Port of Port Hedland Zone 5 Bypass Channel Project

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Benthic Habitat Assessment

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Acronyms and Abbreviations

Abbreviation	Definition
BCH	Benthic Communities and Habitats
CATAMI	Collaborative and Automated Tools for Analysis of Marine Imagery
CD	Chart Datum
CEP	Channel Entry Project
CPCe	Coral Point Count with Excel extensions
DCCEEW	Department of Climate Change, Energy, the Environment and Water
EP Act	Environmental Protection Act 1986
EPA	Environmental Protection Authority
FOV	Field of View
GIS	Geographical Information System
GPS	Geographical Positioning System
LiDAR	Light Detection and Ranging
NAGD	National Assessment Guidelines for Dredging
Pilbara Ports	Previously known as Pilbara Ports Authority
SDP	Sea Dumping Permit
SG7	Spoil Ground 7
SG7C	Spoil Ground 7C
the Channel	Port Hedland Shipping Channel
the Project	Zone 5 Bypass Channel Project
VTS	Vessel Traffic Services
WA	Western Australia

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EXECUTIVE SUMMARY

The Port of Port Hedland (Port) is a single-channel port that underpins a significant proportion of Western Australia's export economy. The Channel can be broken down into six distinct zones based on location, bathymetry, channel slopes and sea conditions. As vessel sizes have increased and traffic volumes grown, the consequences of any disruption to this route have become more pronounced. Although vessel control failures remain relatively infrequent, incidents in recent years have demonstrated that even brief mechanical or navigational issues can escalate quickly within the confined geometry of the channel. In certain sections, such as Zone 5, the physical characteristics of the channel provide limited opportunity for recovery once control is lost.

Pilbara Ports is proposing to conduct capital dredging to create a bypass channel to the east of Zone 5 of the existing Channel (the Project). Once the capital works are completed, this area will become part of the annual channel maintenance dredging campaign. The Project is a strategic marine risk-mitigation project intended to maintain vessel transit at an acceptable reduced capacity, should a grounding incident occur in Zone 5 of the channel.

Loading and disposal of dredge spoil at sea requires approval by the Department of Climate Change, Energy, the Environment and Water under the *Environment Protection (Sea Dumping) Act 1981*. In addition, the Western Australia Environment Protection Authority (EPA) encourages proponents of large-scale dredging projects, such as capital dredging, to refer the project for assessment under Part IV of the *Environmental Protection Act 1986* (EP Act). Prior to completing an application for disposal at sea or referral of a project under the EP Act, proponents are required to undertake appropriate investigations to characterise the existing environment at the loading and disposal sites, as specified in the National Assessment Guidelines for Dredging (NAGD) and EPA technical guidance for marine dredging proposals, so that the impacts of loading and disposal can be assessed and measured. In order to generate realistic impact predictions of loading and disposal of dredge spoil at sea, the NAGD and EPA advise proponents to generate an adequately detailed benthic habitat map for the proposed project area and encourage the use of available historical benthic habitat data to assist in this process. The distribution and composition of subtidal Benthic Communities and Habitats (BCH) off the coast of Port Hedland, including the area in which the Project is located (the Project area), have been described previously for the proposed BHP Outer Harbour Development **(**SKM 2009**)** and Channel Entry Project (MScience 2022).

The objective of the present assessment was to provide a greater certainty and precision in the location and structure of known BCH within and adjacent to the Zone 5 Bypass Channel dredging design and SG7C disposal footprint (the survey area), utilising existing BCH data and hydrographic data to optimise the proposed survey design.

The field survey was completed from a vessel between 13 and 14 July 2025 using a drop camera system with live surface feed to capture high definition downwards-facing video footage. Sampling intensity was high within, and at, the boundaries of known and predicted hard substrate areas to accurately classify and determine the extent of the BCH on the hard substrates. Sampling was less intense within the sand plains where past surveys have shown benthic primary producers were not supported.

Overall, evaluation of transects surveyed in the present assessment recognised two habitat types, with five community types found within one or more of those habitats (Table ES - 1,Figure ES - 1).

Table ES - 1. Benthic community and habitat types

Habitat Type	Community Type	Biota Present
Unconsolidated Sediment Sand (flat or rippled, medium to coarse grained) and gravel	Bare	Occasional macroalgae (including <5 m^2 patches of turf algal mats and filamentous algae), filter feeders (<2 % cover) and <2 m^2 patches of seagrass (<2 % cover)
	Sparse Invertebrates	2 to <10 % cover of invertebrates (sponges and other mixed filter feeders) growing in sand.
Low Relief (<1 m) Consolidated Hard Substrate Hard limestone pavement or rubble with or without a sand veneer	Sparse Invertebrates	2 to <10 % cover of invertebrates (sponges, soft corals, gorgonians and other mixed filter feeders) and occasional hard corals (<3% cover) growing on hard substrate surrounded by patches of bare sand.
	Low Density Invertebrates	10 to <20 % cover of invertebrates (soft corals, sponges, gorgonians and other mixed filter feeders) and hard corals (<5% cover) growing on hard substrate surrounded by patches of bare sand.
	Medium Density Invertebrates	20 to <40 % cover of invertebrates (sponges, soft corals and other mixed filter feeders) and hard corals (<10% cover) growing on hard substrate surrounded by patches of sand.
	Medium Density Mixed Communities	Mixed benthos up to 40% cover of turf algae, invertebrates (sponges, soft corals and other mixed filter feeders) and hard corals (10 to 20 % cover), growing on hard substrate surrounded by patches of sand.

Close to 94% of the survey area was mapped as bare sand (<2 % cover of biota). Sparse (2 to <10 % cover) to medium density (20 to <40 %) invertebrates (non-coral) growing on unconsolidated and hard consolidated substrate formed 4% of the area. Approximately 85 ha, or 2%, consisted of mixed community (up to 40% cover of sponges, soft corals and mixed filter feeders and up to 20% of hard coral cover) growing on isolated outcrops of hard substrate and the hard substrate ridgeline running parallel to the coastline in the north of the zone which appears to be an extension of Minilya Bank to the east of the Project area.

Within the areas proposed for capital dredging, Zone 5A(i) (18.9 ha) was mapped as bare unconsolidated sand habitat (<2 % biota cover), Zone 5A(ii) (6.6 ha) was mapped as mixed community (turf algae, sponges, soft corals and other mixed filter feeders and up to 20% cover of hard corals) growing on consolidated hard substrate, and Zone 5A(iii) (136.4 ha) was mapped as 99% bare unconsolidated sand habitat (<2 % biota cover) and 1% sparse (2 to <10 % cover) to low density (10 to 20 %) sessile invertebrates (non-coral) growing on either unconsolidated sediment or consolidated hard substrate.

The five community types identified are common elsewhere offshore of Port Hedland, as shown by habitat mapping for the BHP Outer Harbour Development (SKM 2009). The present mapping presents the distribution of benthos at a single time. The habitats identified within this survey are known to change their density and distribution over time in response to natural disturbances and seasonal effects. In particular, seagrasses and macroalgae beds of the nearshore Pilbara are recorded as showing regular large seasonal changes in distribution and density.

There were no benthic habitats, communities or biota of regional significance identified in this survey of the Project area. Whilst we accept that community distributions may vary over time, this survey provides an accurate representation of the distribution of communities and habitats immediately prior to dredging and which will be used to inform the dredging management plan for the Project.

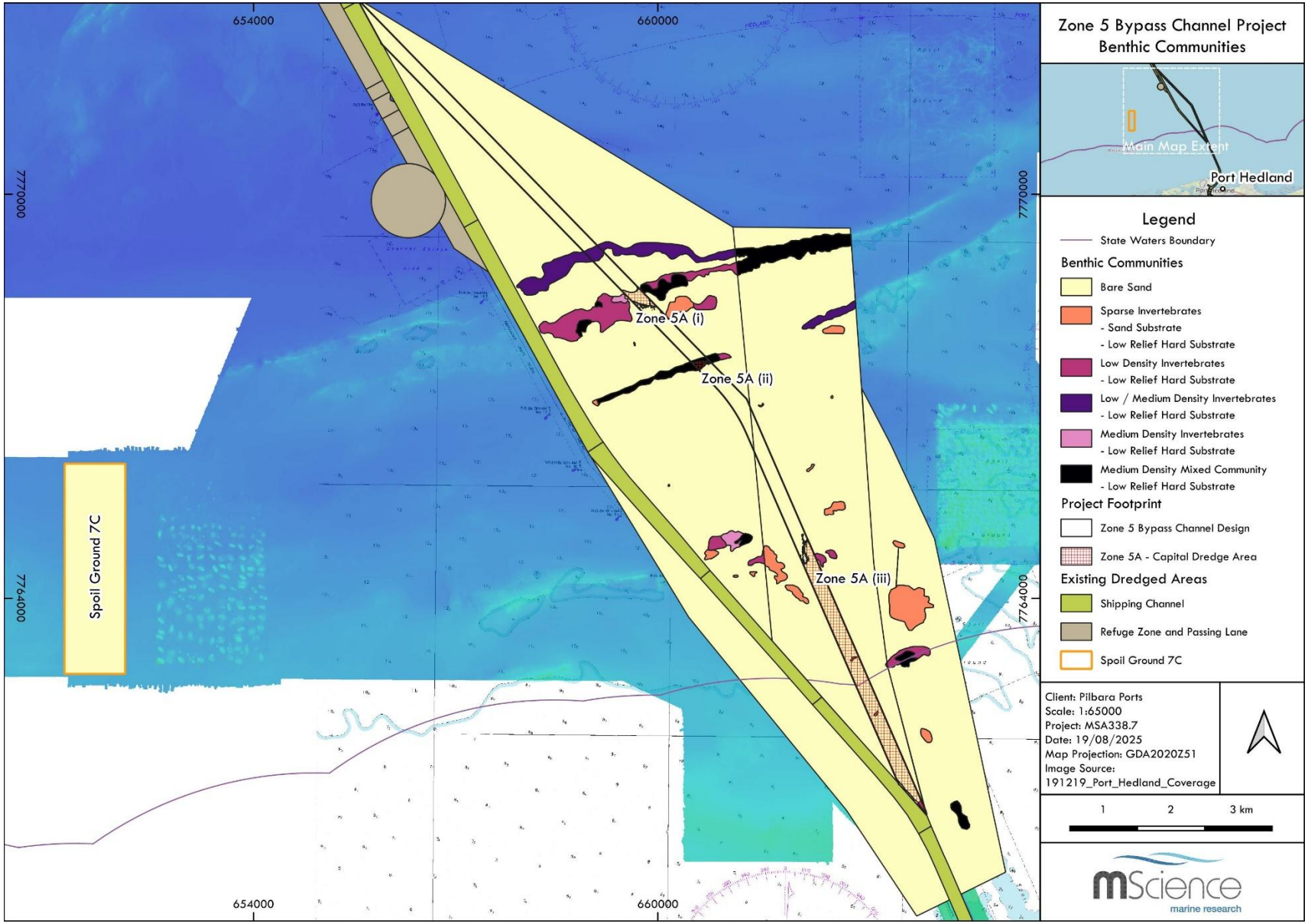


Figure ES - 1. Zone 5 Bypass Channel Project benthic communities

1 INTRODUCTION

1.1 Background

The Port of Port Hedland (Port) is a single-channel port that underpins a significant proportion of Western Australia's export economy. The safe and continuous movement of vessels through the channel is fundamental to maintaining supply chain reliability for the States iron ore industry and the broader national economy. While the channel has been progressively deepened and operational procedures strengthened over time, its underlying configuration remains challenging: all shipping activity depends on a single navigable route.

The channel can be broken down into six distinct zones based on location, bathymetry, channel slopes and sea conditions (Figure 1-1). As vessel sizes have increased and traffic volumes grown, the consequences of any disruption to this route have become more pronounced. Although vessel control failures remain relatively infrequent, incidents in recent years have demonstrated that even brief mechanical or navigational issues can escalate quickly within the confined geometry of the channel. In certain sections, such as Zone 5, the physical characteristics of the channel provide limited opportunity for recovery once control is lost.

Pilbara Ports is proposing to conduct capital dredging to create a bypass channel to the east of Zone 5 of the existing Channel (the Project). The bypass navigation channel design depth is -11.5 m chart datum (CD) and has been divided into two distinct zones (Figure 1-2). Zone 5A includes the targeted areas proposed for capital dredging. Capital dredging within the channel design profile is only required in three discrete areas (Zones 5A(i), 5A(ii) and 5A(iii)) that have been shown via hydrographic survey to be above the channel design depth. Zone 5B is not proposed to be dredged at this stage but may require material to be removed via maintenance dredging in future if sufficient accretion of sediments has occurred as a result of natural forces such that safe navigation may be impeded.

Once the capital works are completed, this area will become part of the annual channel maintenance dredging campaign (via amendment to the existing Port of Port Hedland five-year sea dumping permit for maintenance dredging SD2022/4041). The Project is a strategic marine risk-mitigation project intended to maintain vessel transit at an acceptable reduced capacity, should a grounding incident occur in Zone 5 of the channel.

The Project is proposed to address this specific vulnerability. It would establish a secondary navigable path adjacent to the existing alignment allowing vessel movements to continue should the main channel become obstructed. Unlike procedural or operational mitigations, which reduce likelihood, the bypass provides a physical redundancy that ensures continuity of trade during a major incident within this section of the channel. This Project is therefore a strategic resilience measure. It strengthens the Port's ability to manage low-probability, high-consequence events and safeguards the economic value generated by uninterrupted export operations.

An established spoil ground (Spoil Ground 7 [SG7]) previously approved for spoil disposal and used in several recent capital and maintenance dredging campaigns will be used for spoil disposal. Recent campaigns have used sub-areas SG7A and SG7B inside the SG7 boundaries. These areas are too shallow for the expected draft of the dredge plant and disposal for the Project will target sub-area SG7C inside the greater SG7 (Figure 1-3).

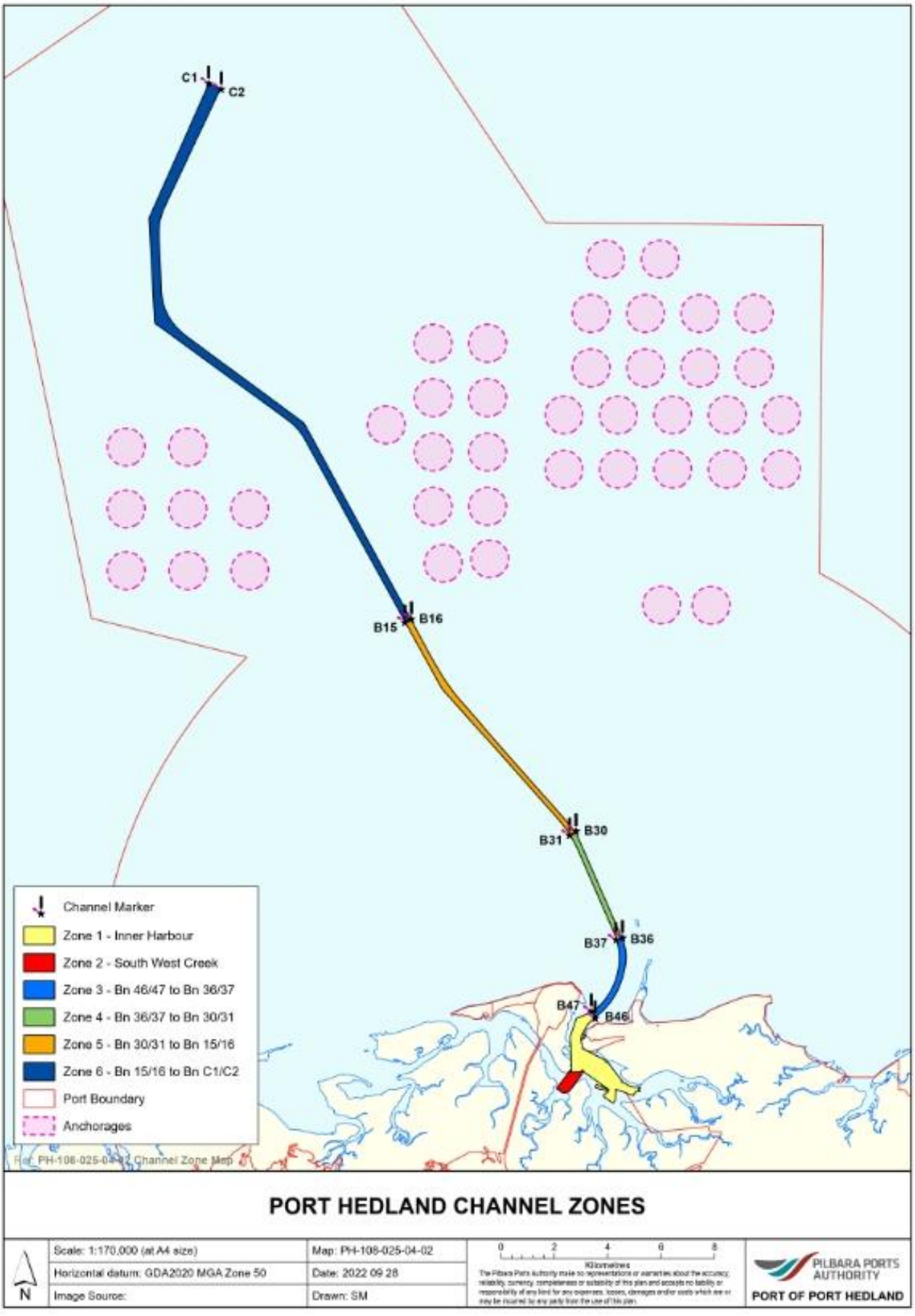


Figure 1-1. Port of Port Hedland Channel Zones

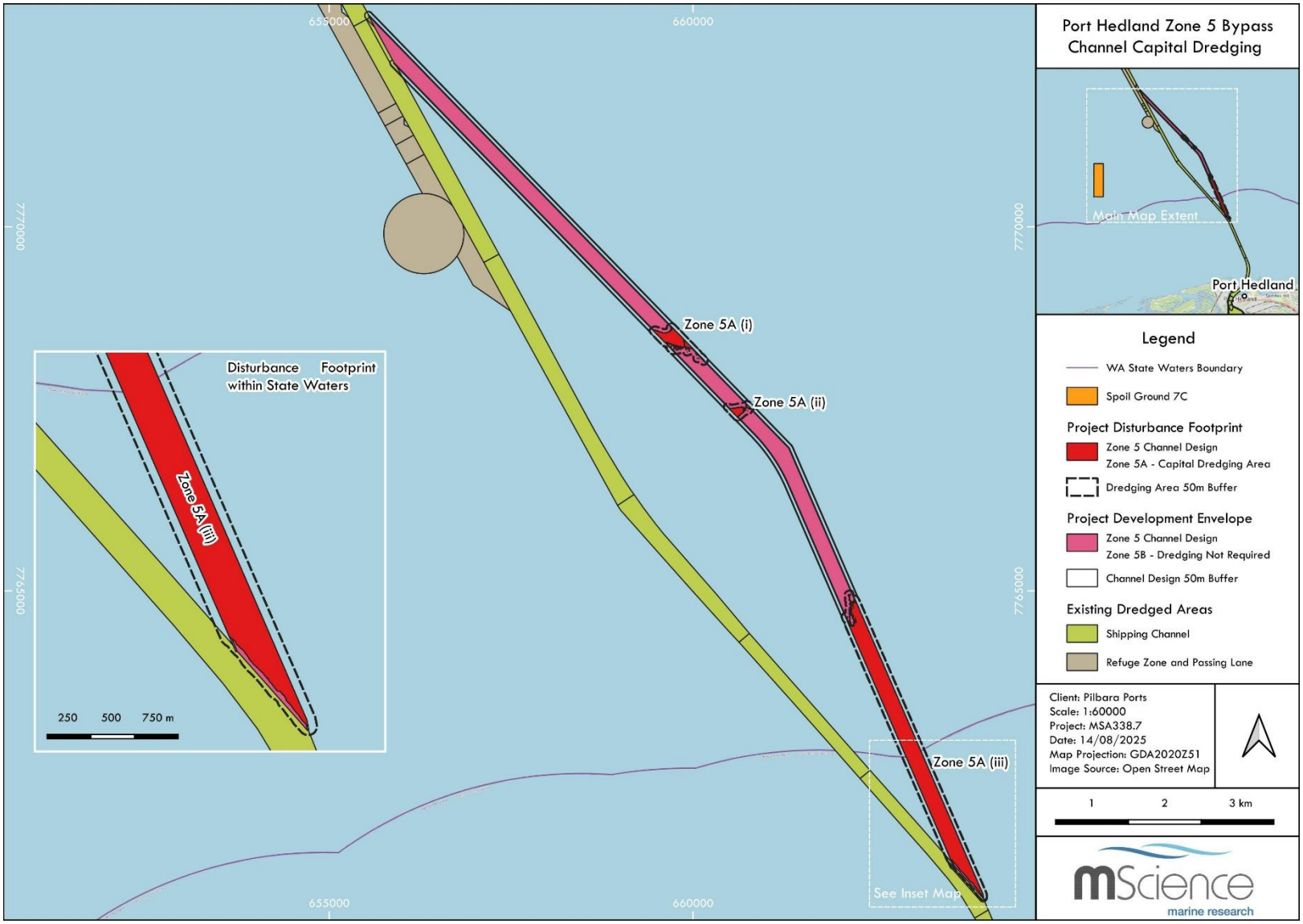


Figure 1-2. Zone 5 bypass channel design and capital dredging area

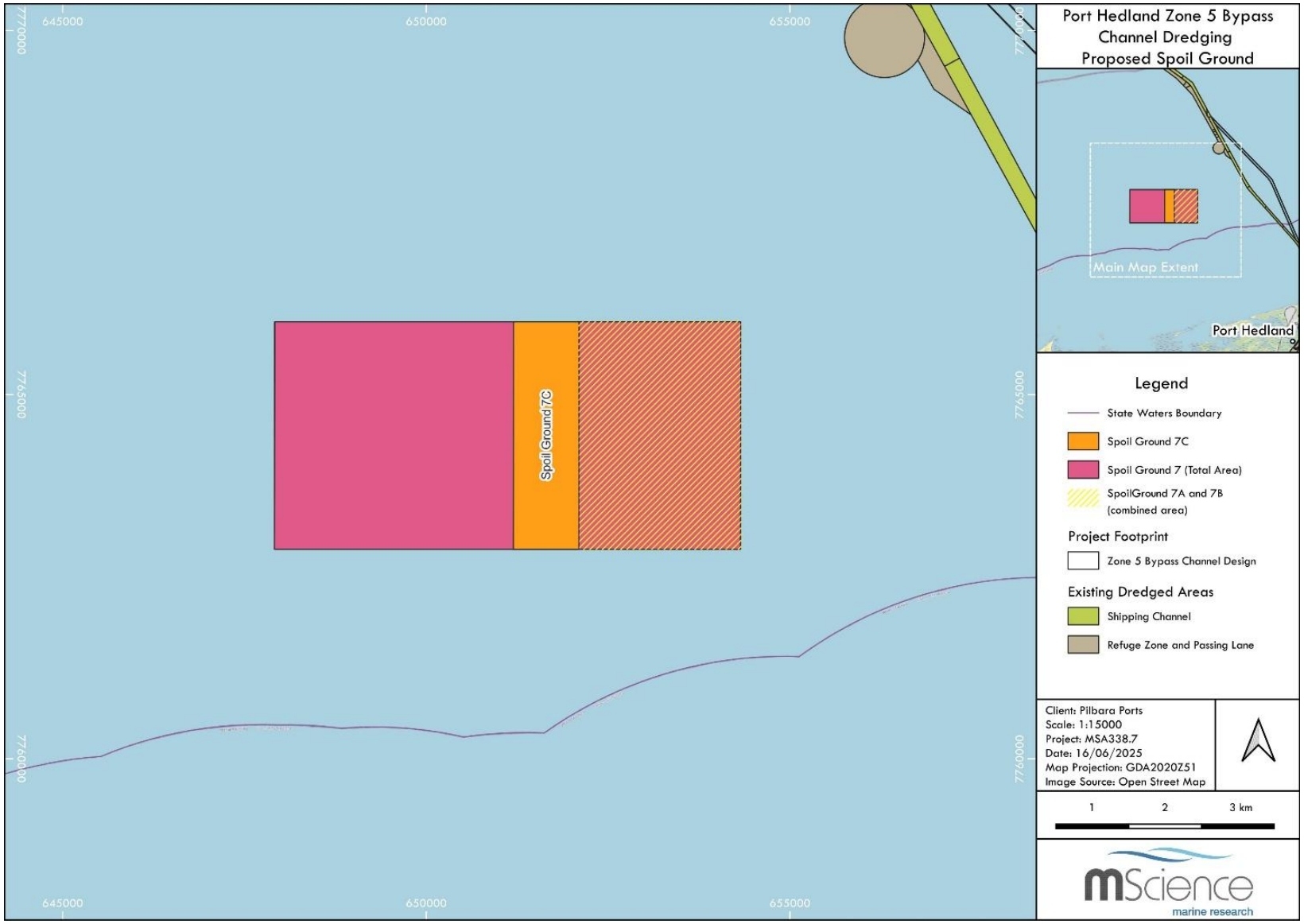


Figure 1-3. Spoil ground proposed for the Project

1.2 Purpose and Objectives

Loading and disposal of dredge spoil at sea requires approval by the Australian Department of Climate Change, Energy, the Environment and Water (DCCEEW) under the *Environment Protection (Sea Dumping) Act 1981*. In addition, the Western Australia Environment Protection Authority (EPA) encourages proponents of large-scale dredging projects, such as capital dredging, to refer the project for assessment under Part IV of the *Environmental Protection Act 1986* (EP Act).

Prior to completing an application for disposal at sea or referral of a project under the EP Act, proponents are required to undertake appropriate investigations to characterise the physical, chemical and biological characteristics of the water column and seabed at the loading and disposal sites, as specified in the National Assessment Guidelines for Dredging (hereafter referred to as the 'NAGD') (Commonwealth of Australia 2009) and EPA technical guidance 'Environmental Impact Assessment of Marine Dredging Proposals' (EPA 2021). This includes the implementation of marine surveys to develop benthic habitat maps which detail the extent of existing marine habitats and proximity to habitats with sensitive receptors such as coral or seagrass. The existing environment needs to be assessed so the impacts of loading and disposal can be assessed and measured.

Both the NAGD and EPA encourage the use of available historical benthic habitat data for proposed project areas to design cost-effective surveys and to consolidate and improve knowledge of these habitats.

The distribution and composition of subtidal Benthic Communities and Habitats (BCH) off the coast of Port Hedland, including the area in which the Project is located (the Project area), have been described previously for the proposed BHP Outer Harbour Development (SKM 2009**)** (Figure 1-4). The distribution and extent of BCH within the extensive Outer Harbour study area (~3,650 km^2, extending 50 km east and west of Port Hedland Inner Harbour, and 40 km seaward) was modelled and predicted using a combination of Light Detection and Ranging (LiDAR) data and ground truthing surveys. The Outer Harbour study area was observed to be dominated by sand plains, devoid of benthic primary producers, interspersed with a series of hard substrate ridgelines (running parallel to the coastline) capable of supporting BCH. In addition, the mapped extent of BCH within two zones (named A and B, encompassing a combined area of ~3 km x 9 km) adjacent to Beacon 30/31 has been verified more recently to support the sea dumping permit (SDP) application for the Channel Entry Project (CEP)(MScience 2022) (Figure 1-5).

The objective of the present assessment was to provide a greater certainty and precision in the location and structure of known BCH within and adjacent to the Zone 5 Bypass Channel dredging design and SG7C disposal footprint (the survey area), utilising existing BCH data and hydrographic data to optimise the proposed survey design and form the basis for an environmental management plan to cover dredging.

Details provided in this assessment will be used to support the environmental referral of the Project under Part IV of the EP Act, and SDP application submitted to DCCEEW for approval under the *Environment Protection (Sea Dumping) Act 1981*. This report is not intended to serve as a baseline environmental investigation for comparison against repeatable surveys.

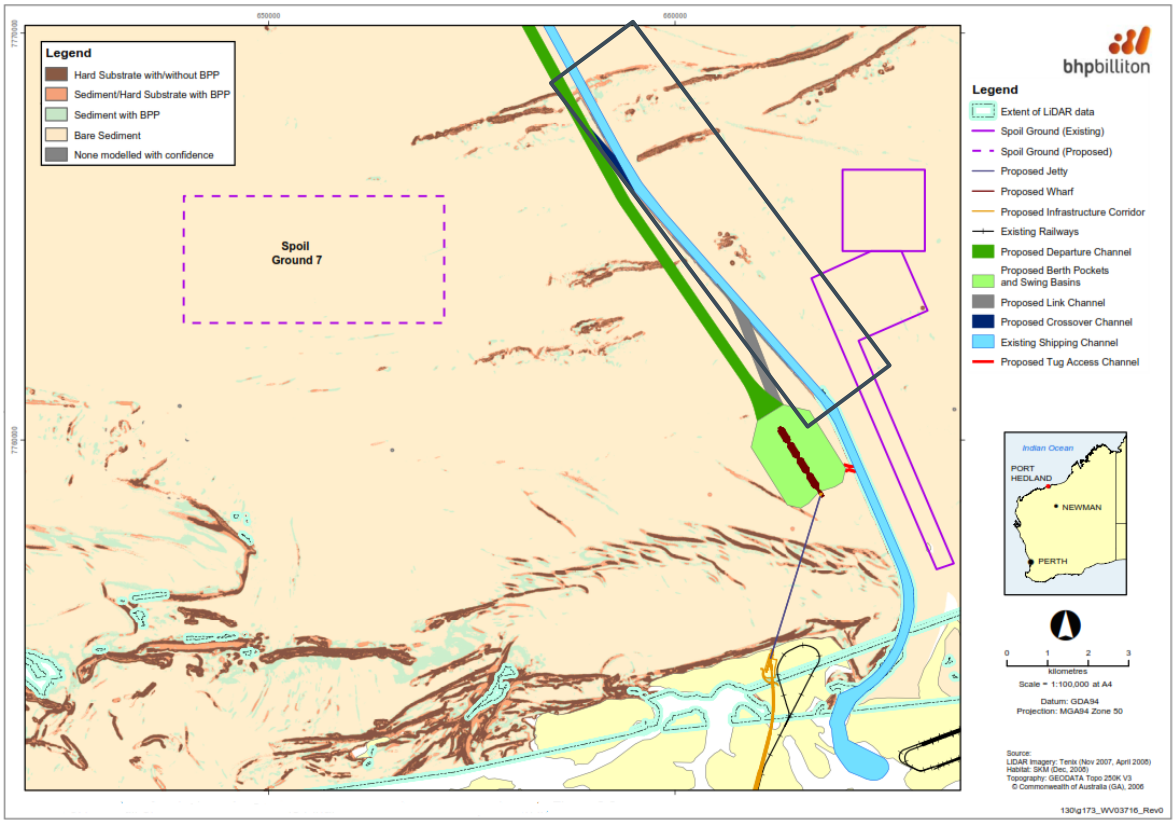


Figure 1-4. Detail of inshore area from SKM (2009) combined habitat map. Relevant Project area located in top right of the map marked by the black rectangle

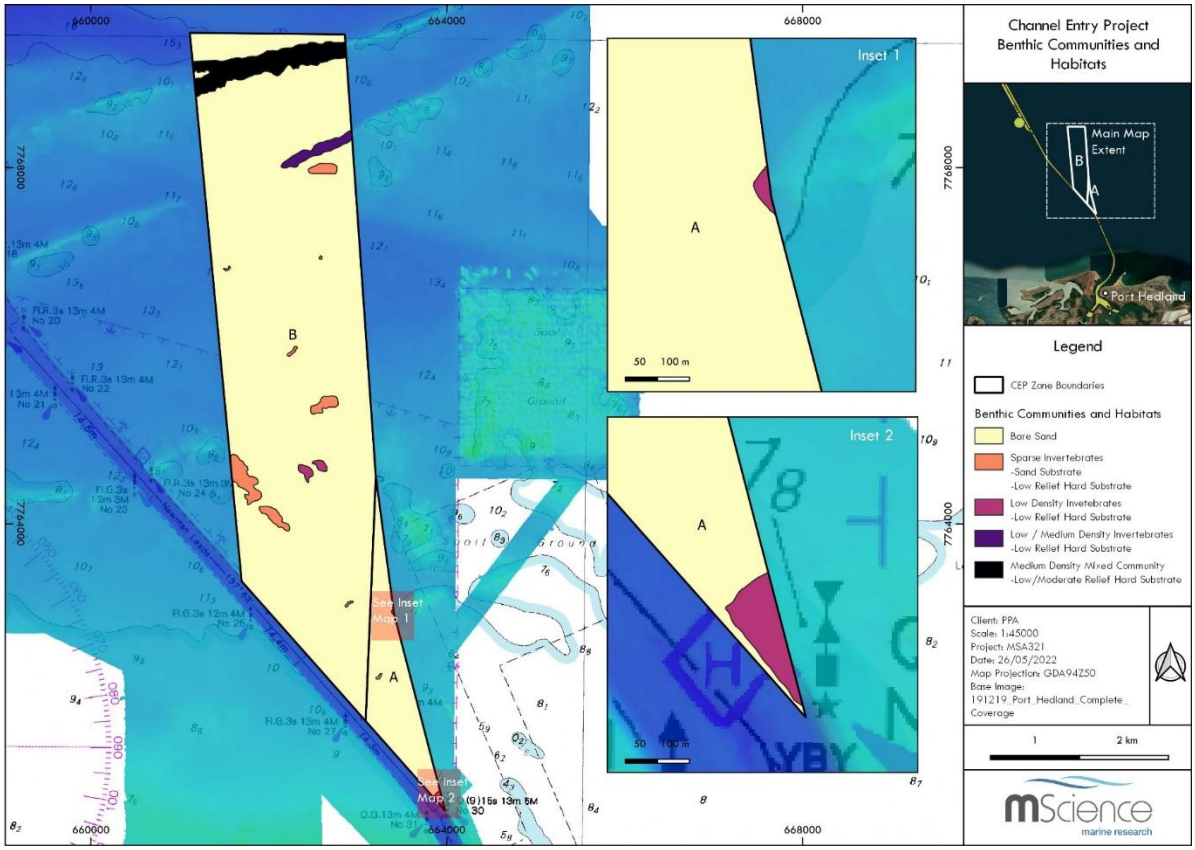


Figure 1-5. BCH identified for the CEP

1.3 Structure of this Document

The document contains:

- The background and purpose to this survey;
- The method of BCH data collection;
- Characterisation of the subtidal BCH within the survey area;
- A BCH map for the survey area; and
- A discussion of the significance of identified BCH in respect to the regional setting.

The document is current as at the date on the cover page and is referenced as Version 2 (Documents with a lower version number are superseded by this document).

2 METHODOLOGY

2.1 Survey Design

Review of the available historical benthic habitat data for the Project area suggested there were small, disjointed patches of consolidated hard substrate capable of supporting BCH located within and adjacent to the Zone 5 Bypass Channel dredging design. Historical data included the Port Hedland habitat maps produced by SKM (2009) and MScience (2022), Pilbara Ports supplied hydrographic survey data and publicly available bathymetric charts. The patches of consolidated hard substrate were located predominantly between the southern tip of the existing refuge zone/passing lane and minor 13-degree alteration in course of the existing main channel (a continuation of Minilya Bank), with sediment (sand/silt) comprising the majority of the substrate in the Project area. The existing SKM (2009) and MScience (2022) reports and available hydrographic data were used to inform site selection for ground truthing (Figure 2-1). Use of the existing data allowed for the allocation of a different sampling density for critical vs noncritical areas. Sampling intensity was high within, and at, the boundaries of known and predicted hard substrate areas (light beige areas in LiDAR basemap of Figure 2-1), to accurately classify and determine the extent of the BCH on the hard substrates. It was less intense within the deep water (>15 m depth) sand plains (dark blue areas in LiDAR basemap of Figure 2-1) where it has been shown by previous surveys benthic primary producers are not supported (SKM 2009). No sampling sites were placed within the areas already verified in 2022 as part of the CEP or to the north of the Zone 5 bypass channel design within the known deep-water sand plains. One-hundred and ten survey sites were pre-selected for the assessment. An additional five sites were selected in the field, resulting in 115 sites being surveyed.

2.2 Sampling Method

The survey was completed from the Jetwave Marine Services vessel *Nelson Point*, between 13 and 14 July 2025 using a drop camera system with live surface feed to capture high definition downwards-facing video footage. The camera system was positioned approximately 0.5 – 1 m above the seabed. A GPS track was recorded during drop camera deployment to allow geo-referencing of the imagery for the purposes of relating the data to the existing hydrographic data. A single transect was surveyed at each sampled location within a 100 m radius area of the predetermined points. Transects were typically between 50 and 200 m long, depending on the substrate type identified (transects were shorter in areas of bare sand and longer in areas of hard substrate supporting benthos), and surveyed at a speed of <1kt.

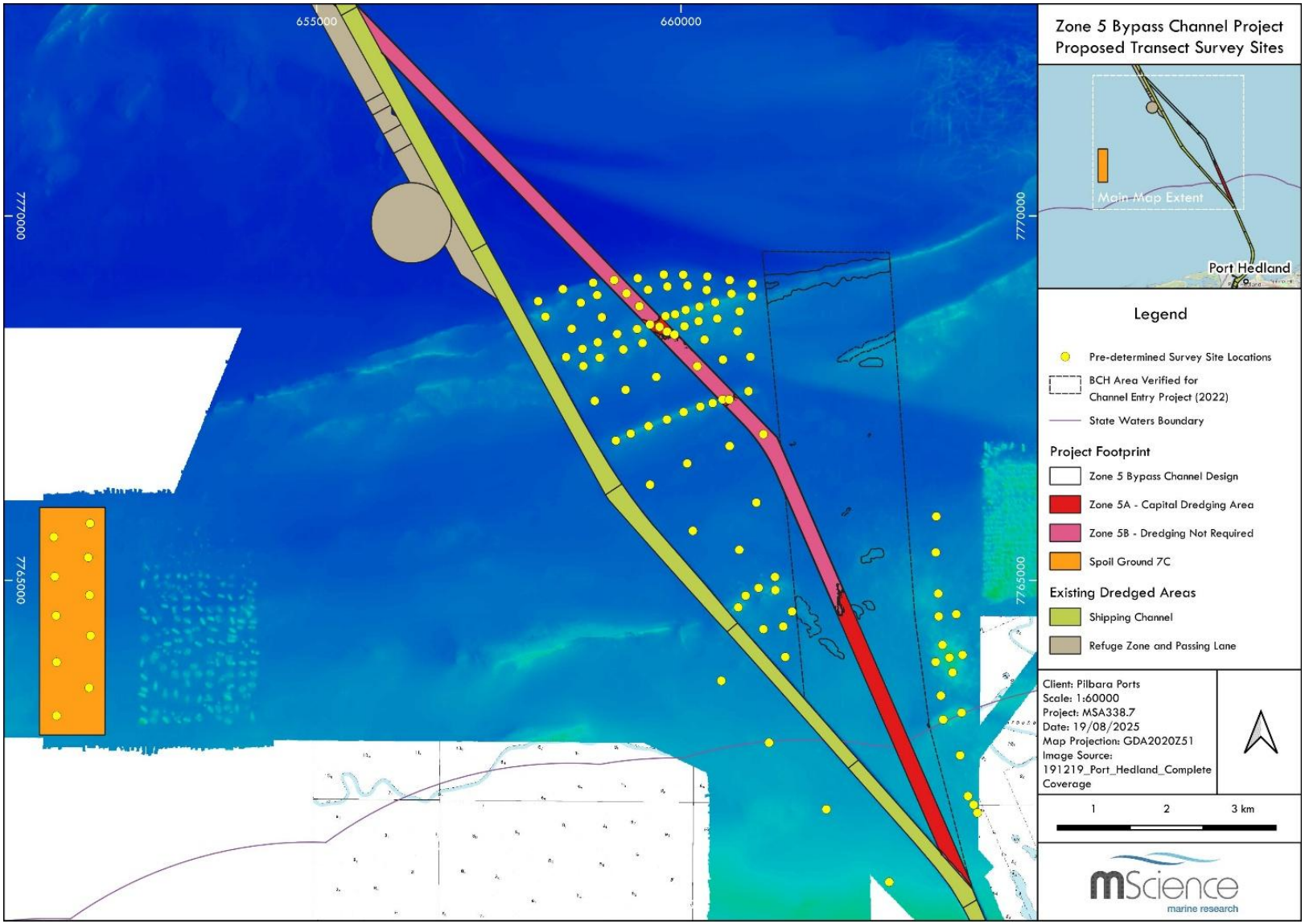


Figure 2-1. Proposed survey locations

2.3 Data Analysis

2.3.1 Qualitative BCH Descriptions

Qualitative analysis of the video footage was completed in real time to provide a general description of the communities and habitats observed along each transect. Post survey, the recorded video footage was analysed further and the transects were classified based on the habitat, community and substrate types described in Table 2-1.

Assessments were conducted by a marine scientist with more than 20 years' experience and mapping habitats of the Pilbara. For consistency with the historical assessment of Port Hedland Outer Harbour benthic communities, the habitat classification scheme employed by SKM (2009) and MScience (2022) was used in the analysis to describe the dominant visible biota and appearance of physical substrata. This scheme was consistent with the CATAMI classification scheme (CATAMI Technical Working Group 2013) used during similar habitat mapping studies within the Pilbara. The community classification term 'mixed community' used in the analysis describes the mix of filter feeder and coral communities (>10% cover) that typically inhabit the areas not dominated by non-coral invertebrates. Communities were then defined as distinct levels of density of cover of the mixed benthos.

The average percentage of benthos cover along a transect was estimated. The density classifications used in Table 2-1 have been based on the following percentages of cover:

- Bare = <2% cover of benthos observed in the field of view (FOV) along the transect
- Sparse = 2 to <10% cover of benthos observed in the FOV along the transect
- Low Density = 10 to <20 % cover of benthos observed in the FOV along the transect
- Medium Density = 20 to <40% cover of benthos observed in the FOV along the transect

Qualitative estimates of percentage cover recorded during the survey were validated by point scoring a subset of random transects known to contain benthos. Ten random still images per transect were extracted for analysis. Analysis used the program Coral Point Count with Excel extensions (CPCe) (Kohler and Gill 2006). Thirty randomly spaced points were projected onto each image, and the substrate beneath each point was classified into one of several benthic substrate categories (provided in Appendix A).

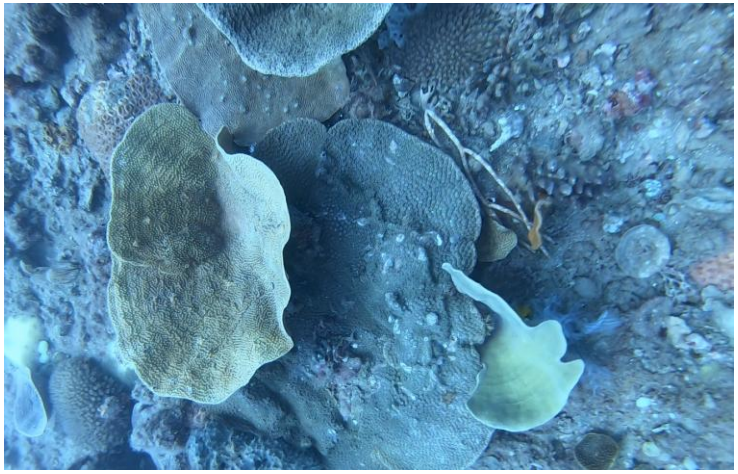
2.3.2 Distribution and Spatial Extent of BCH

Results of the SKM (2009) benthic habitat survey for the proposed BHP Outer Harbour Development demonstrated that the distribution of biota classes was predicted accurately (82% accuracy) by the distribution of topographic complexity associated with hard substrate; essentially the limestone ridgelines and shoals visible on LiDAR imagery. Similarly, the transects surveyed across the transition between the simple and complex areas of topography identified in the bathymetric data used for the CEP (MScience 2022) and the current survey showed an association with the spatial boundaries between bare sand and areas containing benthos (refer to Section 3). On this basis, the spatial extent of the classified BCH recorded in the Zone 5 Bypass Channel areas of interest was digitised within a GIS based on the boundaries of the areas of topographic complexity associated with hard substrate identified in the Pilbara Ports supplied bathymetry data. The bathymetry grid dataset had a resolution of 5 m x 5 m.

Table 2-1. Benthic habitat and community classification description

Habitat/Substrate Classification	Community Classification	Biota Present	Representative Image
Unconsolidated Sediment Sand (flat or rippled, medium to coarse grained) and gravel	Bare	Occasional macroalgae (including <5 m^2 patches of turf algal mats and filamentous algae), filter feeders (<2 % cover) and <2 m^2 patches of seagrass (<2 % cover)	
	Sparse Invertebrates	2 to <10 % cover of invertebrates (sponges and other mixed filter feeders) growing in sand.	

Habitat/Substrate Classification	Community Classification	Biota Present	Representative Image
Low Relief (<1 m) Consolidated Hard Substrate Hard limestone pavement or rubble with or without a sand veneer	Sparse Invertebrates	2 to <10 % cover of invertebrates (sponges, soft corals, gorgonians and other mixed filter feeders) and occasional hard corals (<3% cover) growing on hard substrate surrounded by patches of bare sand.	
	Low Density Invertebrates	10 to <20 % cover of invertebrates (soft corals, sponges, gorgonians and other mixed filter feeders) and hard corals (<5% cover) growing on hard substrate surrounded by patches of bare sand.	

Habitat/Substrate Classification	Community Classification	Biota Present	Representative Image
	Medium Density Invertebrates	20 to <40 % cover of invertebrates (sponges, soft corals and other mixed filter feeders) and hard corals (<10% cover) growing on hard substrate surrounded by patches of sand.	
	Medium Density Mixed Communities	Mixed benthos up to 40% cover of turf algae, invertebrates (sponges, soft corals and other mixed filter feeders) and hard corals (10 to 20 % cover), growing on hard substrate surrounded by patches of sand.	

3 RESULTS

3.1 BCH Characterisation of Transects

A broad description of the components of the mixed benthos community in each transect with an estimated range of percent benthos (corals and filter feeders) cover, is provided in Appendix B (logsheet).

3.1.1 Zone 5 Bypass Channel Design

The community classification for each of the 105 transects surveyed within and adjacent to the Zone 5 Bypass Channel design is shown in Figure 3-1.

Physical habitats identified included unconsolidated medium to coarse grained sand and gravel, and low relief consolidated hard substrate (most likely limestone pavement) which was either exposed or covered by a veneer of sand. The unconsolidated sediment was either devoid of benthos or contained occasional filter feeders (mainly sponges) at generally less than 2% cover or supported sparse (2 to <10% cover) filter feeders. The consolidated hard substrate always supported benthos as either sparse (2 to <10% cover), low density (10 to <20% cover) or medium density (20 to <40% cover) filter feeders (such as sponges, gorgonians, ascidians) or medium density mixed communities including hard corals (predominantly small to medium size *Turbinaria spp* and *Porites spp*), soft corals and filter feeders (such as sponges, gorgonians, ascidians). When present, live coral cover among the mixed communities found on the hard substrate within transects was generally between 10 and 20%.

Forty-nine of the 105 transects surveyed were classified as bare (less than 2% cover) unconsolidated sediment. Sixteen transects were observed to support sparse filter feeders, nine of these were classified as consolidated hard substrate and seven as unconsolidated sediment. The remaining 50 transects were all classed as consolidated hard substrate, of these; 18 supported low-density invertebrates, six supported medium density filter feeders and 16 supported medium density mixed communities.

Most of the transects classified as either medium density invertebrates or mixed community were located along the same hard substrate ridgelines running parallel to the coastline in the northern section of the survey area which appear to be an extension of Minilya Bank to the east of the Project area. This finding is consistent with the SKM (2009) and MScience (2022) habitat mapping.

3.1.1.1 ZONE 5A

The four transects surveyed within the proposed capital dredging footprint of Zone 5A(i) were all classified as unconsolidated sediment devoid of benthos. Two transects were surveyed within the proposed capital dredging footprint of Zone 5A(ii), each of these transects were classified as medium density mixed communities growing on low relief consolidated hard substrate. The proposed capital dredging footprint of Zone 5A(iii) was surveyed as part of the CEP (MScience 2022). The benthic habitats and communities identified in that survey are discussed in Section 3.2 below.

3.1.1.2 ZONE 5B

A large proportion of the southern section of Zone 5B (found between Zone 5A (ii) and 5A(iii)) has been mapped previously as part of the CEP (MScience 2022). In that survey, all physical habitats surveyed within the design footprint of Zone 5B were classified as unconsolidated sediment devoid of benthos (refer to Section 3.2). Four of the five transects surveyed within Zone 5B in the current survey were all classified as unconsolidated sediment devoid of benthos. The remaining transect was located on a hard substrate

ridgeline which appears to be an extension of Minilya Bank and was found to support medium density invertebrates.

3.1.2 Spoil Ground 7C

The habitat classification for each of the ten (10) transects surveyed within the SG7C footprint is shown in Figure 3-2.

Unconsolidated coarse-grained sand and gravel was the only habitat identified. The unconsolidated sediment was either devoid of benthos or supported occasional filter feeders (mainly sponges, gorgonians and anemones) at <2% cover and a few individual echinoderms (starfish and urchins).

This finding is consistent with the SKM (2009; 2011a) selection study and habitat mapping for Spoil Ground 7.

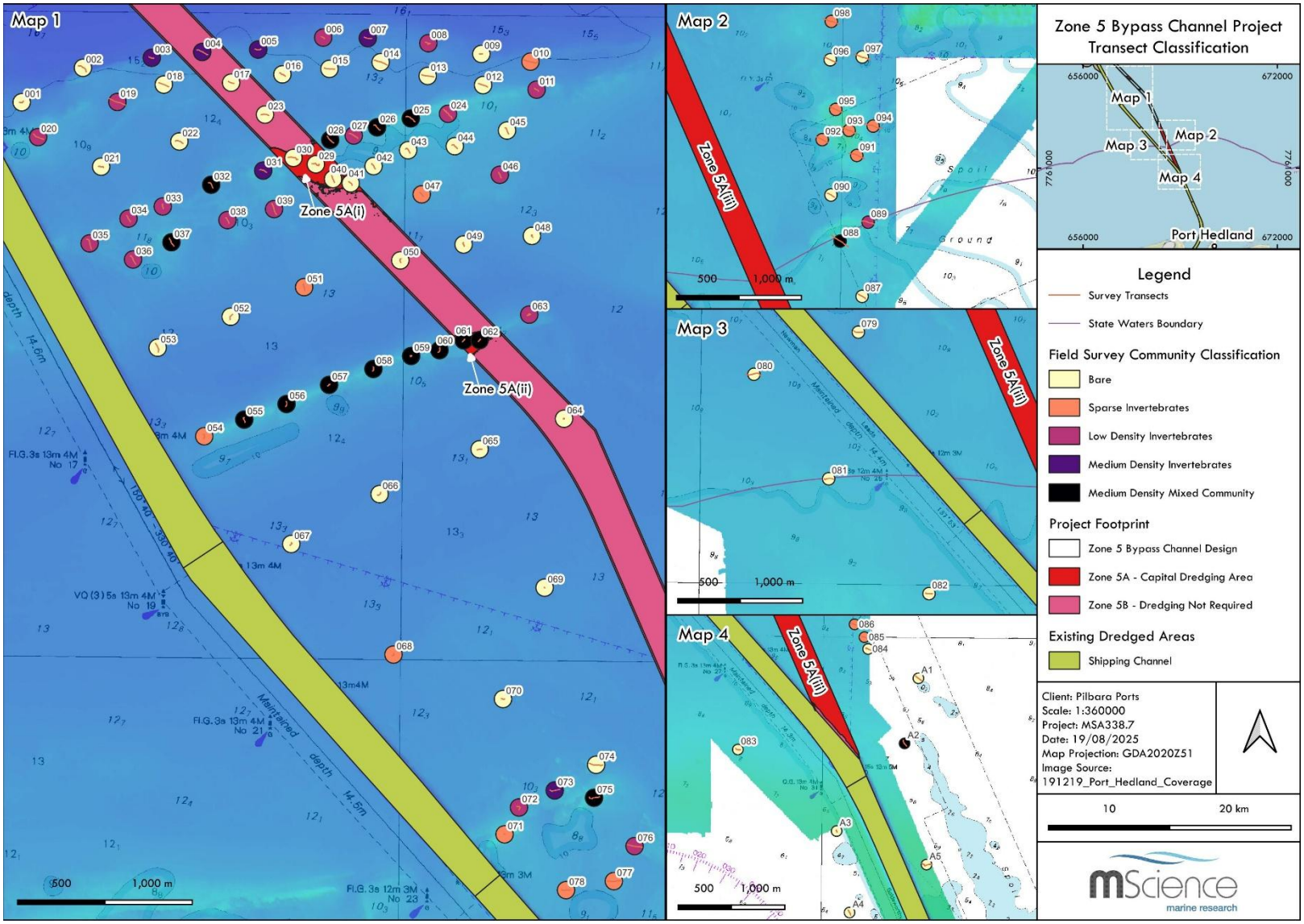


Figure 3-1. Zone 5 Bypass Channel design and adjacent areas transect classification

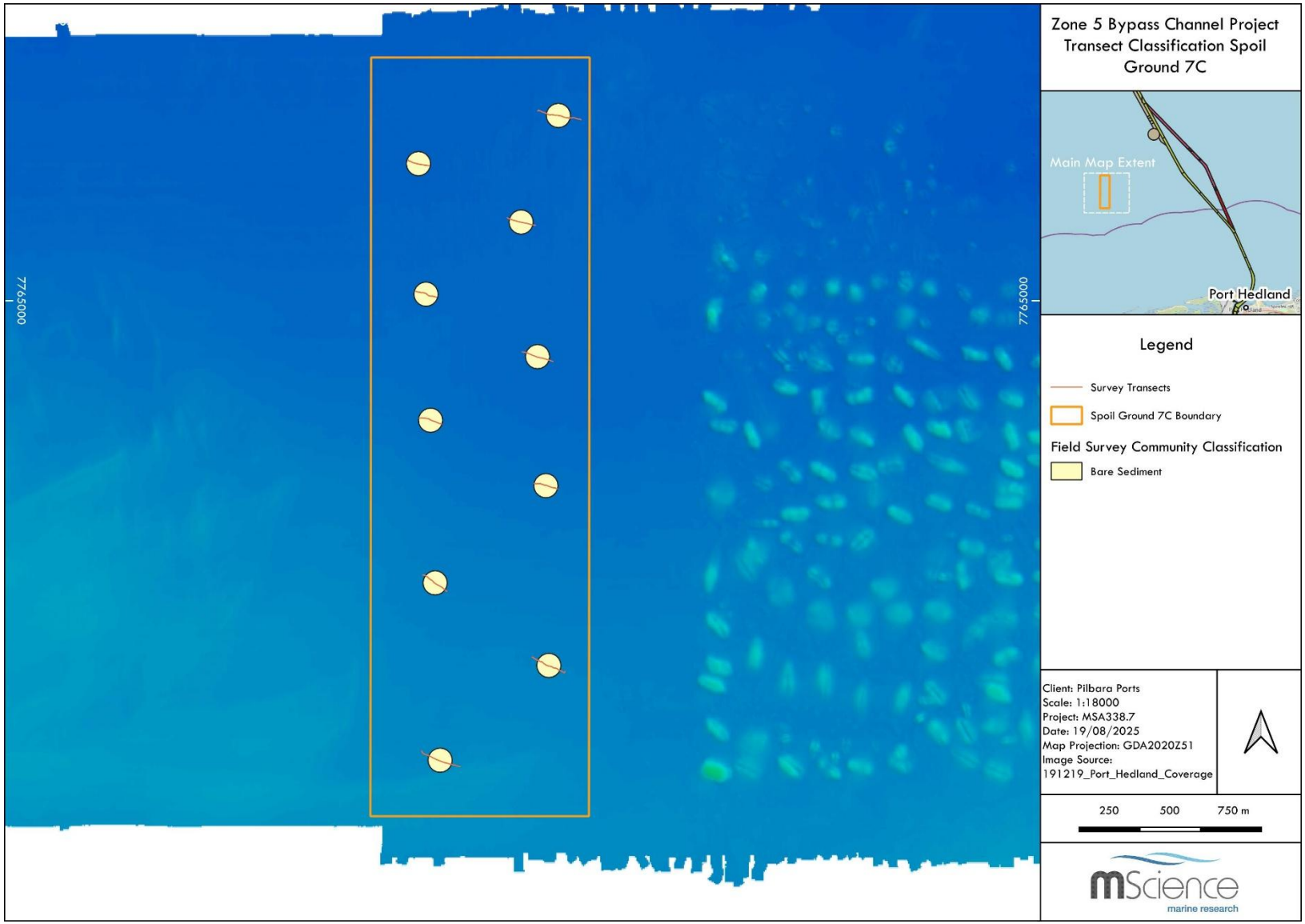


Figure 3-2. Spoil Ground 7C transect classification

3.2 BCH Mapping

Overall, evaluation of transects across the area surveyed (including SG7C and transects surveyed for the CEP) recognised two habitat types (Figure 3-3), with five community types found within one or more of these habitats (Figure 3-4):

Unconsolidated Sediment Habitat: this habitat included the following communities:

- Bare Sand: these habitats occurred outside of areas of complex topography and were uniform expanses of the physical sand habitat with negligible cover of macrobenthos.

- Sparse Invertebrates on Sand: these communities always occurred outside the areas of complex topography visible in the hydrographic data and consisted of mixed filter feeders (such as sponges, gorgonians, ascidians) at 2 to <10 % cover on sand surfaces.

Low Relief Consolidated Hard Substrate Habitat: this habitat included the following communities:

- Sparse Invertebrates on Hard Substrate: these communities occurred within the areas of complex topography visible in the hydrographic data and consisted of mixed filter feeders (such as sponges, gorgonians, ascidians) at 2 to <10 % cover with occasional hard corals (<3%) growing on hard surfaces.

- Low Density Invertebrates on Hard Substrate: these communities occurred within the areas of complex topography visible in the hydrographic data and consisted of mixed filter feeders (such as sponges, gorgonians, ascidians) at 10 to <20 % cover with some hard corals (<5 % cover) growing on hard surfaces.

- Medium Density Invertebrates on Hard Substrate: these communities occurred within the areas of complex topography visible in the hydrographic data and were dominated by filter feeders (such as sponges, gorgonians, ascidians) at 20 to <40 % cover with some hard corals (<10 % cover) growing on hard surfaces.

- Medium Density Mixed Community on Hard Substrate: these communities occurred within the boundaries of the hard substrate ridgeline (likely extension of Minilya Bank), visible in the hydrographic data, in the north of the surveyed area. These communities consisted of mixed benthos (as described in Table 2-1) between 20 and <40 % cover, including up to 20% live coral cover.

The estimated area of cover for each community classification within the area surveyed for the current survey and CEP (MScience 2022) is provided in Table 3-1. Close to 94% of the survey area was mapped as bare sand. Sparse to medium density invertebrates (non-coral) growing on unconsolidated and hard consolidated substrate formed 4% of the area. Approximately 85.5 ha, or 2%, consisted of mixed community growing on isolated outcrops of hard substrate and the hard substrate ridgeline running parallel to the coastline which appears to be an extension of Minilya Bank to the east of the Project area.

Over 98% of each subsection of the Zone 5 bypass channel design was mapped as bare sand, except for Zone 5A(ii). In that zone, 100% of the 6.6 ha area consisted of medium density mixed community.

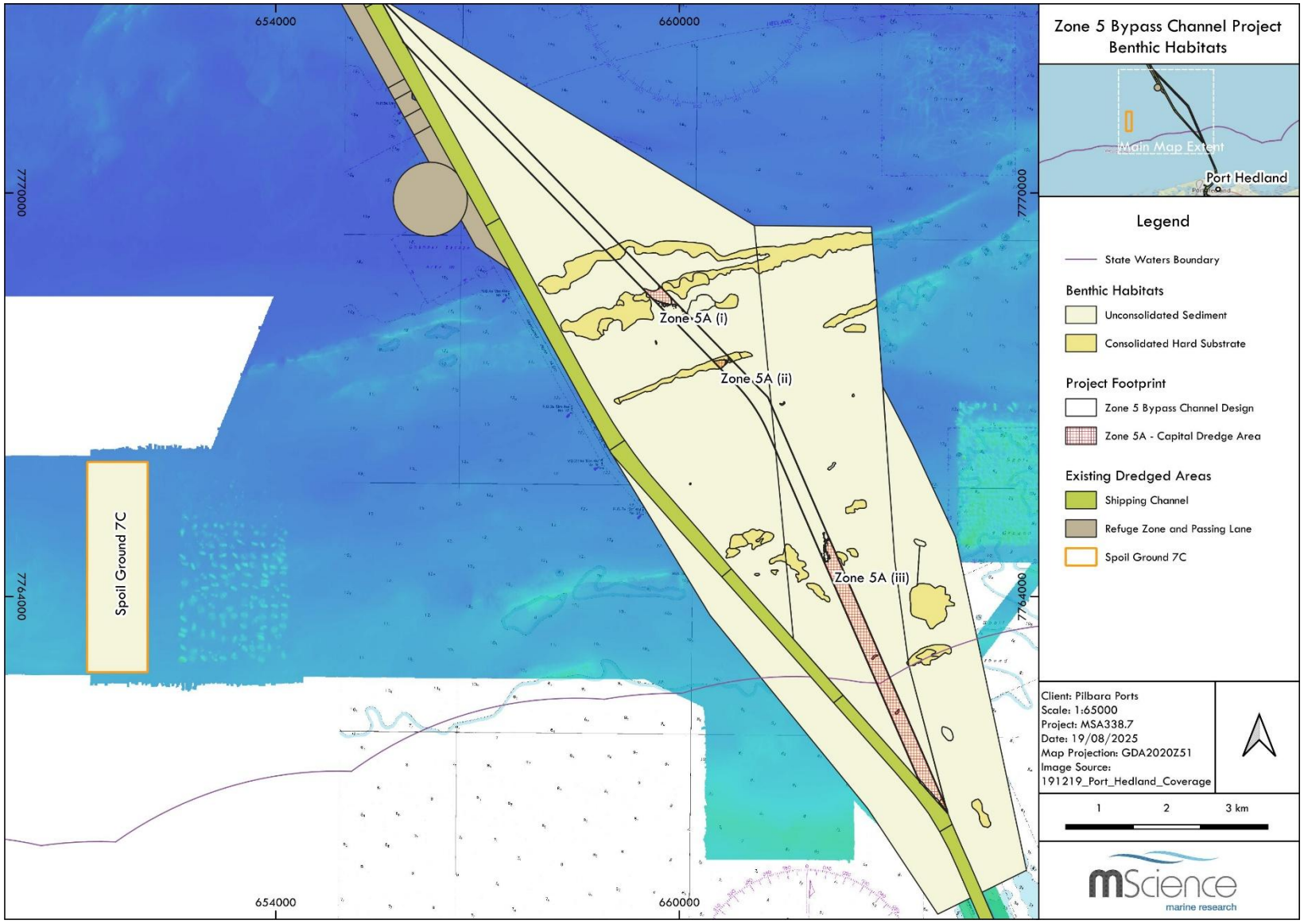


Figure 3-3. Zone 5 Bypass Channel Project benthic habitats

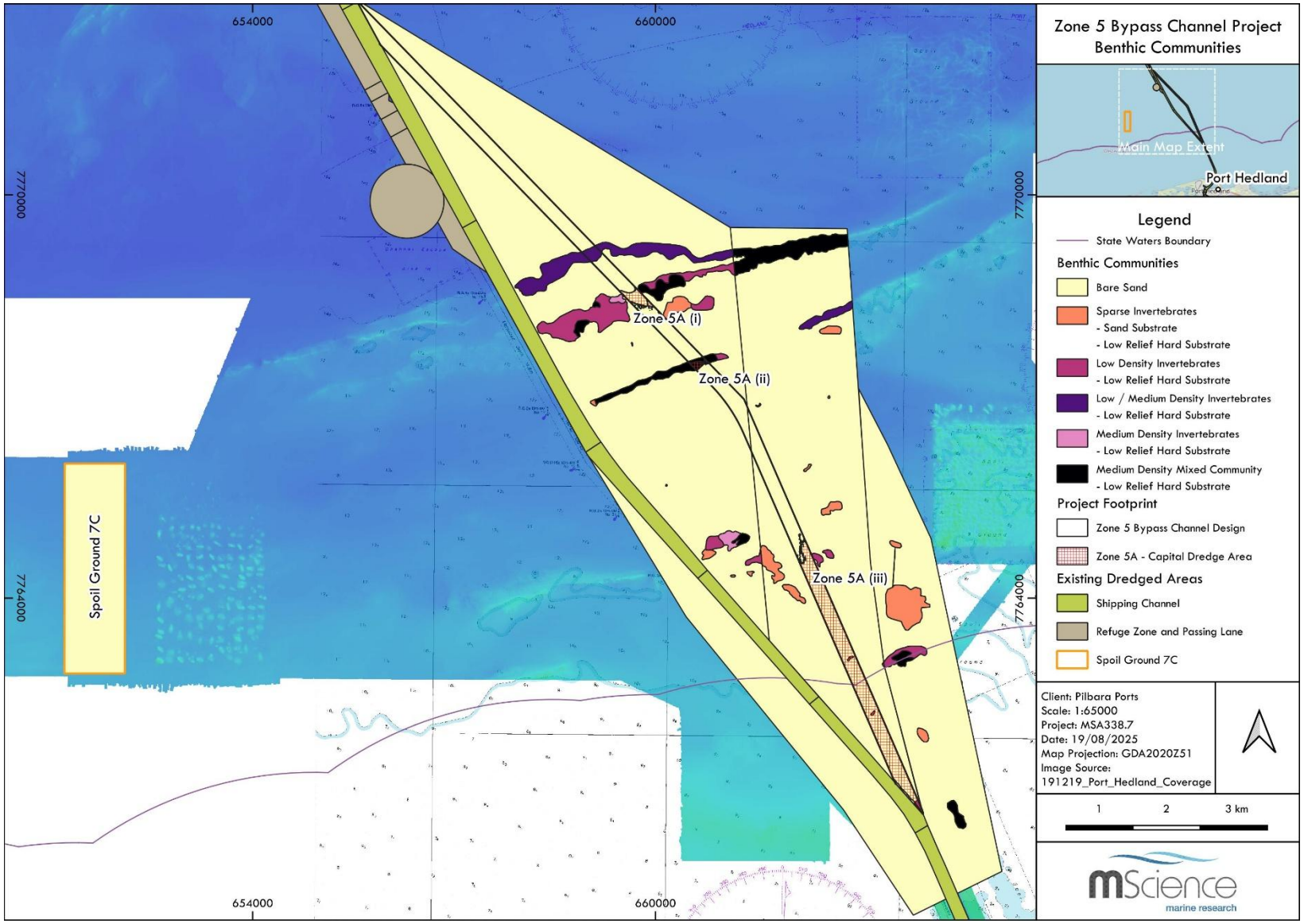


Figure 3-4. Zone 5 Bypass Channel Project benthic communities

Table 3-1. Composition of BCH across the survey area

BCH Classification	Area (ha)						Composition of Total (%)					
	Zone 5 Bypass Channel				SG7C	Total Survey Area	Zone 5 Bypass Channel				SG7C	Total Survey Area
	5A(i)	5A(ii)	5A(iii)	5B			5A(i)	5A(ii)	5A(iii)	5B		
Bare Sand	18.9	0	135.1	265.6	281.1	**4,541**	100	0	99	98.4	100	**93.9**
Sparse Invertebrates, growing on: - Unconsolidated Sand; and/or - Low Relief Hard Consolidated Substrate	0	0	0.4	0	0	**64.4**	0	0	0.3	0	0	**1.3**
Low Density Invertebrates, growing on: - Low Relief Hard Consolidated Substrate	0	0	0.9	2.2	0	**105.1**	0	0	0.7	0.8	0	**2.2**
Medium Density Invertebrates, growing on: - Low Relief Hard Consolidated Substrate	0	0	0	2.2	0	**39.7**	0	0	0	0.8	0	**0.8**
Medium Density Mixed Community, growing on: - Low Relief Hard Consolidated Substrate	0	6.6	0	0	0	**85.5**	0	100	0	0	0	**1.8**
Total	**18.9**	**6.6**	**136.4**	**270**	**281.1**	**4,835.9**	**100**	**100**	**100**	**100**	**100**	**100**

The field data collected at the topographic boundaries derived from the hydrographic data (transitioning from uniform to complex areas of topography) correlated well with the observed presence and absence of the varying densities of benthos, suggesting that the boundaries of the complex areas of topography can be considered to be appropriate for supporting and digitising the various communities present in the area. The low relief consolidated hard substrate identified is likely to be regularly impacted by a shifting sand veneer which disrupts community development resulting in the different densities of benthos identified in these areas. The sparse invertebrates identified growing on sand substrates may have been on hard limestone pavement obscured by a sand veneer. Considering the shifting sand veneer, it would be difficult to accurately map the extent of the sparse invertebrates growing on unconsolidated substrate (see Section 3.2.1 for further discussion).

3.2.1 Mapping Limitations

Habitats found here are subject to natural variability which may occur at varying timescales. Seagrass and macroalgal beds are particularly influenced by seasonal changes. In the current survey (completed in July), seagrass (*Halophila spp)* was observed at low percent cover (<10%) within the mixed community at 18 sites and at a higher percent cover (20 to 25% cover) at two sites (refer to Appendix B for estimated cover of seagrass at each site). The two sites with the higher percent cover of seagrass were located approximately 1000 m and 1500 m west and east, respectively, of the northern most tip of Zone 5A(iii). In the Pilbara region, seagrass (most commonly observed species being *H. ovalis* and *H. uninervis*) is found mixed with macroalgae and filter feeding communities and in unprotected waters (i.e. between islands), such as those surveyed here. Pilbara seagrasses are known to be sparse and ephemeral, being subject to seasonal and interannual variation (McMahon et al. 2017). Very little is known about the seasonal dynamics of seagrass growth in the Pilbara region, however the results of past surveys suggest that cover increases from September to December (McMahon et al. 2017). It is likely that the small amount of seagrass cover observed will reduce further when the light climate is reduced over winter (Hovey et al. 2015), and regrow over the summer months. Considering the transitory nature of the seagrass in this region, mapped community distributions will vary seasonally and interannually. Similarly, common Pilbara macroalgal genera, such as *Sargassum spp*, are strongly seasonal with a spring-summer growth period, followed by reproduction in late summer and then senescence (Fraser et al. 2017). It is likely that the limited macroalgae observed here (in July) on the unconsolidated sand substrate and consolidated hard substrate may develop and increase in cover over the summer months.

Environmental changes following the collection of this data may result in significant expansions or contractions of any habitat type, although the development of filter feeder communities is probably on a longer timeframe than seagrass and macroalgae. Therefore, the boundaries of each feature must be assumed to be variable through time.

3.3 Significance of BCH

Very few marine plants were observed within the survey area. The predominant benthic primary producers (BPP) identified in the survey area were hard corals. These were found to be growing on limestone pavement, associated with a low relief ridgeline extension of Minilya Bank, rather than on bases of calcium carbonate accretion from coral. LiDAR mapping for the BHP Outer Harbour Development indicated low relief ridgelines extending along the entire extent of the coastline from North Turtle Island in the north-east to beyond Cape Thouin in the south-west, which implies a uniform ecosystem composed of parallel

ridge lines extends along this coastline (SKM 2011b). Microphytobenthos generally occur in stable unconsolidated substrates and are rarely seen in mobile sands such as those observed in the survey area (MacIntrye et al. 1996). The dominant coral taxa recorded were *Turbinaria spp* which are known to have relatively low susceptibility to increases in sedimentation and light reduction associated with turbidity (Gilmour et al. 2006; Sofonia and Anthony 2008). Quantitative, diver-based, benthic habitat surveys conducted at sites located along the western low relief ridgeline extension of Minilya Bank reported *Turbinaria spp* as the dominant hard coral and at a similar average percent cover to that reported here (~10%) (Advisian 2019; SKM 2009).

The predominant non-BPP within the survey area were invertebrate filter feeders. This finding is consistent with the benthic habitat surveys completed as part of the Outer Harbour Development (SKM 2009). That report hypothesized that as the waters in the region are typically turbid, the subtidal marine fauna will have become established under conditions which are more suitable for feeding on particulates than for photosynthesis.

Seagrass was recorded with a percentage cover greater than 10% in two of the transects surveyed. Seagrass (predominantly *Halophila ovalis*) has been observed previously in the Port Hedland area within the embayments between Downes and Weerdee Islands (O2 Marine 2019; Walker and Prince 1987).

Based on the above, it is considered that the identified BCH within the survey area are not of regional significance.

4 DISCUSSION AND CONCLUSIONS

Pilbara Ports is proposing to carry out capital dredging and potential future maintenance dredging (and associated dredge spoil activities) at the Port of Port Hedland as part of its proposed Zone 5 Bypass Channel Project. Review of existing data, ground truthing and mapping of the BCH within the Project area (including SG7C) has been completed to support an application for loading and disposal of dredge material at sea under the *Environment Protection (Sea Dumping) Act 1981*, and referral of the under Project Part IV of the *Environmental Protection Act 1986.*

Field validation of the composition of BCH within the survey area identified two habitat types (unconsolidated sediment and consolidated hard substrate), with five community types found within one or more of these habitats:

- Bare
- Sparse invertebrate (non-hard coral) dominant communities
- Low density invertebrate (non-hard coral) dominant communities
- Medium density invertebrate (non-hard coral) dominant communities
- Medium density mixed communities

Ninety-four percent (4,541 ha) of the 4,835-ha survey area was mapped as bare unconsolidated sand habitat (<2 % biota cover). Two-hundred and nine hectares (~ 4%) of the survey area was comprised of sparse (2 to <10 % cover) to medium density (20 to <40%) sessile invertebrates (non-coral) growing on either unconsolidated sediment or consolidated hard substrate. The remaining 85 ha was mapped as mixed community (turf algae, sponges, soft corals and other mixed filter feeders and up to 20% cover of hard corals) growing on consolidated hard substrate.

Within the areas proposed for capital dredging, Zone 5A(i) (18.9 ha) was mapped as bare unconsolidated sand habitat (<2 % biota cover), Zone 5A(ii) (6.6 ha) was mapped as mixed community (turf algae, sponges, soft corals and other mixed filter feeders and up to 20% cover of hard corals) growing on consolidated hard substrate, and Zone 5A(iii) (136.4 ha) was mapped as 99% bare unconsolidated sand habitat (<2 % biota cover) and 1% sparse (2 to <10 % cover) to low density (10 to 20 %) sessile invertebrates (non-coral) growing on either unconsolidated sediment or consolidated hard substrate.

The habitats identified during the assessment are common in the area offshore of Port Hedland, as shown by extensive habitat mapping for the proposed BHP Outer Harbour Development (SKM 2009) and other similar recent surveys completed within the Port of Port Hedland (Advisian 2019; O2 Marine 2019). Within the 365,000 ha study area for the SKM (2009) survey, 30,178 ha was predicted (through modelling and ground truthing) to be comprised of hard substrate (or sediment covered hard substrate) supporting benthic primary producers (specifically hard corals and macroalgae). The SKM (2009) study predicted there to be 18,089 ha of hard coral, 7, 997 ha of sponges, 3, 402 ha of soft corals and 20, 288 ha of other non-coral sessile invertebrates in the area offshore of Port Hedland.

The present mapping presents the distribution of benthos at a single time. The habitats identified within this survey are known to change their density and distribution over time in response to natural disturbances and seasonal effects. In particular, seagrasses and macroalgae beds of the nearshore Pilbara are recorded as showing regular large seasonal changes in distribution and density (refer to Section 3.2.1).

There were no benthic habitats, communities or biota of regional significance identified in this survey of the Project area. Whilst we accept that community distributions may vary over time, this survey provides

an accurate representation of the distribution of communities and habitats immediately prior to dredging and which will be used to inform the dredging management plan for the Project.

5 REFERENCES

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6 APPENDIX A – CPCE SCORING CATEGORIES

Group	CATEGORIES	Code	Comment
	Unknown		
U	Blurred (Blur)	Blur	unresolvable image
U	Unknown (Unk)	Unk	anything not in category below
	Bare Substratum		
A	Rock (R)	R	includes coralline algae
	Sediment		
A	Rubble (Ru)	Ru	includes coralline algae
A	Sand (S)	S	white sand
A	Sand on Hard Coral (SHc)	SHc	sand layer on what appears to be living coral
A	Sand on Soft Coral (SSc)	SSc	sand layer on what appears to be living coral
A	Sand on Sponge (SSp)	SSp	sand layer on what appears to be living coral
A	Shell grit (Sh)	Sh	large particles with edges
A	Silt (Silt)	Silt	dark coloured fine sediments
	Macroalgae		
Ma	Algae	Alg	large & small
	Seagrass		
Sg	General seagrass	USG	species unidentified or not Halophila
Sg	Halophila ovalis	Ho	all oval leafed Halophila
Sg	Halophila spinulosa	Hs	Christmas tree halophila - white stalk
	Turf Algae		
	Turf algae (Tu)	Tu	fine turf
	Dead Standing Coral		

Group	CATEGORIES	Code	Comment
Dc	Dead Standing Coral (DSC)	DSC	white coral with no sign of living tissue - starting to discolour
	CORAL		
Hc	Acropora branching	ACB	As per MScience NW coral guide
Hc	Acropora tabular	ACT	As per MScience NW coral guide
Hc	Astreopora encrusting	AstE	As per MScience NW coral guide
Hc	Astreopora massive	AstM	As per MScience NW coral guide
Hc	Branching Unknown	UNKBra	As per MScience NW coral guide
Hc	Echinophyllia encrusting	EchE	As per MScience NW coral guide
Hc	Encrusting Unknown	UNKEnc	As per MScience NW coral guide
Hc	Favid encrusting	FavE	As per MScience NW coral guide
Hc	Favid foliose	FavF	As per MScience NW coral guide
Hc	Favid massive	FavM	As per MScience NW coral guide
Hc	Foliose Unknown	UNKFol	As per MScience NW coral guide
Hc	Fungid	Fung	As per MScience NW coral guide
Hc	Galaxea	Galax	As per MScience NW coral guide
Hc	Goniopora	Gon	As per MScience NW coral guide
Hc	Hydnophora encrusting	HydE	As per MScience NW coral guide
Hc	Hydnophorasubmassive	HydSub	As per MScience NW coral guide
Hc	Lobophyllia	LoboM	As per MScience NW coral guide

Group	CATEGORIES	Code	Comment
Hc	Massive unknown	UNKMas	As per MScience NW coral guide
Hc	Merulina	Mer	As per MScience NW coral guide
Hc	Montipora	Mon	As per MScience NW coral guide
Hc	Mycedium encrusting	MycE	As per MScience NW coral guide
Hc	Pachyseris	Pach	As per MScience NW coral guide
Hc	Pavona	Pav	As per MScience NW coral guide
Hc	Pocilloporid	Poc	As per MScience NW coral guide
Hc	Porites branching	PorB	As per MScience NW coral guide
Hc	Porites encrusting	PorE	As per MScience NW coral guide
Hc	Porites massive	PorM	As per MScience NW coral guide
Hc	Seriatopora	Ser	As per MScience NW coral guide
Hc	Submassive unknown	UNKSub	As per MScience NW coral guide
Hc	Symphyllia	Sym	As per MScience NW coral guide
Hc	Turbinaria encrusting	TurbE	As per MScience NW coral guide
Hc	Turbinaria foliose	TurbF	As per MScience NW coral guide
	Bleached Coral		
Bc	Acropora branching	BLACB	Bleached - but alive
Bc	Acropora tabular	BLACT	Bleached - but alive
Bc	Astreopora encrusting	BLAstE	Bleached - but alive
Bc	Astreopora massive	BLAstM	Bleached - but alive
Bc	Branching Unknown	BLUNKBra	Bleached - but alive

Group	CATEGORIES	Code	Comment
Bc	Echinophyllia encrusting	BLEchE	Bleached - but alive
Bc	Encrusting Unknown	BLUNKEnc	Bleached - but alive
Bc	Favid encrusting	BLFavE	Bleached - but alive
Bc	Favid foliose	BLFavF	Bleached - but alive
Bc	Favid massive	BLFavM	Bleached - but alive
Bc	Foliose Unknown	BLUNKFol	Bleached - but alive
Bc	Fungid	BLFung	Bleached - but alive
Bc	Galaxea	BLGalax	Bleached - but alive
Bc	Goniopora	BLGon	Bleached - but alive
Bc	Hydnophora encrusting	BLHydE	Bleached - but alive
Bc	Hydnophorasubmassive	BLHydSub	Bleached - but alive
Bc	Lobophyllia	BLLoboM	Bleached - but alive
Bc	Massive unknown	BLUNKMas	Bleached - but alive
Bc	Merulina	BLMer	Bleached - but alive
Bc	Montipora	BLMon	Bleached - but alive
Bc	Mycedium encrusting	BLMycE	Bleached - but alive
Bc	Pachyseris	BLPach	Bleached - but alive
Bc	Pavona	BLPav	Bleached - but alive
Bc	Pocillopora	BLPoc	Bleached - but alive
Bc	Porites branching	BLPorB	Bleached - but alive
Bc	Porites encrusting	BLPorE	Bleached - but alive
Bc	Porites massive	BLPorM	Bleached - but alive
Bc	Submassive unknown	BLUNKSub	Bleached - but alive
Bc	Symphyllia	BLSym	Bleached - but alive
Bc	Turbinaria encrusting	BLTurbE	Bleached - but alive
Bc	Turbinaria foliose	BLTurbF	Bleached - but alive
	Filter Feeders		
FF	Gorgonians		rigid soft corals
FF	Soft Coral spp.		all octocorals except gorgonians

Group	CATEGORIES	Code	Comment
FF	Ascidian		members of Class Ascidia
FF	Clam- and other molluscs		All in tactmolluscs (not shell fragments)
FF	Crinoid		brittle stars
FF	Hydroid		feathery branching hydroids
FF	Sponge spp.		all sponge species
	Other fauna		
Of	Other invertebrate		mobile & bryozoans
Of	COT		Crown of Thorns starfish
Of	Drupella		rugose shelled molluscs with Drupella shape
Of	Zoanthid		zooanthid or palythoans
	TAPE WAND SHADOW		
TWS	Shadow		poorly lit section of image
TWS	Tape		any measuring equipment
TWS	Wand		any measuring equipment

7 APPENDIX B – BENTHIC ASSESSMENT LOGSHEET

Site ID	Habitat Description						Community Classification
	Substrate	Additional Comment	Coral % Cover	Sponge % Cover	Gorgonian % Cover	Seagrass % Cover	
1	Unconsolidated Sediment	sparse Halophila	0	0	0	8	Bare Sediment
2	Unconsolidated Sediment	sparse Halophila	0	0	0	4	Bare Sediment
3	Low relief hard substrate with sediment veneer	moderate to dense inverts	2	12	12	0	Medium Density invertebrates
4	Low relief hard substrate with sediment veneer	moderate to dense inverts	2	8	8	0	Medium Density invertebrates
5	Low relief hard substrate with sediment veneer	moderate to dense inverts	2	8	5	0	Medium Density invertebrates
6	Low relief hard substrate with sediment veneer	Sparse inverts	5	5	5	0	Low Density Invertebrates
7	Low relief hard substrate with sediment veneer	moderate inverts	5	10	5	1	Medium Density invertebrates
8	Low relief hard substrate with sediment veneer	Sparse inverts	2	5	5	0	Low Density Invertebrates
9	Unconsolidated Sediment	Sediment with some rubble	0	1	1	1	Bare Sediment
10	Low relief hard substrate with sediment veneer	Sediment with sparse inverts	0	2	2	4	Sparse Invertebrates
11	Low relief hard substrate with sediment veneer	Sediment with sparse inverts	2	5	5	2	Low Density Invertebrates
12	Unconsolidated Sediment	Sediment and minor rubble	0	0	0	0	Bare Sediment
13	Unconsolidated Sediment	Sediment and minor rubble	0	0	0	0	Bare Sediment
14	Unconsolidated Sediment	Sediment and minor rubble	0	0	0	0	Bare Sediment
15	Unconsolidated Sediment	Sediment with very sparse inverts	0	0	0	0	Bare Sediment
16	Unconsolidated Sediment	Sediment and minor rubble	0	0	0	0	Bare Sediment
17	Unconsolidated Sediment	Sediment and minor rubble	0	0	0	0	Bare Sediment
18	Unconsolidated Sediment	Sediment and minor rubble	0	1	1	2	Bare Sediment
19	Low relief hard substrate with sediment veneer	Sparse inverts, seagrass Halophila	5	5	5	2	Low Density Invertebrates
20	Low relief hard substrate with sediment veneer	Sparse inverts	5	5	5	0	Low Density Invertebrates
21	Unconsolidated Sediment	sediment	0	0	0	0	Bare Sediment

Site ID	Habitat Description						Community Classification
	Substrate	Additional Comment	Coral % Cover	Sponge % Cover	Gorgonian % Cover	Seagrass % Cover	
22	Unconsolidated Sediment	sediment with patchy seagrass, very, very sparse invert	0	1	1	5	Bare Sediment
23	Unconsolidated Sediment	sediment with patchy seagrass	0	0	0	5	Bare Sediment
24	Low relief hard substrate with sediment veneer	patchy hard ground then sand	5	5	5	0	Low Density Invertebrates
25	Low relief hard substrate with sediment veneer	Dense inverts then sands, bleached Turbinaria	10	10	10	0	Medium Density Mixed Community
26	Low relief hard substrate with sediment veneer	High relief and very dense inverts then patchy inverts on sand	10	10	10	0	Medium Density Mixed Community
27	Low relief hard substrate with sediment veneer	Patchy filter feeders, then sands	2	5	5	0	Low Density Invertebrates
28	Low relief hard substrate with sediment veneer	Medium inverts, then sand, bleached Porites	15	5	5	0	Medium Density Mixed Community
29	Unconsolidated Sediment	sediment	0	0	0	0	Bare Sediment
30	Unconsolidated Sediment	sediment	0	0	0	0	Bare Sediment
31	Low relief hard substrate with sediment veneer	patchy filter feeders, significant bleaching, some seagrass	5	5	10	1	Medium Density invertebrates
32	Low relief hard substrate with sediment veneer	significant bleaching	10	10	10	0	Medium Density Mixed Community
33	Low relief hard substrate with sediment veneer	Sparse inverts	5	5	5	0	Low Density Invertebrates
34	Low relief hard substrate with sediment veneer	Sparse inverts	5	5	5	0	Low Density Invertebrates
35	Low relief hard substrate with sediment veneer	Sparse inverts, seagrass	2	5	5	1	Low Density Invertebrates
36	Low relief hard substrate with sediment veneer	Sparse inverts	2	5	5	0	Low Density Invertebrates
37	Low relief hard substrate with sediment veneer	Low relief hardground with abundant small corals and inverts, bleaching	10	5	5	0	Medium Density Mixed Community
38	Low relief hard substrate with sediment veneer	mostly sand and filamentous algae, patches of sparse to medium inverts	5	3	5	0	Low Density Invertebrates
39	Low relief hard substrate with sediment veneer	Patchy filter feeders, then sparser rippled sand, possible seagrass	2	5	5	2	Low Density Invertebrates

Site ID	Habitat Description						Community Classification
	Substrate	Additional Comment	Coral % Cover	Sponge % Cover	Gorgonian % Cover	Seagrass % Cover	
40	Unconsolidated Sediment	sediment	0	0	0	0	Bare Sediment
41	Unconsolidated Sediment	sediment	0	0	0	0	Bare Sediment
42	Unconsolidated Sediment	sediment with occasional whips	0	0	2	0	Bare Sediment
43	Unconsolidated Sediment	sediment with turf algae and filamentous macroalgae	0	1	0	0	Bare Sediment
44	Unconsolidated Sediment	sediment with turf algae and filamentous macroalgae	0	0	0	0	Bare Sediment
45	Unconsolidated Sediment	sediment with turf algae and filamentous macroalgae	0	0	0	0	Bare Sediment
46	Low relief hard substrate with sediment veneer	Medium density filter feeders, then sparser	2	5	10	0	Low Density Invertebrates
47	Unconsolidated Sediment	mostly sand and filamentous algae, patches of sparse to medium sponge	0	2	2	0	Sparse Invertebrates
48	Unconsolidated Sediment	burrowed fine to medium grained sand	0	0	0	0	Bare Sediment
49	Unconsolidated Sediment	rippled medium grained sand	0	0	0	0	Bare Sediment
50	Unconsolidated Sediment	burrowed fine to medium grained sand	0	0	0	1	Bare Sediment
51	Unconsolidated Sediment	coarse sand, shell & rubble with sparse inverts, some bleached coral	1	1	1	0	Sparse Invertebrates
52	Unconsolidated Sediment	fine to medium grained sand & rubble	0	0	0	0	Bare Sediment
53	Unconsolidated Sediment	medium to coarse grained sand & rubble	0	0	0	0	Bare Sediment
54	Low relief hard substrate with sediment veneer	low relief patchy hardground with sparse inverts	2	2	3	0	Sparse Invertebrates
55	Low relief hard substrate with sediment veneer	hardground with inverts, bleached Turbinaria & gorgonians	10	10	10	0	Medium Density Mixed Community
56	Low relief hard substrate with sediment veneer	hardground with inverts, bleached coral	15	5	5	0	Medium Density Mixed Community
57	Low relief hard substrate with sediment veneer	hardground with inverts, bleached coral	10	10	5	0	Medium Density Mixed Community
58	Low relief hard substrate with sediment veneer	hardground with inverts, bleached Turbinaria & Porites	15	10	10	0	Medium Density Mixed Community
59	Low relief hard substrate with sediment veneer	hardground with inverts, diverse coral & sponges, bleaching	15	10	5	0	Medium Density Mixed Community

Site ID	Habitat Description						Community Classification
	Substrate	Additional Comment	Coral % Cover	Sponge % Cover	Gorgonian % Cover	Seagrass % Cover	
60	Low relief hard substrate with sediment veneer	hardground with inverts, diverse coral & sponges, bleaching	20	5	5	0	Medium Density Mixed Community
61	Low relief hard substrate with sediment veneer	hardground with inverts, diverse coral & sponges, bleaching	10	10	5	0	Medium Density Mixed Community
62	Low relief hard substrate with sediment veneer	hardground with inverts, diverse coral & sponges, bleaching	10	5	5	0	Medium Density Mixed Community
63	Low relief hard substrate with sediment veneer	low relief patchy hardground with inverts	5	5	5	0	Low Density Invertebrates
64	Unconsolidated Sediment	sediment	0	0	0	0	Bare Sediment
65	Unconsolidated Sediment	very sparse inverts in coarse sediment	0	0	1	0	Bare Sediment
66	Unconsolidated Sediment	medium to coarse grained sand & rubble	0	0	0	0	Bare Sediment
67	Unconsolidated Sediment	medium to coarse grained sand & rubble	0	0	0	0	Bare Sediment
68	Unconsolidated Sediment	very sparse inverts in coarse sediment	2	2	2	0	Sparse Invertebrates
69	Unconsolidated Sediment	sediment with sparse seagrass	0	0	0	1	Bare Sediment
70	Unconsolidated Sediment	sediment with sparse seagrass	0	0	0	1	Bare Sediment
71	Low relief hard substrate with sediment veneer	Sparse Invertebrates	2	2	0	0	Sparse Invertebrates
72	Low relief hard substrate with sediment veneer	Sparse Invertebrates	1	5	5	0	Low Density Invertebrates
73	Low relief hard substrate with sediment veneer	low relief hardground with medium density inverts	5	10	5	0	Medium Density invertebrates
74	Low relief hard substrate with sediment veneer	low relief hardground with filamentous macroalgae	0	0	0	0	Bare Sediment
75	Low relief hard substrate with sediment veneer	high relief hardground with medium density inverts	15	10	5	0	Medium Density Mixed Community
76	Low relief hard substrate with sediment veneer	low relief hardground with macroalgae & medium density inverts	2	10	2	0	Low Density Invertebrates
77	Low relief hard substrate with sediment veneer	low relief hardground with macroalgae & low-density inverts	1	2	1	0	Sparse Invertebrates
78	Unconsolidated Sediment	coarse sand with filamentous macroalgae	1	2	1	0	Sparse Invertebrates
79	Unconsolidated Sediment	seagrass in sand	0	0	0	25	Bare Sediment
80	Low relief hard substrate with sediment veneer	low relief hard substrate with sediment veneer and filamentous macroalgae	0	0	0	0	Bare Sediment

Site ID	Habitat Description						Community Classification
	Substrate	Additional Comment	Coral % Cover	Sponge % Cover	Gorgonian % Cover	Seagrass % Cover	
81	Unconsolidated Sediment	sediment	0	0	0	0	Bare Sediment
82	Unconsolidated Sediment	sediment	0	0	0	0	Bare Sediment
83	Unconsolidated Sediment	sediment	0	0	0	0	Bare Sediment
84	Unconsolidated Sediment	rubble with turf and macroalgae	0	0	0	0	Bare Sediment
85	Unconsolidated Sediment	sediment and sparse invertebrates	1	1	2	0	Sparse Invertebrates
86	Unconsolidated Sediment	rubble with turf and macroalgae, then sandy	0	1	2	0	Sparse Invertebrates
87	Unconsolidated Sediment	sediment	0	0	0	0	Bare Sediment
88	Low relief hard substrate with sediment veneer	low relief hardground with medium density inverts	15	10	5	0	Medium Density Mixed Community
89	Low relief hard substrate with sediment veneer	low relief hardground with medium density inverts	10	5	2	0	Low Density Invertebrates
90	Unconsolidated Sediment	fine to medium grained sand with trace seagrass	0	0	1	0	Bare Sediment
91	Low relief hard substrate with sediment veneer	Sparse Invertebrates and macroalgae on rubble	1	1	1	0	Sparse Invertebrates
92	Low relief hard substrate with sediment veneer	Sparse Invertebrates and macroalgae on rubble	1	1	1	0	Sparse Invertebrates
93	Low relief hard substrate with sediment veneer	Sparse Invertebrates and macroalgae on rubble	1	1	1	0	Sparse Invertebrates
94	Low relief hard substrate with sediment veneer	hardground with rubble, macroalgae, sparse invertebrates	1	1	1	0	Sparse Invertebrates
95	Low relief hard substrate with sediment veneer	low relief hardground with sparse inverts	1	1	1	0	Sparse Invertebrates
96	Unconsolidated Sediment	sediment	0	1	1	0	Bare Sediment
97	Unconsolidated Sediment	sediment	0	0	0	0	Bare Sediment
98	Unconsolidated Sediment	sediment and sparse invertebrates	1	1	1	1	Sparse Invertebrates
99	Unconsolidated Sediment	fine to medium grained sand	0	1	1	0	Bare Sediment
100	Unconsolidated Sediment	fine to medium grained sand with seagrass	0	0	0	20	Bare Sediment
101	Unconsolidated Sediment	sediment and sparse invertebrates	0	1	1	0	Bare Sediment
102	Unconsolidated Sediment	sediment and sparse invertebrates	0	1	1	0	Bare Sediment
103	Unconsolidated Sediment	sediment	0	0	0	0	Bare Sediment
104	Unconsolidated Sediment	sediment	0	0	0	0	Bare Sediment

Site ID	Habitat Description						Community Classification
	Substrate	Additional Comment	Coral % Cover	Sponge % Cover	Gorgonian % Cover	Seagrass % Cover	
105	Unconsolidated Sediment	sediment	0	0	0	0	Bare Sediment
106	Unconsolidated Sediment	sediment	0	0	0	0	Bare Sediment
107	Unconsolidated Sediment	sediment	0	0	0	0	Bare Sediment
108	Unconsolidated Sediment	sediment	0	0	0	0	Bare Sediment
109	Unconsolidated Sediment	sediment	0	0	0	0	Bare Sediment
110	Unconsolidated Sediment	sediment	0	0	0	0	Bare Sediment
A1	Unconsolidated Sediment	rubble with turf and macroalgae	0	0	0	0	Bare Sediment
A2	Low relief hard substrate with sediment veneer	high relief hardground with medium density inverts	10	10	5	0	Medium Density Mixed Community
A3	Unconsolidated Sediment	sediment	0	0	0	2	Bare Sediment
A4	Unconsolidated Sediment	rippled fine to medium grained sand with turf algae and disc forams	0	0	0	0	Bare Sediment
A5	Unconsolidated Sediment	medium to coarse grained sand and shell	0	0	0	0	Bare Sediment