Rocky Reef Data Layer

Scoping Report for Potential Layer Update

Ministry for the Environment

8 Willis Street
Wellington 6011

Prepared by:

SLR Consulting New Zealand

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Basis of Report

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

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Acronyms and Abbreviations

BOPRC	Bay of Plenty Regional Council
BTM	Benthic terrain modeller
CMA	Coastal marine area
C-SIG	Coastal Special Interest Group
DEM	Digital elevation models
DML	Discovery Marine Limited
DOC	Department of Conservation
ECAN	Environment Canterbury
EEZ	Exclusive economic zone
ENC	Electronic navigation charts
GDC	Gisborne District Council
GIS	Geographic information system
GWRC	Greater Wellington Regional Council
HBRC	Hawke's Bay Regional Council
HRC	Horizons Regional Council
LEK	Local ecological knowledge
LiDAR	Light detection and ranging
LINZ	Land Information New Zealand
MBES	Multibeam echo sounder
MDC	Marlborough District Council
MfE	Ministry for the Environment/Manatū Mō Te Taiao
MOS	MetOcean Solutions Limited
MPI	Ministry for Primary Industries
NCC	Nelson City Council
NIWA	National Institute of Water and Atmospheric Research
NZCPS	New Zealand Coastal Policy Statement
RMA	Resource Management Act 1991
ROV	Remotely operated vehicle
SEA	Significant ecological marine areas
SFI	Southern Fiordland Initiative
SLR	SLR Consulting New Zealand Limited
STB	South Taranaki Bight
TDC	Tasman District Council
TRC	Taranaki Regional Council
TTR	Trans-Tasman Resources Limited

1.0 Introduction

The Department of Conservation (**DOC**) and the Ministry of Fisheries (now the Ministry for Primary Industries (**MPI**)) released a report in 2011 (DOC, 2011) which identified, at a broad scale, the spatial locations of rocky reefs (along with other marine habitats) within New Zealand's territorial sea and is hereafter referred to as '**the 2011 Report**'. In particular, the derivation of rocky reef substrata included within the 2011 Report utilised a digitised geographic information system (**GIS**) layer of coastal reefs from shoal areas on Land Information New Zealand (**LINZ**) nautical charts and a limited coverage of field surveys.

While the methodology utilised in the 2011 Report resulted in a national overview of rocky reef habitats, it also likely over- or under-represented some near-shore and deeper reef habitats due to a desire for consistency. In addition, some detailed surveys that were either available or were underway at the time of drafting the 2011 Report were not included and, as such, the resultant data layer unlikely captured all areas of rocky reef and was inaccurate in places.

The Ministry for the Environment/Manatū Mō Te Taiao (**MfE**) is seeking to rectify the disadvantages associated with the 2011 Report and associated rocky reef data layer; and to potentially update the rocky reef data layer with more recently collected data to ensure effective environmental decision making in the marine environment. In order to do this, MfE engaged SLR Consulting New Zealand Limited (**SLR**) to deliver a scoping report on the development of an updated rocky reef data layer specifically focusing on rocky reefs. This scoping report constitutes **Phase 1** of a two-phase project, with Phase 2 potentially involving the updating of the layer. This scoping report provides the following:

- An analysis of some of the more recently available data, including an assessment of the quality and quantity of those data (**Section 2.1**);
- An analysis of the gaps identified in the recently available data (**Section 2.2**);
- A needs-analysis from key stakeholders so that any new rocky reef data layer can be designed to enable effective environmental decision making in the marine environment (**Section 3.0**); and
- Recommendations for Phase 2 (potential updating the rocky reef data layer), based on the analyses presented in this scoping report (**Section 4.0**).

This scoping report primarily focuses on the available data within the coastal marine area (**CMA**), which extends from the line of mean high water springs out to a distance of 12 nautical miles (the territorial sea), as this is the key area of the marine environment in which habitats have been mapped to enable effective decision-making by regional councils and unitary authorities. However, the recommendations section (**Section 4.0**) provides comment on the utility and feasibility of extending this rocky reef data layer into the exclusive economic zone (**EEZ**).

2.0 Data Analysis

An analysis of available data was undertaken by contacting a variety of stakeholders which are listed below, some of which were recommended by MfE. Many of the stakeholders that were contacted were able to recommend additional stakeholders that may have available data, which resulted in an extensive list of parties contacted as follows:

- Coastal Special Interest Group (**C-SIG**), which includes representatives from all regional councils; responses were received from the following regional councils/unitary authorities:
  - Hawke's Bay Regional Council (**HBRC**);
  - Bay of Plenty Regional Council (**BOPRC**);
  - Tasman District Council (**TDC**);
  - Environment Canterbury (**ECAN**);
- DOC;
- LINZ;
- National Institute of Water and Atmospheric Research (**NIWA**);
- MPI;
- University of Auckland;
- University of Waikato;
- Victoria University of Wellington;
- University of Canterbury;
- University of Otago;
- Auckland Museum; and
- Marine Bioservices Limited.

In addition to the consultation undertaken, an assessment of publicly available data on various websites was undertaken, with the relevant sources for the data discussed in the following sections, either included within footnotes or listed within **Section 7.0**.

Based on the above, an assessment of the available data in both a nationwide- and regional-scale is included in **Sections 2.1.1** and **2.1.2**, respectively. For the most part the responses from central government are discussed in **Section 2.1.1** at the nationwide scale; however, region-specific datasets or studies have been undertaken on behalf of central government are included within the respective regional sections under **Section 2.1.2**.

2.1 Data Availability and Quality

The following sections provide a description of the available data at both a nationwide and regionwide scale. Data collected using multibeam echo sounder (**MBES**) surveys were given the highest priority in the following assessment due to its ability to record broad swaths of habitat that can distinguish a range of hard and soft habitats via post-processing of the collected data. In addition, discussion has been included where underwater photography, videography and other benthic sampling data is available to assist with ground-truthing the location of rocky reefs and develop more accurate delineation of those rocky reefs.

2.1.1 Nationwide Datasets

2.1.1.1 Department of Conservation

In addition to the following discussion on reports prepared by DOC at a national scale, NIWA has also prepared reports on behalf of DOC which are discussed in detail within **Section 2.1.1.3**.

2011 Report

In order to map the coastal habitats in the CMA consistently and to avoid potential bias in over- or under-representing habitats based on the extent and detail of habitat mapping surveys, GIS datasets were sourced that extended across the entire CMA for the 2011 Report. Spatial layers for depth, substrate, and exposure were then overlain to approximate habitat categories (DOC, 2011).

In terms of the reef data aspect of the 2011 Report, coastal reefs were digitised for DOC (Smith, 2008[1], as cited in DOC, 2011) from shoal areas on LINZ nautical charts in addition to some limited coverage of field surveys. However, this inherently overlooked more detailed data that were collected and was still being collected at the time of preparing the 2011 Report. This bias is more pronounced in deeper and offshore waters (DOC, 2011) and is particularly more apparent now that more MBES surveys have been undertaken since the 2011 Report was published.

MPI has tried to address this data gap through commissioning a report (Jones, *et al.* 2016) that mapped expert anecdotal knowledge from scientists and stakeholders, such as commercial fishers (discussed further in **Section 2.1.1.4**), which was followed by dedicated surveys using underwater cameras and MBES (Jones, *et al.* 2018).

The rocky reef data provided by the 2011 Report provides a valuable starting point for the identification of reef habitats in the CMA. A significant amount of work has been undertaken throughout New Zealand since the development of this rocky reef data layer and, as such, provides more accurate data to assist with managing the marine environment in the future.

[1] Smith (2008) was unpublished at the time of writing DOC (2011) and was subsequently published in 2013. However, the Smith (2008) reference has been included in Section 7.0.

Benthic Terrain Modelling

DOC utilised the benthic terrain modeller (**BTM**) tool across MBES survey datasets obtained from LINZ to create benthic terrain maps and provide the ability to compare seafloor topographies (Robertson *et al.*, 2022). The BTM tool can be used on MBES survey data to classify seafloor morphology by creating terrain attributes including slope, rugosity, roughness, and aspect.

A required import for the BTM toolbox is a classification dictionary. To address this, DOC utilised a set of classification zones developed by NIWA (Neil *et al.*, 2015, as cited in Robertson *et al.*, 2022) that are suitable for habitats in New Zealand and to ensure consistency.

The outputs from Robertson *et al.* (2022) are available on DOC's Marine Data Portal[2] and will provide invaluable data for updating the rocky reef data layer and developing a marine benthic habitat classification. DOC plans to update the outputs as new survey datasets become available.

2.1.1.2 Land Information New Zealand

LINZ's mandate for the provision of hydrographic services was set out in 1996 and includes:

- The purchase, management, and specification of hydrographic and bathymetric services;
- The safe passage of maritime vessels through New Zealand's territorial seas and area of charting responsibility through ongoing maintenance and delivery of publicly available hydrographic and bathymetric information; and
- The delivery of nautical charting in support of the management of New Zealand's marine resources and the protection of the marine environment (LINZ, 2022).

Consultation with LINZ provided a wealth of data and assistance in detailing the available data. The following sections provide a description of the three key LINZ programmes that will be beneficial for Phase 2.

National Elevation Programme

The LINZ National Elevation Programme (**Elevation Aotearoa**) began in 2016, in conjunction with regional councils. Elevation Aotearoa aims at providing a consistent baseline elevation dataset for New Zealand, with the intention of covering 80% of the country (**Figure 1**) by 2024[3]. This program provides light detection and ranging (**LiDAR**) elevation open data. These data are available as digital elevation models (**DEM**), digital survey model, and point cloud, and can be obtained through both the LINZ Data Service[4] for the DEMs and OpenTopography[5] for the point cloud data.

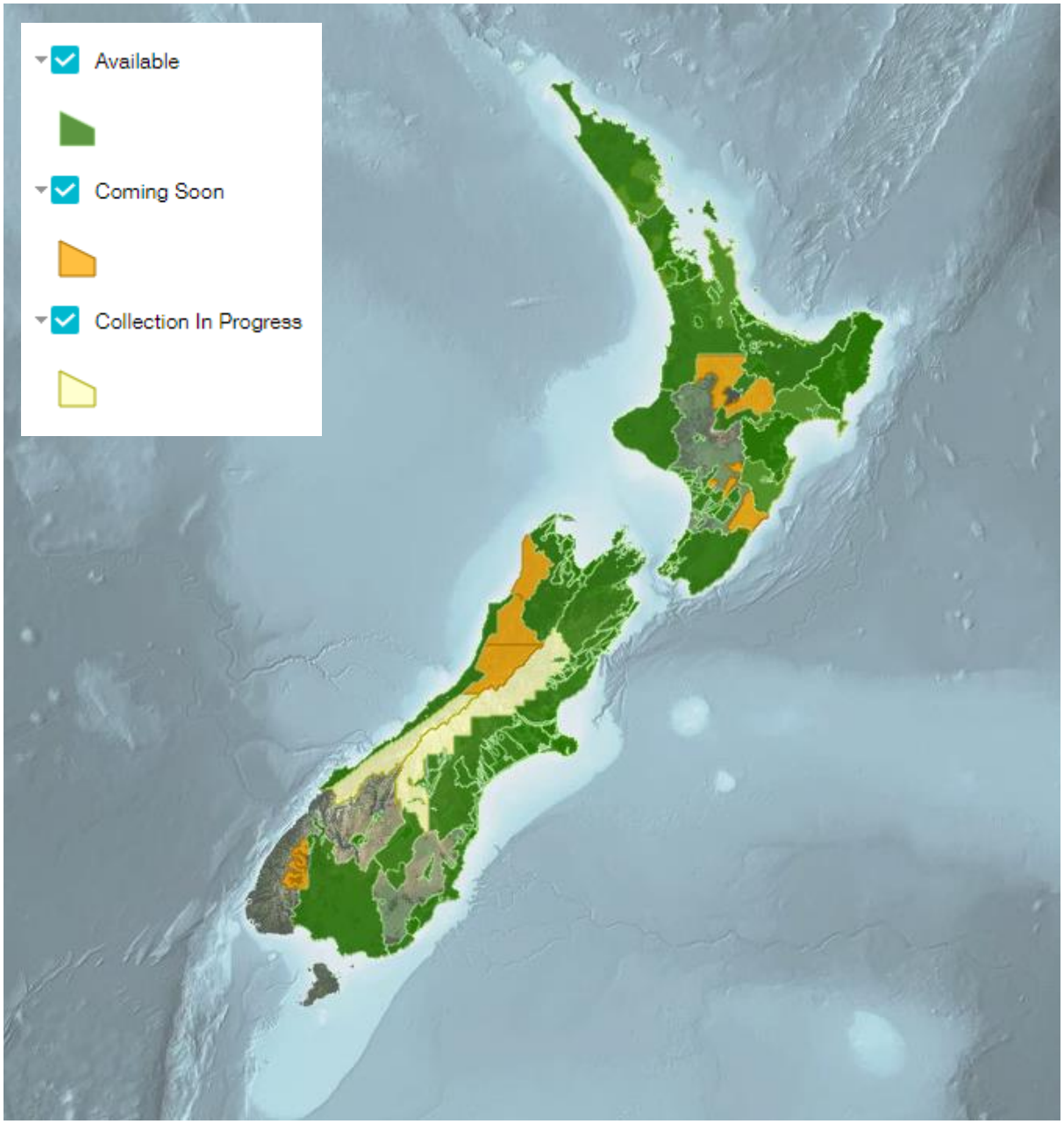
[2] DOC Marine Data Portal

[3] Elevation Aotearoa

[4] NZ Elevation Survey Index | LINZ Data Service

[5] OpenTopography

Figure 1 Coverage of Elevation Aotearoa



Source: Elevation Aotearoa

Although these data are primarily land-based, some of the captured LiDAR datasets cover intertidal areas and, as such, could be utilised for updating some intertidal reefs as part of Phase 2. One benefit of utilising these LiDAR data for intertidal reefs is that the quality of the data will be consistently high around the country, based on the LiDAR base specifications that set the minimum standards which ensure it is suitable for inclusion in the National Elevation Programme.

HYPLAN

LINZ prepared the second edition of New Zealand's long-term national hydrographic survey plan – HYPLAN (LINZ, 2022)[6]. A detailed analysis of the adequacy and accuracy of the nautical charts around New Zealand was undertaken to determine levels of hydrographic risk, in order to develop and prioritise a long-term hydrographic survey plan.

The risk assessment that underpins HYPLAN utilised a GIS-based risk model of 39 layers, with a level of risk associated with the use of out-of-date charts (due to larger, faster vessels) assigned to each cell within the layer. The end result of this risk assessment allowed the prioritisation of hydrographic surveys to be collected as follows (LINZ, 2022):

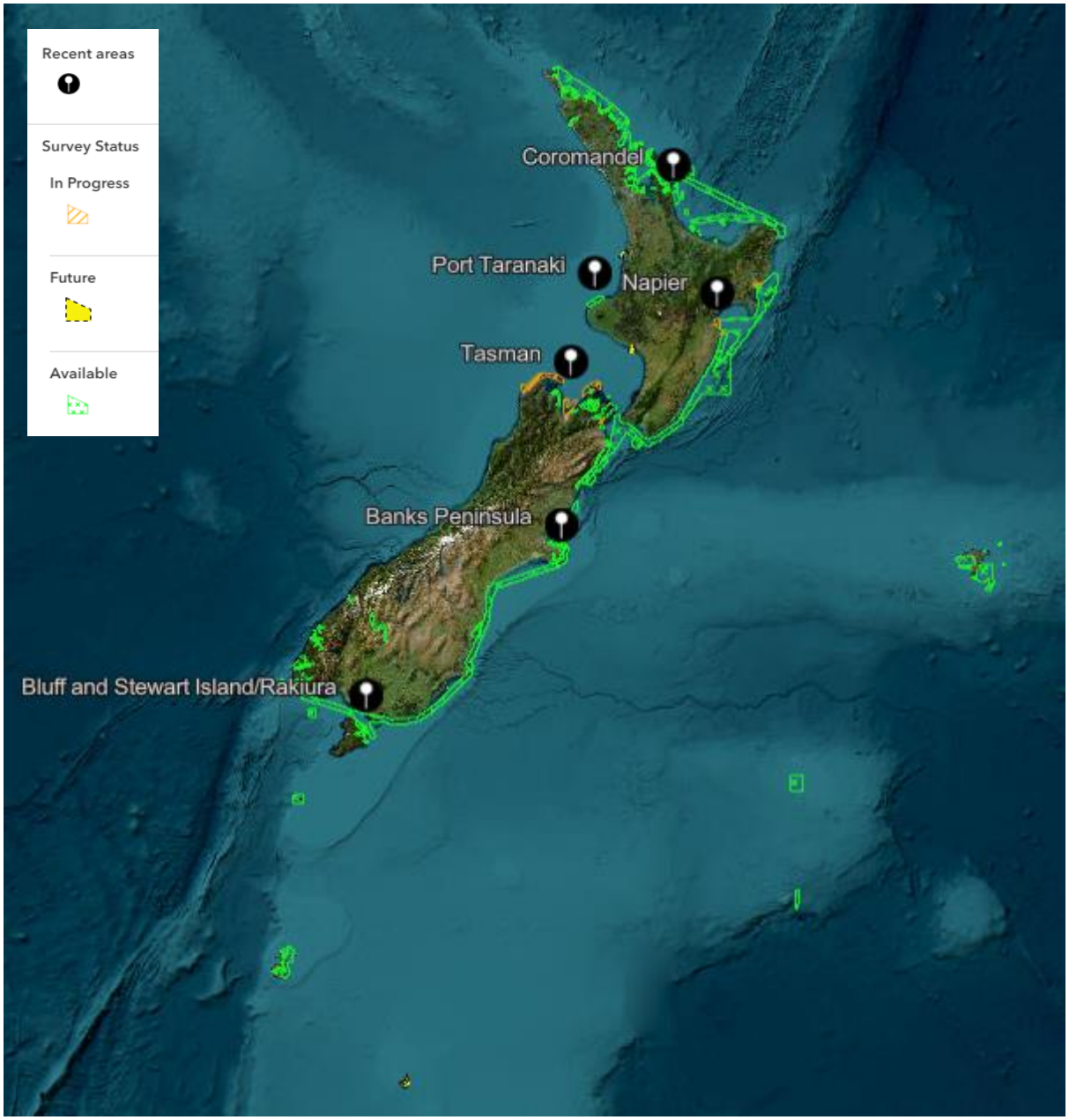
1 Bluff and Steward Island/Rakiura (completed 2022);
2 Banks Peninsula (completed 2022);
3 Approaches to Port Taranaki (completed 2021);
4 Coromandel (completed 2021);
5 Nelson to Kahurangi Shoals (completed 2022 – 2023);
6 Western Marlborough Sounds (completed 2022 – 2023);
7 Approaches to Napier (completed 2023);
8 Approaches to Gisborne (proposed 2023 – 2024);
9 Approaches to Whanganui (to be completed);
10 Taharoa to Kawhia Bar (to be completed);
11 Te Whanganui / Port Underwood (completed 2023);
12 Snares Islands/Tini Heke (to be completed); and
13 Campbell Island/Motu Ihupuku (to be completed).

A wide range of data that will be valuable to update the rocky reef data layer has been collected by several sources using MBES surveys, with data from each of these hydrographic surveys available through LINZ. These data include, but are not limited to, tidal data, bathymetry, seafloor backscatter, and georeferenced coastline photography.

As part of the marine geospatial information work programme, LINZ has undertaken a comprehensive stocktake of all marine geospatial datasets that it holds. The output is published online[7] and is currently being updated at the time of writing of this report. Due to the coverage of the available data (**Figure 2**), it is considered that MBES survey data obtainable from LINZ will be important to consider for Phase 2.

[6] Mapping Aotearoa's Seafloor
[7] LINZ Marine Geospatial Inventory - Dataset

Figure 2 HYPLAN Coverage



Source: LINZ – Mapping Aotearoa's Seafloor

3D Coastal Mapping Project

As discussed above, Elevation Aotearoa aims to provide a nationally consistent baseline, covering 80% of New Zealand, that is freely available on open licence. When adding this dataset to HYPLAN (discussed above), it is anticipated that this combined dataset will provide depth and other geospatial datasets for wider use to stakeholders. However, a spatial gap exists between these datasets, being an area located between (approximately) from the coastline out to a water depth of approximately 5-10 m.

In order to address this gap, LINZ has proposed the collection of LiDAR along this coastal strip; this project is called the '3D Coastal Mapping Project'. The proposed 3D Coastal Mapping Project is a four-year programme focused on capturing data across the land/sea interface. This project will cover an area from approximately 200 m inland out to a water

depth of approximately 25 m, resulting in an overlap of the datasets associated with the National Elevation Programme and HYPLAN. This will deliver a near-seamless data layer across both land and sea that will allow for integrated ocean and coastal mapping.

The 3D Coastal Mapping Project is proposed to capture LiDAR data for approximately 85% of the New Zealand coastline, focusing on vulnerable communities, infrastructure, and habitats. However, the prioritisation of the areas that are to be captured has not been finalised by LINZ and will be subject to budgets prior to knowing the full scope of the work. The primary data collection will be by bathymetric LiDAR, mobilised on a fixed wing or helicopter, and will result in outputs of bathymetric surface or DEM, a point cloud and reflectance/intensity.

This technology relies on clear weather and calm waters to obtain suitable bathymetric LiDAR data. This reliance on good weather and sea conditions was evident when, in early 2024, a trial of the survey methodology and specifications that began in Invercargill needed to be moved due to deteriorating weather. The trial moved to Tauranga, with the coast between Maketu and Waihi Beach, including Mount Maunganui and Mayor Island/Tūhua, being surveyed. The results of this trial are expected to be delivered in June 2024.

Although an analysis of these data is not possible as part of this scoping report (Phase 1) and is not available yet for inclusion within Phase 2, the end result will likely be highly beneficial to provide accurate data on locations of rocky reefs along New Zealand's coastline. Therefore, it is recommended that MfE should directly engage with LINZ to ensure that the 3D Coastal Mapping data can be incorporated into Phase 2 (see **Section 4.0**).

2.1.1.3 National Institute of Water and Atmospheric Research

NIWA holds a significant amount of data through its work with both public and private sector clients, in addition to its own collected data (such as MBES surveys). An important source for the publicly available data that NIWA holds is contained within its metadata catalogue[8]. Consultation with NIWA staff conducted as part of this scoping report found that the publicly available information (which includes reports/data prepared for the public sector, such as DOC) was readily available. However, much of the additional data held by NIWA was not able to be released for assessment as part of this report due to the time and personnel requirements for collating the information (resulting in significant costs) and the fact that some of these data are confidential in nature (e.g. that collected for private sector clients).

Nevertheless, it is recommended that MfE consult with NIWA to procure these data as part of Phase 2. The following discussion provides a summary of some of the relevant data contained within the available NIWA reports; noting that the region-specific work that NIWA has completed is discussed in **Section 2.1.2**, where relevant.

NIWA prepared a report for DOC in 2023 that reviewed and described the datasets and imagery for New Zealand's deep reefs, including examining datasets for indicator species as a proxy for reef presence (Morrison, *et al.* 2023a). Morrison *et al.* (2023a) utilised a variety of data sources, including seafloor substrates marked on nautical charts, the DOC rocky reef GIS layer, local ecological knowledge (**LEK**), 'TRAWL' database for unsuccessful tows and sediment chart sources.

Morrison *et al.* (2023a) provided regional summaries within the body of their report and detailed analyses of video imagery and spatial distributions of reef-indicator species within the appendices. The information contained within the Morrison *et al.* (2023a) report will

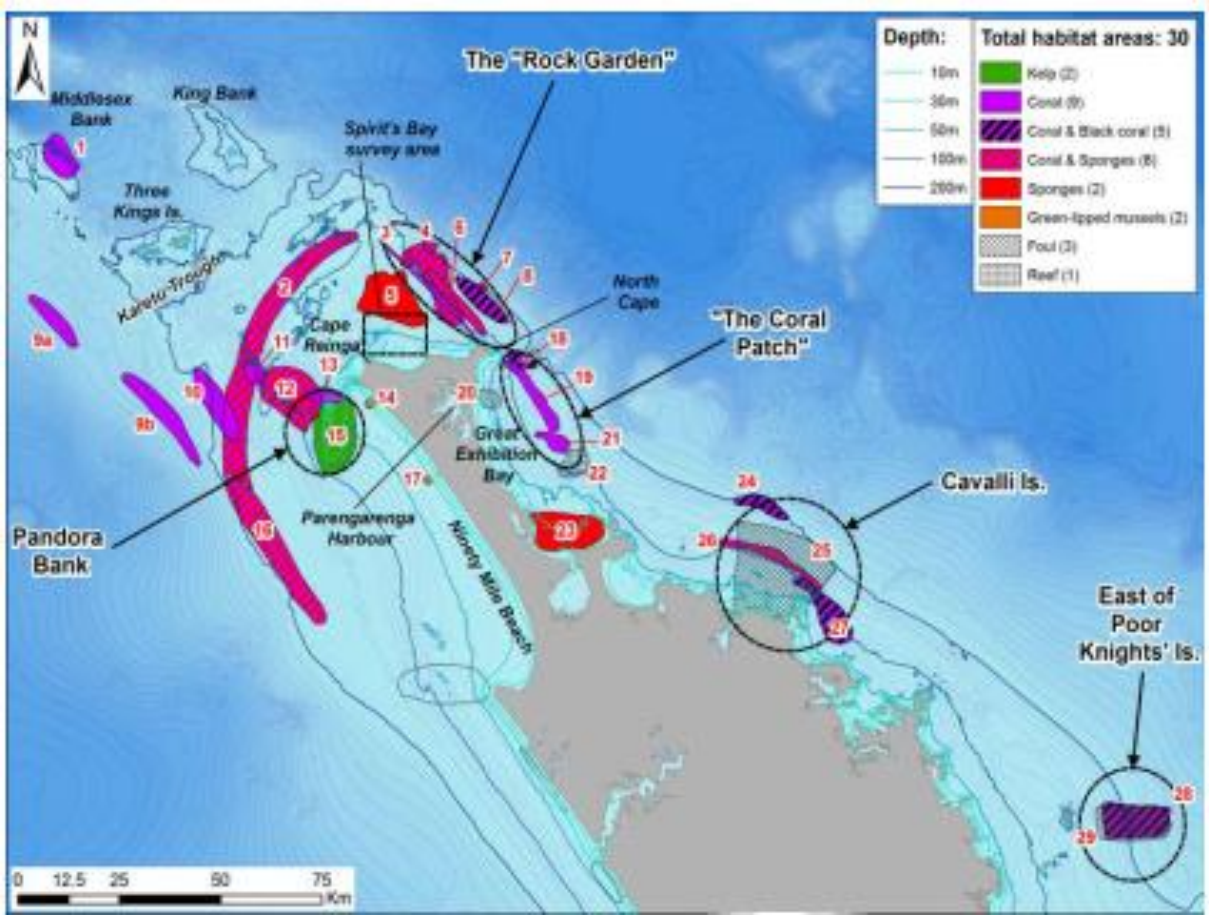
[8] NIWA Metadata Catalogue

provide useful guidance on the location of reefs around New Zealand and assist with providing another level of confidence on the spatial extent of reefs.

2.1.1.4 Ministry for Primary Industries

A report was prepared by MPI in 2016 that characterised and mapped significant areas of biogenic habitat in the near-shore coastal zone (Jones, *et al.* 2016). This was completed by utilising data provided by fishers (especially retired commercial fishers) who had developed extensive knowledge of their fishing grounds over many years of experience. The data provided by the fishers complemented the known scientific data, and in some cases exceeded it (Jones, *et al.* 2016). As part of this process, 70 observations of 'reef' or 'foul' areas were identified, where the fishers knew that the area was untrawlable, and, in some cases, areas they believed to be important nursery and spawning sites. An example of the output from Jones *et al.* (2016) is shown in **Figure 3**. The identification of habitats as part of the LEK has been utilised in a variety of reports, including some discussed through **Section 2.1.2**.

Figure 3 Example of LEK Outputs



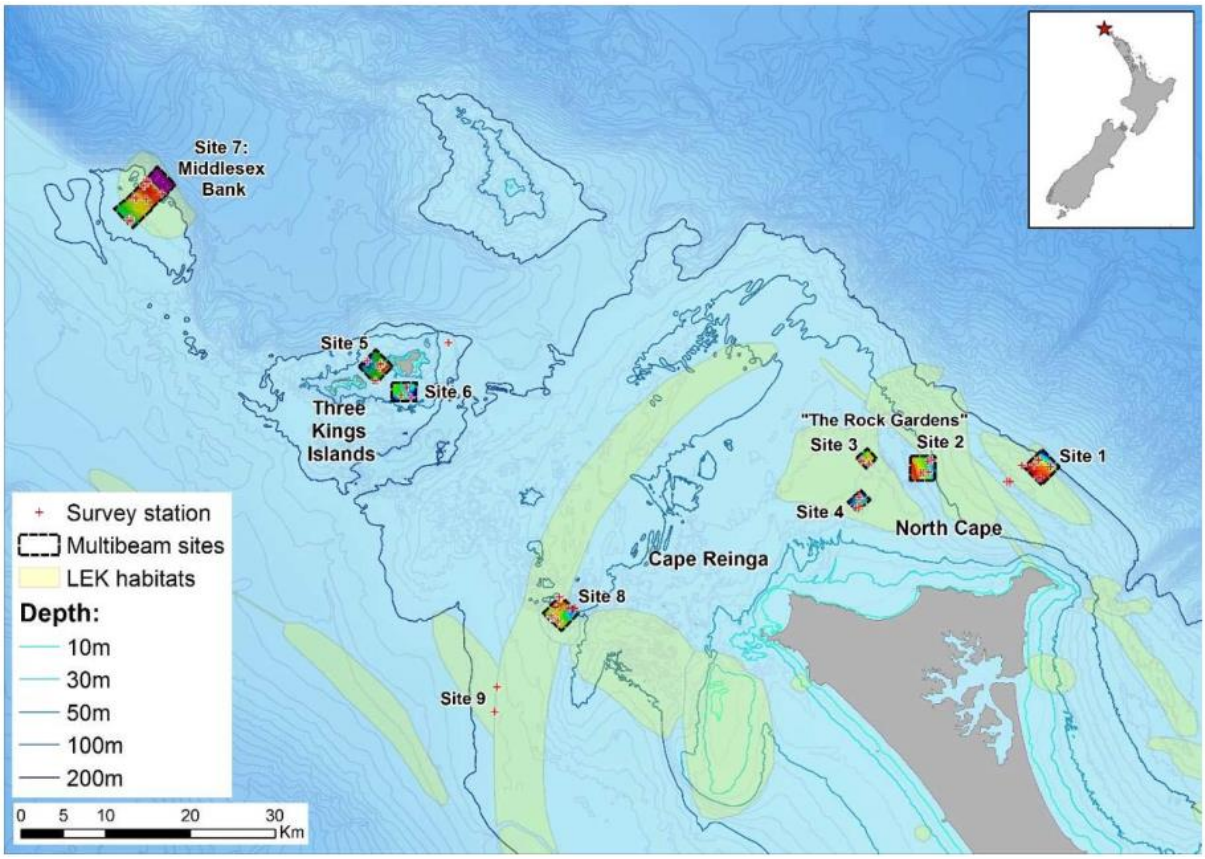
Source: Jones, *et al.* (2016)

MPI followed up Jones *et al.* (2016) with a report on field surveys and data analyses in 2018 (Jones, *et al.* 2018). The objective of that report was to design and deploy a series of voyages to selected locations to map and characterise the seabed. A list of 'Key Sites' was developed based on available scientific information in addition to the data from the fishers, particularly relating to those areas that were described by multiple fishers, consistent with

scientific information (if available) and/or considered especially unusual and interesting (Jones, *et al.* 2018).

The Key Sites were surveyed using MBES surveys, video transects and physical sampling of sediments and macrofauna to confirm presence or absence of biogenic structures identified by the LEK process. Each MBES survey area had the bathymetry and back-scatter scrutinised to identify areas of interest that might contain or represent the biogenic habitat described, such as drop offs, rocky outcrops, or distinctive patterns in topography or seafloor hardness; an example of which is shown in **Figure 4**.

Figure 4 Example of Field Surveys on LEK



Source: Jones, *et al.* (2018)

Although the reef locations identified as part of Jones *et al.* (2016) are generalised in nature, the MBES surveys that were undertaken for Jones *et al.* (2018) will provide useful confirmation on the specific areas of interest surveyed.

2.1.2 Regional Datasets

As outlined within **Section 2.1**, to determine what data is available at the regional scale, SLR undertook a search through the publicly available data on council websites, and contacted regional councils through C-SIG to determine what data is available on rocky reefs in their jurisdiction. The following sections contain a discussion on what data is available for each of the Council jurisdictions.

Although not detailed in this scoping report, many resource consent applications for works in the CMA would include delineation of habitats, including rocky reefs, that could contribute to Phase 2 and/or be utilised for ground-truthing the update to the rocky reef data layer. Examples of this include maintenance dredging campaigns at various ports around New Zealand (e.g. Port Taranaki, Napier Port, Eastland Port, Lyttelton Port of Christchurch, Port Otago, and Southport) and marine farms (e.g. New Zealand King Salmon in Marlborough Sounds) among others.

2.1.2.1 Northland

The identification of significant ecological marine areas (**SEAs**) in the Northland region was undertaken in consultation with a group of experts, in response to the requirements to protect significant biodiversity values set out in the Resource Management Act 1991 (**RMA**), New Zealand Coastal Policy Statement (**NZCPS**) and the Proposed Regional Policy Statement for Northland. A desktop assessment was undertaken by Kerr (2016) that included gathering spatial data to map areas for consideration as an SEA (Kerr, 2016). This process utilised the existing Northland Marine Habitat map for the East Coast and Far North (Kerr, 2009), and produced a draft habitat map for the West Coast.

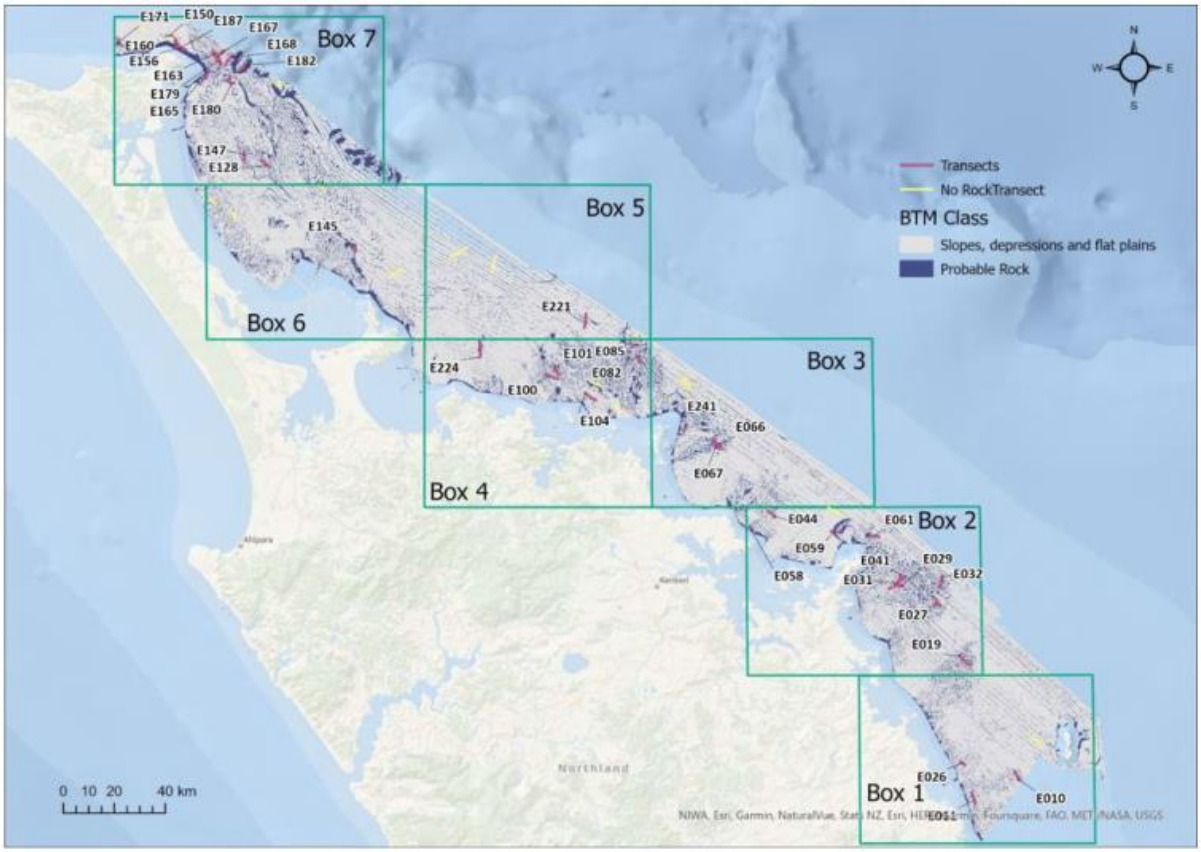
The result of this process was a geospatial inventory of SEAs available on the Northland Regional Council website[9]; of particular interest to this scoping report is the identification of reef habitats in the Northland region. Two important conventions were utilised when mapping the reefs of significance (Kerr, 2016), as follows:

- Firstly, where reefs extended beyond 30 m water depth, they were mapped offshore to 100 m deep, as there was not as much information on the deeper parts of the reefs in comparison to the shallow near-shore parts; and
- Secondly, those reefs that had a high score in relation to their ecological significance also included an ‘edge’ habitat to recognise the importance of these reef edge habitats. Depending on the size of the mapped reef, this reef edge habitat ranged from 300 m to 1,000 m.

Further to the mapping undertaken for the identification of SEAs, NIWA has undertaken a work programme to describe deep reefs (defined as 50 – 300 m water depth) present on the continental shelf on the east coast of Northland (Morrison *et al*., 2023b). Morrison *et al.* (2023b) utilised data collected in 2008/09 as part of the ‘Bay of Islands OS2020’ survey undertaken by NIWA which collected detailed MBES along with video footage across identified reef habitats. The MBES survey data collected in 2008/09 was interrogated by DOC using the BTM tool which uses bathymetric data to classify the seafloor into landscapes that help with interpretation of rock presence and reef structures (**Figure 5**). This process found deep rocky reefs present along much of the coast, with the most dominant being low height (<1 m) reef patches interspersed with soft sediments.

[9] Northland Regional Council Proposed Regional Plan

Figure 5 Imagery Transects Overlain on MBES Survey DTM Classes



Source: Morrison *et al*. (2023b)

Further to the above, a significant amount of research has been undertaken through the University of Auckland (including master's theses) (N. Shears, *pers. comm.*) and scientific journal articles. This scientific research will provide important data when determining the location of rocky reefs, and for future work relating to the habitat types of the identified reefs and the management of the marine environment. A summary of these are as follows:

- Kerr *et al.* (2024) estimated the extent of urchin barrens and kelp forest loss in seven study locations on the east coast of Northland and Auckland. The mapping of the reef habitats as part of this study involved acquiring high-quality aerial imagery and conducting field studies to ground-truth the habitats. The results of this study showed significant reef habitats across all locations surveyed, including reef systems that extend beyond the limits of the study; and
- Lawrence (2019) mapped the long-term changes in rocky reef ecosystems in three locations in northeastern New Zealand (Mokohinau Islands, Mimiwhangata and the Leigh region). This research produced habitat maps via satellite imagery and remote sensing methods and undertook ground-truthing using drop camera imagery. The result of this study provides detailed descriptions of rocky reef habitat in the specific locations that were studied.

2.1.2.2 Auckland

MetOcean Solutions Limited (**MOS**) prepared a report in 2022 for Auckland Council with a scope of works that included a bathymetry data layer, a rocky reef data layer, and a soft sediment data layer for the Auckland region CMA (MetOcean Solutions, 2022). The rocky reef data layer aspect of this report is of particular interest when assessing data availability and quality for Phase 2 which is discussed further below.

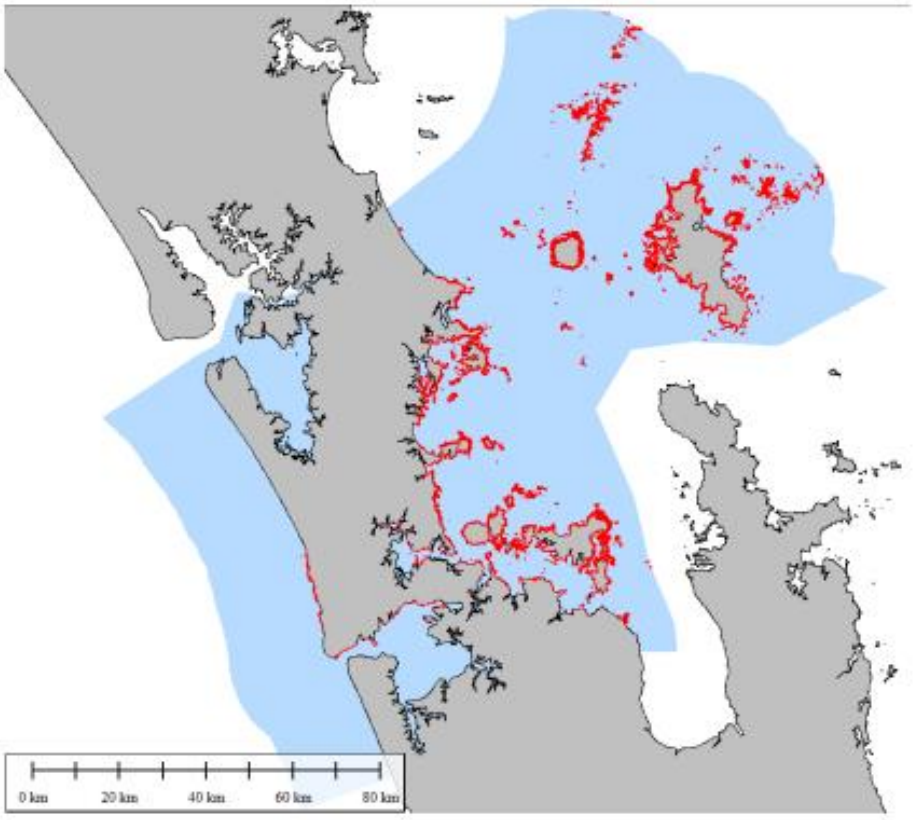
The data sources that MOS utilised for the development of a rocky reef data layer in the Auckland region included the layer created by the 2011 Report, along with high-resolution bathymetry data (consisting of mainly MBES) where this was available.

Data availability for the west coast of the Auckland region was limited and, as such, aerial imagery was analysed to map locations of rocky reefs, along with utilising electronic navigation charts (**ENC**) and sounding sheets which were then combined and compared with the datasets from the 2011 Report (MetOcean Solutions, 2022). The resultant dataset created by MOS for the west coast of Auckland has a lower confidence level associated in terms of the spatial accuracy of the rocky reefs.

In terms of the east coast of Auckland, MOS utilised high-resolution MBES surveys to update the available bathymetry by analysing the rate of slope change to identify areas of rocky reef. Subsequently, a higher confidence value was assigned to the spatial accuracy of the reef locations due to the previous slope analysis data and previously indicative reef maps produced by DOC.

The final map prepared by MOS (2022) detailing the rocky reef habitats for the Auckland CMA is shown in **Figure 6**.

Figure 6 Rocky Reef Habitats (shown in red) for the Auckland CMA



Source: MOS (2022)

In addition to the MOS report, the Hauraki Gulf Marine Spatial Plan (Sea Change Tai Timu Tai Pari, 2017) covers the eastern coast of the Auckland region and is discussed further in **Section 2.1.2.3**.

Further studies have been conducted to map broad-scale reef habitats at Hauturu and the Noises Islands to see how kina barrens and kelp beds have changed over time (Dartnall, 2022). The result of this work has identified significant reef habitats over the areas studied and has shown the increase in area identified as kina barrens compared to historical aerial imagery. Studies such as this one provides detailed identification of rocky reef locations at the specific sites studied.

Although the Auckland region has a recently completed detailed report on rocky reef locations, potential data gaps still exist, particularly around the west coast of the region where there is limited data availability as discussed above.

2.1.2.3 Waikato

Habitat mapping of the CMA associated with the Waikato region was completed in January 2020 which focused on bathymetry and substrate type due to the relevancy of these parameters when determining the presence of ecological communities (WRC, 2020). Recommendations were made in WRC (2020) that included prioritising further data collection to address identified data gaps.

Habitat mapping work in the Waikato region was previously disconnected, with individual smaller studies being undertaken for specific purposes and by a variety of agencies. This was first collated as part of the development of the Hauraki Gulf Marine Spatial Plan (Sea Change Tai Timu Tai Pari, 2017), and subsequently updated as part of the WRC (2020) to assist with the review of the Waikato Regional Coastal Plan. The data layers created as part of the Hauraki Gulf Marine Spatial Plan can be found on the legacy version of SeaSketch[10].

Further work by NIWA on behalf of Fisheries New Zealand is planned to be conducted in August 2024 (date may vary) in the Hauraki Gulf Marine Park. This work will look at potential trawl corridors and wider general seafloor biodiversity, with some of the targets being reef edges and patch reefs, either from specific targets from existing MBES surveys or as discoveries from stations in unmapped areas (M. Morrison, *pers. comm.*). This future work should be considered during Phase 2 as it will assist with ground truthing identified reef areas, providing further confidence on what habitats are associated with them, and highlighting new reef locations.

The datasets utilised in WRC (2020) differed between the two coastlines of the Waikato region. As with the western coastlines for Northland and Auckland discussed in **Sections 2.1.2.1** and **2.1.2.2**, respectively, the available data for the western coast of Waikato were also sparsely distributed, resulting in potential spatial gaps in seabed features.

For the bathymetric dataset, digitised sounding sheets, ENCs, LiDAR, and MBES surveys were utilised to produce gridded (50 m resolution) bathymetry for the Waikato region which can be used to identify the extent of rocky reefs. However, the availability of data (or lack thereof) between the eastern and western coasts of Waikato has resulted in the difference in both quantity and quality of the bathymetric dataset.

Datasets utilised for the development of the rocky reef data layer for the Waikato region were obtained for WRC (2020) from a variety of sources, including interviews with fishermen, digitised sounding sheets, ENCs, aerial photography, bathymetric slope analysis and datasets created by DOC (including from the 2011 Report). All available data were then

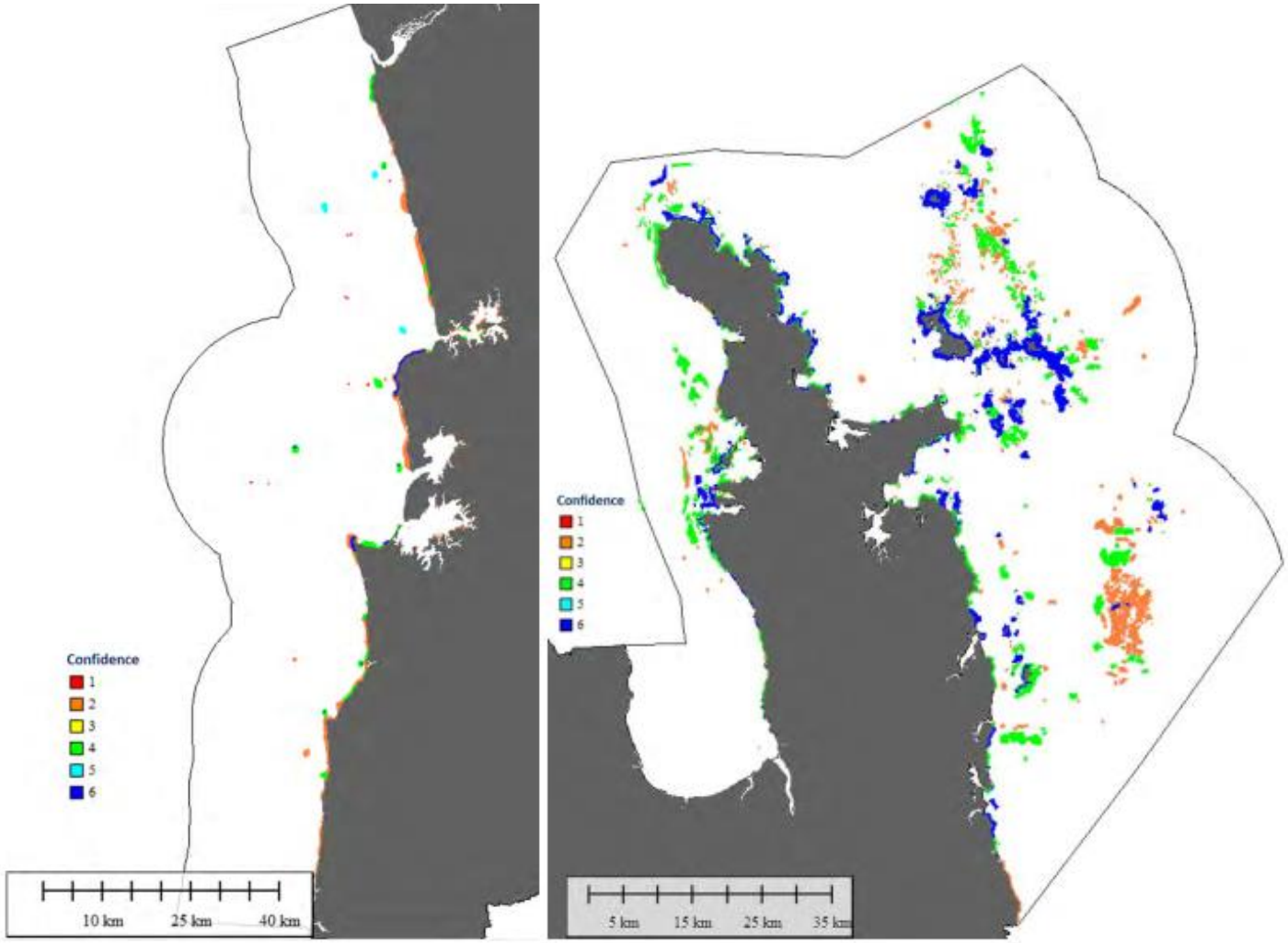
[10] Legacy SeaSketch

integrated with a confidence level attributed to the identified polygons, depending on the data sources used for the reef identification; the polygons with low confidence score could then be used for guiding future investigations (**Figure 7**).

The quality of the dataset created by WRC (2020) is considered to be high and will be useful for Phase 2 based on the recency of the report, the data used, and the end result of the data layer. One important aspect of the work that has already been completed in the Waikato region is the implementation of a confidence level which was identified in the preparation of this scoping report as a data parameter that would be beneficial to include (**Section 4.0**).

In addition to the above, Kibele and Shears (2017) mapped subtidal reefs along a 10 km stretch of coast on the Coromandel Peninsula from Cook's Beach to Hot Water Beach. This study included utilising drop-camera systems to ground-truth the dataset.

Figure 7 Rocky Reef Extent and Confidence Level for the West Coast (left) and East Coast (right) of the Waikato Region



Source: WRC (2020)

2.1.2.4 Bay of Plenty

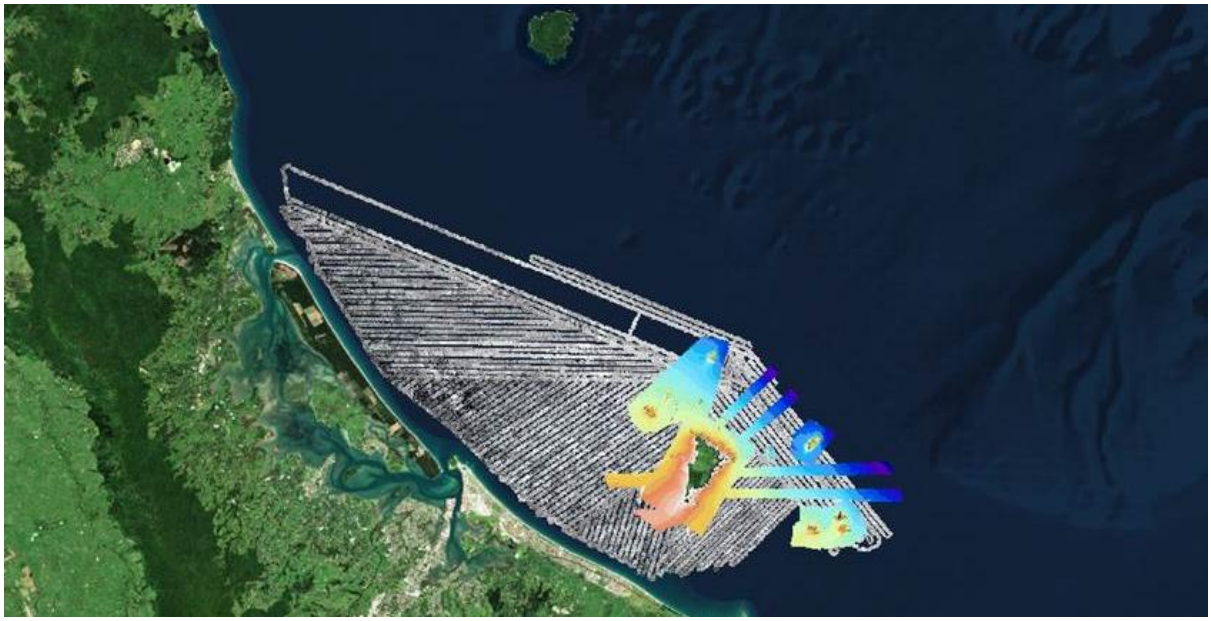
The BOPRC recently reviewed the Regional Coastal Environment Plan which included some identified rocky reefs. However, most of the reefs that have been identified within this plan are ones that break the sea surface, which has resulted in the submerged rocky structures that occur across the coastline being missed (J. Crawshaw, *pers. comm*).

The Environment Court directed the BOPRC to implement new rules within the Regional Coastal Environment Plan to protect three reef systems near Motiti Island, called the Motiti Protection Area. To address this, the BOPRC initially commissioned Discovery Marine Limited (**DML**) to undertake a desktop scoping study of the existing bathymetric data in the Motiti Protection Area (DML, 2021). This report assessed seven distinct datasets which included MBES surveys (around Motiti Island and in relation to shipping lanes), bathymetric LiDAR, benthic photographic profiling, side-scan backscatter, and nautical charts. Priority areas for future mapping were then presented and subsequently completed through a focused MBES survey; these MBES survey data are available on request.

Although this MBES survey provided an updated identification of the reef systems that were surveyed, it did not reassess any other reefs along the coastline which would likely have similar biological value (if investigated). However, the benthic photographic profiling detailed in DML (2021) will provide useful details on the habitats found in the nearshore environment and could potentially be utilised for ground-truthing of identified reefs and assist in allocation of confidence levels.

In October 2011, the MV *Rena* ran aground on the Astrolabe Reef, approximately 20 km northeast of Tauranga. Following this disaster, a side-scan survey of the reef was undertaken in April 2014 to determine the extent of the debris field (LOC, 2014). In addition to this, acoustic side-scan backscatter was collected by Seaworks Limited in the Bay of Plenty as part of the recovery from the MV *Rena* grounding. **Figure 8** shows the extent of the backscatter (grey) as well as the MBES survey collected for the Motiti Protection Area (in colour) discussed above.

Figure 8 Extent of Backscatter (grey) and MBES (colour) Surveys in the Bay of Plenty



Source: J. Crawshaw, *pers. comm.*

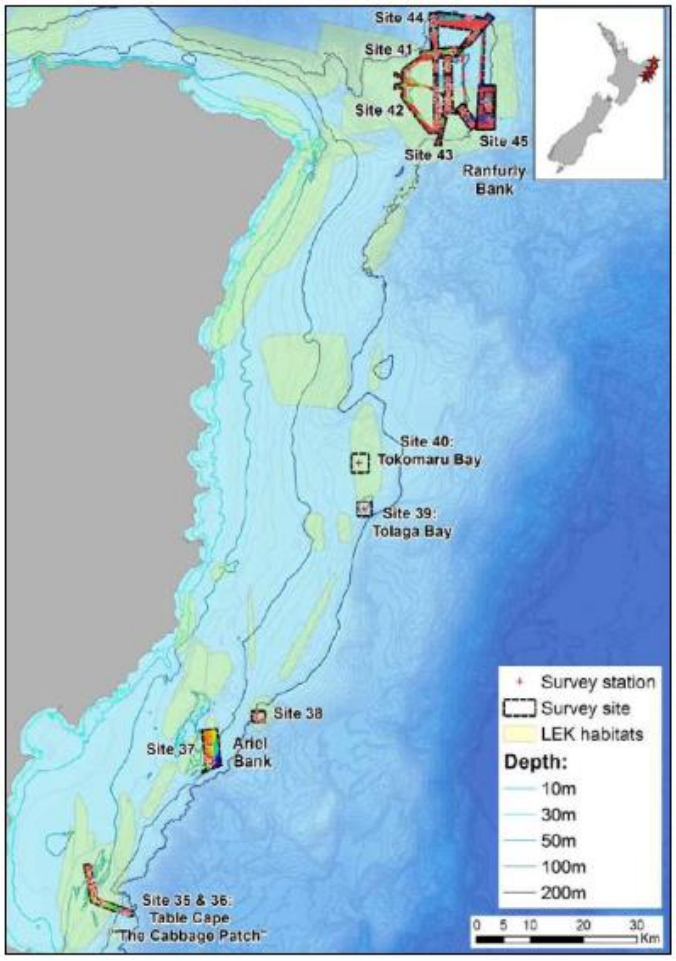
Further to the above, and as discussed within **Section 2.1.1.2**, LINZ conducted a trial of coastal LiDAR between Maketu and Waihi Beach, including Mount Maunganui and Mayor Island/Tūhua, which will capture some of the key western shoreline reef systems once the data are available.

2.1.2.5 Gisborne

The Gisborne District Council (**GDC**) is a unitary authority that has the task of managing the coastal habitats within the region under the RMA. Unfortunately, there is a lack of data in the Gisborne region in comparison to other regions. To address this lack of data and to plan for facilitating the development of a new coastal plan, GDC commissioned a report (Ross, 2021) that reviewed the scientific, local, and customary knowledge regarding the coastal habitats which will provide useful data for Phase 2.

Two key pieces of work that has been completed in the Gisborne region relate to the biogenic habitats on New Zealand's continental shelf (Jones *et al.*, 2016 and Jones *et al*, 2018) which are discussed in more detailed in **Section 2.1.1.3**. Of particular interest in these two reports are the identification of habitats associated with both a review of scientific literature and from LEK, which included areas classed as "foul" or "reef". Following the identification of these areas, the second aspect of these reports was undertaking ground truthing using MBES surveys, seafloor photography, and trawl/dredge surveys.

Figure 9 Map Showing Gisborne LEK Areas and MBES Ground Truthing Surveys

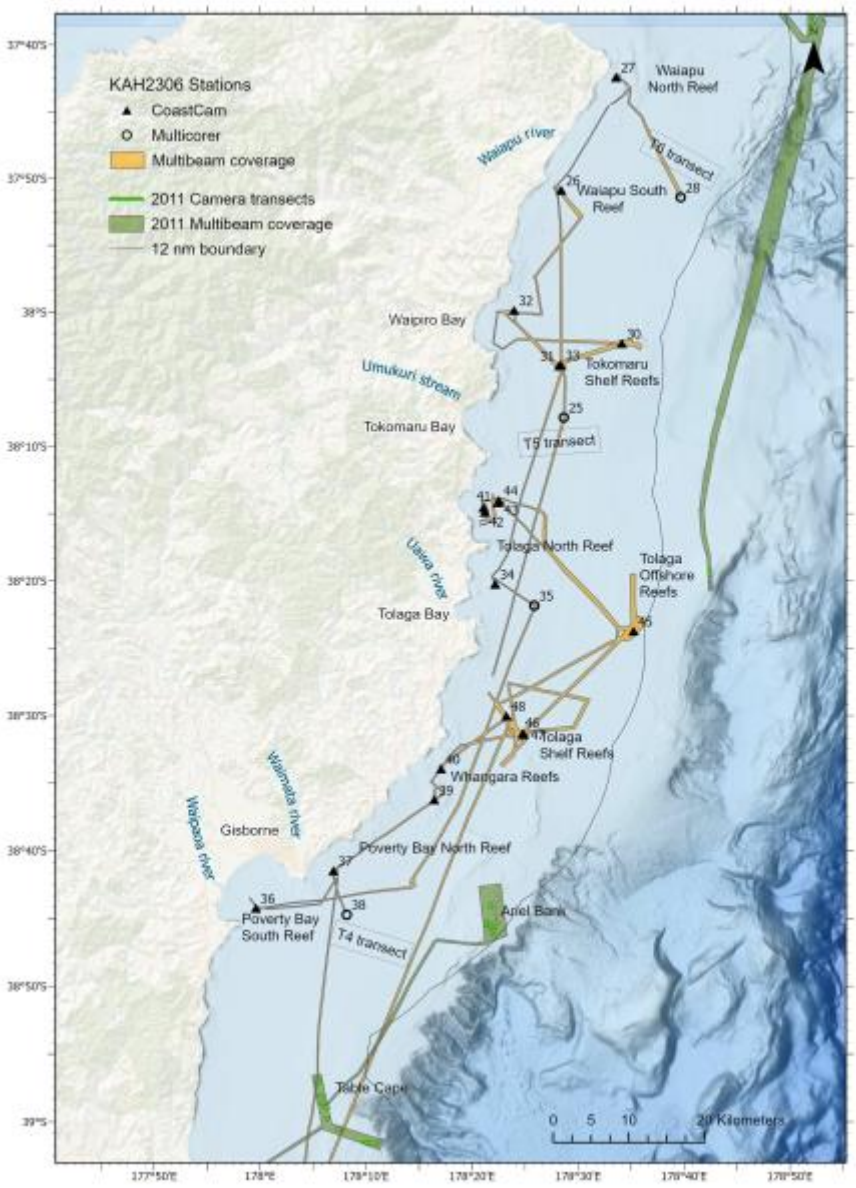


Source: Ross (2021)

Two areas identified in the Gisborne region by Jones *et al*. (2016) and Jones *et al.* (2018) were the Ranfurly Bank (offshore of East Cape) and much of the seafloor between Tokomaru Bay and Mahia Peninsula. The MBES surveys undertaken in these areas identified reef features which could be utilised for Phase 2.

Leduc *et al.* (2024) conducted surveys in 2023 (shown in **Figure 10**) to focus on the offshore seabed environments of the Gisborne and Hawke's Bay CMA in order to understand the impacts of Cyclone Gabrielle that occurred in February 2023. This work included undertaking MBES surveys at several locations (totalling over 700 km^2 of seabed over the three surveys) to assess potential changes in the seafloor following the cyclone, including mapping several reefs for the first time. In addition to the MBES surveys, towed camera transects were completed that focused on areas of rocky reefs and soft substrate, which would provide confidence in the identification of reefs by the MBES surveys.

Figure 10 Location of Gisborne Survey Sites



Source: Leduc *et al* (2024)

Further to the reports discussed above, SLR is aware of seabed habitat mapping work that is being undertaken in the Te Tapuwae o Rongokako Marine Reserve, north of Gisborne, including the creation of a GIS layer which is still in progress (T. Anderson, *pers. comm.*), along with work being undertaken inside Gisborne harbour (C. Battershill, *pers. comm.*).

SLR is also aware that further work has been proposed in the Gisborne region in response to Cyclone Gabrielle that devastated the region in early 2023. Professor Chris Battershill is the lead investigator in a Ministry of Business, Innovation and Employment programme (Toka ākau toitu Kaitiakitanga) that was awarded in 2022 for a five-year term that will, through co-design and partnerships with mana whenua, monitor, improve, and report on the coastal environment, with the aim of reversing reef degradation. This project may include Gisborne as a focus area, due to the devastation from this cyclone, which may provide useful information when analysing confidence levels of identified rocky reef habitats.

As shown in the above discussion, the Gisborne region has many spatial gaps. However, the areas that have been surveyed have a high confidence level of data based on the ground truthing of identified areas.

2.1.2.6 Taranaki

Rocky reefs dominate the coastline around Taranaki, and consequently much information is known about them, particularly for nearshore reefs. The Taranaki Regional Council (**TRC**) recently reviewed its coastal plan which resulted in the identification of several near-shore reefs, sites of outstanding value (outstanding natural character and outstanding natural features) as well as sites of significance to Māori which are all identifiable on the TRC mapping system[11].

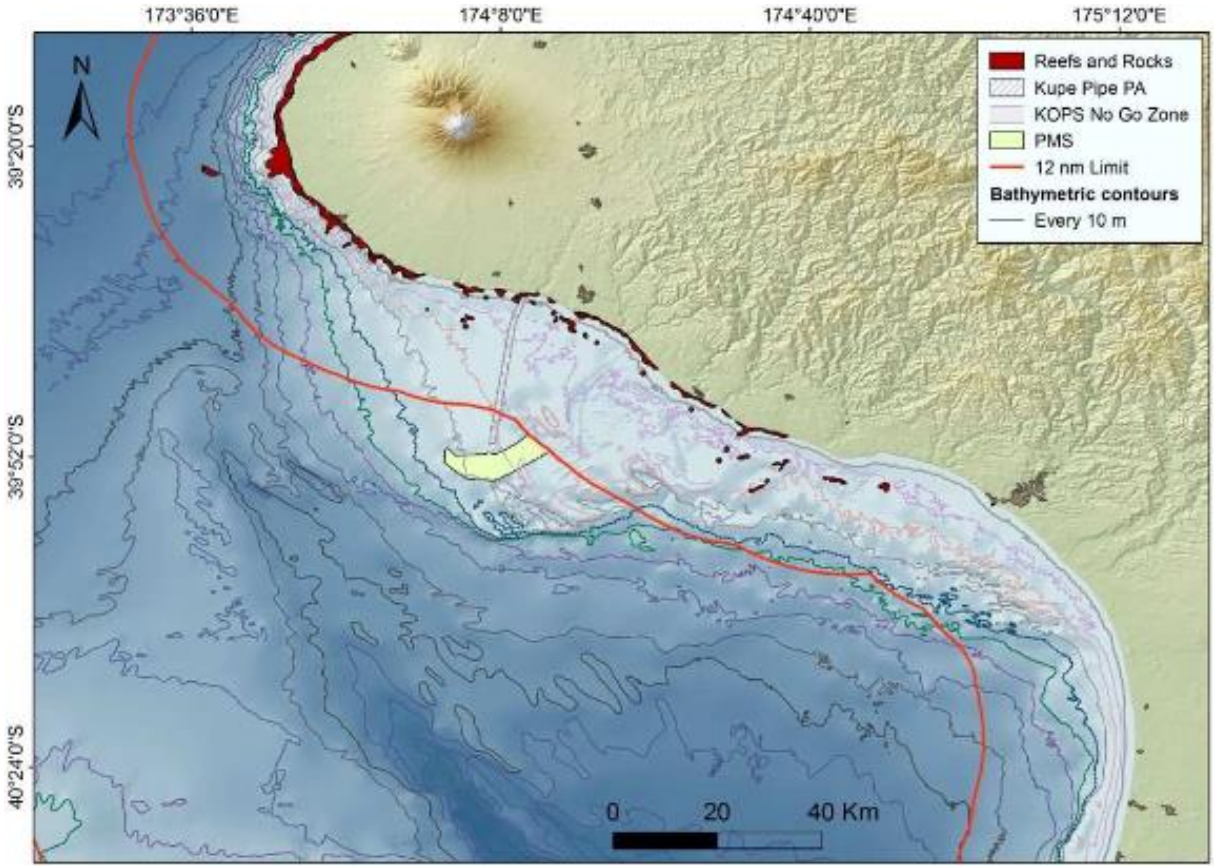
The TRC conducts regular monitoring activities throughout the region, including at reef locations, which results in a high degree of confidence in the location and extent of the reefs. In addition, its detailed monitoring programme would allow further data parameters to be defined in Phase 2 relating to biogenic habitat classification.

Further to the identification of reefs by the TRC, the South Taranaki Bight (**STB**) is a heavily surveyed area due to its suitability for extractive industries (seabed mining and oil and gas extraction) and active community groups.

Trans-Tasman Resources Limited (**TTR**) was proposing a seabed mining operation in the STB which has resulted in detailed studies in the area surrounding the proposed mining site, and the areas which might be impacted by operations. Included within these studies was a report prepared by NIWA on the fish and fisheries of the STB which may be impacted by the mining operations (MacDiarmid *et al*., 2013). When focusing on the reef fish communities in the STB, MacDiarmid *et al*. (2013) amended the DOC reef dataset as shown in **Figure 11**. Several of the reefs identified in 'reef and rock' layer were further studied, including a site-specific MBES survey which confirmed the location of what appeared to be rocky outcrops (Pallentin *et al*., 2013)

[11] Coastal Plan for Taranaki LocalMaps

Figure 11 Location of Reefs and Rocks (amended from DOC dataset)

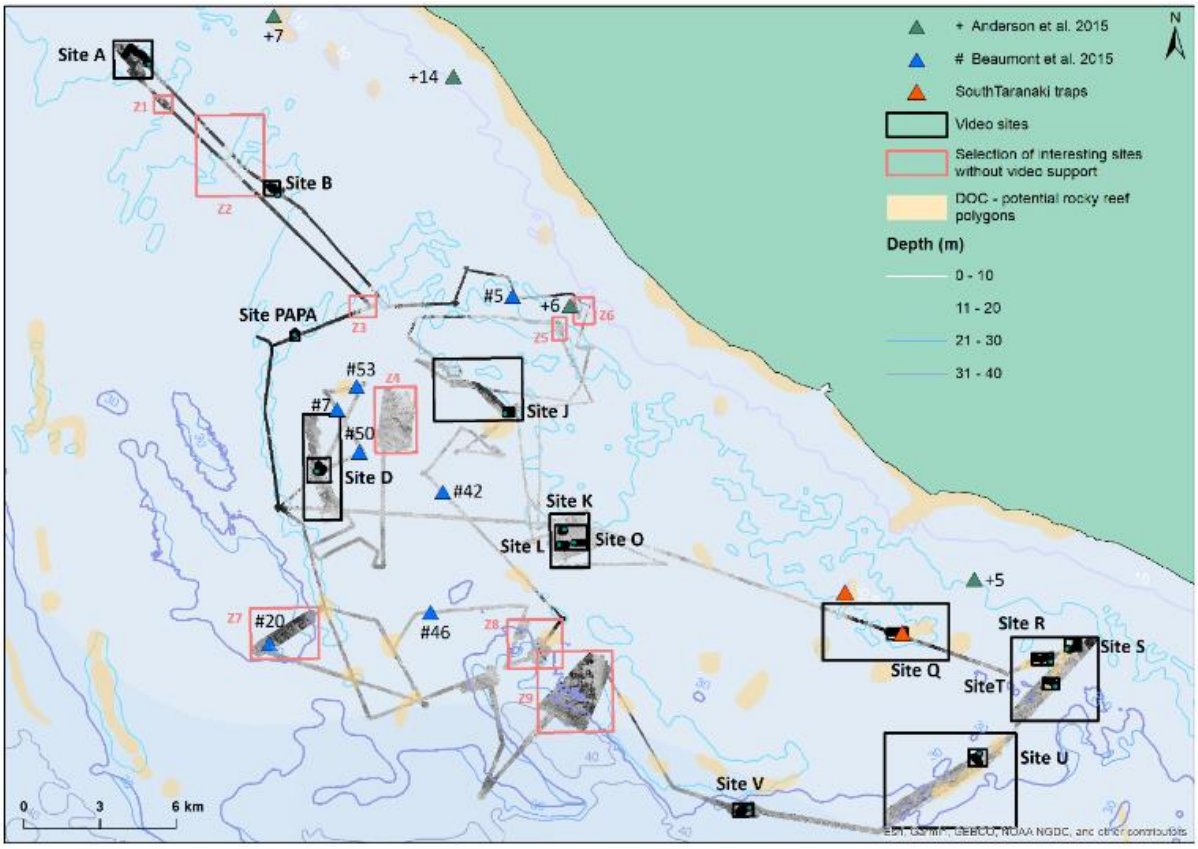


Source: MacDiarmid *et al*., 2013

More recently, the TRC commissioned NIWA to undertake an analysis of the sub-tidal rocky reef habitats in the STB (Morrison *et al*. 2022). Specifically, the sub-tidal reefs of the Pātea Bank were selected for detailed surveys (including MBES), over as many of the targeted reef locations as possible and was followed by collection of underwater imagery. The potential sub-tidal reef locations subject to this study were identified using a range of data sources, including the 'Project Reef' citizen science group, the South Taranaki Underwater Club members and local divers, as well as the rocky reef data layer prepared by the 2011 Report and rock-associated sites identified in Beaumont *et al*. (2015). The MBES surveys covered 61.5 km^2 of seafloor across the targeted reef sites as shown in **Figure 12**.

Morrison *et al*. (2022) provided a useful contextualisation of the regional sub-tidal reef knowledge in both North Taranaki and South Taranaki. Of particular note are MBES and backscatter surveys that have been undertaken around the Sugar Loaf Islands sub-tidal reefs in 2021 and the Pariokariwa Reef and Waikiekie Reef in 2015.

Figure 12 MBES Survey Route



Source: Morrison *et al*. 2022

The Project Reef[12] citizen science group will be an important stakeholder to consult with further in relation to Phase 2 as it should be able to provide detailed information on the rocky reefs in the STB.

As can be seen in the discussion above, the Taranaki region is one of the few regions in New Zealand which has had detailed surveys undertaken in relation to rocky reefs in recent years. The work that has been undertaken in the past 10 years in both South Taranaki and North Taranaki will be highly beneficial for Phase 2.

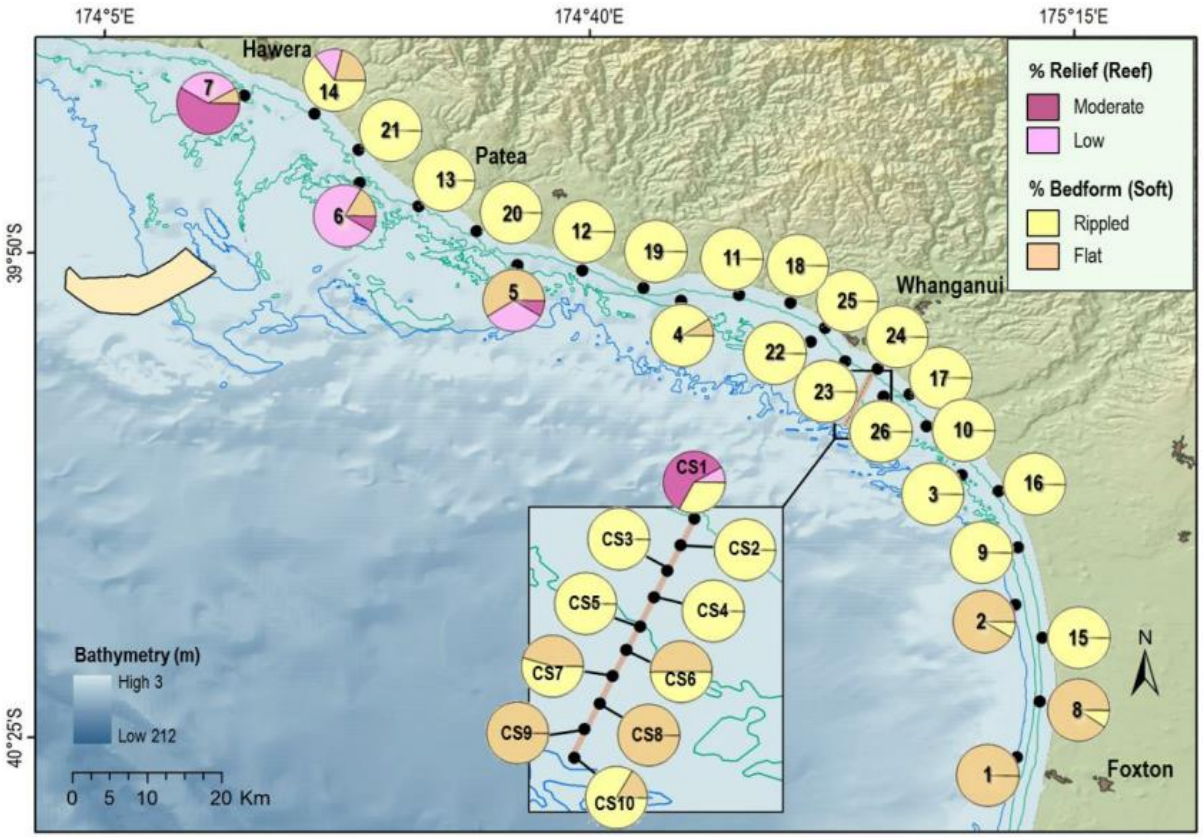
2.1.2.7 Manawatū-Whanganui

NIWA undertook a review of the available information in the Manawatū-Whanganui region for the Horizons Regional Council (**HRC**) in 2018 (MacDiarmid *et al.*, 2018). This review found that there were no data detailing the distribution of seafloor sediments or biogenic habitats in either the eastern or western CMAs of HRC. One of the recommendations made by MacDiarmid *et al*. (2018) was that funding should be secured to undertake MBES surveys, firstly along the western coastline, and then along the eastern coastline. Following the development of the approximate distribution of seafloor habitats from this MBES survey, ground-truthing could be completed which would further target those habitats identified (MacDiarmid *et al.*, 2018).

[12] Our Story | Project Reef (projectreefsouthtaranaki.org)

As part of the TTR surveys (**Section 2.1.2.6**), rocky reef habitat was identified offshore of Whanganui; further details of which can be found in Anderson *et al.* (2015) and shown in **Figure 13** (station CS1).

Figure 13 Seabed Relief and Bedform Structures



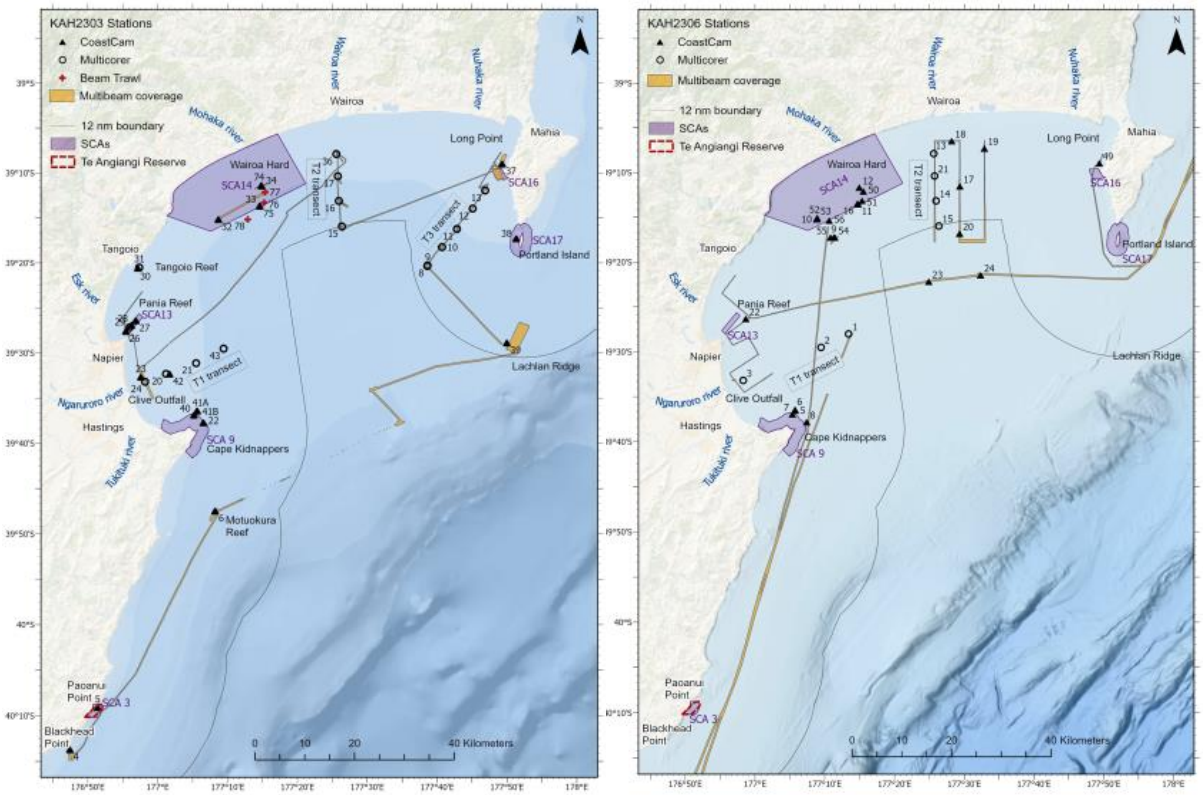
Source: Anderson *et al.* (2015)

Based on the above, large spatial gaps are present in available data on rocky reefs in the Manawatū-Whanganui region.

2.1.2.8 Hawke's Bay

As discussed within **Section 2.1.2.5**, Leduc *et al.* (2024) conducted MBES surveys and towed camera surveys in 2023 to focus on the offshore seabed environments of the Gisborne and Hawke's Bay CMAs (shown in **Figure 14**). MBES survey data were obtained over several reef areas during the three surveys, followed by towed camera transects being completed that focused on rocky reefs, as well as soft substrate areas.

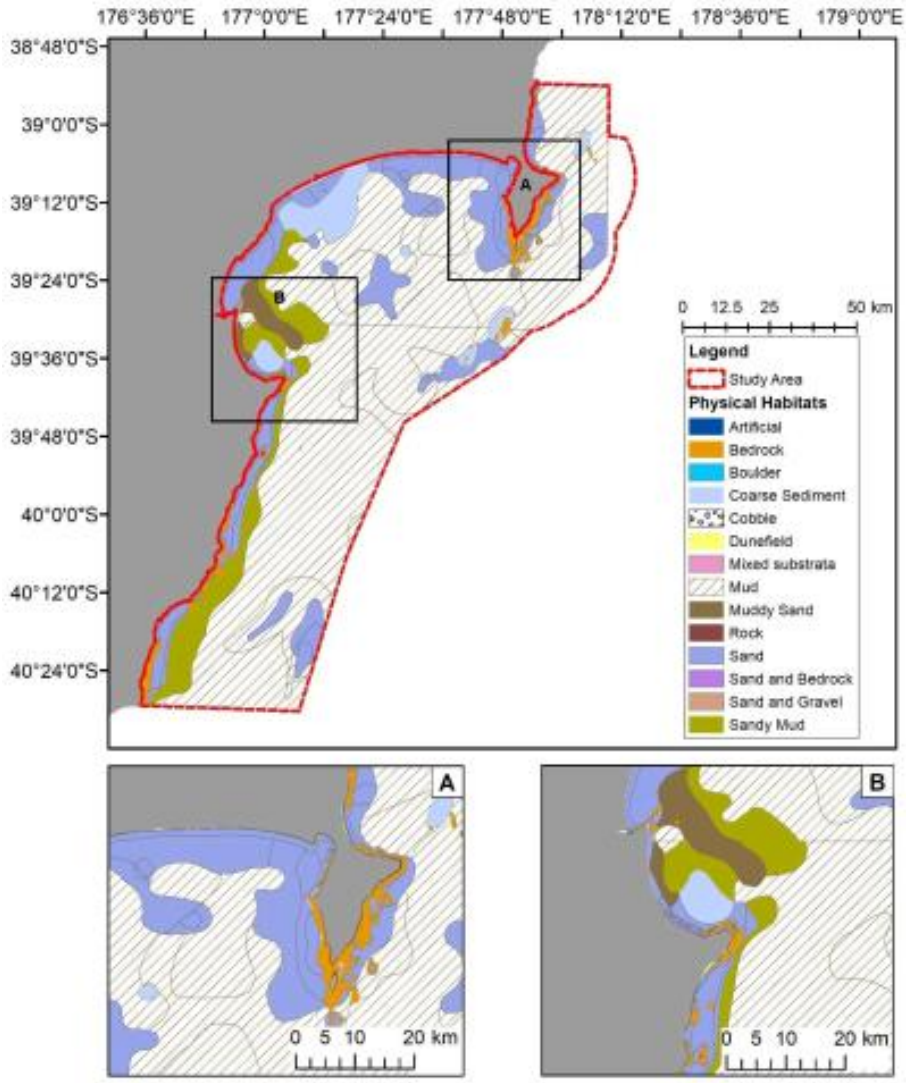
Figure 14 Location of Hawke's Bay Sampling Sites, June 2023 (left), October 2023 (right)



Source: Leduc *et al* (2024)

NIWA was contracted by the HBRC to assess ecologically significant areas as part of the national Key Ecological Areas project funded by DOC (Lundquist *et al.,* 2020). Various data layers were utilised by Lundquist *et al.* (2020), including 'abiotic' and 'biotic' regional habitat data layers (shown in **Figure 15**). The regional data were utilised for this report as they provided a much higher resolution than national data (such as the rocky reef data layer from the 2011 Report). These data layers also provided additional information, such as data type, confidence, and source. The abiotic datasets included information on sedimentary habitat types and bathymetry, with the biotic dataset including a 'biogenic' layer which refers to biogenic reefs, as well as macroalgae layers.

Figure 15 Hawke's Bay Abiotic Datasets



Source: Lundquist *et al.* (2020)

Consultation with the HBRC confirmed that intertidal mapping of three rocky reef sites was conducted in 2017, as well as seagrass mapping (mostly on intertidal reefs), which may be available upon request (B. Shanahan, *pers. comm.*). In addition, the HBRC has recently contracted out some MBES survey work which included ground-truthing with a remotely operated vehicle (**ROV**) to determine some sub-tidal biological features which will be turned into GIS layers later in 2024 (B. Shanahan, *pers. comm.*).

In recent years, NIWA has conducted MBES surveys in a joint project with the HBRC over two locations in Hawke Bay, Wairoa Hard and Clive Hard. This MBES survey work resulted in just over 330 km^2 of seabed being mapped to identify the substrate and, in turn, the biodiversity of the mapped areas. Consultation with LINZ identified the HBRC Marine and Coastal Data Inventory[13] which has a list of 43 datasets from the HBRC. This inventory includes a variety of datasets, including the MBES surveys for the Wairoa Hard and Clive Hard discussed above, as well as other useful datasets.

[13] HBRC Marine and Coastal Data Inventory

2.1.2.9 Wellington

The majority of the shoreline in the Wellington region contains sub-tidal rocky reef habitats. MacDiarmid *et al*. (2012) identified marine areas of significant biodiversity value in the Wellington region, which included the identification of both sites of significance and habitats of significance for marine biodiversity. Much of the identified habitats/sites of significance have been included within the Greater Wellington Regional Council's (**GWRC**) Natural Resources Plan.

The GWRC has identified many reef locations in its Natural Resources Plan. These reef sites can be found in various schedules, including Schedule C (sites with significant mana whenua values), Schedule F (ecosystems and habitats with significant indigenous biodiversity values), and Schedule J (significant geological features in the CMA), all of which are mapped on the GWRC Web Map Viewer[14] and shown in **Figure 16** (note this figure displays all schedules sites, including non-reef features).

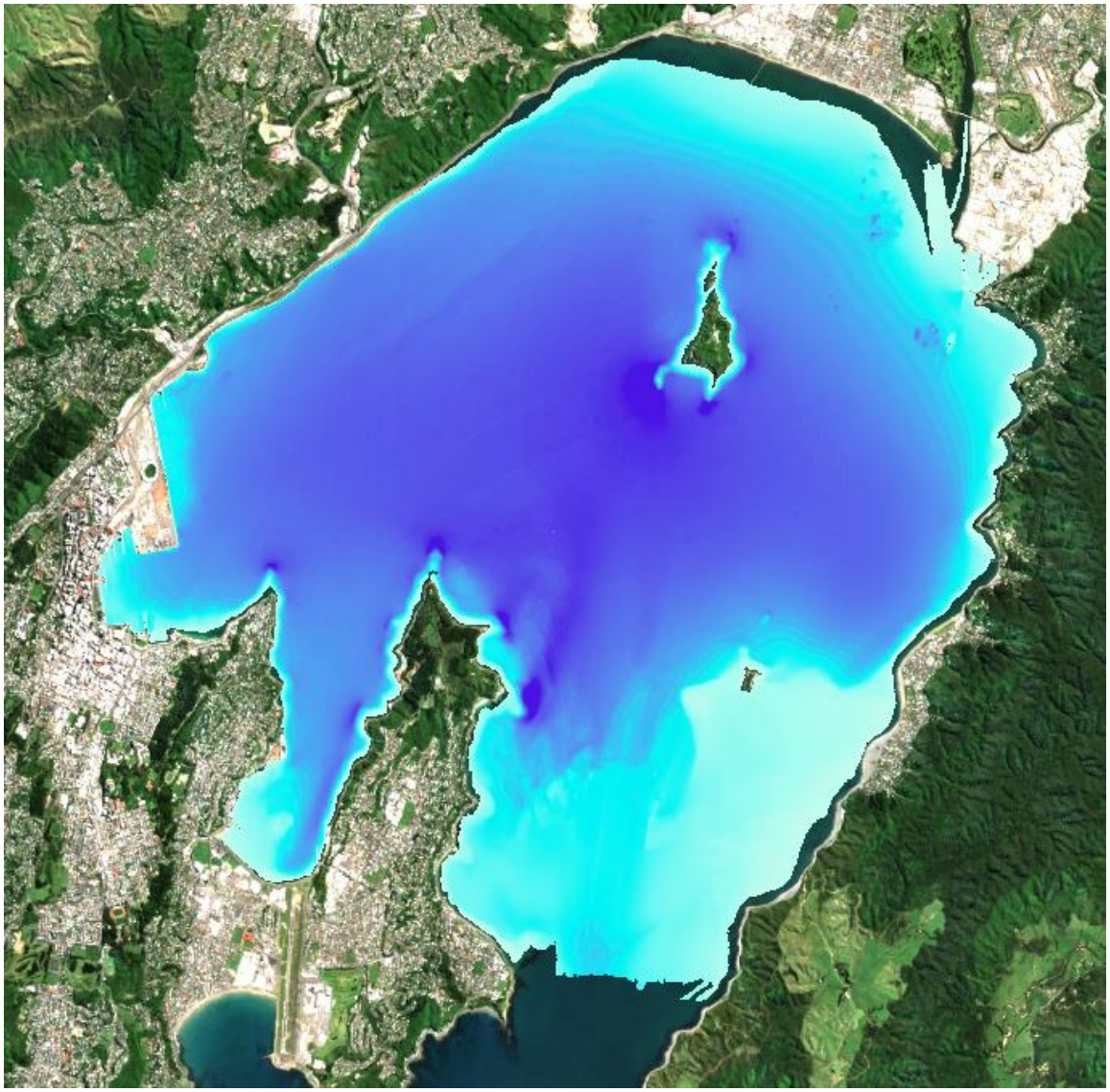
Figure 16 GWRC Natural Resources Plan Scheduled Sites

Source: GWRC Natural Resources Plan.

In addition to the schedules seen on the GWRC Web Map Viewer, the Wellington harbour depth and associated bathymetry contours appear to be taken from a MBES survey undertaken by NIWA (**Figure 17**), which could be utilised to determine reef locations within the Wellington Harbour.

[14] GWRC Web Map Viewer

Figure 17 Wellington Harbour MBES Survey



Source: GWRC Natural Resources Plan

Consultation with LINZ identified the GWRC Marine Geospatial Data Inventory[15] that includes a list of over 500 datasets from the GWRC. This inventory includes a variety of dataset types, including habitat mapping (including those identified in the Schedules of the Natural Resources Plan), and bathymetric contours, DEMs, and DTMs.

Detailed assessments have been undertaken in recent years by Victoria University of Wellington to identify and map shallow-water animal-dominated habitats and rocky temperate benthic mesophotic communities in the Wellington region (Bell *et al.* 2022, Micaroni *et al.* 2023 and Bell *et al.* 2024). These surveys were conducted via ROVs, SCUBA diving and citizen science observations. The results of these surveys provide relevant information detailing the confidence level of reef sites, as well as habitat types should this be utilised for Phase 2.

[15] GWRC Marine Geospatial Data Inventory

2.1.2.10 Nelson-Tasman

The TDC and the Nelson City Council (**NCC**) are both unitary authorities and both in the process of reviewing their respective regional coastal plans. In order to give effect to Policy 11 of the NZCPS[16], both councils commissioned the Cawthron Institute along with Salt Ecology, NIWA, and Davidson Environmental to gather data regarding the indigenous biodiversity values of the coastal environment, titled the 'Indigenous Marine Biodiversity Project'[17].

Stage One of the Indigenous Marine Biodiversity Project was completed in 2023 and is a literature and data review of existing marine and coastal indigenous biodiversity information. This process included assessing the relevant spatial data and production of a series of map layers and reports outlining what is known about marine indigenous biodiversity in Nelson/Tasman that can be used to categorise identified areas against Policy 11 of the NZCPS. The first two reports prepared for the Indigenous Marine Biodiversity Project will provide useful data for Phase 2.

Report 1 (Berthelsen *et al.* 2023a) collated the available bathymetry (and hydrosystems) data found during a literature review into a GIS layer. The key mapped data relating to bathymetry included hydrographic surveys, ENCs, LiDAR (all sourced from LINZ), bathymetric data (sourced from NIWA and DOC), and mean high water springs (sourced from the NCC and the TDC).

Report 2A (Berthelsen *et al.* 2023b) considered two topics: habitats and biodiversity, which included a data search and literature review of the available information for the Nelson/Tasman regions, including spatial data. Of particular importance to this scoping report is the identification of the 'Nelson Bays Ecosystems Map: Reef' data layer that was created as part of Report 2A which was developed originally from the DOC shapefile of reefs and modified by Clark (2014) using other data, including aerial imagery, habitat maps and bathymetry data.

The maps associated with the Indigenous Marine Biodiversity Project are too large to made readily available for public, data-wise, and include some restrictions on how they can be utilised. Further consultation with the TDC and the NCC should be undertaken to gain access to the relevant data layer.

2.1.2.11 Marlborough

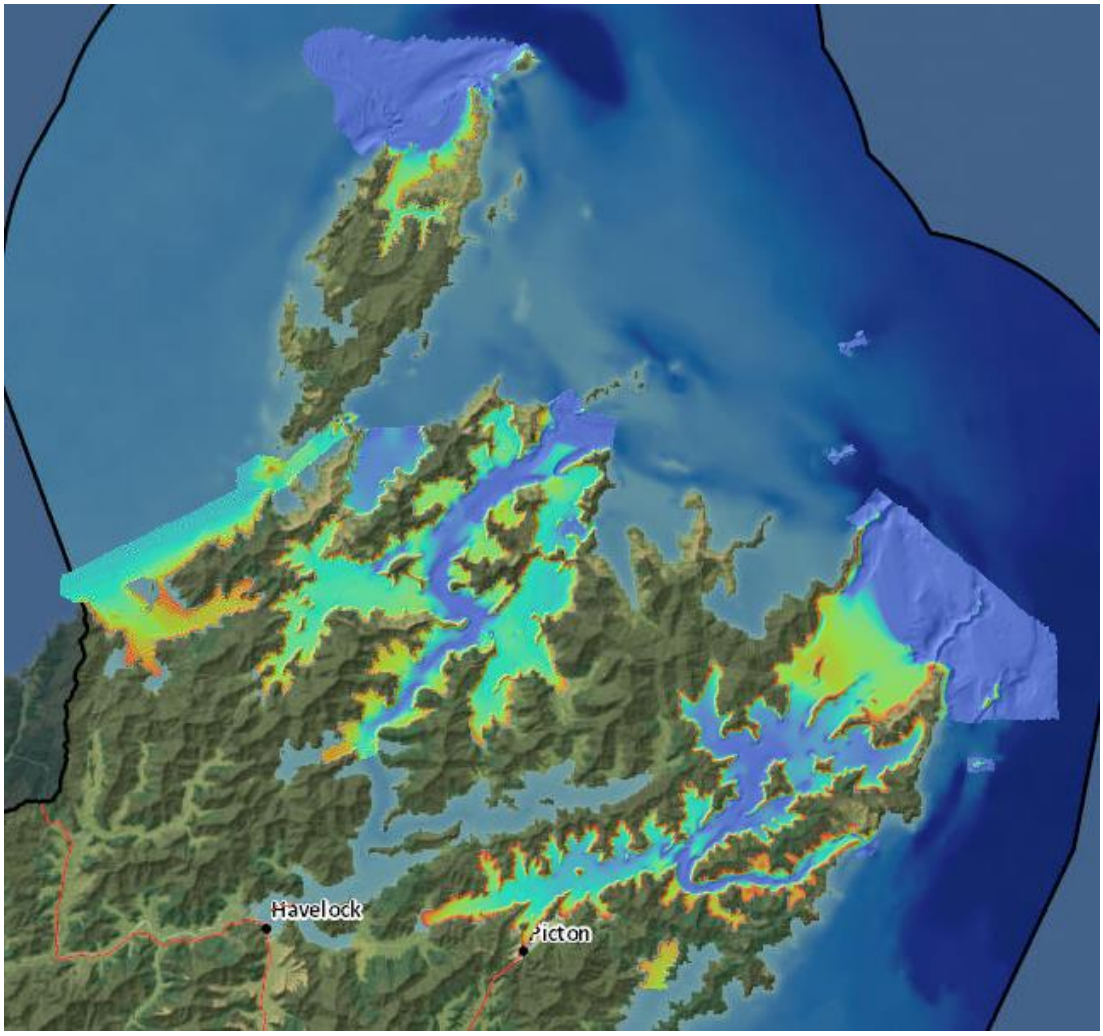
The Marlborough District Council (**MDC**) procured detailed MBES survey data from NIWA across much of the Marlborough Sounds which included bathymetry, backscatter and additional MBES derived data layers including seafloor slope, rugosity, benthic terrain models, and seafloor classifications[18]. This data collection covered over 750 km^2 of area in Pelorus Sounds, French Pas, Admiralty Bay, Queen Charlotte Sound, Tory Channel, and adjacent areas in the Cook Strait across two NIWA surveys HS51 and HS66 (**Figure 18**).

[16] Policy 11 relates to the protection of indigenous biological diversity in the coastal environment.

[17] Indigenous Marine Biodiversity Project

[18] Marlborough Sounds Seabed Habitat Maps

Figure 18 Marlborough Sounds MBES Survey Extent



Source: https://experience.arcgis.com/experience/fc87317f47ce4fbea18a9bf7846f7b05/page/Bathymetry/

Following the collection of the MBES survey data in the Marlborough Sounds, NIWA was commissioned by the MDC to ground-truth and characterise habitats and communities across parts of the HS51 survey areas (Anderson *et al*. 2020). An interactive map of these ground-truth locations has been provided by the Sustainable Seas national science challenge[19]. Further to this work, Anderson (2022) examined the HS66 MBES survey data layers in order to answer a variety of questions from the MDC around the utilisation of the HS66 survey data.

The post-processing work for the HS51 and HS66 MBES survey layers will be important when determining the rocky reef data layer in the Marlborough Sounds. The seafloor rugosity layer provides a good indication of rocky reef habitats as highly rugose habitats are associated with changes in vertical height changes. In addition, the BTM classification for rocky outcrops layer enables estimates of rocky reefs, especially when associated with a high rugosity and seafloor curvature. Ground truthing data could then be utilised to fine tune the layer.

[19] Queen Charlotte Sound Interactive Map

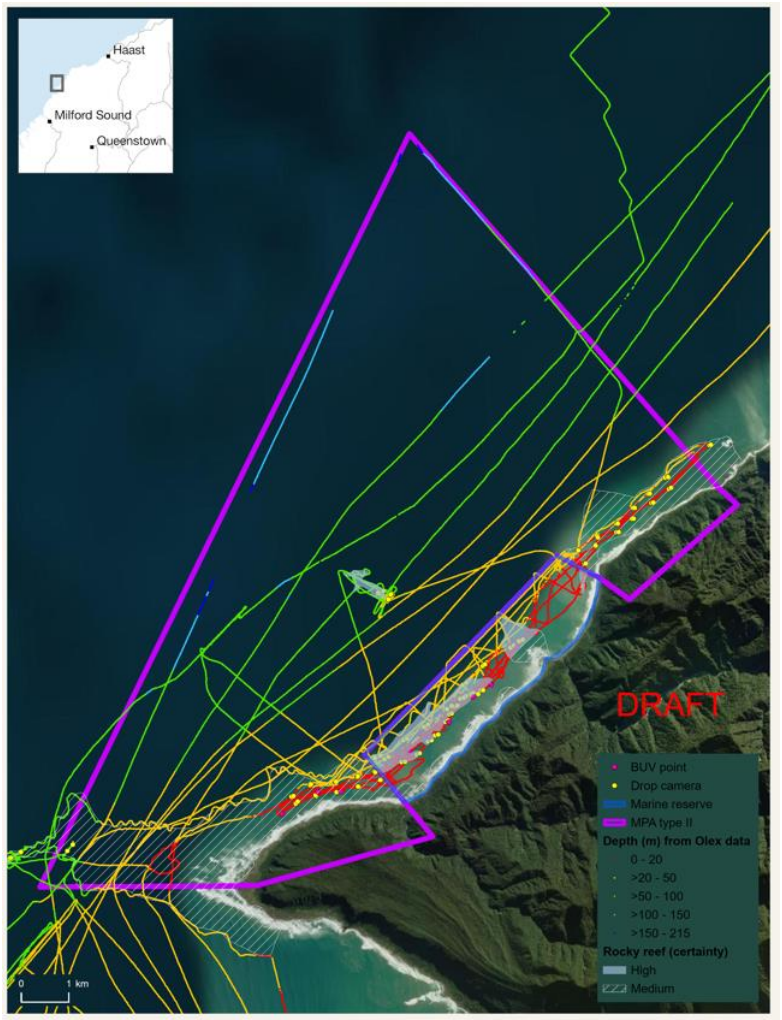
The seabed habitat mapping conducted in the Marlborough Sounds provides a detailed description of potential rocky reef habitats. This, in conjunction with the ground truthing, will provide useful data when determining the confidence of rocky reef habitats.

2.1.2.12 West Coast

In 2016 the West Coast Regional Council publicly notified its proposed Regional Coastal Plan which included the identification of outstanding coastal landscapes and natural character via two technical reports (Brown NZ Ltd, 2013a and 2013b). These technical reports provide a description of various areas that were determined to have outstanding and high natural character in the CMA. Some of the descriptions of the areas identified in these technical reports list 'rocky shoals' as a key attribute. However, the mapping of these areas is very low resolution and tends to encompass large tracts of the CMA, without specifically defining areas of 'rocky shoals'.

Consultation with DOC identified little new seabed substrate data for most of the West Coast region since the 2011 Report. An exception to this is a recently completed piece of work in 2022 which included some mapping work of the Hautai Marine Reserve (southern South Westland) as shown in **Figure 19**. The mapping and data analysis is still a work-in-progress for this area, with some ground-truthing (drop-camera analysis) proposed in the near future.

Figure 19 Hautai Marine Reserve Habitat Mapping



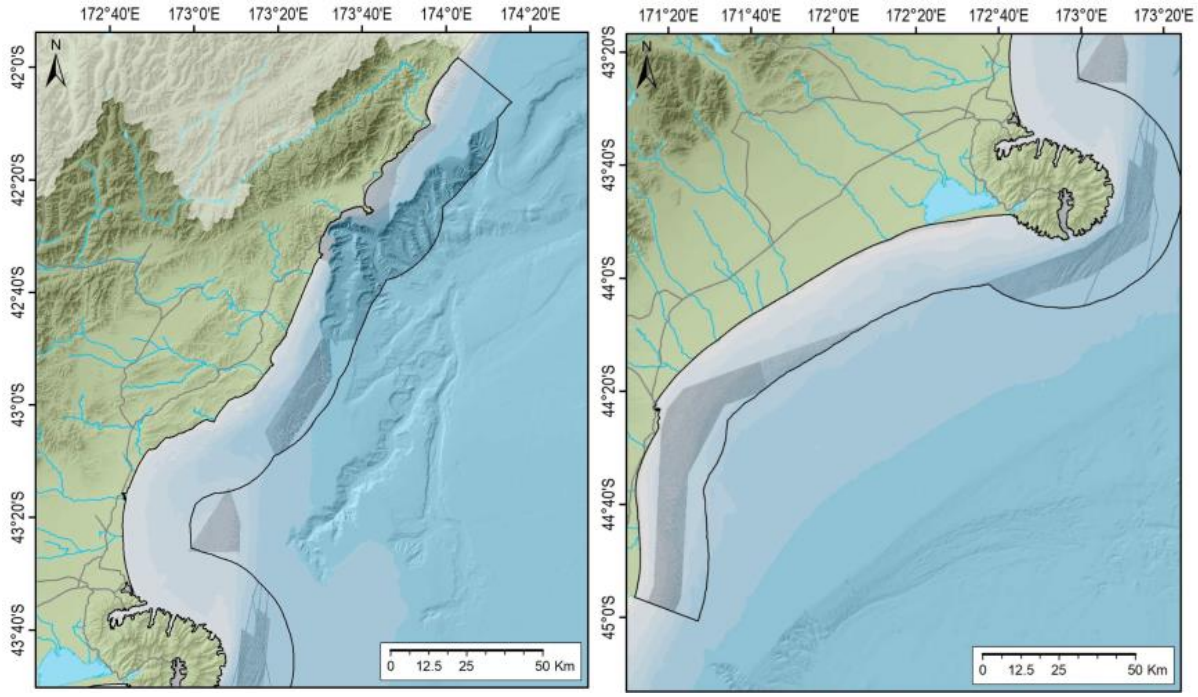
Source: D. Neale, *pers. comm.*

As can be seen in the discussion above, the West Coast region has very few data available for the identification of rocky reefs and poses a large spatial data gap for Phase 2.

2.1.2.13 Canterbury

NIWA was commissioned by ECAN to provide a desktop collation, assessment, visual representation, and interpretation of existing data and information in the Canterbury CMA to inform the review of its coastal planning framework (Leduc, *et al.* 2022). This report includes discussions and figures detailing the bathymetry and sediment data based on available data from LINZ, NIWA, DOC, and the University of Canterbury. MBES surveys span approximately 35% of the total Canterbury CMA (**Figure 20**) and can provide detailed information on the topography of the seabed, including the identification of coastal reefs (Leduc, *et al.* 2022).

Figure 20 MBES Survey Coverage in the Northern Canterbury CMA (left) and Southern Canterbury CMA (right)



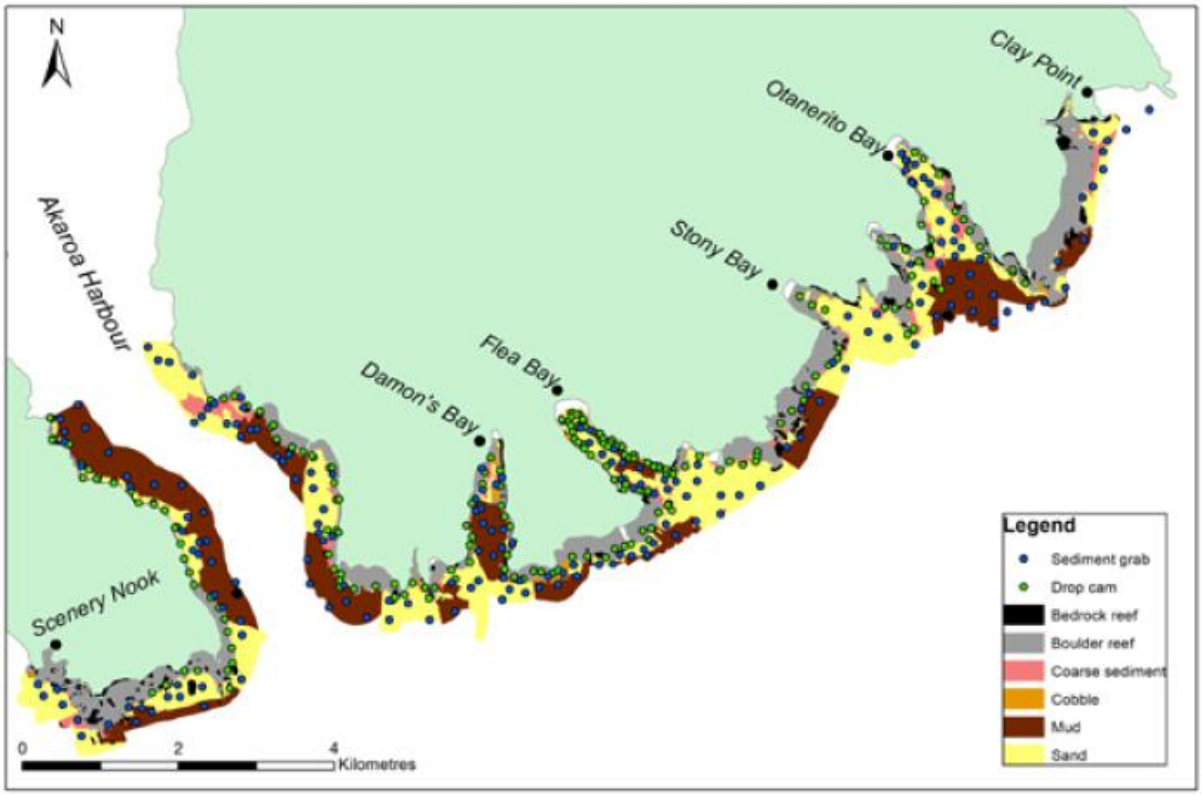
Source: Leduc, *et al.* (2022)

Leduc *et al.* (2022) also identified seafloor backscatter data being available in the north-east of the CMA (covering approximately 12% of the Canterbury CMA) which can be utilised to differentiate between 'soft' and 'hard' seabed. In addition, intertidal and subtidal rocky reef surveys have been undertaken around Kaikōura (which included aerial surveys) and Banks Peninsula that provide beneficial data for describing habitats along these coastal reefs in Phase 2 (if this type of parameter is used).

In 2018, a collaboration between the University of Otago, DOC, and ECAN aimed to generate a continuous map of the physical habitat types along part of the southern coastline of Banks Peninsula in order to provide a baseline upon which to assess ecological changes in the area (Brough *et al*. 2018). This survey utilised data from three previous side-scan sonar surveys and the acquisition of additional side-scan and MBES surveys to provide a continuous bathymetric habitat map of the study area.

The results of the side-scan surveys were utilised to classify the habitats following the New Zealand Marine Habitat Classification System, with particular interest (for this scoping report) on the hard-substrate reefs that were classified into either bedrock reef, boulder reef or cobble. Following this, ground-truthing was completed using drop-camera deployments and ponar sediment grabs (Brough *et al*. 2018). The results of the habitat classification and the location of the ground-truthing surveys are shown in **Figure 21**.

Figure 21 Habitat Classification and Ground-truthing Stations throughout Banks Peninsula Study Area



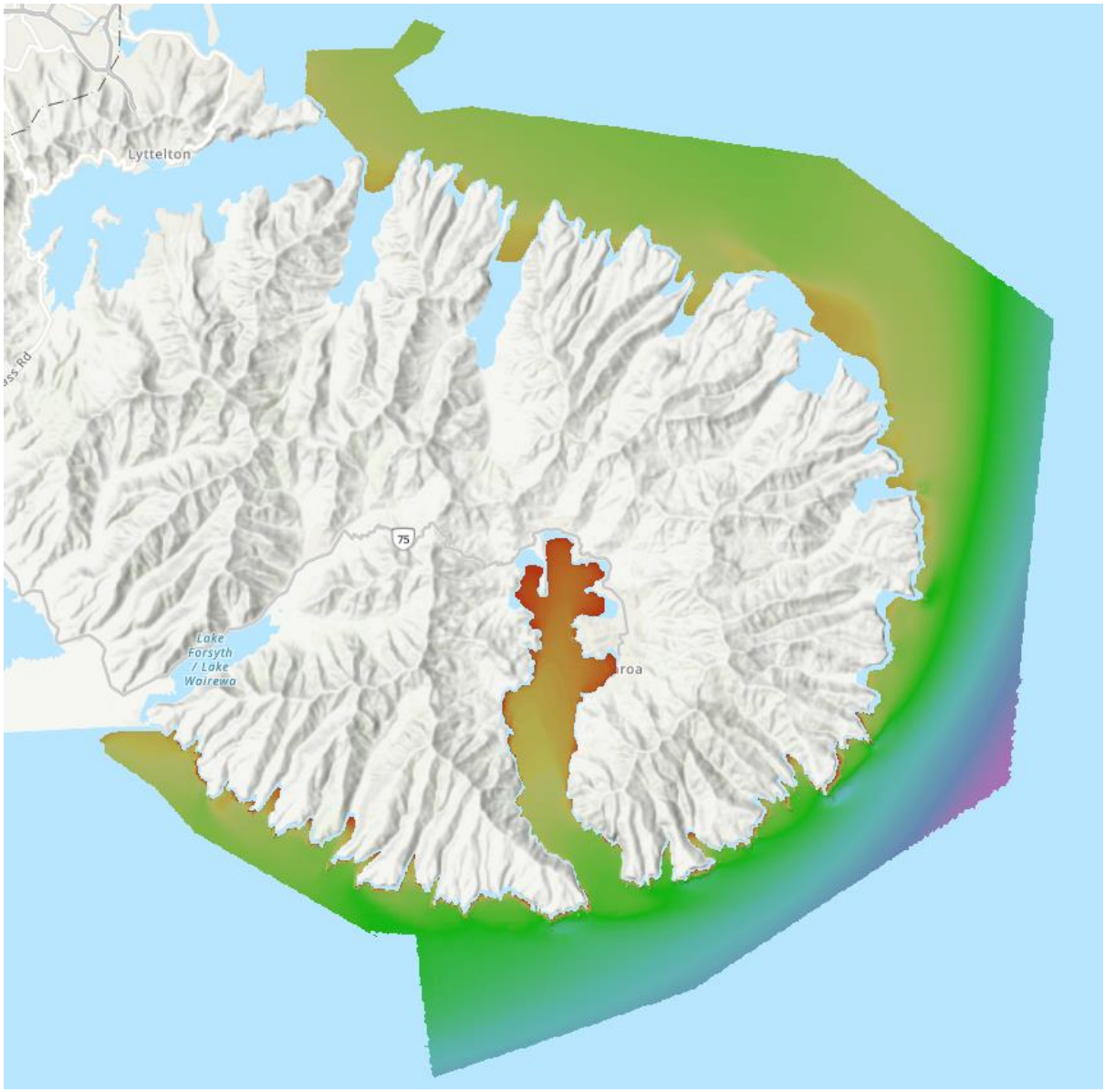
Source: Brough *et al*. (2018)

Brough *et al*. (2018) provides useful information on the nearshore habitat types along the southern coast of Banks Peninsula which can be added to the detailed data being collected as part of "Iongairo" which is a collaboration between ECAN, DOC, and rūnanga. Iongairo has been designed to better understand the distribution, functioning and health of the subtidal ecosystem around Banks Peninsula with aim to provide a broad-scale habitat map detailing the distribution of physical and biological ecosystems[20].

Iongairo utilised MBES survey data collected in 2021/22 to form the basis of the habitat map, followed by ground-truthing of the seafloor features via collecting sediment samples, video and still imagery of the seafloor and biological communities. This process will allow the confirmation of expected habitats in discrete locations that can be utilised to model the distribution of habitats across a larger scale[20].

[20] Iongairo Story Map

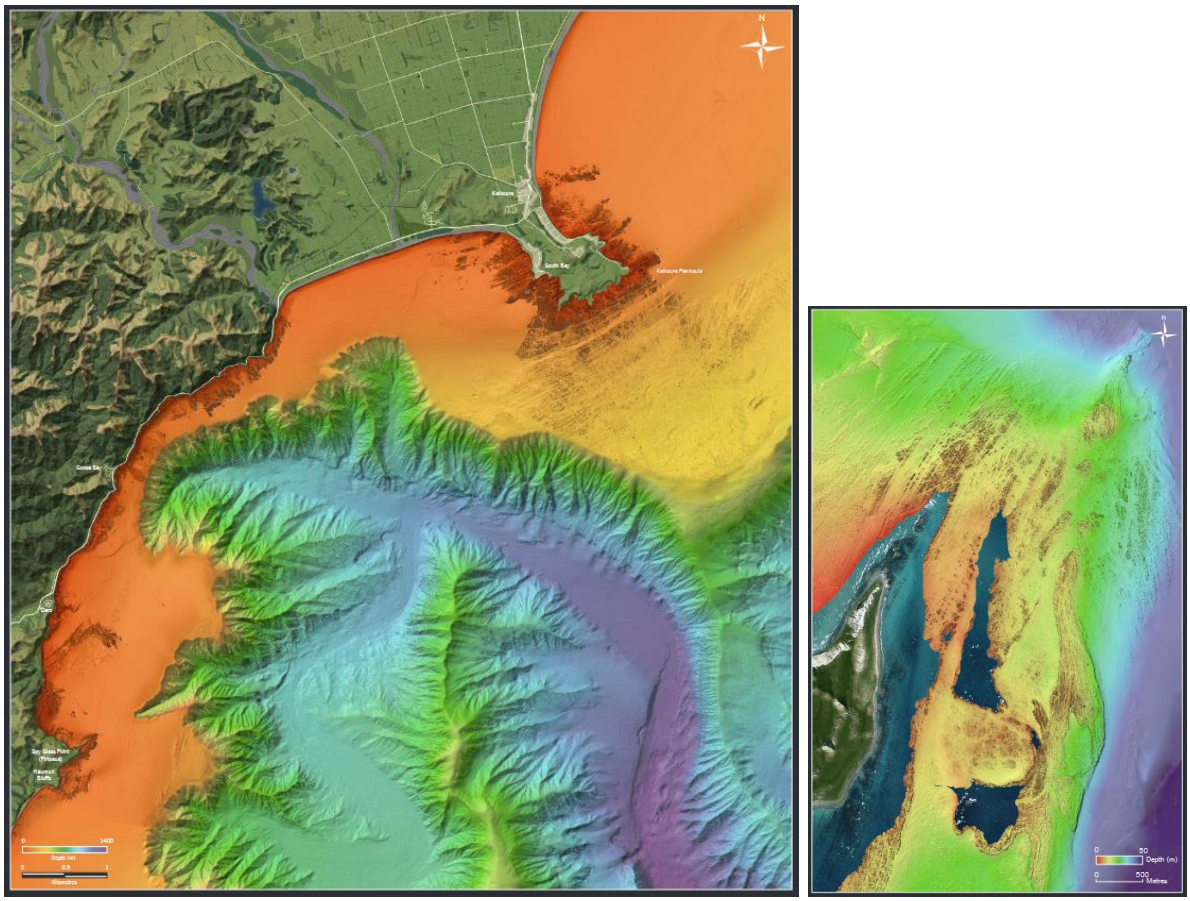
Figure 22 Extent of MBES Survey Data Utilised for Iongairo



Source: Iongairo Story Map[20] and LINZ Data Service

MBES surveys were undertaken by NIWA in 2017 and 2018 in North Canterbury after the Kaikōura earthquake that occurred in 2016. This MBES survey provides high-resolution coastal bathymetry maps for the area between Cape Campbell to Haumuri Bluffs that show locations of discrete substrates including rocky reefs (Neil *et al*. 2018).

Figure 23 MBES Survey Coverage from Kaikōura (left) and Cape Campbell (right) in 2017/18



Source: Neil *et al*. (2018)

2.1.2.14 Chatham Islands

Spatial data for the CMA surrounding the Chatham Islands is very sparse. No additional data was able to be found relating to rocky reefs in and around the Chatham Islands, outside of the rocky reef data layer associated with original 2011 Report and the nationwide data discussed in **Section 2.1.1**. The Chatham Islands Resource Management Document does identify “Areas of Significant Natural Value”; however, little information is detailed about these areas within the document itself.

2.1.2.15 Otago

The Otago Regional Council contracted NIWA to identify SEAs within the CMA of the Otago region in 2022 (Brough *et al*. 2022). This process included the acquisition and appraisal of data relating to coastal biodiversity and habitats, and assessing these data against ecological criteria developed by DOC. The first phase of this process was holding a workshop with a broad stakeholder group and collating identified datasets to be critically reviewed.

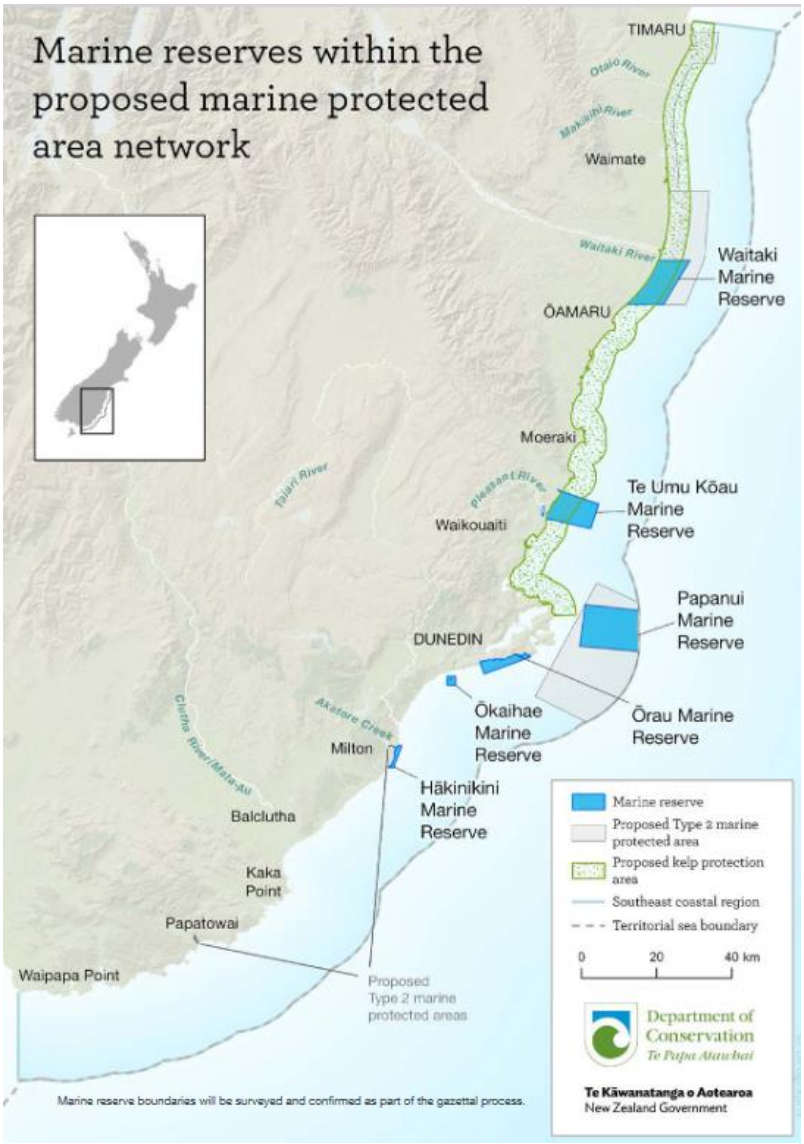
The spatial datasets identified by Brough *et al.* (2022) was aggregated into various management classes based on similar taxonomic and/or biophysical characteristics. Of particular importance to this scoping report is the 'seafloor geomorphological features' management class which relates to locations with notable geomorphic features (such as canyons and reef platforms). This management class utilised four datasets, including a national scale bathymetric layer, DOC rocky reef layer, marine protected area habitat layer and a LINZ dataset on bathymetry within a shipping lane. The result of this work was the identification of nine SEAs throughout the Otago region, primarily consisting of areas of reef systems and submarine canyons.

The identification of SEAs also identified clear gaps in understanding the seafloor geomorphological features management class. The key information required to identify SEAs under this management class requires high-resolution bathymetric and MBES survey data which is generally unavailable for much of the CMA. As such, Brough *et al.* (2022) identified various areas that likely have significant rocky reef habitat that should be prioritised in future seabed mapping studies.

In late 2023, six new marine reserves were announced along the southeast coast of the South Island, from Timaru to Waipapa Point in Southland[21] as shown in **Figure 24**. Consultation was undertaken as part of this scoping report with the University of Otago which found that MBES surveys are available (through DOC) for much of Te Umu Koau, and parts of Papanui Ōrau, Okaihae and Hākinikini (M. Desmond, *pers. comm.*).

[21] Southeast Marine Reserve

Figure 24 Marine Reserves for the Southeast of the South Island



Source: Southeast Marine Reserve

Based on the above discussions, in particular the discussions by Brough *et al.* (2022), there appears to be spatial gaps along much of the CMA within the Otago region, outside of specifically surveyed areas (such as for the southeast marine protection network).

2.1.2.16 Southland

SLR are aware of a report prepared by NIWA in 2021 that was funded by the Ministry of Business, Innovation and Employment's Envirolink Scheme, titled "Assessment of Southland Marine Significant Ecological Areas". A copy of this report was not able to be sourced at the time of completing this scoping report. However, due to the scope of the report (i.e. assessment of SEAs), it is likely that this report will detail rocky reef habitats similar to what has been completed in other regions (such as **Sections 2.1.2.1** and **2.1.2.15**), and should be assessed during Phase 2.

LINZ commissioned NIWA to undertake a hydrographic survey using MBES in Fiordland in early 2019 (HS58), focusing on Dusky, Doubtful, and Thompson Sounds. The results of this hydrographic survey can be found as part of LINZ's Marine Geospatial Inventory[7], and

includes processed bathymetry, backscatter, seafloor reflectance and identification of significant bathymetric features (amongst many other data) that will prove useful in updating the rocky reef data layer in these particular Sounds.

The Southern Fiordland Initiative (**SFI**)[22] is a citizen-science initiative that works closely with Prof James Bell and Dr Alice Rogers at Victoria University of Wellington. SFI undertakes a variety of projects in Dusky and Breaksea Sounds, including a habitat mapping project that collects biological data to overlay on recent seafloor surveys that have mapped the physical rocky habitats. In addition to this habitat mapping project, the SFI has established sites where the changes in biological communities are monitored utilising ROVs to take photographs and videos. This will be useful when determining confidence levels at these locations and assist with describing habitats on the rocky reefs should this type of detail be included in Phase 2.

Consultation was undertaken as part of this scoping report with the University of Otago, which found that MBES surveys are available for Hawea Bligh Sound Reserve and Poison Bay (partial survey) in Fiordland (M. Desmond, *pers. comm.*).

2.2 Gap Analysis

As can be seen in the discussions throughout **Section 2.1.2**, the availability and quality of data on rocky reefs varies significantly around New Zealand. The higher quality data tends to correlate with population of the regions, areas of the coastal environment that are subject to greater anthropogenic pressures, and/or in response to natural events (e.g. the 2016 Kaikōura earthquake and the 2023 Cyclone Gabrielle). A prime example of this is the lack of data within the West Coast region (**Section 2.1.2.12**), which correlates to the low population of the region and the subsequent lesser use of the coastal environment.

Both the Waikato and Auckland regions have recently undertaken work to delineate the rocky reefs within their respective regions which has resulted in detailed spatial datasets. Nevertheless, the quality of these data differs between the coasts, with the west coast of these two regions having less confidence associated with the reef areas due to the data available. Outside of Waikato and Auckland, much of the coast around the remaining regions of New Zealand tend to have patchy information, primarily relating to already identified sites of significance.

It is worth noting that many of the spatial gaps in data pertaining to rocky reefs in the nearshore environment will eventually be filled over time with the collection of LiDAR data as part of LINZs 3D Coastal Mapping Project (**Section 2.1.1.2**), subject to final scope and budgets. In addition to this, as regional councils review their regional coastal plans additional data will eventually be obtained through the identification of SEAs in response to the requirements of the RMA and associated policies in the NZCPS. To address this ongoing data collection, it is recommended that the potential updating of the rocky reef data layer should be reviewed on a regular basis.

[22] Southern Fiordland Initiative

3.0 Needs Analysis

Ultimately, the rocky reef data layer should be designed to assist in effective environmental decision making in the marine environment, with the key users of this information being governmental departments (DOC, MfE, MPI) and local government (regional councils and unitary authorities). As part of the consultation undertaken for this scoping report, the stakeholders were asked what type of information they would like included within the updated rocky reef data layer. Not many of the stakeholders provided a response to this query, potentially due to the short timeframe provided to them to respond; however, a summary of the responses is detailed below.

DOC has been utilising the current rocky reef layer for habitat suitability models for taxa that are obligate to rocky reefs (e.g. some macroalgae) and for informing marine spatial planning and marine protected area processes (such as the Southeast Marine Protection Forum) (S. Geange, *pers. comm.*). DOC was also keen to have a spatially quantifiable confidence layer (refer **Section 2.1.2.3** for an example of this process), especially for particular areas to allow planning of future work to identify gaps, for continued updates to the rocky reef data layer

Few responses were received from regional councils. However, the general response was that stakeholders were keen to have more knowledge on where rocky reefs existed, and that the rocky reef data layer would be in a format that could feed into their existing mapping system.

Further information on the types of habitats that exist on the reefs would also be very useful. For example, information on biodiversity values, and whether reefs contained high-value species such as threatened taxa, mahinga kai and kelp beds, or whether the reefs are considered culturally significant would be valuable. Also identified as useful information in a layer would be the type of reef, such as island systems, volcanic, deep reefs/shoals. In addition, the ability to define habitats based on commonly used descriptors would be beneficial for management of the reef locations, such as: sponge garden, kelp bed, mixed algal stand, barren etc. With climate change in mind, delineating habitats that are predicted to (continue to) change (such as kelp beds) would be valuable for ongoing marine spatial planning.

Since much of the MBES survey data have targeted specific areas often known to have rocky reefs, it would be valuable to have areas covered that are generally thought to primarily be soft sediment but could contain reef outcrops.

Much of the above data could be included within the metadata associated with the rocky reef data layer, which would also benefit from parameters relating to the data type (such as from MBES and LiDAR surveys etc.) that delineated the reef and a temporal aspect to allow reviews of the data over time.

Further consultation with stakeholders that may utilise this information will be important when undertaking the update to the rocky reef data layer. As a starting point the key stakeholders identified in this scoping report should be involved in the next phase. Consultation with the New Zealand Marine Geospatial working group would be an efficient means to undertake this due to the number of members within it.

One important aspect of the rocky reef data layer will be use of the information by iwi. Due to the significant number of iwi groups involved around the country it was not feasible to consult with them. Therefore, consultation with iwi is recommended during the next phase of the process.

4.0 Recommendations

If MfE proceed with Phase 2 this would involve procuring some or all of these data from the variety of sources described in this report. Recommendations are outlined here to aid in prioritisation of areas, potential parameters to be included, further steps and considerations from the needs analysis.

The gap analysis identified large areas that are missing data, and in particular, the west coasts of both islands are lacking data for most of the coastline. Auckland, Waikato, Taranaki and the Marlborough Sounds have relatively comprehensive data available, primarily due to the high use of the coastal areas of these regions. Other regions have much patchier coverage, and most data collected have targeted specific areas within the regions.

A significant repository of data that would be useful for Phase 2 is contained within many of the resource consent application documents for activities within the CMA. An example of this would be those resource consent applications for capital and maintenance dredging in port facilities (e.g. Port Taranaki, Napier Port, Eastland Port, Lyttelton Port of Christchurch, Port Otago, and Southport). The collation of these data would be a significant piece of work in and of itself but will provide site-specific information on the seafloor habitats, including rocky reefs, that may be impacted by the activities proposed in the application documents.

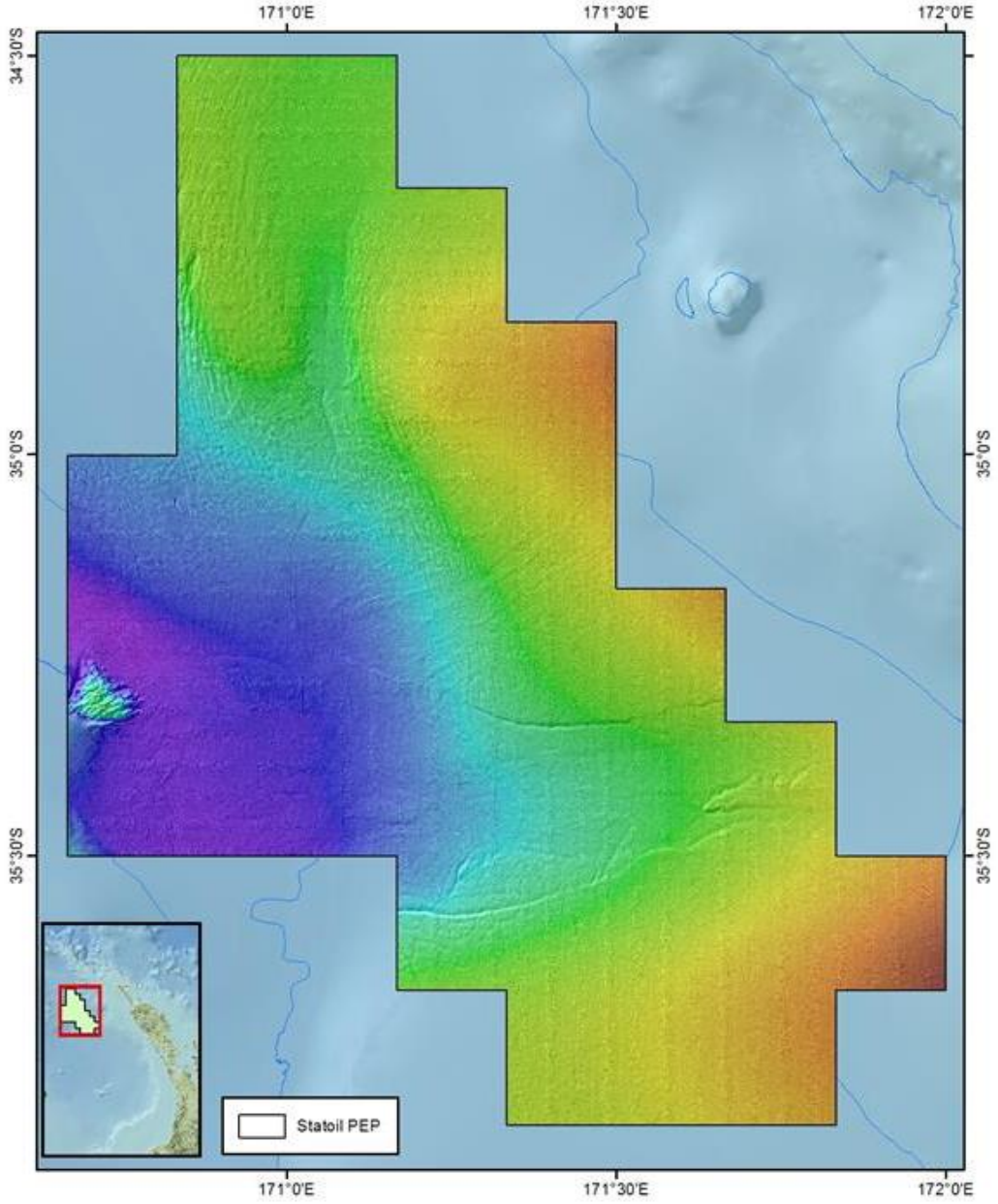
MBES survey data provide generally good quality, accurate data as a first step for delineating rocky reef extents. Procurement of MBES survey data would likely be the best initial stage for updating the rocky reef layer, and sources such as LINZ, DOC, and NIWA generally have the most extensive coverage which are likely to be in a format that would be easy to incorporate into the layer. Other sources have smaller coverage of targeted areas but would also be valuable for inclusion to fill gaps not covered by the areas collected by LINZ, DOC, and NIWA.

As a second stage, procuring data such as LiDAR, drop-camera and video imagery would be valuable for ground-truthing MBES survey data. Since this process can be time-consuming and expensive, this stage may need to be restricted to targeted areas.

Extending the rocky reef data layer into the EEZ will be possible in places. However, this will likely be highly patchy as few surveys have been undertaken and given the size of New Zealand's EEZ. **Section 2.1.1.2** details some of the MBES surveys that have been undertaken for navigational purposes; some of which extends out past the CMA. In addition, there are some areas within the EEZ that are currently (or previously) of interest to the extractive industries, such as offshore mining and oil and gas exploration. The New Zealand Petroleum and Minerals website[23] includes data relating to permits under the Crown Minerals Act. These data include MBES surveys undertaken on behalf of the permit holders, an example of which is shown in **Figure 25** that shows the MBES survey coverage for an offshore petroleum permit off the Auckland region.

[23] Geodata Catalogue

Figure 25 Example of MBES Survey Coverage within Crown Minerals Act Permits



Consultation with DOC provided useful recommendations, including undertaking an expert evaluation of any updated layer (S. Geange, *pers. comm.*). An evaluation of the rocky reef data layer will reduce the likelihood of erroneous data as happens with the current layer. This type of process would need to be undertaken at a regional scale and include those with local knowledge, as this was previously how inaccuracies have been determined for the existing layer.

To ensure that the rocky reef data layer can be continually used by stakeholders, a robust maintenance framework is recommended. This framework would ensure the rocky reef data layer is actively maintained, improved, and promoted for use in marine spatial planning. Collection of data is constantly occurring throughout New Zealand based on several factors, and building in a timeframe for regular updates to the rocky reef data layer is important to capture this data. Consultation with stakeholders will be important when determining how often this should be conducted, but a reasonable timeframe could be in the region of 5 to 10

years as is the case with the New Zealand Seafloor Community Classification (Stephenson, 2023).

While some of these data discussed above will be in a format that is easily incorporated into the update of the rocky reef data layer (such as the layers developed in Auckland and Waikato, and the MBES survey datasets around New Zealand), other site-specific data (including data utilised for ground-truthing) will be more labour intensive. Although these timeframes will be variable, utilising a maintenance framework discussed above will result in the rocky reef data layer effectively being a 'live document' where it can be continuously updated.

Consultation with C-SIG identified the potential for MfE to present the next phase of this project to the members of C-SIG. Meetings are regularly held with the members of C-SIG which would present an ideal opportunity to discuss the updated layer to assist them with their management processes.

The New Zealand Marine Geospatial Information working group will likely be interested in this work, and any future updates to the rocky reef data layer. It was suggested by LINZ that MfE may wish to provide some details on the update to the rocky reef data layer in their next newsletter which is due to go out at the end of June. It is understood that MfE have already organised this.

5.0 Conclusion

The 2011 Report by DOC and the then Ministry of Fisheries (now MPI) identified the spatial locations of rocky reefs (along with other marine habitats) at a broad scale within New Zealand's CMA. The rocky reef substrate aspect of the 2011 Report utilised a digitised GIS layer of coastal reefs from shoal areas on LINZ nautical charts, and a limited coverage of field surveys. The methodology utilised in the 2011 Report unlikely captured all areas of rocky reef and was inaccurate in places. To address this, MfE engaged SLR to deliver this scoping report that analysed some of the more recently available data (including assessing the quality and quantity of those data), identified gaps in the recently available data, undertook a needs analysis from key stakeholders and provide recommendations on the next phase of updating the rocky reef data layer.

Identification of available data was undertaken using two primary methods; that being consulting with a variety of stakeholders (listed in **Section 2.0**), and assessing the publicly available data on various websites including those associated with both central government and local government. An assessment of the available data was then split into data that occurred at a nationwide-scale and at a regional-scale, where relevant. This assessment found that the availability of data and the quality of that data varies significantly around New Zealand. In particular, the higher quantity and quality of data tended to correspond with areas with higher populated regions, areas of the coastal environment that are subject to greater pressures, or areas targeted in response to catastrophic events (such as earthquakes or cyclones).

Many of the identified spatial gaps in data pertaining to rocky reefs in the nearshore environment will eventually be filled over time with the collection of LiDAR data as part of LINZs 3D Coastal Mapping Project, subject to final scope and budgets. In addition to this, as regional councils review their regional coastal plans, data will eventually be obtained through the identification of SEAs in response to the requirements of the RMA and associated policies in the NZCPS.

During the consultation process for this scoping report, stakeholders were asked to outline what type of information they would like included within the updated rocky reef data layer to feed into a needs analysis. Not many responses were obtained, however those that were received from regional councils generally related to simply having more knowledge on where rocky reefs existed, and that the data layer be in a format that could feed into their existing mapping system. In addition to those responses from regional councils, DOC provided feedback on the current use of the rocky reef data layer for habitat suitability models and the desire to have a spatially quantifiable confidence layer to identify gaps and allow planning of future work to continue updating the layer.

A variety of recommendations have been made based on the available data, the gap analysis and needs analysis. These recommendations included utilising data for ground-truthing of reef locations/habitat types, extension of the data layer into the EEZ, undertaking regional-based expert evaluation, and development of a robust maintenance framework. Ongoing consultation with interested parties was also recommended, including stakeholders consulted with as part of this scoping report, such as C-SIG, DOC, LINZ, as well as new stakeholders such as iwi and the New Zealand Marine Geospatial Information working group.

6.0 Acknowledgments

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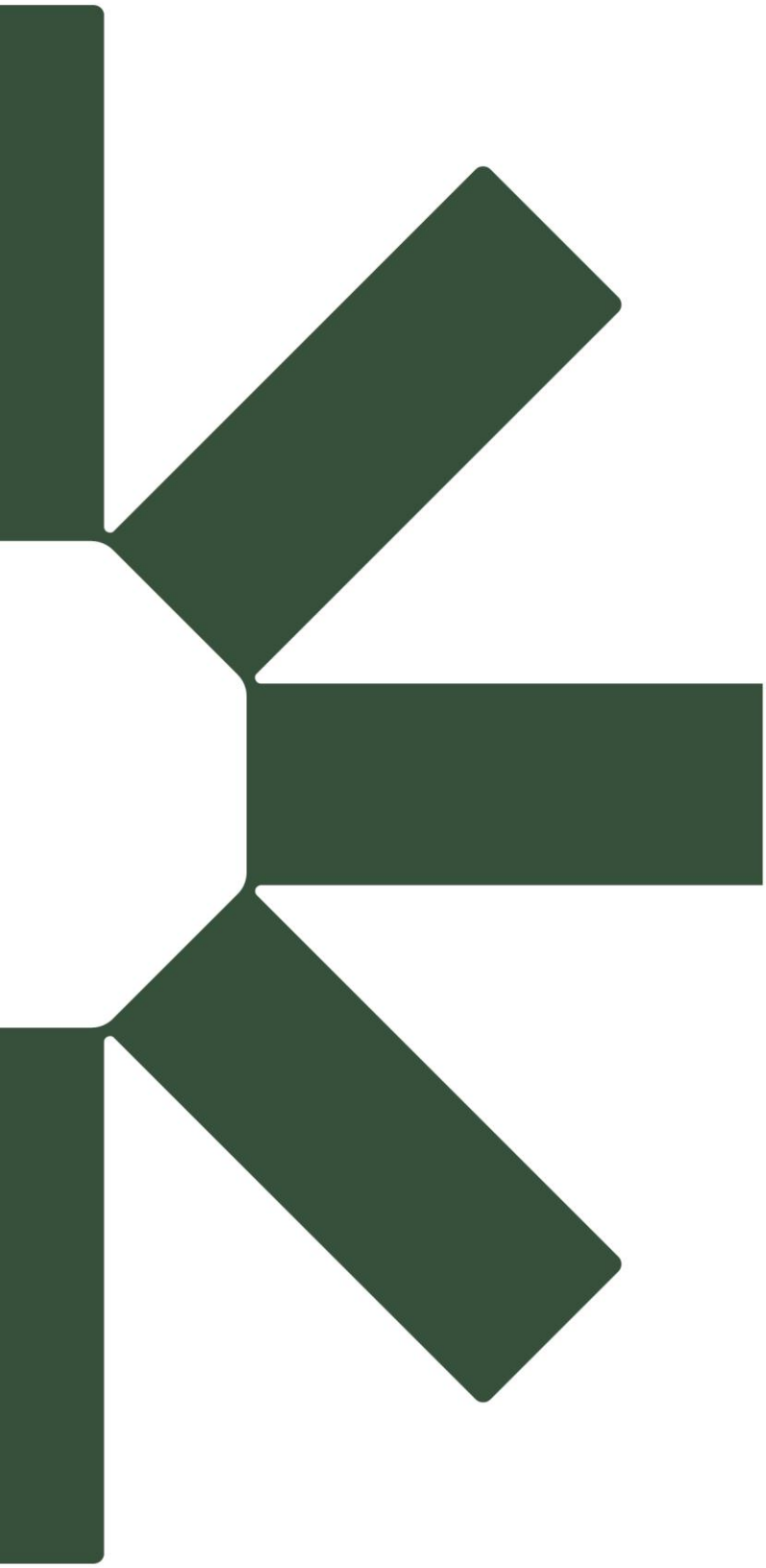

Making Sustainability Happen