449	114.547447	-28.776943	114.546638	Ben Piek	29/04/2020 0:00	39.5	1.0	24.5	1.0	15.0	1.0	0.0	0.0	0.0	0.0	0.3	0.0	206	2.1	161 -Spoil Ground - Algae on boulders	50.0	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	109
43	30139 - MWP	47	-28.778433	114.55419	-28.778765	114.55459	-28.7781	114.553789	Ben Piek	29/04/2020 0:00	11.5	1.0	6.9	0.0	4.5	0.0	0.0	0.0	0.4	0.0	0.5	0.0	283	2.7	159 - Spoil ground	32.1	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	121
44	30139 - MWP	48	-28.783661	114.535868	-28.783684	114.536087	-28.783638	114.535648	Ben Piek	29/04/2020 0:00	10.7	1.0	3.4	0.0	7.2	0.0	0.0	0.0	0.0	0.0	0.3	0.0	296	1.2	155	29.3	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	77
45	30139 - MWP	49	-28.802524	114.53284	-28.802233	114.53314	-28.802815	114.53254	Ben Piek	29/04/2020 0:00	15.6	1.0	7.7	0.0	8.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	269	0.9	154	28.8	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	115
46	30139 - MWP	50	-28.802602	114.549995	-28.802283	114.550019	-28.802921	114.549972	Ben Piek	29/04/2020 0:00	18.8	1.0	8.2	0.0	10.6	1.0	0.0	0.0	0.0	0.0	2.8	0.0	367	1.7	153	38.4	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	107
47	30139 - MWP	51	-28.807185	114.565363	-28.807064	114.565404	-28.807305	114.565322	Ben Piek	29/04/2020 0:00	18.7	1.0	12.2	1.0	6.5	0.0	0.0	0.0	0.0	0.0	2.1	0.0	431	1.4	152	34.3	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	87
48	30139 - MWP	52	-28.838278	114.583687	-28.837928	114.583893	-28.838628	114.58348	Ben Piek	29/04/2020 0:00	1.5	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	393	1.9	142	2.4	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	134
49	30139 - MWP	53	-28.838886	114.609896	-28.83897	114.609821	-28.838802	114.609972	Ben Piek	29/04/2020 0:00	8.6	0.0	0.0	0.0	8.6	0.0	29.4	1.0	0.0	0.0	0.0	0.0	294	1.0	140	0.0	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	76
50	30139 - MWP	54	-28.83901	114.616063	-28.839065	114.615878	-28.838955	114.616248	Ben Piek	29/04/2020 0:00	30.1	1.0	0.0	0.0	30.1	1.0	9.3	1.0	0.0	0.0	0.0	0.0	301	0.8	139	0.0	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	66
51	30139 - MWP	55	-28.838348	114.625629	-28.838095	114.62569	-28.8386	114.625569	Ben Piek	29/04/2020 0:00	6.0	0.0	0.0	0.0	6.0	0.0	3.5	1.0	0.0	0.0	0.0	0.0	321	0.7	136	0.0	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	74
52	30139 - MWP	56	-28.825872	114.621921	-28.826132	114.622031	-28.825612	114.621811	Ben Piek	29/04/2020 0:00	26.7	1.0	0.0	0.0	26.7	1.0	65.9	1.0	0.0	0.0	0.0	0.0	250	1.5	137	0.0	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	73
53	30139 - MWP	57	-28.80984	114.617217	-28.809737	114.617328	-28.809943	114.617105	Ben Piek	29/04/2020 0:00	31.1	1.0	9.9	0.0	21.3	1.0	19.2	1.0	0.0	0.0	0.0	0.0	307	0.5	138	30.2	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	69
54	30139 - MWP	58	-28.808992	114.600247	-28.809024	114.600448	-28.80896	114.600047	Ben Piek	29/04/2020 0:00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	370	0.6	144	0.0	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	29/04/2020 0:00	94
55	30139 - MWP	59	-28.549415	114.558489	-28.549511	114.558849	-28.549318	114.558129	Ben Piek	30/04/2020 0:00	47.2	1.0	3.8	0.0	43.5	1.0	19.9	1.0	0.0	0.0	0.0	0.0	238	1.1	228	0.0	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	91
56	30139 - MWP	60	-28.554981	114.559148	-28.555189	114.559513	-28.554773	114.558783	Ben Piek	30/04/2020 0:00	46.1	1.0	25.1	1.0	20.9	1.0	13.9	1.0	0.0	0.0	0.0	0.0	269	0.8	227	74.0	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	98
57	30139 - MWP	61	-28.562881	114.562519	-28.562965	114.562905	-28.562796	114.562133	Ben Piek	30/04/2020 0:00	14.1	1.0	5.1	0.0	9.0	0.0	31.8	1.0	0.0	0.0	0.0	0.0	250	1.1	226	84.3	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	86
58	30139 - MWP	62	-28.555867	114.54458	-28.555392	114.54513	-28.556341	114.544031	Ben Piek	30/04/2020 0:00	16.0	1.0	5.8	0.0	10.2	1.0	1.5	1.0	0.1	0.0	1.3	0.0	357	1.6	229	15.7	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	179
59	30139 - MWP	63	-28.564485	114.550165	-28.564306	114.550469	-28.564665	114.549861	Ben Piek	30/04/2020 0:00	1.8	0.0	1.0	0.0	0.8	0.0	2.4	1.0	0.0	0.0	0.0	0.0	173	1.0	230	2.9	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	82
60	30139 - MWP	64	-28.572689	114.556753	-28.572522	114.557039	-28.572855	114.556466	Ben Piek	30/04/2020 0:00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	211	0.7	220	0.0	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	79
61	30139 - MWP	65	-28.570054	114.563266	-28.569826	114.56351	-28.570281	114.563022	Ben Piek	30/04/2020 0:00	31.2	1.0	2.1	0.0	29.1	1.0	31.8	1.0	0.0	0.0	0.0	0.0	237	1.8	221	78.5	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	85
62	30139 - MWP	66	-28.568546	114.567794	-28.568547	114.568239	-28.568545	114.56735	Ben Piek	30/04/2020 0:00	35.7	1.0	21.5	1.0	14.2	1.0	26.2	1.0	0.0	0.0	1.1	0.0	209	1.0	222	88.2	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	91
63	30139 - MWP	67	-28.579501	114.572722	-28.579592	114.573132	-28.579409	114.572312	Ben Piek	30/04/2020 0:00	39.4	1.0	26.0	1.0	13.5	1.0	29.0	1.0	0.0	0.0	0.8	0.0	300	0.8	217	83.8	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	91
64	30139 - MWP	68	-28.581045	114.568949	-28.581085	114.569409	-28.581006	114.56849	Ben Piek	30/04/2020 0:00	30.3	1.0	20.0	1.0	10.3	1.0	18.5	1.0	0.0	0.0	0.0	0.0	276	0.7	218	52.5	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	102
65	30139 - MWP	69	-28.583598	114.571191	-28.583613	114.571567	-28.583583	114.570815	Ben Piek	30/04/2020 0:00	0.6	0.0	0.3	0.0	0.4	0.0	22.9	1.0	0.0	0.0	0.0	0.0	235	1.5	223	39.9	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	80
66	30139 - MWP	70	-28.583739	114.581043	-28.583713	114.581371	-28.583766	114.580715	Ben Piek	30/04/2020 0:00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	194	0.6	225	0.0	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	66
67	30139 - MWP	71	-28.584887	114.58175	-28.584575	114.581747	-28.585199	114.581752	Ben Piek	30/04/2020 0:00	4.3	0.0	0.0	0.0	4.3	0.0	2.0	1.0	0.0	0.0	0.0	0.0	207	1.3	225A - Visible lump	22.5	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	106
68	30139 - MWP	72	-28.587911	114.577367	-28.588041	114.57768	-28.587781	114.577055	Ben Piek	30/04/2020 0:00	34.6	1.0	14.3	1.0	20.3	1.0	12.0	1.0	0.0	0.0	0.0	0.0	190	0.6	216	90.1	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	80
69	30139 - MWP	73	-28.584672	114.576879	-28.584651	114.577153	-28.584693	114.576605	Ben Piek	30/04/2020 0:00	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	252	1.4	224 - Incorrect on overlay	0.0	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	64
70	30139 - MWP	74	-28.591853	114.580172	-28.591723	114.580658	-28.591983	114.579685	Ben Piek	30/04/2020 0:00	36.2	1.0	20.6	1.0	15.6	1.0	11.3	1.0	0.0	0.0	0.0	0.0	182	0.9	215	59.7	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	106
71	30139 - MWP	75	-28.593146	114.576598	-28.593333	114.576763	-28.592958	114.576433	Ben Piek	30/04/2020 0:00	56.6	1.0	49.1	1.0	7.5	0.0	7.0	1.0	0.0	0.0	0.0	0.0	215	0.7	214	88.5	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	69
72	30139 - MWP	76	-28.611284	114.587643	-28.611297	114.588063	-28.611271	114.587224	Ben Piek	30/04/2020 0:00	13.7	1.0	11.8	1.0	2.0	0.0	2.4	1.0	0.0	0.0	0.0	0.0	233	0.5	210	33.0	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	85
73	30139 - MWP	77	-28.621153	114.594621	-28.62113	114.595111	-28.621177	114.59413	Ben Piek	30/04/2020 0:00	51.7	1.0	33.0	1.0	18.8	1.0	8.5	1.0	0.0	0.0	0.0	0.0	230	2.7	207	82.2	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	103
74	30139 - MWP	78	-28.622178	114.58671	-28.622268	114.587172	-28.622088	114.586248	Ben Piek	30/04/2020 0:00	44.4	1.0	20.0	1.0	24.3	1.0	7.5	1.0	0.0	0.0	2.2	0.0	257	0.6	208	58.3	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	96
75	30139 - MWP	79	-28.634293	114.590748	-28.634316	114.591099	-28.634269	114.590396	Ben Piek	30/04/2020 0:00	52.4	1.0	25.8	1.0	26.6	1.0	7.7	1.0	0.0	0.0	3.0	0.0	290	0.7	206	44.3	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	78
76	30139 - MWP	80	-28.63577	114.601261	-28.635678	114.601609	-28.635863	114.600912	Ben Piek	30/04/2020 0:00	27.5	1.0	18.6	1.0	8.9	0.0	33.2	1.0	0.0	0.0	3.0	0.0	256	1.2	205	79.4	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	80
77	30139 - MWP	81	-28.646091	114.597692	-28.646166	114.5982	-28.646016	114.597184	Ben Piek	30/04/2020 0:00	63.5	1.0	60.5	1.0	3.0	0.0	3.1	1.0	0.0	0.0	3.0	0.0	342	1.1	203 - Repeat	90.5	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	107
78	30139 - MWP	82	-28.687976	114.601517	-28.687896	114.602085	-28.688057	114.600949	Ben Piek	30/04/2020 0:00	7.8	0.0	5.6	0.0	2.2	0.0	42.7	1.0	0.0	0.0	0.3	0.0	313	1.3	201	20.8	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	119
79	30139 - MWP	83	-28.715167	114.612361	-28.715091	114.612814	-28.715244	114.611908	Ben Piek	30/04/2020 0:00	6.9	0.0	1.9	0.0	5.0	0.0	19.3	1.0	0.0	0.0	0.0	0.0	352	0.7	196	15.1	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	91
80	30139 - MWP	84	-28.722803	114.617408	-28.722757	114.617952	-28.72285	114.616864	Ben Piek	30/04/2020 0:00	33.7	1.0	26.4	1.0	7.3	0.0	39.5	1.0	0.0	0.0	0.0	0.0	282	1.5	195	66.0	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	111
81	30139 - MWP	85	-28.760897	114.610689	-28.760665	114.611306	-28.761128	114.610072	Ben Piek	30/04/2020 0:00	0.5	0.0	0.0	0.0	0.5	0.0	50.0	1.0	0.2	0.0	0.9	0.0	418	0.6	181	2.3	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	135
82	30139 - MWP	86	-28.771273	114.606875	-28.771203	114.607259	-28.771342	114.606491	Ben Piek	30/04/2020 0:00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	157	0.8	179	0.0	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	78
83	30139 - MWP	87	-28.770398	114.603835	-28.770307	114.604234	-28.770489	114.603436	Ben Piek	30/04/2020 0:00	0.0	0.0	0.0	0.0	0.0	0.0	10.3	1.0	0.0	0.0	0.0	0.0	241	1.0	170	0.0	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	83
84	30139 - MWP	88	-28.765056	114.595421	-28.764995	114.59576	-28.765117	114.595083	Ben Piek	30/04/2020 0:00	0.0	0.0	0.0	0.0	0.0	0.0	14.6	1.0	0.0	0.0	0.0	0.0	176	1.1	170	0.0	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	70
85	30139 - MWP	89	-28.770297	114.594257	-28.770062	114.594459	-28.770533	114.594055	Ben Piek	30/04/2020 0:00	0.0	0.0	0.0	0.0	0.0	0.0	5.4	1.0	0.0	0.0	0.0	0.0	186	1.8	171	0.0	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	83
86	30139 - MWP	90	-28.770834	114.593077	-28.770731	114.593403	-28.770938	114.59275	Ben Piek	30/04/2020 0:00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	220	1.2	178 - Can't See bottom from wrack	0.0	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	70
87	30139 - MWP	91	-28.767419	114.598773	-28.767424	114.598467	-28.767414	114.59908	Ben Piek	30/04/2020 0:00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	271	0.5	171	0.0	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	66
88	30139 - MWP	93	-28.768496	114.601255	-28.76833	114.601574	-28.768663	114.600936	Ben Piek	30/04/2020 0:00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	216	0.5	175	0.0	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	75
89	30139 - MWP	94	-28.771193	114.601384	-28.771141	114.601783	-28.771244	114.600985	Ben Piek	30/04/2020 0:00	4.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	145	0.6	177	8.2	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	80
90	30139 - MWP	95	-28.765234	114.604437	-28.76512	114.604693	-28.765347	114.604182	Ben Piek	30/04/2020 0:00	17.5	1.0	8.5	0.0	9.0	0.0	13.1	1.0	0.0	0.0	2.6	0.0	270	0.7	180	31.4	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	76
91	30139 - MWP	96	-28.771205	114.586566	-28.771409	114.586762	-28.771001	114.58637	Ben Piek	30/04/2020 0:00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	455	0.7	167 - Cameras stuck at end	30.5	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	177
92	30139 - MWP	97	-28.790853	114.581184	-28.790803	114.581705	-28.790903	114.580663	Ben Piek	30/04/2020 0:00	17.4	1.0	16.2	1.0	1.2	0.0	38.1	1.0	0.0	0.0	0.0	0.0	280	0.8	150	27.9	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	107
93	30139 - MWP	98	-28.785755	114.589953	-28.785725	114.590352	-28.785786	114.589553	Ben Piek	30/04/2020 0:00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	200	0.5	149	0.0	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	83
94	30139 - MWP	99	-28.792597	114.59406	-28.792875	114.594189	-28.792319	114.593932	Ben Piek	30/04/2020 0:00	40.1	1.0	34.6	1.0	5.5	0.0	22.7	1.0	0.0	0.0	0.0	0.0	178	1.1	148	73.8	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	76
95	30139 - MWP	100	-28.794732	114.599963	-28.794514	114.600108	-28.79495	114.599818	Ben Piek	30/04/2020 0:00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	189	0.6	147	0.0	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	62
96	30139 - MWP	101	-28.806501	114.575922	-28.806318	114.57625	-28.806684	114.575593	Ben Piek	30/04/2020 0:00	37.1	1.0	35.1	1.0	2.0	0.0	0.9	1.0	0.0	0.0	0.0	0.0	204	1.0	151	64.2	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	84
97	30139 - MWP	102	-28.838306	114.604893	-28.838116	114.605239	-28.838496	114.604547	Ben Piek	30/04/2020 0:00	56.3	1.0	17.9	1.0	38.4	1.0	1.2	1.0	0.0	0.0	0.0	0.0	204	0.7	141	90.4	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	86
98	30139 - MWP	103	-28.784347	114.567334	-28.784311	114.567906	-28.784384	114.566762	Ben Piek	30/04/2020 0:00	52.5	1.0	25.3	1.0	27.2	1.0	0.0	0.0	0.5	0.0	0.6	0.0	275	0.8	156	80.4	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	120
99	30139 - MWP	104	-28.761413	114.57609	-28.761421	114.576443	-28.761404	114.575737	Ben Piek	30/04/2020 0:00	37.2	1.0	37.2	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	172	0.7	166	77.3	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	30/04/2020 0:00	77
100	30139 - MWP	105	-28.759536	114.601698	-28.75905	114.603113	-28.760021	114.600283	Sebastian Brekke	1/05/2020 0:00	3.1	0.0	0.0	0.0	3.1	0.0	21.9	1.0	1.2	0.0	1.0	0.0	751	1.5	231. Saw some coral.	22.6	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	317
101	30139 - MWP	106	-28.754999	114.598901	-28.754067	114.599943	-28.755931	114.59786	Sebastian Brekke	1/05/2020 0:00	3.9	0.0	0.0	0.0	3.9	0.0	27.8	1.0	2.1	0.0	0.9	0.0	861	1.2	232. Saw quite a few solitary corals.	14.3	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	301
102	30139 - MWP	107	-28.751669	114.584327	-28.750571	114.585339	-28.752767	114.583314	Sebastian Brekke	1/05/2020 0:00	29.3	1.0	0.8	0.0	28.5	1.0	9.9	1.0	0.2	0.0	0.2	0.0	801	1.3	233	14.8	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	336
103	30139 - MWP	108	-28.740503	114.59803	-28.73991	114.598784	-28.741096	114.597276	Sebastian Brekke	1/05/2020 0:00	8.1	0.0	0.0	0.0	8.1	0.0	48.3	1.0	0.4	0.0	0.0	0.0	553	1.1	234. mostly amphibolis but some solitary coral	31.5	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	206
104	30139 - MWP	109	-28.742346	114.572272	-28.741331	114.573084	-28.743362	114.57146	Sebastian Brekke	1/05/2020 0:00	59.0	1.0	58.8	1.0	0.2	0.0	4.8	1.0	0.0	0.0	0.0	0.0	528	1.3	235. Mostly sargassum	58.0	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	281
105	30139 - MWP	110	-28.720268	114.588964	-28.719382	114.589819	-28.721155	114.588109	Sebastian Brekke	1/05/2020 0:00	3.4	0.0	2.0	0.0	1.4	0.0	44.6	1.0	0.0	0.0	0.0	0.0	689	1.8	236	9.1	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	272
106	30139 - MWP	111	-28.701573	114.57993	-28.700939	114.580749	-28.702208	114.579112	Sebastian Brekke	1/05/2020 0:00	3.0	0.0	0.0	0.0	3.0	0.0	60.5	1.0	0.0	0.0	0.0	0.0	355	3.0	237	3.9	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	220
107	30139 - MWP	112	-28.699839	114.599821	-28.698798	114.600835	-28.700879	114.598807	Sebastian Brekke	1/05/2020 0:00	20.2	1.0	7.9	0.0	12.3	1.0	23.8	1.0	0.0	0.0	0.0	0.0	690	2.6	238	18.3	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	311
108	30139 - MWP	113	-28.702762	114.610682	-28.701645	114.611554	-28.70388	114.60981	Sebastian Brekke	1/05/2020 0:00	7.9	0.0	7.9	0.0	0.0	0.0	6.4	1.0	0.0	0.0	0.0	0.0	662	6.1	239. Mainly patches of sargassum and amphibolis intersper	3.5	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	307
109	30139 - MWP	114	-28.735337	114.611252	-28.734768	114.611976	-28.735907	114.610528	Sebastian Brekke	1/05/2020 0:00	0.0	0.0	0.0	0.0	0.0	0.0	33.0	1.0	0.0	0.0	0.0	0.0	371	2.4	240. patches of seagrass among the sand. Mostly amphibol	0.6	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	198
110	30139 - MWP	115	-28.769094	114.587712	-28.770342	114.589252	-28.767845	114.586172	Sebastian Brekke	1/05/2020 0:00	1.5	0.0	0.1	0.0	1.4	0.0	8.9	1.0	0.0	0.0	0.0	0.0	1111	4.8	241. Mostly sand with some halophila areas.	3.3	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	438
111	30139 - MWP	116	-28.768124	114.590956	-28.769687	114.592246	-28.766561	114.589666	Sebastian Brekke	1/05/2020 0:00	3.4	0.0	0.7	0.0	2.7	0.0	43.8	1.0	0.0	0.0	0.0	0.0	1134	5.2	242. Various seagrass beds.	1.4	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	444
112	30139 - MWP	117	-28.769681	114.584453	-28.770832	114.586537	-28.76853	114.582369	Sebastian Brekke	1/05/2020 0:00	3.8	0.0	3.4	0.0	0.5	0.0	19.8	1.0	0.0	0.0	0.0	0.0	978	3.8	243. moving through sand, seagrass to sargassum and ecklo	2.1	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	514
113	30139 - MWP	118	-28.757413	114.578315	-28.758961	114.579201	-28.755866	114.577429	Sebastian Brekke	1/05/2020 0:00	70.2	1.0	67.8	1.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	981	4.0	244. Mostly sargassum and ecklonia.	67.0	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	408
114	30139 - MWP	119	-28.742075	114.555939	-28.741333	114.555339	-28.742817	114.556539	Sebastian Brekke	1/05/2020 0:00	20.3	1.0	14.3	1.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	492	1.6	245. Various red algae.	44.0	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	209
115	30139 - MWP	120	-28.773856	114.546357	-28.774202	114.547031	-28.773511	114.545683	Sebastian Brekke	1/05/2020 0:00	38.3	1.0	36.1	1.0	2.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0	493	2.3	246. Pebble bottom with various red algae.	78.1	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	167
116	30139 - MWP	121	-28.754458	114.565491	-28.754861	114.566267	-28.754056	114.564715	Sebastian Brekke	1/05/2020 0:00	54.4	1.0	44.4	1.0	10.1	1.0	0.0	0.0	0.0	0.0	0.6	0.0	449	5.1	247. Sargassum and red algae.	67.8	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	185
117	30139 - MWP	122	-28.725809	114.571881	-28.725757	114.570439	-28.725862	114.573323	Sebastian Brekke	1/05/2020 0:00	58.9	1.0	58.8	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	680	2.8	248. Mostly sargassum.	54.8	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	291
118	30139 - MWP	123	-28.721772	114.583347	-28.72168	114.581866	-28.721863	114.584827	Sebastian Brekke	1/05/2020 0:00	19.6	1.0	18.0	1.0	1.6	0.0	21.6	1.0	0.0	0.0	0.0	0.0	695	2.6	249. Mixture of sargassum, amphibolis, red algae and possi	32.0	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	300
119	30139 - MWP	124	-28.740695	114.585863	-28.740308	114.585255	-28.741082	114.586471	Sebastian Brekke	1/05/2020 0:00	15.5	1.0	1.9	0.0	13.6	1.0	0.0	0.0	0.0	0.0	0.1	0.0	331	2.6	250. Red algae on mostly rocky substrate	18.1	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	150
120	30139 - MWP	125	-28.767991	114.575087	-28.767142	114.57438	-28.768841	114.575794	Sebastian Brekke	1/05/2020 0:00	59.4	1.0	59.4	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	581	2.6	251. Bumpy bottom going from Ecklonia to sargassum and	70.7	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	244
121	30139 - MWP	126	-28.773508	114.581632	-28.774137	114.582109	-28.772879	114.581156	Sebastian Brekke	1/05/2020 0:00	0.0	0.0	0.0	0.0	0.0	0.0	18.4	1.0	0.0	0.0	0.0	0.0	502	2.6	252. sand with various seagrass species.	0.0	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	173
122	30139 - MWP	127	-28.767686	114.596081	-28.769395	114.596412	-28.765978	114.595749	Sebastian Brekke	1/05/2020 0:00	0.0	0.0	0.0	0.0	0.0	0.0	7.4	1.0	0.0	0.0	0.0	0.0	1179	2.8	253. sand with floating weed. Patches of halophila and posi	0.0	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	419
123	30139 - MWP	128	-28.759116	114.596784	-28.759909	114.59547	-28.758323	114.598097	Sebastian Brekke	1/05/2020 0:00	8.0	0.0	2.9	0.0	5.1	0.0	17.4	1.0	0.0	0.0	0.0	0.0	710	3.6	254. sand with floatingg weed. Some seagrass and some ca	0.0	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	1/05/2020 0:00	322
124	30139 - MWP	129	-28.773138	114.588214	-28.77317	114.588228	-28.773107	114.5882	Ben Piek	4/05/2020 0:00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	433	2.6	North Pens Rockwall	0.0	19/09/2000 0:00	19/09/2000 0:00	18/09/2000 0:00	18/09/2000 0:00	175
																														Total	16459

AECOM
AECOM Australia Pty Ltd
181 Adelaide Terrace
Perth WA 6000
GPO Box B59
Perth WA 6849
Australia
T +61 8 6230 5600

www.aecom.com
ABN 20 093 846 925