ATTACHMENT TWENTY-NINE
Environmental Monitoring Management Plan (“EMMP”)

McCALLUM BROS LTD
Established 1904

Site: Te Ākau Bream Bay Sand Extraction Site

Report Title: Environmental Monitoring Management Plan for the Te Ākau Bream Bay Sand Extraction Site

Date	Version	Description	Certified
4 July 2025	1	Draft for RC Application	

Contents

Glossary

ASEA	Approved Sand Extraction Sub-Area
Consent Holder	McCallum Bros. Ltd
DOC	Department of Conservation
EMMP	Environmental Monitoring Management Plan
Extraction Area	The proposed sand extraction area
FTAA	Fast Track Approvals Act (2024)
MBL	McCallum Bros. Ltd
MBES	Multibeam Echo Sounder
Cell	The Cells defined on the Bioresearches Drawing “Map Showing Proposed Sand Extraction Area and Proposed Control Areas” dated 18/09/2024 or at any subsequent revisions, in Appendix Two. These cells are 1000m x 200m in area.
NRC	Northland Regional Council
PSEAR	Pre-Sand Extraction Assessment Report
SQEP	Suitably Qualified and Experienced Person
SEMR	Sand Extraction Monitoring Report
Sensitive Benthic Communities	Means the habitats described in the table included in Appendix F.

1. INTRODUCTION

McCallum Bros Limited ("**MBL**") holds resource consent (TBC) for sand extraction at the Te Akau Bream Bay Sand Extraction site. This document is the Environmental Monitoring Management Plan ("**EMMP**") required under Condition 16.

The Objectives of this EMMP are:

(1) To outline a monitoring programme to:
   a) Provide the baseline ecological and bathymetric information for subsequent monitoring.
   b) Identify areas where sand extraction is not to be undertaken.
   c) Identify benthic ecological or bathymetric changes arising from the sand extraction.
   d) To identify that the underwater noise monitoring does not represent a soundscape change that exceeds 3db.
   e) Confirm compliance with Condition 31 (Plume)

(2) Identify changes required to the sand extraction method to minimise any identified significant unanticipated adverse ecological, bathymetric and/or coastal processes effects on the environment.

This is a living document which includes the following:

- Methodology and timing of EMMP Reviews
- The monitoring objectives and rationale
- Cell and control sites identification
- Pre Sand Extraction Assessment ("**PSEAR**") Methodology
- Sand Extraction Monitoring Report ("**SEMR**") Methodology
- Underwater Noise Modelling Verification
- Sand Extraction and Vessel Track Reporting Methodology
- Approved Sand Extraction Sub Areas

This EMMP is also the depository for the other ecological log and reporting requirements.

This EMMP has been compiled by MBL with input from the following SQEPs:

Section X	**Inputs**
1, 2, 3.1, 4, 5, 6, 8, 9, 10	Simon West – Bioresearches
3.2, 4.1, 5.1, 6.1	Eddie Beetham – Tonkin + Taylor
6.8	Pete Wilson – SLR Consulting New Zealand
7	Matt Pine, Jon Styles – Styles Group

2. EMMP CERTIFICATION, REVIEW AND KEY REPORTING DATES

This section:

- Records the dates and nature of the EMMP updates and certification.
- Sets out the EMMP review dates.
- Records the dates of completed PSEARs.
- Sets out the dates SEMR's are required.

All updates, including any changes to monitoring methodology, are required to be provided to NRC for certification (except for administrative and *de minimis* changes provided for under Condition 12) before any changes are implemented.

2.1 EMMP Version and Certificate Dates

Update Number	Date of Update	Nature of Update	Certification from NRC required	Certification Date
Original	4/07/2025	Submitted with Application	No	

2.2 EMMP Review Dates

Under Condition 16, this EMMP is to be reviewed at least at year three, year five and then every five years from the commencement of the consent with the reviewed EMMP having to then be submitted to NRC for certification. The dates the reviewed EMMP are due at NRC are:

Review Due	Submitted
1 November 2029	
1 November 2031	
1 November 2036	
1 November 2041	
1 November 2046	
1 November 2051	

2.3 EMMP Review Methodology

The objective of the review is:

- To identify any changes required to the monitoring methodology and timing to provide better understanding of observed effects, if any, arising from the sand extraction.
- To include new or revised sampling techniques if current sampling methods did not work as expected.
- To adopt new technology that makes data collection easier and/or more accurate.

The review should be commenced at least 6 months prior to the date the updated EMMP is due at NRC. The review is to be led by the MBL Environmental Manager (or similar) and is to involve the following personnel:

- The ecologist(s) (or their replacement) responsible for preparing the ecological inputs any PSEAR or SEMR completed during the preceding 5-year period.

- The coastal processes specialist (or their replacement) responsible for preparing any coastal processes (including bathymetric survey reviews) into any PSEAR or SEMR completed during the preceding 5-year period.
- Any other environmental specialist (or their replacement) used to provide input into any specific environmental issue which has been identified through the SEMR process or in any required responses to NRC s128 reviews or responses to complaints during the preceding 5 year period.
- Te Pouwhenua o Tiakiriri Kūkupa Trust (Te Parawhau ki Tai) are to be provided any proposed changes to the EMMP for their review and comments Te Parawhau ki Tai are to be given 20 working days to undertake the review and provide any comments.

The review shall consider:

- Any recommendations from the SEMR reports
- Any comments and recommendations received from Te Parawhau ki Tai after their review of any proposed changes to the EMMP.

The updated EMMP shall be submitted to NRC along with a letter identifying the changes made and the basis for these changes.

2.4 Pre-Sand Extraction Assessment Report (PSEAR)

The following Pre-Sand Extraction Assessment Reports have been completed and approved along with their Approved Sand Extraction Sub Area Plans.

PSEAR Number and Date	ASEA Plan Number and Date	ASEA Cells Covered	Approved	ASEA Superseded
1 (added date)	1 (add date)	All (to confirmed)	Approved as part of the consent.	No

The Approved Sand Extraction Sub-Area Plans are included in Appendix E.

2.5 Sand Extraction Monitoring Report (SEMR)

Under Condition 37, the Consent Holder must prepare a SEMR for those ASEA's where sand extraction has occurred since the last SEMR monitoring in those years specified in the Table below.

SEMR Required
Year 1 – Sand Extraction Commences (no SEMR)
Years 2-7 (inclusive)
Then every 3rd Year for Remainder of the Period the Consent is Given Effect To

The SEMR is to be undertaken in accordance with the methodology outlined in Section 6 of this EMMP.

The SEMR is to include an updated ASEA Map and any recommended changes to the sand extraction method based on the findings, monitoring and reporting of that SEMR.

The SEMR must be submitted to the NRC for certification by 31 November of the year it is required. The monitoring required to prepare the SEMR must be completed in March/April of that year.

The following SEMR have been completed and approved along with their Approved Sand Extraction Sub Area Plans.

Year	ASEA Plan Number and Date	ASEA Cells	Approved	ASEA Superseded
Year 2				
Year 3				
Year 4				
Year 5				
Year 6				
Year 7				
Year 10				
Year 13				
Year 16				
Year 19				
Year 22				
Year 25				
Year 28				
Year 31				
Year 34				
At completion				

The ASEA are included in Appendix C.

3. ENVIRONMENTAL MONITORING DESIGN RATIONALE

3.1 Monitoring for benthic ecology effects

The monitoring design is based on a "cause" and "effect" basis, as well as a trend analysis of accumulative effects basis:

1. "Cause" is defined as sand extraction.
2. "Effects" are those changes in the bathymetry, bedforms, grain size and/or benthic macrofaunal communities in the sand extraction area that are statistically significantly outside the natural fluctuations recorded at the control sites. However, in some cases, statistically significantly changes may have no ecological significance i.e. they have little or no meaning in terms of the ecology.

Practical experience suggests that most natural populations show fluctuations from time to time that are not parallel from place to place. As a result, there is considerable interaction between space and time in the data from any sampling design. An ecologically realistic proposition is that an environmental impact on the abundance of a population in some location should be defined as an anthropogenic perturbation that causes more temporal change in the population than is usually the case in similar populations in other similar locations where no such disturbance occurs.

A typical environmental monitoring design often involves 'Before' sampling in 'Impact' and 'Control' locations followed by 'After' sampling in the same 'Impact' and 'Control' locations, i.e. BACI. It has been recognised in the international literature (Underwood, 1991[1], 1992[2], 1994[3]) that a simplistic BACI design has a number of deficiencies which do not adequately allow for natural spatial and temporal variations, particularly over large areas, which can lead to false assessments of effects. Due to the size of the proposed sand extraction area, a simplistic BACI comparison of ecological parameters from before and after sand extraction in both control and impact zones will not effectively account for the ecological spatial and multi-year temporal variation that may occur at the site over the life of the consent. Therefore, the monitoring design that was chosen uses beyond BACI methods where possible.

In terms of the use of multiple control sites, the logic of the design is that an impact in one site should cause the composition and abundance of animals in the community to change more than expected on average in undisturbed sites. Composition and abundances in the control, undisturbed sites will continue to vary in time, independently of one another. On average, however, they can be expected to continue as before. Individual control sites may differ and may change significantly from one another. It is expected that on average the set of control sites should continue to show similar behaviour. Impacts are those disturbances that cause average composition and abundance in a site to change more than is found on average.

The PSEAR Report 2025 which covers the full sand extraction area provides the true 'Before' monitoring samples as this assessment was undertaken prior to any sand extraction occurring in this area.

Because the sand extraction is an ongoing series of events, the 'After' samples will be a series of samples

[1] Underwood, A. J. (1991). Beyond BACI: experimental designs for detecting human environmental impacts on temporal variations in natural populations. *Marine and Freshwater Research*, *42*(5), 569-587.

[2] Underwood, A. J. (1992). Beyond BACI: the detection of environmental impacts on populations in the real, but variable, world. *Journal of experimental marine biology and ecology*, *161*(2), 145-178.

[3] Underwood, A. J. (1994). On beyond BACI: sampling designs that might reliably detect environmental disturbances. *Ecological applications*, *4*(1), 3-15.

during sand extraction until the end of the consent as part of the SEMR reporting. The SEMR monitoring will record the benthic ecology and potential effects relative to natural variation in the benthic ecology, over a period of time. These periodic monitoring events will then be assessed for any trends which may show accumulative effects from a number of smaller potentially undetected effects. If effects and or trends differentiating the impact sites from the control sites are detected, then there is a potential opportunity to manage the sand extraction to attempt to minimise any effects. In terms of accumulative effects in this case 'accumulative' is used in the absolute sense of a gathering or growing by gradual increases and or decreases.

3.2 Monitoring for bathymetric effects

Monitoring of the shoreface and offshore bathymetry is being undertaken to confirm the extraction is not having an adverse effect on coastal processes. Monitoring and analysis of bathymetry will be undertaken inside the extraction area, at adjacent control sites, and along six bathymetric profile transects that extend to shore (as far shoreward as practicable). The adjacent control areas are used to quantify natural variation and survey accuracy as a reference for understanding change within the extraction area.
Specific monitoring objectives are to:

1. Identify cumulative change in sea-bed level and volume within the extraction area.
2. Identify and manage any unexpected dredge track anomalies.
3. Identify and manage any unexpected seabed lowing on the shoreface.

Repeat bathymetric surveys of the of the extraction area are recommended to monitor the change in seabed level and volume. Analysis of cut and fill volumes can be undertaken to understand the change over time. Calculation of difference in seabed level since the baseline survey can be used to understand if there is progressive lowering over time. Bathymetric survey cut and fill volumes can be compared to dredge volume records. In a closed system the surveyed cut volume should be close to the recorded extraction volume. Bathymetric surveys have an error of approximately ±0.15 m and the rate of seabed lowering across the full area is approximately -0.016 m/yr based on the annual extraction volume, with individual tracks of -0.1 m. Therefore, it may take multiple years before measurable change beyond the error margin is detected in bathymetric surveys.

MBL have a dredge track management plan based on using equipment that extracts to a maximum depth of 0.1 m on a single pass, and no repetition of the same dredge line in any 12-month period. This is to avoid dredge track anomalies, defined as a single extraction track with a width less than 2 m and a depth exceeding 0.4 m below the surrounding seabed level and longer than 100 m in length. Such an anomaly may locally interrupt coastal processes. Bathymetric monitoring across the extraction site should be collected and analysed to identify and manage dredge track anomalies. If an anomaly is identified during the monitoring, that is attributable to sand extraction, that cell will be excluded from the ASEA.

If an adverse effect on coastal morphology were to occur as a result of the extraction, the first location where this would be realised is the lowering of the lower shoreface close to the proposed extraction area. Monitoring of the lower shoreface is undertaken in the form of:

1) Bathymetric monitoring of a 100 m bathymetric control area on the landward (west) and northern and southern sides of the extraction area, to identify and manage any unexpected loss in volume on the adjacent lower shoreface that could be attributed to sand extraction.
2) Bathymetric profiles from the proposed extraction area to the shoreline (as close to shore as practical – no greater than 5 m in water depth) are recommended to confirm the stability of the seabed landward of the proposed extraction area.

4. CELLS AND CONTROL AREAS

To aid in the monitoring and management of the sand extraction, the proposed sand extraction area has been divided into cells 1000 m long and 200 m wide orientated along the shore in the general direction of the dredging runs.

Three control sites have been identified. Due to differences in seafloor slope, the seaward extent of each control area will vary to match the depth range in the sand extraction area. However, each extends 1000 m parallel to the shoreline. All control areas are subdivided into cells of 1000 m long by 200 m wide, consistent with the dimensions of the cells in the proposed extraction area.

An area with of width of 100 m has been identified on the landward, northern and southern side of the sand extraction site for the bathymetric monitoring area.

The Cell and Control Area Plan is included in Appendix B.

4.1 Sand Extraction from Cells

Cells where sand extraction can occur are identified in the operative ASEA plan. The current approved plan is listed in Section 2 of this Report and included in Appendix C.

The initial approved ASEA was approved as part of the coastal permit. Subsequent ASEA's will be prepared either through the PSEAR or the SEMR process.

4.2 Cell Exclusion Criteria

Areas of seafloor will be excluded from the ASEA where:

a) Sediment with an average proportion of mud (grain size finer than 0.063 mm) exceeding 20% by weight; or
b) Areas of immobile layers (e.g. rock) or historic facies (e.g. partly consolidated orange Pleistocene sand deposit); or
c) Sensitive benthic communities (as defined by Appendix F); or
d) Any absolutely protected species under the Wildlife Act 1953, excluding any species for which a Wildlife Authority is held; or
e) Extraction track(s) with a width less than 2 m and a depth exceeding 0.4 m below the surrounding seabed level and longer than 100 m in length.

4.3 Cell Reopening Criteria

Where an area has been excluded from the ASEA, a new PSEAR report can be undertaken for that cell(s) to determine if it now no longer meets the criteria under Condition 20 to be excluded.

In the event of a cell(s) having being closed as a result of non-compliance with Condition 20(e), the SQEP may recommend that cell(s) remains closed despite it now complying with the requirements of Condition 20(e) if they consider there are circumstances where opening the cell may generate future adverse effects.

The updated ASEA plan is to be submitted to NRC for certification.

5. PRE-SAND EXTRACTION ASSESSMENT REPORT (PSEAR)

A PSEAR in 2025 was completed for the full extraction area and submitted as part of the Resource Consent Application and was the basis for the initial approved ASEA.

Subsequent PSEAR's will be required if:

1. For extraction in any cell covered in the approved ASEA 2025 which sand extraction has not occurred in prior to 1 April 2027.

2. For extraction in any cell not covered by a currently approved ASEA.

3. For extraction in any cell where no extraction has occurred in the preceding 36-month period.

Any new PSEAR is to be certified by NRC in accordance with Condition 22.

The timeline included in clauses 1 and 3 above is on the basis that the baseline bathymetry and ecological data is valid for an approximately 3 year period from the date of monitoring.

The PSEAR is to include:

5.1 Bathymetry monitoring

Bathymetric survey collection using MBES with ±0.15 m vertical accuracy or better:

1. Within the extraction area, covering at least the cells covered by the PSEAR and the adjoining cells.
2. The control areas.
3. A 100 m wide area outside of the extraction area to the west (landward), north and south.
4. Six across shore bathymetric profiles (in the locations shown in Appendix B) that extend from seaward of the extraction to as shallow as practicable - no greater than 5 m in water depth.

The MBES survey output is to comprise of:

1. Gridded bathymetry surface data at a spatial cell resolution of 1 m horizontal.
2. A colour-shaded bathymetric map of all data collected and otherwise relied on for the PSEAR.
3. Separate colour-shaded bathymetric maps of the extraction area and control areas.
4. Close up (high resolution) colour shaded bathymetric maps of any anomalous features.
5. Profile sections for the 6 profiles from shore to offshore.
6. Map view of all MBES backscatter data (separate map).
7. 15 detailed cross-sections across the sand extraction area (including the 100 m inshore margin), Northern and Southern Control areas (as shown on Appendix B), including relative seabed levels and chainages, water depths, cross-section start and end coordinates to allow accurate comparisons between annual surveys.

5.2 Drop camera images

As part of the requirement to assess the benthic communities drop camera images will be taken concurrently or prior to Ponar grab and dredge tow sampling. During each sampling event Drop camera photographs and Ponar grab samples are to be taken in the same stratified random locations in each of the extraction area and control cells.

Drop camera images of 1 m² of the seabed, plus lateral views are to be recorded at:
a. At least five stratified random locations within each control area cells,
b. At least three stratified random locations, within cells where sand extraction will occur.

The cameras will have a resolution of at least 20MP, including RAW capture. The cameras will be set to record images at 2-second intervals at the best available image quality setting, and the best representative images selected. A vertical image of the seabed will be framed by a 1 m² quadrate to allow measurements and quantification and have a compass for orientation. The lateral image will provide a wider view of the seabed nearby.

The images will have multiple uses;
1. To assess changes in fine scale (< 1 m) bed forms and as confirmation of the multibeam interpretations,
2. To provide an indication of substrate heterogeneity,
3. To assess epibenthic habitat for the presence of any conspicuous sensitive benthic species or communities.

Sample locations will be predetermined based on cells, with the cells spilt equally based on the number of samples per cell, sampling points will be randomly located with the spilt cells, but no closer than 50 m from any other sample point. The sampling locations will be located by GPS, with sampling occurring as close as possible but no greater than 20 m from the planned location. These locations will be common to the seabed photographs, sediment texture and benthic biota sampling.

The seabed photography survey output is to comprise of;
1. Tabulated results, describing geomorphology and biota observed,
2. Maps of key data if deemed necessary,
3. Figures presenting each selected photograph.

5.3 Sediment Texture

Seabed sediment samples will be collected from:
a. At least five stratified random locations within each control area cell,
b. At least three stratified random locations, within the cells where sand extraction will occur.

For the proposes of experimental design, the site is deemed to be the cell, and each sample is thus a replicate. Each grab sample will be common to both sediment texture and benthic biota sampling. Samples will be collected with a modified Standard Ponar Grab sampler or similar quantitative technique, with a sample area of at least 250 x 285 mm (0.071 m²), and a bite depth of about 100 mm, producing sample volumes of 1 - 4 Litres. If the sample volume is less than 2 Litres the grab sample will be discarded and repeated.

The grab will be lowered to the seabed in a controlled manner halting 1-2 m above the seabed, before being lowered gently to the seabed. The grab will be triggered and raised a few metres above the seabed by hand with care to avoid the grab recontacting the seabed as a result of swell troughs etc and then raised to the surface by winch. The contents of the grab will be deposited in a clean fish bin. The volume of sample will be assessed to confirm a suitable sample has been collected.

The sample will be homogenised by mixing, a 100 ml subsample will be collected with an aluminium scoop into a clean new polyethylene 'zip lock'-type bag, sealed and double bagged with a pre-printed waterproof label (identifying site, sample date and testing required) between the two bags. A second 100 ml scoop will be collected and composited with other samples from the same cell, sealed and double bagged with a pre-printed waterproof label (identifying site, sample date and testing required) between the two bags. All sediment samples will be placed in a chilly bin and protected from warming. Sediment texture samples will only be chilled in the fridge and not frozen prior to transportation to the laboratory.

Particle size testing will be conducted initially on the cell composite samples, by an accredited laboratory such as Hill Laboratories using accredited testing methods. Samples will be wet-sieved through six sieves (2.0, 1.0, 0.5, 0.25, 0.125, and 0.063 mm) and the remainder collected in the pan. The sieved samples will then be dried and weights recorded as percentages of the total sample. If the composite samples show potential sediment texture trigger exceedances, (greater than 15% silt and clay), then the individual samples from those cells will be tested.

The sediment texture survey output is to comprise of;

1. Tabulated results, including sediment texture classification,
2. A map or maps showing the distribution of the percentage of silt and clay-sized particles,
3. Statistical comparisons between initial, previous and current survey results as per Section 6.7.

5.4 Benthic Monitoring

Benthic biota samples will be collected from:

a) At least five stratified random locations within each control area cell,
b) At least three stratified random locations within cells where sand extraction will occur.

For the proposes of experimental design, the site is deemed to be the cell, and each sample is thus a replicate. Each grab sample will be common to both sediment texture and benthic biota sampling.

Once the two 100 ml sediment texture sub-samples have been removed from the grab sample, the sample will be sieved as soon as practicable after collection by puddle washing each whole sample through both 3 mm and 1 mm mesh sieves with seawater. Where possible the biota in the sieves will be kept below the puddle water level. No greater than 500ml sub samples will be washed through the sieves at any one time, in order to maximise the potential for observation of macrofauna for the presence of cup corals, by a suitably qualified and experienced person. The 3 mm sieve mesh size was selected to retain larger material and allow a rapid visual assessment of the sample as it is being processed for the presence of cup corals, by a suitably qualified and experienced person, before preservation. If absolutely protected species, sensitive species (Appendix F), or known macrofauna are found alive, they will be photographed, enumerated, and returned to the seabed. The 1 mm sieve mesh was selected based on the known coarser sediment particle size present, mesh sizes any smaller result in the majority of the sample being retained.

The material retained on both sieves will be combined and transferred to a polyethylene 'zip lock'-type bag with a pre-printed waterproof label (identifying site, sample date and testing required), and preserved in a solution of 5% glyoxal, 70% ethanol seawater solution. They will be sealed and placed in a second polyethylene 'zip lock' bag and packed into labelled plastic containers for transportation to the laboratory.

Following sieving or if sieving is delayed after sampling, all samples will be stored in a cool shaded location and sieved within six hours of collection.

Prior to sorting, the samples will be rinsed through a 1 mm sieve with fresh water and placed in a white sorting tray. All fauna will be picked out of the samples and placed in labelled vials of 70% ethanol solution prior to taxonomic identification. Fauna will be counted and identified to the lowest taxonomic group possible. Only animals with intact heads and live and dead coral will be counted and identified.

Any biota recorded in the seabed photographs not represented in the benthic biota grab samples at the same location will be added to the quantitative benthic biota data, based on its density of occurrence. Otherwise, it will be added as 1 observed individual to provide a more complete diversity.

The benthic biota survey output is to comprise of;
1. Tabulated results, including summary statistics,
2. Maps showing the distribution of summary statistics,
3. Maps showing the distribution and density of key species based on the combined biota data,
4. Statistical comparisons between initial, previous and current survey results as per Section 6.7.

5.5 Epibenthic dredge tows

The grab sampling targets the smaller more densely occurring biota within the substrate, and may accidentally capture larger epibenthic biota. However, the area sampled is small and thus the larger biota will not be adequately sampled by the grab sampler. The seabed photographs provide some additional abundance data, but they do not provide size data, nor do they adequately sample the lower-density biota such as carrier shells, scallops, or starfish. It is also difficult to determine the living status of gastropod shells observed. Previous sampling has shown that the carrier shells provide microhabitat for brachiopods, which are listed as a sensitive species in Appendix F. Photographs and or video are not sufficient to determine the presence of brachiopods, as they are often obscured under the shells or by other biota, thus epibenthic dredge tows are required to retrieve individual larger biota which can then be identified and measured.

Epibenthic dredge tows will be collected from one random location, spread across two cells (adjoining along the seaward side) within the sand extraction area and control areas.

Each epibenthic dredge tow will consist of lowering a 600 mm wide dredge fitted with a 35 mm mesh bag, to the seafloor and towing at low speed (~<1kt) for approximately 200 m between two predetermined GPS points, in an alongshore direction. All species captured during each tow will be removed and immediately sorted. All larger macrofauna such as bivalves, hermit crabs and starfish, will be identified, photographed, counted, measured and returned to the sea. The larger macrofauna, flora and shell fragments will be examined for smaller macrofauna attached, these will be identified and counted, this will include any attached life stages of stony corals.

The epibenthic biota survey output is to comprise of;
1. Tabulated results, including summary statistics,
2. Maps showing the distribution and density of key species based on the combined biota data,
3. Statistical comparisons between current survey area results as per below.

5.6 Statistics

The aim of the statistics for the PSEAR is to describe the data and test for similarity between the control and sand extraction areas.

The infauna in each biota grab sample will be summarised by the following descriptive statistics:

- the number of individuals,
- the number of taxa,
- the Shannon-Wiener Diversity Index.

Variations in these indices will be compared by an Analysis of Variance (ANOVA) test if the assumptions of normality and equal variance were not met then nonparametric analogous tests will be conducted. The nonparametric equivalent of the one-way analysis of variance (ANOVA) is the Kruskal–Wallis test by ranks. If Significant differences were detected, then pairwise multiple comparison procedures such as Tukey tests or equivalent will be conducted to determine where the difference were.

A multivariate analysis approach will allow examination and testing of differences in species assemblages or grain size data between samples, cells and groups of cells.

Typically, the raw benthic biota data has a lot of taxa with very few individuals, the following protocols will be applied in order to “clean” the data to reduce “noise” levels in the data set. If taxa are recorded in 5 samples or less, then taxa will be grouped with similar taxa by either genus or family when possible. If no obvious grouping is present, then these samples will be retained. If fewer than 5 individuals of a taxa are recorded in all the samples, then the taxa will either be deleted or combined in a higher taxon grouping.

Grain size percentages are not independent an increase in one component must be offset by a decrease in another. This violates assumptions of many standard statistical methods. To properly analyse this kind of data, a transformation that accounts for the constant-sum constraint, such as Centred Log-Ratio (CLR) Transformation is required.

The multivariate data of the sediment texture and benthic biota surveys will be visualised by nonmetric Multi-Dimensional Scaling (nMDS) plots. nMDS is a rank-based ordination technique used to visualize similarities or dissimilarities among samples in a low-dimensional space, typically for ecological community data. It creates an ordination based on a distance or dissimilarity matrix, preserving the rank order of the distances rather than the actual distances, allowing for flexible use with many types of ecological distance measures like Bray-Curtis. It is widely used for detecting patterns and gradients in multivariate ecological data.

Permutational Multivariate Analysis of Variance (PERMANOVA) is a non-parametric multivariate statistical test used to compare groups of objects, typically ecological communities or other complex datasets. Multivariate data can differ in relation to the location of the centroid of each group within the multivariate cloud and in the spread of data within a group around each centroid. PERMANOVA tests the null hypothesis that the centroids (multivariate means) and dispersion (spread) of the groups, defined in terms of a chosen distance or dissimilarity measure, are equivalent across all groups. Rejection of the null hypothesis suggests there are significant differences in group centroids and/or dispersion. In order to determine the sources of differences between groups if determined to be statistically significant, the analysis method SIMPER (Similarity Percentage), will be used to assess the contribution of each species or variable to the overall dissimilarity between groups. It breaks down the percentage contribution of individual species to explain differences observed, helping identify species mostly responsible for group separation.

5.7 Written Deliverables

A draft PSEAR Report including the outputs outlined above and an updated ASEA plan.

The draft PSEAR Report is to be provided Te Parawhau ki Tai for their review and comments. Te Parawhau ki Tai are to be given 20 working days to undertake this review and provide comments. Comments from Te Parawhau ki Tai may include results from their hapu-led monitoring and assessment of findings against mātauranga Māori indicators of mauri.

A final PSEAR Report (including the updated ASEA plan) which is to include any comments received from Te Parawhau ki Tai and if and how they have been addressed.

6. SAND EXTRACTION MONITORING REPORT (SEMR)

Condition 37 sets out the requirement for a SEMR and Section 2 of this report sets out the timing for the delivery of SEMR to NRC.

The SEMR assesses the effects occurring as a result of sand extraction in those cells where sand extraction has occurred since the last SEMR.

The following monitoring programme is to be undertaken for an SEMR:

6.1 Written Deliverables

A draft SEMR Report including the outputs outlined above and an updated ASEA plan.

The draft SEMR Report is to be provided to Te Parawhau ki Tai for their review and comments. Te Parawhau ki Tai are to be given 20 working days to undertake this review and provide comments. Comments from Te Parawhau ki Tai may include results from their hapu-led monitoring and assessment of findings against mātauranga Māori indicators of mauri.

A final SEMR Report (including the updated ASEA plan) which is to include any comments received from Te Parawhau ki Tai and if and how they have been addressed.

6.2 Bathymetry monitoring

Bathymetry monitoring is to occur inside the extraction area, at control sites and on the shoreface to collectively:

- Inside the extraction area, identify the change in volume and bed level and any seafloor bathymetry anomalies due to the combined influence of natural sedimentation processes and extraction.
- Identify any (unexpected) changes to the lower shoreface morphology that may be associated with the extraction.
- Identify changes in the upper shoreface (using the 6 profiles) to detect the landward limit of dynamic profile change. The upper shoreface is expected to be dynamic in response to storms and coastal processes but is not expected to be modified by extraction in the proposal area.

Bathymetric survey collection using MBES with ±0.15 m vertical accuracy or better:

1. Within the extraction area, covering at least the cells covered by the PSEAR and the adjoining cells.
2. The control areas.
3. A 100m wide bathymetric control area outside of the extraction area to the west (landward), north and south.
   Six across shore bathymetric profiles that extend from seaward of the extraction to as shallow as practicable - no greater than 5 m in water depth.

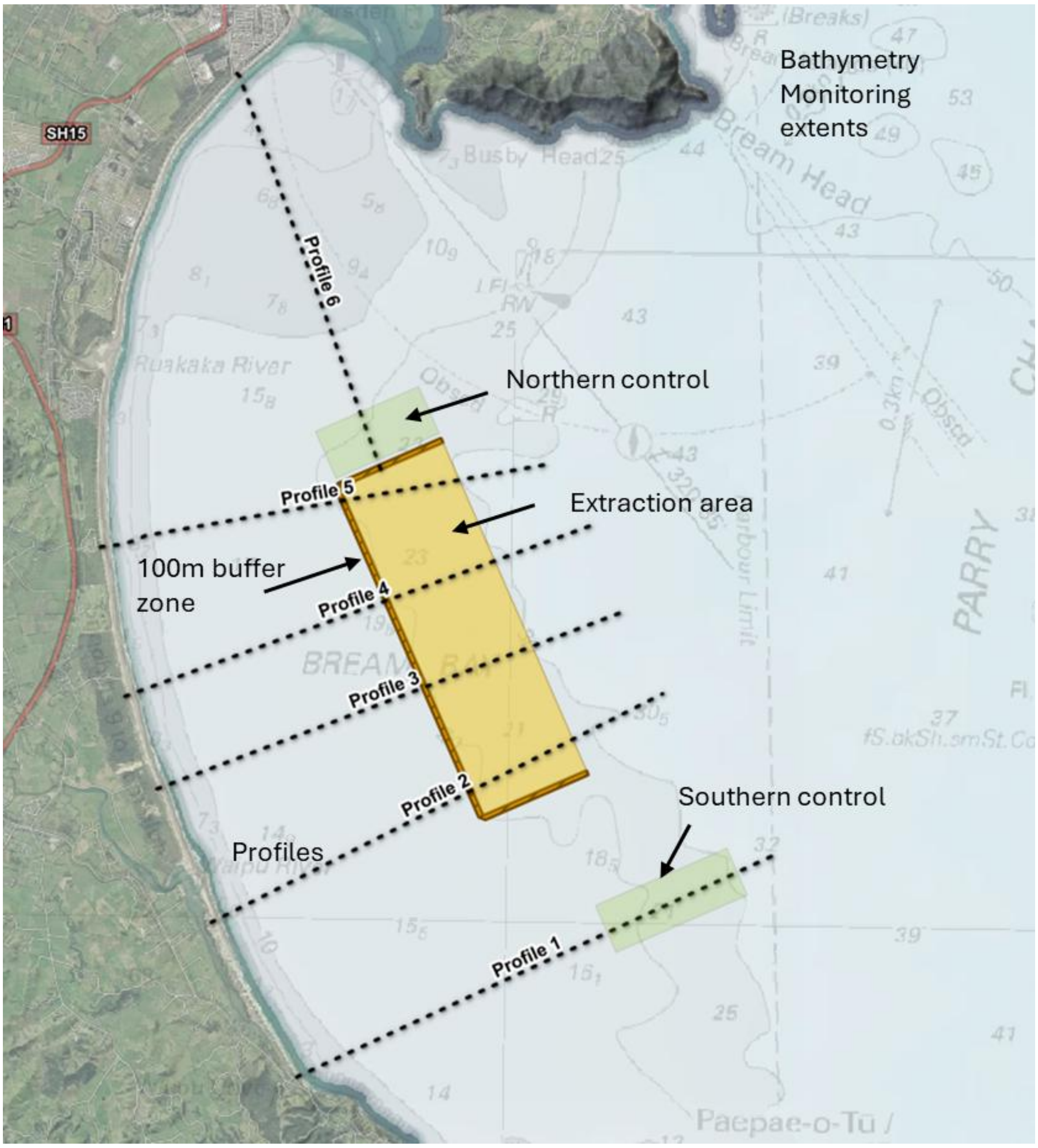


Figure 1: Locations for bathymetry monitoring. Note: Refer to Appendix B for the official map. Source: Tonkin + Taylor.

The MBES survey output is to comprise of:

i. Gridded bathymetry surface data at a spatial cell resolution of 1m horizontal.
ii. A colour-shaded bathymetric map of all data collected and otherwise relied on for the PSEA.
iii. Separate colour-shaded bathymetric maps of the extraction area control areas.

iv. Close up (high resolution) colour shaded bathymetric maps of any anomalous features.
v. Profile sections for the 6 profiles from shore to offshore.
vi. Map view of all MBES backscatter data (separate map).
vii. 15 detailed cross-section transect across the sand extraction area, including relative seabed levels and chainages, water depths, cross-section start and end coordinates to allow accurate comparisons between annual surveys. Analysis transects to be spaced every 500 m as in figure below and also undertaken in the control sites.

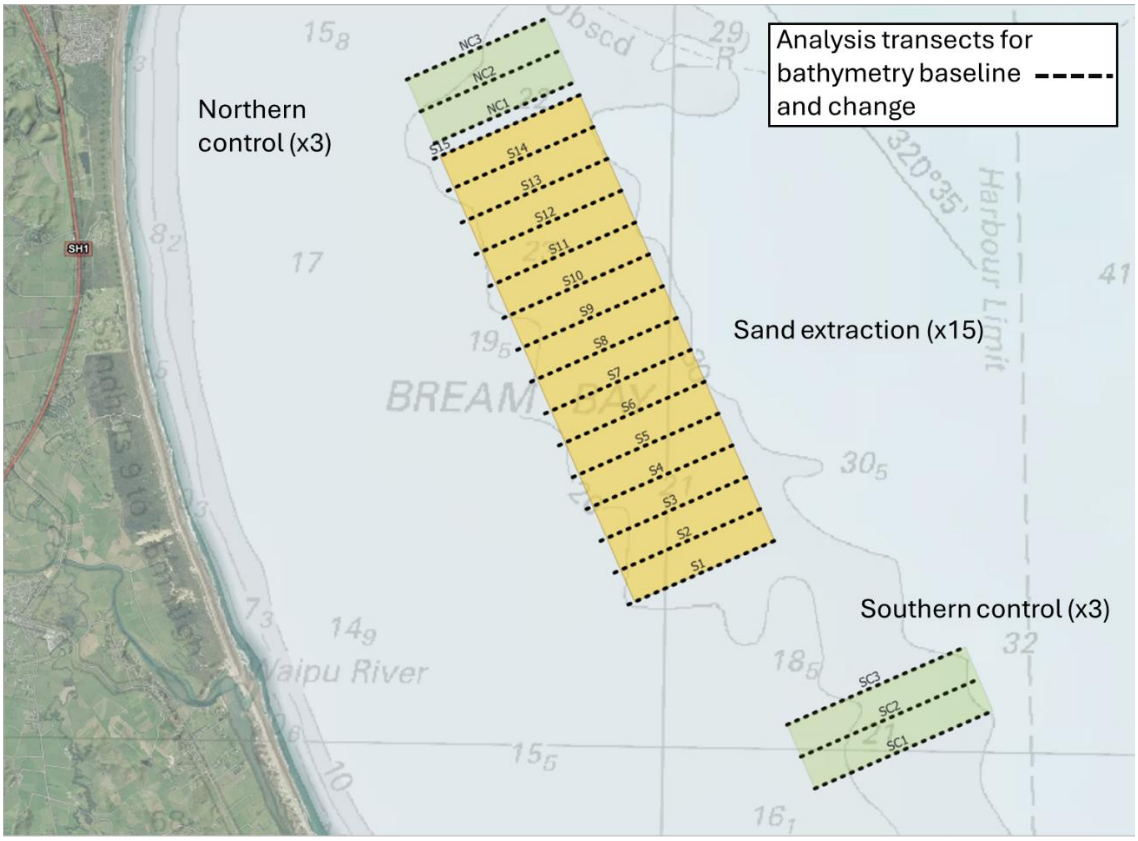


Figure 2: Analysis transects for bathymetry monitoring. Note: Refer to Appendix B for the official map. Source: Tonkin + Taylor.

Assessment:

Analysis of bathymetric survey data with reference to pre-extraction baseline and previous monitoring surveys:

1) Identify the presence of any track anomalies that exceed 2 m wide, 0.4 m depth, and 100 m in length.
2) Produce bathymetric difference maps comparing the assessment year to the pre-extraction baseline, and to the previous survey.
3) Cut and fill volume analysis of the pre-extraction and post extraction bed level to identify:
    a) Where extraction has occurred.
    b) Any natural infilling and recharge can be calculated by comparing the bathymetry cut volume to the extraction volume records.
    c) Consideration of survey error when comparing cut volume to extraction volume.
4) Analysis of bathymetric profiles to identify the presence of any lowering of the shoreface landward of the extraction site that is above the survey error margin of ±0.15 m, and check against change in bed level at control sites.
5) Interpretation of the causes of any unexpected volume loss that cannot be explained by extraction volume records and tracks, taking natural processes and storm events into consideration. Monitoring of control areas to be used as a reference for natural variation to determine potential effect of

extraction. Metocean conditions during each monitoring period should be characterised in each monitoring report, using the best available data.

6.3 Drop camera images

As part of the requirement to assess the benthic communities as per Condition 16 (and any relevant consent conditions), drop camera images will be taken concurrently or prior to Ponar grab and dredge tow sampling. During each sampling event Drop camera photographs and Ponar grab samples are to be taken in the same stratified random locations in each of the monitoring and control cells. Drop camera images of 1 m² of the seabed, plus lateral views are to be recorded at:

i. At least five stratified random locations within each control area cell,
ii. At least three stratified random locations within cells of the ASEA where sand extraction has occurred since the last SEMR.

The cameras will have a resolution of at least 20MP, including RAW capture. The cameras will be set to record images at 2-second intervals at the best available image quality setting, and the best representative images selected. A vertical image of the seabed will be framed by a 1 m² quadrate to allow measurements and quantification and have a compass for orientation. The lateral image will provide a wider view of the seabed nearby.

The images will have multiple uses;

i. To assess changes in fine scale (< 1m) bed forms and as confirmation of the multibeam interpretations,
ii. To provide an indication of substrate heterogeneity,
iii. To assess epibenthic habitat for the presence of any conspicuous sensitive benthic species or communities.

Sample locations will be predetermined based on cells, with the cells spilt equally based on the number of samples per cell, sampling points will be randomly located with the spilt cells, but no closer than 50 m from any other sample point. The sampling locations will be located by GPS, with sampling occurring as close as possible but no greater than 20 m from the planned location. These locations will be common to the seabed photographs, sediment texture and benthic biota sampling.

The seabed photography survey output is to comprise of;

i. Tabulated results, describing geomorphology and biota observed,
ii. Maps of key data if deemed necessary,
iii. Figures presenting each selected photograph.

6.4 Sediment Texture

Seabed sediment samples will be collected from:

i. At least five stratified random locations within each control area cell,
ii. At least three stratified random locations within cells of the ASEA where sand extraction has occurred since the last SEMR.

For the proposes of experimental design, the site is deemed to be the cell, and each sample is thus a replicate. Each grab sample will be common to both sediment texture and benthic biota sampling. Samples will be collected with a modified Standard Ponar Grab sampler or similar quantitative technique, with a sample area of at least 250 x 285 mm of seabed (0.071 m^2), and a bite depth of about 100 mm, producing sample volumes of 1 - 4 Litres. If the sample volume is less than 2 Litres the grab sample will be discarded and repeated.

The grab will be lowered to the seabed in a controlled manner halting 1-2 m above the seabed, before being lowered gently to the seabed. The grab will be triggered and raised a few metres above the seabed by hand with care to avoid the grab recontacting the seabed as a result of swell troughs and then raised to the surface by winch. The contents of the grab will be deposited in a clean fish bin. The volume of sample will be assessed to confirm a suitable sample has been collected.

The sample will be homogenised by mixing, a 100 ml subsample will be collected with an aluminium scoop into a clean new polyethylene 'zip lock'-type bag, sealed and double bagged with a pre-printed waterproof label (identifying site, sample date and testing required) between the two bags. A second 100 ml scoop will be collected and composited with other samples from the same cell, sealed and double bagged with a pre-printed waterproof label (identifying site, sample date and testing required) between the two bags. All sediment samples will be placed in a chilly bin and protected from warming. Sediment texture samples will only be chilled in the fridge and not frozen prior to transportation to the laboratory.

Particle size testing will be conducted initially on the cell composite samples, by an accredited laboratory such as Hill Laboratories using accredited testing methods. Samples will be wet-sieved through six sieves (2.0, 1.0, 0.5, 0.25, 0.125, and 0.063 mm) and the remainder collected in the pan. The sieved samples will then be dried and weights recorded as percentages of the total sample. If the composite samples show potential sediment texture trigger exceedances, (greater than 15% silt and clay), then the individual samples from those cells will be tested.

The sediment texture survey output is to comprise of:

i. Tabulated results, including sediment texture classification,

ii. A map or maps showing the distribution of the percentage of silt and clay-sized particles,

iii. Statistical comparisons between initial, previous and current survey results as per Section 6.7.

6.5 Benthic Monitoring

Benthic biota samples will be collected from:

i. At least five stratified random locations within each control area cell,

ii. At least three stratified random locations within cells of the ASEA where sand extraction has occurred since the last SEMR.

For the proposes of experimental design, the site is deemed to be the cell, and each sample is thus a replicate. Each grab sample will be common to both sediment texture and benthic biota sampling.

Once the two 100 ml Sediment Texture sub-samples have been removed from the grab sample, the sample will be sieved as soon as practicable after collection by puddle washing each whole sample through both 3 mm and 1 mm mesh sieves with seawater. Where possible the biota in the sieves will be kept below the puddle water level. No greater than 500ml sub samples will be washed through the sieves at any one time, in order to maximise the potential for observation of macrofauna for the presence of cup corals, by a suitably qualified and experienced person. Biota retained on the 3 mm sieve will be visually inspected by a SEQP for the presence of cup corals or notable macrofauna. If detected they will be photographed, enumerated, and returned to the seabed to minimize potential sampling impacts. The 1 mm sieve mesh was selected based on the known coarse sediment particle sizes, mesh sizes any smaller result in the majority of the sample being retained.

The remaining material retained on both sieves will be combined and transferred to a polyethylene 'zip lock'-type bag with a pre-printed waterproof label (identifying site, sample date and testing required), and preserved in a solution of 5% glyoxal, 70% ethanol seawater solution. They will be sealed and placed in a second polyethylene 'zip lock' bag and packed into labelled plastic containers for transportation to the laboratory.

Following sieving or if sieving is delayed after sampling, all samples will be stored in a cool shaded location and sieved within six hours of collection.

Prior to sorting, the samples will be rinsed on a 1 mm sieve with fresh water and placed in a white sorting tray. All fauna will be picked out of the samples and placed in labelled vials of 70% ethanol solution prior to taxonomic identification. Fauna will be counted and identified to the lowest taxonomic group possible. Only animals with intact heads will be identified and counted, by an SQEP benthic taxonomist. Both living and dead corals will be identified and counted, with the living and dead specimens counted separately. Any biota recorded in the seabed photographs not represented in the benthic biota grab samples at the same location will be added to the quantitative benthic biota data, based on its density of occurrence. Otherwise, it will be added as 1 observed individual to provide a more complete diversity.

The benthic biota survey output is to comprise of;

i. Tabulated results, including summary statistics,
ii. Maps showing the distribution of summary statistics,
iii. Maps showing the distribution and density of key species based on the combined biota data,
iv. Statistical comparisons between initial, previous and current survey results as per Section 6.7.

6.6 Epibenthic dredge tows

The grab sampling targets the smaller more densely occurring biota with the substrate, and may accidentally capture larger epibenthic biota. However, the area sampled is small and thus the larger biota will not be adequately sampled by the grab sampler. The seabed photographs provide some additional abundance data, but they do not provide size data, nor do they adequately sample the lower-density biota such as carrier shells, scallops, or starfish. It is difficult to determine the living status of gastropod shells observed. Previous sampling has shown that the carrier shells provide microhabitat for brachiopods, which are listed as a sensitive species in Appendix F. Photographs and or video are not sufficient to determine the presence of brachiopods, as they are often obscured under the shells or by other biota, thus epibenthic dredge tows are required to retrieve individual larger biota which can then be identified and measured.

Epibenthic dredge tows will be collected from one random location, spread across two cells (adjoining along the seaward side) within the sand extraction area and control areas.

Each epibenthic dredge tow will consist of lowering a 600 mm wide dredge fitted with a 35 mm mesh bag, to the seafloor and towing at low speed (~<1kt) for approximately 200 m between two predetermined GPS points, in an alongshore direction. All species captured during each tow will be removed and immediately sorted. All larger macrofauna such as bivalves, hermit crabs and starfish, will be identified, photographed, counted, measured and returned to the sea.

The epibenthic biota survey output is to comprise of;

i. Tabulated results, including summary statistics,

ii. Maps showing the distribution and density of key species based on the combined biota data,

iii. Statistical comparisons between previous and current survey results as per Section 6.7.

6.7 Statistics

The infauna in each biota grab sample will be summarised by the following descriptive statistics:

- the number of individuals,
- the number of taxa,
- the Shannon-Wiener Diversity Index.

Variations in these indices will be compared by an Analysis of Variance (ANOVA) test if the assumptions of normality and equal variance were not met then nonparametric analogous tests were conducted. The nonparametric equivalent of the one-way analysis of variance (ANOVA) is the Kruskal–Wallis test by ranks. The nonparametric equivalent of the two-way analysis of variance (ANOVA) is the Scheirer–Ray–Hare (SRH) test. If Significant differences were detected, then pairwise multiple comparison procedures such as Tukey tests or equivalent will be conducted to determine where the difference were.

A multivariate analysis approach will allow examination and testing of differences in species assemblages or grain size data between samples, cells and groups of cells.

Typically the raw benthic biota data has a lot of taxa with very few individuals, the following protocols will be applied in order to "clean" the data to reduce "noise" levels in the data set. If taxa are recorded in 5 samples or less, then taxa will be grouped with similar taxa by either genus or family when possible. If no obvious grouping is present, then these samples will be retained. If fewer than 5 individuals of a taxa are recorded in all the samples, then the taxa will either be deleted or combined in a higher taxon grouping.

Grain size percentages are not independent an increase in one component must be offset by a decrease in another. This violates assumptions of many standard statistical methods. To properly analyse this kind of data, a transformation that accounts for the constant-sum constraint, such as Centred Log-Ratio (CLR) Transformation is required.

The multivariate data of the sediment texture and benthic biota surveys will be visualised by nonmetric Multi-Dimensional Scaling (nMDS) plots. nMDS is a rank-based ordination technique used to visualize similarities or dissimilarities among samples in a low-dimensional space, typically for ecological community data. It creates an ordination based on a distance or dissimilarity matrix, preserving the rank order of the distances rather than the actual distances, allowing for flexible use with many types of ecological distance measures like Bray-Curtis. It is widely used for detecting patterns and gradients in multivariate ecological data.

Permutational Multivariate Analysis of Variance (PERMANOVA) is a non-parametric multivariate statistical test used to compare groups of objects, typically ecological communities or other complex datasets. Multivariate data can differ in relation to the location of the centroid of each group within the multivariate cloud and in the spread of data within a group around each centroid. PERMANOVA tests the null hypothesis that the centroids (multivariate means) and dispersion (spread) of the groups, defined in terms of a chosen distance or dissimilarity measure, are equivalent across all groups. Rejection of the null hypothesis suggests there are significant differences in group centroids and/or dispersion. In order to determine the sources of differences between groups if determined to be statistically significant, the analysis method SIMPER (Similarity Percentage), will be used to assess the contribution of each species or variable to the overall dissimilarity between groups. It breaks down the percentage contribution of individual species to explain differences observed, helping identify species mostly responsible for group separation.

Testing will be conducted to determine if there are differences between the sand extraction area and the control areas, as a whole, and if there are changes over time in the sand area relative to the changes in the control areas. If changes are detected in the sand extraction area additional testing will be conducted to determine if any particular locations along shore are more effected than others. Also, an attempt will be made to determine if there are any differences related to different sand extraction rates per cell. While these tests will determine statistical significance of the data, discussion will be added as to the ecological significance of the differences.

6.8 Assessment of Monitoring and Reporting Methodologies

The SEMR is to include a review of the monitoring and reporting methodologies to identify any issues arising from the monitoring and reporting methodology being used and to make recommendations to modify/improve the monitoring or reporting methodologies. This may also enable adopting new technology that can improve accuracy and efficiency. Adopting new survey methods should only be undertaken after a trial overlap to ensure compatibility with baseline and past monitoring data.

6.9 Plume Monitoring

Turbidity monitoring of the plume shall be conducted once annually during active extraction to assess the impact of the sand extraction process on water clarity and confirm that the effects are similar to those that have been assessed and that there is compliance with Condition 31.

6.9.1 Monitoring locations

Monitoring shall be conducted at the following locations:

- **Plume**: 500 m down current from the vessel, aligned with the direction of the sediment plume.
- **Background**: two locations approximately 300–500 m away from the plume location, perpendicular to either side of the plume direction. These locations must be outside the influence of the plume and serve as background reference points.

6.9.2 Methodology

Turbidity measurements shall be carried out in the field using a handheld optical turbidity sensor. The sensor shall be lowered to a depth between 2 to 5 m water depth, and readings should be recorded once the sensor output has stabilised.
During each monitoring occasion, the following shall be recorded for each of the three locations:

- Date and time;
- GPS coordinates;
- Photographic evidence of the output of the handheld optical turbidity sensor; and
- Turbidity measurement.

6.9.3 Consent Conditions

The turbidity level within the upper 2-5 m of the water column at approximately 500 m from the *William Fraser* in the direction of the plume shall not be more than 2 NTU higher than the greater of either of the two background turbidity measurements.

6.9.4 Trigger response

If the trigger above (6.9.3) is exceeded;

- The known seabed sediment texture composition of the area extracted at the time of water quality sampling will be reviewed,
- An investigation into the maintenance and operation of the ship and its operations shall be conducted to determine whether it is working to the level expected.

Repeat sampling shall be conducted within one month. Further expertise will be required if repeat sampling also exceeds the trigger response. Actions could include, for example, revision of the seabed sediment texture composition exclusion criteria, and or the upgrade or replacement of ship components to achieve compliance with Condition 42.

6.10 SEMR Recommendations

The SEMR is to:

i. Identify any significant adverse effects arising based on the SEMR monitoring. If no significant adverse effects are identified then this is to be stated.
ii. Include recommendations to the extraction methodology to address any significant adverse effects arising.
iii. Identify recommended changes to the SEMR monitoring methodology and/or reporting.
iv. Recommend any changes to the EMMP (and any relevant consent conditions).
v. An updated ASEA.

In order to determine if an adverse ecological effect has occurred, the benthic fauna and grain size will be assessed as a comparison between the sand extraction area and the control areas and will be assessed in terms of a set of "ecological criteria". These ecological criteria are set in relation to baseline variability, ecological significance, and natural variability and therefore cannot be fixed values.

The benthic infauna criteria are;

- >30% decline in mean species richness or Shannon **diversity** at impact sites relative to baseline / control areas (beyond natural seasonal variation).
- >50% reduction in mean infaunal **abundance** of key taxa (e.g. polychaetes, bivalves) compared to baseline / control areas.
- **Community composition**, significant BACI effect detected (PERMANOVA $p<0.05$) with >40% similarity loss (Bray–Curtis) relative to baseline / control areas.
- **Loss of sensitive functional groups** (e.g. deep-burrowing bioturbators, suspension-feeders) with >30% shift in trait composition relative to baseline / control areas.

The epibenthic fauna & habitat features criteria are;

- **Biogenic habitat** cover, >20% reduction in percent cover within or immediately adjacent to extraction area.

- **Sensitive species** occurrence, absence of previously present keystone species (e.g. *Atrina zelandica*, Dog cockle *Glycymeris*, large sponges).

The sediment grain size composition criteria are;

- **Grain size** change, shift in median grain size >20% relative to baseline / control areas.

If these criteria are met over at least 2 consecutive surveys that may provide an indication of a potential adverse effect which will then need to be assessed to determine whether that potential adverse effect is significant in terms of (i) above and is related to sand extraction.

6.11 Year Four SEMR (the Third SEMR)

After three years of monitoring while operating at the initial extraction limit of 150,000 m^3/yr, the year three SEMR is to evaluate and confirm the level of effect on the environment is being managed to prevent bathymetric and ecologically significant adverse effects to benthic biota communities, before the rate of extraction increases to 250,000 m^3/yr.

Sand extraction cannot increase to 250,000 m^3/year if:

Monitoring over the first three years detects lowering of the shoreface landward of the extraction area that exceeds -0.15 m (limit of survey error) on average across the 100 m bathymetric control area that cannot be explained by natural processes (e.g. same trend is not occurring in the control areas) and could be attributed to the extraction having an adverse effect on the lower shoreface; and/or,

Monitoring over the first three years detects an ecologically statistically significant change in the benthic biota assemblage, composition, and abundance relative to changes in the control biota and attributable to sand extraction.

If it is determined that sand extraction cannot increase to 250,000 m^3/year then this is to be reassessed in the following SEMR until such time that it is confirmed that sand extraction can increase to 250,000 m^3/year. It is likely that the monitoring period will remain at 1 year, however the period between SEMR assessments can be increased at this time if the sand extraction volume is not increased and the monitoring results are supportive. The consent holder has the right to delay increasing the sand extraction volume.

7. METHODOLOGY FOR SOUNDSCAPE CHANGE MEASUREMENT AND ASSESSMENT

7.1 Objective

The objective of the Acoustic Monitoring Program (AMP) is to demonstrate that change in the soundscape level at the monitoring locations arising from the Project does not exceed 3dB over any calendar month, or to set out the change and any mitigation response(s) if it is greater than 3dB.
The soundscape is described in the executive summary of the Underwater Report as:

> *A soundscape is all sounds within a specific area, including the spectral, temporal and spatial variation of biologically-generated sounds (termed biophony), natural sounds such as wind and rain (termed geophony) and man-made noise (termed anthrophony).*

The AMP has three primary components:

1) Continuous acoustic measurements for six months to quantify the soundscape without the Project (the '**without Project'** measurements) and for the same six months with the Project (the '**with Project'** measurements).
2) Assessment of the 'without Project' and 'with Project' soundscapes, and
3) Production of a report setting out the results of the measurement and assessment and the calculation of the overall soundscape change in decibels, adjusted for the maximum permitted extraction volumes.

7.2 Site selection

The AMP monitoring will be undertaken at two monitoring locations. These locations are set in southern area of Te Ākau Bream Bay, approximately 1.5km apart and relatively close to Langs Beach.

The coordinates of the positions are:

	World Geodetic System 1984 EPGS:4326		New Zealand Transverse Mercator Projection EPGS:2193	
	Latitude	**Longitude**	**Northing**	**Easting**
Mark 1	-36.025073	174.550723	6012157.276	1739723.867
Mark 2	-36.014353	174.524521	6013383.690	1737381.437

Although only one monitoring position is strictly required, two have been adopted to provide sampling redundancy should equipment failure occur. Monitoring at two positions will deliver additional data and certainty if there are no failures.

This area of Te Ākau Bream Bay is selected for the monitoring because it is furthest from the shipping channels and is predicted to have the lowest levels of existing anthropogenic noise sources.

More specifically:

- The soundscape at the monitoring locations is predominantly natural, consisting predominately of geophonic and biophonic sound sources.

- The introduction of the Project is predicted to have a higher cumulative effect in the southern areas of Te Ākau Bream Bay where anthropogenic noise is at its lowest, and where the monitoring is proposed.
- By contrast, the northern parts of Te Ākau Bream Bay (closer to the extraction area) are nearer Whangarei Harbour entrance and where shipping traffic converges to narrow shipping lanes that increase the anthropogenic contribution to the soundscapes.

7.3 Measurement methodology

1) Each monitoring location will contain at least one underwater sound recorder. Each recorder must produce 16-bit raw audio files at 48 kHz sampling rates (or ideally 96kHz) or better. These sampling rates are required to capture the complete soundscape frequency range that is relevant for the marine mammal species that occur in Te Ākau Bream Bay.
2) Higher sampling rates are not required as Very High Frequency (VHF) cetaceans (such as hector's dolphins) producing narrow-band high frequency echolocation clicks are not present in Te Ākau Bream Bay.
3) The recorders must be secured 1-2m off the seafloor on moorings specifically designed to minimise extraneous noise sources. This is critical due to the reliance of sound pressure levels being measured to determine the soundscape change due to the Project.
4) The recording periods must be continuous (not duty-cycled) for the monitoring period[4].
5) The recordings must be continuous for at least six months without the Project and for at least the same six months with the Project. The 'with Project' measurements must commence at the same time as the commencement of extraction.
6) Short periods of downtime in the monitoring are permitted provided these are avoided as far as practicable and are due to unforeseen circumstances for reasons such as device loss or failure, timer or data errors, the intervals between swapping recorders during the monitoring, or bad weather delaying retrieval before battery failure. Any gaps in recordings must be clearly defined and explained in the final report.

7.4 Soundscape change assessment methodology

The analysis methods/protocol should follow that described in Pine et al. (2021). Additional and specific requirements are set out below:

1) Measured sound levels should be calculated for each calendar month of the 'with Project' and 'without Project' measurement campaigns.
2) Measured sound levels are likely to require adjustment to remove hours with high geophony (such as breaking waves and significant swells).

[4] Monitoring period is likely to be 1-2 years, so to obtain baseline data over all seasons. However, a complete summer and winter are the minimums as the two extremes for vessel activity and different weather effects.

a. Exclusions are likely to be required for wind speeds over 10 knots and/or when the average swell height exceeds 2.5m. The Interim Report shall specify the exclusion parameters.

b. Wind speeds should be taken from the nearest weather station with as near 360º exposure as possible. Northport is best location for these data, available via NIWA's CliFlo database.

c. The geophony exclusion parameters and exclusions in the 'without Project' measurements must be specified following analysis of all hours and sea conditions prior to the Project commencing.

d. The same exclusion parameters must be applied to the 'with Project' measurements when the Project commences.

3) The daily and monthly data shall be processed following the methodology in Pine et al. (2021). Any variations to this methodology shall be made clear and justified.

4) The change in soundscape at the monitoring locations generated by the Project shall be reported for each calendar month, for at least six months. The 'without Project' and 'with Project' monthly comparisons shall be for the same calendar months (e.g. August 2025 without Project vs August 2026 with Project) unless (5) applies below.

7.5 Methodology for soundscape change assessment where 'without Project' monitoring is not available for the same calendar months as the 'with Project' monitoring

5) It is possible that consent may be granted, and extraction could commence in advance of the 'without Project' measurements being available for the same six-month period[5]. If that situation arises, there would be no 'without Project' measurement data collected for the same calendar months in which extraction could commence.

The following methodology must be followed if 'without Project' measurements are not available for the calendar months when extraction could otherwise commence after consent is granted:

a. Soundscape measurements must be undertaken in accordance with the Measurement Methodology set out above, and as soon as practicable following the granting of consent (if it is not already underway).

b. The *William Fraser* will only be in the area for approximately four hours each day (including transit times). Soundscape measurements in the remaining 20 hours (approximately) will represent the 'without Project' soundscape for the period that the *William Fraser* was not present. The soundscape measurements for each day shall be processed to determine the hourly L_{eq} level for the whole hours that the *William Fraser* makes no measurable contribution to the soundscape.

c. The 'without Project' soundscape for the full day shall be calculated by:

[5] The 'without Project' measurements commenced in mid-July 2025. If consent was granted in (say) March 2026, there would be no 'without Project' measurements available in March, April, May or June 2026 to compare to 'with Project' measurements in those months when extraction could commence.

i. Removing the soundscape measurement data where the *William Fraser* did contribute measurably to the soundscape,

ii. Calculating the L_{eq} level between sunrise and sunset where the *William Fraser* did not contribute measurably to the soundscape,

iii. Substituting the L_{eq} value (from ii) for when the *William Fraser* did contribute measurably to the soundscape,

iv. Recalculating the 24-hour L_{eq} from the data derived from i. and ii. above,

v. These recalculated 24-hour L_{eq} levels become the equivalent 'without Project' days for the purpose of the 'without Project' and 'with Project' comparisons required in the Reporting section below.

d. The analysis in section 5 may be supplemented with or explained by additional statistical (non-L_{eq}) acoustic data if required.

7.6 Reporting

The consent holder must prepare an interim report and final report as follows:

1) **Interim Report** – no later than eight weeks after the commencement of extraction or the first full 12 calendar months of 'without Project' measurements – whichever is the earlier. The Interim Report must set out:

   a. The details of all measurements, including locations, wind speed and direction, swell height (if available) and any issues, deficiencies or gaps in the data.

   b. The exclusion parameters for geophony and the reasons for their selection, and the L_{eq} levels for each calendar month following those exclusions.

An Interim Report is not required if consent is granted before July 2026 and 'without Project' measurements are required in accordance with the process outlined in section 5 of "Soundscape change assessment methodology".

2) **Final Report** – within eight weeks of collecting the recorders after the first six months of 'with Project' measurements. The Final Report must set out:

   a. All findings from (1) above for 'without Project' data,

   b. An analysis of the six months of 'with Project' measurements using the same assessment methods as for the 'without Project' measurements,

   c. A method and results for adjusting the 'with Project' measurements to represent the contribution of the Project to the soundscape based on maximum extraction rates as set out in Condition 23.

   d. Comparisons of:

i. The ‘with Project’ and ‘without Project’ measured data following only exclusions for geophony. The data for ‘with Project’ months must show the actual extraction rates for those months

ii. The ‘with Project’ and ‘without Project’ measured data following exclusions for geophony and adjustments to the ‘with Project’ data to show the contribution of the Project to the soundscape change using maximum sand extraction rates as set out in Condition 23.

e. The soundscape changes for each month shall be expressed as an average, in decibels and rounded to one decimal place.

f. An ultimate conclusion on the average monthly change in soundscape at the monitoring location for each calendar month, arising due to the commencement of extraction, when adjusted for the maximum extraction rates set out in Condition 23.

g. An assessment of mitigation options if required, and as set out below.

7.7 Mitigation options

If the Final Report demonstrates that the commencement of the Project changed the monthly soundscape at the monitoring locations by an average of 3dB or less in all calendar months, no further action is required.

If the Final Report shows that the commencement of the Project changed the monthly soundscape at the monitoring location by more than 3dB in any calendar month, the Final Report shall set out the mitigation options that will be adopted by the consent holder to reduce the soundscape change arising from the Project to no more than 3dB in any calendar month at the monitoring locations.

The mitigation options could be physical (e.g. reducing the noise of the vessel and extraction operations at source) or by management (e.g. reducing the time spent in the area).

7.8 Certification

The Final Report must be submitted to the Northland Regional Council within 32 weeks of the commencement of the Project.

8. SAND EXTRACTION AND VESSEL TRACKING RECORDS

Under Condition 34 the following information is to be retained by MBL and submitted to the NRC:

a) The date, time and sea conditions during the period of extraction and the water depth of extraction.

b) The volume of sand extracted from each cell where extraction has occurred.

c) The total volume of sand extracted. In the event that the *William Fraser* is not fully loaded, the Consent Holder may report the volume of the incomplete load calculated from the onboard sensors measuring compliance with the load line marked on the vessel’s hull in accordance with Maritime NZ requirements before any unloading of sand. The record must include for each load:

   i. A screenshot or other verifiable way of showing the date and time, and the reading of the sensors.

   ii. The volume of the load by reference to the load-line.

d) An electronic record of the track of the *William Fraser* (using a GPX file format or equivalent) and mapped using a differential global positioning system (“DGPS”) showing:

i. A complete track of the *William Fraser* from the entry point into and departure point from the sand extraction area.
ii. A track of the *William Fraser* showing when the draghead is on the seabed extracting sand and when the dredge head is above the seabed and not extracting sand.

8.1 Reporting Requirements

The Consent Holder must provide to the NRC a copy of the records required by Condition 35 quarterly from the commencement of the consent along with a running record of the total volume of sand extraction to date for each cell, and for that month, year and consent period.

If no sand extraction has occurred during that quarterly period, then a statement to that effect will be provided to the NRC.

9. LOGS

This EMMP is the depository for the various logs required to be kept by the consent holder.

These are:

- **Seabird Interaction Log** (Condition 38) (Appendix G)
  A log is to be maintained to record any seabird fatality or injury arising from an interaction with the *William Fraser*, recording time and date of interaction, species involved (and a photograph if practical).
  A record shall also be kept of any seabird which after alighting on the *William Fraser* is unable to leave the vessel without assistance (but which appears otherwise uninjured).
  This is to be submitted to DOC quarterly for information collection purposes.

- **Marine Reptile Sighting Log** (Condition 39) (Appendix H).
  A log is to be maintained to record any sightings of marine reptiles recording location, time and date of sighting, species sighted and a photograph (if practical).
  The log is to be submitted to DOC within 5 working days of a marine reptile sighting.

- **Marine Mammal Sighting Log** (Condition 40) (Appendix I).
  All sightings of Marine Mammals must be recorded in the "Marine Mammal Sighting Log". A summary the daily Marine Mammal records log shall be submitted to DOC, Te Parawhau ki Tai, and the Patuharaheke Te Iwi Trust Board annually for information collection purposes.

- **Marine Mammal Incident Log** (Condition 41) (Appendix J).
  The Consent Holder must record and report any incident which results in injury or mortality to a marine mammal to the NRC, Te Parawhau ki Tai, and the Patuharakeke Iwi Trust Board and the DOC as soon as practicable.

10. CHANGE OF EXTRACTION/DISCHARGE METHODOLOGY AND/OR VESSEL

Any change to the approved sand extraction and/or discharge methodology and/or the use of an alternative vessel(s) for extraction to the *William Fraser* will require written certification from the NRC, before any change in the sand extraction operation or vessel(s) used for the sand extraction.

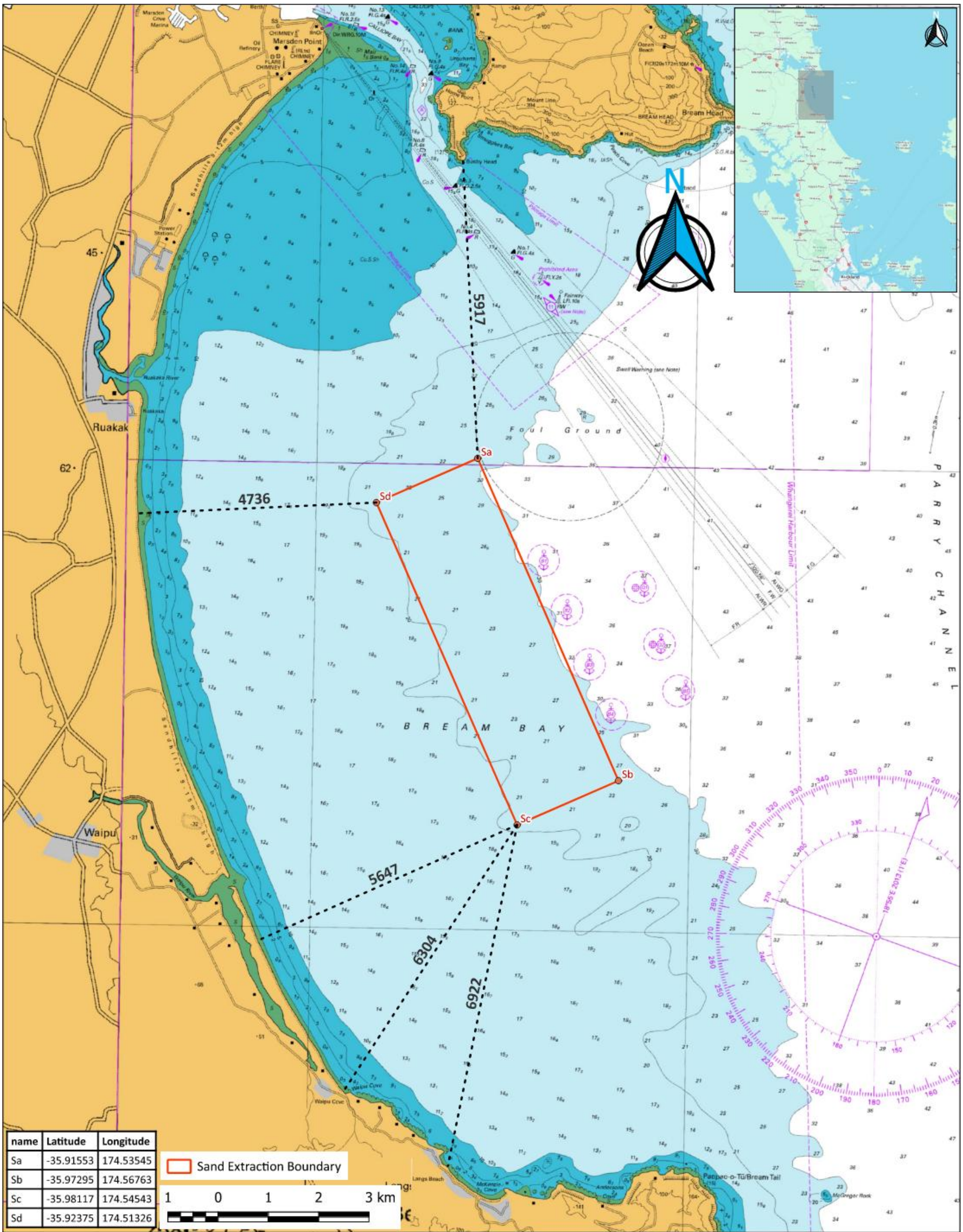
Any proposed change of vessel or extraction and/or discharge methodology must be notified in writing to the NRC and be accompanied by a report prepared by a SQEP(s) that:

a. Identifies the proposed changes and the reasons why the change is being made; and
b. Identifies and quantifies expected underwater noise changes resulting from the change and the potential changes in effects arising from these changes (if any);
c. Identifies and quantifies expected changes in the discharge (including the size and duration of the visible plum) and the potential changes in effects arising from these changes (if any);
d. Identifies any changes to the drag-head extraction width and depth and extraction rates, and the potential changes in effects arising from these changes (if any);
e. Includes any changes required to any certified Management Plans; and
f. Includes a report from an independent engineering surveyor stating the volume of sand in cubic metres that is carried by the new vessel(s) for extraction and transport when loaded to the load line marked on the vessel's or vessels' hull(s) in accordance with Maritime NZ requirements.

The applications for changes and the NRC approval are included in Appendix K

Change Number	**Date Lodged**	**Summary of Changes Sought**	**Date Approved By NRC**	**Date Implemented**

Appendix A Proposed Sand Extraction Area Drawing



name	Latitude	Longitude
Sa	-35.91553	174.53545
Sb	-35.97295	174.56763
Sc	-35.98117	174.54543
Sd	-35.92375	174.51326

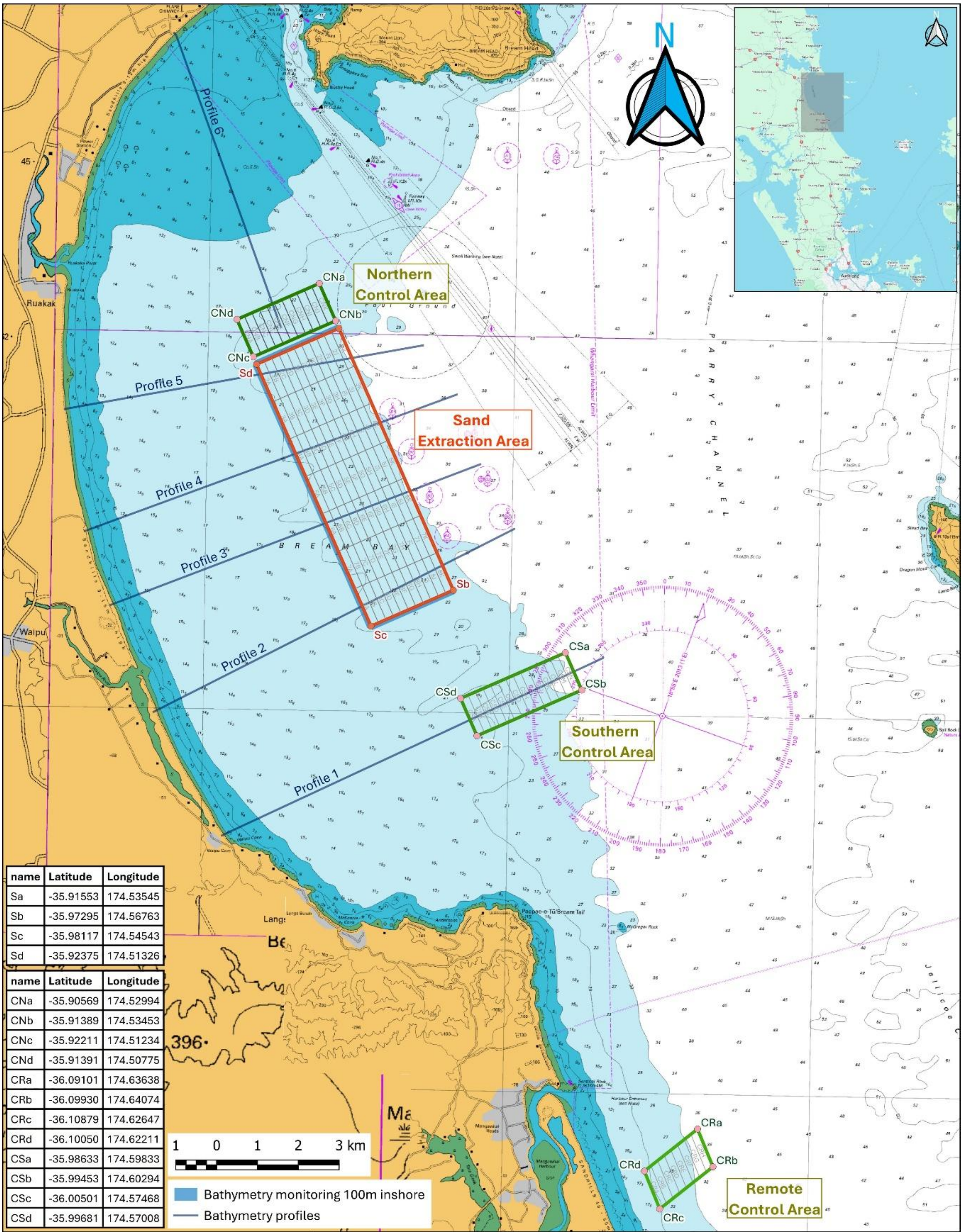
CLIENT / PROJECT		MAP REVISIONS
McCallum Bros. Ltd.	CD – Chart Datum as measured at Marsden Point (LINZ code DJM9) Map projection - NZ Transverse Mercator EPGS:2193 GPS points - WGS 84 EPGS:4326	Drawing Date: 22/10/2024 Version 0.1.2 by SW.

MAP FILE NAME

Map showing Proposed Sand Extraction Area and distances (m) to shore

Bioresearches

Appendix B Proposed Extraction And Control Cells Drawing



name	Latitude	Longitude
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Sb	-35.97295	174.56763
Sc	-35.98117	174.54543
Sd	-35.92375	174.51326

name	Latitude	Longitude
CNa	-35.90569	174.52994
CNb	-35.91389	174.53453
CNc	-35.92211	174.51234
CNd	-35.91391	174.50775
CRa	-36.09101	174.63638
CRb	-36.09930	174.64074
CRc	-36.10879	174.62647
CRd	-36.10050	174.62211
CSa	-35.98633	174.59833
CSb	-35.99453	174.60294
CSc	-36.00501	174.57468
CSd	-35.99681	174.57008

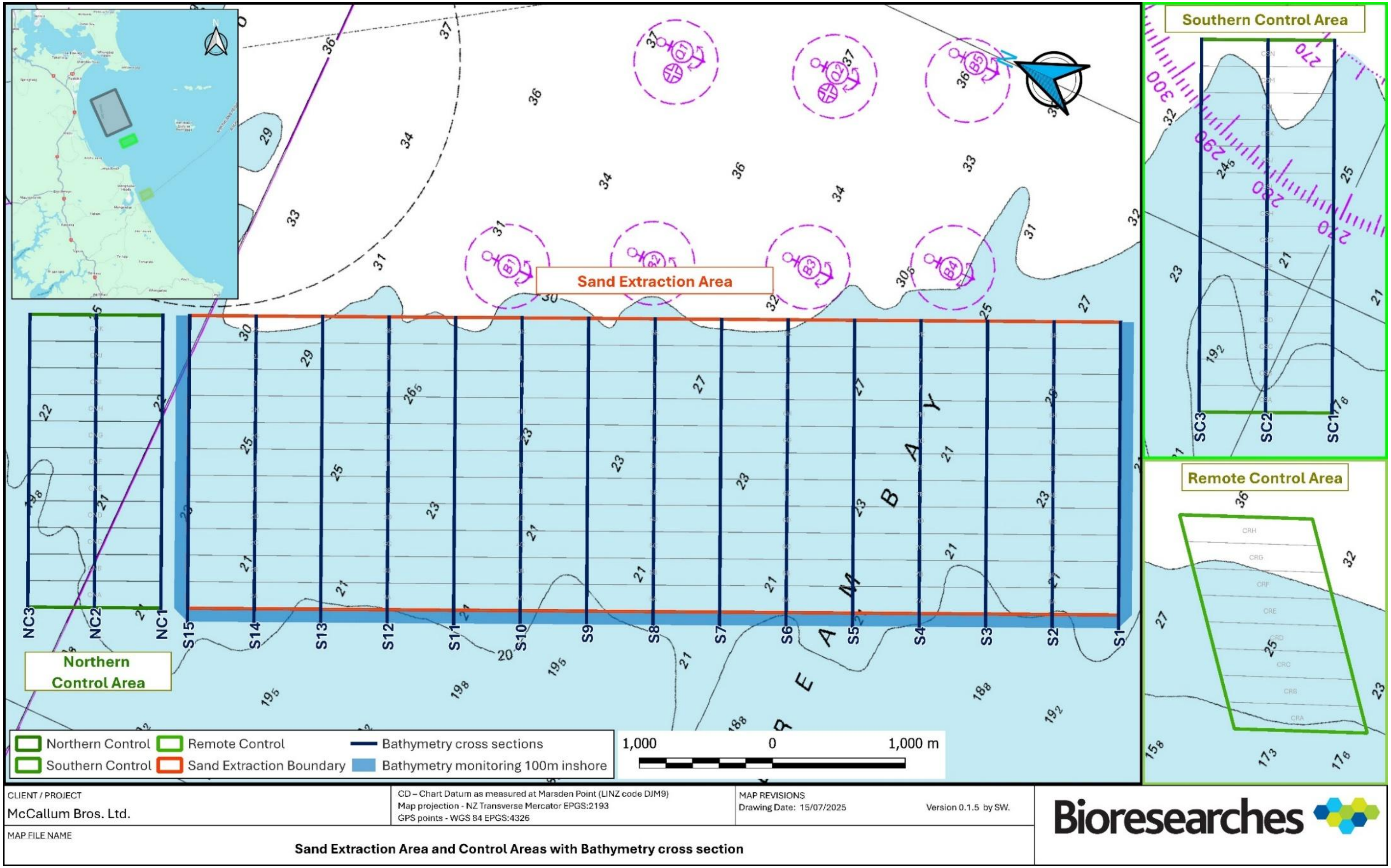
CLIENT / PROJECT
McCallum Bros. Ltd.

CD – Chart Datum as measured at Marsden Point (LINZ code DJM9)
Map projection - NZ Transverse Mercator EPGS:2193
GPS points - WGS 84 EPGS:4326

MAP REVISIONS
Drawing Date: 15/07/2025 Version 1.0.3 by SW.

MAP FILE NAME
Map showing Sand Extraction Area and Control Areas

Bioresearches


Southern Control Area
Sand Extraction Area
Remote Control Area
Northern Control Area
NC3
NC2
NC1
S15
S14
S13
S12
S11
S10
S9
S8
S7
S6
S5
S4
S3
S2
S1
SC3
SC2
SC1
Northern Control
Southern Control
Remote Control
Sand Extraction Boundary
Bathymetry cross sections
Bathymetry monitoring 100m inshore
1,000 0 1,000 m
CLIENT / PROJECT
McCallum Bros. Ltd.
CD – Chart Datum as measured at Marsden Point (LINZ code DJM9)
Map projection - NZ Transverse Mercator EPGS:2193
GPS points - WGS 84 EPGS:4326
MAP REVISIONS
Drawing Date: 15/07/2025
Version 0.1.5 by SW.
Bioresearches
MAP FILE NAME
Sand Extraction Area and Control Areas with Bathymetry cross section

Appendix C Pre Sand Extraction Monitoring Reports (PSEAR)

Te Ākau Bream Bay Sand Extraction Project

Pre Sand Extraction Assessment Report, February - March 2024

for: McCallum Bros Limited

Consulting Biologists – Established 1972
P.O. Box 2027, Auckland 1140. New Zealand
www.Bioresearches.co.nz

DOCUMENT CONTROL AND REVISION RECORD

Document title	Te Ākau Bream Bay Sand Extraction Project Pre Sand Extraction Assessment Report, February - March 2024
Prepared for	McCallum Bros Limited

Author(s)	Simon West, M.Sc. (Hons), Marine Ecologist Bioresearches	
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Reviewer(s)	Dr Laureline Meynier, Senior Marine Ecologist	
Approved for Release	Simon West, Technical Director Marine Ecology	

Version	Date	Author(s)	Reviewer	Approved for Release
Draft v1	7 August 2025	S. West, E. Beetham, L. Murdoch-Tighe, J. Patino Perez	L. Meynier	
Draft v2	8 August 2025	S. West, E. Beetham, L. Murdoch-Tighe, J. Patino Perez	L. Meynier	S. West
Draft v3	17 October 2025	S. West, E. Beetham, L. Murdoch-Tighe, J. Patino Perez	L. Meynier	S. West
Final v4	9 December 2025	S. West, E. Beetham, L. Murdoch-Tighe, J. Patino Perez	L. Meynier	S. West

Job number	67129
Filename	67129 Te Ākau Bream Bay PSEAR Draft V4.Docx

Reference: West, S., Beetham, E., *et al.* (2025). Te Ākau Bream Bay Sand Extraction Project, Pre Sand Extraction Assessment Report, February - March 2024. Report for McCallum Bros Limited pp 180.

Cover Illustration: Sand extraction vessel "William Fraser" in operation off Pakiri beach (November 2019)

EXECUTIVE SUMMARY

An initial monitoring survey was completed in February-March 2024 of the Te Ākau Bream Bay sand extraction area.

The survey consisted of complementary techniques: Bathymetry monitoring to determine water depth and seabed level, drop camera sampling to determine the nature of the seabed and identify epibiota; dredge tows to determine the abundance and size of epibiota and sparse shellfish like scallops; and grab samples to characterise the infauna communities, and determine grain size composition. The survey area included the sand extraction area and three control areas all in areas of 22 to 32 m water depth relative to the 2016 New Zealand Vertical Datum (NZVD). The sand extraction area and control areas were divided into cells with dimensions of 1000 m alongshore and 200 m perpendicular to shore. In the sand extraction area, 231 sites were located in a random stratified pattern were photographed, sampled for sediment, and infauna benthic biota, and 40 dredge tows of 200 m long were conducted. In the control areas, the sampling was carried out at 143 sites which were located in a random stratified pattern and 16 dredge tows.

Physical characteristics of the seabed

The average bed level in the proposed extraction area is -2.75 m RL, with the range between -21.9 and -33.8 m RL. The seabed generally slopes seaward although there is alongshore and across shore variation in due to macro scale bedforms.

Each of the 374 seabed photographs were categorised by bedform shape and size, and by the percentage of shell, in order to provide any indications of habitat heterogeneity which may influence benthic biota populations.

With few exceptions, sediment within the sand extraction area was described as either "slightly gravelly Sand" or "Sand." The silt and clay proportions for all 77 cells were low: 59 cells had less than 5% silt and clay, 17 had between 5 and 10%. The percentage to silt and clay did not exceed 20%. Similar proportions were also recorded in the control areas.

Biological characteristics of the seabed

From the dredge tows, a total of 51 different epibenthic taxa were identified. Forty-two taxa were recorded from the sand extraction area, 10 of these taxa were unique to the sand extraction area (i.e. not recorded in the Control areas). Forty-one taxa were recorded in the Control areas; of these, nine were not recorded in the sand extraction area.

Brachiopods and horse mussels, considered sensitive benthic organisms, were not detected in either the seabed photographs or the dredge tows in the sand extraction area. Large bivalves including Scallops (*Pecten novaezelandiae*), Clams (*Dosinia* sp.), Purple cockle (*Purpurocardia purpurata*) were recorded in the sand extraction area, along with a number of large shellfish including Volutes (*Alcithoe* sp.), the whelks (*Austrofusus* sp., and *Cominella adspersa*), Ostrich foot whelks (*Struthiolaria papulosa*), large Trophon (*Penion sulatus*), and Carrier shell (*Xenophora neozelanica*). All over these species are typical of this sandy shallow seabed habitat along the North Islands east coast, from northland to the Bay of Plenty. The most abundant Scallops and Dosinia, did not form shellfish beds (as defined in NIWA, 2013).

There were 218 taxa identified among the infauna community from the combined sand extraction area and control areas. For each replicate sample, the number of taxa averaged 26.9 and ranged from 8 to 44. The biota at 20-30 m depth was dominated by Urothoidae and Phoxocephalidae amphipods. The >30 m biota was dominated by an unidentified group of amphipods and the polychaete worm *Owenia petersenae*, other taxa that defined this community were the gastropod *Sigapatella tenuis*, the bivalves *Gari* sp., *Scalpomactra scalpellum* and *Corbula zelandica*. All the biota consisted of nationally and locally common species, with no "At Risk" species. The detection of a few cup corals does not notably increase the ecological value of the area, as these species are very small, solitary and do not form complex habitats.

The biotic composition and abundance of the sand extraction area and the three control areas combined were tested by PERMANOVA. This showed that the biotic composition and abundance of the sand extraction area were statistically significantly different (p=0.0001) to the control area. The SIMPER results show that the control and sand extraction assemblages are ecologically comparable and characterised by the same dominant species. The moderate within-group similarities and between-group dissimilarity values are consistent with naturally patchy and dynamic soft-sediment environments. The observed variation is most likely related to small-scale differences in sediment composition or shell content rather than direct effects of extraction. These results support the interpretation that benthic communities within the proposed extraction area are typical of well-sorted, high-energy sand habitats and are not compositionally distinct from nearby control areas.

As a result of the surveys, all cells in the sand extraction area are found to be suitable for sand extraction and no cells should be excluded based on the consent condition triggers. Several cells are highlighted as having either elevated silt and clay proportions or live cup corals though neither are cause for exclusion based on the consent conditions.

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1 INTRODUCTION

McCallum Bros Ltd (MBL) is applying for a resource consent (TBC) to extract marine sand offshore of Te Ākau Bream Bay in Northland, New Zealand. This Pre-Sand Extraction Assessment Report (PSEAR) (including the Approved Sand Extraction Area Plan) forms part of this application and has been prepared in accordance with the Environmental Monitoring Management Plan (EMMP) submitted with the application. The EMMP requires the PSEAR to provide the baseline ecological and bathymetric information for subsequent monitoring, and to identify areas where sand extraction can be undertaken within the sand extraction area.

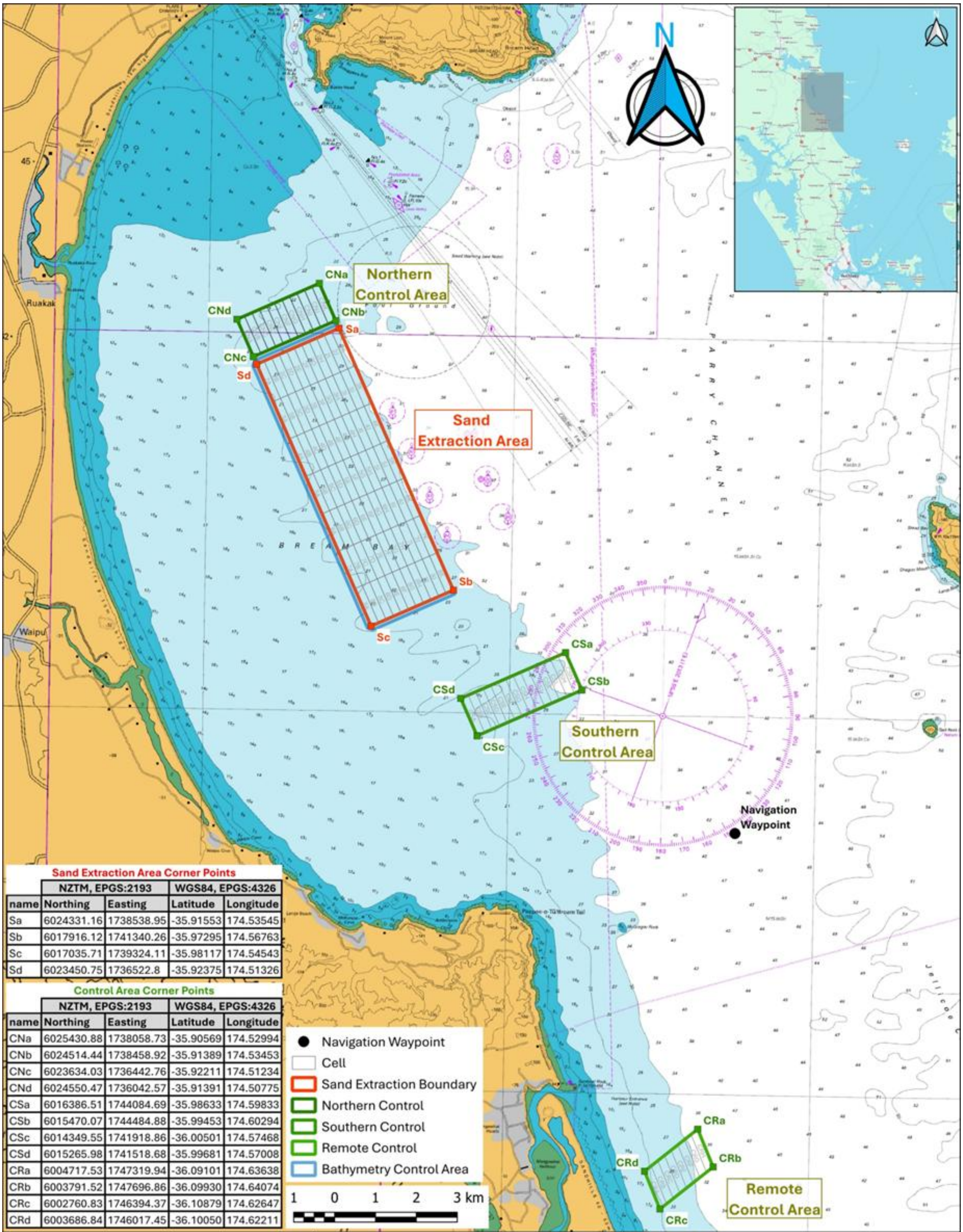
The EMMP specifies the PSEAR is to include survey data on;

- Geomorphic features
  - Bathymetry
  - Seabed imagery
  - Sediment texture
- Benthic Biota
  - Infauna
  - Epifauna

A recommended Resource Consent Condition specifies that the extraction area must not include areas of the seafloor that contain any of the following:

a) Sediment with an average proportion of mud (grain size finer than 0.063 mm) exceeding 20% by weight; or
b) Areas of immobile layers (e.g. rock) or historic facies (e.g. partly consolidated orange Pleistocene sand deposit); or
c) Sensitive benthic communities (as defined in Table 1); or
d) Any absolutely protected species under the Wildlife Act 1953, excluding any species for which a Wildlife Authority is held.

This report documents the geomorphic and ecological investigations undertaken in the Te Ākau Bream Bay sand extraction area and control areas in Te Ākau Bream Bay and beyond, prior to any sand extraction (Figure 1). The report is divided into two main sections: geomorphological features which focuses on physical seabed environments; and benthic biota. A set of monitoring methodologies has been developed and specified in the EMMP, to describe, quantify, and evaluate the physical seabed environment and benthic fauna.



Sand Extraction Area Corner Points

	NZTM, EPGS:2193		WGS84, EPGS:4326	
name	Northing	Easting	Latitude	Longitude
Sa	6024331.16	1738538.95	-35.91553	174.53545
Sb	6017916.12	1741340.26	-35.97295	174.56763
Sc	6017035.71	1739324.11	-35.98117	174.54543
Sd	6023450.75	1736522.8	-35.92375	174.51326

Control Area Corner Points

	NZTM, EPGS:2193		WGS84, EPGS:4326	
name	Northing	Easting	Latitude	Longitude
CNa	6025430.88	1738058.73	-35.90569	174.52994
CNb	6024514.44	1738458.92	-35.91389	174.53453
CNc	6023634.03	1736442.76	-35.92211	174.51234
CNd	6024550.47	1736042.57	-35.91391	174.50775
CSa	6016386.51	1744084.69	-35.98633	174.59833
CSb	6015470.07	1744484.88	-35.99453	174.60294
CSc	6014349.55	1741918.86	-36.00501	174.57468
CSd	6015265.98	1741518.68	-35.99681	174.57008
CRa	6004717.53	1747319.94	-36.09101	174.63638
CRb	6003791.52	1747696.86	-36.09930	174.64074
CRc	6002760.83	1746394.37	-36.10879	174.62647
CRd	6003686.84	1746017.45	-36.10050	174.62211

CLIENT / PROJECT		MAP REVISIONS
McCallum Bros. Ltd.	CD – Chart Datum as measured at Marsden Point (LINZ code DJM9) Map projection - NZ Transverse Mercator EPGS:2193 GPS points - NZTM EPGS:2193, WGS 84 EPGS:4326	Drawing Date: 12/11/2025 Version 1.0.4 by SW.
MAP FILE NAME Map Showing Sand Extraction Area and Control Areas With Cells		Bioresearches

Figure 1 Te Ākau Bream Bay Sand Extraction Area and Control areas[1]

[1] Note depths on chart are in meters below Marsden Point chart datum, to convert chart datum depths to NZVD2016 add 1.746 m

2 METHODS

Sand extraction will occur in an alongshore direction, with the vessel roughly following a predetermined extraction track. The sand extraction area (7 km by 2.2 km) and control areas (northern, southern and remote) were divided into cells with dimensions of 1000 m alongshore and 200 m perpendicular to shore (Figure A.1, Table A.1[2]). The sand extraction area was aligned with the charted depth contours and covers a depth range of approximately -22 m to -32 m New Zealand Vertical Datum 2016 (NZVD16). Numerous studies have shown that the benthic ecology varies with depth, the proposed control locations have thus been selected based on a depth profile that parallels the sand extraction area. Due to differences in seafloor slope, the geographic extents of the control areas differ from each other and the sand extraction area.

The Northern Control area was defined after benthic biota sampling results were analysed. The sampling showed there was a gradient in benthic communities north to south and thus a northern control was needed. As the initial sampling area did not allow the addition of a 1000 km long area to the north the decision was made to use the northern most set of cells (1A to 1K) as the Northern control with a 200 m buffer between the new Northern Control and the sand extraction area (Figure A.1, Table A.1).

The EMMP proscribes the sampling methods to obtain data on the benthic environment and benthic ecology. They range in scale of sampling area, to account for the differing abundances and ranges in distribution of benthic biota expected to be present. The sampling methods are detailed below. Given the sites ecology was unknown, the aim has been to conduct non-invasive sampling such as hydrography and drop camera sampling prior to more invasive sampling methods such as dredge tows and grab samples. This was to avoid unnecessary impacts if very high-value habitats were detected as being present.

2.1 Geomorphological Features

2.1.1 Bathymetry

In order to quantify geomorphological conditions, a detailed bathymetric survey was undertaken by Discovery Marine Ltd. (DML) (DML, 2024) that covered the sand extraction area, the control areas, and six shore profiles that extend from offshore of the extraction site to an inshore depth of approximately 5 m (Figure A.2). The bathymetry of a zone 100 m wide to the north, south and along the inshore margin of the sand extraction area was also recorded. Surveys were undertaken in the first quarter of 2024 and provided gridded data at 1 m horizontal resolution with a vertical accuracy of 0.15 m vertical. MBES backscatter was also recorded to determine any seabed features of interest, in addition to MBES bathymetric data.

The cross section profiles of the bathymetry data from the sand extraction area, northern and southern control areas were extracted from 15 transects (as shown on Figure A.3), including relative seabed levels and chainages, water depths, cross-section start and end coordinates to allow accurate comparisons between monitoring surveys.

The locations of Bathymetric profiles are shown in Figure A.2. The LINZ chart identifies a bathymetric feature of Mair Bank, which is a shallow shoal south of the Whangārei harbour entrance. The shoal extends south to Ruakākā River and offshore to approximately 5 km. Bathymetric Profile 6 is 7,682 m long,

[2] For the ease of navigation within the document, figures and tables with a number starting with a letter are in the Appendix with that letter

located from the end of Mair Road to cell E in the northern control area. Bathymetric Profile 5 is 8,910 m long, located south of Ruakākā and intercepts and extends to offshore of the northern end of the extraction area. Bathymetric Profile 4 is 9,655 m long, located halfway between Waipū River and Ruakākā River and intercepts and extends offshore of the central area of the extraction area. Bathymetric Profile 3 is 9,640 m long, located to the north of the Waipū River mouth and extends through and to seaward of the extraction area. Bathymetric Profile 2 is 9,835 m long, located south of the Waipū River mouth and extends through and to seaward of the extraction area. Bathymetric Profile 1 is 10,275 m long, located at Waipū Cove and extends through and to seaward of the southern control area.

All elevations presented in this report are relative to NZVD16 which is referred to as reduced level (RL) or meters RL (m RL). The difference between NZVD16 and Chart Datum at Marsden Point is 1.746 m.

2.1.2 Seabed Morphology

In support of the MBES, drop camera images of 1 m^2 of the seabed plus lateral views were recorded in March 2024 at three stratified random locations within each of the combined Northern Control and sand extraction cells. Within the southern and remote control areas, drop camera images of 1 m^2 of the seabed plus lateral views were recorded at five stratified random locations within each of the cells. The locations of the drop camera sample points are presented in Table A.2 and Table A.3 and shown graphically in Figure A.4 in Appendix A.

The replication rate within the cells was based on statistical data analysis obtained in similar habitats nearby, particularly with the aim of providing sufficient data to form a baseline with which to compare future studies. At the time of sampling, it was suggested more replication was needed in the control areas compared with the sand extraction area to balance the statistical design. Thus with 3 replicates in the sand extraction and 5 in the control areas better balance was achieved. Since the Northern Control area samples were initially sampled as part of the sand extraction area, only three replicate samples were collected. In subsequent sand extraction monitoring studies five replicate samples will be collected in the northern control area.

The Hero 4 GoPro cameras were set to record images at 2 second intervals at the best available image quality setting. The best representative images were used to assess changes in fine scale (< 1 m) bed forms and as confirmation of the multibeam interpretations. Details of the substrate and the presence of any conspicuous species were recorded.

Seabed bedforms, such as ripples and flat sand, provide valuable information about the underwater environment and the forces acting upon it. Below is a brief overview of what different bedforms can indicate:

- **Ripples**: These are small, wave-like structures formed by the movement of water over sandy sediments. They can be symmetrical or asymmetrical:
    - **Symmetrical ripples** are typically formed by oscillatory currents, like waves, indicating a back-and-forth motion.
    - **Asymmetrical ripples** are created by unidirectional currents, such as river flows or tidal currents, showing a consistent direction of water movement.

- **Flat Sand**: A flat seabed usually indicates low-energy environments where sediment deposition occurs without significant disturbance. This can be found in deeper waters or sheltered areas where currents and wave action are minimal.

These bedforms provide an insight into past and present hydrodynamic conditions, sediment transport processes, and the overall health and stability of marine environments.

2.1.3 Seabed sediment particle size

In March 2024, at the same stratified random locations (Figure A.4, Table A.2 and Table A.3) within each of the cells, a modified Standard Ponar Grab sampler was used with a sample area of 250 x 285 mm (0.071 m^2) and a bite depth of about 100 mm that typically produces sample volumes of 1 – 4 L. The material collected was mixed and a 200 ml subsample was collected for sediment analysis. All sediment samples were double bagged in clean new polyethylene 'zip lock'-type bags with a pre-printed waterproof label (identifying site, sample date and testing required) between the two bags and placed in a chilly bin. Prior to sending to the laboratory for testing, sediment particle size samples were stored chilled, and 50 ml subsamples from each of the samples collected within a cell were combined into a composite sample for particle size analysis.

Testing was conducted by the University of Waikato using a Malven Instruments laser mastersizer following the ISO13320 (2020) methods. Laser diffraction measures particle size distributions by measuring the angular variation in the intensity of light scattered as a laser beam passes through a dispersed particulate sample. Large particles scatter light at small angles relative to the laser beam and small particles scatter light at large angles. The angular scattering intensity data is then analysed to calculate the size of the particles responsible for creating the scattering pattern, using the Mie theory of light scattering. The particle size is reported as a volume equivalent sphere diameter. Thus, all results are expressed as percentage composition by volume.

Raw data from the laboratory reports were grouped into the following size classes based on their diameter:

Grain size (mm)	Class	
> 3.35	Gravel	Gravel
3.35 - 2.00	Granules	
2.00 - 1.18	Very Coarse Sand	Coarse Sand
1.18 - 0.600	Coarse Sand	
0.600 - 0.300	Medium Sand	Medium Sand
0.300 - 0.150	Fine Sand	Fine Sand
0.150 - 0.063	Very Fine Sand	
0.063 – 0.0039	Silt	Mud
< 0.0039	Clay	

The sediments were assigned a description based on the principal grain size fraction with modifiers based on the next important grain sizes. These descriptions are given as letter codes. For example, a sample which consisted of mostly sand with a significant proportion of silt and clay would be described as muddy sand. This would be denoted mS. If the sample had a gravel component it would be described as slightly gravelly muddy sand. This would be denoted (g)mS. The descriptions of the sediments are based on criteria illustrated in Figure 2.

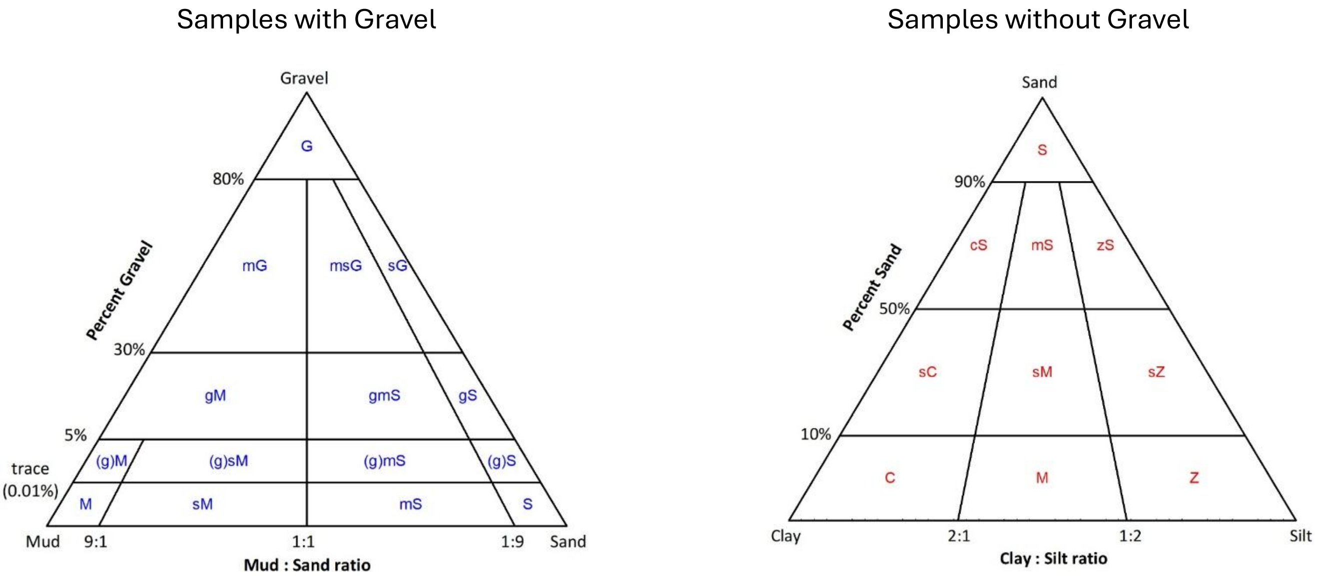


Figure 2 Sediment Grain Size Description.

Sediment particle size plays a crucial role in shaping the habitat and community structure of infaunal biota in marine environments.

- **Habitat Suitability**: Different infaunal species have specific preferences for sediment types. For example, some species thrive in fine sediments like mud, while others prefer coarser sediments like sand.
- **Oxygen Availability**: The size of sediment particles affects the porosity and permeability of the sediment, which in turn influences the oxygen levels within the sediment. Fine sediments tend to have lower oxygen levels compared to coarser sediments.
- **Feeding and Burrowing**: The particle size can impact the feeding and burrowing behaviour of infaunal organisms. For instance, deposit feeders may find it easier to process finer sediments, while burrowing organisms might prefer coarser sediments for stability.
- **Predation and Protection**: Sediment particle size can also affect the ability of infaunal organisms to avoid predators. Finer sediments might offer better protection by allowing organisms to burrow deeper.

Understanding these dynamics is essential for assessing habitat quality and the ecological health of marine benthic ecosystems.

2.2 Benthic Biota Monitoring

Because benthic biota varies in preferred habitat, size and abundance, a number of different methods of sampling are needed to determine the presence / absence, abundance, and population structure of biota from the sand extraction area and control areas. The EMMP specifies that benthic grab samples should be used to sample smaller biota living within the seabed sediments. Seabed scaled photographs should be used to sample the abundance of larger abundant biota that live on the surface of the seabed. Epibenthic dredge tows should be used to sample the abundance and sizes of less abundant larger biota that live on or near the surface of the seabed. The combination of these sampling methods provides a good assessment of the biota present on the seabed.

2.2.1 Epibenthic macrofauna dredge tows

Since the larger epibenthic biota are not expected to vary as much as infauna species, and that the epibenthic dredge tows cover a larger area than infauna sampling, the epibenthic macrofauna dredge tows were conducted across paired cells, in both the sand extraction area and control areas. Locations of the start and end points of the epibenthic macrofauna dredge tows are presented in Table A.4 and Table A.5 and shown graphically in Figure A.5 in Appendix A. This sampling was conducted in March 2024.

Each epibenthic macrofauna dredge tow consisted of lowering a 600 mm wide dredge fitted with a 35 mm mesh bag, to the seafloor and towing it for approximately 200 m in an alongshore direction, between pre-determined GPS start and endpoints. All material captured during each tow was placed in a fish bin, photographed, and immediately sorted, with all dead shell immediately returned to the sea. Polychaete worms, amphipods, and small gastropods and bivalves that were too difficult to immediately identify in the field were preserved in a solution of 5% glyoxal, 70% ethanol seawater solution. Larger macrofauna such as bivalves, hermit crabs and starfish that could be identified, were photographed, counted, and returned to the sea. Any scallops (*Pecten novaezelandiae*) retrieved were counted, measured (± 1 mm) and returned to the sea. Preserved epibenthic macrofauna dredge tow samples were processed in the laboratory as described below for grab samples.

Data were then compiled and analysed to provide a description of the macrobenthic community structure (species richness and evenness).

2.2.2 Benthic biota grab samples

In March 2024, at three stratified random locations within each of the Northern Control[3] and sand extraction cells, and at five stratified random locations within each control cell of comparable depths, a modified Standard Ponar Grab sampler was used to sample a sediment area of 250 x 285 mm (0.071 m^2) and a bite depth of about 100 mm that produces sample volumes of 1 - 4 L. If the sample volume was less than 2 L, the grab sample was discarded and repeated. The locations of the modified Standard Ponar grab sample points are presented in Table A.2 and shown graphically in Figure A.4 in Appendix A.

Each grab sample was sieved as soon as practicable after collection by washing each whole sample through both 3 mm and 1 mm mesh sieves with seawater. The 3 mm mesh sieve was used as a screening method, while the 1 mm mesh was selected over the more typical 0.5 mm mesh sieve, as the typical grain size is around the 0.5 mm diameter size which clogs the sieve making biota sample sieving impractical with the 0.5 mm mesh.

All samples were stored in a cool shaded location until sieving, however sieving usually occurred immediately following collection. The biota retained on the 3 mm sieve was visually assessed, unaided, for the presence of absolutely protected species defined in the Wildlife Act 1953 by a suitably qualified and experienced person, before preservation. If absolutely protected species or known macrofauna were found alive, they were photographed, enumerated, and returned to the sea as soon as possible. The remaining material retained on both sieves was transferred to a polyethylene 'zip lock'-type bag with a pre-printed waterproof label (identifying site, sample date and testing required), and preserved in a solution of 5% glyoxal, 70% ethanol sea water solution. They were sealed and placed in a second

[3] Note: Since the northern control area samples were initially sampled as part of the sand extraction area, only three replicate samples were collected, in subsequent sand extraction monitoring studies five replicate samples will be collected in the northern control area.

polyethylene 'zip lock'-type bag and packed into a labelled plastic container, for transportation to the laboratory.

Prior to sorting, the samples were rinsed through a 1 mm sieve with freshwater and placed in a white sorting tray. All organisms were picked out of the samples and placed in labelled vials of 70% ethanol solution prior to taxonomic identification (to the lowest taxonomic group possible) and counting. Only animals with intact heads and/or live coral were identified and counted, for ecological assessment, by an experienced benthic taxonomist (Rod Asher, Biolive, Nelson). Note, the Cup Coral Management Plan (CCMP) (McCallum Bros Limited, 2025) requires the counting of both dead and live cup corals, thus while not ecologically relevant, dead cup corals were identified and counted as part of the sampling.

At each sample location, the depth and time were recorded from the vessel depth sounder, the sounding depths were then tidally corrected and referenced to NZVD16. Depths were also independently surveyed by DML in 2024 as part of the wider project and referenced to NZVD16.

At the same sampling locations, drop camera photographs were recorded and assessed for the presence of larger biota that were either too large or present at densities too low to be reliably collected via Ponar sampling. If any biota recorded in the photographs are not represented in the benthic biota grab samples at the same location, then the qualitative photographic biota will be added to the quantitative benthic biota data as 1 individual observed.

2.2.3 Statistical procedures

Biota in each sample were summarised by the following descriptive statistics:

- the number of individuals,
- the number of taxa,
- the Shannon-Wiener Diversity Index, and
- the Shannon-Wiener evenness.

Shannon-Wiener Diversity Index measures the rarity and commonness of species in a community and is calculated using the following formula.

$$H = -\Sigma (p_i \ln p_i)$$

Where p_i is the proportion of the total number of species made up of the i^{th} species.

Shannon-Wiener Evenness is a measure of how close in numbers (how equal) each species is in an environment. Mathematically, it is calculated by dividing the Shannon-Wiener Diversity Index by the natural logarithm of species richness.

$$J = H / \ln(S)$$

Note that species evenness ranges from zero to one, with zero signifying no evenness and one, complete evenness.

A multivariate analysis approach is required to examine and test differences in species assemblages between cells and groups of cells. The multivariate procedure "data transform – Bray-Curtis – nMDS – ANOSIM – SIMPER" has become a common statistical methodology for communities' structure in the past 15 years (Clarke *et al.*, 2014). Rather than use the ANOSIM test, we have chosen to use the PERMANOVA test which uses the actual dissimilarity values rather than the ranks of these values. Multivariate tests were conducted with the software PRIMER-E (version 8 Beta 2.0.34, Quest Research Ltd). The monitoring programme will use a modified Before–After–Control–Impact (BACI) design that evaluates changes in each area over time rather than relying solely on spatial comparison. Monitoring will therefore focus on detecting temporal changes in biotic composition, abundance, and diversity within each site and then comparing the magnitude and direction of those changes between extraction and control areas. Multivariate analyses (e.g., PERMANOVA) incorporating both time and area as factors will be used to distinguish natural spatial variation from changes attributable to sand extraction. This approach ensures that any observed differences in future years can be robustly attributed to either natural variability or project-related effects.

2.2.4 Sensitive benthic biota and communities

NIWA (2013) describes and defines a number of sensitive[4] benthic communities in New Zealand's Exclusive Economic Zone (EEZ) (Table 1). A number of these communities may occur in shallow coastal water; thus, the sensitive benthic community definitions should be taken as a starting point for determining communities that sand extraction should avoid. The list (Table 1) includes specific mention of a number of large bivalves.

In addition to guidelines around sensitive benthic communities, there are other legal criteria that extend protection to marine species such as Wildlife Act 1953 and species protected within the New Zealand Coastal Policy.

[4] For the avoidance of confusion sensitive refers to the benthic communities, and if they are sensitive to disturbance. In this report sensitive does not refer to the how sensitive or tolerant a species is to contaminant concentrations.

Table 1 Sensitive Benthic Communities from NIWA 2013.

Habitat	Primary indicators
Beds of large bivalve molluscs	A bed of large bivalves exists where living specimens of bivalve species: • are estimated to cover 30% or more of the seabed on average in visual images of either 1 m^2 or lateral view; or • comprise 30% or more by average weight or volume in grab samples. Large bivalves include: Horse mussels (*Atrina zelandica*), Scallops (*Pecten novaezelandiae*), Large dog cockle (*Tucetona laticostata*), Dredge oysters (*Ostrea chilensis*), Green lipped mussels (*Perna canaliculus*), Geoducks (*Panopea zelandica* and *P. smithae*), Trough Shells (*Spisula discors* and *S. murchisoni*), Triangle Shell (*Crassula aequilatera*). Shellfish known to pass through dredge alive at greater than 90% should be excluded; Clam (*Dosinia anus*, *D. subrosea*, *Bassina yatei, Myadora sp*.
Brachiopod beds	A brachiopod bed exists if: • one live brachiopod occurs per m^2 of seabed sampled using seabed photographs; or • one or more live specimens occur in grab samples.
Bryozoan thicket	A bryozoan thicket (here the term thicket is used synonymously with the terms bed, reef, meadow, etc.) is present if: • colonies of large frame-building bryozoan species cover at least 50% of the seabed in visual imaging surveys; • one or more colonies of large frame building bryozoan species occur per m^2 of seabed sampled using towed sampling gear; or • one or more large frame building bryozoan species is found in grab samples.
Calcareous tube worm thickets	A sensitive tube worm thicket is present if: • 2 or more colonies of a mound forming species of tube worm are found in any grab sample; or • 2 or more colonies are observed at a greater than 10% coverage in a visual image, either 1 m^2 or lateral view.
Chaetopteridae worm fields	A sensitive Chaetopteridae worm field is present if worm tubes and/or epifaunal species: • contribute 25% or more of the volume of a sample collected in a grab sample; or • colonies of tube worm species cover at least 50% of the seabed in visual imaging surveys.
Macro-algae beds	Detection of a single occurrence of any fixed specimen of a red, green, or brown macroalga at greater than 30% cover is sufficient to indicate that this habitat has been encountered.
Rhodolith (maerl) beds	A rhodolith bed exists if: • a single specimen of a rhodolith species is found in grab sample; or • there is more than 10% cover of living coralline thalli in visual images.
Sea pen field	A sea pen field exists if: • one or more specimens of any species of sea pen is found in a grab sample; or • two or more specimens per m^2 are found in seabed imaging surveys.
Sponge gardens	A sponge garden exists if metazoans of Class Demospongiae, Class Hexactinellida, Class Calcarea or Class Homoscleromorpha: • are estimated to cover 25% or more of the seabed in visual images of either 1 m^2 or lateral view.

3 RESULTS AND DISCUSSION

3.1 Bathymetry

3.1.1 Bathymetric profiles

Bathymetric profiles are shown in Figure 3 and the distance from the coast to the landward edge of the extraction area is shown in Table 2.

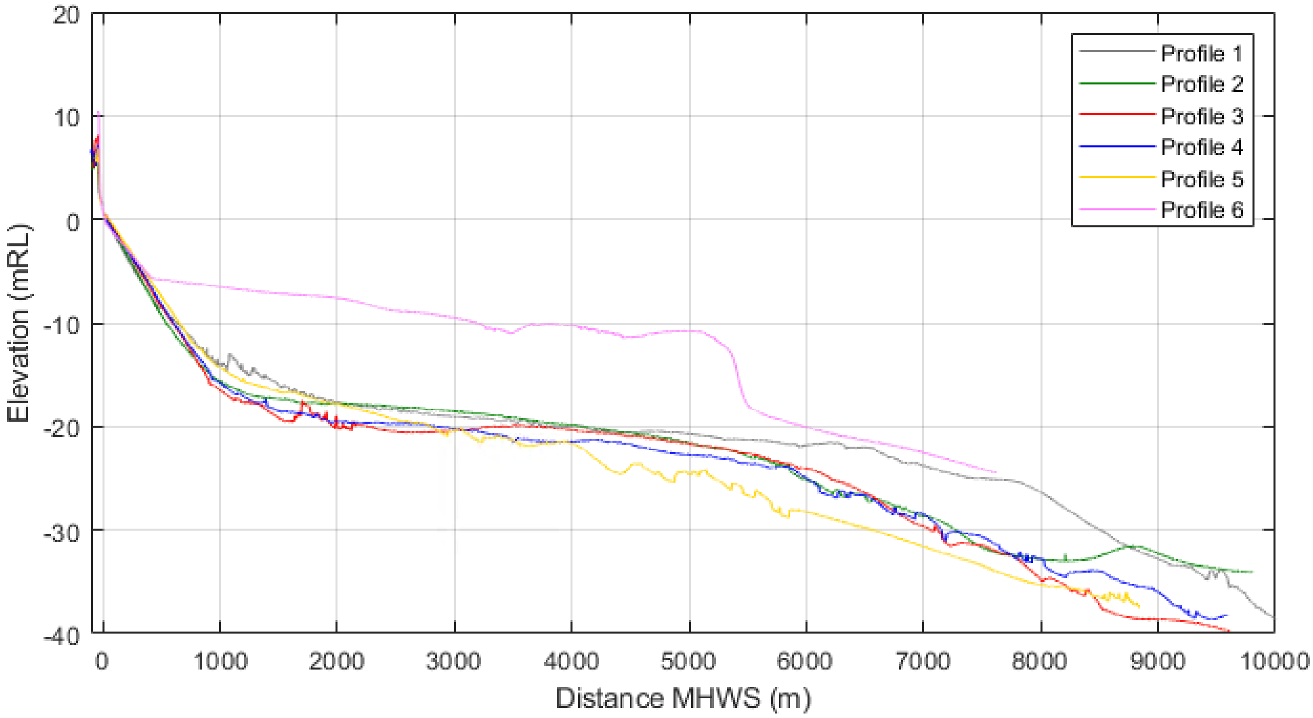


Figure 3 Extraction area bathymetry and long section across the landward boundary. (T&T 2025)

Table 2 Location and elevation of extraction/control area on each profile

	Distance from MHWS (m)	Seabed level at landward boundary of the extraction area (m RL)
Profile 1*	6,699	-22.5
Profile 2	5,726	-23.0
Profile 3	5,648	-22.7
Profile 4	5,499	-23.5
Profile 5	4,876	-25.0
Profile 6	7,266	-23.2

* Profile 1 intersects through the southern control area, refer Figure A.2

Bathymetric Profile 1 is located at Waipū Cove and extends through the southern control site. The profile extends to a landward limit of -5.2 m RL, which is 300 m offshore of the beach. The upper shoreface drops to -14 m RL at a slope of -1.2 degrees, with undulating ridges before a gradual lower shoreface plateau (-0.06 degrees) that extends to a distance of 5.5 km offshore of the beach.

Bathymetric Profile 2 is located south of the Waipū River mouth and extends to a shallow limit of -7.5 m RL, which is 400 m offshore of the beach. The upper shoreface slopes down to -15 m RL at a slope of -0.85 degrees before curving concave and flattening to a gentle slope of -0.08 over 4 km before the extraction site. The extraction area is on a downward slope of -0.25 degrees, from -23 m RL at the landward boundary to -32 m RL at the seaward boundary.

Bathymetric Profile 3 is located to the north of the Waipū River mouth and extends to a shallow depth of -5.5 m RL, located 335 m offshore. The upper shoreface slope is -1 degree to the -15 m RL contour before the profile curves concave to a 3 km long plateau at around -20 m RL. The toe of the upper shoreface slope has a ridge feature and the lower shoreface convex bulges before sloping seaward from approximately 4 km offshore. Depth at the extraction boundary is -22.7 m RL, with the seabed sloping down (-0.26 degrees) to -32 m RL at the seaward extent of the extraction boundary.

Bathymetric Profile 4 is located halfway between Waipū River and Ruakākā River and intercepts the central area of the extraction zone. The landward extent of the survey is -6 m RL located 400 m offshore of MHWS line. The profile drops in a linear slope (-0.95 degrees) from -5 m RL to -15 m RL, located 1.0 km offshore from the beach. From -15 m RL, the shoreface slope is concave for 1.8 km to a depth of -20 m RL. The slope from -20 m RL to the extraction boundary is -0.07 degrees, with some undulating features. The extraction area's landward boundary is -23.5 m RL, with an increase in slope (to -0.21 degrees) across the extraction area, to a depth of -31 m RL at the seaward boundary.

Bathymetric Profile 5 is located south of Ruakākā and intercepts the northern end of the extraction area. The landward extent of the survey is -5 m RL located 330 m offshore of MHWS line. The profile drops in a concave shape from -5 m RL to -15 m RL, located 1.1 km offshore from the beach. From -15 m RL, the shoreface slope becomes gradual, at -0.17 degrees to a distance 8 km offshore from the beach. Some undulations and bedform features are noted on the profile. Profile 5 intercepts the extraction area at a depth of -25 m RL. The seaward limit of the extraction area is a depth of -32 m RL.

The bathymetric Profile 6 shows the Mair Bank shoal slopes from -5 m RL 400 m offshore from the beach to -11 m RL at the seaward limit of the shoal. The seaward slope is approximately 2.1 degrees and drops to a level of -20 m RL, which is more consistent with the wider embayment.

3.1.2 Extraction area

Bathymetry of the extraction site is presented in Figure 4 showing a more detailed view of the extraction area that demonstrates a complex underwater terrain that is influenced by ridges that protrude about a quarter or halfway across the extraction area. Contour lines have been plotted at 1 m RL intervals.

The bathymetric cross sections through the extraction area and control sites are summarised into the Extraction Area (Figure 5), Northern Control (Figure 6) and Southern Control (Figure 7) to show the range of slopes and features through the seabed. Individual profiles are presented in Appendix B to show more detail.

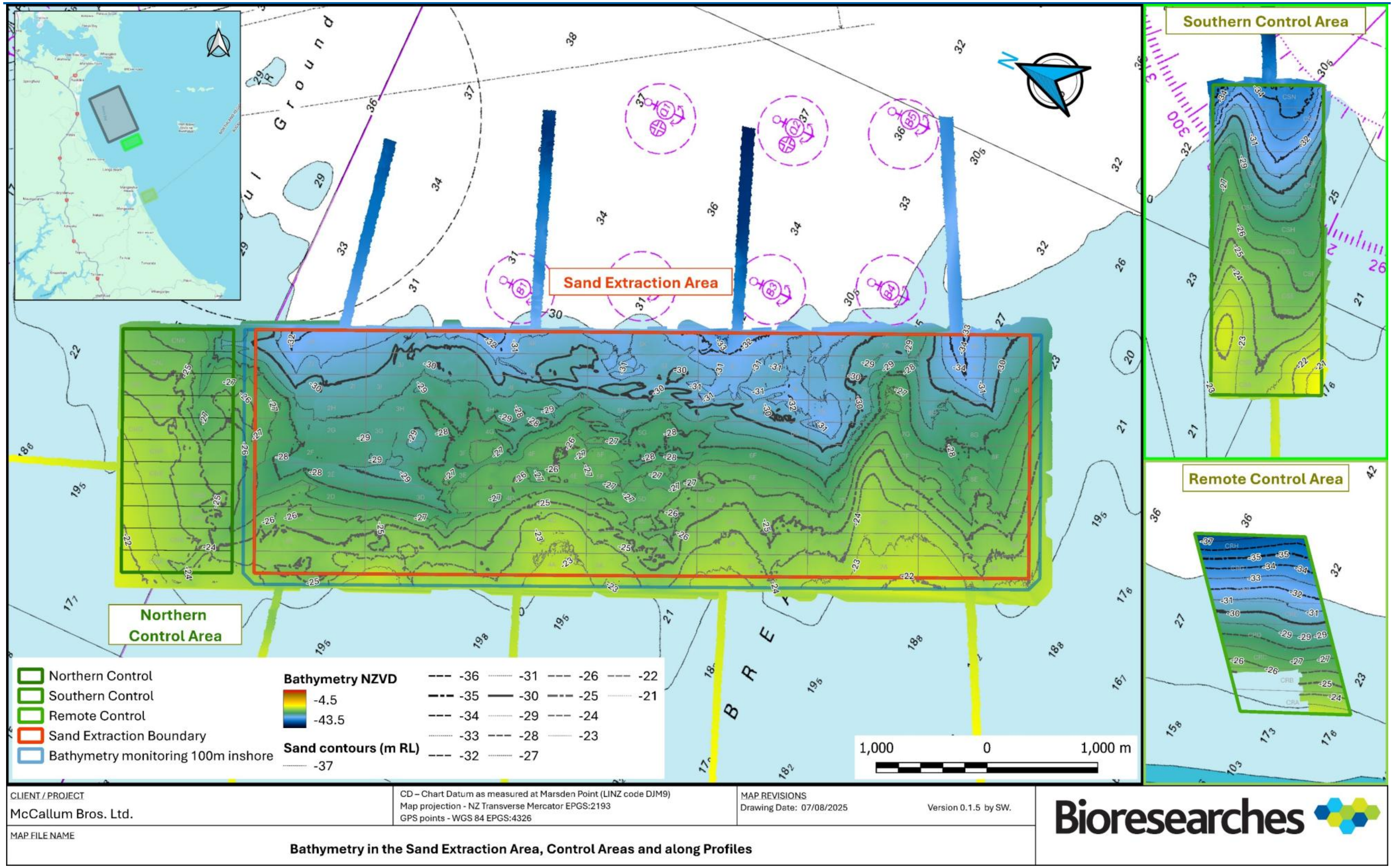


Figure 4 Extraction area, and Control area bathymetry.

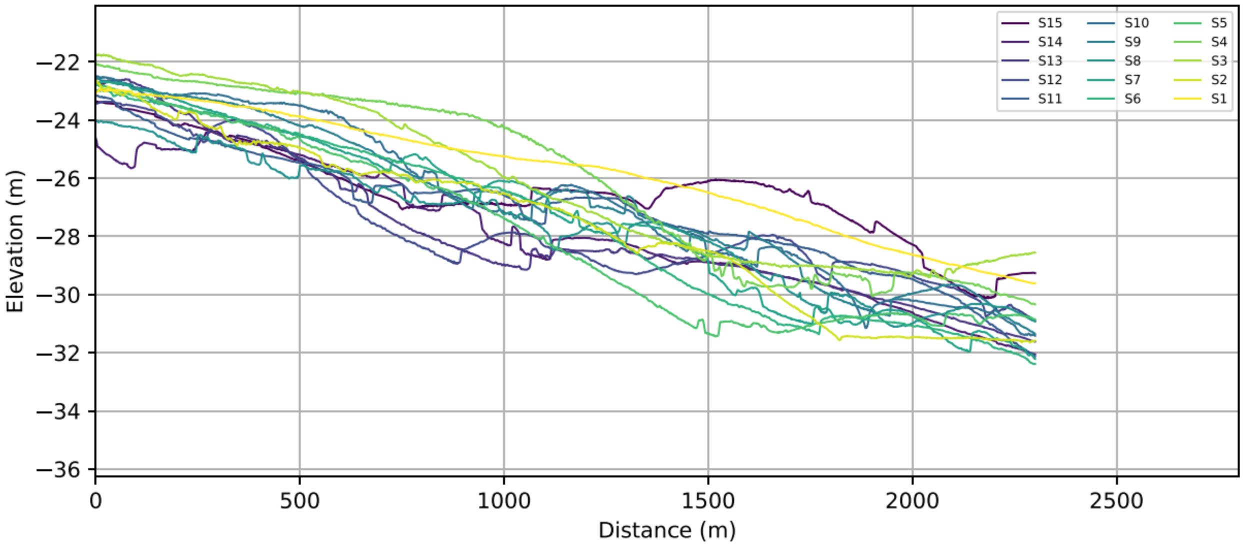


Figure 5 ***Bathymetry profiles across the Sand Extraction area from west to east, profile locations shown in Figure A.3.***

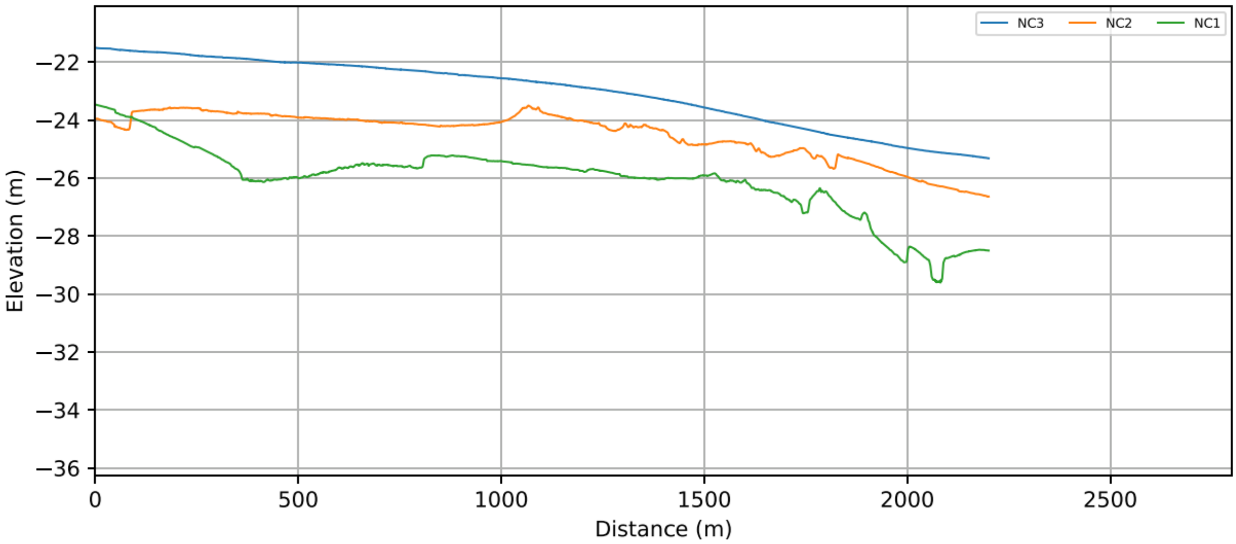


Figure 6 ***Bathymetry profiles across the Northern Control area from west to east, profile locations shown in Figure A.3.***

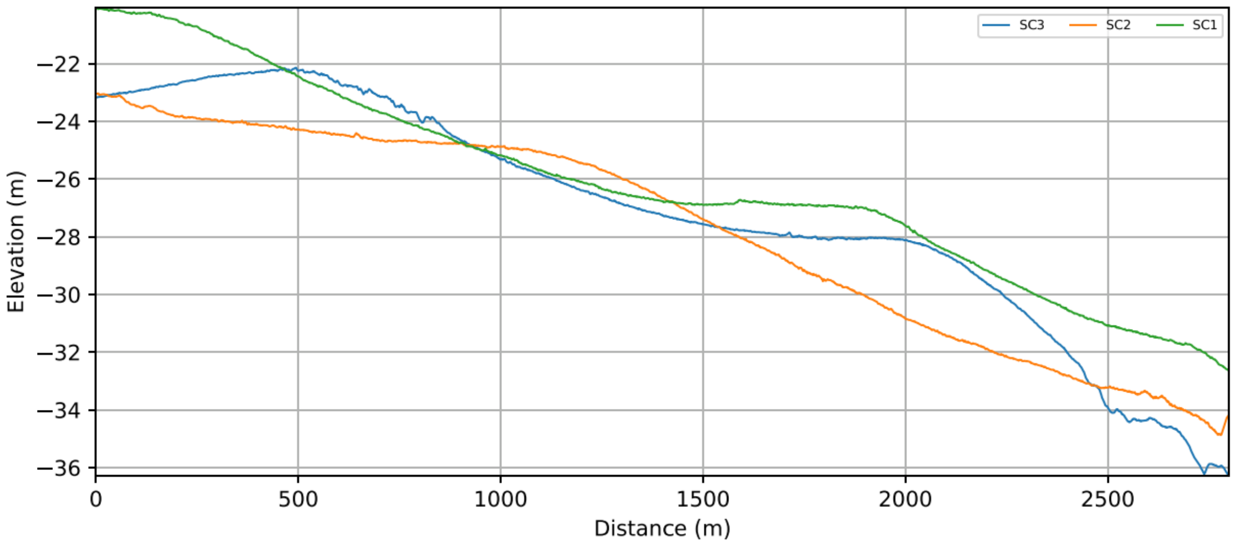


Figure 7 ***Bathymetry profiles across the Southern Control area from west to east, profile locations shown in Figure A.3.***

These profiles highlight existing macro scale bedforms and slope changes that are on the existing pre-extracted seabed. Across the extraction area, there are small scale ridges and troughs across a range of length scales. Some examples include:

- On profile S15 (Figure B.15) there is a ~0.5 m rise at a slope of 8 degrees from -26.9 to -26.35 (chainage = 1,100 m).
- On profile S14 (Figure B.14) there are a series of ridges and swales that appear to intercept alongshore features with features extending for 20 - 100 m in the across shore direction (chainage = 700 - 1,200 m).
- On profile S8 (Figure B.8) there are localised troughs that extend for 60 m alongshore and are 0.5 m below the sounding seabed.

3.2 Seabed Morphology

Seabed photographs from each of the photographic sites sampled in March 2024 are presented in Appendix C. Comments on sediment composition, topography and biota are presented in Table C.1 for the sand extraction area and in Table C.2 for the control areas.

The descriptive nature of the photographic data (Table C.1 and Table C.2) precludes statistical analysis. In general, the seabed micro topography (Figure 8) and shell coverage (Figure 9) show several areas of higher seabed relief: one in the north in the nearshore (cells CNC,CN, 2D, 2E), and a couple of areas in the south east of the sand extraction area (cells 4J, 5I, 5K, 6I, 6J, 7I, 8J). The higher seabed relief generally indicates currents in these areas. The southern and remote control areas show a pattern of relatively homogeneous low relief.

Within the sand extraction area, approximately 20% of the seabed was flat, with a further 70% with small bedforms indicating much of the area is typically a low energy environment. Almost 90% of the bedform features in the sand extraction area were either flat or irregular and asymmetrical in nature suggesting the seabed features are functions of weak tidal movements. There was more variation in bedform shape and size in the sand extraction area than the control areas with the presence of more flat areas of the seabed. The current control site locations represent the most suitable available options given the requirement for alignment with the sand extraction area. No alternative control areas are obvious, based on the seabed topography of the wider area, to a provide a suitable control areas.

In the sand extraction area, as the relief increases, the troughs tend to fill more with shell lag, resulting in higher percentages of shell coverage. However, even areas with flatter relief show relatively high shell coverage. Both control areas exhibit a high percentage of shell cover, regardless of seabed relief. The higher shell percentage provides small-scale hard structures that support greater biodiversity.

There does not appear to be any relationship between depth and either seabed relief or shell coverage. The percentage cover of shell has some correlations with the back scatter imagery (Figure 10).

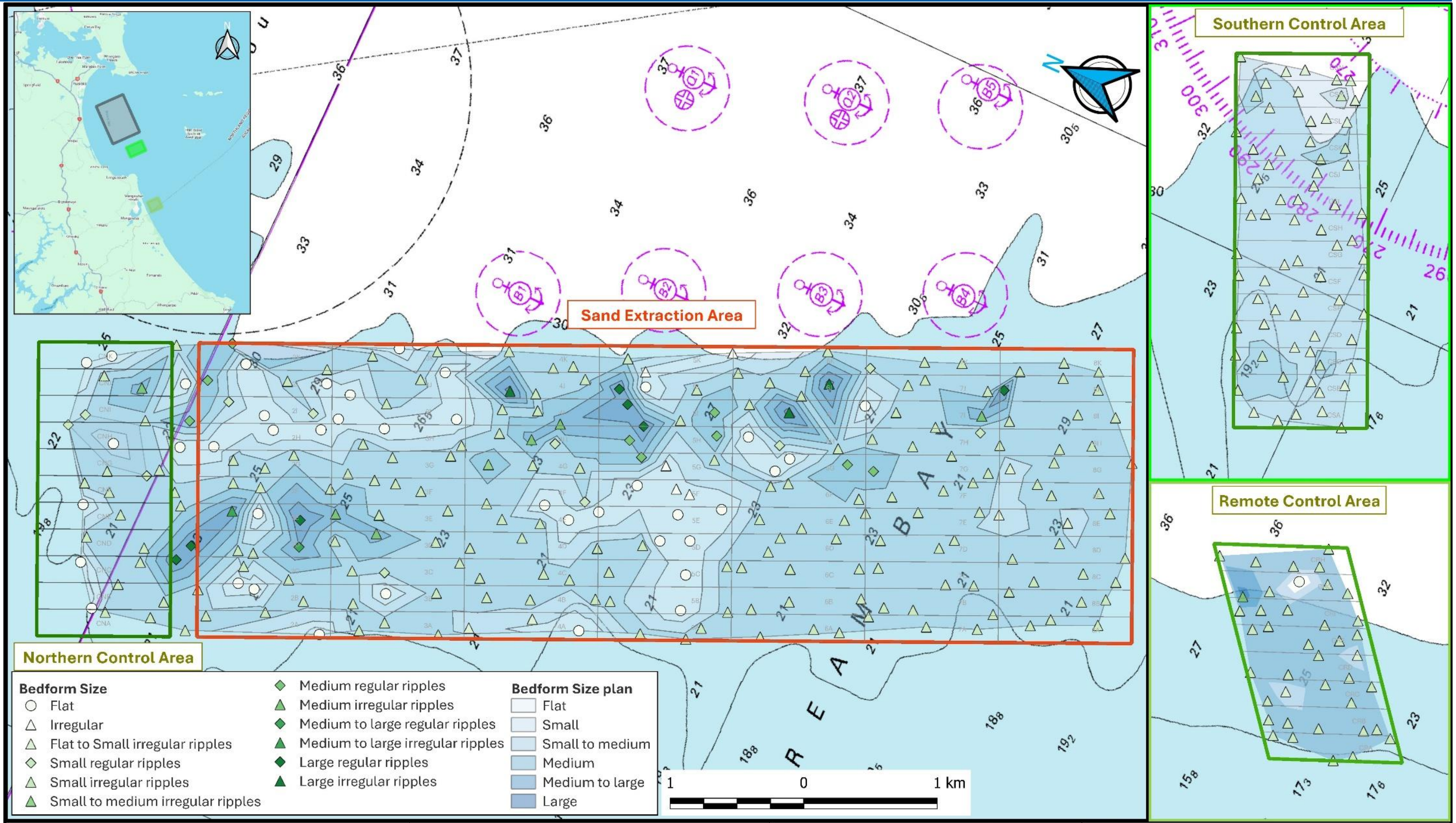


Figure 8 Distribution of seabed topography features observed in photographic samples.

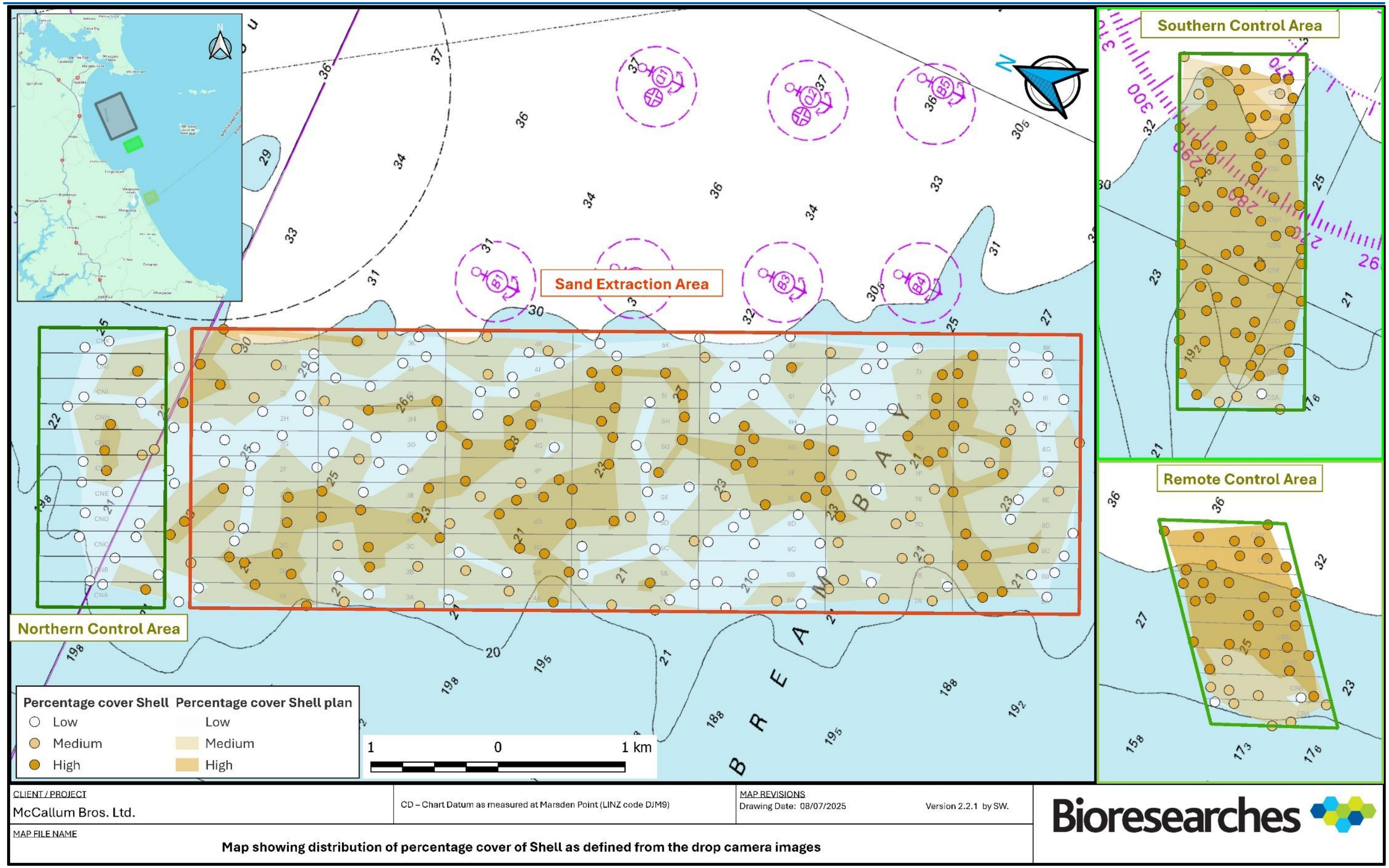
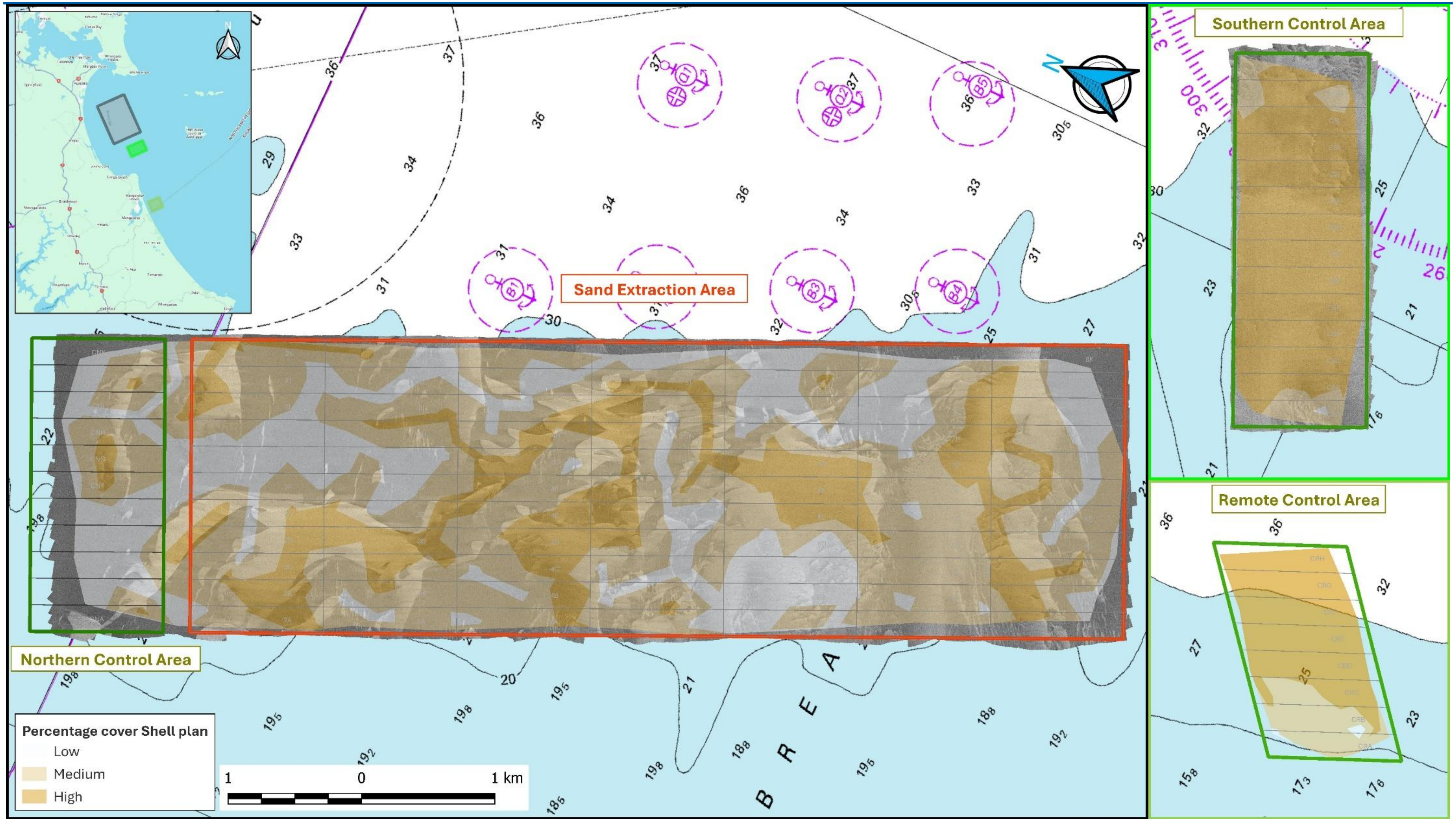


Figure 9 Distribution of shell content observed in photographic samples.



CLIENT / PROJECT McCallum Bros. Ltd.	CD – Chart Datum as measured at Marsden Point (LINZ code DJM9)	MAP REVISIONS Drawing Date: 08/07/2025 Version 2.3.1 by SW.	Bioresearches
MAP FILE NAME Map showing backscatter seabed imagery with shell cover distribution overlay			

Figure 10 Distribution of shell content observed in photographic samples overlayed on Backscatter imagery.

3.3 Seabed Sediment Particle Size

The raw particle size data for each of the 77 cells sampled within the sand extraction area are presented in Table D.1 of Appendix D. The raw particle size data from 33 Control cells are presented in Table D.2. The proportions of gravel, coarse sand, medium sand, fine sand and mud are shown in pie charts for each cell are shown in Figure 11 to show the geographic differences in the grain size composition across the sand extraction area and control areas.

The particle size data per cell were grouped alongshore in the sand extraction area and Control areas (Table 3), offshore in the sand extraction area (Table 4), and offshore in the Control areas (Table 5).

Table 3 Summary of Sediment particle size Statistics by alongshore cell groupings within the Te Ākau Bream Bay Sand Extraction Area and Control Areas, March 2024

Alongshore		Size Class (mm)							Mean Size	Grain size description
		Gravel	Very Coarse Sand	Coarse Sand	Medium Sand	Fine Sand	Very Fine Sand	Silt and Clay		
		> 2.00	2.00 - 1.18	1.18 - 0.600	0.600 - 0.300	0.300 - 0.150	0.150 - 0.063	< 0.063		
2	Average	**0.9**	**3.4**	**10.5**	**15.4**	**39.9**	**24.9**	**5.0**	**0.243**	**(g)S**
	SD	1.5	3.7	10.2	12.3	10.1	11.7	4.6	0.108	
3	Average	**0.6**	**2.1**	**7.8**	**22.1**	**43.5**	**19.7**	**3.9**	**0.247**	**(g)S**
	SD	0.9	1.6	7.3	9.2	8.3	9.7	1.9	0.066	
4	Average	**0.8**	**3.0**	**8.6**	**17.7**	**44.4**	**21.7**	**3.6**	**0.247**	**(g)S**
	SD	1.8	3.8	7.5	7.9	9.7	8.3	2.0	0.074	
5	Average	**0.4**	**2.2**	**15.7**	**30.6**	**35.3**	**12.6**	**3.2**	**0.321**	**(g)S**
	SD	0.7	1.4	12.8	12.7	15.4	9.3	1.7	0.114	
6	Average	**0.4**	**2.2**	**20.9**	**35.8**	**28.1**	**9.1**	**2.9**	**0.378**	**(g)S**
	SD	0.8	3.8	15.1	15.6	16.7	10.5	2.6	0.149	
7	Average	**0.4**	**2.4**	**16.3**	**34.2**	**33.2**	**10.3**	**3.3**	**0.332**	**(g)S**
	SD	0.6	2.1	10.6	14.3	11.0	9.5	2.2	0.097	
8	Average	**0.2**	**0.9**	**10.3**	**29.8**	**39.6**	**15.0**	**3.8**	**0.269**	**(g)S**
	SD	0.3	1.2	4.7	10.4	7.6	6.2	1.5	0.046	
Sand	Average	**0.5**	**2.3**	**12.9**	**26.5**	**37.7**	**16.2**	**3.7**	**0.291**	**(g)S**
	SD	1.0	2.7	10.8	13.8	12.5	10.7	2.5	0.107	
Northern Control	Average	**1.0**	**2.4**	**4.6**	**12.9**	**46.4**	**29.4**	**3.2**	**0.203**	**(g)S**
	SD	0.9	1.6	3.1	4.7	4.1	5.8	0.7	0.035	
Southern Control	Average	**1.0**	**4.7**	**26.9**	**44.2**	**20.0**	**1.1**	**2.0**	**0.465**	**(g)S**
	SD	1.6	3.5	5.1	4.4	5.7	0.8	1.0	0.061	
Remote Control	Average	**0.3**	**3.4**	**40.9**	**44.6**	**8.7**	**1.2**	**0.8**	**0.555**	**(g)S**
	SD	0.8	4.5	5.3	8.4	2.1	0.5	0.5	0.064	
Controls	Average	**0.8**	**3.6**	**22.9**	**33.8**	**26.1**	**10.5**	**2.1**	**0.399**	**(g)S**
	SD	1.2	3.3	14.9	16.0	15.9	13.9	1.2	0.155	

Table 4 Summary of Sediment particle size Statistics by offshore cell groupings within Te Ākau Bream Bay Sand Extraction Area, March 2024

Offshore		Size Class (mm)							Mean Size	Grain size description	Depth (m)
		Gravel	Very Coarse Sand	Coarse Sand	Medium Sand	Fine Sand	Very Fine Sand	Silt and Clay			
		> 2.00	2.00 - 1.18	1.18 - 0.600	0.600 - 0.300	0.300 - 0.150	0.150 - 0.063	< 0.063			
K	**Average**	**0.8**	**1.7**	**3.8**	**15.1**	**47.1**	**25.3**	**6.3**	**0.192**	(g)S	**26.1**
	SD	0.7	1.1	1.7	7.8	4.6	7.5	4.9	0.048		1.6
J	**Average**	**0.6**	**2.3**	**8.2**	**17.7**	**42.1**	**23.6**	**5.0**	**0.233**	(g)S	**25.5**
	SD	1.0	1.5	7.7	12.8	10.3	10.1	1.4	0.083		1.8
I	**Average**	**0.6**	**2.1**	**6.5**	**18.5**	**46.0**	**22.3**	**4.1**	**0.228**	(g)S	**24.9**
	SD	0.7	1.8	7.6	7.0	9.2	6.8	1.0	0.053		1.6
H	**Average**	**1.4**	**3.7**	**9.1**	**19.1**	**40.8**	**20.9**	**4.8**	**0.253**	(g)S	**24.2**
	SD	2.0	4.1	5.8	8.9	8.8	8.2	1.5	0.071		1.8
G	**Average**	**0.6**	**3.9**	**17.9**	**26.8**	**31.7**	**15.1**	**3.5**	**0.347**	(g)S	**23.6**
	SD	1.1	4.4	15.5	14.1	16.1	13.5	0.9	0.169		1.6
F	**Average**	**0.2**	**1.3**	**12.6**	**26.3**	**38.2**	**17.6**	**3.8**	**0.283**	(g)S	**22.9**
	SD	0.4	1.3	13.2	14.9	14.6	13.2	2.2	0.114		1.6
E	**Average**	**0.9**	**3.4**	**15.3**	**23.8**	**36.2**	**17.2**	**3.2**	**0.301**	(g)S	**22.3**
	SD	1.7	3.8	11.6	13.8	13.3	10.6	1.6	0.106		1.5
D	**Average**	**0.5**	**2.5**	**14.4**	**31.2**	**36.2**	**12.8**	**2.3**	**0.313**	(g)S	**21.6**
	SD	0.8	2.8	7.3	15.9	9.2	11.1	1.3	0.077		1.2
C	**Average**	**0.5**	**1.8**	**16.5**	**33.9**	**32.8**	**11.2**	**2.7**	**0.330**	(g)S	**20.6**
	SD	0.8	1.9	10.4	15.0	13.2	10.5	2.6	0.097		3.0
B	**Average**	**0.2**	**1.6**	**11.8**	**27.8**	**39.0**	**16.7**	**2.6**	**0.287**	(g)S	**20.1**
	SD	0.5	1.8	12.0	13.8	13.3	12.1	1.9	0.111		0.9
A	**Average**	**0.1**	**1.3**	**14.0**	**32.8**	**36.6**	**13.5**	**1.6**	**0.312**	(g)S	**19.3**
	SD	0.1	1.4	12.2	15.6	13.5	12.6	1.0	0.113		0.7

Table 5 Summary of Sediment particle size Statistics by offshore cell groupings based on depth within the Control Areas, March 2024

Grain size		Size Class (mm)							Mean Size	Grain size description	Depth (m)
		Gravel	Very Coarse Sand	Coarse Sand	Medium Sand	Fine Sand	Very Fine Sand	Silt and Clay			
		> 2.00	2.00 - 1.18	1.18 - 0.600	0.600 - 0.300	0.300 - 0.150	0.150 - 0.063	< 0.063			
CSN, CRF-H	**Average**	**0.5**	**6.5**	**42.0**	**37.5**	**9.5**	**1.9**	**2.0**	**0.575**	(g)S	**31.3**
	SD	1.1	4.7	8.3	5.8	6.0	0.4	1.6	0.098		1.6
CSK-M, CRE	**Average**	**1.1**	**5.2**	**31.0**	**42.7**	**17.0**	**1.2**	**1.9**	**0.492**	(g)S	**28.3**
	SD	1.6	2.5	8.4	3.5	5.9	0.4	1.0	0.051		0.6
CSI-J, CRC-D	**Average**	**0.1**	**1.8**	**32.5**	**48.9**	**15.0**	**0.7**	**1.0**	**0.483**	(g)S	**25.8**
	SD	0.2	1.5	7.8	2.0	6.5	0.1	0.7	0.049		0.6
CNI-K, CSG-H	**Average**	**2.3**	**6.0**	**15.0**	**23.3**	**34.1**	**16.1**	**2.8**	**0.348**	(g)S	**24.2**
	SD	1.9	4.1	13.6	14.5	17.2	14.8	0.7	0.186		0.6
CNE-H, CSF	**Average**	**1.3**	**4.0**	**11.6**	**20.8**	**37.9**	**21.3**	**2.8**	**0.283**	(g)S	**22.1**
	SD	1.0	3.1	11.6	11.0	14.6	12.3	0.6	0.144		0.4
CNA-D, CSD-E, CRB	**Average**	**0.2**	**1.7**	**13.9**	**26.3**	**35.1**	**20.0**	**2.7**	**0.298**	(g)S	**21.8**
	SD	0.4	1.6	14.9	21.2	17.2	18.1	1.4	0.157		0.3
CSA-C, CRA	**Average**	**0.0**	**1.0**	**25.8**	**48.9**	**22.0**	**1.4**	**0.9**	**0.432**	S	**20.7**
	SD	0.0	1.2	9.7	4.0	10.6	1.2	0.5	0.069		0.2

3.3.1 Particle size classification

With few exceptions, sediment within the sand extraction area was described as either slightly gravelly Sand ((g)S) or Sand (S). The distribution of sediment particle size classifications is shown in Figure 12. Thirty-nine (51%) of the 77 cells sampled within the sand extraction area were classified as Sand (S); thirty-six cells (47%) were classified as slightly gravelly Sand ((g)S); one cell (1%) (4H) was classified as gravelly Sand (gS); and one cell (1%) (2K) was classified as silty Sand (zS). Similar proportions were also recorded in the three control areas with eighteen cells (55%) of the 33 cells sampled classified as slightly gravelly Sand ((g)S), 14 cells (42%) classified as Sand (S), and one cell (3%) (CSH) classified as gravelly Sand (gS).

Those sediments classed as gravelly Sand (gS) have between 5% and 30% gravel and a mud to sand ratio greater than 1:9; those classified as slightly gravelly Sand ((g)S) have less than 5% gravel and a mud to sand ratio between 1:1 and 1:9; those classified as Sand (S) have no or only trace amounts of gravel and greater than 90% sand, while those classified as silty Sand (zS) have no gravel, greater than 50% sand with the clay to silt ratio greater than 1:2.

3.3.2 Silt and clay

The percentage of silt and clay is highly important in that when the draghead sucks up the seabed sediments, the very fine and coarse sediments are returned to the sea via the sub surface moon pools. The larger material settles to the seabed very quickly without causing any significant ecological issues, but the fine material, particularly silt and clay sized material, remains in suspension for a longer period of time. Condition 21 limits the percentage of silt and clay in the seabed sediments to less than 20% by weight, any areas with greater 20% should be excluded from sand extraction.

The percentage abundance and distribution of silt and clay sized sediment particles is shown in Figure 13.

Twenty (26%) of the 77 cells sampled within the sand extraction area had silt and clay proportions of less than 2%, and a further 39 (51%) cells had proportions ranging from 2 to 5% (Figure 13). Seventeen (22%) of the 77 cells sampled within the sand extraction area had silt and clay proportions ranging between 5 and 10% and one cell (2K) had silt and clay proportions ranging between 15 and 20%.

From the summary data presented in Table 3, the highest average silt and clay content alongshore was recorded in the “2” cells. This is highly influenced by the high proportion recorded in cell 2K, the other “2” cells all recorded less than 7% silt and clay.

From the summary data presented in Table 4, the highest average silt and clay content (6.6%) was recorded in the most seaward cells, “K” cells. Again, this is influenced by the high proportion recorded in 2K, but cells 5K, 7K and 8K all had a silt and clay content of greater than 5%.

The composite sample from cell 2K had a higher percentage of silt and clay at 18.1%. With the exception of cell 2K, all cells had silt and clay contents at less than 9%. None of the cells had a silt and clay proportion greater than the 20% trigger, thus none are required to be excluded from sand extraction based on sediment grain size.

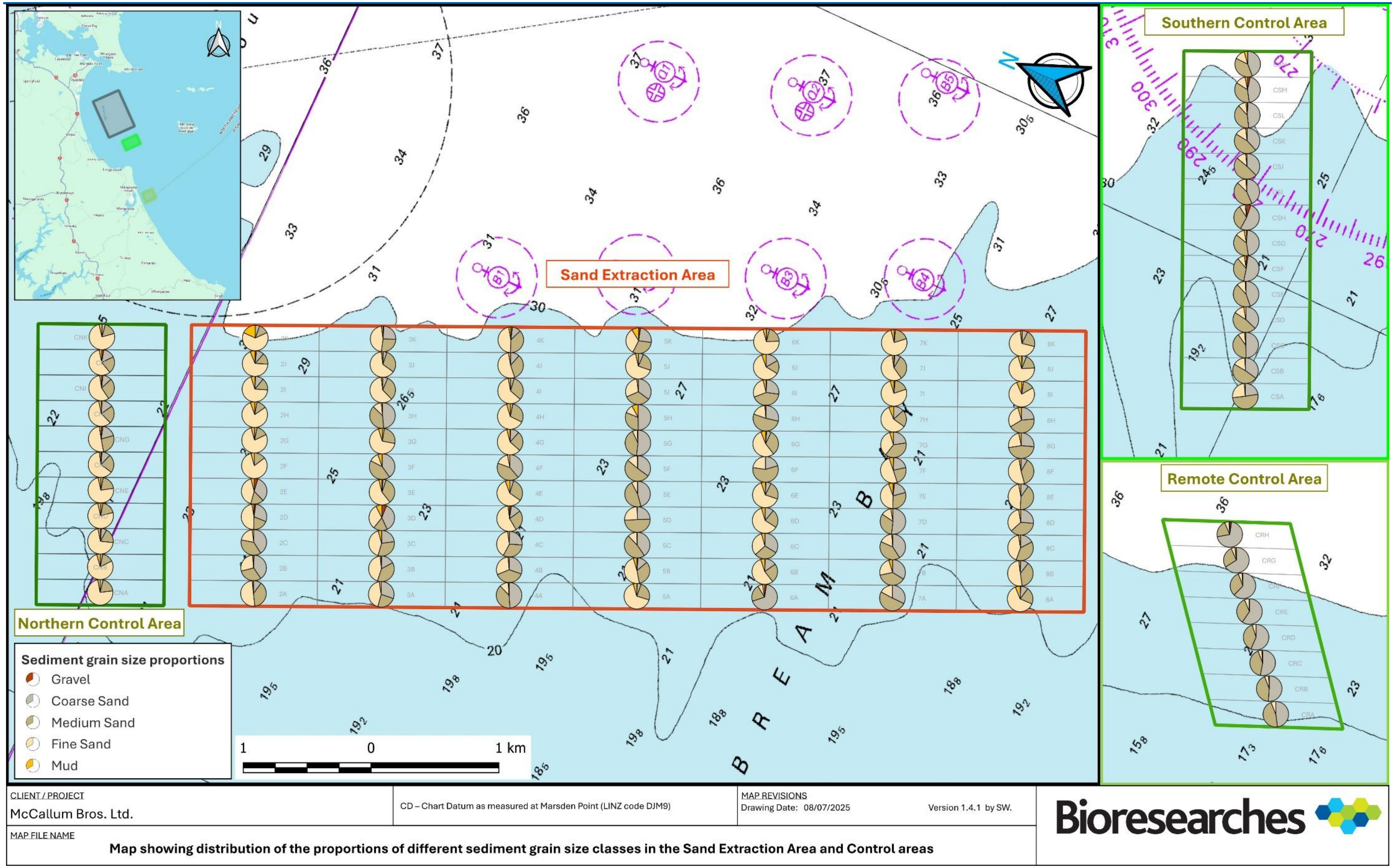


Figure 11 Pie charts showing the proportion of sediment size classes for each cell within the sand Extraction Area and Control areas.

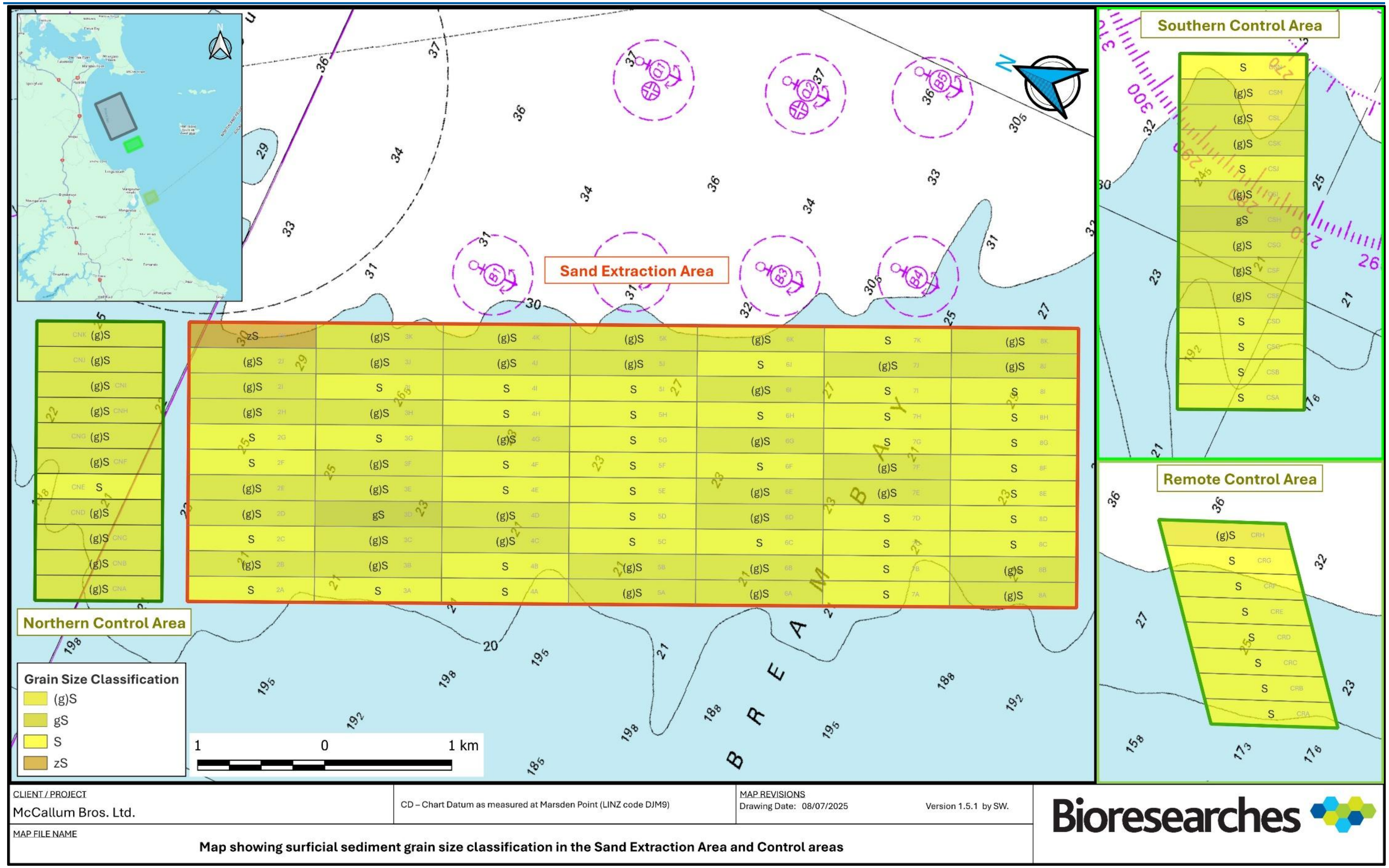


Figure 12 Sediment Particle Size Classifications within the sand Extraction Area and Control areas.

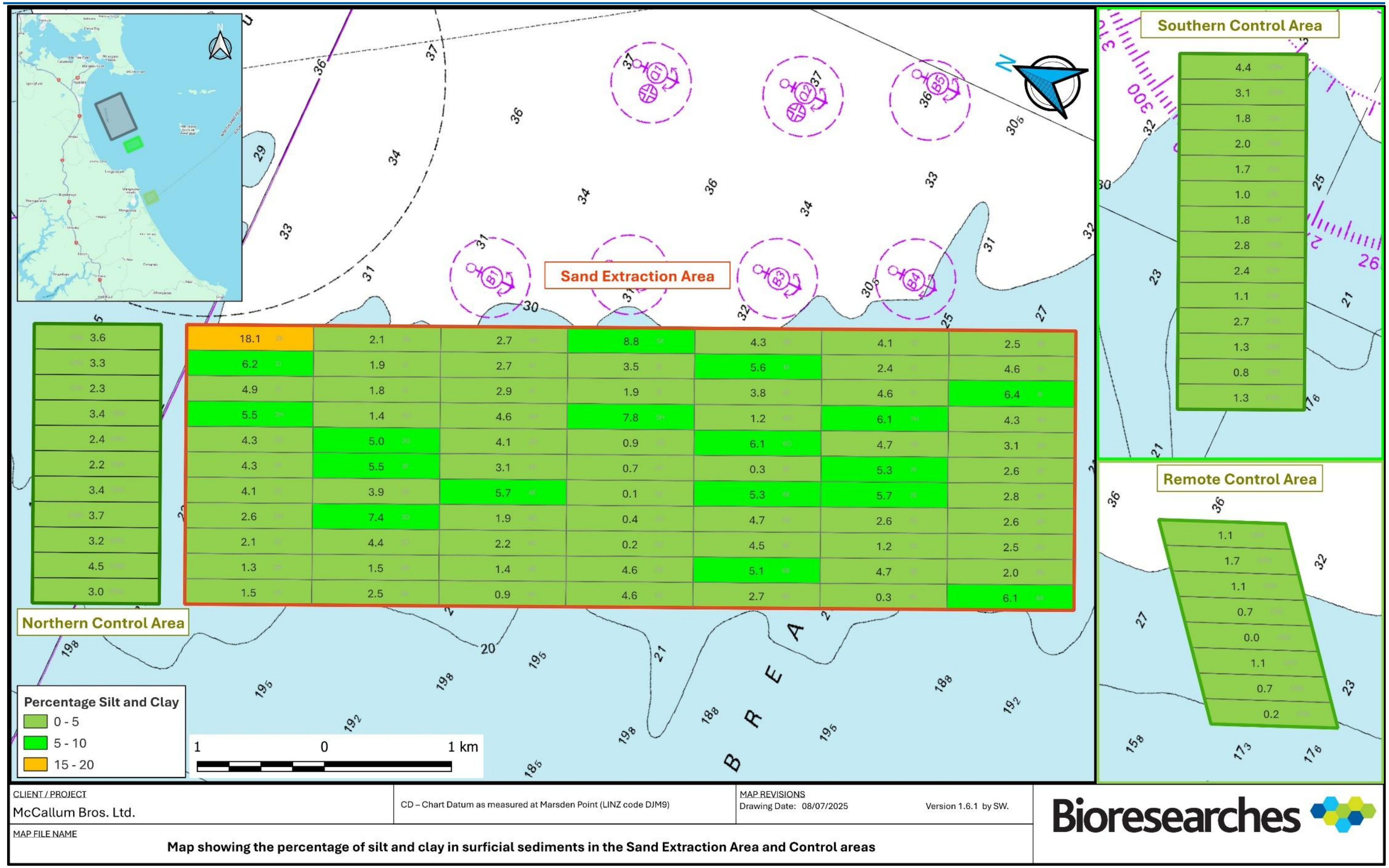


Figure 13 Percentage of Silt and Clay sized sediment particles within the Sand Extraction Area and Control areas.

3.4 Benthic Biota

3.4.1 Dredge tow and Photographic quadrat Epibenthic Macrofauna

A total of 35 dredge tows were conducted in March 2024 within the sand extraction area, and five additional dredge tows (4KL, 5KL, 6KL, 7KL, 8KL) were conducted on the edge or just outside eastward from the sand extraction area (Figure A.5). Another 16 dredge tows were conducted in the Control areas (Figure A.5).

The samples collected per dredge tow were photographed, identified, measured, and released alive (Appendix E). Thus, some small taxa were not identified to the species level. The detailed dredge tow data (densities per 100 m^2) are presented in Table E.1 and Table E.2 in Appendix E. The sizes of scallops recorded are presented in Table E.3 in Appendix E. Only one dredge tow did not contain any biota (3IK).

3.4.1.1 Diversity and number of individuals

A total of 51 different taxa were identified over the 56 tows. Forty-two taxa were recorded from the sand extraction area, 10 of these taxa were unique to the sand extraction area (i.e. not recorded in the Control area). Forty-one taxa were recorded in the Control areas; of these, nine were not recorded in the sand extraction area.

Seabed photographs from each of the 374 photographic sites sampled in March 2024 are presented in Appendix C. The biota presented at each site are listed in Table C.1 for the sand extraction area and in Table C.2 for the control areas. All taxa identified in the seabed photographs were already listed in the dredge tows.

Brachiopods (*Calloria inconspicua*) were not detected either in the seabed photographs or the dredge tows from within the sand extraction area. One brachiopod was recorded in the southern control near the eastern margin in a dredge tow from cells K and L. Large bivalves including Scallops (*Pecten novaezelandiae*), Clams (*Dosinia* sp.), Purple cockle (*Purpurocardia purpurata*) were recorded in the sand extraction area, along with a number of large shellfish including Volutes (*Alcithoe* sp.), whelks (*Austrofusus* sp., and *Cominella adspersa*), small Ostrich foot whelks (*Struthiolaria papulosa*), large Trophon (*Penion sulatus*), and Carrier shell (*Xenophora neozelanica*). The distribution of brachiopods and Carrier shell are shown together in Figure 14[5], because previous experience sampling in similar habitats has shown that brachiopods are sometimes found attached to the carrier shells, rather than present within the sediments (Bioresearches 2016a, 2016b, 2016c, 2024a). The distribution of scallops is shown in Figure 15 while Figure 16 shows the distribution of other bivalves. At three dredge tow locations, small (<10cm long) individual octopus (*Octopus maorum*) were recovered and returned to the sea (Figure 20).

High densities (> 10/100 m^2) of epi-macrobenthos were recorded (Table E.1) for the Hermit crabs, and barnacles. The distribution of abundance of Hermit crabs is shown in Figure 17.

Sponges were recorded in both the seabed photographs and the dredge tows (Figure 18).

Individual green, brown and red algae plants were recorded scattered sporadically attached to shell on the seabed within the sand extraction area (Figure 19) with red algae being most common. No rocky reef

[5] Note the widths of the dredge tow path boxes in Figure 14 to Figure 20 have been increased for graphical representation.

areas were identified within the sand extraction area. Figure 19 shows algae were present at the majority of sites sampled.

Two species of starfish were found, the comb sea star (*Astropecten polyacanthus*) and southern sand star (*Luidia australiae*). Figure 20 shows the starfish were distributed evenly over the sand extraction area and control areas.

The alongshore median numbers of individuals (Table E.4), average number of taxa (Table E.5) and median diversity index (Table E.6) showed no geographic pattern of fluctuations. The differences between the alongshore cell groupings including the control cells, were not statistically significant for the numbers of individuals (p=0.623), number of taxa (p=0.961), or diversity index (p=0.845).

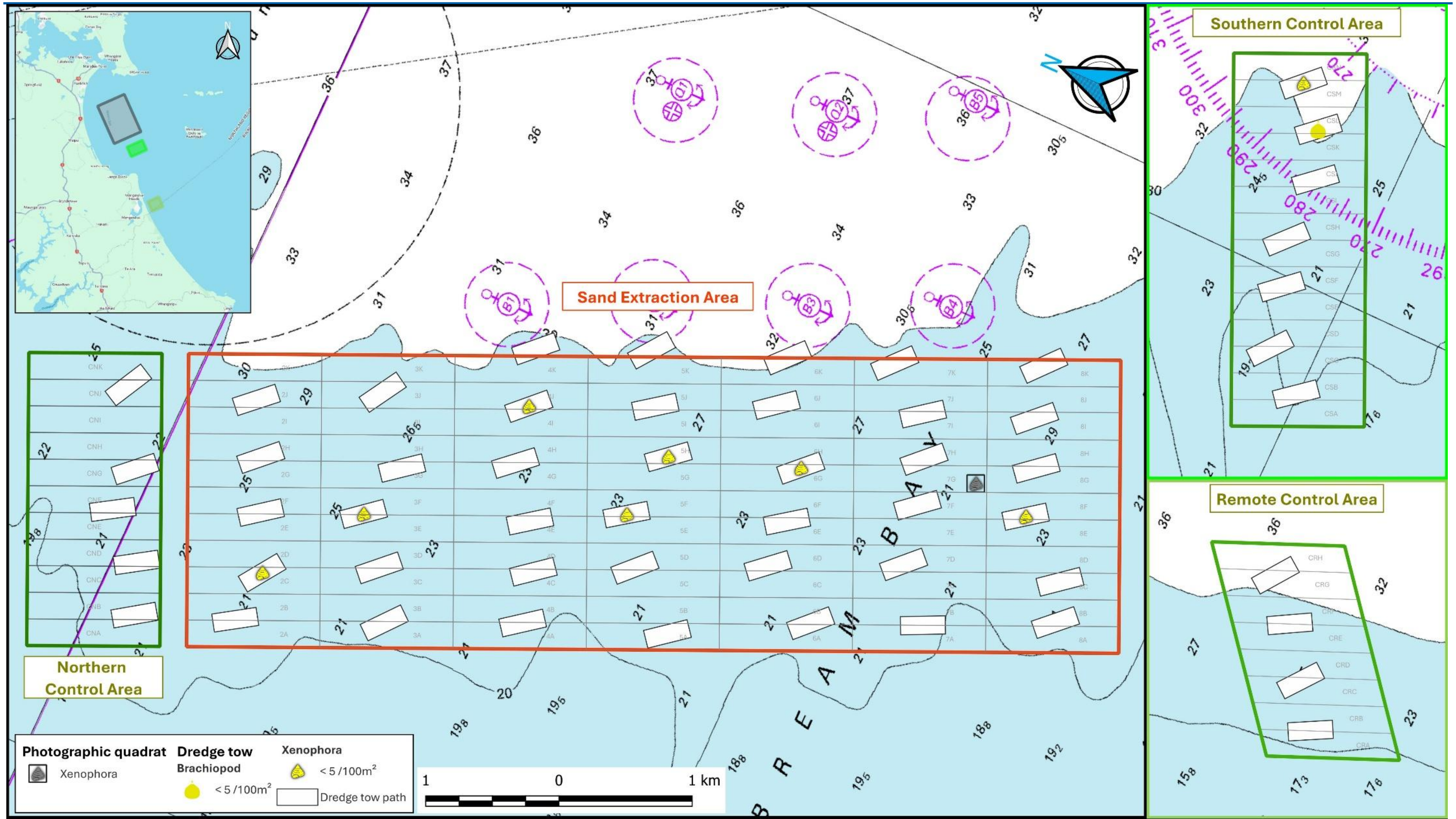
As outlined in section 2.2.3, a multivariate approach is required to examine variation in species composition and abundance. The replicate tow data were subjected to fourth-root transformations to scale down high numbers which dominated the biota assemblages and to give more influence to the rare taxa. A Bray-Curtis (B-C) similarity matrix was created on the transformed data set.

The biotic composition and abundance of the tows in the numerical rows of cells in the proposed sand extraction area and the three control areas were tested by PERMANOVA (Table E.7). This showed that the biotic composition and abundance of the shore perpendicular numerical rows of cells (alongshore) in the proposed sand extraction area and those of the three control areas were not statistically significantly different (p=0.6568).

In summary the macrofauna communities in the epibenthic dredge tows were not statistically significantly different across the proposed sand extraction, between the control areas, or between the proposed sand extraction area and the control areas.

3.4.1.2 Size of Individuals

The sizes of 33 scallops were measured (Table E.3). Four of the scallops measured exceeded the minimum size limit (100 mm) for recreational harvesting. The sizes of scallops were larger in the sand extraction area (median size of 77 mm) compared with the Control area (median size of 44 mm).



CLIENT / PROJECT
McCallum Bros. Ltd.

CD – Chart Datum as measured at Marsden Point (LINZ code DJM9)

MAP REVISIONS
Drawing Date: 09/07/2025
Version 1.7.1 by SW.

Bioresearches

MAP FILE NAME
Distribution of Brachiopods detected in epibenthic macrofauna tows and the distribution of Xenophora neozelanica detected in both epibenthic macrofauna tows and photographs in the Sand Extraction Area and Control areas

Figure 14 Distribution of Brachiopods detected in epibenthic macrofauna tows and the distribution of Xenophora neozelanica detected in both epibenthic macrofauna tows and photographs.

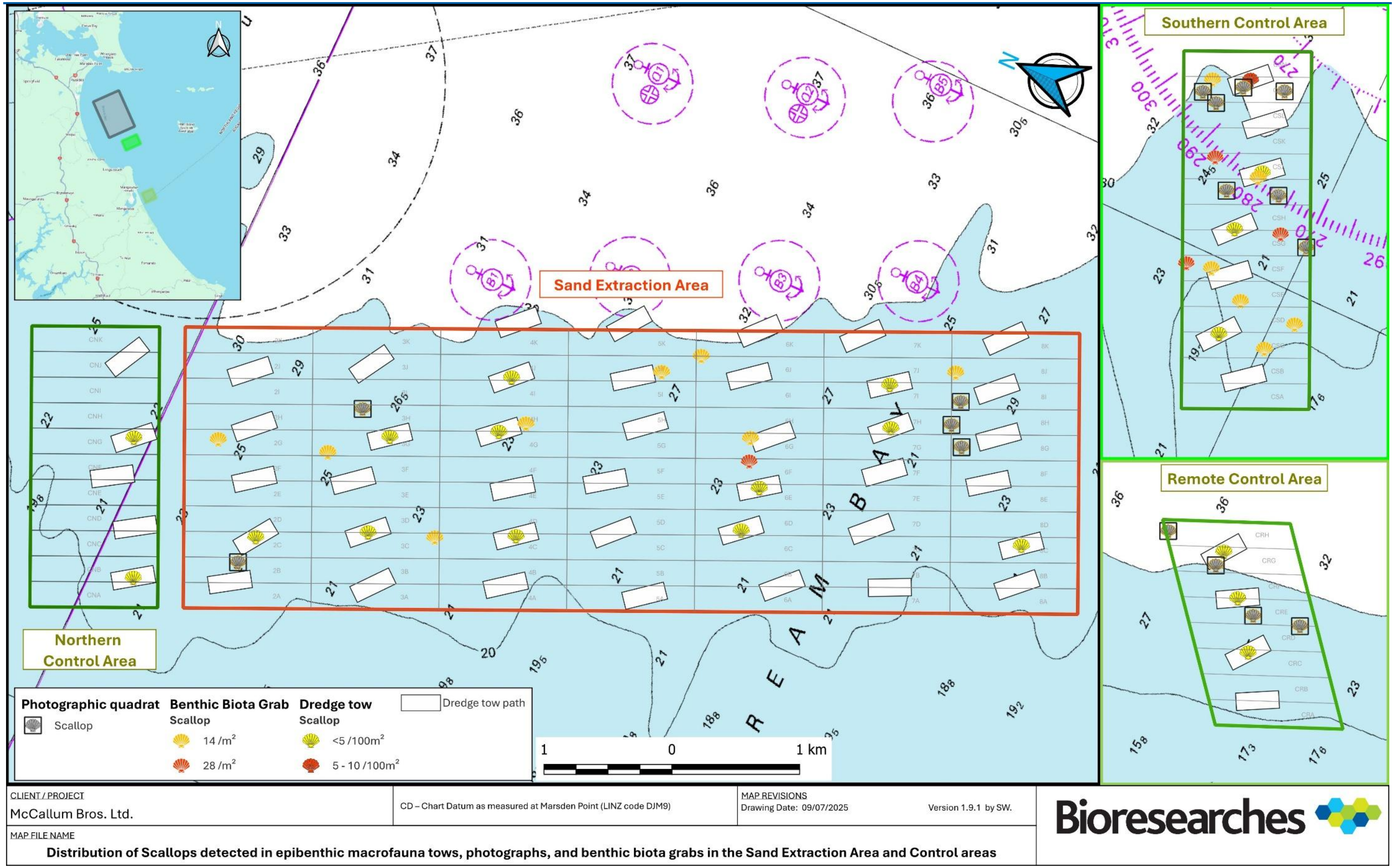


Figure 15 Distribution of Scallops detected in both epibenthic macrofauna tows and photographic samples.

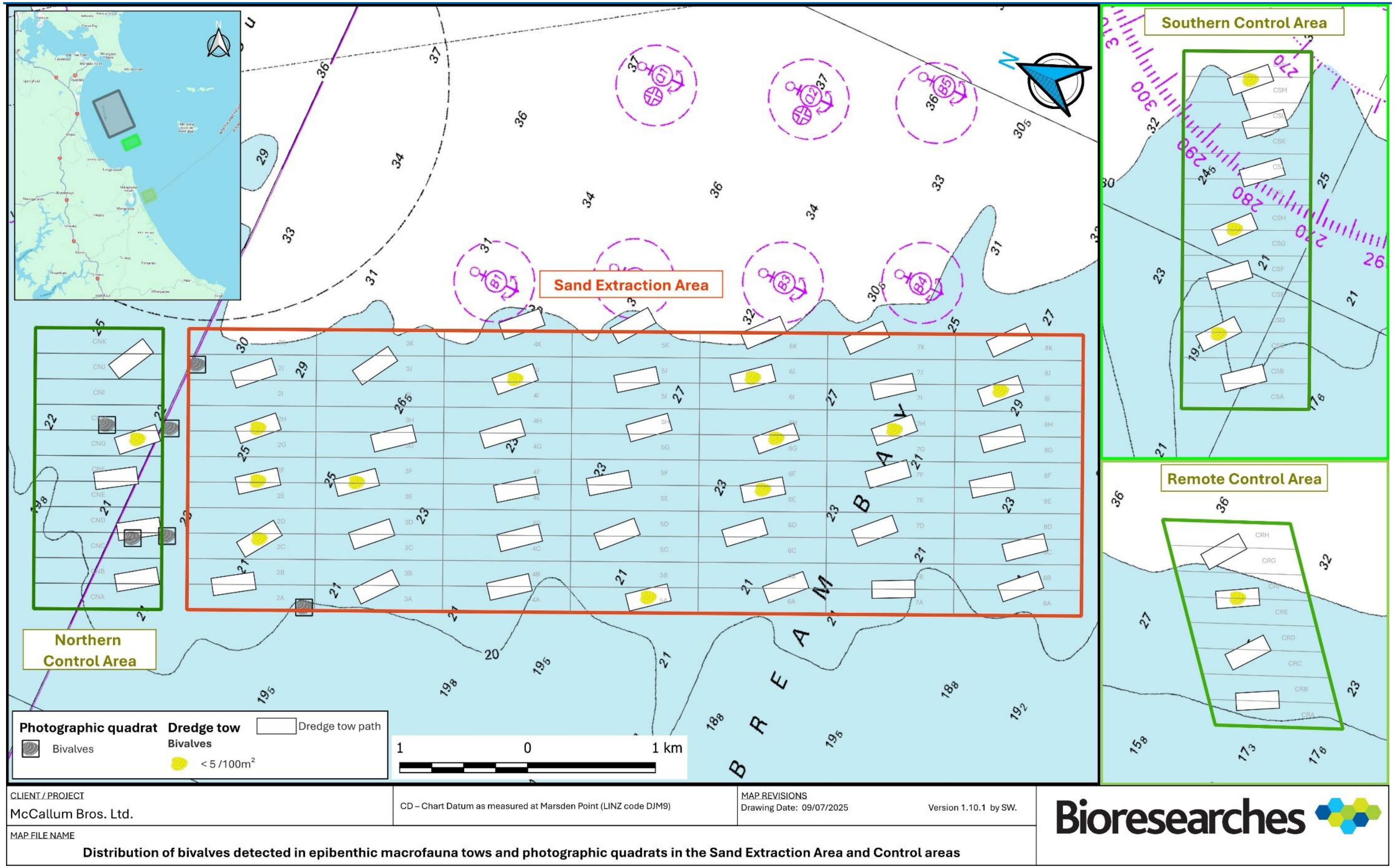


Figure 16 Distribution and abundance of the bivalves detected in epibenthic macrofauna tows and photographic samples.

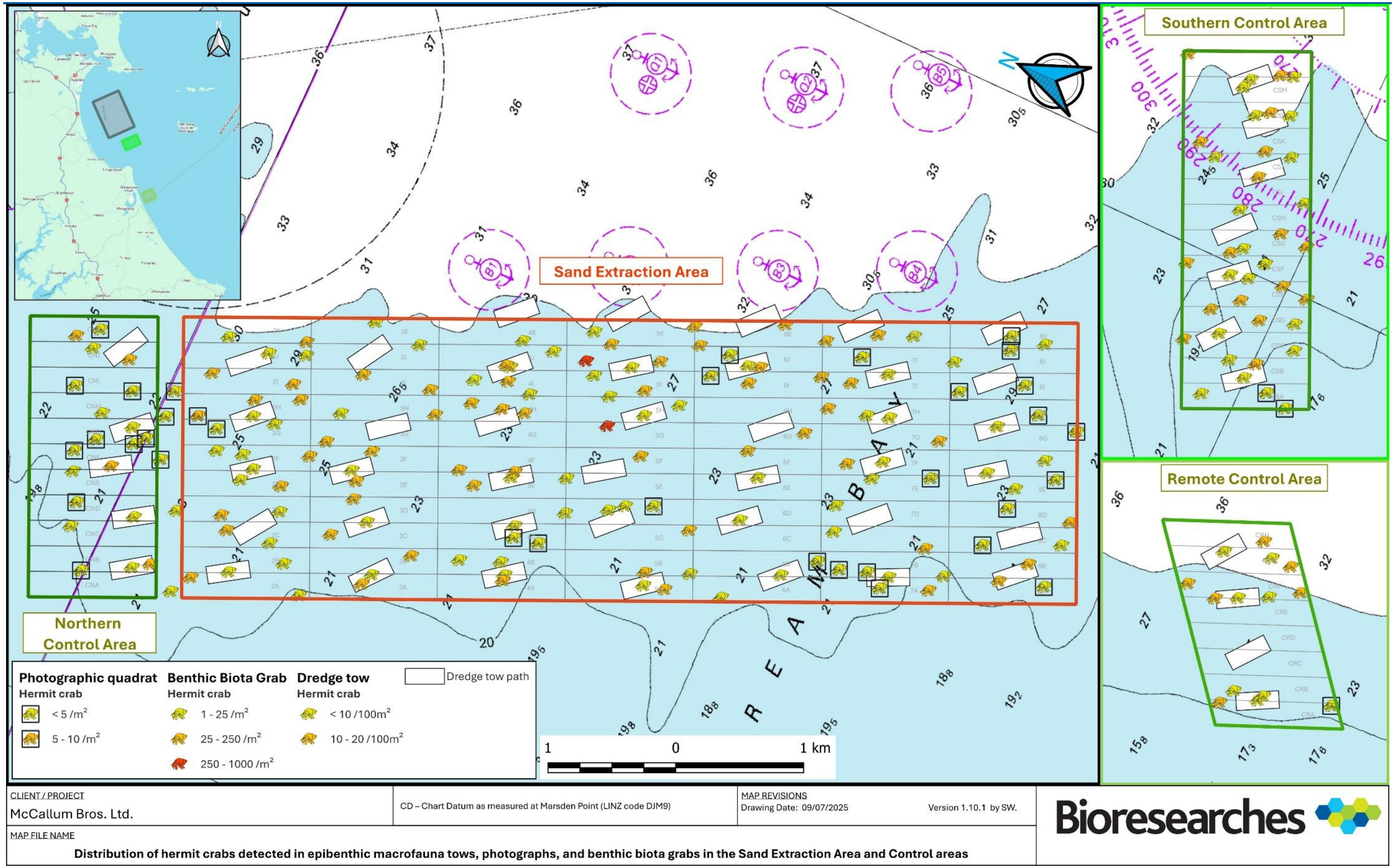
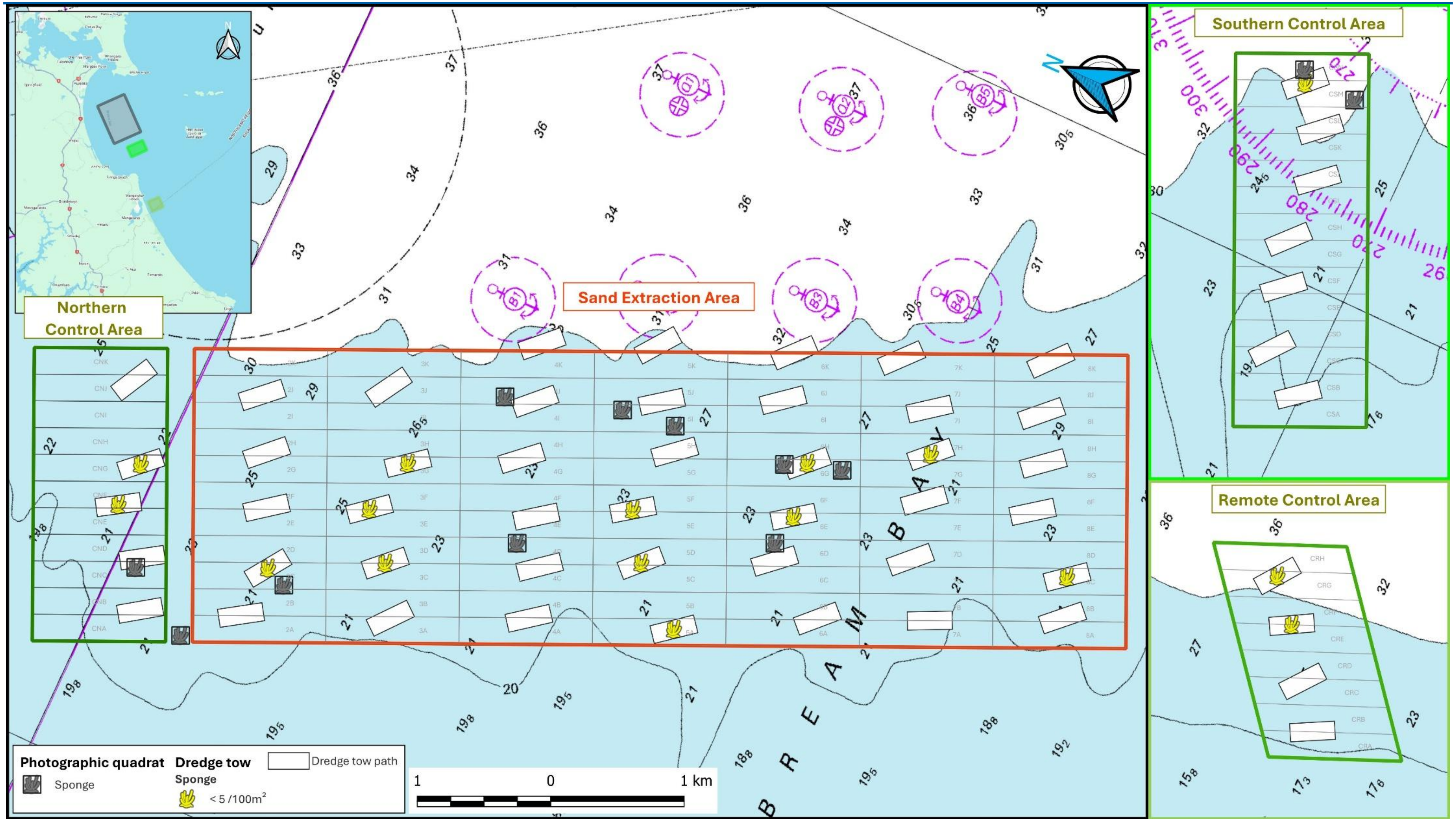


Figure 17 Distribution and abundance of the Hermit crabs detected in epibenthic macrofauna tows, photographs, and Benthic Grab samples.



CLIENT / PROJECT
McCallum Bros. Ltd.
CD – Chart Datum as measured at Marsden Point (LINZ code DJM9)
MAP REVISIONS
Drawing Date: 09/07/2025 Version 1.11.1 by SW.
MAP FILE NAME
Distribution of sponges detected in epibenthic macrofauna tows and photographic quadrats in the Sand Extraction Area and Control areas

Figure 18 Distribution and abundance of the sponges detected in epibenthic macrofauna and photographic samples.

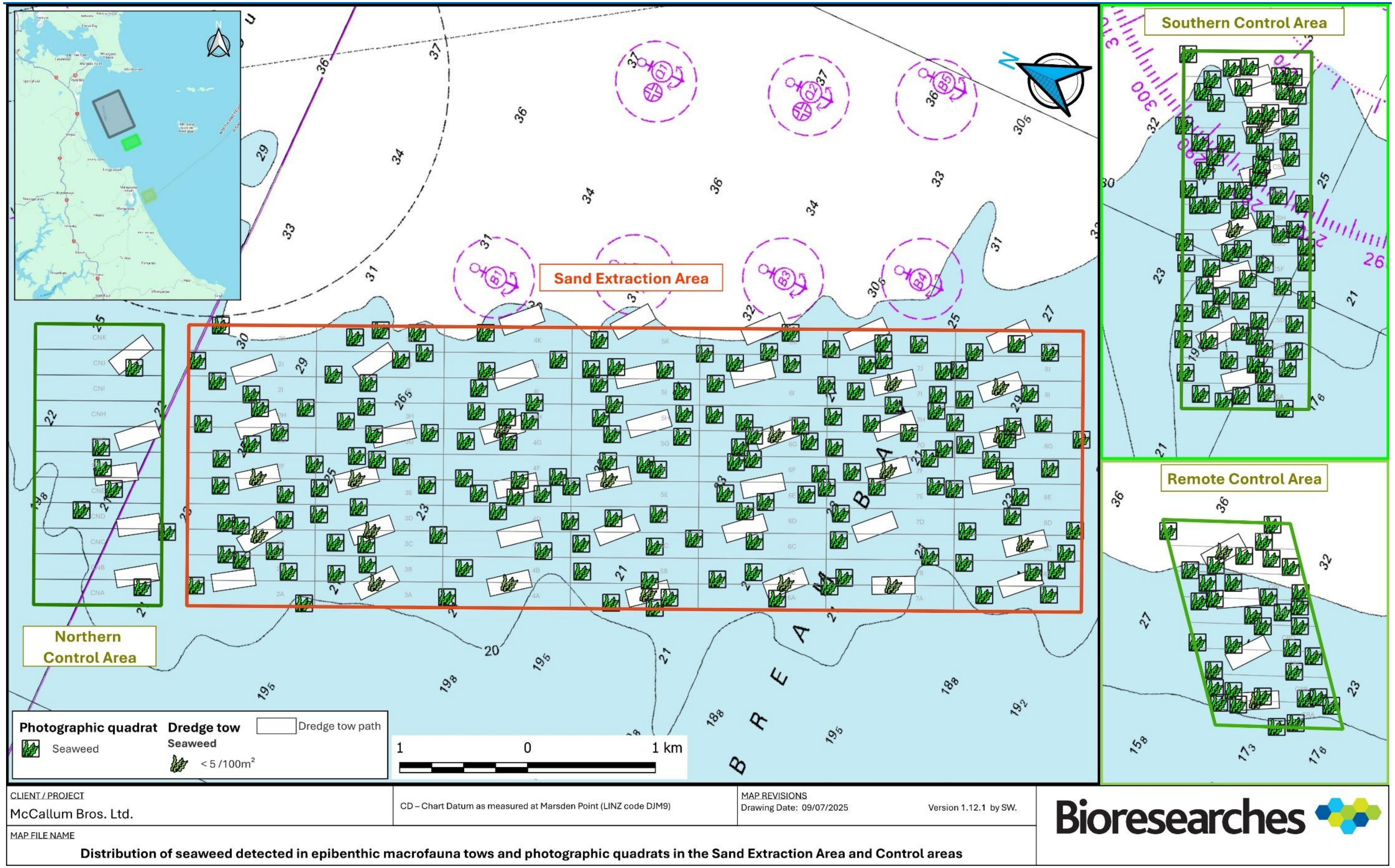


Figure 19 Distribution and abundance of the macro algae detected in epibenthic macrofauna and photographic samples.

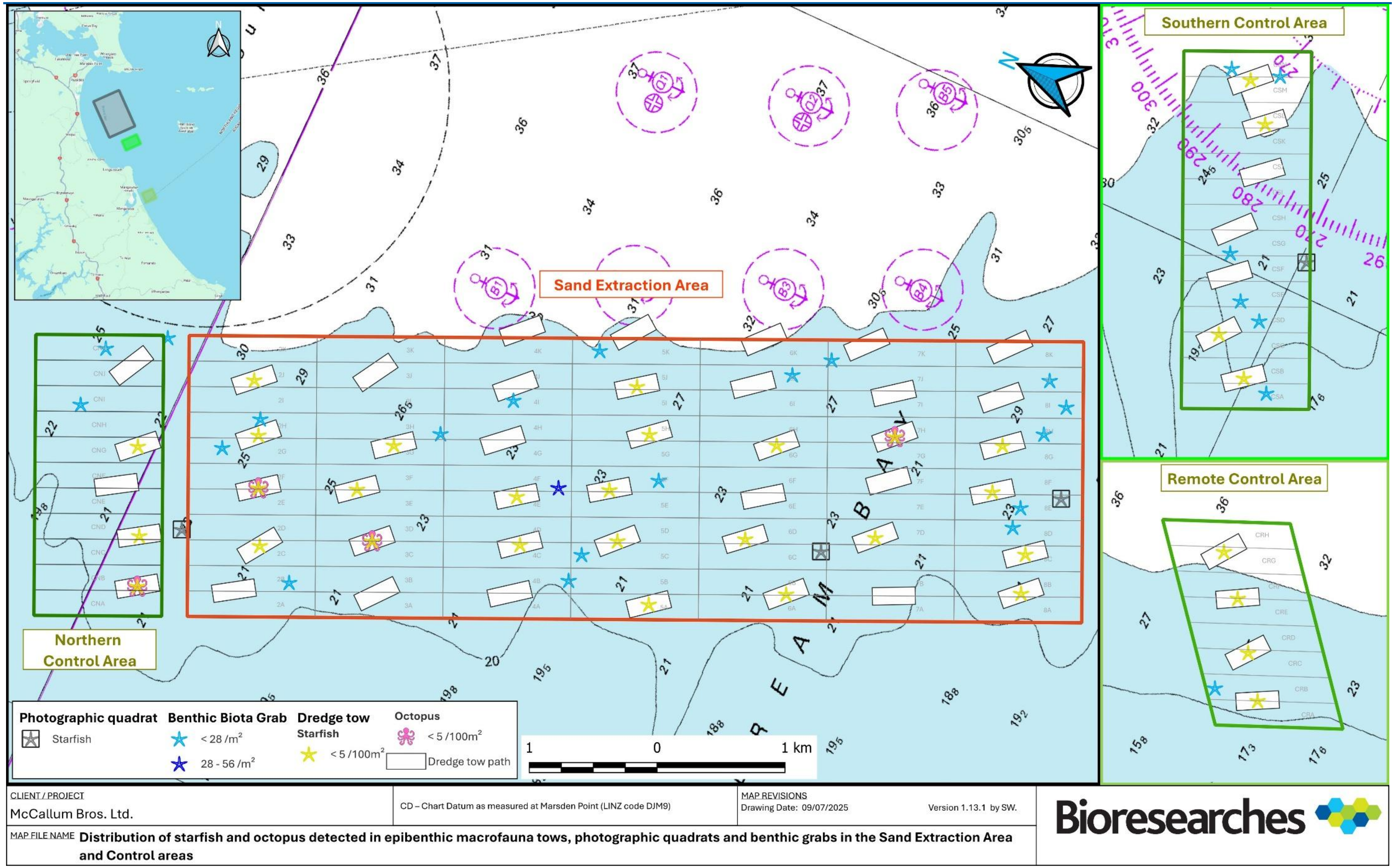


Figure 20 Distribution and abundance of starfish and octopus detected in epibenthic macrofauna, photographs and benthic grab samples.

3.4.2 Benthic Infauna

A total of 231 modified Standard Ponar Grab (0.071 m^2) samples were conducted in March 2024 within the sand extraction area. The locations of the modified Standard Ponar grab sample points are presented in Table A.2 and shown graphically in Figure A.4 in Appendix A.

One hundred and forty-three modified Standard Ponar Grab (0.071 m^2) samples were conducted in the Control areas (Figure A.4). This assumes that those samples collected in the 200 m gap between the sand extraction area and the post sampling defined Northern Control area are in the control area.

The raw data for each replicate sample along with the individual replicate summary statistics (Number of Individuals, Number of Taxa, Shannon-Wiener Diversity index, and Evenness) in the sand extraction area are presented in Table F.1 to Table F.7, and from in the Control areas in Table F.8 to Table F.11 in Appendix F. Data from the photographic quadrats were added to the grab sample data with a single individual addition to each grab sample data set that did not have records of scallops, Xenophora, sponges, hermit crabs, and starfish. These data additions are reported as blue italics in the Appendix F tables.

In addition to the large species reported in the dredge tows and photographic data in section 3.4.1 above, juvenile horse mussels (*Atrina zelandica*) were detected in some of the grab samples. The distribution and abundance are shown in Figure 21. Live horse mussels were not detected in the tow or photographic samples nor were there any indications of wider beds in the backscatter survey, undertaken by DML (DML, 2024). Occasional larger long dead shells were recovered in the tows.

Benthic biota results are summarised by the number of taxa, number of individual organisms, and Shannon-Wiener diversity index for each replicate at each sampling location. Including the photographic biota data, a total of 197 identified species/taxa and a total of 23,840 live individuals were counted from within the sand extraction area. The number of individuals averaged 103.2 per replicate sample and ranged from 12 to 520. The number of taxa averaged 26.7 per replicate sample and ranged from 8 to 41. The Shannon-Wiener diversity index averaged 2.630 per replicate sample and ranged from 0.7 to 3.359.

The replicate data were grouped by cells alongshore (Table 6) and eastward offshore in the sand extraction area (Table 7). Since the control areas differ in eastward offshore extent groupings are not similarly matched based on distances (cell letters). Thus, for the control areas the offshore cell groupings follow those used in the sediment particle size summary which is based on depth (Table 8). The depths used are from the vessel depth sounder, recorded at the time of sampling, tidally corrected, and referenced to NZVD16.

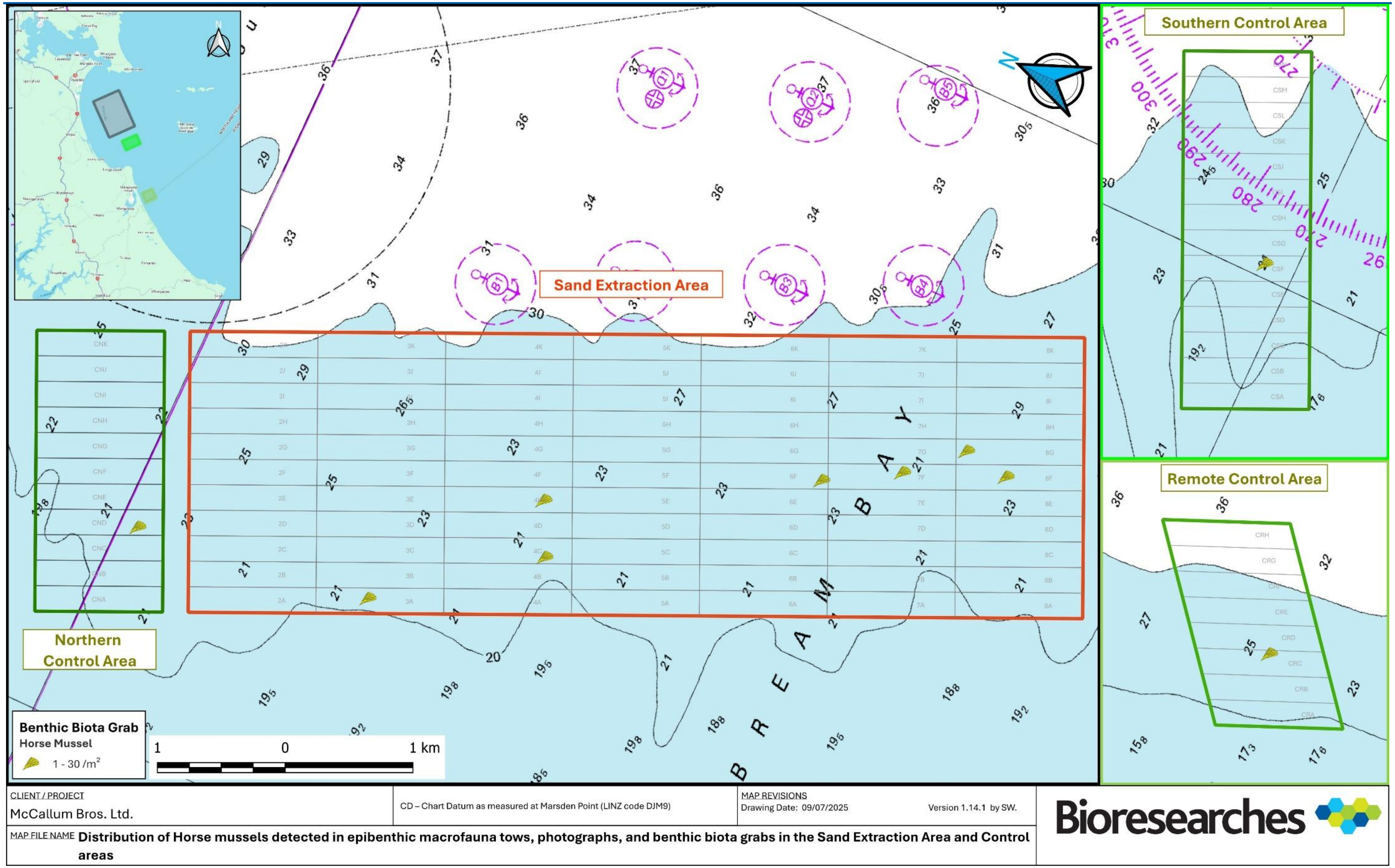


Figure 21 Distribution of horse mussels detected in epibenthic macrofauna, photographs and benthic grab samples.

Table 6 Summary of Benthic Biota Population Statistics by alongshore cell groupings March 2024

Alongshore	Sand Extraction Area																Controls							
	2		3		4		5		6		7		8		Sand Area		Northern		Southern		Remote		Controls	
	Ave.	SD	Ave.	SD	Ave.	SD	Ave.	SD	Ave.	Ave.	SD	SD	Ave.	SD	Ave.	SD	Ave.	SD	Ave.	SD	Ave.	SD	Ave.	SD
Average Depth (m) (NZVD2016)	25.1	2.5	25.4	2.1	24.4	11.6	25.4	12.1	25.1	12.0	24.2	11.6	24.6	11.7	24.9	10.9	22.5	1.4	24.5	3.6	27.1	4.3	24.8	3.8
Number of samples	33		33		33		33		33		33		33		231		33		70		40		143	
Number of Individuals	103.2	35.2	114.9	38.3	102.8	83.2	125.8	72.0	83.1	40.8	88.7	42.9	103.9	53.5	103.2	55.9	101.5	49.7	97.3	59.6	79.5	37.1	93.3	52.3
Number of Taxa	29.6	7.3	29.5	6.3	25.4	6.3	26.9	5.9	25.0	5.6	25.1	6.9	25.5	6.6	26.7	6.6	28.5	5.7	25.3	6.2	22.9	5.0	25.4	6.1
Total Number of Taxa	129		133		113		117		119		117		123		197		127		141		95		145	
Diversity Index	2.750	0.345	2.716	0.251	2.554	0.430	2.522	0.414	2.630	0.290	2.611	0.306	2.628	0.295	2.630	0.343	2.748	0.225	2.505	0.385	2.510	0.235	2.562	0.330
Evenness	0.822	0.067	0.810	0.049	0.800	0.125	0.772	0.118	0.825	0.081	0.821	0.066	0.820	0.062	0.810	0.086	0.829	0.082	0.783	0.105	0.810	0.074	0.801	0.094

Note: Ave. = average, SD = standard deviation

Table 7 Summary of Benthic Biota Population Statistics by Application area offshore cell groupings March 2024

Offshore Sand	A		B		C		D		E		F		G		H		I		J		K	
	Ave.	SD	Ave.	SD	Ave.	SD	Ave.	SD	Ave.	SD	Ave.	SD	Ave.	SD	Ave.	SD	Ave.	SD	Ave.	SD	Ave.	SD
Average Depth (m) (NZVD2016)	21.0	0.7	21.8	0.9	22.4	1.0	23.5	1.2	24.4	1.2	25.1	1.1	25.8	1.0	26.5	1.1	27.1	1.0	27.6	1.4	28.3	1.1
Number of samples	21		21		21		21		21		21		21		21		21		21		21	
Number of Individuals	136.8	64.7	118.1	65.3	110.8	40.2	86.6	35.2	74.2	39.3	108.0	48.1	85.1	42.6	102.2	39.7	109.3	98.6	98.1	49.5	106.0	46.7
Number of Taxa	27.3	5.3	25.8	6.1	27.6	5.8	24.4	7.0	22.6	7.1	28.0	6.6	23.6	7.3	28.7	6.8	28.8	6.1	27.5	5.8	29.5	6.2
Total Number of Taxa	106		99		109		107		111		116		104		126		121		108		110	
Diversity Index	2.463	0.316	2.481	0.311	2.647	0.236	2.591	0.243	2.557	0.341	2.697	0.343	2.557	0.387	2.761	0.279	2.735	0.528	2.695	0.285	2.748	0.313
Evenness	0.749	0.085	0.769	0.072	0.804	0.057	0.823	0.044	0.834	0.059	0.819	0.099	0.821	0.093	0.830	0.055	0.820	0.150	0.821	0.083	0.819	0.080

Table 8 Summary of Benthic Biota Population Statistics by Control area offshore cell groupings March 2024

Offshore Control	CSA-C, CRA		CNA-D, CSD-E, CRB		CNE-H, CSF		CNI-K, CSG-H		CSI-J, CRC-D		CSK-M, CRE		CSN, CRF-H	
	Ave.	SD	Ave.	SD	Ave.	SD	Ave.	SD	Ave.	SD	Ave.	SD	Ave.	SD
Average Depth (m) NZVD2016	20.7	0.9	21.8	0.9	22.2	0.9	23.9	1.0	25.8	1.6	28.3	1.6	31.3	1.5
Number of samples	20		27		17		19		20		20		20	
Number of Individuals	109.1	36.4	106.7	50.7	109.7	53.2	115.5	92.3	64.8	21.6	79.8	36.0	66.4	17.9
Number of Taxa	23.5	4.5	26.5	5.9	29.1	6.2	26.8	6.1	20.7	4.5	25.7	7.3	25.7	4.7
Total Number of Taxa	92		116		117		109		81		92		89	
Diversity Index	2.337	0.335	2.565	0.322	2.674	0.257	2.521	0.404	2.452	0.210	2.661	0.354	2.739	0.242
Evenness	0.744	0.092	0.791	0.095	0.804	0.098	0.775	0.126	0.819	0.067	0.829	0.075	0.849	0.059

3.4.2.1 Number of Individuals

The number of individuals per sample in the sand extraction area ranged from 14 to 520 averaging 103.2, while in the control areas ranged from 28 to 259 averaging 93.3.

The median numbers of individuals in the sand extraction area were 8% higher than in the control areas (Table G.1). While the difference was statistically significant (p=0.043), the difference is unlikely to be ecologically significant. The numbers of individuals reported from within the control areas were within the range reported from the sand extraction area. To further evaluate the differences between the sand extraction area and the control areas, the alongshore median numbers of individuals show a general trend of decreasing numbers from north to south with fluctuations (Table G.2). The differences between the highest median number, Cells 03 (117 / sample), and the two lowest median numbers from Cells 06 (70 / sample, p= 0.016) and Remote Control (71 / sample, p = 0.002) were statistically significant, as was the difference between the second highest median, Cells 05 (111 / sample), and the Remote control (71 / sample, p= 0.018) (Table G.2). The median number of individuals varied east to west across the sand extraction area, with the highest numbers recorded in row A in the west and lowest in row E in the middle of the sand extraction area. The difference between the row A and E was statistically significant (Table G.3).

The numbers of individuals thus varied in both alongshore and offshore directions. The geographical distribution variations in the numbers of individuals are shown in Figure 22. The patches of darker red and yellow alongshore in the sand extraction area, reflect some of the differences observed in the statistics above. Within both control areas, redder areas can be seen at the inshore ends of the area, suggesting some variation as a result of either geographic location or depth.

3.4.2.2 Number of Taxa

The number of taxa per sample in the sand extraction area ranged from 8 to 41 averaging 26.7, while in the control areas it ranged from 13 to 44 averaging 25.4.

The mean numbers of taxa in the sand extraction area are 3% higher than in the control areas (Table G.4), however the difference is not statistically significant (p=0.197), and unlikely to be ecologically significant. To further evaluate the differences between the sand extraction area and the control areas the alongshore average number of taxa (Table G.5) show a general trend of decreasing numbers from north to south with fluctuations. The differences between the highest average number, Cells 02 (29.61 / sample), and the Remote Control (22.88 / sample, p<0.001), and the Southern Control (25.31 / sample, p=0.046) were statistically significant. The differences between the next two highest average numbers, Cells 03 (29.49 / sample, p<0.001) and Northern Control (28.49 / sample, p=0.006), and the Remote Control (22.88 / sample) were also statistically significant (Table G.5). The numbers of taxa reported from within the Southern Control area were within the range reported from the sand extraction area, however the numbers of taxa in the Remote Control were statistically significantly lower than some of the alongshore cell groupings (Cells 02 p<0.001, Cells 03 p<0.001) in the sand extraction area.

The highest numbers of taxa per sample were recorded in the sand extraction area cells “K” (29.48 / sample), and the lowest numbers of taxa per sample in cells “E” (22.57 / sample), with the difference being statistically significant (Table G.6). Differences between other cell rows were not statistically significant.

The numbers of taxa varied in both alongshore and offshore directions. The geographical distribution variations in the numbers of taxa are shown in Figure 23. The patches of darker blue alongshore in the sand extraction area reflect some of the differences observed in the statistics above.

3.4.2.3 Diversity Index

The Shannon-Wiener Diversity Index can range from 0 to around 4, depending on the complexity and diversity of the ecosystem being studied. Generally:

- **Low Diversity**: Values close to 0 indicate low diversity, meaning the community is dominated by one or a few species.
- **Moderate Diversity**: Values around 1 to 2 suggest moderate diversity.
- **High Diversity**: Values above 2 are considered high, indicating a more diverse and evenly distributed community. Any values above 3 are considered very high.

The Shannon-Wiener Diversity Index values per sample in the sand extraction area ranged from 0.70 to 3.36 averaging 2.63, while in the control areas ranged from 1.23 to 3.42 averaging 2.56. All sand extraction area and control cell average Shannon-Wiener Diversity Index values were in the high range (>2). One replicate sample 4I3 had a low Shannon-Wiener Diversity Index value of 0.7. This was largely due to very high numbers of an unidentified amphipod, with the other taxa only represented by very few numbers of individuals. Similarly, the 17 replicate samples which were in the moderate range of 1-2 had one or two taxa with elevated numbers compared with many taxa with low numbers of individuals.

The median Shannon-Wiener Diversity Index values in the sand extraction area are 5% higher than in the control areas (Table G.7). While the difference is statistically significant (p=0.002), the difference is unlikely to be ecologically significant. The Shannon-Wiener Diversity Index values reported from within the control areas were generally within the range reported from the sand extraction area. To further evaluate the differences between the sand extraction area and the control areas the alongshore median diversity index (Table G.8) show a general trend of decreasing diversity from north to south with fluctuations. The highest median diversity was recorded in the north at Cell group 02 (2.806 / sample), and the lowest median diversity from the Remote Control (2.471 / sample). The median diversity from cell group 02 was statistically significantly higher than the southern and remote control areas, but not the northern control area (Table G.8). The median diversity from cell group 03 was statistically significantly higher than the remote control area (Table G.8), but not the southern control area. The median diversity from the northern control area was statistically significantly higher than the southern and remote control areas (Table G.8). The median diversities reported from within the control areas was within the range reported from the sand extraction area.

Within the sand extraction area the median diversity per sample was not statistically significant between the western inshore cell group “A” and the eastern offshore cell group “K” (Table G.9). The highest diversity per sample was recorded in cells “I” (2.879 / sample), and the lowest median diversity per sample in cells “B” (2.521 / sample). Both cell groups “A “and “B” were statistically significantly lower than the cell group “I” (Table G.9).

The diversity index varies in both alongshore and offshore directions. The geographical distribution variations in the diversity index are shown in Figure 24. Within the sand extraction area and remote control area the patterns of diversity (the intensity of green colouring) can be seen as relatively uniform, this suggests the variation in the diversity between samples was not large.

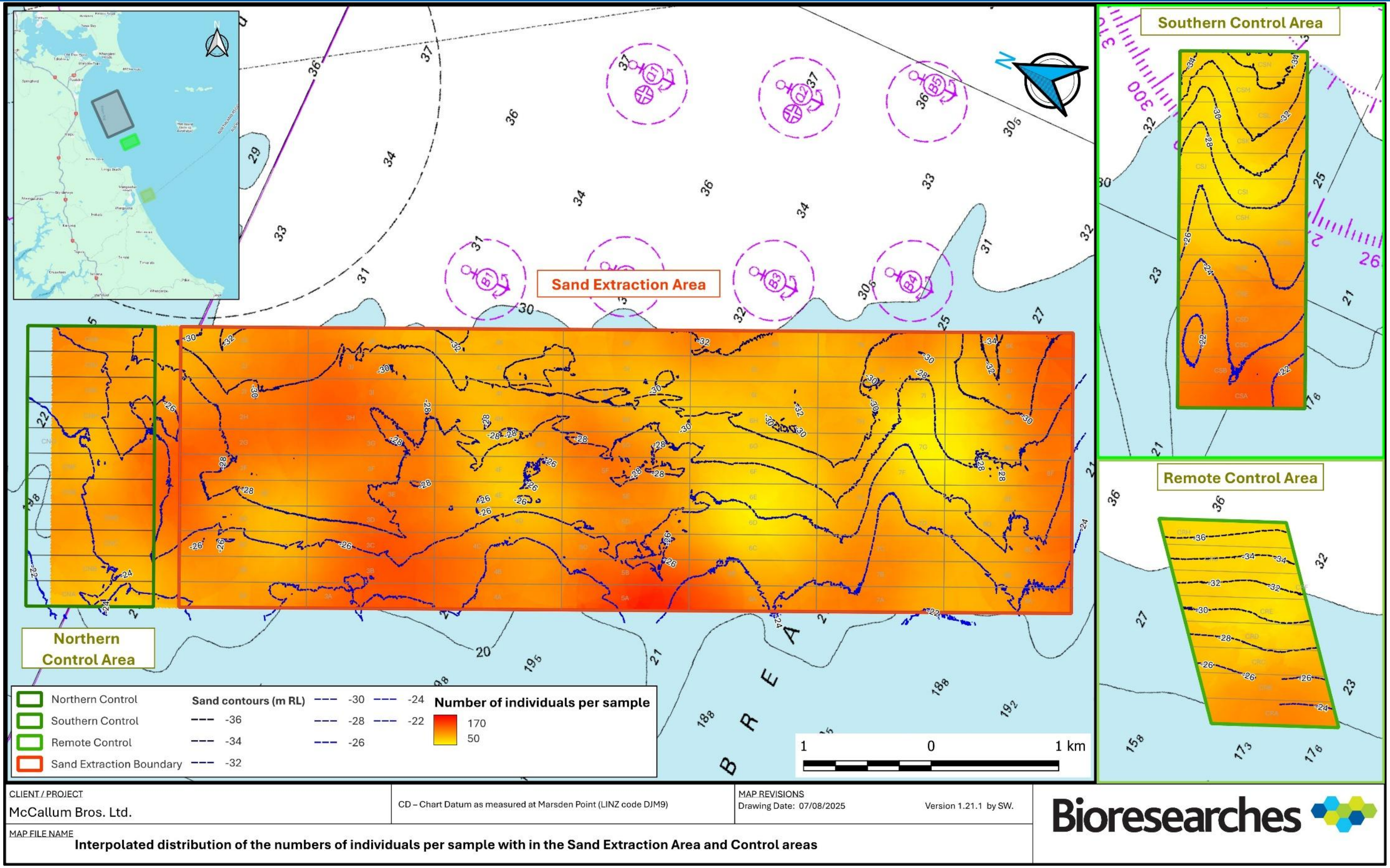


Figure 22 Interpolated distribution of the Numbers of benthic biota individuals per sample within the sand Extraction Area and Control areas, with depth contours from DML survey (m RL).

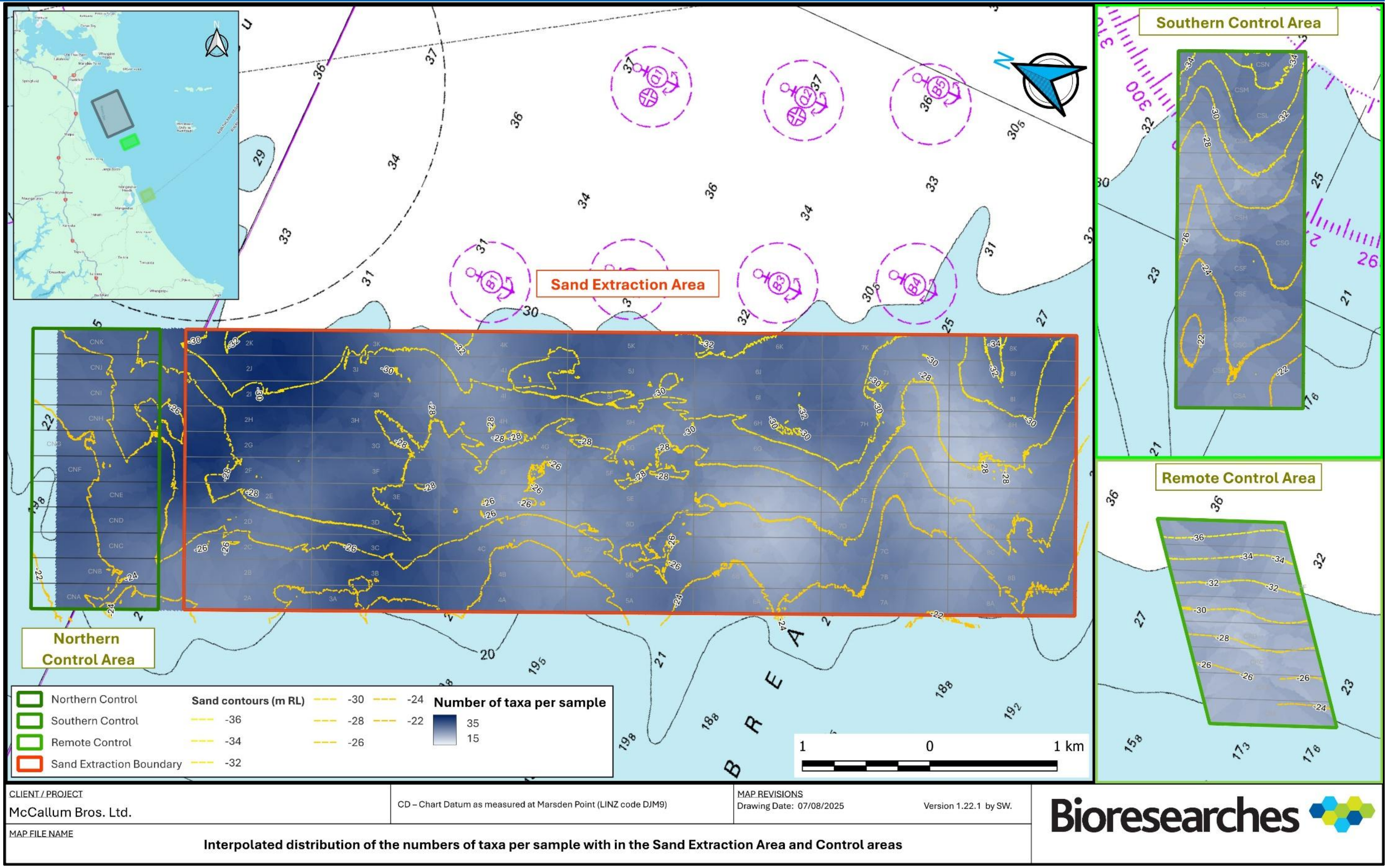


Figure 23 Interpolated distribution of the Numbers of benthic biota taxa per sample within the sand Extraction Area and Control areas, with depth contours (m RL).

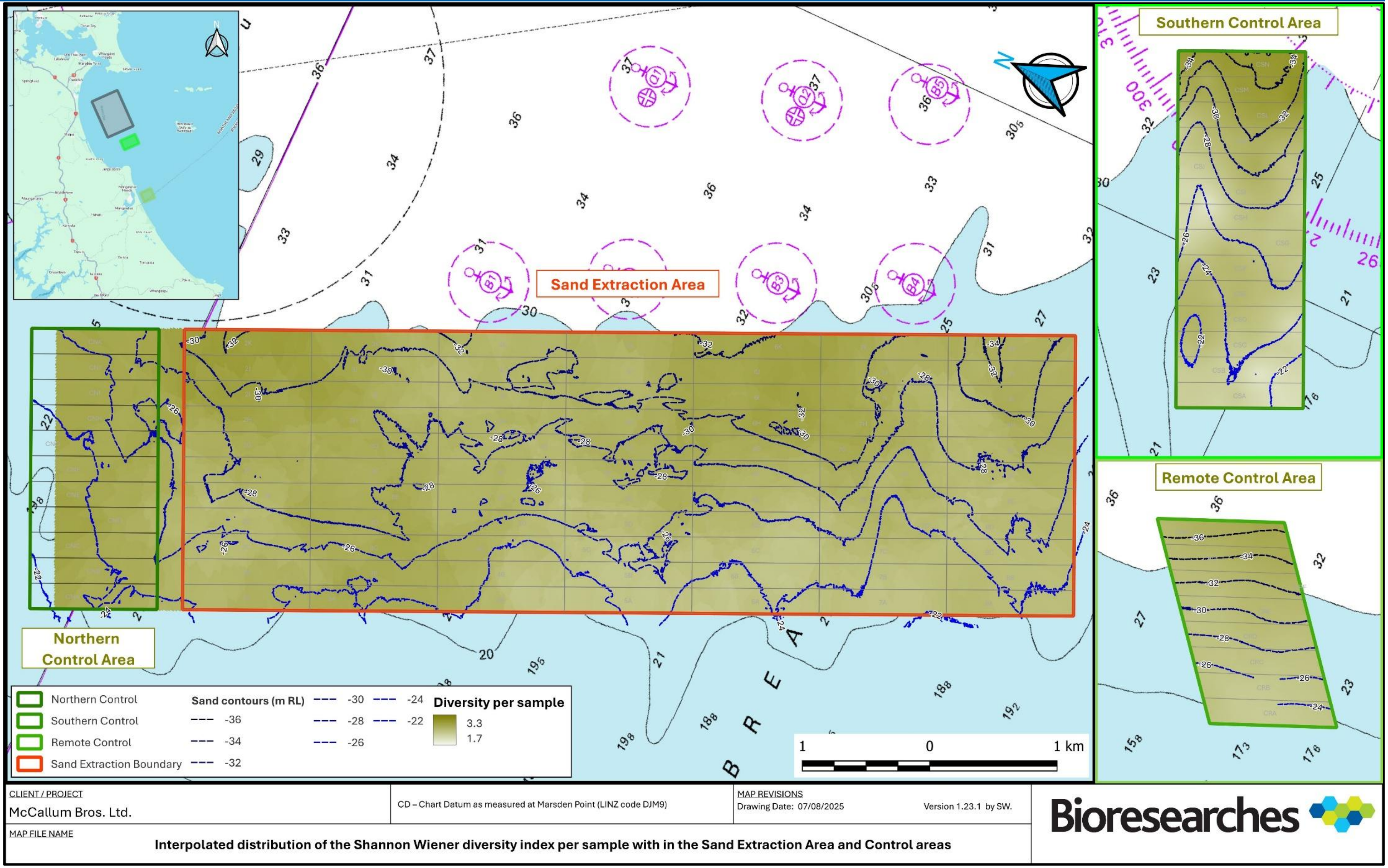


Figure 24 Interpolated distribution of the Shannon-Wiener diversity index per sample within the sand Extraction Area and Control areas, with depth contours (m RL).

3.4.2.4 Multivariate

As outlined in section 2.2.3, a multivariate approach is required to examine variation in species composition and abundance.

Because the raw benthic biota data has a high number of taxa with very few individuals, the following protocols were applied in order to "clean" the data to reduce "noise" levels in the data set. If taxa were recorded in 5 samples or less, then taxa were grouped with similar taxa by either genus or family when possible. If no obvious grouping was present, then these samples were retained. If fewer than 5 individuals were recorded, then the taxa were either deleted or combined in a higher taxa grouping. For example, the taxa *Marphysa* sp. was grouped with the family taxa Eunicidae.

The following multivariate approach was conducted on the biota for each sample. The "cleaned" replicate data set were subjected to a fourth-root transformation to scale down high numbers which dominated the biota assemblages and to give more influence on the rare taxa. The values for the fourth root transformation range from 0 to 5 (Figure G.1).

A Bray-Curtis (B-C) similarity matrix was created on each transformed data set, and threshold metric Multi-Dimensional Scaling (tmMDS) was used to visualise the degree of similarity among different samples in both 2 and 3 dimensions. Primer produces a stress value for each plot to indicate how well the plots fit the full multidimensional data set, with the lower the stress the better fit.

- Stress levels of <0.05 give an excellent representation with no prospect of misinterpretation,
- Stress levels of <0.1 corresponds to a good ordination with no real prospect of a misleading interpretation,
- Stress levels of <0.2 still gives a potentially useful 2-dimensional picture, though for values at the upper end of this range little reliance should be placed on the detail of the plot.

The stress levels observed for the fourth root transformed data were 0.248 for the 2D plot (Figure G.2) and 0.184 for the 3D plot (Figure G.3). Each of the tmMDS plots using the individual replicate data was high, with none below 0.1. Thus while these figures are included in the appendices for completeness the figures were not assess for patterns due to the high stress. To reduce the stress values and gain a clearer representation of the data relationships, the number of samples whose inter-relationships are being represented needs to be reduced, the simplest approach is to average the cell replicate data.

Thus, the replicate data for each cell were averaged and shade plots reproduced. Based on the shade plots produced the square-root transformations showed the best result (Figure G.4). Repeating the creation of Bray-Curtis similarity matrices, and tmMDS 2 and 3 D plots, showed better stress values for both transformations, with the square-root transformed cell averaged data producing the lowest 2D stress of 0.213 (Figure G.5) and 3D stress of 0.149 (Figure 25).

The 3D cell averaged square root transformed, tmMDS plot (Figure 25) does not show any clear visual separation of alongshore cell groupings. However, two sets of control cell data (+, ×) are located to the left of the plot, while the cells from the sand extraction area and the northern control cells (*) appear to be aligned more to the right of the plot. There appears little to differentiate the cells within each alongshore grouping however the inshore cells (A, B, C) are generally near the bottom of the plot. This suggests some differences between the sand extraction area and the more southern controls, and that species composition and abundance changes with difference offshore and increased depth.

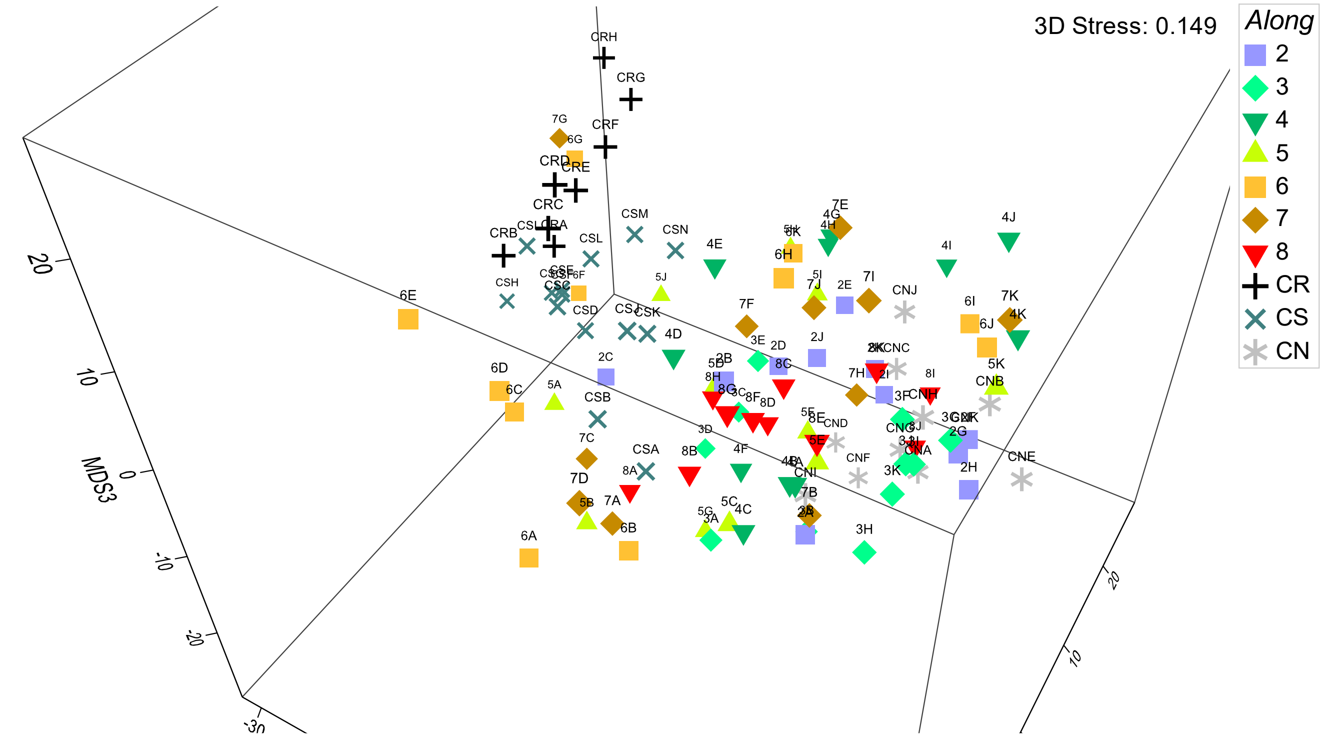


Figure 25 3 dimensional threshold metric Multi-Dimensional Scaling (tmMDS) of square-root transformed cell averaged benthic biota data, with symbol grouping by alongshore cells.

The MDS plots are not statistical tests but a way to visualise the complex multidimensional data.

Differences between the sand extraction areas and the Controls

There are differences in biota based on depth (West, *et al*, 2025), therefore any comparison between sand extraction area and control area needs to be based on areas that contain similar depth ranges. The three control areas were designed to include the same or very similar depth ranges to that of the sand extraction area. Under ideal conditions, each control area location would cover the same area, however the seabed slope is different in each control area compared to the sand extraction area. To the north of the sand extraction area, the shore slope changes by approximately 90° to slop down from the NNW as opposed to from the WSW. In addition, east of the northern control area is the area of foul ground known as “three mile reef,” which has different seabed composition, this means the northern control does not cover the same depth range as the sand extraction area. To the south of the sand extraction area the shore slopes more shallowly, thus the southern control area covers the same depth range but is some 400 m wider. At the remote control area, the shore slope is steeper thus while the depth range is the same, the remote control area is some 600 m narrower than the sand extraction area. The average depths for each sampling block as shown in Table 6 reflect this, however the average depths for the sand extraction area and the controls combined are not significantly different (p=0.153)(Table G.10).

The biotic composition and abundance of the sand extraction area and the three control areas combined were tested by PERMANOVA (Table G.11). This showed that the biotic composition and abundance of the sand extraction area were statistically significantly different (p=0.0001) to the control area. PRIMER’s SIMPER routine was then used to characterise the dominant taxa for each area (Table G.12) and the relative contributions of taxa to the differences.

Within-group similarity for the control sites was 39.3%, indicating moderate internal variation typical of sandy benthic habitats. The community similarity within the control area was primarily driven by polychaete and amphipod taxa including *Maldanidae*, discoid *Bryozoa*, *Phoxocephalidae*, unidentified *Amphipoda*, *Urothoidae*, and the gastropod *Sigapatella tenuis*. Together, these taxa accounted for approximately half of the total similarity, with secondary contributions from *Sigalionidae*, *Nucula nitidula*, *Scalpomactra scalpellum*, *Sabellidae*, juvenile *Gari* spp., and *Owenia petersenae*.

Within the sand extraction area, the average similarity was 38.6%, showing a comparable level of internal heterogeneity. The dominant taxa were similar to those found in the control sites and included *Phoxocephalidae*, *Urothoidae*, *Maldanidae*, unidentified *Amphipoda*, *N. nitidula*, *S. tenuis*, *Ampharetidae*, and *S. scalpellum*. Minor contributors included juvenile *Gari* spp., *Aglaophamus* sp., *Sigalionidae*, discoid *Bryozoa*, and *Lysianassidae*. These results confirm that both the control and sand extraction areas are dominated by the same characteristic assemblage of polychaetes, amphipods, and small bivalves typical of mobile sand habitats.

The average dissimilarity between the two groups was 63.7%, suggesting moderate differences in community structure. No single species was strongly responsible for this dissimilarity; instead, it was driven by shifts in the relative abundances of widely distributed taxa such as discoid *Bryozoa*, *Urothoidae*, *Ampharetidae*, *Phoxocephalidae*, *Maldanidae*, *Hydroides* sp., and *N. nitidula*. The lack of unique or indicator species within either group indicates that compositional differences are subtle and reflect reweighting among common taxa rather than distinct faunal replacement.

Overall, the SIMPER results show that the control and sand extraction assemblages are ecologically comparable and characterised by the same dominant species. The moderate within-group similarities and between-group dissimilarity values are consistent with naturally patchy and dynamic soft-sediment environments. The observed variation is most likely related to small-scale differences in sediment composition or shell content rather than direct effects of extraction.

These results support the interpretation that benthic communities within the proposed extraction area are typical of well-sorted, high-energy sand habitats and are not compositionally distinct from nearby control areas.

The biotic composition and abundance of the numerical rows of cell in the sand extraction area and the three control areas were tested by PERMANOVA (Table G.13). The biotic composition and abundance of the shore perpendicular numerical rows of cells (alongshore) in the sand extraction area and those of the three control areas were statistically significantly different (p=0.0001). Pairwise comparisons showed that all sand extraction area alongshore cell groupings were statistically significantly different from those in the control areas. PRIMER's SIMPER routine was then used to characterise the dominant taxa for each alongshore area (Table G.14). The SIMPER results also characterise the differences between alongshore cell groupings. The pairwise comparisons in Table G.14 have been limited to those between cell 2, 5, and 8 in the sand extraction area and those in each of the control areas.

Within the sand extraction area those alongshore groupings closed to each other were generally more similar to each other than those further apart. The plot of alongshore cell grouping centroids (Figure 26) shows a gradient effect between the northern control cell grouping (CN) and those to the south in the sand extraction area (2, 3, 4, 5, 6, 7, 8) with the southern control (CS) being the most distant along an axis (bottom left to top right in Figure 26). Centroids for cells 3 and 8 show some separation from the axis CN to CS, suggesting slightly different biota. The remote control centroid is not only distant along the axis but separated from the axis, indicating the biota at the remote control is influenced by slightly different factors from those nearer the sand extraction area. For the controls to function as indicators of the natural variation in the biotic communities, they should ideally cover the pre-effect range of variation in the potential impact sites. The gradient effect detected in the benthic biota data shows that the two controls north and south provide sufficient data to cover the range of data in the sand extraction area.

3.4.3 Sensitive benthic biota and communities

A number of sensitive benthic communities have been defined in Table 1. The list (Table 1) includes specific mention of a number of taxa types which could be present in the sand extraction area, including large bivalves, brachiopods, worms, macroalgae, rhodoliths and sponges. In addition to the taxa in Table 1, taxa like stony corals are protected under the Wildlife Act 1953.

Based on the sampling results from the photographic records, dredge tows, and benthic grab samples the following taxa have been assessed.

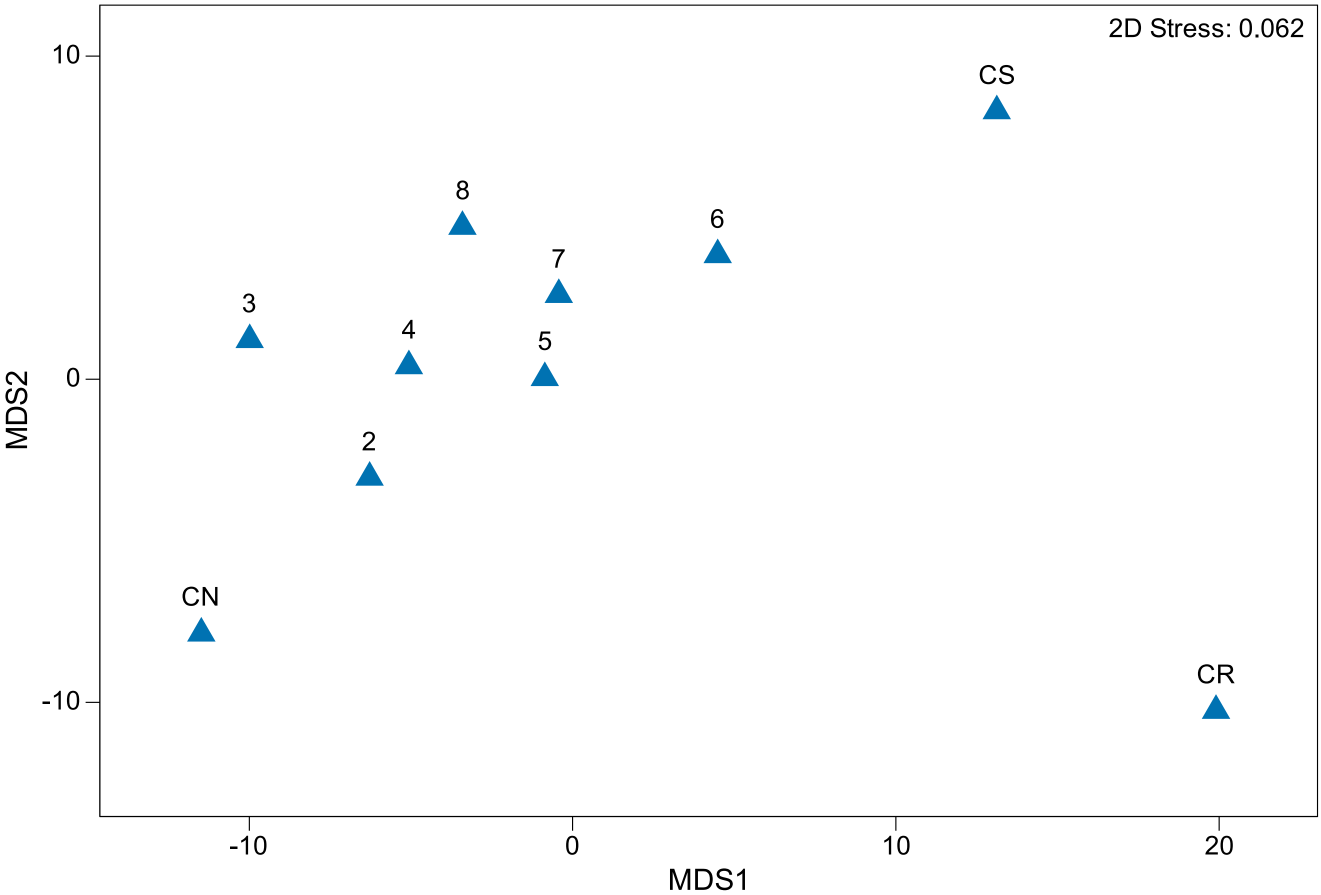


Figure 26 Threshold metric Multi-Dimensional Scaling (tmMDS) of centroids of alongshore cell groupings produced from square-root transformed replicate benthic biota data.

3.4.3.1 Brachiopods (*Calloria inconspicua*)

A brachiopod bed is defined as occurring if; one live brachiopod occurs per m^2 of seabed sampled using seabed photographs; or one or more live specimens occur in grab samples. Brachiopods were not detected either in the seabed photographs or the dredge tows from within the sand extraction area. One brachiopod was recorded in the southern control near the eastern margin in a dredge tow from cells K and L.

Previous experience sampling in similar habitats has shown that brachiopods are sometimes found attached to a Carrier shell (*Xenophora neozelanica*), rather than present within the sediments. Brachiopods were not recorded in any of the seabed photographs, most likely due to their small size and that they often occur under the carrier shells or are obscured by fouling biota. Therefore, the distribution of carrier shells observed in photographs has been plotted to show the potential for brachiopods. However, no brachiopods were recorded on the 12 carrier shells recovered during the dredge tow survey. A single carrier shell was recorded at 1 of the 231 photographic sites in the sand extraction area. Thus, it is unlikely brachiopods are sufficiently abundant in the sand extraction area (Figure 14) to classify them as forming a sensitive community.

3.4.3.2 Large bivalves

Large bivalves including Scallops (*Pecten novaezelandiae*), Clams (*Dosinia* sp.), Purple cockle (*Purpurocardia purpurata*) were recorded in the sand extraction area, along with a number of large shellfish including Volutes (*Alcithoe* sp.), the whelks (*Austrofusus* sp., and *Cominella adspersa*), small Ostrich foot whelks (*Struthiolaria papulosa*), large Trophon (*Penion sulatus*), and Carrier shell (*Xenophora neozelanica*).

Table 1 defines a bed of large bivalves as, where living specimens of bivalve species are estimated to cover 30% or more of the seabed on average in visual images of either 1 m^2 or lateral view; or comprise 30% or more by average weight or volume in grab samples. Of the species listed above, only Scallops and Dosinia are mentioned in the Table 1 definition. The densities of scallops and Dosinia reported in Table E.1 do not exceed the triggers above. The distribution of scallops is shown in Figure 15 while Figure 16 shows the distribution of other bivalves.

3.4.3.3 Sponges

Sponges were recorded in both the seabed photographs and the dredge tows (Figure 18) however at no point where they observed to occur at more than 25% cover of the seabed in visual images of either 1 m^2 or lateral view. Thus, while present, the sponges did not form a sponge garden habitat.

3.4.3.4 Macroalgae

Green, brown and red algae were recorded within the sand extraction area (Figure 19) with red algae being most common. At no point did the macroalgae cover exceed 30%, all occurrences were individual plants scattered sporadically attached to shell on the seabed. However, Figure 19 shows algae were present at the majority of sites sampled.

3.4.3.5 Cup corals

A total of 9 individual cup corals from 7 grab samples were found alive within the sand extraction area. Stony corals (all species in the order Scleractinia) are absolutely protected under the Wildlife Act 1953. An additional 3 individuals were detected around the 4 anchorages east of the sand extraction area, with one further in the control areas. Within the sand extraction area, two species were identified, with 7 individuals of *Sphenotrochus* sp. and 2 individuals of *Kionotrochus suteri* recorded. Within the controls, 1 *Sphenotrochus* sp. was recorded. These live cup corals are shown by the red symbols in Figure 27.

The Wildlife Act 1953 specifies in Section 2 that "*animal means … any marine species declared to be an animal under section 7BA; and also includes the dead body or any part of the dead body of any animal.*" By this definition, the protection extends to all dead cup corals. However, since the cup corals are all larger than the 2.0 mm screening mesh all will be returned to the seabed along with other over size material via the moonpool discharge under the keel. For completeness in Figure 27 the locations and abundance of dead cup corals are shown by blue symbols.

McCallum Bros Limited is seeking a wildlife approval allowing the incidental capture and killing of these cup corals during sand extraction and scientific benthic biota monitoring required as part of their consent. When this wildlife approval is obtained, no sand extraction management restrictions are required.

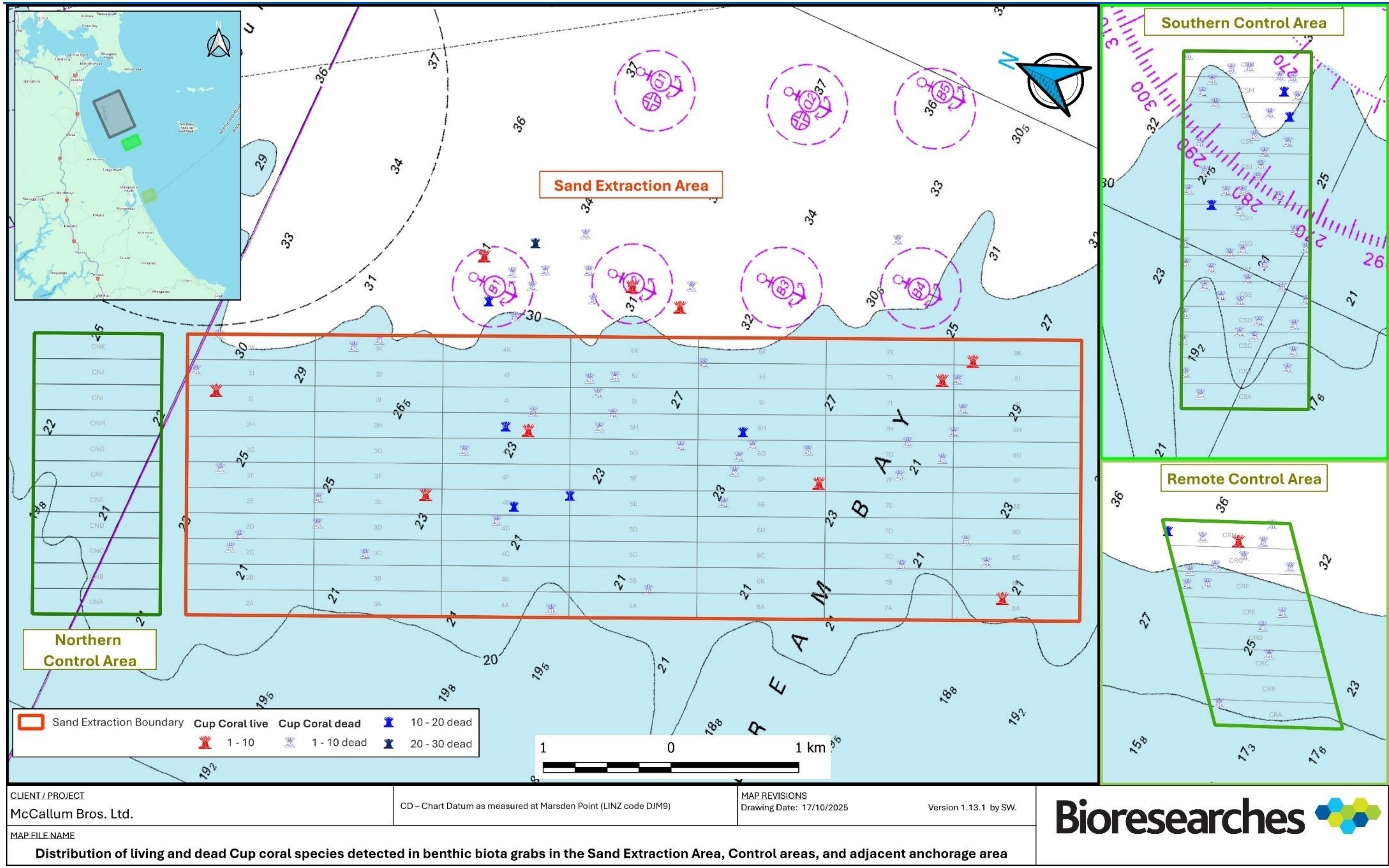


Figure 27 ***Distribution and numbers of living Cup Coral species detected in benthic grab samples, including data from the discontinued Stage 1 sand extraction area.***

4 CONCLUSIONS

The seabed surveys conducted in February-March 2024 in the sand extraction area and control areas at Te Ākau Bream Bay form the baseline survey of the seabed before sand extraction. The monitoring consisted of drop camera sampling to determine the nature of the seabed and identify epibiota; dredge tows to determine the abundance and sizes of epibiota and sparse shellfish, like scallops; and grab samples to characterise the infauna communities and determine grain size composition.

Grain size consisted of sand to gravelly sand with typically low proportions of silt and clay (i.e. most less than 8%). The proportion of silt and clay did not exceed the consented trigger value of 20% therefore no cells were required to be excluded based on grain size.

The biotic composition and abundance of biota in the sand extraction area and the three control areas varies statistically significantly in both alongshore and offshore directions. When the sand extraction area is divided by alongshore cell groupings of similar depths, the biotic composition and abundance of biota in the sand extraction area and the three control areas were statistically significantly different. For the controls to act as indicators of the natural variation in the biotic communities they should ideally cover the pre-effect range of variation in the potential impact sites. The northern and southern controls provide data sufficient to cover the range of data in the sand extraction area. No alternative control areas are obvious.

While the biota in the sand extraction area has a high diversity of taxa. The biota consisted of nationally and locally common species, with no “At Risk” species. Therefore, no exclusions are proposed based on the benthic biota diversity.

The EMMP sets definitions of sensitive benthic communities. The trigger values for defining these communities were not exceeded. No sand extraction exclusions are proposed based on sensitive benthic biota.

The detection of a few living cup corals does not significantly increase the ecological value of the area, as the species detected are all widely occurring, solitary, infaunal, non-habitat forming species (Beaumont *et al*. 2025). With a Wildlife Authority, McCallum Bros Limited would not need to exclude the cells in which the live cup corals were recorded.

As a result of the surveys, all the cells in the sand extraction area are found to be suitable for sand extraction and no cells should be excluded based on the consent condition triggers. Several cells are highlighted as having either elevated silt and clay proportions or live cup corals neither are cause for exclusion based on the proposed consent conditions.

Thus Figure 28 shows the entire sand extraction area as approved for sand extraction area.

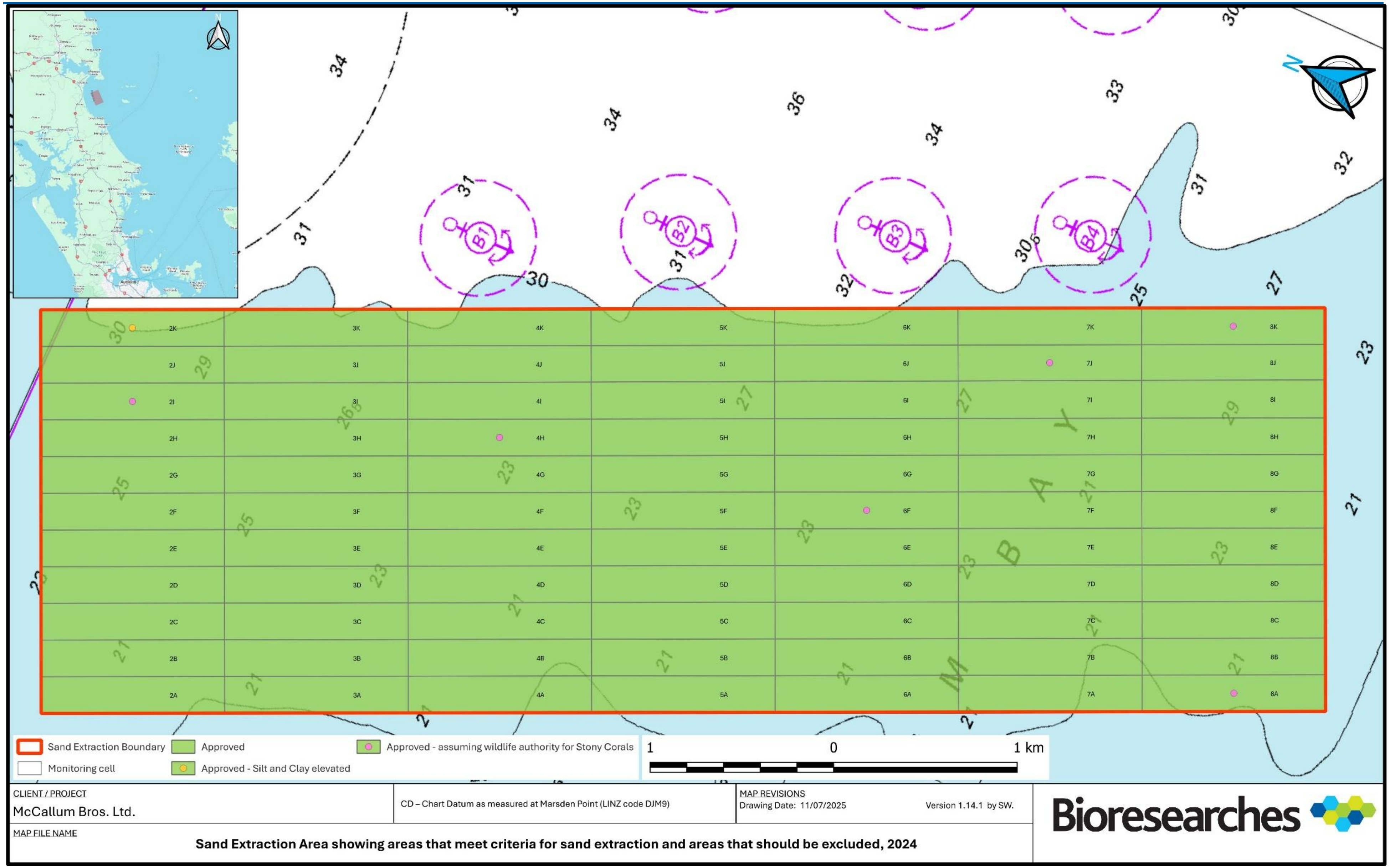


Figure 28 Approved sand extraction areas

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APPLICABILITY AND LIMITATIONS

Restrictions of Intended Purpose

This report has been prepared solely for the benefit of McCallum Bros Limited as our client with respect to the brief. The reliance by other parties on the information or opinions contained in the report shall, without our prior review and agreement in writing, be at such party's sole risk.

Legal Interpretation

Opinions and judgements expressed herein are based on our understanding and interpretation of current regulatory standards and should not be construed as legal opinions. Where opinions or judgements are to be relied on, they should be independently verified with appropriate legal advice.

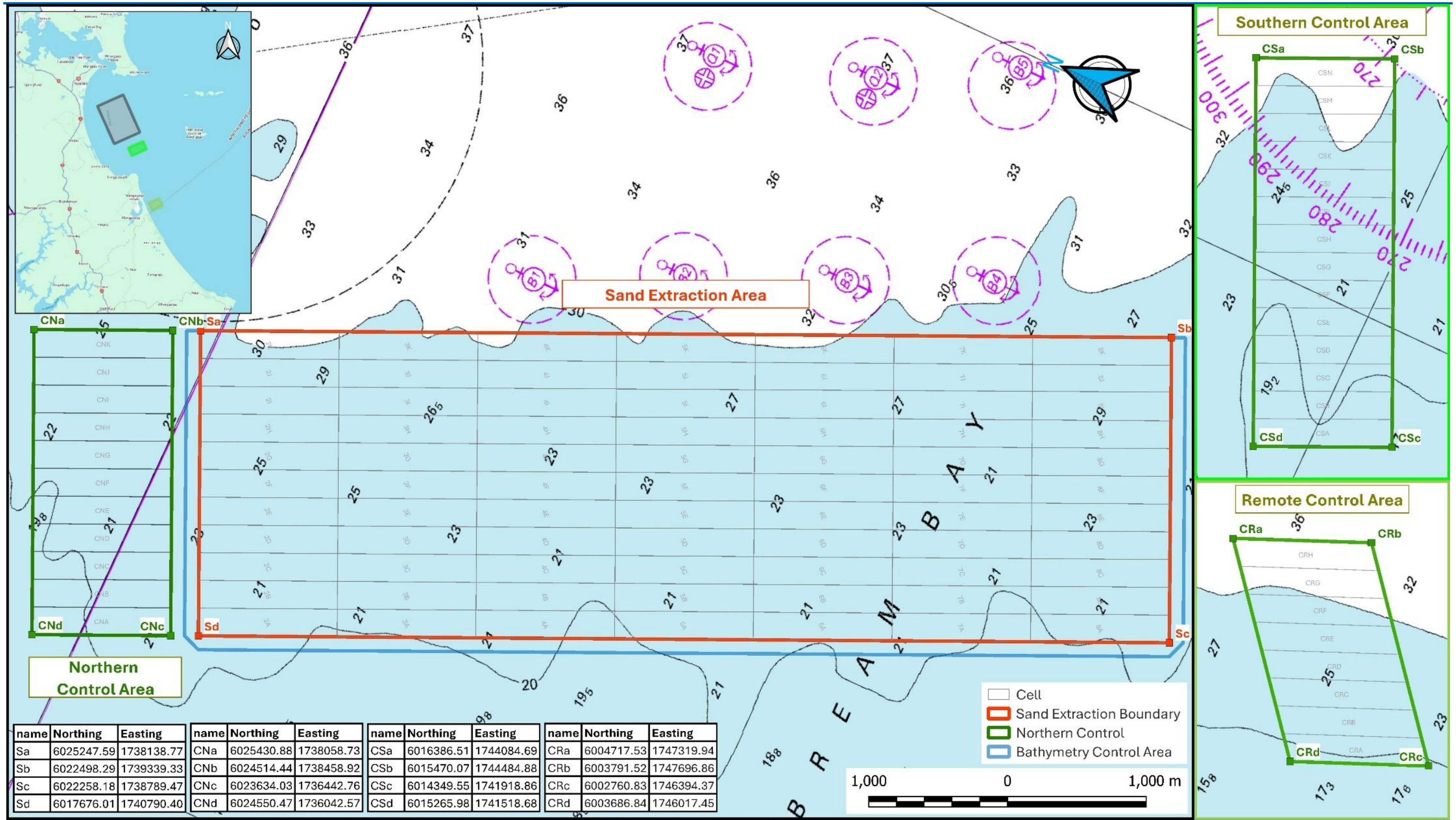
Maps and Images

All maps, plans, and figures included in this report are indicative only and are not to be used or interpreted as engineering drafts. Do not scale any of the maps, plans or figures in this report. Any information shown here on maps, plans and figures should be independently verified on site before taking any action. Sources for map and plan compositions include LINZ Data and Map Services and local council GIS services. For further details regarding any maps, plans or figures in this report, please contact Bioresearches.

Appendix A Sampling Area Positions

Table A.1 Sand Extraction and Control Area Boundary corner points(WGS84, NZTM)

Point	World Geodetic System 1984 EPGS:4326		New Zealand Transverse Mercator Projection EPGS:2193	
	Latitude	Longitude	Northing	Easting
Sand Extraction Area Corners				
Sa	-35.91553	174.53545	6024331.38	1738539.10
Sb	-35.97295	174.56763	6017915.84	1741340.51
Sc	-35.98117	174.54543	6017035.97	1739324.31
Sd	-35.92375	174.51326	6023450.83	1736522.69
Control Areas Corners				
CNa	-35.90569	174.52994	6025430.69	1738059.01
CNb	-35.91389	174.53453	6024514.60	1738458.95
CNc	-35.92211	174.51234	6023634.03	1736442.50
CNd	-35.91391	174.50775	6024550.02	1736042.41
CSa	-35.98633	174.59833	6016386.51	1744084.69
CSb	-35.99453	174.60294	6015470.07	1744484.88
CSc	-36.00501	174.57468	6014349.55	1741918.86
CSd	-35.99681	174.57008	6015265.98	1741518.68
CRa	-36.09101	174.63638	6004717.53	1747319.94
CRb	-36.09930	174.64074	6003791.52	1747696.86
CRc	-36.10879	174.62647	6002760.83	1746394.37
CRd	-36.10050	174.62211	6003686.84	1746017.45



name	Northing	Easting
Sa	6025247.59	1738138.77
Sb	6022498.29	1739339.33
Sc	6022258.18	1738789.47
Sd	6017676.01	1740790.40

name	Northing	Easting
CNa	6025430.88	1738058.73
CNb	6024514.44	1738458.92
CNc	6023634.03	1736442.76
CNd	6024550.47	1736042.57

name	Northing	Easting
CSa	6016386.51	1744084.69
CSb	6015470.07	1744484.88
CSc	6014349.55	1741918.86
CSd	6015265.98	1741518.68

name	Northing	Easting
CRa	6004717.53	1747319.94
CRb	6003791.52	1747696.86
CRc	6002760.83	1746394.37
CRd	6003686.84	1746017.45

CLIENT / PROJECT
McCallum Bros. Ltd.

CD – Chart Datum as measured at Marsden Point (LINZ code DJM9)
Map projection - NZ Transverse Mercator EPGS:2193
GPS points - NZ Transverse Mercator EPGS:2193

MAP REVISIONS
Drawing Date: 12/11/2025
Version 0.1.5 by SW.

Bioresearches

MAP FILE NAME
Sand Extraction Area and Control Areas With Cells

Figure A.1 Sand Extraction Area and Control Areas showing cells.

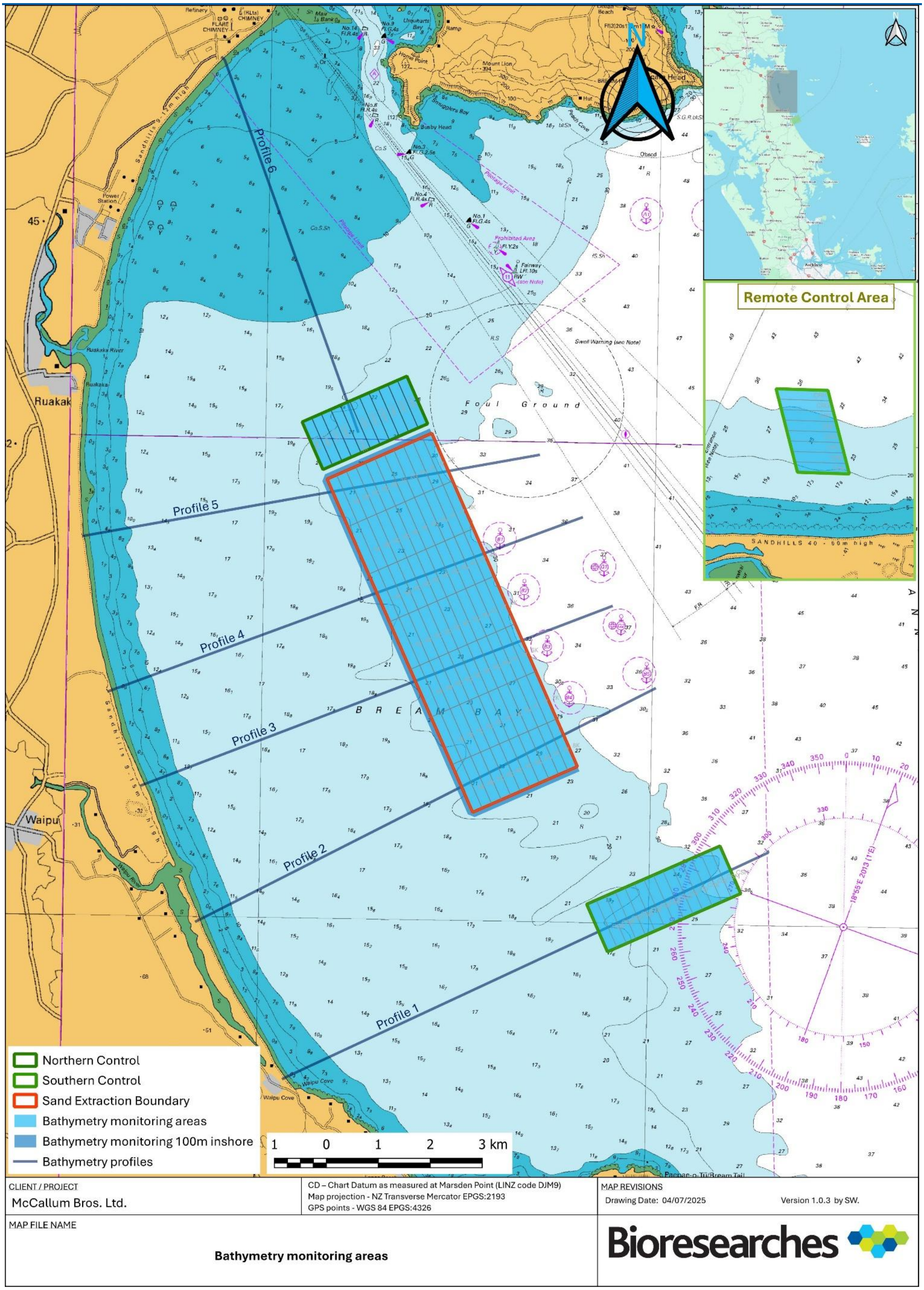


Figure A.2 Bathymetry survey area within and around the Sand Extraction area and Control areas.

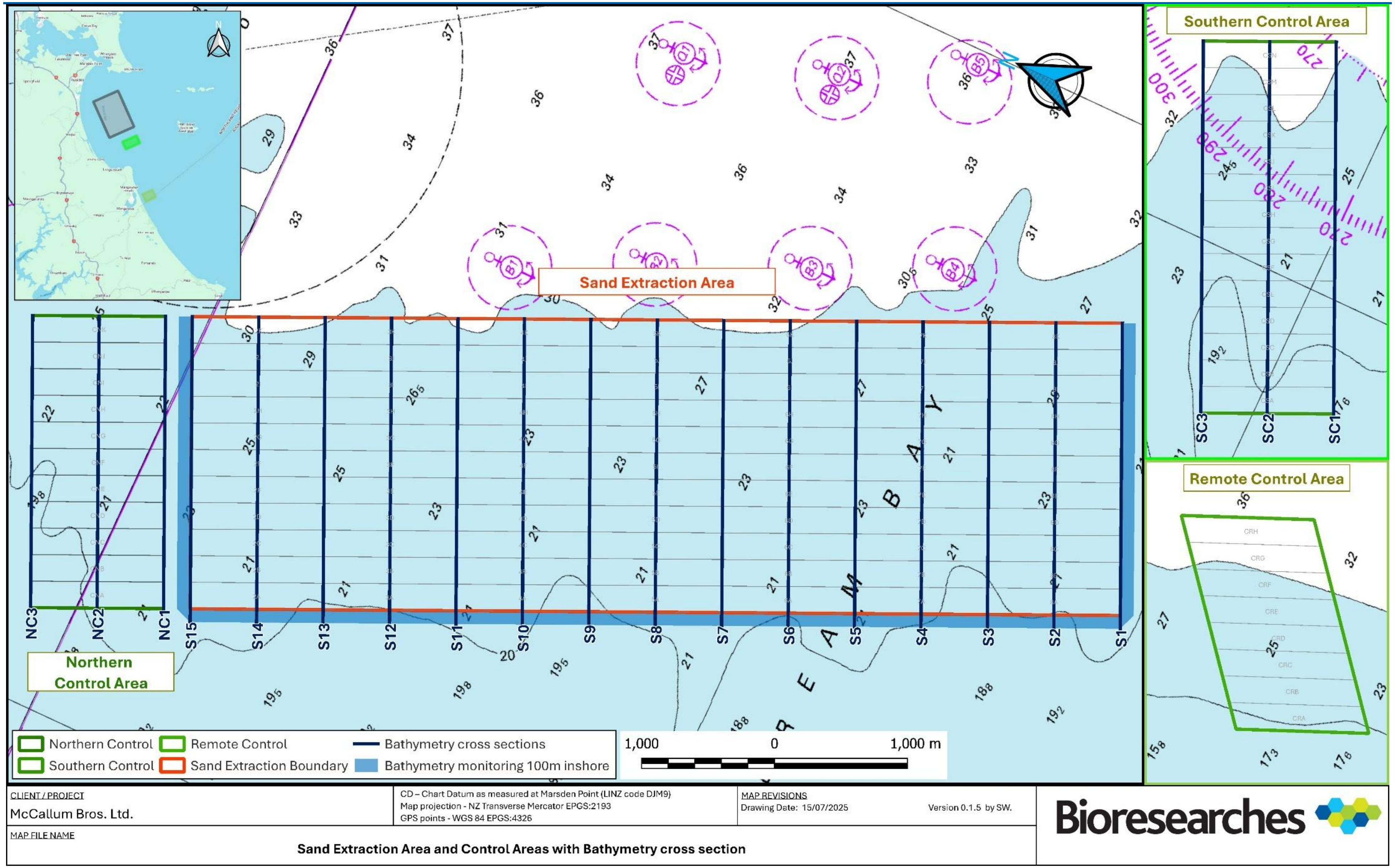


Figure A.3 Bathymetry cross section transect lines through the Sand Extraction area and Control areas.

Table A.2 Drop Camera, Benthic Grab, Sediment grain size Grab sampling points, from the Sand Extraction area (WGS84, NZTM)

Point	World Geodetic System 1984 EPGS:4326		New Zealand Transverse Mercator Projection EPGS:2193		Sampling		
	Latitude	Longitude	Northing	Easting	Photos	Biota	Grain size
[6]2K1	-35.917600	174.536561	6024100.21	1738635.76	x	x	
2K2	-35.919015	174.535498	6023944.68	1738537.34	x	x	2K
2K3	-35.924138	174.537922	6023373.06	1738747.09	x	x	
2J1	-35.917131	174.532931	6024157.30	1738309.05	x	x	
2J2	-35.922049	174.535661	6023607.97	1738546.75	x	x	2J
2J3	-35.924518	174.536849	6023332.34	1738649.61	x	x	
2I1	-35.919033	174.532058	6023947.58	1738226.95	x	x	
2I2	-35.921605	174.532263	6023662.07	1738240.93	x	x	2I
2I3	-35.924541	174.534122	6023333.67	1738403.54	x	x	
2H1	-35.919392	174.528163	6023913.26	1737874.84	x	x	
2H2	-35.922563	174.531482	6023556.91	1738168.81	x	x	2H
2H3	-35.925476	174.533173	6023231.36	1738316.34	x	x	
2G1	-35.920972	174.527831	6023738.51	1737842.19	x	x	
2G2	-35.923131	174.528348	6023498.27	1737885.03	x	x	2G
2G3	-35.924537	174.530309	6023339.54	1738059.51	x	x	
2F1	-35.921611	174.526098	6023670.10	1737684.68	x	x	
2F2	-35.923407	174.526740	6023469.97	1737739.52	x	x	2F
2F3	-35.927725	174.529051	6022987.65	1737940.54	x	x	
2E1	-35.922339	174.523949	6023592.32	1737489.58	x	x	
2E2	-35.923998	174.524673	6023407.32	1737552.00	x	x	2E
2E3	-35.926771	174.525639	6023098.32	1737634.32	x	x	
2D1	-35.923818	174.521201	6023432.13	1737239.02	x	x	
2D2	-35.924823	174.521523	6023320.22	1737266.38	x	x	2D
2D3	-35.927454	174.523586	6023025.43	1737447.92	x	x	
2C1	-35.924759	174.518745	6023331.27	1737015.80	x	x	
2C2	-35.924614	174.520204	6023345.21	1737147.69	x	x	2C
2C3	-35.927748	174.520760	6022996.81	1737192.43	x	x	
2B1	-35.922476	174.516862	6023587.08	1736849.85	x	x	
2B2	-35.925899	174.518858	6023204.56	1737024.06	x	x	2B
2B3	-35.929258	174.519661	6022830.89	1737090.69	x	x	
2A1	-35.923714	174.515169	6023452.14	1736694.99	x	x	
2A2	-35.927240	174.517510	6023057.75	1736900.11	x	x	2A
2A3	-35.931180	174.517716	6022620.36	1736911.94	x	x	
3K1	-35.926535	174.540535	6023103.37	1738978.67	x	x	
3K2	-35.927973	174.542025	6022941.78	1739110.57	x	x	3K
3K3	-35.930384	174.543132	6022672.74	1739206.25	x	x	
3J1	-35.926272	174.536814	6023137.82	1738643.39	x	x	
3J2	-35.930141	174.540450	6022703.56	1738964.69	x	x	3J
3J3	-35.931452	174.541824	6022556.18	1739086.32	x	x	
3I1	-35.926233	174.534580	6023145.42	1738441.97	x	x	
3I2	-35.928750	174.537417	6022862.19	1738693.52	x	x	3I
3I3	-35.933480	174.538690	6022335.62	1738800.05	x	x	

Point	World Geodetic System 1984 EPGS:4326		New Zealand Transverse Mercator Projection EPGS:2193		Sampling		
	Latitude	Longitude	Northing	Easting	Photos	Biota	Grain size
3H1	-35.928453	174.533580	6022900.53	1738347.87	x	x	
3H2	-35.929322	174.535477	6022801.41	1738517.48	x	x	3H
3H3	-35.934525	174.536895	6022222.27	1738636.34	x	x	
3G1	-35.928369	174.530813	6022913.72	1738098.33	x	x	
3G2	-35.930640	174.533594	6022657.92	1738345.26	x	x	3G
3G3	-35.934158	174.535740	6022264.69	1738532.79	x	x	
3F1	-35.930191	174.531250	6022711.09	1738134.64	x	x	
3F2	-35.931576	174.531714	6022556.72	1738174.11	x	x	3F
3F3	-35.933335	174.532039	6022361.13	1738200.33	x	X	
3E1	-35.928757	174.527349	6022875.58	1737785.16	x	x	
3E2	-35.931454	174.528788	6022574.40	1737910.32	x	x	3E
3E3	-35.935539	174.531515	6022117.45	1738149.25	x	x	
3D1	-35.929496	174.525289	6022796.56	1737598.00	x	x	
3D2	-35.931815	174.527292	6022536.47	1737774.67	x	x	3D
3D3	-35.935687	174.528742	6022104.98	1737898.82	x	x	
3C1	-35.931388	174.523654	6022588.96	1737447.21	x	x	
3C2	-35.933423	174.524635	6022361.90	1737532.23	x	x	3C
3C3	-35.937751	174.528008	6021877.01	1737828.98	x	x	
3B1	-35.932367	174.521226	6022483.78	1737226.54	x	x	
3B2	-35.934093	174.523107	6022289.71	1737393.21	x	x	3B
3B3	-35.937174	174.524920	6021945.41	1737551.44	x	x	
3A1	-35.933500	174.519408	6022360.72	1737060.52	x	x	
3A2	-35.934842	174.520884	6022209.70	1737191.40	x	x	3A
3A3	-35.938471	174.521848	6021805.82	1737272.03	x	x	
4K1	-35.934767	174.545650	6022182.94	1739425.72	x	x	
4K2	-35.937949	174.545934	6021829.57	1739445.70	x	x	4K
4K3	-35.939120	174.546759	6021698.47	1739518.09	x	x	
4J1	-35.935949	174.542690	6022056.05	1739156.59	x	x	
4J2	-35.937603	174.543386	6021871.60	1739216.47	x	x	4J
4J3	-35.940217	174.546202	6021577.62	1739465.94	x	x	
4I1	-35.935990	174.541052	6022053.89	1739008.76	x	x	
4I2	-35.938199	174.542185	6021807.22	1739107.09	x	x	4I
4I3	-35.939956	174.541964	6021612.66	1739084.09	x	x	
4H1	-35.936501	174.539140	6021999.95	1738835.42	x	x	
4H2	-35.938642	174.539791	6021761.49	1738890.41	x	x	4H
4H3	-35.940203	174.540302	6021587.56	1738933.70	x	x	
4G1	-35.936712	174.536411	6021980.40	1738588.80	x	x	
4G2	-35.939445	174.537915	6021675.04	1738719.75	x	x	4G
4G3	-35.942407	174.539352	6021344.49	1738844.21	x	x	
4F1	-35.937702	174.533419	6021874.84	1738317.22	x	x	
4F2	-35.941309	174.535314	6021472.06	1738481.90	x	x	4F
4F3	-35.943677	174.536956	6021207.03	1738625.87	x	x	

[6] Note sites 1K1 – 1A3 were converted to the Northern Control area

Point	World Geodetic System 1984 EPGS:4326		New Zealand Transverse Mercator Projection EPGS:2193		Sampling		
	Latitude	Longitude	Northing	Easting	Photos	Biota	Grain size
4E1	-35.939103	174.532754	6021720.35	1738254.78	x	x	4E
4E2	-35.941546	174.533784	6021447.90	1738343.41	x	x	
4E3	-35.943191	174.535034	6021263.60	1738453.34	x	x	
4D1	-35.937954	174.529482	6021852.43	1737961.58	x	x	4D
4D2	-35.940853	174.532067	6021527.16	1738189.75	x	x	
4D3	-35.945758	174.533909	6020980.52	1738347.38	x	x	
4C1	-35.939410	174.527566	6021693.58	1737786.22	x	x	4C
4C2	-35.943197	174.530098	6021269.93	1738008.06	x	x	
4C3	-35.944947	174.530577	6021075.21	1738048.27	x	x	
4B1	-35.940382	174.526351	6021587.57	1737674.94	x	x	4B
4B2	-35.943101	174.527704	6021283.99	1737792.31	x	X	
4B3	-35.947079	174.530025	6020839.43	1737994.73	x	X	
4A1	-35.940150	174.523428	6021617.34	1737411.68	x	x	4A
4A2	-35.943784	174.526317	6021210.15	1737665.97	x	x	
4A3	-35.946962	174.527068	6020856.57	1737728.18	x	x	
5K1	-35.942247	174.549248	6021348.11	1739737.15	x	x	5K
5K2	-35.943698	174.548882	6021187.68	1739701.59	x	x	
5K3	-35.948505	174.553329	6020648.05	1740094.21	x	x	
5J1	-35.942585	174.546654	6021314.31	1739502.54	x	x	5J
5J2	-35.944139	174.547736	6021140.39	1739597.38	x	x	
5J3	-35.947344	174.549315	6020782.63	1739734.20	x	x	
5I1	-35.943531	174.545800	6021210.58	1739423.85	x	x	5I
5I2	-35.947212	174.546441	6020801.37	1739475.21	x	x	
5I3	-35.949087	174.548228	6020590.88	1739633.10	x	x	
5H1	-35.944668	174.543160	6021088.27	1739183.74	x	x	5H
5H2	-35.945129	174.544712	6021034.86	1739322.88	x	x	
5H3	-35.949874	174.546544	6020505.95	1739479.79	x	x	
5G1	-35.945869	174.542300	6020956.26	1739104.05	x	x	5G
5G2	-35.947614	174.542530	6020762.38	1739121.70	x	x	
5G3	-35.950418	174.544650	6020448.30	1739307.99	x	x	
5F1	-35.946417	174.540029	6020898.66	1738898.19	x	x	5F
5F2	-35.948907	174.541136	6020620.93	1738993.72	x	x	
5F3	-35.949865	174.541194	6020514.62	1738997.24	x	x	
5E1	-35.944813	174.536694	6021081.34	1738600.23	x	x	5E
5E2	-35.949733	174.539256	6020531.97	1738822.70	x	x	
5E3	-35.952269	174.541174	6020247.91	1738991.28	x	x	
5D1	-35.948448	174.535717	6020679.52	1738505.78	x	x	5D
5D2	-35.949380	174.536652	6020574.86	1738588.50	x	x	
5D3	-35.951220	174.537702	6020369.24	1738679.96	x	x	
5C1	-35.947145	174.532536	6020828.62	1738221.14	x	x	5C
5C2	-35.951923	174.534999	6020295.11	1738434.89	x	x	
5C3	-35.954210	174.537076	6020038.42	1738618.27	x	x	
5B1	-35.948037	174.530382	6020732.66	1738025.26	x	x	5B
5B2	-35.952619	174.532145	6020221.92	1738176.27	x	x	
5B3	-35.955547	174.533674	6019894.98	1738309.07	x	x	

Point	World Geodetic System 1984 EPGS:4326		New Zealand Transverse Mercator Projection EPGS:2193		Sampling		
	Latitude	Longitude	Northing	Easting	Photos	Biota	Grain size
5A1	-35.950805	174.528986	6020427.66	1737894.51	x	x	5A
5A2	-35.953750	174.530175	6020099.28	1737996.65	x	x	
5A3	-35.954386	174.531524	6020026.81	1738117.21	x	x	
6K1	-35.949405	174.552018	6020550.18	1739974.35	x	x	6K
6K2	-35.953461	174.554507	6020096.68	1740191.71	x	x	
6K3	-35.954270	174.556795	6020003.62	1740396.62	x	x	
6J1	-35.951611	174.552400	6020304.89	1740004.92	x	x	6J
6J2	-35.953925	174.552509	6020048.07	1740010.64	x	x	
6J3	-35.955284	174.554386	6019894.63	1740177.55	x	x	
6I1	-35.950989	174.550060	6020377.19	1739794.93	x	x	6I
6I2	-35.953646	174.550839	6020081.39	1739860.55	x	x	
6I3	-35.958108	174.553987	6019581.93	1740136.53	x	x	
6H1	-35.951846	174.547573	6020285.72	1739569.13	x	x	6H
6H2	-35.953998	174.548017	6020046.36	1739605.44	x	x	
6H3	-35.957667	174.549828	6019636.79	1739762.27	x	x	
6G1	-35.954446	174.545933	6019999.70	1739416.64	x	x	6G
6G2	-35.954993	174.547363	6019936.98	1739544.64	x	x	
6G3	-35.958700	174.548941	6019523.46	1739680.41	x	x	
6F1	-35.954618	174.544630	6019982.43	1739298.81	x	x	6F
6F2	-35.955609	174.545465	6019871.36	1739372.39	x	x	
6F3	-35.960375	174.546760	6019340.79	1739480.77	x	x	
6E1	-35.954871	174.541765	6019958.43	1739040.02	x	x	6E
6E2	-35.957696	174.542566	6019643.97	1739107.31	x	x	
6E3	-35.960091	174.544655	6019375.28	1739291.51	x	x	
6D1	-35.956320	174.539622	6019800.78	1738844.20	x	x	6D
6D2	-35.956659	174.541089	6019761.03	1738975.91	x	x	
6D3	-35.960114	174.542991	6019375.14	1739141.41	x	x	
6C1	-35.955131	174.537525	6019935.66	1738657.15	x	x	6C
6C2	-35.958160	174.539080	6019597.47	1738792.04	x	x	
6C3	-35.962368	174.541525	6019127.21	1739005.24	x	x	
6B1	-35.956909	174.534708	6019742.39	1738399.95	x	x	6B
6B2	-35.959019	174.536592	6019505.67	1738566.23	x	x	
6B3	-35.963345	174.539327	6019021.94	1738805.29	x	x	
6A1	-35.958242	174.532943	6019597.02	1738238.48	x	x	6A
6A2	-35.961306	174.535376	6019253.70	1738452.51	x	x	
6A3	-35.962972	174.536035	6019067.96	1738509.09	x	x	
7K1	-35.957354	174.556994	6019661.26	1740409.05	x	x	7K
7K2	-35.960504	174.559363	6019308.36	1740617.17	x	x	
7K3	-35.962834	174.560575	6019048.18	1740722.29	x	x	
7J1	-35.960141	174.557052	6019351.99	1740409.36	x	x	7J
7J2	-35.961043	174.558040	6019250.47	1740496.91	x	x	
7J3	-35.965203	174.559372	6018787.08	1740609.62	x	x	
7I1	-35.960186	174.554583	6019350.51	1740186.62	x	x	7I
7I2	-35.963017	174.554848	6019036.12	1740205.53	x	x	
7I3	-35.965534	174.557299	6018753.40	1740422.09	x	x	

Point	World Geodetic System 1984 EPGS:4326		New Zealand Transverse Mercator Projection EPGS:2193		Sampling		
	Latitude	Longitude	Northing	Easting	Photos	Biota	Grain size
7H1	-35.959484	174.551749	6019432.53	1739932.34	x	x	
7H2	-35.962170	174.552602	6019133.35	1740004.47	x	x	7H
7H3	-35.965927	174.555983	6018711.73	1740302.77	x	x	
7G1	-35.960478	174.549356	6019325.60	1739714.71	x	x	
7G2	-35.964825	174.553245	6018837.90	1740057.76	x	x	7G
7G3	-35.967556	174.553231	6018534.95	1740051.71	x	x	
7F1	-35.962335	174.548084	6019121.49	1739596.75	x	x	
7F2	-35.965312	174.550332	6018788.03	1739794.28	x	x	7F
7F3	-35.966890	174.551987	6018610.58	1739940.69	x	x	
7E1	-35.961180	174.545928	6019252.69	1739404.38	x	x	
7E2	-35.964373	174.547822	6018895.78	1739569.56	x	x	7E
7E3	-35.968124	174.550012	6018476.55	1739760.41	x	x	
7D1	-35.962863	174.544403	6019068.19	1739263.92	x	x	
7D2	-35.966677	174.545865	6018642.96	1739389.06	x	x	7D
7D3	-35.967385	174.547006	6018562.82	1739490.68	x	x	
7C1	-35.963518	174.542244	6018998.63	1739068.04	x	x	
7C2	-35.968105	174.543352	6018488.17	1739159.93	x	x	7C
7C3	-35.969863	174.544262	6018291.86	1739238.90	x	x	
7B1	-35.964980	174.539469	6018840.34	1738815.24	x	x	
7B2	-35.966842	174.540305	6018632.66	1738887.34	x	x	7B
7B3	-35.971861	174.542775	6018072.32	1739101.26	x	x	
7A1	-35.964299	174.538249	6018917.68	1738706.43	x	x	
7A2	-35.968130	174.539498	6018490.88	1738812.31	x	x	7A
7A3	-35.971314	174.541092	6018135.46	1738950.48	x	x	
8K1	-35.966609	174.561994	6018627.36	1740843.57	x	x	
8K2	-35.969064	174.564180	6018351.90	1741036.32	x	x	8K
8K3	-35.971453	174.564718	6018086.15	1741080.61	x	x	
8J1	-35.966171	174.560015	6018678.82	1740665.94	x	x	8J
8J2	-35.969448	174.563000	6018310.95	1740929.29	x	x	
8J3	-35.971916	174.563340	6018036.73	1740955.52	x	x	
8I1	-35.967377	174.557883	6018548.10	1740471.50	x	x	
8I2	-35.971383	174.560760	6018099.63	1740723.80	x	x	8I
8I3	-35.973765	174.561861	6017833.75	1740818.84	x	x	
8H1	-35.967470	174.555733	6018540.92	1740277.50	x	x	
8H2	-35.971244	174.557522	6018119.70	1740432.10	x	x	8H
8H3	-35.973139	174.558907	6017907.47	1740553.64	x	x	
8G1	-35.968772	174.554349	6018398.42	1740150.32	x	x	
8G2	-35.971292	174.556334	6018116.08	1740324.92	x	x	8G
8G3	-35.976061	174.559016	6017583.23	1740558.25	x	x	
8F1	-35.970880	174.554124	6018164.96	1740126.31	x	x	
8F2	-35.972065	174.553764	6018034.02	1740091.77	x	x	8F
8F3	-35.974902	174.555568	6017716.74	1740249.46	x	x	
8E1	-35.969400	174.550482	6018334.35	1739800.52	x	x	
8E2	-35.973832	174.552256	6017840.20	1739952.71	x	x	8E
8E3	-35.976162	174.554451	6017578.58	1740146.47	x	x	
8D1	-35.971473	174.547621	6018108.51	1739538.92	x	F	
8D2	-35.973916	174.550435	6017833.46	1739788.36	x	F	8D
8D3	-35.978349	174.551612	6017339.99	1739886.63	x	x	
8C1	-35.973432	174.546662	6017892.55	1739448.98	x	x	
8C2	-35.976224	174.548985	6017579.54	1739653.52	x	x	8C
8C3	-35.978461	174.549490	6017330.69	1739695.12	x	x	
8B1	-35.972214	174.545030	6018030.04	1739304.04	x	x	
8B2	-35.976924	174.546809	6017504.97	1739456.13	x	x	8B
8B3	-35.978347	174.547819	6017345.74	1739544.71	x	x	
8A1	-35.974460	174.543225	6017783.42	1739137.31	x	x	
8A2	-35.975538	174.544392	6017662.24	1739240.66	x	x	8A
8A3	-35.978582	174.545613	6017322.76	1739345.33	x	x	

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Table A.3 Drop Camera, Benthic Grab, and Sediment grain size Grab sampling points from the Control areas (WGS84, NZTM)

Point	World Geodetic System 1984 EPGS:4326		New Zealand Transverse Mercator Projection EPGS:2193		Sampling		
	Latitude	Longitude	Northing	Easting	Photos	Biota	Grain size
1K1 / CNK1	-35.909212	174.530037	6025039.89	1738061.62	x	x	
1K2 / CNK2	-35.910570	174.531407	6024887.32	1738182.95	x	x	1K / CNK
1K3 / CNK3	-35.914226	174.534493	6024477.41	1738455.01	x	x	
1J1 / CNJ1	-35.910669	174.529666	6024878.74	1738025.65	x	x	
1J2 / CNJ2	-35.913320	174.530067	6024584.14	1738057.21	x	x	1J / CNJ
1J3 / CNJ3	-35.915881	174.531897	6024297.43	1738217.85	x	x	
1I1 / CNI1	-35.910622	174.526075	6024889.11	1737701.68	x	x	
1I2 / CNI2	-35.914457	174.527730	6024461.34	1737844.32	x	x	1I / CNI
1I3 / CNI3	-35.917179	174.529250	6024157.25	1737976.80	x	x	
1H1 / CNH1	-35.909855	174.524720	6024976.02	1737580.74	x	x	
1H2 / CNH2	-35.913160	174.524885	6024609.25	1737589.93	x	x	1H / CNH
1H3 / CNH3	-35.917335	174.526939	6024143.20	1737767.95	x	x	
1G1 / CNG1	-35.913564	174.522591	6024567.64	1737382.19	x	x	
1G2 / CNG2	-35.916114	174.523621	6024283.34	1737470.71	x	x	1G / CNG
1G3 / CNG3	-35.916725	174.524505	6024214.26	1737549.46	x	x	
1F1 / CNF1	-35.912504	174.520933	6024687.51	1737234.37	x	x	
1F2 / CNF2	-35.914280	174.521070	6024490.39	1737243.74	x	x	1F / CNF
1F3 / CNF3	-35.918290	174.523366	6024042.28	1737443.90	x	x	
1E1 / CNE1	-35.913032	174.519246	6024631.29	1737081.29	x	x	
1E2 / CNE2	-35.915614	174.519784	6024344.14	1737125.34	x	x	1E / CNE
1E3 / CNE3	-35.919037	174.522556	6023960.60	1737369.53	x	x	
1D1 / CND1	-35.914169	174.516943	6024508.39	1736871.46	x	x	
1D2 / CND2	-35.918001	174.518098	6024081.71	1736969.12	x	x	1D / CND
1D3 / CND3	-35.920816	174.519904	6023766.99	1737127.24	x	x	
1C1 / CNC1	-35.914512	174.514833	6024473.31	1736680.46	x	x	
1C2 / CNC2	-35.918168	174.516908	6024064.95	1736861.42	x	x	1C / CNC
1C3 / CNC3	-35.920298	174.518343	6023826.65	1736987.28	x	x	
1B1 / CNB1	-35.916496	174.511741	6024257.57	1736398.10	x	x	
1B2 / CNB2	-35.917439	174.514466	6024149.17	1736642.33	x	x	1B / CNB
1B3 / CNB3	-35.920730	174.514735	6023783.73	1736660.99	x	x	
1A1 / CNA1	-35.917436	174.511923	6024153.13	1736412.90	x	x	
1A2 / CNA2	-35.920357	174.513090	6023827.40	1736513.21	x	x	1A / CNA
1A3 / CNA3	-35.922852	174.513344	6023550.34	1736531.79	x	x	

Point	World Geodetic System 1984 EPGS:4326		New Zealand Transverse Mercator Projection EPGS:2193		Sampling		
	Latitude	Longitude	Northing	Easting	Photos	Biota	Grain size
CRH1	-36.091707	174.635682	6004641.41	1747255.47	x	x	
CRH2	-36.094097	174.636483	6004375.11	1747323.11	x	x	
CRH3	-36.096525	174.637478	6004104.28	1747408.17	x	x	CRH
CRH4	-36.098143	174.638353	6003923.41	1747483.84	x	x	
CRH5	-36.098189	174.640009	6003915.76	1747632.88	x	x	
CRG1	-36.094289	174.633408	6004358.46	1747045.87	x	x	
CRG2	-36.095777	174.634723	6004191.42	1747161.53	x	x	
CRG3	-36.097314	174.636513	6004018.17	1747319.79	x	x	CRG
CRG4	-36.099141	174.637304	6003814.34	1747387.63	x	x	
CRG5	-36.100613	174.637342	6003651.01	1747388.22	x	x	
CRF1	-36.094507	174.632229	6004336.04	1746939.31	x	x	
CRF2	-36.095779	174.633020	6004193.80	1747008.17	x	x	
CRF3	-36.097415	174.633980	6004010.76	1747091.55	x	x	CRF
CRF4	-36.100110	174.634140	6003711.60	1747100.90	x	x	
CRF5	-36.102019	174.635645	6003497.55	1747232.84	x	x	
CRE1	-36.095808	174.631283	6004193.14	1746851.71	x	x	
CRE2	-36.096698	174.632058	6004093.24	1746919.82	x	x	
CRE3	-36.099663	174.632122	6003764.24	1746920.11	x	x	CRE
CRE4	-36.101454	174.633468	6003563.57	1747037.92	x	x	
CRE5	-36.102380	174.634556	6003459.15	1747134.15	x	x	
CRD1	-36.096899	174.627985	6004077.06	1746552.81	x	x	
CRD2	-36.099285	174.629118	6003810.72	1746650.33	x	x	
CRD3	-36.100596	174.631637	6003661.47	1746874.71	x	x	CRD
CRD4	-36.103113	174.631002	6003383.23	1746812.86	x	x	
CRD5	-36.102966	174.633015	6003396.51	1746994.33	x	x	
CRC1	-36.098775	174.626403	6003871.36	1746406.90	x	x	
CRC2	-36.099620	174.627754	6003775.64	1746526.97	x	x	
CRC3	-36.101842	174.629680	6003526.23	1746696.16	x	x	CRC
CRC4	-36.103956	174.629221	6003292.45	1746650.95	x	x	
CRC5	-36.104735	174.631139	6003203.12	1746822.19	x	x	
CRB1	-36.099369	174.625024	6003807.54	1746281.65	x	x	
CRB2	-36.100640	174.625458	6003665.91	1746318.33	x	x	
CRB3	-36.102682	174.626115	6003438.46	1746373.69	x	x	CRB
CRB4	-36.105505	174.627514	6003123.16	1746494.37	x	x	
CRB5	-36.106274	174.628093	6003036.92	1746545.14	x	x	
CRA1	-36.100089	174.624013	6003729.17	1746189.32	x	x	
CRA2	-36.101357	174.624573	6003587.71	1746237.32	x	x	
CRA3	-36.104486	174.624221	6003241.20	1746199.85	x	x	CRA
CRA4	-36.105577	174.625217	6003118.61	1746287.46	x	x	
CRA5	-36.107349	174.627883	6002918.01	1746524.18	x	x	

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Point	World Geodetic System 1984 EPGS:4326		New Zealand Transverse Mercator Projection EPGS:2193		Sampling		
	Latitude	Longitude	Northing	Easting	Photos	Biota	Grain size
CSN1	-35.986707	174.598232	6016344.98	1744074.90	x	x	
CSN2	-35.989913	174.598709	6015988.63	1744112.06	x	x	
CSN3	-35.991024	174.599498	6015864.32	1744181.16	x	x	CSN
CSN4	-35.993241	174.599875	6015617.82	1744211.12	x	x	
CSN5	-35.994130	174.600282	6015518.61	1744246.17	x	x	
CSM1	-35.988762	174.595812	6016120.62	1743852.97	x	x	
CSM2	-35.989012	174.597135	6016090.95	1743971.80	x	x	
CSM3	-35.991225	174.597616	6015844.79	1744011.08	x	x	CSM
CSM4	-35.993979	174.598829	6015537.49	1744115.44	x	x	
CSM5	-35.994957	174.598963	6015428.78	1744125.76	x	x	
CSL1	-35.988569	174.592455	6016147.00	1743550.67	x	x	
CSL2	-35.989937	174.595415	6015990.93	1743815.02	x	x	
CSL3	-35.992832	174.595843	6015669.09	1743848.33	x	x	CSL
CSL4	-35.993710	174.596601	6015570.64	1743915.07	x	x	
CSL5	-35.995074	174.597050	6015418.61	1743953.05	x	x	
CSK1	-35.990103	174.591721	6015977.86	1743481.72	x	x	
CSK2	-35.991792	174.592564	6015789.32	1743554.68	x	x	
CSK3	-35.993382	174.594296	6015610.42	1743707.94	x	x	CSK
CSK4	-35.994514	174.593351	6015486.22	1743620.68	x	x	
CSK5	-35.995722	174.595012	6015349.74	1743768.21	x	x	
CSJ1	-35.991229	174.589676	6015856.05	1743295.33	x	x	
CSJ2	-35.991494	174.591101	6015824.55	1743423.32	x	x	
CSJ3	-35.994846	174.591085	6015452.69	1743415.80	x	x	CSJ
CSJ4	-35.994676	174.592199	6015469.90	1743516.54	x	x	
CSJ5	-35.996363	174.593834	6015280.43	1743660.88	x	x	
CSI1	-35.990758	174.587620	6015911.22	1743110.79	x	x	
CSI2	-35.993221	174.588889	6015636.23	1743220.75	x	x	
CSI3	-35.994276	174.589514	6015518.21	1743275.18	x	x	CSI
CSI4	-35.996695	174.590387	6015248.59	1743349.52	x	x	
CSI5	-35.998571	174.590697	6015040.11	1743374.07	x	x	
CSH1	-35.991841	174.586703	6015792.51	1743026.25	x	x	
CSH2	-35.992703	174.587254	6015696.01	1743074.31	x	x	
CSH3	-35.994651	174.587837	6015479.15	1743123.35	x	x	CSH
CSH4	-35.996561	174.588038	6015266.97	1743138.06	x	x	
CSH5	-35.998750	174.588327	6015023.73	1743160.09	x	x	
CSG1	-35.992069	174.583292	6015772.14	1742718.25	x	x	
CSG2	-35.995304	174.584120	6015412.08	1742787.09	x	x	
CSG3	-35.996004	174.584893	6015333.37	1742855.51	x	x	CSG
CSG4	-35.997968	174.587429	6015111.81	1743080.61	x	x	
CSG5	-36.000002	174.587326	6014886.31	1743067.59	x	x	
CSF1	-35.992799	174.581708	6015693.57	1742574.19	x	x	
CSF2	-35.994548	174.582243	6015498.76	1742619.30	x	x	
CSF3	-35.997222	174.582731	6015201.39	1742658.41	x	x	CSF
CSF4	-35.997861	174.584501	6015127.88	1742816.81	x	x	
CSF5	-36.000465	174.586159	6014836.70	1742961.62	x	x	

Point	World Geodetic System 1984 EPGS:4326		New Zealand Transverse Mercator Projection EPGS:2193		Sampling		
	Latitude	Longitude	Northing	Easting	Photos	Biota	Grain size
CSE1	-35.994638	174.580641	6015491.06	1742474.73	x	x	
CSE2	-35.996023	174.580415	6015337.76	1742451.84	x	x	
CSE3	-35.997390	174.580721	6015185.69	1742476.93	x	x	CSE
CSE4	-35.999662	174.583387	6014929.77	1742713.22	x	x	
CSE5	-36.001567	174.583206	6014718.77	1742693.43	x	x	
CSD1	-35.994156	174.577691	6015548.87	1742209.64	x	x	
CSD2	-35.995744	174.578948	6015370.87	1742320.09	x	x	
CSD3	-35.998272	174.578256	6015091.48	1742253.17	x	x	CSD
CSD4	-35.999179	174.579827	6014988.57	1742393.15	x	x	
CSD5	-36.001546	174.580845	6014724.49	1742480.67	x	x	
CSC1	-35.994877	174.575615	6015471.93	1742021.24	x	x	
CSC2	-35.996551	174.576469	6015285.04	1742095.22	x	x	
CSC3	-35.999344	174.578487	6014972.24	1742272.09	x	x	CSC
CSC4	-36.000336	174.577820	6014863.13	1742210.21	x	x	
CSC5	-36.002303	174.578710	6014643.65	1742286.88	x	x	
CSB1	-35.996007	174.573059	6015350.30	1741788.81	x	x	
CSB2	-35.998419	174.575625	6015078.97	1742015.77	x	x	
CSB3	-36.000251	174.576264	6014874.90	1742070.10	x	x	CSB
CSB4	-36.001086	174.575745	6014783.03	1742021.80	x	x	
CSB5	-36.002421	174.577138	6014632.92	1742144.95	x	x	
CSA1	-35.997621	174.571942	6015172.84	1741685.15	x	x	
CSA2	-35.999305	174.572174	6014985.76	1741703.09	x	x	
CSA3	-36.000263	174.573273	6014877.85	1741800.48	x	x	CSA
CSA4	-36.001782	174.574400	6014707.78	1741899.32	x	x	
CSA5	-36.003422	174.573853	6014526.58	1741847.04	x	x	

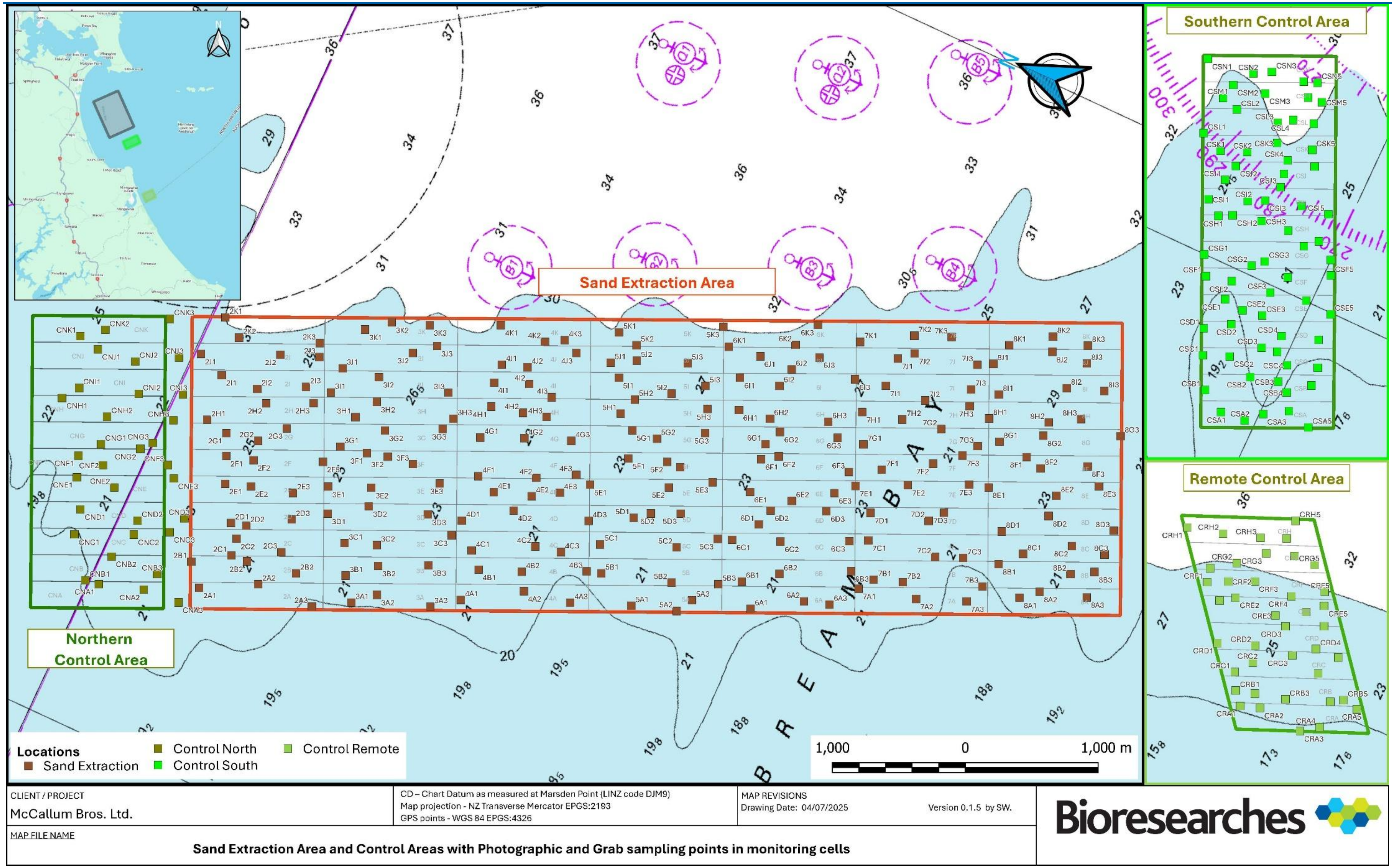

Figure A.4 Drop Camera, Benthic Grab and Sediment particle size Grab sampling point locations within the Sand Extraction area and Control areas.

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Table A.4 Benthic Dredge tow sampling start and end points from the Sand Extraction area (WGS84, NZTM)

Point	World Geodetic System 1984 EPGS:4326		New Zealand Transverse Mercator Projection EPGS:2193	
	Latitude	Longitude	Northing	Easting
2IKs	-35.920341	174.533573	6023799.31	1738361.18
2IKe	-35.921658	174.535085	6023651.12	1738495.35
2GHs	-35.922260	174.529372	6023592.41	1737978.78
2GHe	-35.923557	174.530910	6023446.39	1738115.30
2EFs	-35.923758	174.525304	6023432.00	1737609.15
2EFe	-35.925186	174.526656	6023271.76	1737728.65
2CDs	-35.925768	174.520575	6023215.73	1737179.05
2CDe	-35.926786	174.522403	6023100.24	1737342.22
2ABs	-35.925210	174.516390	6023283.45	1736802.44
2ABe	-35.926715	174.517609	6023114.85	1736909.83
3IKs	-35.928071	174.538388	6022935.02	1738782.17
3IKe	-35.928995	174.540291	6022829.87	1738952.18
3GHs	-35.931171	174.533591	6022598.03	1738343.97
3GHe	-35.932575	174.534979	6022440.26	1738466.72
3EFs	-35.930133	174.528769	6022719.94	1737910.77
3EFe	-35.931518	174.530188	6022564.38	1738036.31
3CDs	-35.932678	174.525192	6022442.73	1737583.66
3CDe	-35.933976	174.526729	6022296.58	1737720.04
3ABs	-35.934633	174.521124	6022231.54	1737213.21
3ABe	-35.935776	174.522837	6022102.44	1737365.82
4KLs	-35.936046	174.547202	6022037.82	1739563.35
4KLe	-35.937335	174.548753	6021892.70	1739700.98
4IJs	-35.937261	174.542614	6021909.60	1739147.26
4IJe	-35.938542	174.544174	6021765.32	1739285.77
4GHs	-35.938039	174.537901	6021830.11	1738720.75
4GHe	-35.939374	174.539389	6021679.89	1738852.64
4EFs	-35.940538	174.534082	6021558.27	1738371.95
4EFe	-35.941981	174.535409	6021396.27	1738489.06
4CDs	-35.942199	174.530363	6021379.25	1738033.59
4CDe	-35.943598	174.531761	6021222.16	1738157.22
4ABs	-35.942992	174.526144	6021297.27	1737651.58
4ABe	-35.944417	174.527500	6021137.31	1737771.47
5KLs	-35.943309	174.551033	6021226.70	1739896.09
5KLe	-35.944381	174.552816	6021105.30	1740055.03
5IJs	-35.944965	174.547132	6021048.67	1739541.27
5IJe	-35.946407	174.548461	6020886.76	1739658.68
5GHs	-35.947226	174.543749	6020802.70	1739232.18
5GHe	-35.948591	174.545195	6020649.21	1739360.25
5EFs	-35.946264	174.537996	6020917.54	1738714.98
5EFe	-35.947723	174.539296	6020753.81	1738829.67
5CDs	-35.948391	174.534129	6020687.11	1738362.48
5CDe	-35.949646	174.535720	6020545.67	1738503.74
5ABs	-35.952201	174.530376	6020269.83	1738017.34
5ABe	-35.953605	174.531765	6020112.08	1738140.12

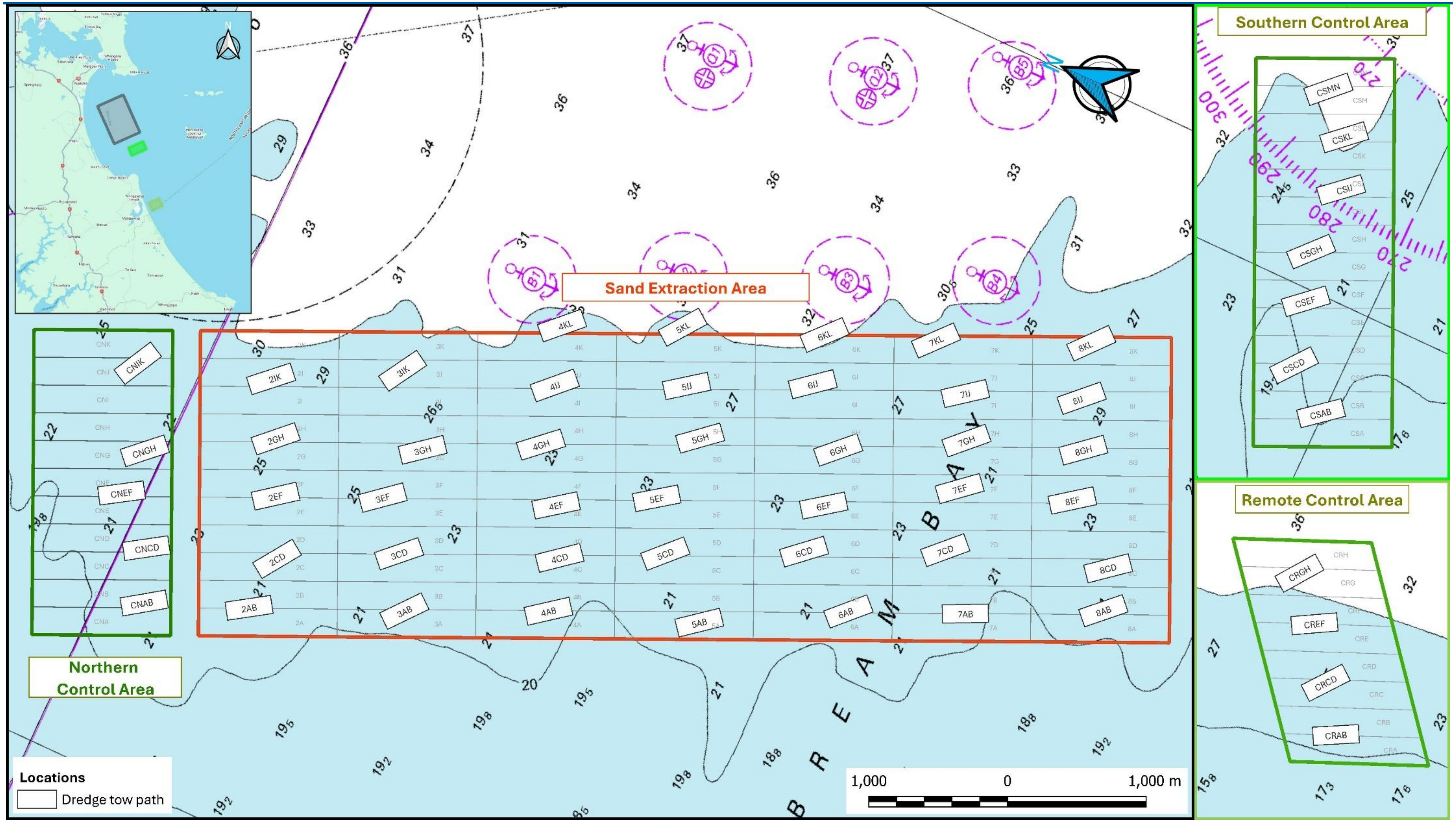
Point	World Geodetic System 1984 EPGS:4326		New Zealand Transverse Mercator Projection EPGS:2193	
	Latitude	Longitude	Northing	Easting
6KLs	-35.951812	174.555311	6020277.42	1740266.93
6KLe	-35.953020	174.556956	6020141.04	1740413.22
6IJs	-35.952375	174.551466	6020220.47	1739919.19
6IJe	-35.953769	174.552871	6020063.76	1740043.45
6GHs	-35.955722	174.547489	6019854.87	1739554.57
6GHe	-35.957007	174.549042	6019710.12	1739692.43
6EFs	-35.956313	174.543083	6019795.63	1739156.19
6EFe	-35.957763	174.544399	6019632.91	1739272.31
6CDs	-35.956467	174.539002	6019784.32	1738787.90
6CDe	-35.957812	174.540478	6019633.05	1738918.58
6ABs	-35.960761	174.536107	6019312.14	1738519.27
6ABe	-35.962024	174.537687	6019169.77	1738659.59
7KLs	-35.958539	174.558655	6019526.33	1740556.68
7KLe	-35.959734	174.560316	6019391.41	1740704.31
7IJs	-35.961601	174.555944	6019190.57	1740306.70
7IJe	-35.963026	174.557303	6019030.62	1740426.78
7GHs	-35.963033	174.552476	6019036.76	1739991.42
7GHe	-35.964314	174.554034	6018892.40	1740129.70
7EFs	-35.963901	174.548826	6018945.69	1739660.79
7EFe	-35.965265	174.550274	6018792.26	1739788.94
7CDs	-35.964783	174.543814	6018855.06	1739207.28
7CDe	-35.966056	174.545383	6018711.55	1739346.45
7ABs	-35.967532	174.540191	6018555.26	1738875.70
7ABe	-35.969152	174.541160	6018374.14	1738960.29
8KLs	-35.967775	174.563677	6018494.58	1740993.14
8KLe	-35.968950	174.565359	6018361.81	1741142.70
8IJs	-35.968657	174.559434	6018402.84	1740608.98
8IJe	-35.969947	174.560984	6018257.59	1740746.47
8GHs	-35.970138	174.555785	6018243.88	1740277.28
8GHe	-35.971512	174.557219	6018089.42	1740404.17
8EFs	-35.970832	174.551815	6018172.57	1739918.11
8EFe	-35.972272	174.553147	6018010.88	1740035.65
8CDs	-35.974818	174.548068	6017735.77	1739573.16
8CDe	-35.976213	174.549471	6017579.07	1739697.27
8ABs	-35.975751	174.544763	6017637.03	1739273.58
8ABe	-35.977050	174.546299	6017490.70	1739409.78

Table A.5 Benthic Dredge tow sampling start and end points from the control areas (WGS84, NZTM)

Point	World Geodetic System 1984 EPGS:4326		New Zealand Transverse Mercator Projection EPGS:2193	
	Latitude	Longitude	Northing	Easting
CNIKs	-35.912292	174.529999	6024697.29	1738052.68
CNIKe	-35.913131	174.531959	6024601.42	1738228.10
CNGHs	-35.914870	174.524109	6024419.64	1737516.71
CNGHe	-35.916184	174.525624	6024271.71	1737651.16
CNEFs	-35.914544	174.520439	6024460.98	1737186.14
CNEFe	-35.916063	174.521629	6024290.75	1737290.94
CNCDs	-35.917520	174.517261	6024135.26	1736894.29
CNCDe	-35.919028	174.518474	6023966.32	1737001.15
CNABs	-35.918907	174.513189	6023987.10	1736524.41
CNABe	-35.920387	174.514452	6023821.15	1736635.86
CRGHs	-36.0953408	174.6352049	6004238	1747205.5
CRGHe	-36.0964019	174.6370004	6004117.6	1747365.2
CREFs	-36.0973652	174.632384	6004017.7	1746947.8
CREFe	-36.0989313	174.6334839	6003842.4	1747043.9
CRCDs	-36.0998757	174.6281552	6003745.6	1746562.4
CRCDe	-36.1009853	174.6299057	6003619.9	1746718
CRABs	-36.1016697	174.6250631	6003551.3	1746280.7

Point	World Geodetic System 1984 EPGS:4326		New Zealand Transverse Mercator Projection EPGS:2193	
	Latitude	Longitude	Northing	Easting
CRABe	-36.1032589	174.6261115	6003373.4	1746372.2
CSMNs	-35.9908051	174.5977247	6015890.2	1744021.5
CSMNe	-35.9920917	174.5992784	6015745.1	1744159.2
CSKLs	-35.9930253	174.5948063	6015648.2	1743754.4
CSKLe	-35.9943625	174.596294	6015497.7	1743886.1
CSIJs	-35.9942756	174.5908981	6015515.3	1743399.8
CSIJe	-35.9956289	174.5923635	6015363	1743529.5
CSGHs	-35.9942684	174.585331	6015524.2	1742898
CSGHe	-35.9954836	174.5869682	6015387	1743043.4
CSEFs	-35.9952538	174.5816307	6015420.3	1742562.7
CSEFe	-35.9966013	174.5831026	6015268.7	1742692.9
CSCDs	-35.9964199	174.5764626	6015298.5	1742094.7
CSCDe	-35.9975398	174.5781996	6015171.8	1742249.3
CSABs	-35.9991903	174.5740654	6014994.7	1741873.6
CSABe	-36.0005839	174.5754709	6014838.1	1741997.8

Bioresearches
A Babbage Company



CLIENT / PROJECT	CD – Chart Datum as measured at Marsden Point (LINZ code DJM9) Map projection - NZ Transverse Mercator EPGS:2193 GPS points - WGS 84 EPGS:4326	MAP REVISIONS Drawing Date: 04/07/2025 Version 0.1.5 by SW.	Bioresearches
McCallum Bros. Ltd.			
MAP FILE NAME **Sand Extraction Area and Control Areas with Epibenthic dredge tow lines in monitoring cells**			

Figure A.5 Benthic dredge tow sampling transect locations within the Sand Extraction area and Control areas.

Appendix B Bathymetry Profiles

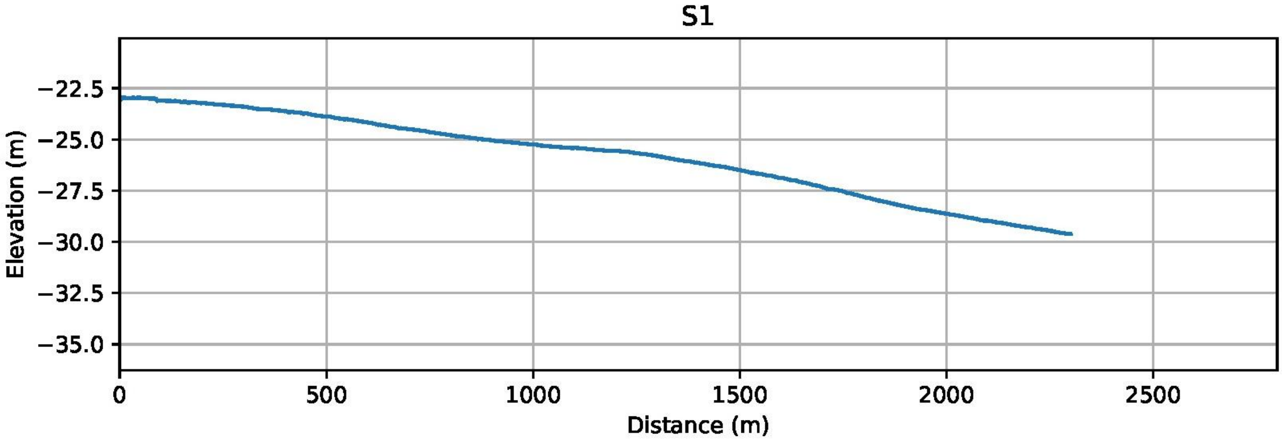


Figure B.1 Bathymetry profile S1 across the Sand Extraction area from west to east, profile locations shown in Figure A.3.

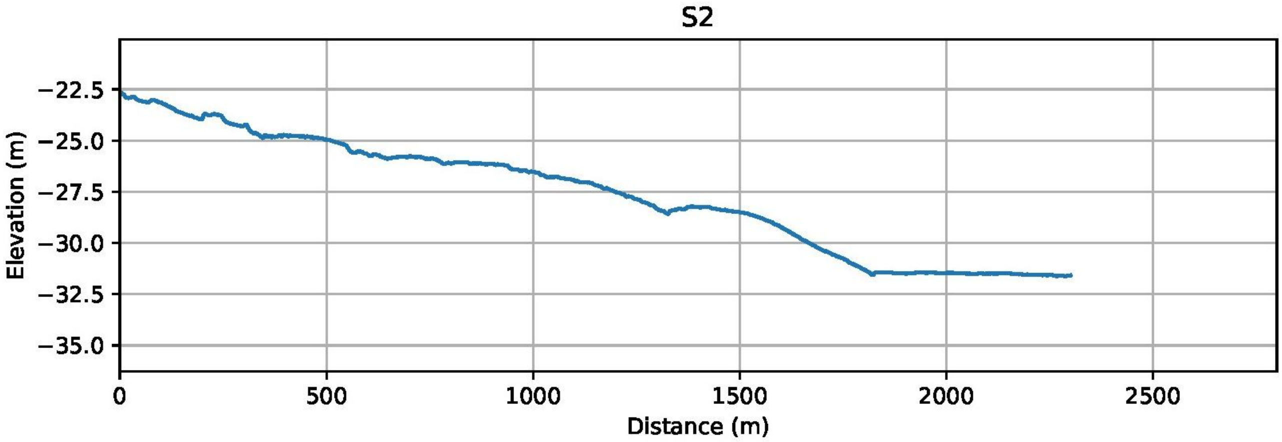


Figure B.2 Bathymetry profile S2 across the Sand Extraction area from west to east, profile locations shown in Figure A.3.

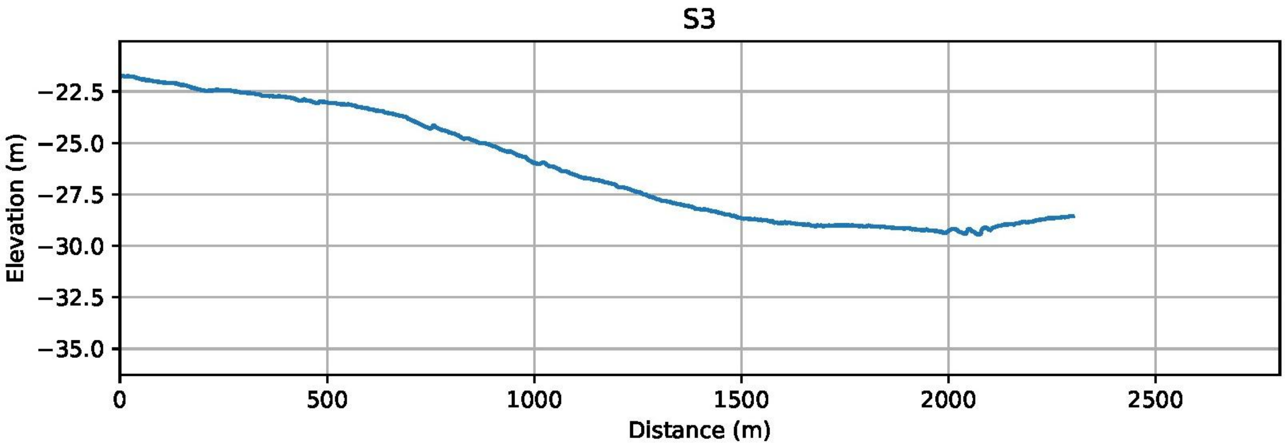


Figure B.3 Bathymetry profile S3 across the Sand Extraction area from west to east, profile locations shown in Figure A.3.

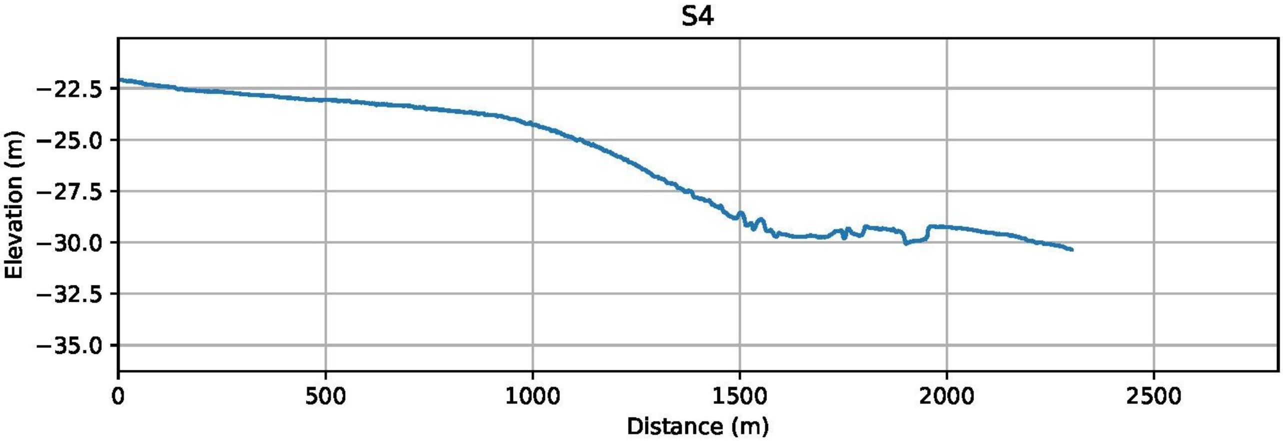


Figure B.4 Bathymetry profile S4 across the Sand Extraction area from west to east, profile locations shown in Figure A.3.

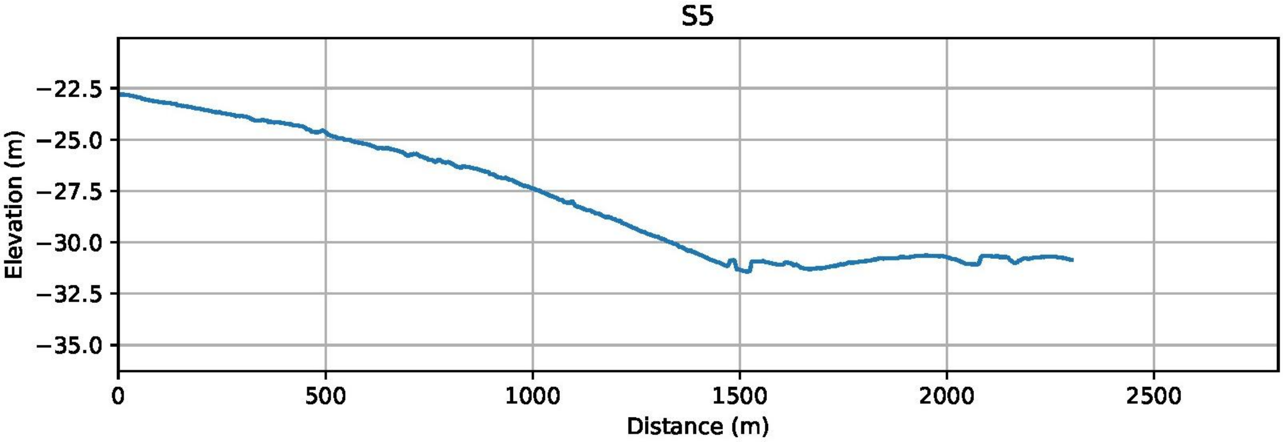


Figure B.5 Bathymetry profile S5 across the Sand Extraction area from west to east, profile locations shown in Figure A.3.

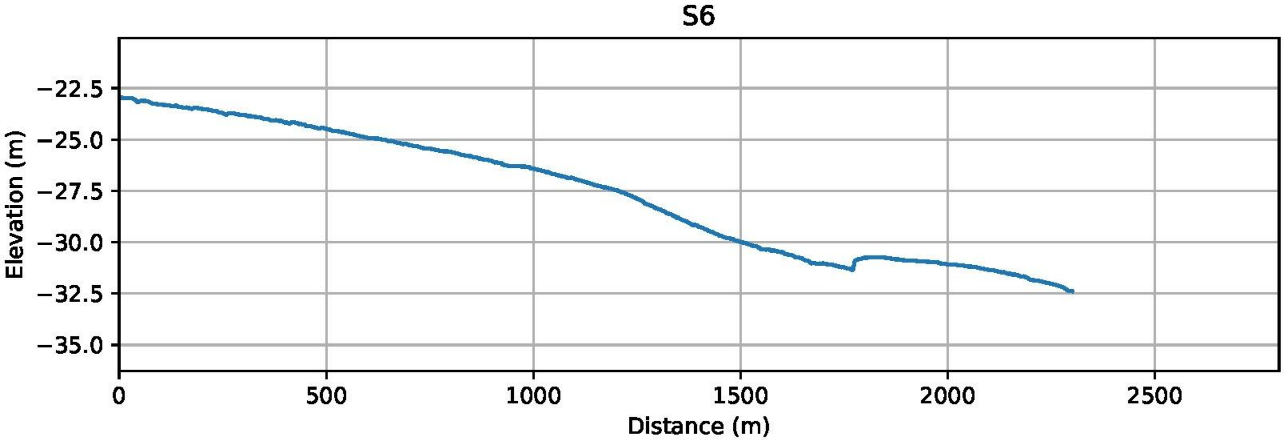


Figure B.6 Bathymetry profile S6 across the Sand Extraction area from west to east, profile locations shown in Figure A.3.

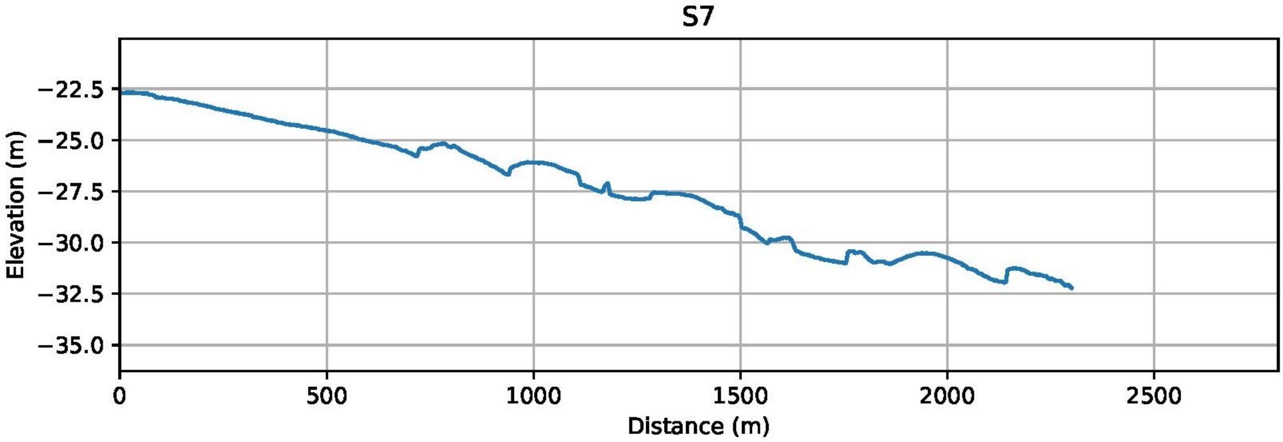


Figure B.7 Bathymetry profile S7 across the Sand Extraction area from west to east, profile locations shown in Figure A.3.

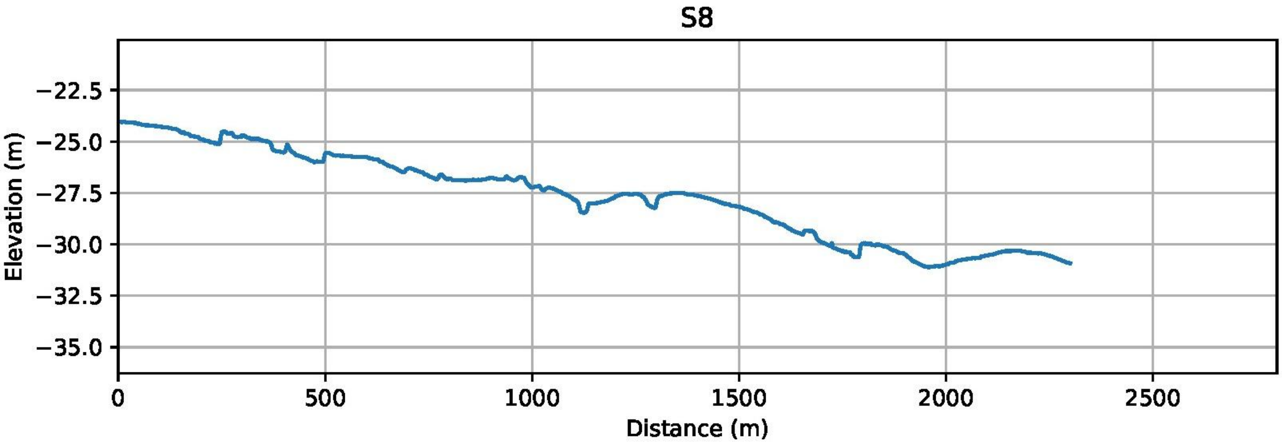


Figure B.8 Bathymetry profile S8 across the Sand Extraction area from west to east, profile locations shown in Figure A.3.

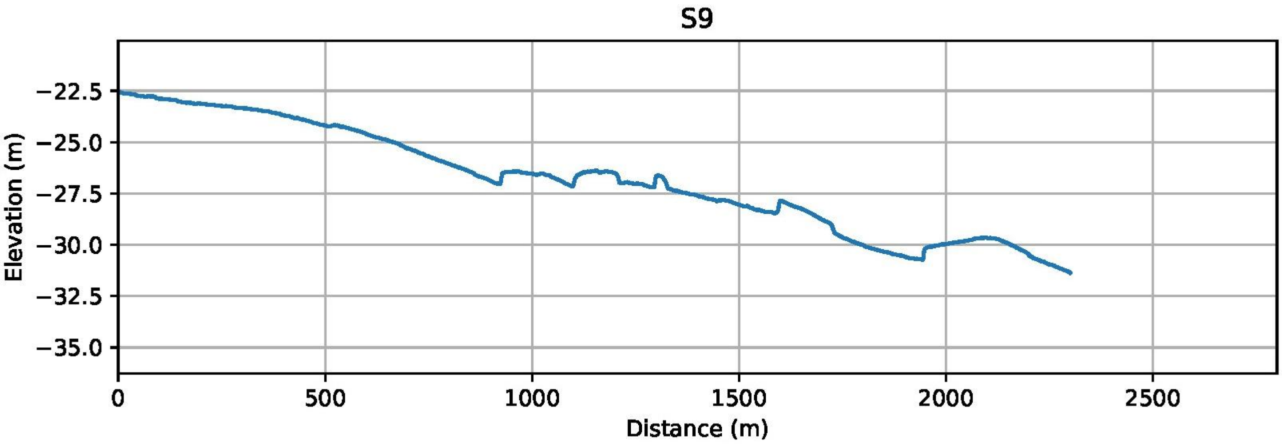


Figure B.9 Bathymetry profile S9 across the Sand Extraction area from west to east, profile locations shown in Figure A.3.

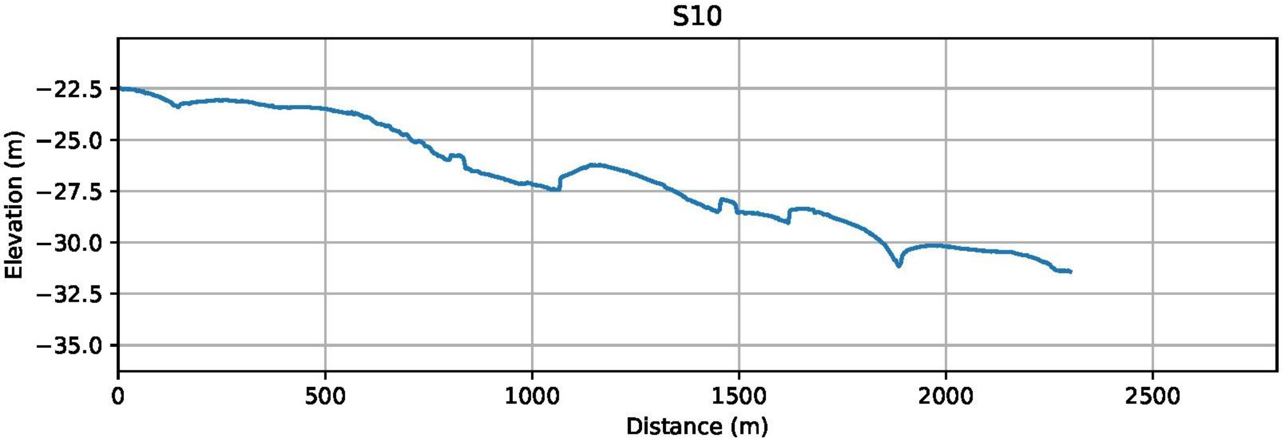


Figure B.10 Bathymetry profile S10 across the Sand Extraction area from west to east, profile locations shown in Figure A.3.

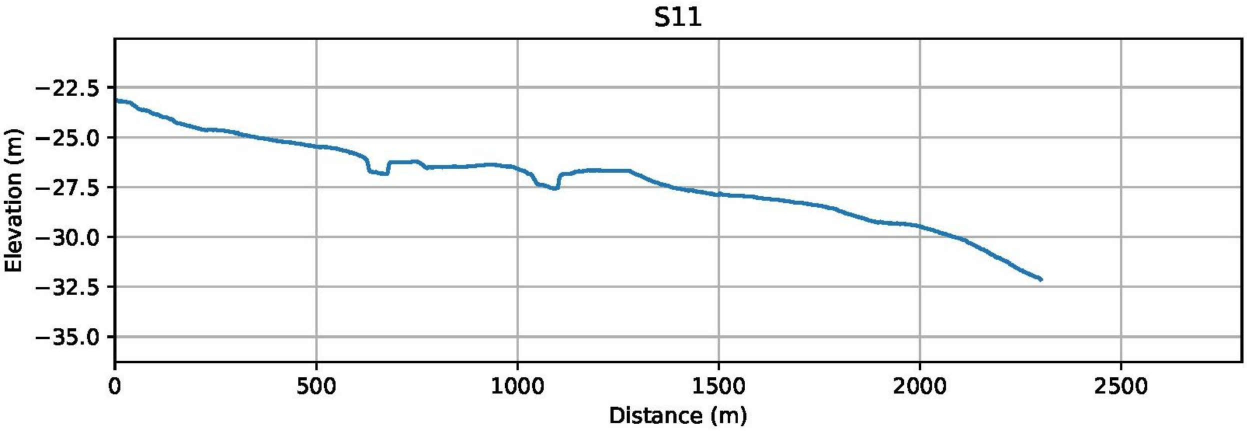


Figure B.11 Bathymetry profile S11 across the Sand Extraction area from west to east, profile locations shown in Figure A.3.

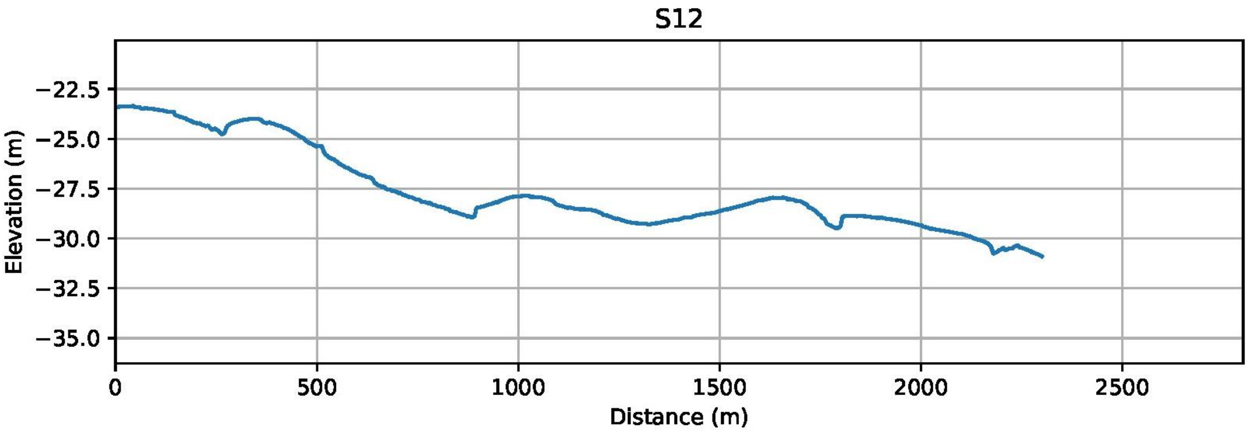


Figure B.12 Bathymetry profile S12 across the Sand Extraction area from west to east, profile locations shown in Figure A.3.

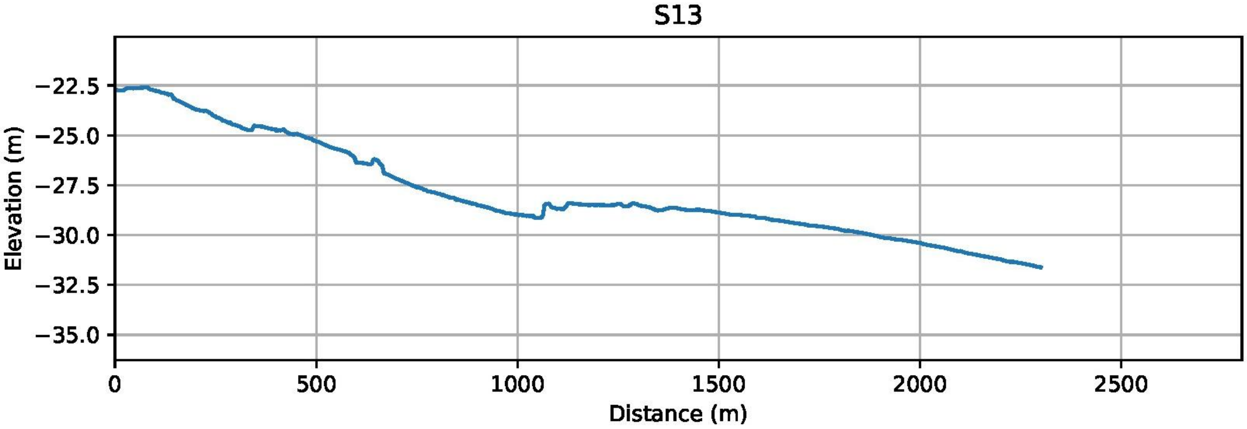


Figure B.13 Bathymetry profile S13 across the Sand Extraction area from west to east, profile locations shown in Figure A.3.

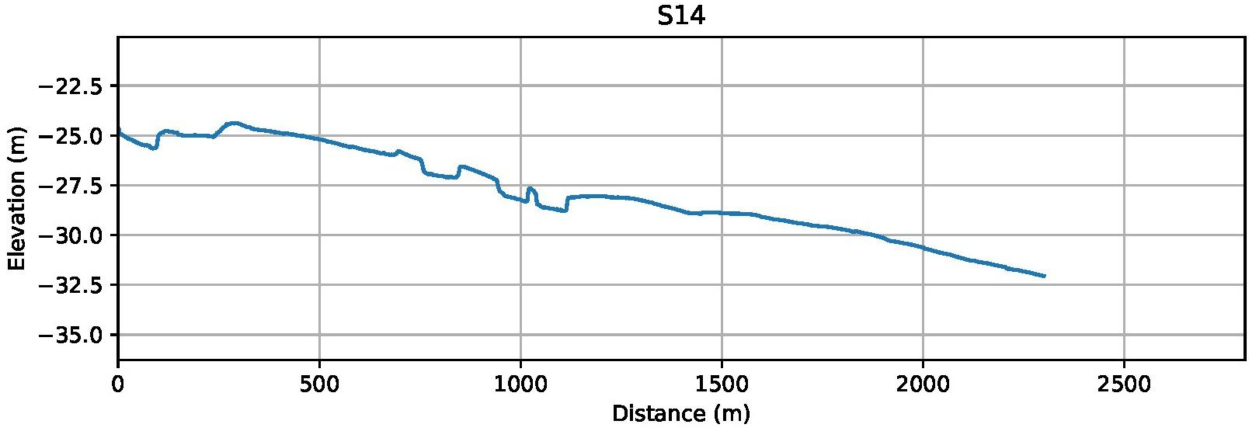


Figure B.14 Bathymetry profile S14 across the Sand Extraction area from west to east, profile locations shown in Figure A.3.

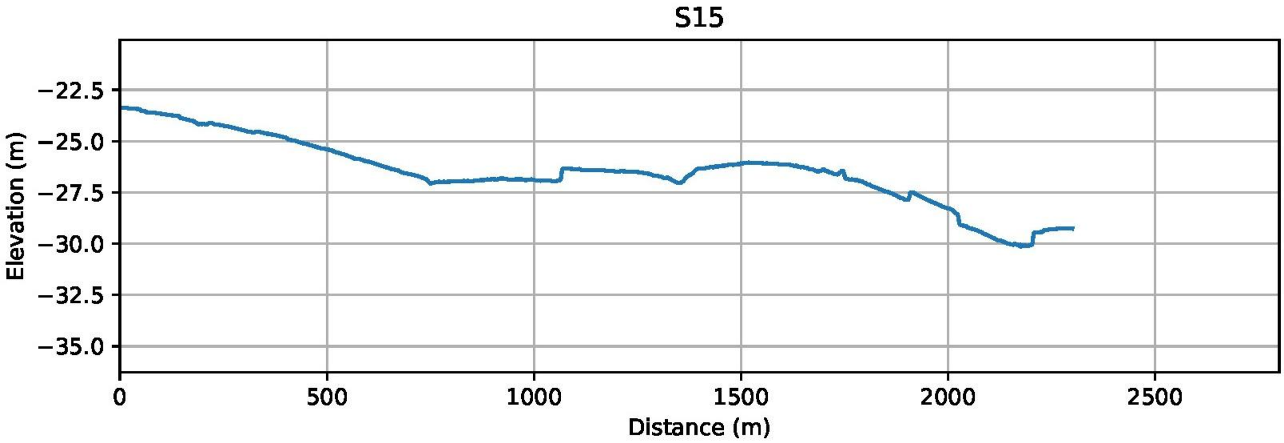


Figure B.15 Bathymetry profile S15 across the Sand Extraction area from west to east, profile locations shown in Figure A.3.

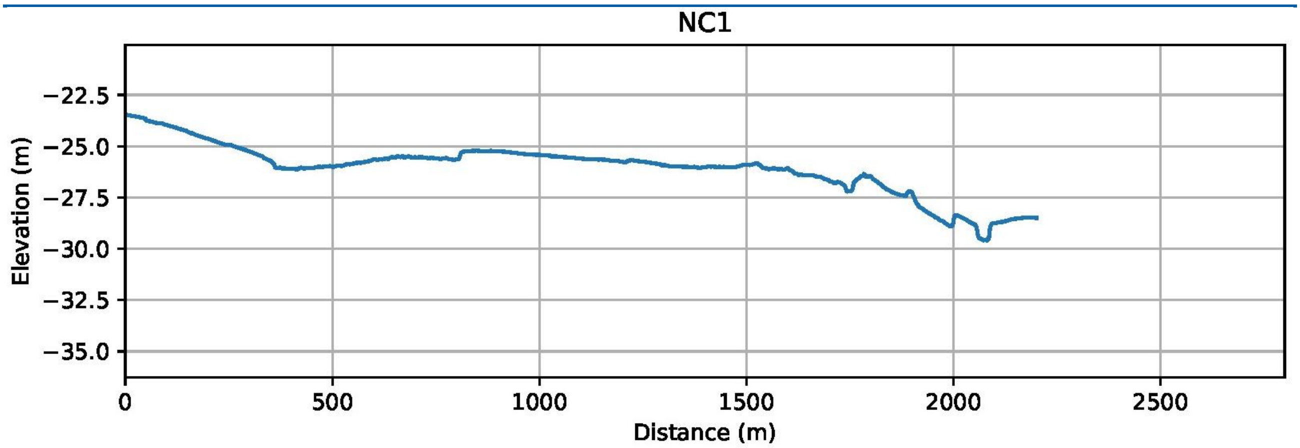


Figure B.16 Bathymetry profile NC1 across the Northern Control area from west to east, profile locations shown in Figure A.3.

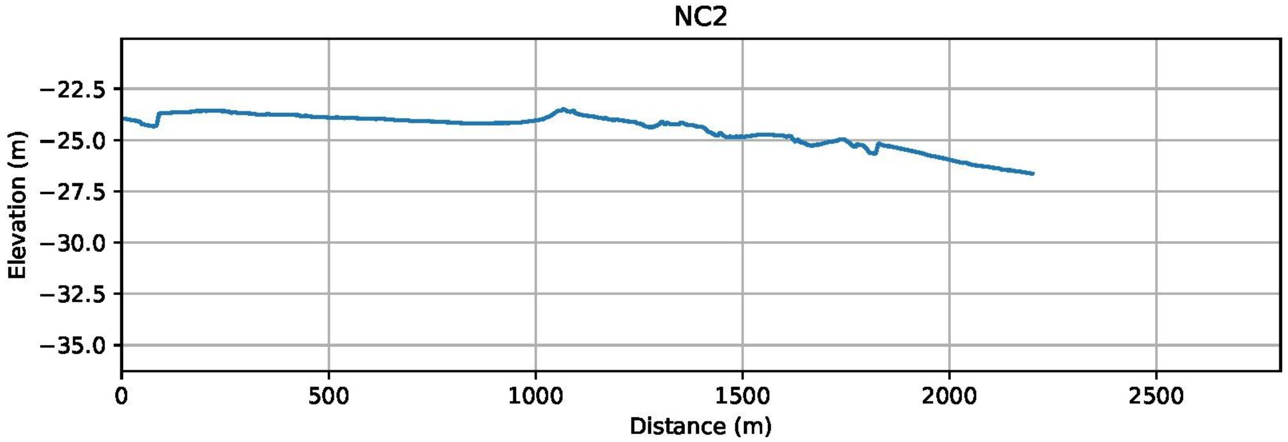


Figure B.17 Bathymetry profile NC2 across the Northern Control area from west to east, profile locations shown in Figure A.3.

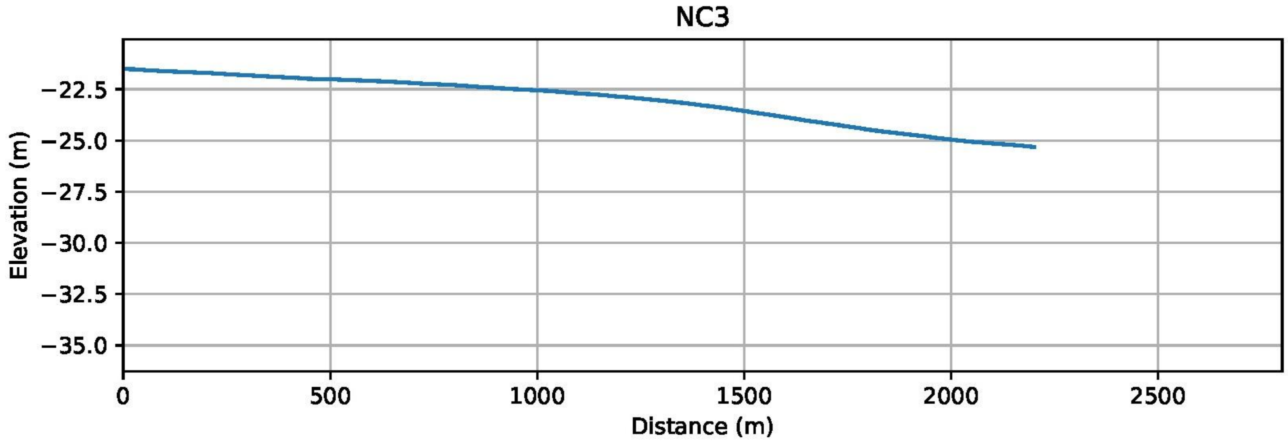


Figure B.18 Bathymetry profile NC3 across the Northern Control area from west to east, profile locations shown in Figure A.3.

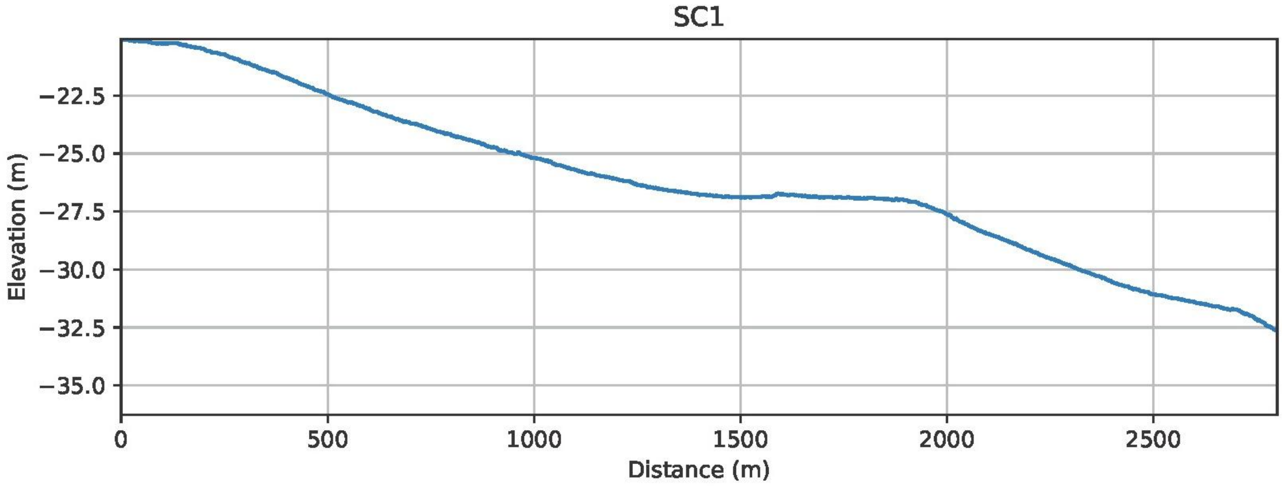


Figure B.19 Bathymetry profile SC1 across the Southern Control area from west to east, profile locations shown in Figure A.3.

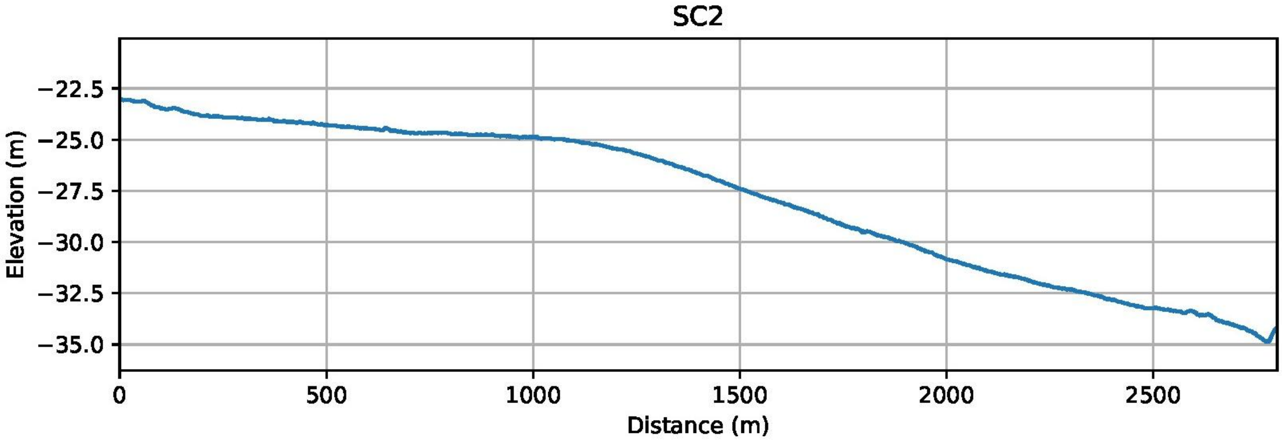


Figure B.20 Bathymetry profile SC2 across the Southern Control area from west to east, profile locations shown in Figure A.3.

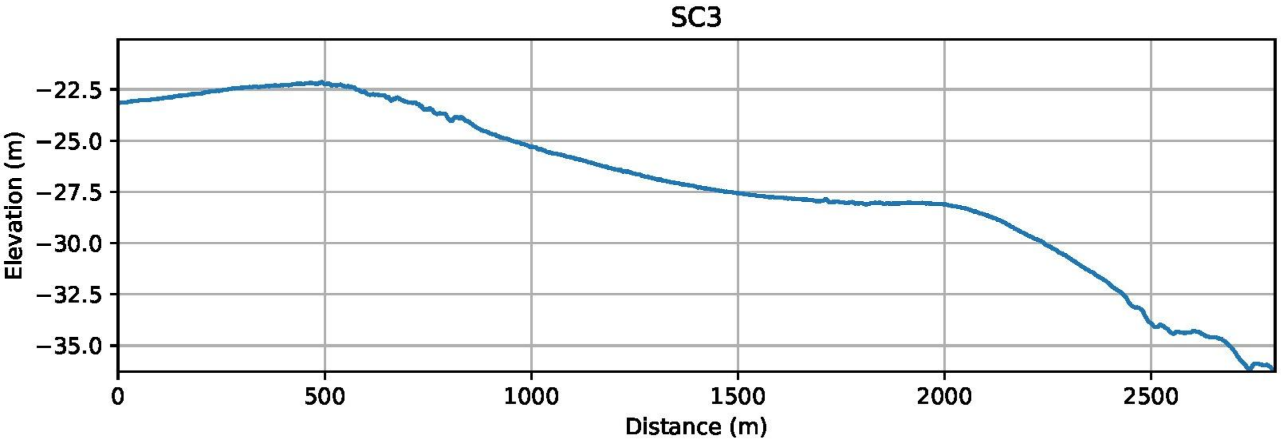
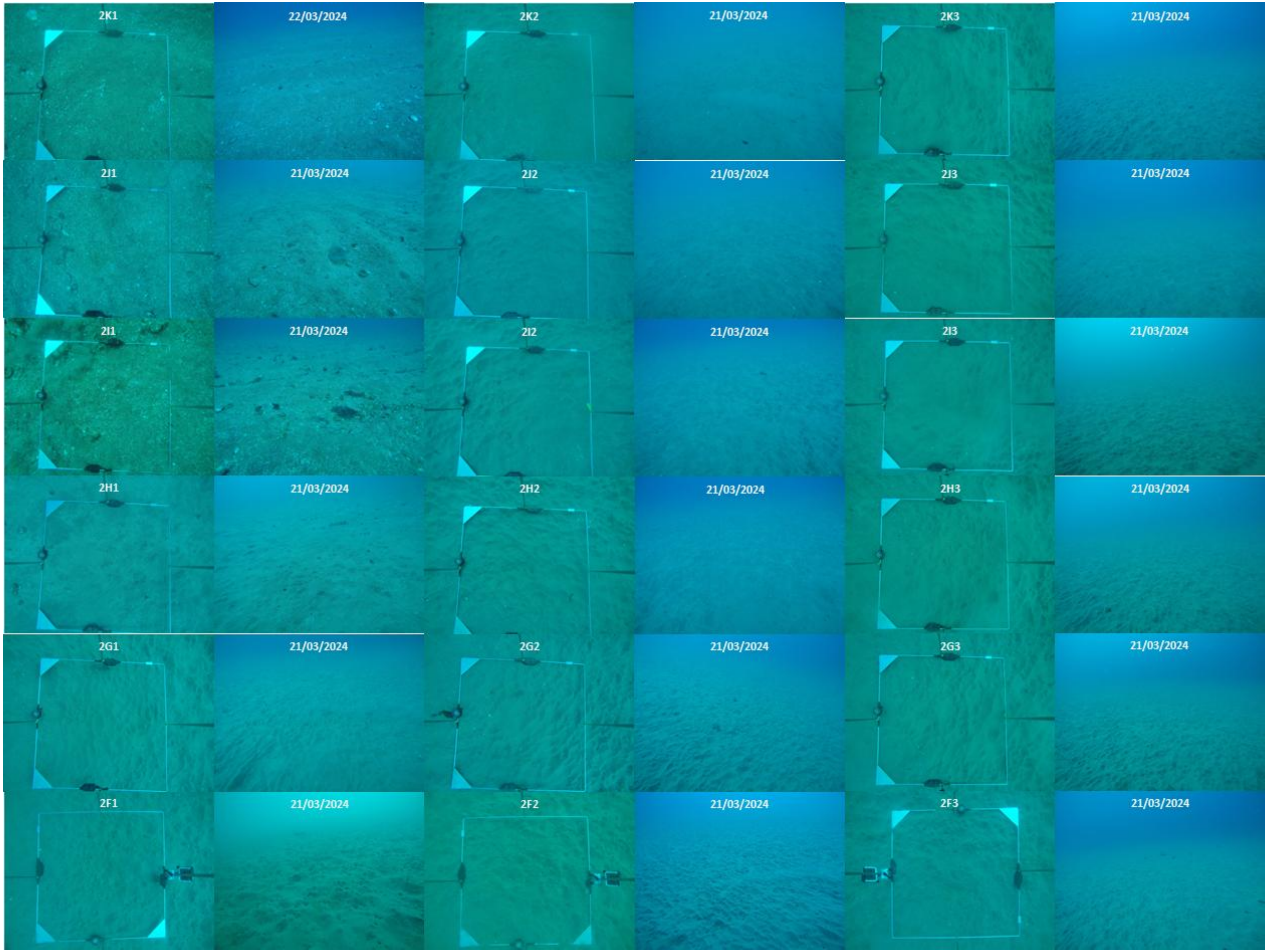


Figure B.21 Bathymetry profile SC3 across the Southern Control area from west to east, profile locations shown in Figure A.3.

Appendix C Drop Camera Images



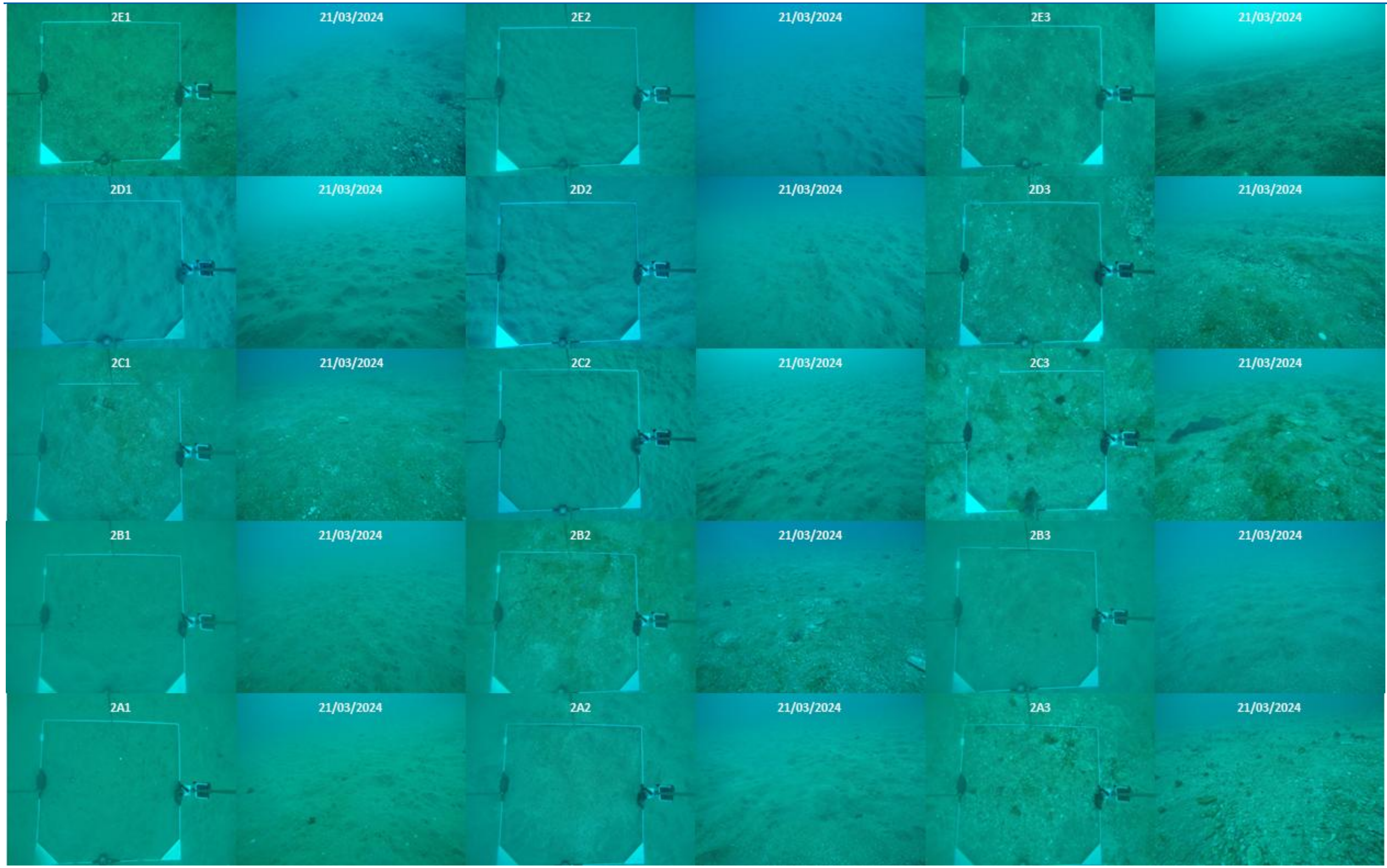
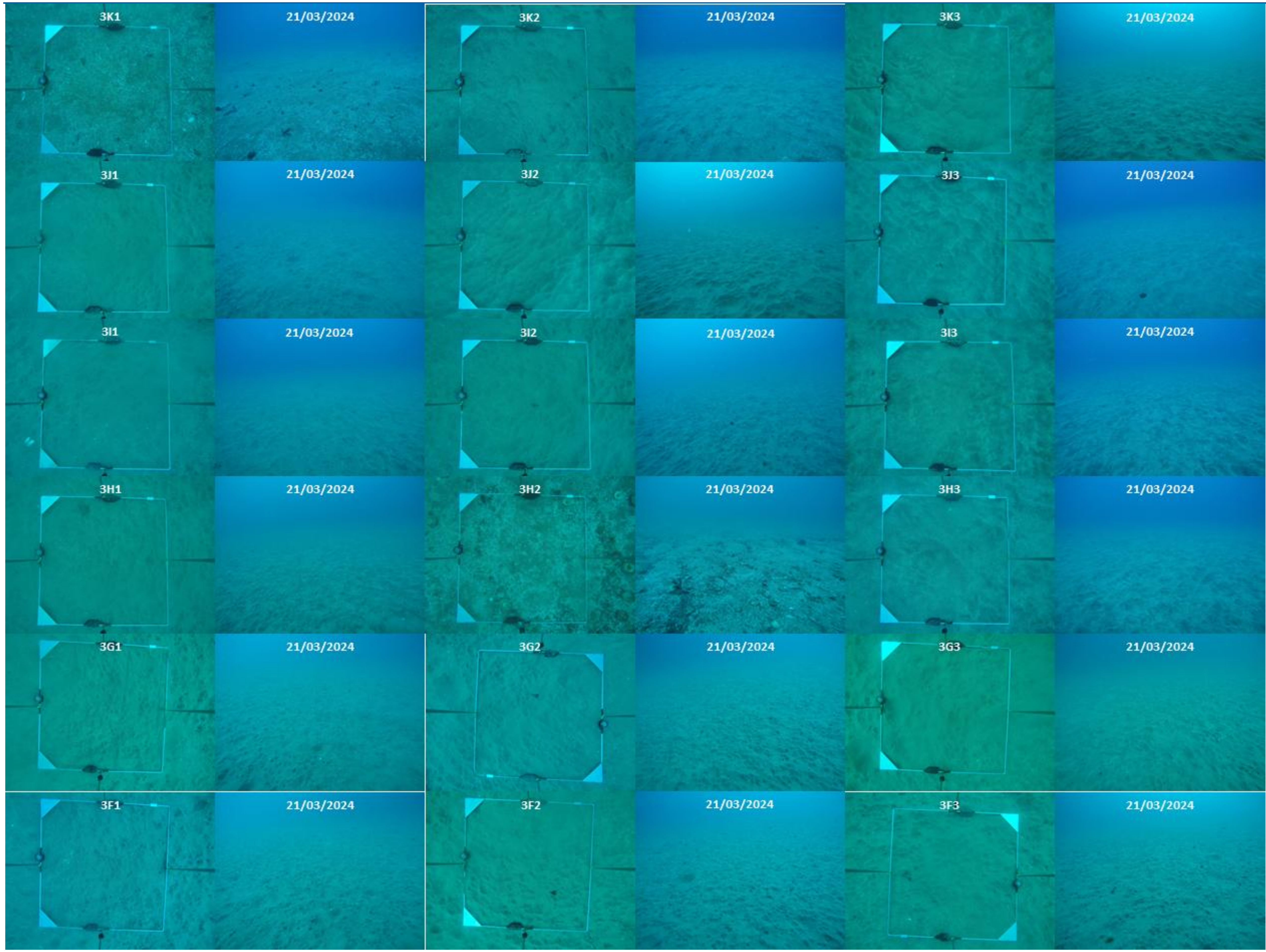


Figure C.1 Drop Camera images from the Sand Extraction Area 2 Cells, 2024.


3K1
21/03/2024
3K2
21/03/2024
3K3
21/03/2024
3J1
21/03/2024
3J2
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3J3
21/03/2024
3I1
21/03/2024
3I2
21/03/2024
3I3
21/03/2024
3H1
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3H2
21/03/2024
3H3
21/03/2024
3G1
21/03/2024
3G2
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3F3
21/03/2024

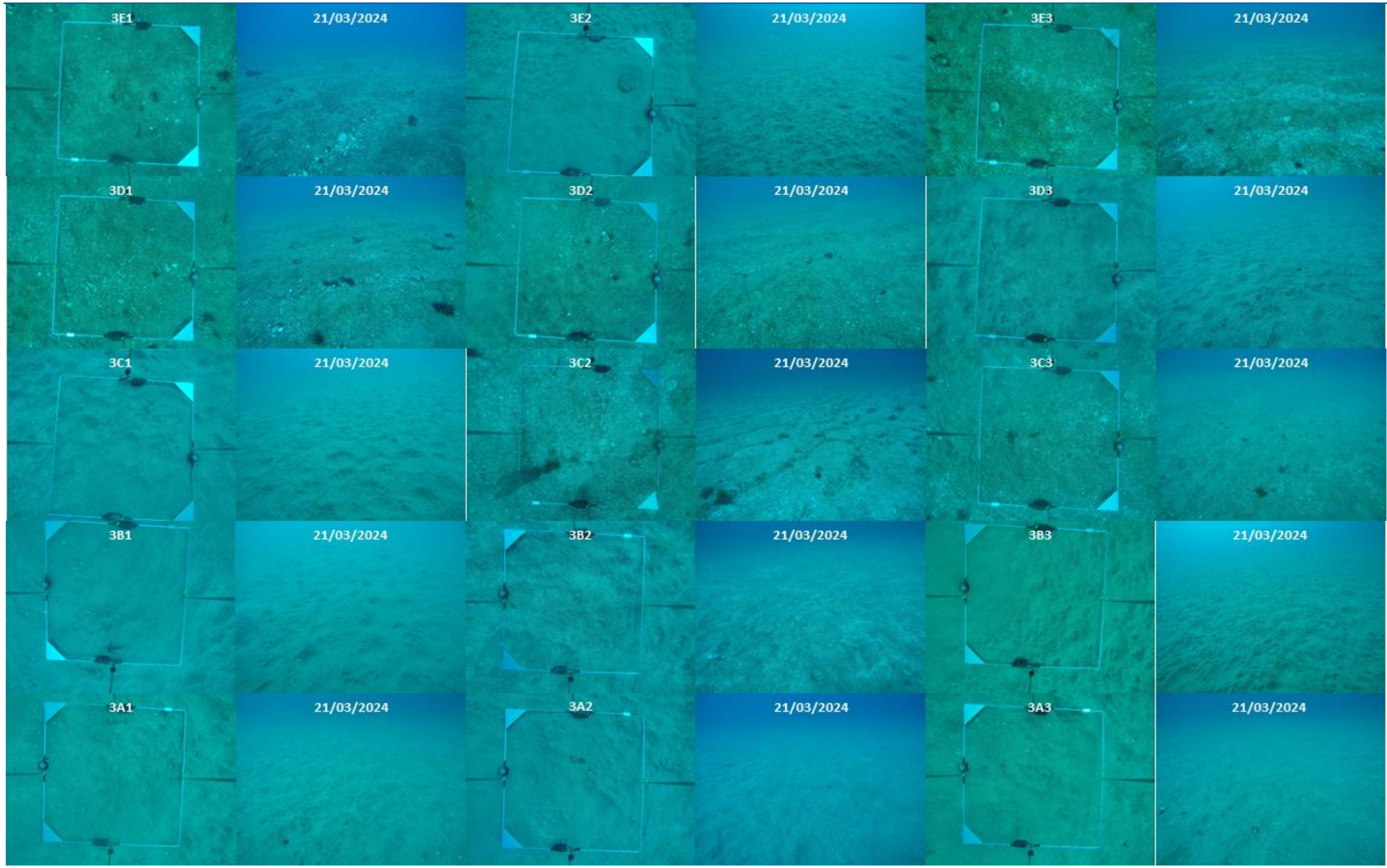
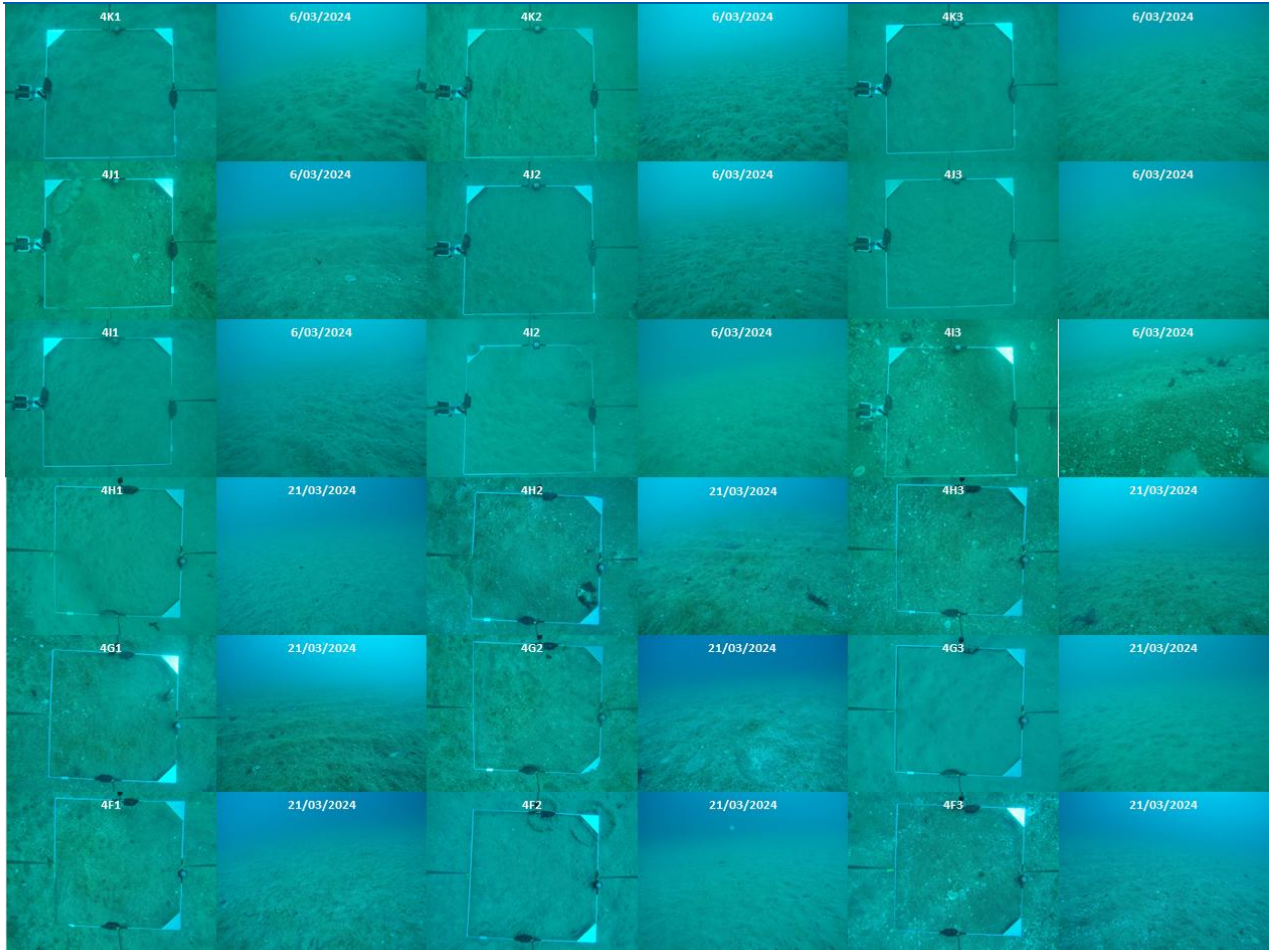


Figure C.2 Drop Camera images from the Sand Extraction Area 3 Cells, 2024.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4K2
6/03/2024
4K3
6/03/2024
4J1
6/03/2024
4J2
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4F3
21/03/2024

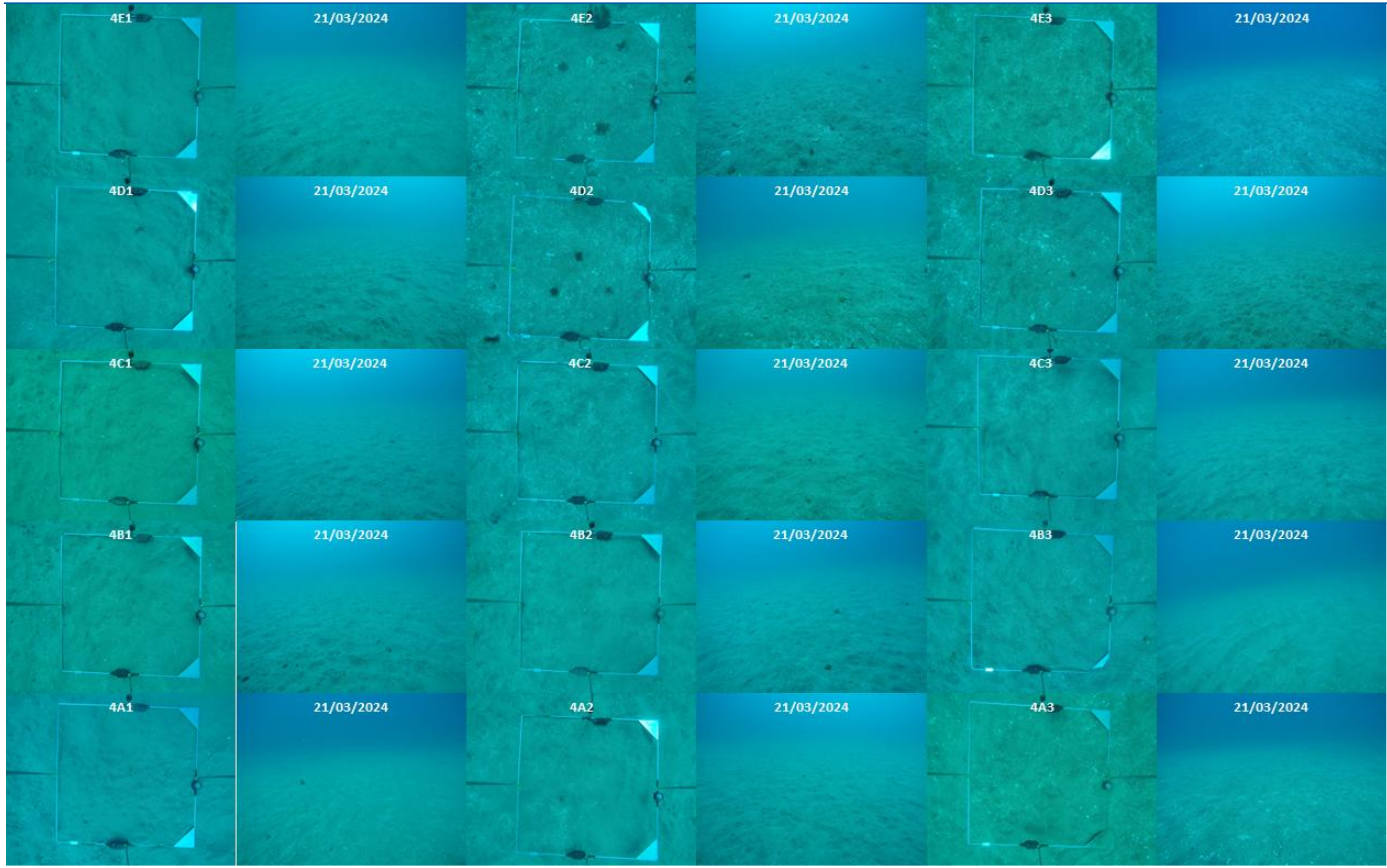
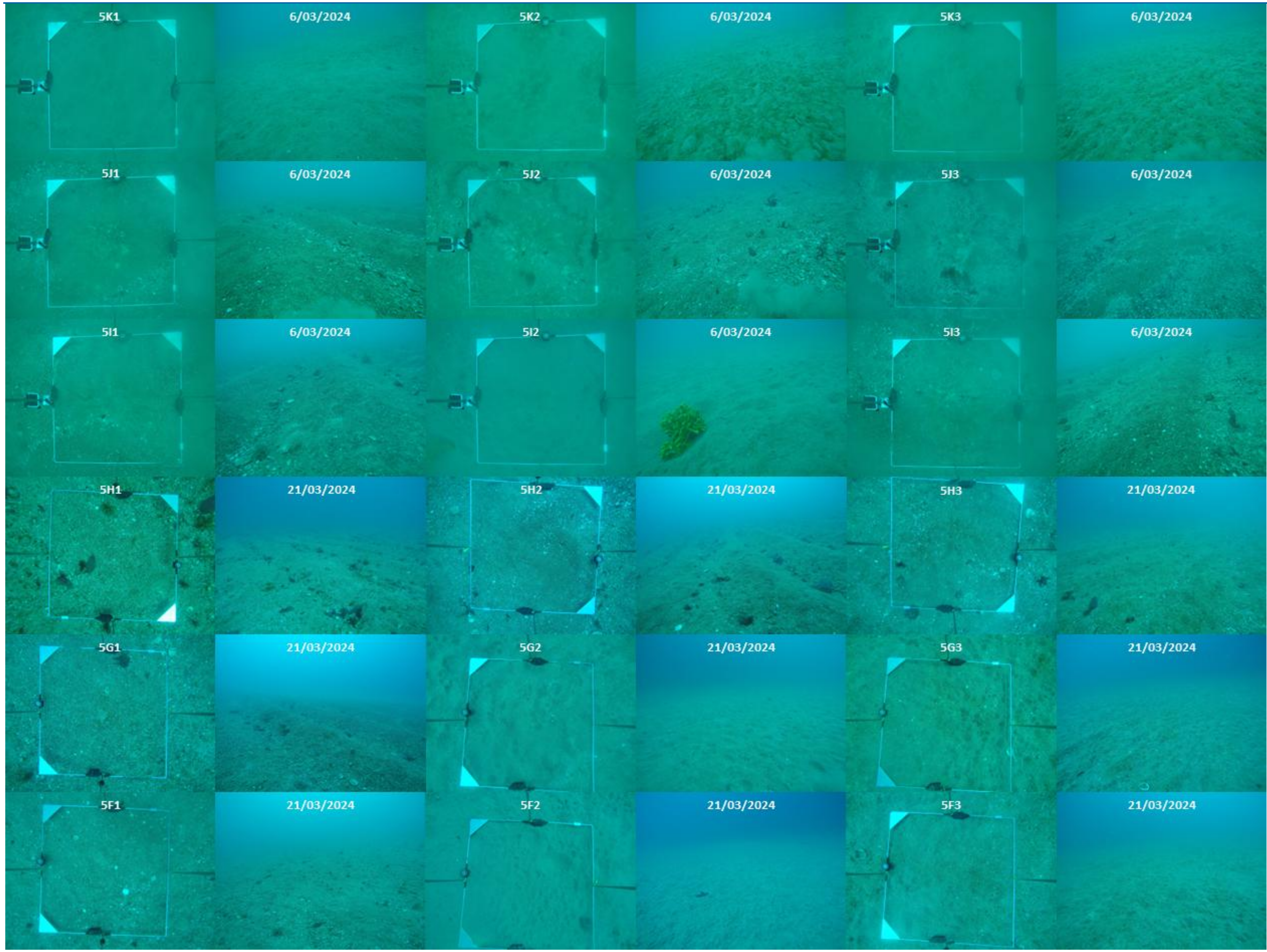


Figure C.3 Drop Camera images from the Sand Extraction Area 4 Cells, 2024.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21/03/2024

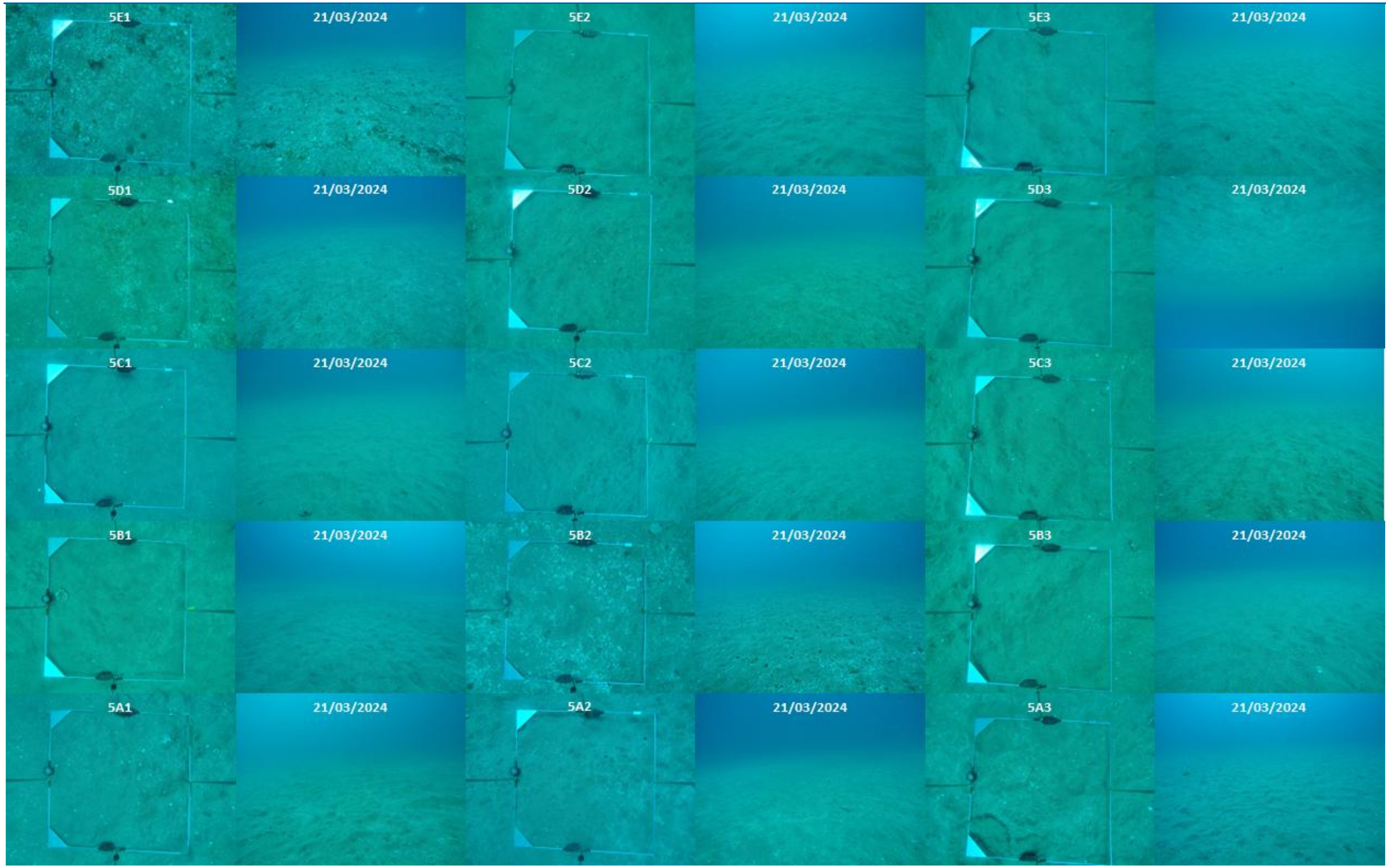
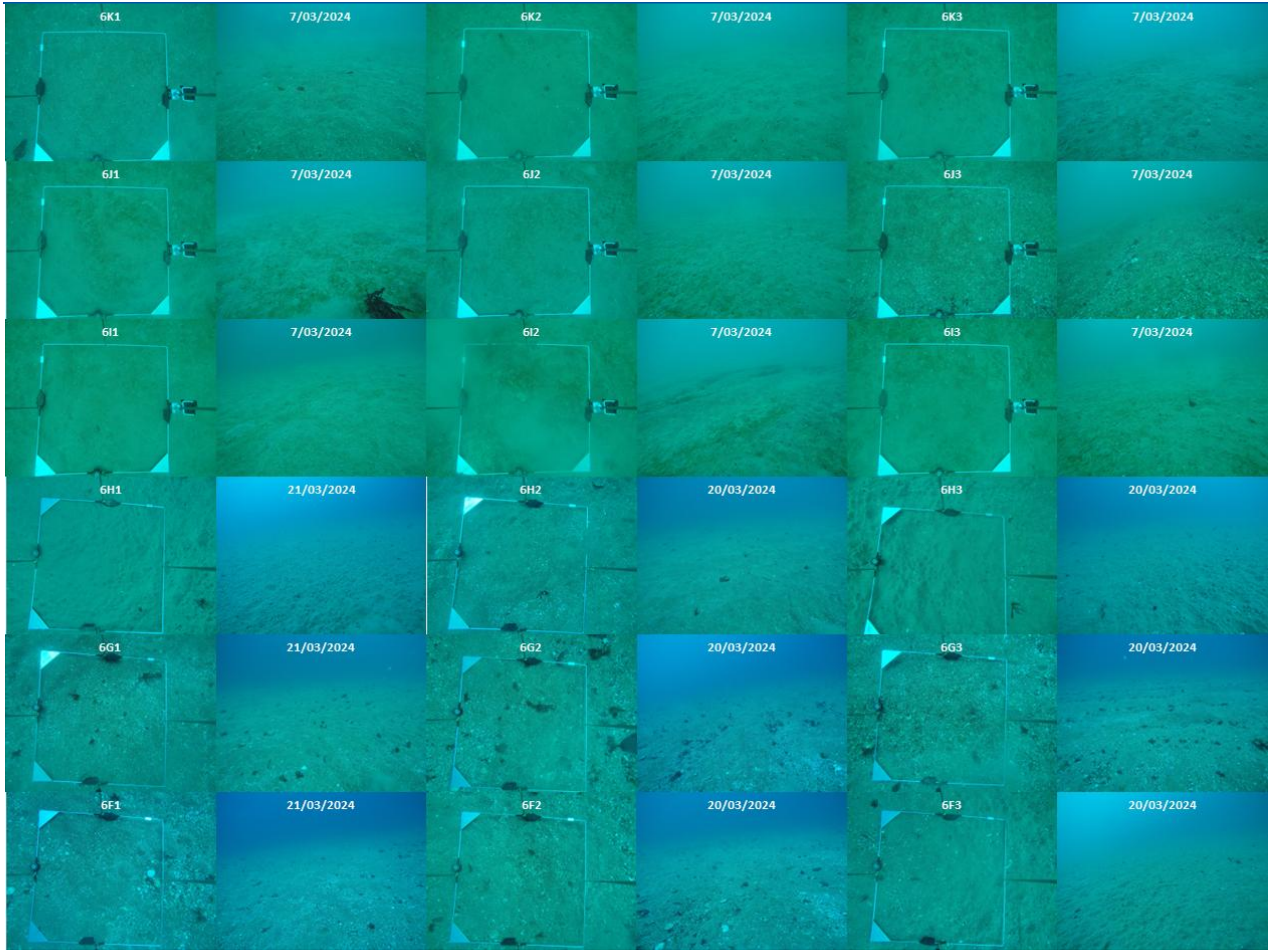


Figure C.4 Drop Camera images from the Sand Extraction Area 5 Cells, 2024.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20/03/2024

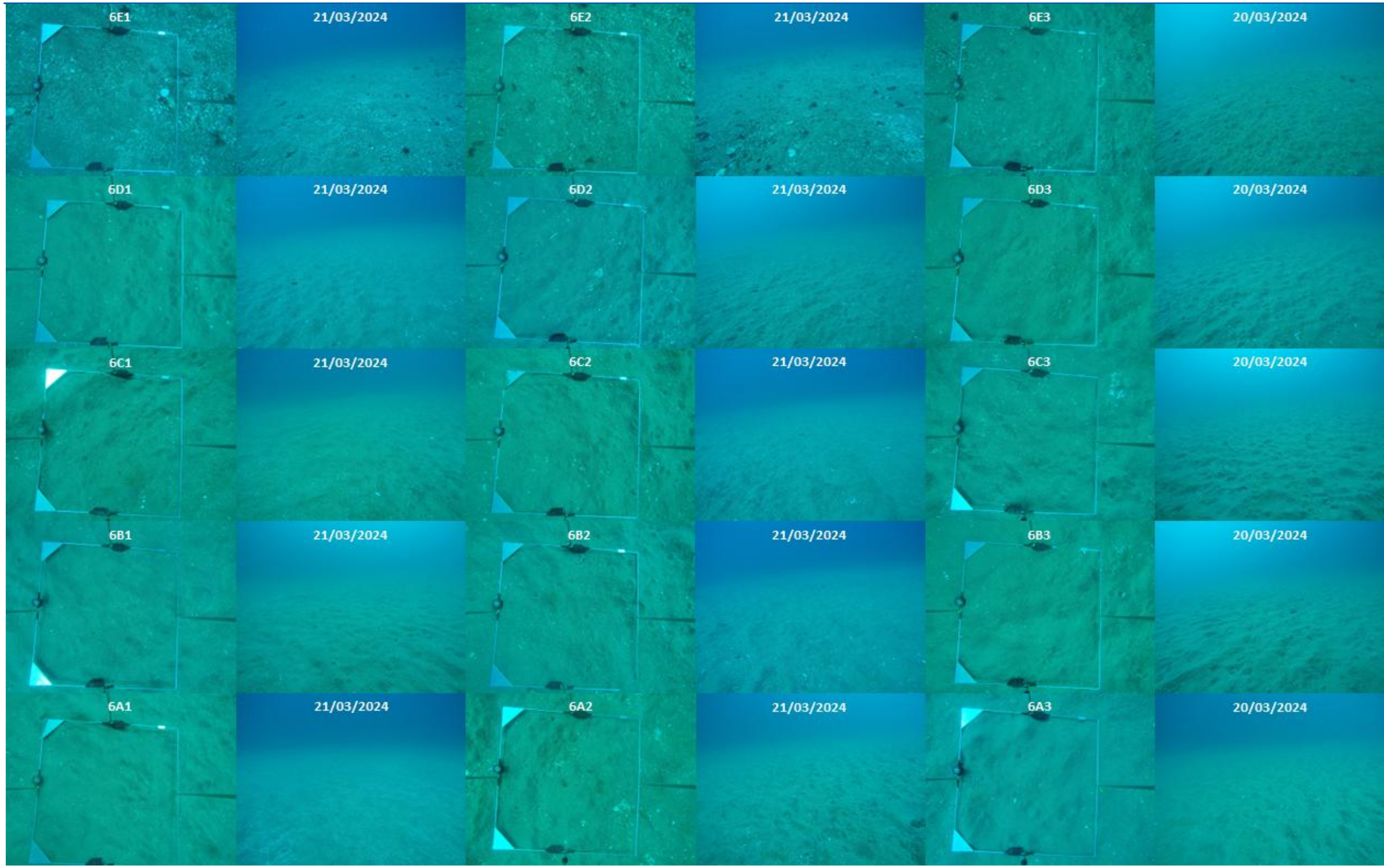
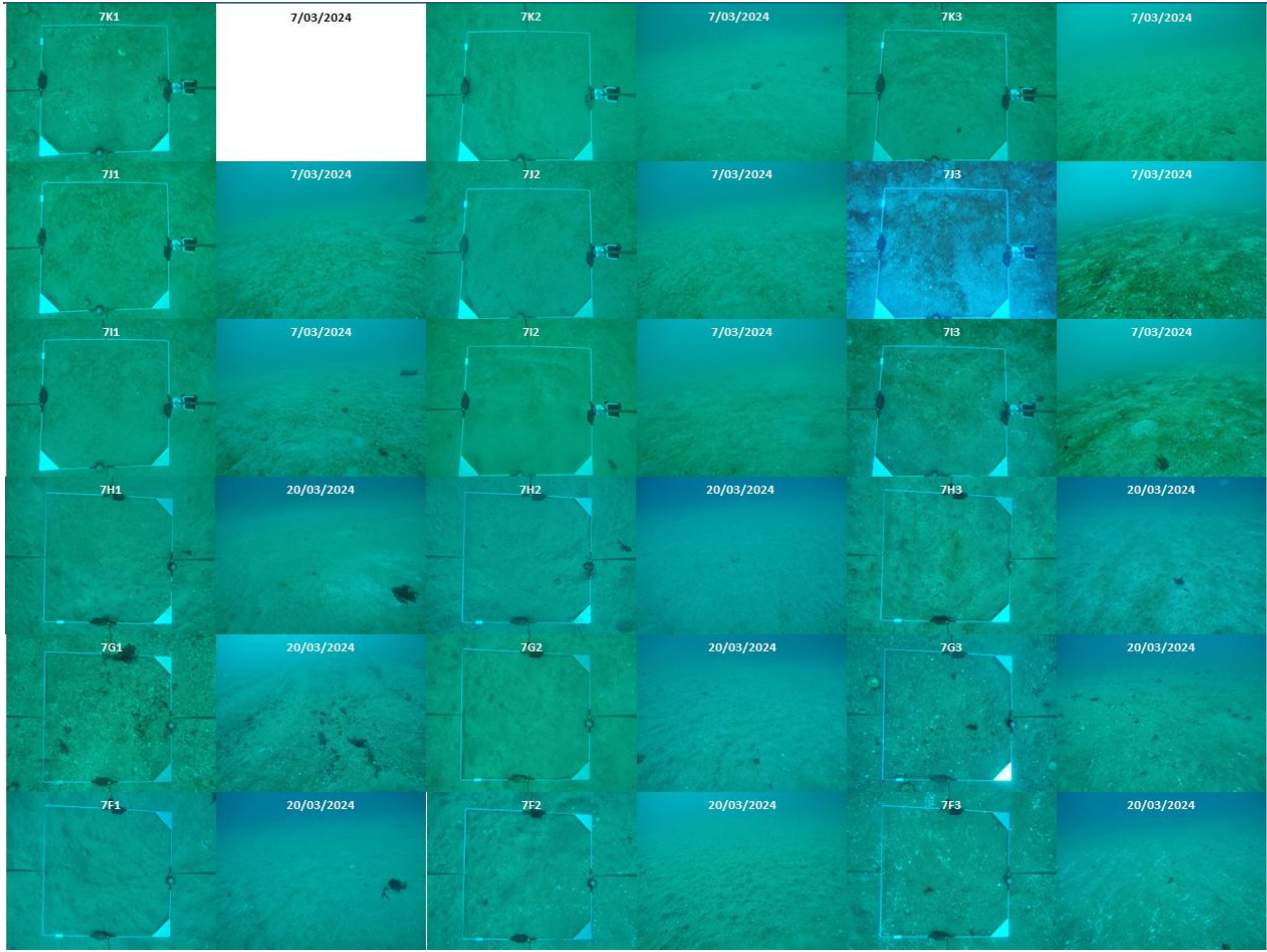


Figure C.5 Drop Camera images from the Sand Extraction Area 6 Cells, 2024.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7F3
20/03/2024

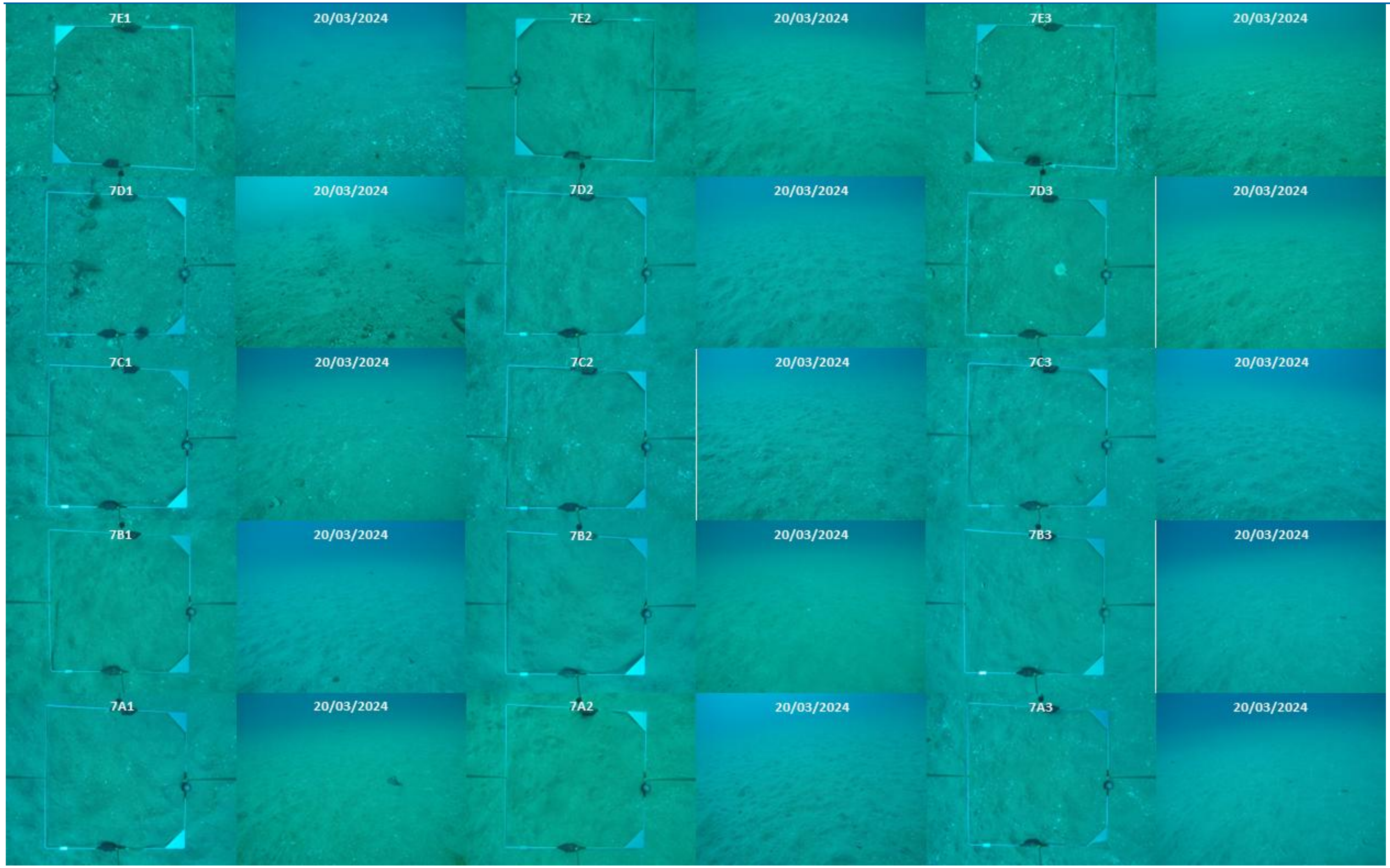
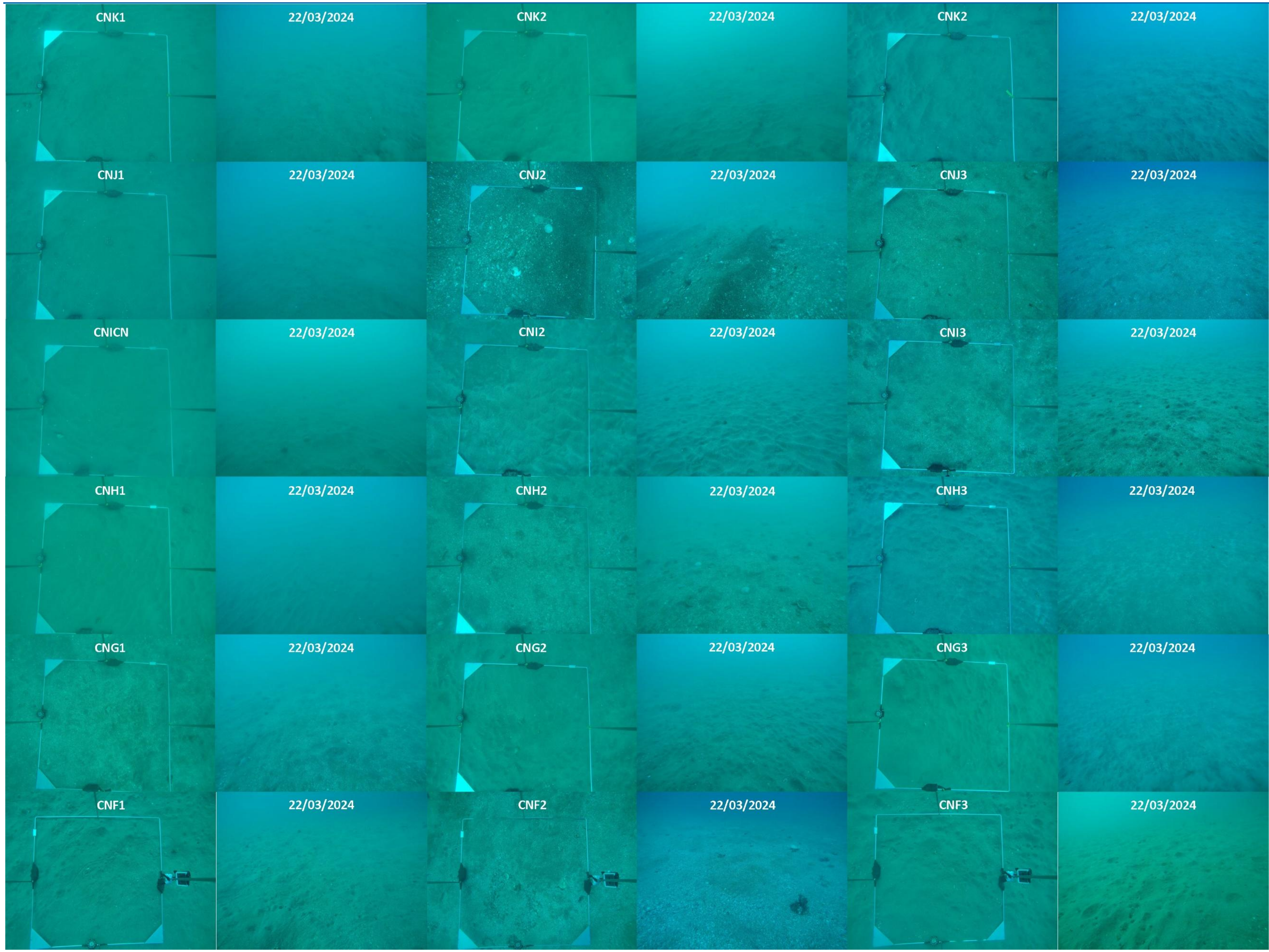


Figure C.6 Drop Camera images from the Sand Extraction Area 7 Cells, 2024.
(white square indicates no photo available)

Figure C.7 Drop Camera images from the Sand Extraction Area 8 Cells, 2024.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22/03/2024

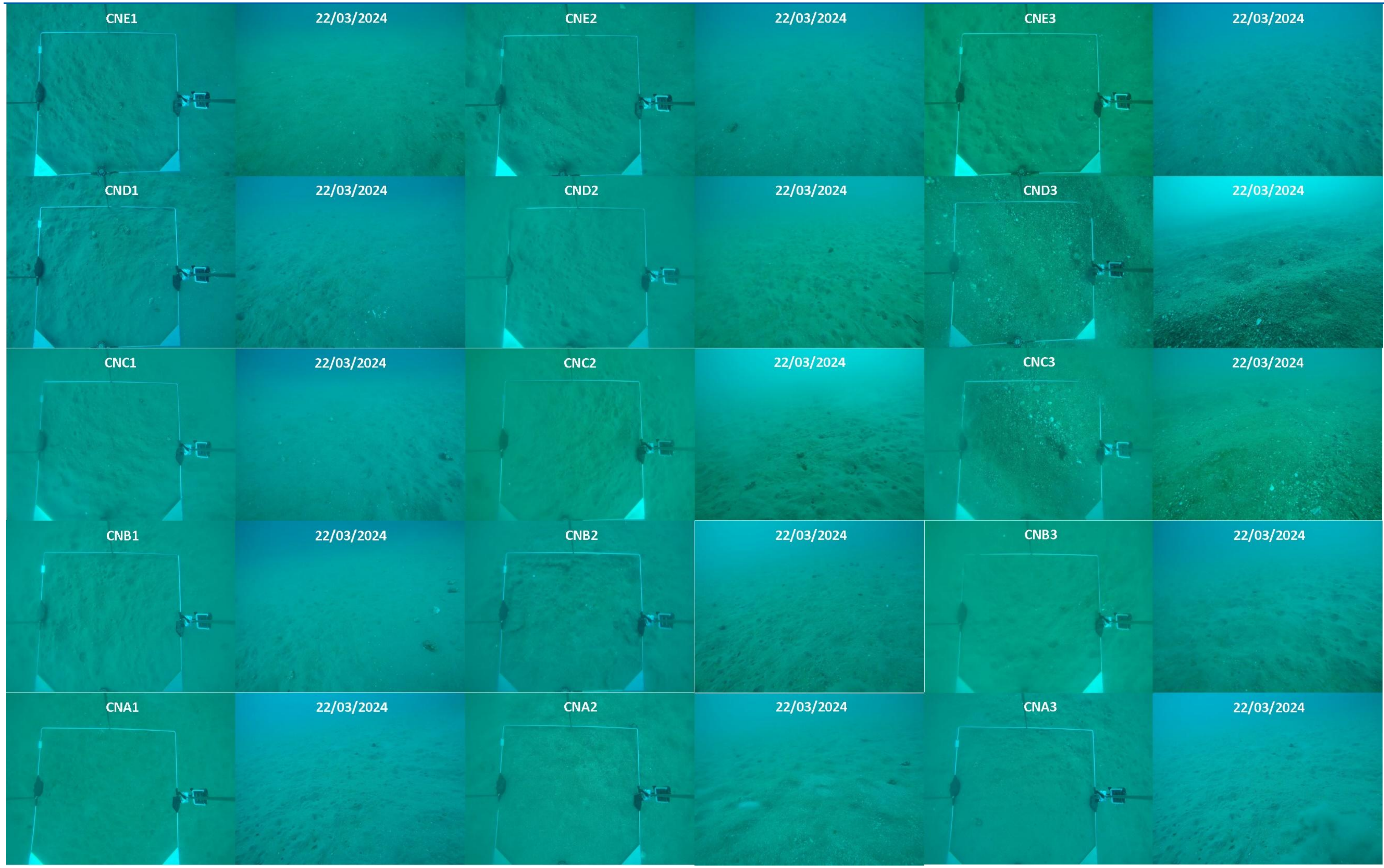
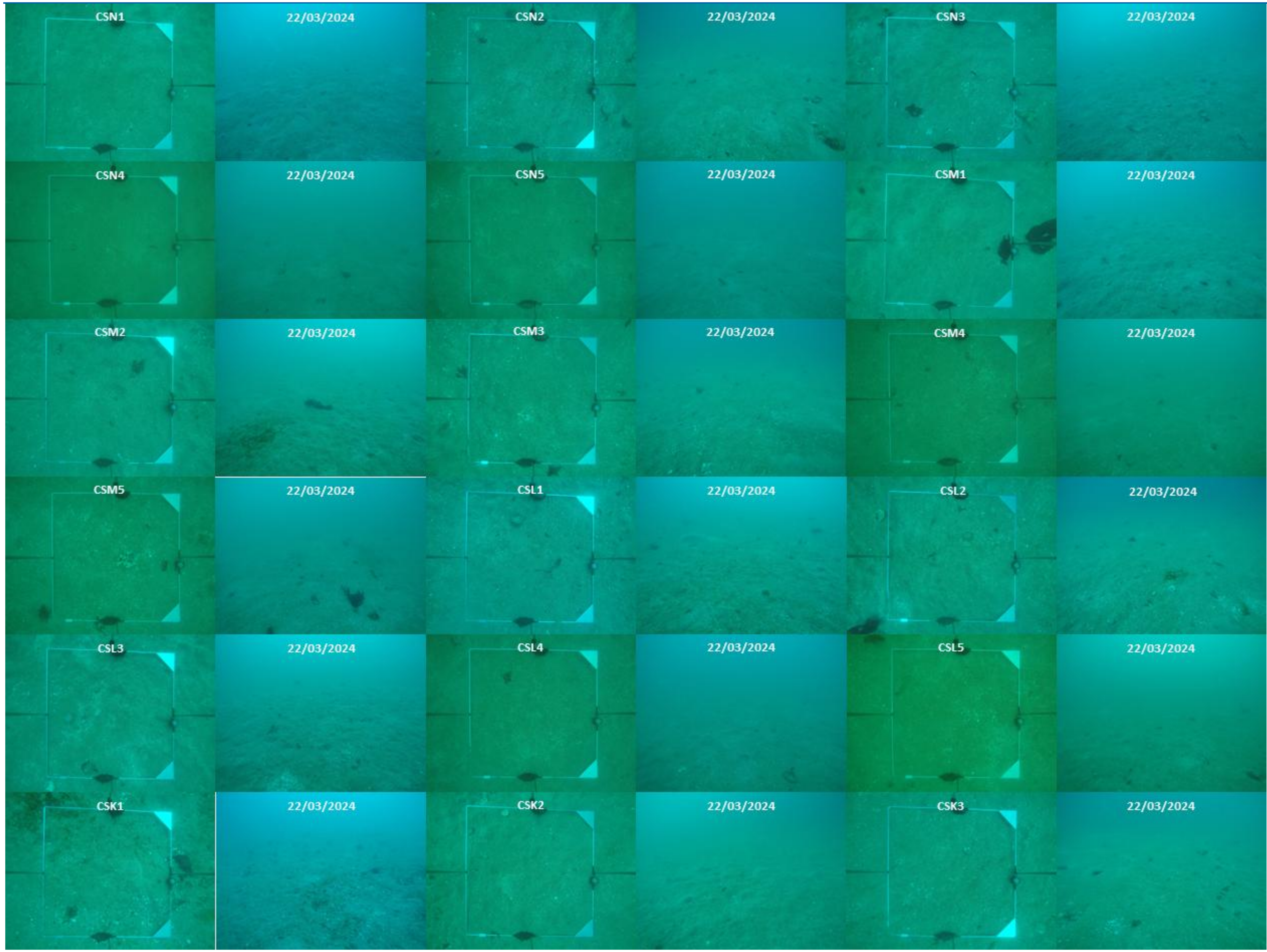


Figure C.8 Drop Camera images from the Northern Control Area Cells, 2024.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CSL3
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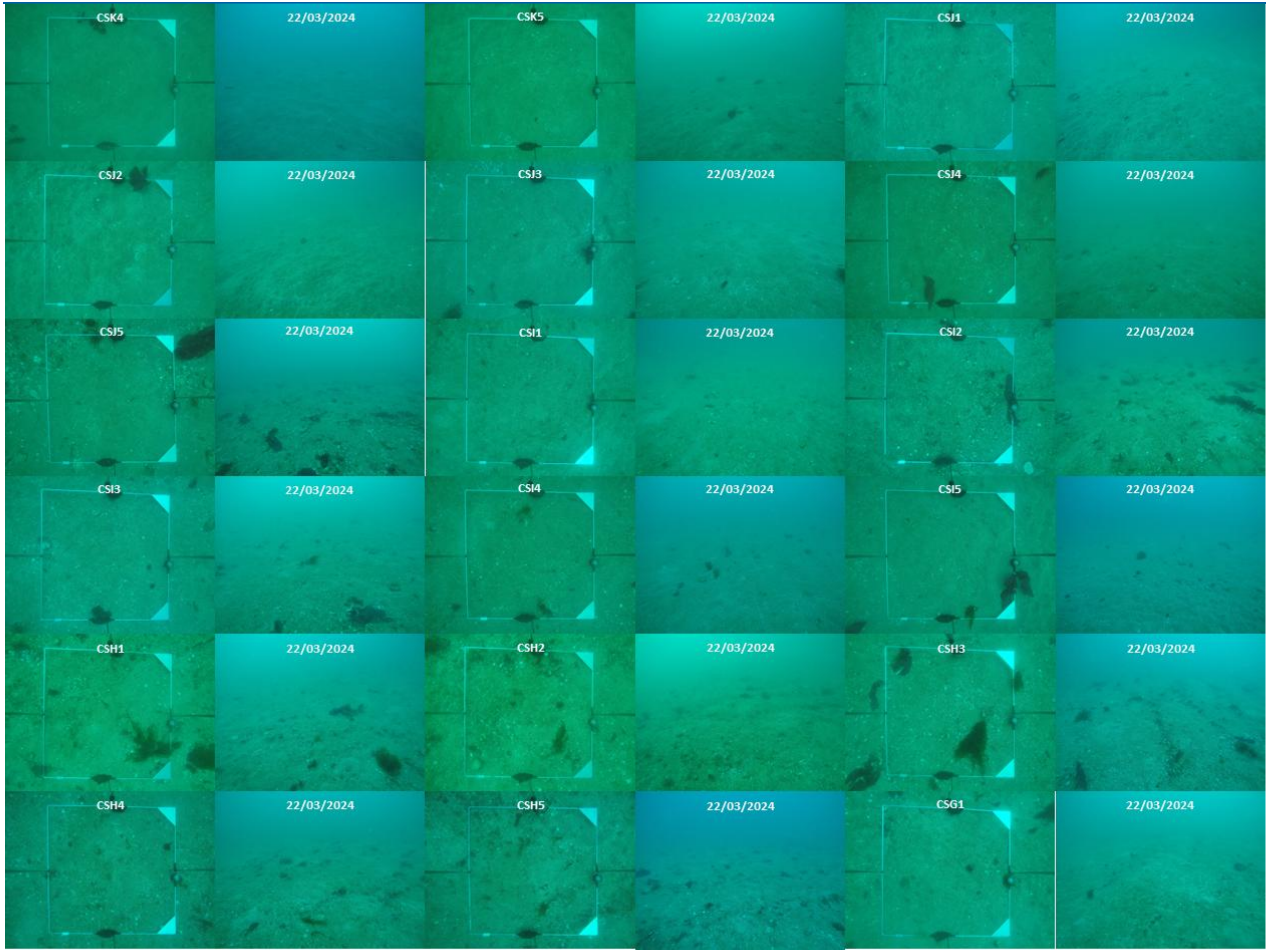
CSK2
22/03/2024
CSK3
22/03/2024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CSJ4
22/03/2024
CSJ5
22/03/2024
CSI1
22/03/2024
CSI2
22/03/2024
CSI3
22/03/2024
CSI4
22/03/2024
CSI5
22/03/2024
CSH1
22/03/2024
CSH2
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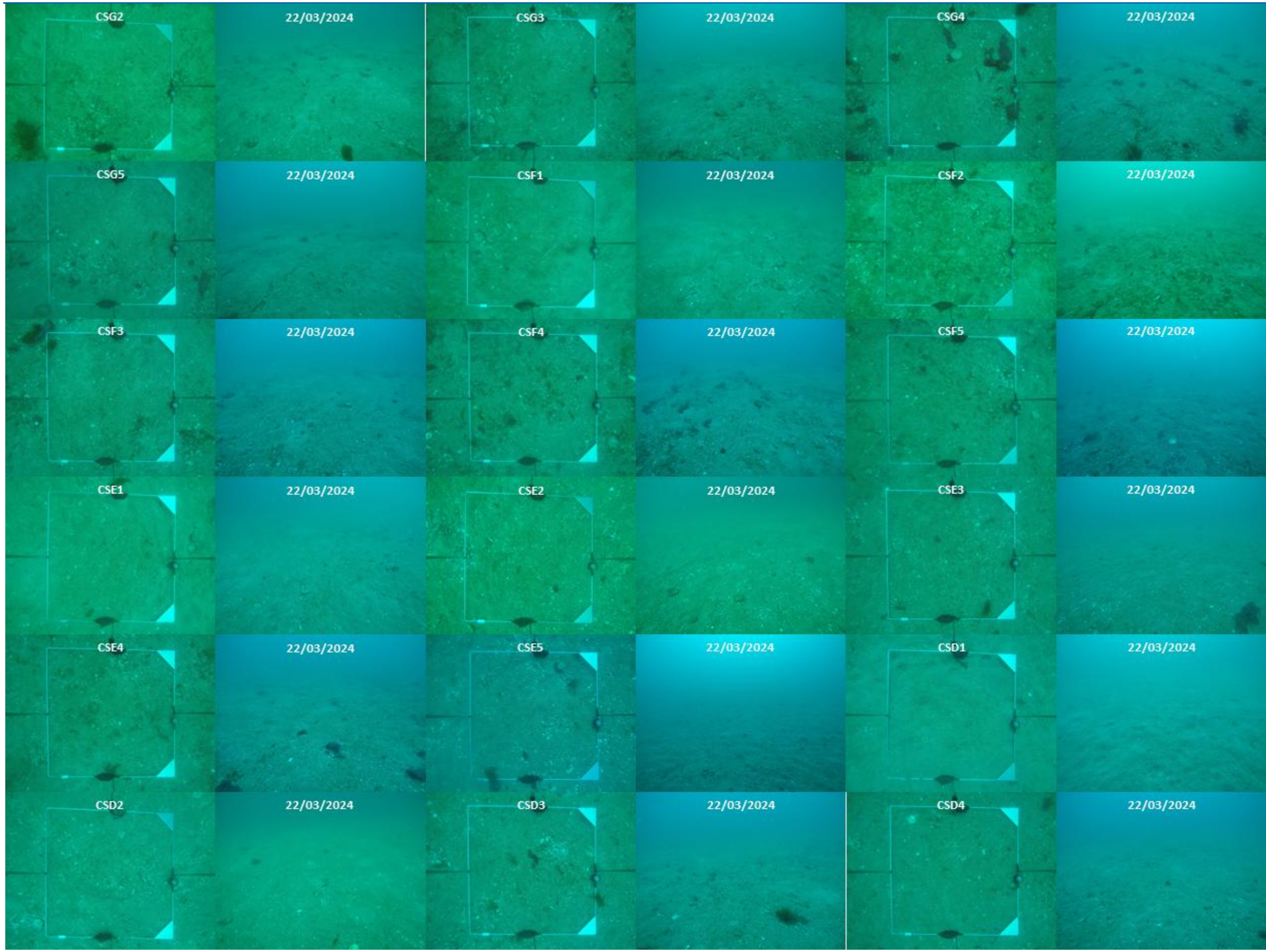
CSG1
22/03/2024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CSF2
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CSF3
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CSF4
22/03/2024
CSF5
22/03/2024
CSE1
22/03/2024
CSE2
22/03/2024
CSE3
22/03/2024
CSE4
22/03/2024
CSE5
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CSD4
22/03/2024

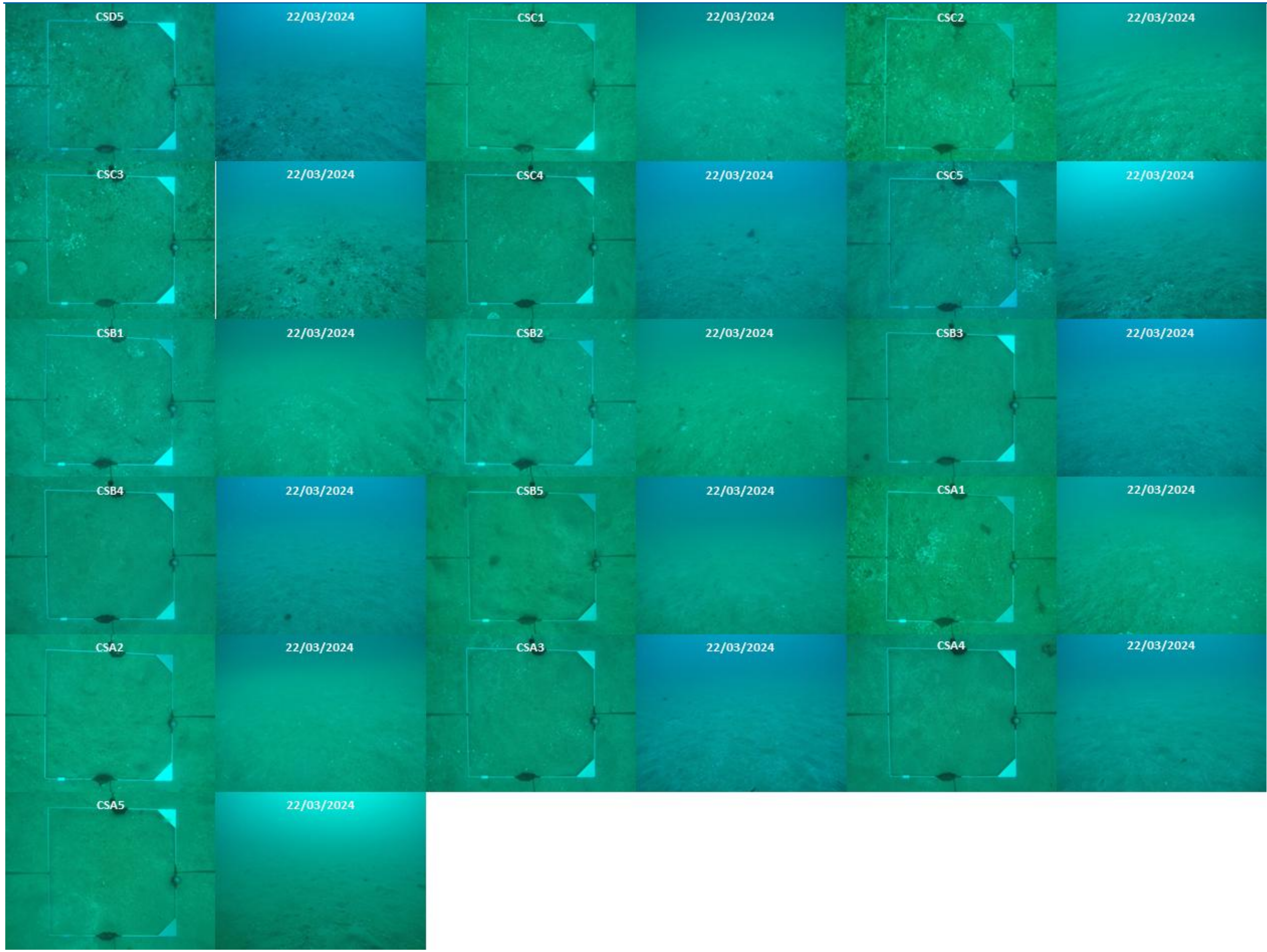
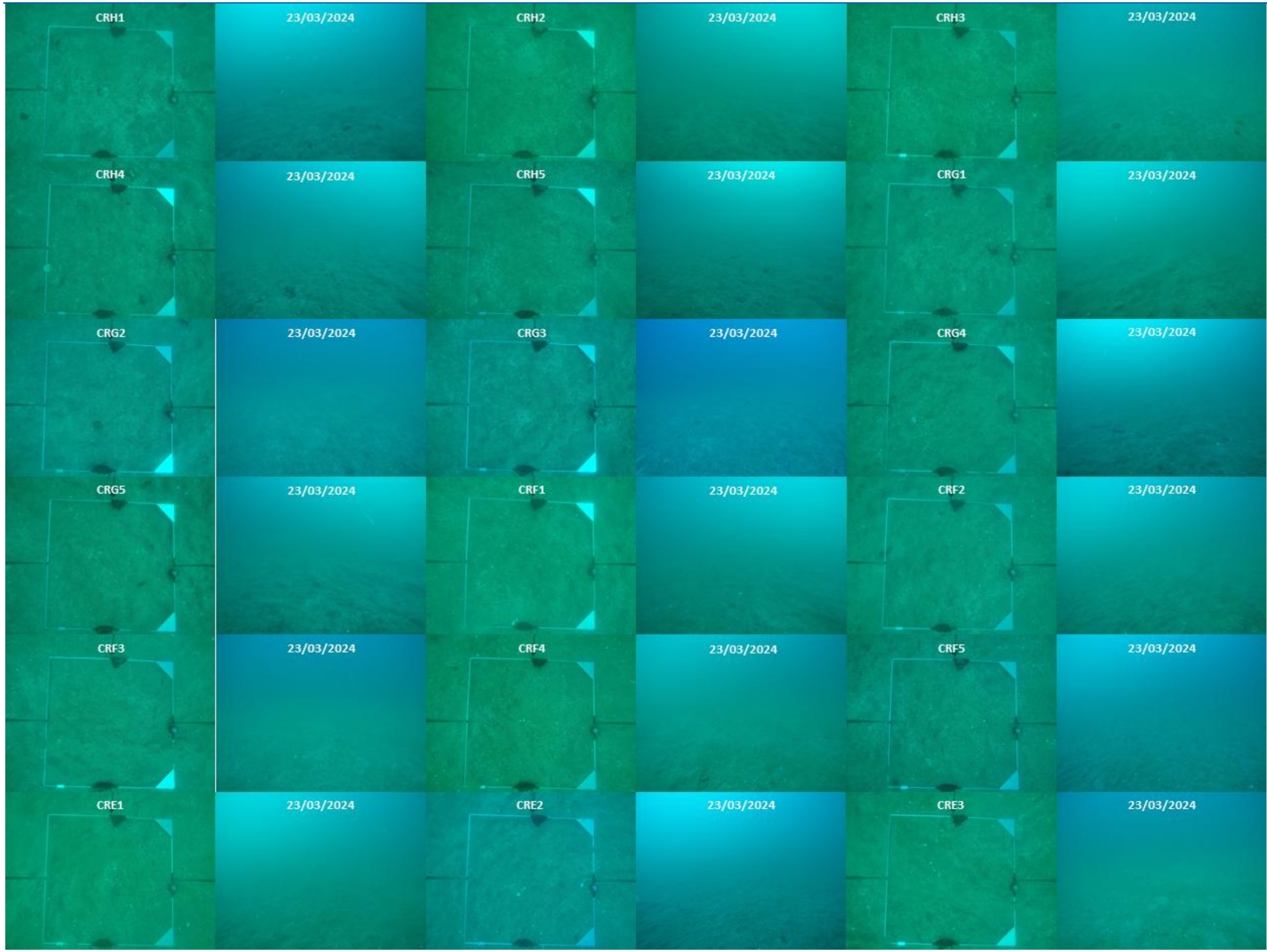


Figure C.9 Drop Camera images from Southern Control Area cells, 2024.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CRH2
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CRH3
23/03/2024
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23/03/2024
CRH5
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CRG1
23/03/2024
CRG2
23/03/2024
CRG3
23/03/2024
CRG4
23/03/2024
CRG5
23/03/2024
CRF1
23/03/2024
CRF2
23/03/2024
CRF3
23/03/2024
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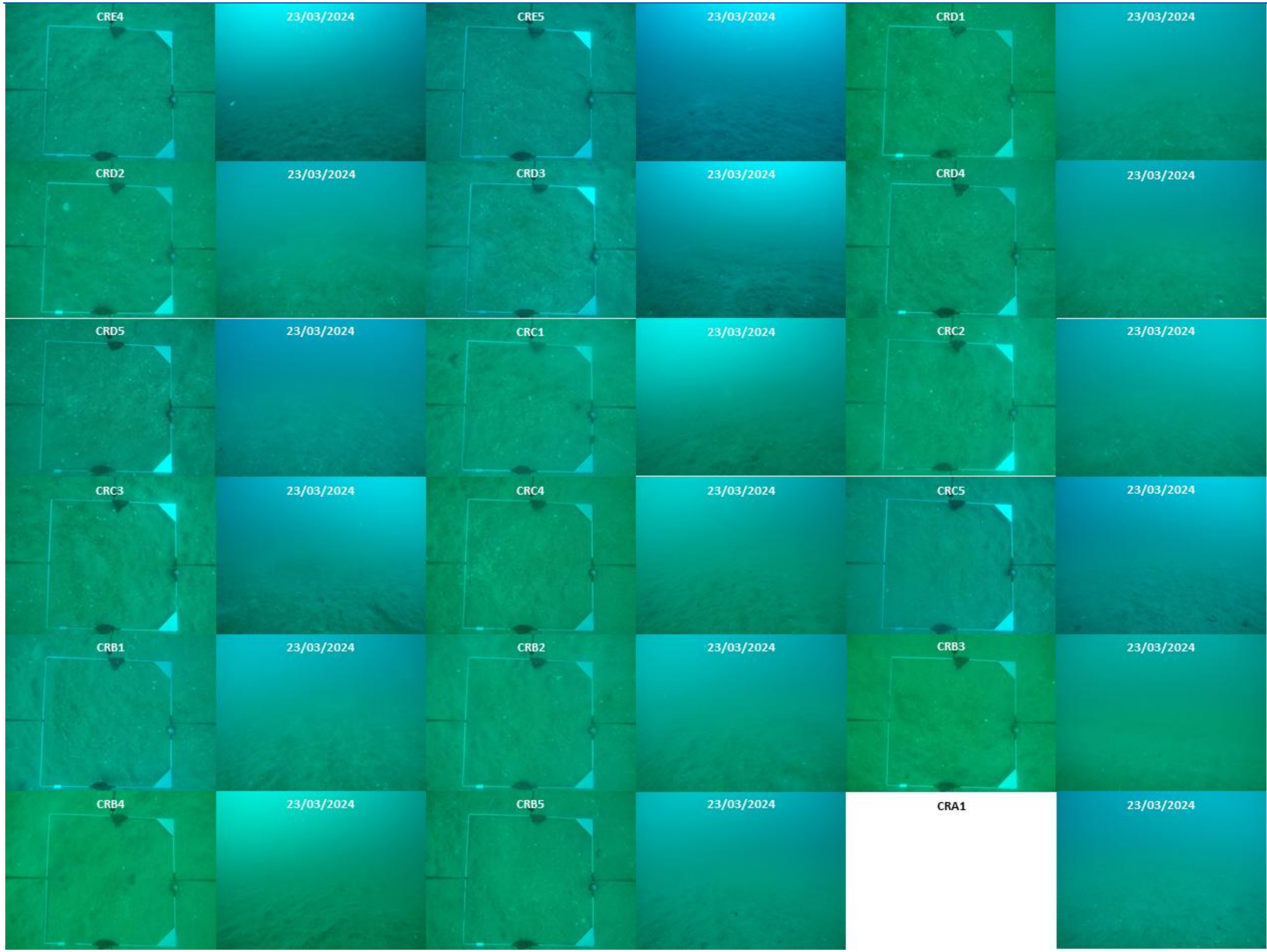
CRE3
23/03/2024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CRD5
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CRC1
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CRC2
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CRA1
23/03/2024

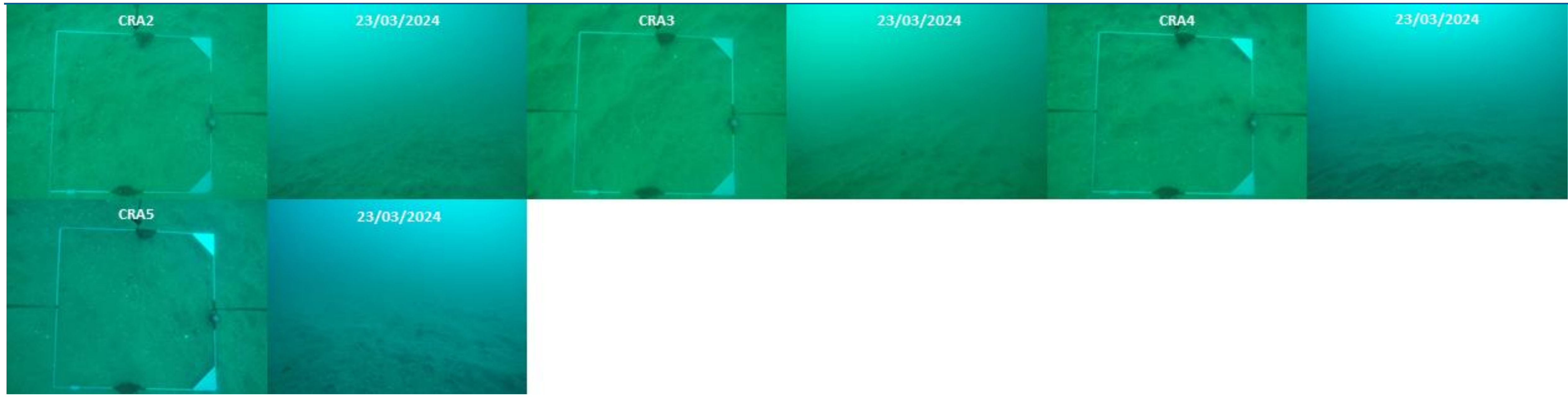

Figure C.10Drop Camera images from Remote Control Area cells, 2024.

Table C.1 Seabed photography summary descriptions from the Sand Extraction Area, March 2024. (grey indicates not sampled, or missing photo)

Sample site	Date	Topography	Shell		Rocks	Biota
			Density	Comments		
2K1	21-Mar-24	Medium regular ripples	High	Shell lag in troughs		
2K2	21-Mar-24	Flat	Medium	Small shells		
2K3	21-Mar-24	Small irregular ripples	Low			Burrows
2J1	21-Mar-24	Medium regular ripples	High			Jellyfish, bivalve
2J2	21-Mar-24	Small irregular ripples	Medium			Burrows
2J3	21-Mar-24	Flat	Low			Burrows
2I1	21-Mar-24	Small regular ripples	High			
2I2	21-Mar-24	Flat	Medium			Burrows
2I3	21-Mar-24	Small regular ripples	Low			Burrows
2H1	21-Mar-24	Flat	Low			Gastropods, hermit crab,
2H2	21-Mar-24	Flat	Low			
2H3	21-Mar-24	Flat	Low			Burrows
2G1	21-Mar-24	Small irregular ripples	Low			Hermit crab, burrow
2G2	21-Mar-24	Small irregular ripples	Low			
2G3	21-Mar-24	Small irregular ripples	Low			Burrows
2F1	21-Mar-24	Small irregular ripples	Low			Burrows
2F2	21-Mar-24	Small irregular ripples	Low			Burrows
2F3	21-Mar-24	Small irregular ripples	Low			Burrows
2E1	21-Mar-24	Medium/Large irregular ripples	High	Shell lag in troughs		
2E2	21-Mar-24	Flat	Low			
2E3	21-Mar-24	Large regular ripples	High	Shell lag in troughs		
2D1	21-Mar-24	Small irregular ripples	Medium			
2D2	21-Mar-24	Small irregular ripples	Low			
2D3	21-Mar-24	Medium large ripples	High	Shell lag in troughs		
2C1	21-Mar-24	Flat	High			
2C2	21-Mar-24	Small irregular ripples	Low			Burrows
2C3	21-Mar-24	Small irregular ripples	High			Finger sponge?
2B1	21-Mar-24	Small irregular ripples	Medium			Burrows, large ostrich foot
2B2	21-Mar-24	Flat	High			Scallop
2B3	21-Mar-24	Small irregular ripples	High			
2A1	21-Mar-24	Small irregular ripples	Low			Burrows
2A2	21-Mar-24	Small irregular ripples	High			
2A3	21-Mar-24	Flat	High			Bivalves
3K1	21-Mar-24	Small irregular ripples	High			
3K2	21-Mar-24	Flat	Medium			
3K3	21-Mar-24	Small irregular ripples	Low			
3J1	21-Mar-24	Flat	Low			
3J2	21-Mar-24	Small irregular ripples	Low			
3J3	21-Mar-24	Flat	Low			
3I1	21-Mar-24	Flat	Medium			Burrows
3I2	21-Mar-24	Small irregular ripples	Low			
3I3	21-Mar-24	Flat	High			
3H1	21-Mar-24	Small irregular ripples	Low			Burrows
3H2	21-Mar-24	Flat	High	High density of shell debris, big shell debris		Scallops
3H3	21-Mar-24	Small irregular ripples	High			
3G1	21-Mar-24	Small irregular ripples	Low			Burrows
3G2	21-Mar-24	Small irregular ripples	Low			
3G3	21-Mar-24	Small irregular ripples	Low			
3F1	21-Mar-24	Small irregular ripples	Medium			Burrows
3F2	21-Mar-24	Small irregular ripples	Low			Burrows
3F3	21-Mar-24	Small irregular ripples	Low			Burrows
3E1	21-Mar-24	Medium irregular ripples	High	Shell lag in troughs		
3E2	21-Mar-24	Small irregular ripples	Low			Burrows
3E3	21-Mar-24	Small irregular ripples	High	High density of shell debris, big shell debris		
3D1	21-Mar-24	Small irregular ripples	High	High density of shell debris, big shell debris		
3D2	21-Mar-24	Medium irregular ripples	High	High density of shell debris, small and big shell debris		
3D3	21-Mar-24	Small irregular ripples	High	Mainly fine shells		Burrows
3C1	21-Mar-24	Small irregular ripples	Medium	Mainly fine shells		Burrows
3C2	21-Mar-24	Small regular ripples	High	High density of shell debris, small and big shell debris		
3C3	21-Mar-24	Small irregular ripples	High	High density of shell debris, small debris		
3B1	21-Mar-24	Small irregular ripples	Low			
3B2	21-Mar-24	Flat	High	High density of shell debris, small debris		
3B3	21-Mar-24	Small irregular ripples	Medium			Burrows
3A1	21-Mar-24	Small irregular ripples	Medium			Gastropods
3A2	21-Mar-24	Small irregular ripples	Low			Gastropods
3A3	21-Mar-24	Small irregular ripples	Medium			
4K1	6-Mar-24	Small irregular ripples	Medium			Burrows
4K2	6-Mar-24	Small irregular ripples	Low			Burrows
4K3	6-Mar-24	Small irregular ripples	Medium			
4J1	6-Mar-24	Large irregular ripples	Medium			Finger sponge
4J2	6-Mar-24	Small irregular ripples	Low			Burrows
4J3	6-Mar-24	Small irregular ripples	Low			Burrows
4I1	6-Mar-24	Small irregular ripples	Low			Burrows

Sample site	Date	Topography	Shell		Rocks	Biota
			Density	Comments		
4I2	6-Mar-24	Small irregular ripples	Low			Burrows
4I3	6-Mar-24	Medium irregular ripples	High	Shell lag I troughs. White bands are well marked and wide		
4H1	21-Mar-24	Small irregular ripples	Low			Burrows
4H2	21-Mar-24	Medium irregular ripples	High			
4H3	21-Mar-24	Small regular ripples	High			
4G1	21-Mar-24	Small/Medium irregular ripples	High	High density of shell debris, small debris		
4G2	21-Mar-24	Small irregular ripples	High	High density of shell debris, small debris		
4G3	21-Mar-24	Small irregular ripples	Low	Mainly sand		Burrows
4F1	21-Mar-24	Small irregular ripples	High	High density of shell debris, small debris		Burrows
4F2	21-Mar-24	Flat	Medium			Burrows
4F3	21-Mar-24	Small regular ripples	High	High density of shell debris, medium debris		
4E1	21-Mar-24	Small irregular ripples	Medium	Mainly sand		Burrows
4E2	21-Mar-24	Small irregular ripples	High	High density of shell debris, small debris		
4E3	21-Mar-24	Flat	High	High density of shell debris, small debris		
4D1	21-Mar-24	Small irregular ripples	Medium			Burrows
4D2	21-Mar-24	Small irregular ripples	High	High density of shell debris, small debris		Sponge
4D3	21-Mar-24	Small irregular ripples	High	High density of shell debris, small debris		
4C1	21-Mar-24	Small irregular ripples	Low			Burrows
4C2	21-Mar-24	Small irregular ripples	High	High density of shell debris, small debris		Jack mackerel (*Trachurus* sp.), hermit crab
4C3	21-Mar-24	Small irregular ripples	High	High density of shell debris, small debris		Hermit crab, burrows
4B1	21-Mar-24	Small irregular ripples	Medium			
4B2	21-Mar-24	Small irregular ripples	Low			
4B3	21-Mar-24	Small irregular ripples	High	High density of shell debris, small debris		
4A1	21-Mar-24	Flat/Small irregular ripples	Low	Mainly sand		Burrows
4A2	21-Mar-24	Flat/Small irregular ripples	Medium	Mainly sand		Burrows
4A3	21-Mar-24	Flat	High	High density of shell debris, patchy distribution, small debris		
5K1	6-Mar-24	Small irregular ripples	Low			Burrows
5K2	6-Mar-24	Irregular bottom	Low			Burrows
5K3	6-Mar-24	Irregular bottom	Low			Burrows
5J1	6-Mar-24	Large regular ripples	High	Shell lag I troughs. High density of shell debris, large debris		
5J2	6-Mar-24	Flat?	High	Shell lag I troughs. High density of shell debris, large debris		
5J3	6-Mar-24	Small irregular ripples	High	Shell lag I troughs. High density of shell debris, large debris		
5I1	6-Mar-24	Large regular ripples	High	Shell lag I troughs. High density of shell debris, large debris		Finger sponge, snail?
5I2	6-Mar-24	Small irregular ripples	Low			Finger sponge, burrows
5I3	6-Mar-24	Medium regular ripples	High	Shell lag I troughs. High density of shell debris		
5H1	21-Mar-24	Medium regular ripples	High	Shell lag I troughs. High density of shell debris		
5H2	21-Mar-24	Large regular ripples	High	Shell lag I troughs. High density of shell debris		
5H3	21-Mar-24	Medium regular ripples	High	Shell lag I troughs. High density of shell debris, varying size of debris		
5G1	21-Mar-24	Medium regular ripples	High	High density of shell debris, varying size of debris		
5G2	21-Mar-24	Irregular bottom	Low			Burrows
5G3	21-Mar-24	Small irregular ripples	High	High density of shell debris, small debris		
5F1	21-Mar-24	Flat	High	High density of shell debris		
5F2	21-Mar-24	Irregular bottom	Low	Mainly sand		Burrows
5F3	21-Mar-24	Irregular bottom	High	High density of shell debris, small debris		Burrows
5E1	21-Mar-24	Flat	High	High density of shell debris, varying size of debris		
5E2	21-Mar-24	Flat	Low	Mainly sand		Burrows
5E3	21-Mar-24	Flat	Low	Mainly sand		Burrows
5D1	21-Mar-24	Small irregular ripples	High			
5D2	21-Mar-24	Flat	Medium			Burrows
5D3	21-Mar-24	Flat	Low	Mainly sand		Hermit crab
5C1	21-Mar-24	Small irregular ripples	Low	Mainly sand		
5C2	21-Mar-24	Flat	Low	Mainly sand		Burrow
5C3	21-Mar-24	Small irregular ripples	Medium			
5B1	21-Mar-24	Small irregular ripples	Low			Burrows
5B2	21-Mar-24	Flat	High	High density of shell debris, varying size of debris		
5B3	21-Mar-24	Small irregular ripples	Low			Burrows
5A1	21-Mar-24	Small irregular ripples	Medium			
5A2	21-Mar-24	Small irregular ripples	Medium			
5A3	21-Mar-24	Small irregular ripples	Low			
6K1	7-Mar-24	Small irregular ripples	Medium			

Sample site	Date	Topography	Shell		Rocks	Biota
			Density	Comments		
6K2	7-Mar-24	Small irregular ripples	Low			
6K3	7-Mar-24	Small irregular ripples	Low			Burrow
6J1	7-Mar-24	Small irregular ripples	Low			Hermit crab?
6J2	7-Mar-24	Small irregular ripples	Low	Mainly sand		Burrow
6J3	7-Mar-24	Large irregular ripples	High	High density of shell debris, varying size of debris		
6I1	7-Mar-24	Small irregular ripples	Low	Mainly sand		hermit crab
6I2	7-Mar-24	Large irregular ripples	Low			Burrows,
6I3	7-Mar-24	Flat	Low			Burrows
6H1	21-Mar-24	Flat	Low	Mainly sand		Burrows
6H2	20-Mar-24	Small regular ripples	High			
6H3	21-Mar-24	Small irregular ripples	Low	Mainly sand		Burrows
6G1	21-Mar-24	Flat	High			
6G2	20-Mar-24	Flat	High	High density of shell debris, varying size of debris		Finger sponge
6G3	20-Mar-24	Medium regular ripples	High	Shell lag I troughs. High density of shell debris, large debris		Finger sponge
6F1	21-Mar-24	Small irregular ripples	High	High density of shell debris, varying size of debris		
6F2	20-Mar-24	Small irregular ripples	High	High density of shell debris, varying size of debris		
6F3	20-Mar-24	Small irregular ripples	High	High density of shell debris, varying size of debris		
6E1	21-Mar-24	Small irregular ripples	Medium			Burrows
6E2	21-Mar-24	Small irregular ripples	High	Small shell debris		
6E3	20-Mar-24	Small irregular ripples	High	Small shell debris		
6D1	21-Mar-24	Small irregular ripples	Low	Mainly sand		
6D2	21-Mar-24	Small irregular ripples	Low	Mainly sand		Finger sponge
6D3	20-Mar-24	Small irregular ripples	Low	Mainly sand		
6C1	21-Mar-24	Small irregular ripples	Low	Mainly sand		
6C2	21-Mar-24	Small irregular ripples	Low	Mainly sand		Gastropods, burrow
6C3	20-Mar-24	Small irregular ripples	Low	Mainly sand		Southern sand star (*Luidia australiae*)
6B1	21-Mar-24	Small irregular ripples	Low	Mainly sand		
6B2	21-Mar-24	Small irregular ripples	Low	Mainly sand		
6B3	20-Mar-24	Small irregular ripples	Low	Mainly sand		Hermit crab
6A1	21-Mar-24	Small irregular ripples	Low	Mainly sand		
6A2	21-Mar-24	Small irregular ripples	Medium	Patches of shell debris		
6A3	20-Mar-24	Small irregular ripples	Low	Mainly sand		Burrows
7K1	7-Mar-24		Medium			
7K2	7-Mar-24	Small irregular ripples	Low	Mainly sand		Burrows
7K3	20-Mar-24	Small irregular ripples	Low	Mainly sand		Snail?* Brown olive shell
7J1	7-Mar-24	Small irregular ripples	Low	Mainly sand		Snail (*Pelicaria vermis*)?, hermit crab, burrows
7J2	7-Mar-24	Small irregular ripples	Low			Burrows
7J3	20-Mar-24	Small irregular ripples	High	High density of shell debris, varying size of debris		
7I1	7-Mar-24	Small irregular ripples	Low	Mainly sand		Burrows
7I2	7-Mar-24	Small irregular ripples	Low	Mainly sand		Snail (*Pelicaria vermis*)?, burrows
7I3	20-Mar-24	Medium irregular ripples	High	High density of small shell debris		
7H1	20-Mar-24	Small irregular ripples	Low	Mainly sand with some patches of shell debris		Burrows
7H2	20-Mar-24	Small irregular ripples	Low	Mainly sand		Burrows
7H3	20-Mar-24	Small regular ripples	High	High density of small shell debris		
7G1	20-Mar-24	Medium regular ripples	High	Shell lag I troughs. High density of shell debris, large debris		
7G2	20-Mar-24	Small irregular ripples	High	Mainly sand		
7G3	20-Mar-24	Small irregular ripples	High	High density of shell debris, varying size of debris		Xenophora
7F1	20-Mar-24	Small irregular ripples	Medium	Small shell debris		Burrows
7F2	20-Mar-24	Small irregular ripples	Medium	Small shell debris		
7F3	20-Mar-24	Small irregular ripples	High	High density of shell debris, varying size of debris		
7E1	20-Mar-24	Small irregular ripples	High	High density of shell debris, varying size of debris		
7E2	20-Mar-24	Small irregular ripples	Low	Mainly sand		Burrows
7E3	20-Mar-24	Small irregular ripples	Medium	Small shell debris		Hermit crab
7D1	20-Mar-24	Small irregular ripples	High	High density of shell debris, varying size of debris		
7D2	20-Mar-24	Small irregular ripples	Medium	Small shell debris		
7D3	20-Mar-24	Small irregular ripples	Medium	Small shell debris		
7C1	20-Mar-24	Small irregular ripples	Medium	Small shell debris		
7C2	20-Mar-24	Small irregular ripples	Medium	Small shell debris		
7C3	20-Mar-24	Small irregular ripples	Medium	Small shell debris		
7B1	20-Mar-24	Small irregular ripples	Medium	Small shell debris		Hermit crab
7B2	20-Mar-24	Small irregular ripples	Low	Mainly sand		small ostrich foot shell?, hermit crab
7B3	20-Mar-24	Small irregular ripples	Low	Mainly sand		Brown olive shell
7A1	20-Mar-24	Small irregular ripples	Medium	Small shell debris		
7A2	20-Mar-24	Small irregular ripples	Medium	Small shell debris		Hermit crab
7A3	20-Mar-24	Small irregular ripples	Medium	Small shell debris		Brown olive shell
8K1	21-Mar-24	Small irregular ripples	High	High density of shell debris, varying size of debris		
8K2	21-Mar-24	Small irregular ripples	Low	Mainly sand		Burrows, small ostrich foot shell, hermit crab
8K3	21-Mar-24	Small irregular ripples	Low	Mainly sand		

Sample site	Date	Topography	Shell Density	Shell Comments	Rocks	Biota
8J1	21-Mar-24	Large regular ripples	High	High density of shell debris, varying size of debris		
8J2	21-Mar-24	Small irregular ripples	Low	Mainly sand		Hermit crab, burrows
8J3	21-Mar-24	Small irregular ripples	Low	Mainly sand		Burrows
8I1	21-Mar-24	Small irregular ripples	High			Scallop, hermit crab
8I2	21-Mar-24	Small irregular ripples	Low	Mainly sand		Hermit crab, Brown olive shell, burrows
8I3	21-Mar-24	Small irregular ripples	Low	Mainly sand		Snail?
8H1	20-Mar-24	Small irregular ripples	High			Scallop?
8H2	20-Mar-24	Small irregular ripples	Medium	Patchy distribution of shell debris		Burrows
8H3	20-Mar-24	Small irregular ripples	Low	Mainly sand		Hermit crab
8G1	20-Mar-24	Flat/Small irregular ripples	Medium			Scallop?
8G2	20-Mar-24	Small irregular ripples	High	Small shell debris		Snapper (*Pagrus auratus*)
8G3	20-Mar-24	Small irregular ripples	Medium			Burrows, hermit crab
8F1	20-Mar-24	Small irregular ripples	Medium			
8F2	20-Mar-24	Small irregular ripples	High	High density of shell debris, varying size of debris		
8F3	20-Mar-24	Small irregular ripples	Low	Mainly sand		Burrows
8E1	20-Mar-24	Flat/Small irregular ripples	High	Small shell debris		Burrows
8E2	20-Mar-24	Flat/Small irregular ripples	Low			Gastropoda*
8E3	20-Mar-24	Small irregular ripples	Medium			Burrows, hermit crabs, starfish (*Astropecten polyacanthus*)?
8D1	20-Mar-24	Small irregular ripples	High	High density of shell debris, varying size of debris		
8D2	20-Mar-24	Small irregular ripples	Low			Burrows, hermit crab
8D3	20-Mar-24	Small irregular ripples	Low			Burrows
8C1	20-Mar-24	Small irregular ripples	High	Small shell debris		Hermit crab, burrows
8C2	20-Mar-24	Small irregular ripples	High	Small shell debris		
8C3	20-Mar-24	Small irregular ripples	Low			Burrows
8B1	20-Mar-24	Small irregular ripples	High			
8B2	20-Mar-24	Small irregular ripples	Low			Burrows
8B3	20-Mar-24	Small irregular ripples	Low			Burrows
8A1	20-Mar-24	Small irregular ripples	High	High density of shell debris, varying size of debris		
8A2	20-Mar-24	Small irregular ripples	High	High density of shell debris, varying size of debris		
8A3	20-Mar-24	Small irregular ripples	Low	Mainly sand		Hermit crab

Table C.2 Seabed photography summary descriptions from the Control Areas, March 2024. (grey indicates not sampled, or missing photo)

Sample site	Date	Topography	Shell Density	Shell Comments	Rocks	Biota
CNK1 / 1K1	22-Mar-24	Flat	Low			
CNK2 / 1K2	22-Mar-24	Flat	Low			Hermit crab?
CNK3 / 1K3	22-Mar-24	Small irregular ripples	Low			
CNJ1 / 1J1	22-Mar-24	Small irregular ripples	Low			Burrows
CNJ2 / 1J2	22-Mar-24	Medium irregular ripples	High	Shell lag in troughs		
CNJ3 / 1J3	22-Mar-24	Flat	Low			
CNI1 / 1I1	22-Mar-24	Small regular ripples	Low			Hermit crab, gastropod
CNI2 / 1I2	22-Mar-24	Small irregular ripples	Low			Hermit crab
CNI3 / 1I3	22-Mar-24	Medium regular ripples	High			Hermit crab, burrows
CNH1 / 1H1	22-Mar-24	Small regular ripples	Low		Small	
CNH2 / 1H2	22-Mar-24	Flat	High			Horse mussel
CNH3 / 1H3	22-Mar-24	Flat	Low			Hermit crab, gastropod, burrows, brown olive shell?, burrow
CNG1 / 1G1	22-Mar-24	Small irregular ripples	High			Hermit crab
CNG2 / 1G2	22-Mar-24	Small regular ripples	Medium	Patchy concentrations of shells		Hermit crab, burrows
CNG3 / 1G3	22-Mar-24	Small irregular ripples	Medium	Patchy concentrations of shells		Hermit crab
CNF1 / 1F1	22-Mar-24	Small irregular ripples	Low			Hermit crab, sea cucumber?*, burrows
CNF2 / 1F2	22-Mar-24	Small irregular ripples	High	Patchy concentrations of small/medium shells	Small	Gastropod
CNF3 / 1F3	22-Mar-24	Small irregular ripples	Low			Hermit crabs b2, burrows
CNE1 / 1E1	22-Mar-24	Flat	Low			Gastropod, burrows
CNE2 / 1E2	22-Mar-24	Small irregular ripples	Low	Patchy concentrations of small shells		Burrows, large ostrich foot, gastropod
CNE3 / 1E3	22-Mar-24	Small irregular ripples	Low	Patchy concentrations of small shells		Burrows
CND1 / 1D1	22-Mar-24	Small irregular ripples	Low			Burrows, gastropods Large Ostrich Foot, hermit crab b2
CND2 / 1D2	22-Mar-24	Small irregular ripples	Low			Burrows
CND3 / 1D3	22-Mar-24	Large regular ripples	High	Shell lag in troughs		Starfish - *Astropecten polyacanthus*
CNC1 / 1C1	22-Mar-24	Flat	Low			Burrows
CNC2 / 1C2	22-Mar-24	Small irregular ripples	Low			Sponge, bivalves, burrows
CNC3 / 1C3	22-Mar-24	Large regular ripples	High	Shell lag in troughs		Bivalves
CNB1 / 1B1	22-Mar-24	Flat	Low			Hermit crab, burrow
CNB2 / 1B2	22-Mar-24	Small irregular ripples	Low			Burrow, gastropod
CNB3 / 1B3	22-Mar-24	Small irregular ripples	Low			
CNA1 / 1A1	22-Mar-24	Small irregular ripples	Low			Burrows
CNA2 / 1A2	22-Mar-24	Small irregular ripples	High	Small shells		
CNA3 / 1A3	22-Mar-24	Small irregular ripples	Low			Sponge, burrows
CSN1	22-Mar-24	Small irregular ripples	Medium	Small shell debris		
CSN2	22-Mar-24	Flat/Small irregular ripples	High	Small shell debris		

Sample site	Date	Topography	Shell		Rocks	Biota
			Density	Comments		
CSN3	22-Mar-24	Flat/Small irregular ripples	High	Small shell debris		Finger sponge?
CSN4	22-Mar-24	Flat/Small irregular ripples	High	Small shell debris in patches		
CSN5	22-Mar-24	Flat/Small irregular ripples	High	Small shell debris		Burrows
CSM1	22-Mar-24	Small irregular ripples	Medium	Small shell debris		Scallop?
CSM2	22-Mar-24	Flat/Small irregular ripples	High	Small shell debris		
CSM3	22-Mar-24	Flat/Small irregular ripples	High	Small shell debris		Scallop?, burrows
CSM4	22-Mar-24	Small irregular ripples	Medium	Small shell debris		Scallop?
CSM5	22-Mar-24	Flat/Small irregular ripples	High	Small shell debris		Sponge
CSL1	22-Mar-24	Flat/Small irregular ripples	High	Small shell debris		
CSL2	22-Mar-24	Flat/Small irregular ripples	High	Small shell debris		Scallop
CSL3	22-Mar-24	Flat/Small irregular ripples	High	Small shell debris		
CSL4	22-Mar-24	Flat/Small irregular ripples	High	Small shell debris		
CSL5	22-Mar-24	Flat/Small irregular ripples	High	Small shell debris		
CSK1	22-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, small size of debris	Rock	
CSK2	22-Mar-24	Flat/Small irregular ripples	High	Small shell debris		
CSK3	22-Mar-24	Flat/Small irregular ripples	High	Small shell debris		
CSK4	22-Mar-24	Small irregular ripples	High	Small shell debris		
CSK5	22-Mar-24	Small irregular ripples	High	Small shell debris		
CSJ1	22-Mar-24	Flat/Small irregular ripples	High	Small shell debris		
CSJ2	22-Mar-24	Flat/Small irregular ripples	High	Small shell debris		Burrow
CSJ3	22-Mar-24	Flat/Small irregular ripples	High	Small shell debris, patchy distribution		Burrow
CSJ4	22-Mar-24	Flat/Small irregular ripples	High	Small shell debris		
CSJ5	22-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, varying size of debris		
CSI1	22-Mar-24	Flat/Small irregular ripples	High	Small shell debris		
CSI2	22-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, varying size of debris		Scallop
CSI3	22-Mar-24	Flat/Small irregular ripples	High	Small shell debris		
CSI4	22-Mar-24	Flat/Small irregular ripples	High	Small shell debris		Scallop
CSI5	22-Mar-24	Flat/Small irregular ripples	High	Small shell debris		
CSH1	22-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, varying size of debris		
CSH2	22-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, varying size of debris		
CSH3	22-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, varying size of debris.		
CSH4	22-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, varying size of debris.		
CSH5	22-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, varying size of debris.		
CSG1	22-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, varying size of debris.		Burrows
CSG2	22-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, varying size of debris.		
CSG3	22-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, varying size of debris.		
CSG4	22-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, varying size of debris.		
CSG5	22-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, varying size of debris.		Scallop?
CSF1	22-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, varying size of debris.		
CSF2	22-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, varying size of debris.		Burrows
CSF3	22-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, varying size of debris.		
CSF4	22-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, varying size of debris.		
CSF5	22-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, varying size of debris.		Starfish
CSE1	22-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, varying size of debris.		
CSE2	22-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, varying size of debris.		
CSE3	22-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, varying size of debris.		
CSE4	22-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, varying size of debris.		
CSE5	22-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, varying size of debris.		
CSD1	22-Mar-24	Flat/Small irregular ripples	High	Small shell debris		
CSD2	22-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, varying size of debris.		
CSD3	22-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, varying size of debris.		
CSD4	22-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, varying size of debris.		
CSD5	22-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, varying size of debris.		
CSC1	22-Mar-24	Flat/Small irregular ripples	High	Small shell debris		
CSC2	22-Mar-24	Small irregular ripples	High	High density of shell debris, varying size of debris.		
CSC3	22-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, varying size of debris.		

Sample site	Date	Topography	Shell		Rocks	Biota
			Density	Comments		
CSC4	22-Mar-24	Small irregular ripples	High	Small shell debris		
CSC5	22-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, varying size of debris.		
CSB1	22-Mar-24	Small irregular ripples	High	High density of shell debris, varying size of debris.		
CSB2	22-Mar-24	Small irregular ripples	High	Small shell debris		
CSB3	22-Mar-24	Flat/Small irregular ripples	High	Small shell debris		Crab
CSB4	22-Mar-24	Flat/Small irregular ripples	High	Small shell debris		Burrows
CSB5	22-Mar-24	Flat/Small irregular ripples	High	Small shell debris		Burrows
CSA1	22-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, varying size of debris.		
CSA2	22-Mar-24	Flat/Small irregular ripples	Medium	Mainly sand		Burrows
CSA3	22-Mar-24	Flat/Small irregular ripples	Medium	Mainly sand		Burrows, snail (*Pelicaria vermis*)
CSA4	22-Mar-24	Flat/Small irregular ripples	Low	Mainly sand		Hermit crab
CSA5	22-Mar-24	Flat/Small irregular ripples	Medium	Small shell debris		Hermit crab
CRH1	23-Mar-24	Small irregular ripples	High	High density of shell debris, small size of debris		Scallop alive?
CRH2	23-Mar-24	Small irregular ripples	High	High density of shell debris, small size of debris		
CRH3	23-Mar-24	Small irregular ripples	High	High density of shell debris, small size of debris		
CRH4	23-Mar-24	Small irregular ripples	High	High density of shell debris, small size of debris		
CRH5	23-Mar-24	Small irregular ripples	High	High density of shell debris, small size of debris		
CRG1	23-Mar-24	Medium irregular ripples	High	High density of shell debris, small size of debris		
CRG2	23-Mar-24	Small irregular ripples	High	High density of shell debris, small size of debris		Scallop?
CRG3	23-Mar-24	Flat	High	High density of shell debris, small size of debris		
CRG4	23-Mar-24	Small irregular ripples	High	High density of shell debris, small size of debris		
CRG5	23-Mar-24	Small irregular ripples	High	High density of shell debris, small size of debris		
CRF1	23-Mar-24	Small irregular ripples	High	High density of shell debris, small size of debris		
CRF2	23-Mar-24	Small irregular ripples	High	High density of shell debris, small size of debris		
CRF3	23-Mar-24	Small irregular ripples	High	High density of shell debris, small size of debris		
CRF4	23-Mar-24	Small irregular ripples	High	High density of shell debris, small size of debris		
CRF5	23-Mar-24	Small irregular ripples	High	High density of shell debris, small size of debris		
CRE1	23-Mar-24	Small irregular ripples	High	High density of shell debris, small size of debris		
CRE2	23-Mar-24	Small irregular ripples	High	High density of shell debris, small size of debris		
CRE3	23-Mar-24	Small irregular ripples	High	High density of shell debris, small size of debris		Scallop?
CRE4	23-Mar-24	Small irregular ripples	High	High density of shell debris, small size of debris		
CRE5	23-Mar-24	Small irregular ripples	High	High density of shell debris, small size of debris		Burrows
CRD1	23-Mar-24	Small irregular ripples	High	High density of shell debris, small size of debris		
CRD2	23-Mar-24	Small irregular ripples	High	High density of shell debris, small size of debris		
CRD3	23-Mar-24	Small irregular ripples	High	High density of shell debris, small size of debris		Burrows
CRD4	23-Mar-24	Small irregular ripples	High	High density of shell debris, small size of debris		
CRD5	23-Mar-24	Flat/Small irregular ripples	High	High density of shell debris, small size of debris		Scallops alive?
CRC1	23-Mar-24	Small irregular ripples	High	High density of shell debris, small size of debris		
CRC2	23-Mar-24	Flat/Small irregular ripples	Medium	Small shell debris		
CRC3	23-Mar-24	Small irregular ripples	High	High density of shell debris, small size of debris		
CRC4	23-Mar-24	Small irregular ripples	High	High density of shell debris, small size of debris		
CRC5	23-Mar-24	Small irregular ripples	High	High density of shell debris, small size of debris		
CRB1	23-Mar-24	Small irregular ripples	Medium	Small shell debris		
CRB2	23-Mar-24	Small irregular ripples	Medium	Varying size of debris		
CRB3	23-Mar-24	Small irregular ripples	Medium	Small shell debris		
CRB4	23-Mar-24	Small irregular ripples	Low	Mainly sand		
CRB5	23-Mar-24	Small irregular ripples	High	High density of shell debris, small size of debris		
CRA1	23-Mar-24	Small irregular ripples	Low			
CRA2	23-Mar-24	Small irregular ripples	Medium	Small shell debris		
CRA3	23-Mar-24	Small irregular ripples	Medium	Small shell debris		
CRA4	23-Mar-24	Small irregular ripples	Medium	Small shell debris		
CRA5	23-Mar-24	Small irregular ripples	Medium	Small shell debris		Hermit crab

Appendix D Sediment Particle Size Results

Table D.1 Summary Sediment Particle Size Data from the Sand Extraction area (Percentage by Weight)

Area	Site	Date	Size Class (mm)							Classification
			Gravel	Very Coarse Sand	Coarse Sand	Medium Sand	Fine Sand	Very Fine Sand	Silt & Clay	
			>/= 2	< 2, >/= 1	< 1, >/= 0.5	< 0.5, >/= 0.25	< 0.25, >/= 0.125	< 0.125, >/= 0.063	< 0.063	
2 Cells	2K	21-Mar-2024	0.0	0.3	4.3	7.3	38.1	32.0	18.1	zS
	2J	21-Mar-2024	1.7	3.6	5.3	7.8	43.0	32.4	6.2	(g)S
	2I	21-Mar-2024	0.8	2.9	6.3	8.4	44.5	32.2	4.9	(g)S
	2H	21-Mar-2024	0.0	1.1	1.8	4.9	49.0	37.6	5.5	(g)S
	2G	21-Mar-2024	0.0	0.9	2.3	6.1	51.3	35.0	4.3	S
	2F	21-Mar-2024	0.0	0.0	0.0	6.1	52.4	37.1	4.4	S
	2E	21-Mar-2024	4.6	11.7	18.9	12.4	32.0	16.2	4.1	(g)S
	2D	21-Mar-2024	2.3	7.7	17.7	15.6	35.0	19.2	2.6	(g)S
	2C	21-Mar-2024	0.0	3.5	27.8	38.4	23.9	4.3	2.1	S
	2B	21-Mar-2024	0.6	5.2	26.2	32.0	24.1	10.5	1.3	(g)S
	2A	21-Mar-2024	0.0	0.0	5.4	30.7	45.1	17.3	1.5	S
3 Cells	3K	21-Mar-2024	2.1	3.3	4.2	27.7	47.5	12.5	2.7	(g)S
	3J	21-Mar-2024	0.1	1.1	6.3	26.0	44.9	18.9	2.7	(g)S
	3I	21-Mar-2024	0.0	0.0	2.0	22.6	49.9	22.7	2.9	S
	3H	21-Mar-2024	1.1	1.8	3.3	21.9	50.4	19.2	2.4	(g)S
	3G	21-Mar-2024	0.0	0.4	0.9	9.2	51.3	33.6	4.6	S
	3F	21-Mar-2024	0.1	1.3	2.0	11.0	51.9	29.5	4.3	(g)S
	3E	21-Mar-2024	0.0	2.7	11.5	12.6	38.5	29.1	5.6	S
	3D	21-Mar-2024	0.8	3.5	15.5	38.0	33.5	4.9	3.8	(g)S
	3C	21-Mar-2024	2.3	5.5	14.4	25.9	33.4	9.8	8.8	(g)S
	3B	21-Mar-2024	0.0	0.9	3.8	15.5	48.3	27.9	3.5	(g)S
	3A	21-Mar-2024	0.0	3.2	24.1	32.5	29.3	8.9	2.0	S
4 Cells	4K	6-Mar-2024	0.5	1.8	3.1	9.7	49.1	31.1	4.6	(g)S
	4J	6-Mar-2024	0.0	0.5	1.8	6.2	50.2	34.9	6.4	S
	4I	6-Mar-2024	0.0	0.5	0.9	8.6	55.3	30.6	4.1	S
	4H	21-Mar-2024	6.0	13.3	20.4	15.2	25.3	12.5	7.4	gS
	4G	21-Mar-2024	0.1	3.1	14.5	27.2	36.9	13.9	4.4	(g)S
	4F	21-Mar-2024	0.2	1.2	10.3	31.3	43.2	12.3	1.5	(g)S
	4E	21-Mar-2024	0.0	5.0	20.3	21.4	33.9	16.9	2.5	S
	4D	21-Mar-2024	0.9	5.0	15.5	21.7	38.6	16.2	2.1	(g)S
	4C	21-Mar-2024	0.5	1.2	1.9	18.6	55.0	20.9	1.9	(g)S
	4B	21-Mar-2024	0.0	0.1	3.8	21.7	52.3	20.3	1.8	S
	4A	21-Mar-2024	0.2	1.5	4.2	13.3	49.2	29.1	2.5	(g)S
5 Cells	5K	6-Mar-2024	0.0	0.1	1.3	15.5	52.3	25.8	5.0	S
	5J	6-Mar-2024	0.0	2.6	26.1	45.7	18.1	1.9	5.5	(g)S
	5I	6-Mar-2024	1.2	1.6	0.8	21.9	54.2	16.3	3.9	(g)S
	5H	21-Mar-2024	0.7	3.0	6.2	16.1	48.0	22.0	4.1	(g)S
	5G	21-Mar-2024	0.0	2.2	25.6	44.3	21.0	3.8	3.1	S
	5F	21-Mar-2024	0.0	0.0	2.3	21.4	47.5	23.2	5.7	S
	5E	21-Mar-2024	2.2	4.5	6.4	17.4	47.8	19.8	1.9	(g)S
	5D	21-Mar-2024	0.2	2.9	16.9	28.2	36.8	12.8	2.2	(g)S
	5C	21-Mar-2024	0.0	0.9	20.6	37.9	30.2	9.0	1.4	S
	5B	21-Mar-2024	0.0	3.3	33.4	44.4	15.9	2.2	1.0	S
	5A	21-Mar-2024	0.0	3.6	32.9	43.7	16.1	2.2	1.5	(g)S
6 Cells	6K	7-Mar-2024	1.3	2.1	6.5	25.9	43.4	16.3	4.6	(g)S
	6J	7-Mar-2024	0.4	1.6	2.5	14.4	51.0	25.6	4.6	(g)S
	6I	7-Mar-2024	0.0	0.0	1.5	19.0	51.4	23.5	4.6	S
	6H	20-Mar-2024	0.5	2.6	9.2	18.0	42.0	22.5	5.1	(g)S
	6G	20-Mar-2024	2.5	13.3	44.0	28.7	6.8	2.0	2.7	(g)S
	6F	20-Mar-2024	0.0	3.3	35.5	37.0	13.2	3.2	7.8	S
	6E	20-Mar-2024	0.0	0.8	36.8	49.1	11.8	0.6	0.9	S
	6D	20-Mar-2024	0.0	0.0	22.4	53.3	22.7	0.9	0.7	S
	6C	20-Mar-2024	0.0	0.2	31.1	53.5	14.7	0.4	0.1	S
	6B	20-Mar-2024	0.0	0.3	14.9	46.6	33.7	4.2	0.4	S
	6A	20-Mar-2024	0.0	0.5	27.5	50.7	20.5	0.7	0.2	S
7 Cells	7K	7-Mar-2024	0.8	2.2	3.3	13.7	48.8	25.9	5.3	(g)S
	7J	7-Mar-2024	0.1	2.1	6.7	15.8	45.2	25.5	4.7	(g)S
	7I	7-Mar-2024	0.0	4.6	22.1	28.9	28.1	11.8	4.5	S
	7H	20-Mar-2024	1.8	4.5	10.6	23.9	38.0	15.6	5.7	(g)S
	7G	20-Mar-2024	0.0	6.6	34.9	36.6	16.6	2.7	2.6	S
	7F	20-Mar-2024	0.0	1.9	28.4	42.6	23.0	2.9	1.2	S
	7E	20-Mar-2024	0.0	2.1	22.5	38.1	26.1	6.4	4.7	S
	7D	20-Mar-2024	0.0	0.0	20.5	51.3	26.5	1.4	0.3	S
	7C	20-Mar-2024	0.0	0.0	17.4	51.3	28.1	1.9	1.2	S
	7B	20-Mar-2024	1.3	1.9	1.7	22.0	49.8	17.2	6.1	(g)S
	7A	20-Mar-2024	0.0	0.0	10.7	52.4	34.8	1.7	0.3	S
8 Cells	8K	21-Mar-2024	0.8	2.4	5.4	13.3	46.4	25.5	6.1	(g)S
	8J	21-Mar-2024	0.0	1.8	9.0	15.3	42.9	24.9	6.1	S
	8I	21-Mar-2024	0.7	3.7	13.3	19.0	37.8	20.2	5.3	(g)S
	8H	20-Mar-2024	0.0	0.1	14.7	36.1	31.8	12.5	4.7	S
	8G	20-Mar-2024	0.0	0.0	14.6	41.4	31.1	8.6	4.3	S
	8F	20-Mar-2024	0.0	0.0	16.4	45.6	29.1	5.9	3.1	S

Area	Site	Date	Size Class (mm)							Classification
			Gravel	Very Coarse Sand	Coarse Sand	Medium Sand	Fine Sand	Very Fine Sand	Silt & Clay	
			>/= 2	< 2, >/= 1	< 1, >/= 0.5	< 0.5, >/= 0.25	< 0.25, >/= 0.125	< 0.125, >/= 0.063	< 0.063	
	8E	20-Mar-2024	0.0	0.2	4.3	28.2	49.1	15.6	2.6	S
	8D	20-Mar-2024	0.0	0.0	5.1	32.3	47.0	12.8	2.8	S
	8C	20-Mar-2024	0.0	0.7	17.7	35.4	32.3	11.4	2.6	S
	8B	20-Mar-2024	0.0	0.1	11.0	33.1	40.2	13.0	2.5	S
	8A	20-Mar-2024	0.3	0.8	5.4	28.4	48.1	15.0	2.0	(g)S

Table D.2 Summary Sediment Particle Size Data from the Control areas (Percentage by Weight)

Area	Site	Date	Size Class (mm)							Classification
			Gravel	Very Coarse Sand	Coarse Sand	Medium Sand	Fine Sand	Very Fine Sand	Silt & Clay	
			>/= 2	< 2, >/= 1	< 1, >/= 0.5	< 0.5, >/= 0.25	< 0.25, >/= 0.125	< 0.125, >/= 0.063	< 0.063	
Northern Control	CNK	22-Mar-2024	0.45	1.66	2.13	7.6	51.03	33.51	3.62	gS
	CNJ	22-Mar-2024	2.6	5.3	7.96	14.62	41.76	24.47	3.34	(g)S
	CNI	22-Mar-2024	1.8	3.37	5.54	19.25	46.33	21.39	2.3	(g)S
	CNH	22-Mar-2024	0.9	3.04	8.56	16.69	42.12	25.28	3.41	(g)S
	CNG	22-Mar-2024	2.2	4.61	10.02	21.3	38.4	21.04	2.42	(g)S
	CNF	22-Mar-2024	1.3	3	5.72	15.64	45.51	26.65	2.19	(g)S
	CNE	22-Mar-2024	0.0	0.47	1.9	10.86	50.54	32.8	3.43	S
	CND	22-Mar-2024	0.1	0.8	1.73	9.35	49.92	34.43	3.68	(g)S
	CNC	22-Mar-2024	1.1	2.7	3.35	10.56	47.21	31.85	3.2	(g)S
	CNB	22-Mar-2024	0.1	0.83	1.94	6.88	47.52	38.21	4.53	(g)S
	CNA	22-Mar-2024	0.1	0.96	2.1	10.82	49.69	33.36	2.97	(g)S
Southern Control	CSN	22/03/2024	0.0	3.7	29.7	41.4	18.5	2.4	4.4	S
	CSM	22/03/2024	3.4	8.4	26.8	37.8	18.9	1.6	3.1	(g)S
	CSL	22/03/2024	0.8	5.9	30.4	43.5	17.0	0.7	1.8	(g)S
	CSK	22/03/2024	0.1	3.7	23.8	46.2	23.1	1.1	2.0	(g)S
	CSJ	22/03/2024	0.0	1.3	24.2	50.7	21.5	0.6	1.7	S
	CSI	22/03/2024	0.4	4.0	27.6	46.6	19.6	0.7	1.0	(g)S
	CSH	22/03/2024	5.3	12.1	30.9	36.3	13.2	0.4	1.8	gS
	CSG	22/03/2024	1.2	7.6	28.6	40.6	18.2	0.9	2.8	(g)S
	CSF	22/03/2024	2.3	8.9	31.6	39.3	15.0	0.6	2.4	(g)S
	CSE	22/03/2024	0.1	5.0	28.3	45.9	19.0	0.5	1.1	(g)S
	CSD	22/03/2024	0.0	1.5	24.2	48.7	22.1	0.8	2.7	S
	CSC	22/03/2024	0.0	2.7	34.5	45.8	15.3	0.5	1.3	S
	CSB	22/03/2024	0.0	0.8	22.9	49.2	24.9	1.3	0.8	S
	CSA	22/03/2024	0.0	0.5	13.4	46.2	35.5	3.2	1.3	S
Remote Control	CRH	23/03/2024	2.2	13.2	46.0	29.6	6.0	1.9	1.1	(g)S
	CRG	23/03/2024	0.0	6.4	46.9	36.9	6.3	1.7	1.7	S
	CRF	23/03/2024	0.0	2.6	45.5	42.2	7.2	1.5	1.1	S
	CRE	23/03/2024	0.0	2.8	42.9	43.2	9.0	1.4	0.7	S
	CRD	23/03/2024	0.0	1.3	40.6	48.0	9.2	0.9	0.0	S
	CRC	23/03/2024	0.0	0.6	37.4	50.4	9.8	0.7	1.1	S
	CRB	23/03/2024	0.0	0.3	35.6	52.2	10.3	0.8	0.7	S
	CRA	23/03/2024	0.0	0.0	32.6	54.4	12.1	0.7	0.2	S

Appendix E Epibenthic Macrofauna Dredge Tow Results

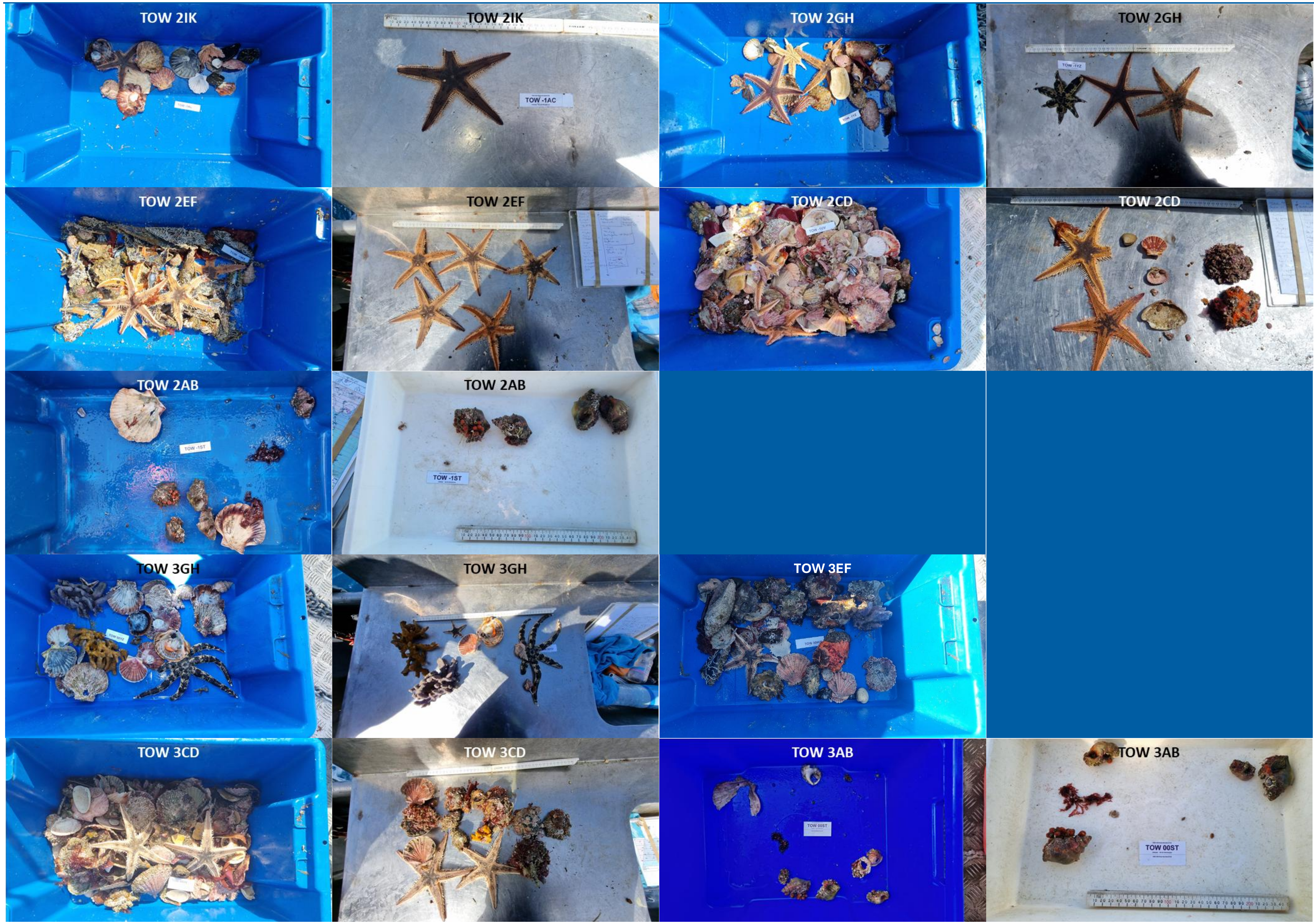

Figure E.1 Photographic records of Epibenthic Macrofauna Dredge Tow captures in Sand Extraction Area Cells 2 - 3, 2024. (Blue square indicates photo is not available for the point).

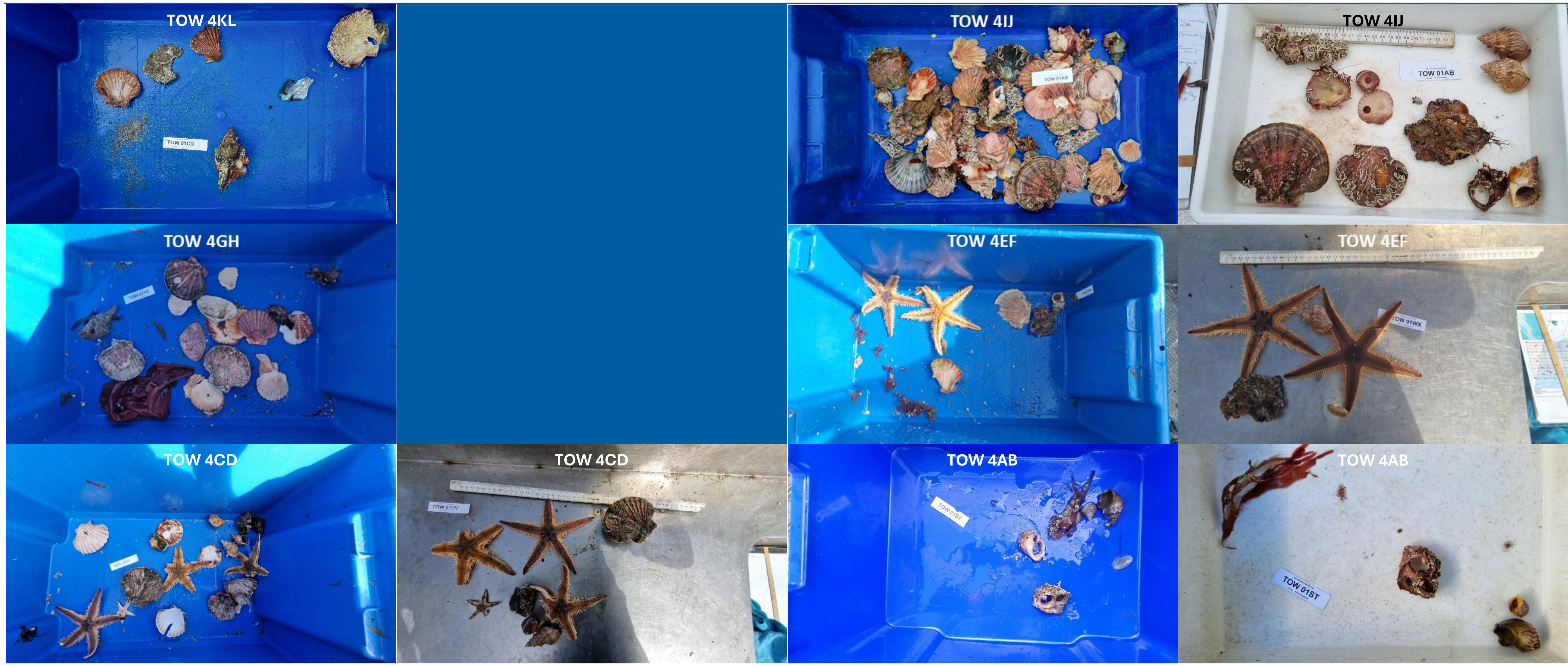

Figure E.2 Photographic records of Epibenthic Macrofauna Dredge Tow captures in Sand Extraction Area Cells 4, 2024. (Blue square indicates photo is not available for the point).

Figure E.3 Photographic records of Epibenthic Macrofauna Dredge Tow captures in Sand Extraction Area Cells 5, 2024. (Blue square indicates photo is not available for the point).

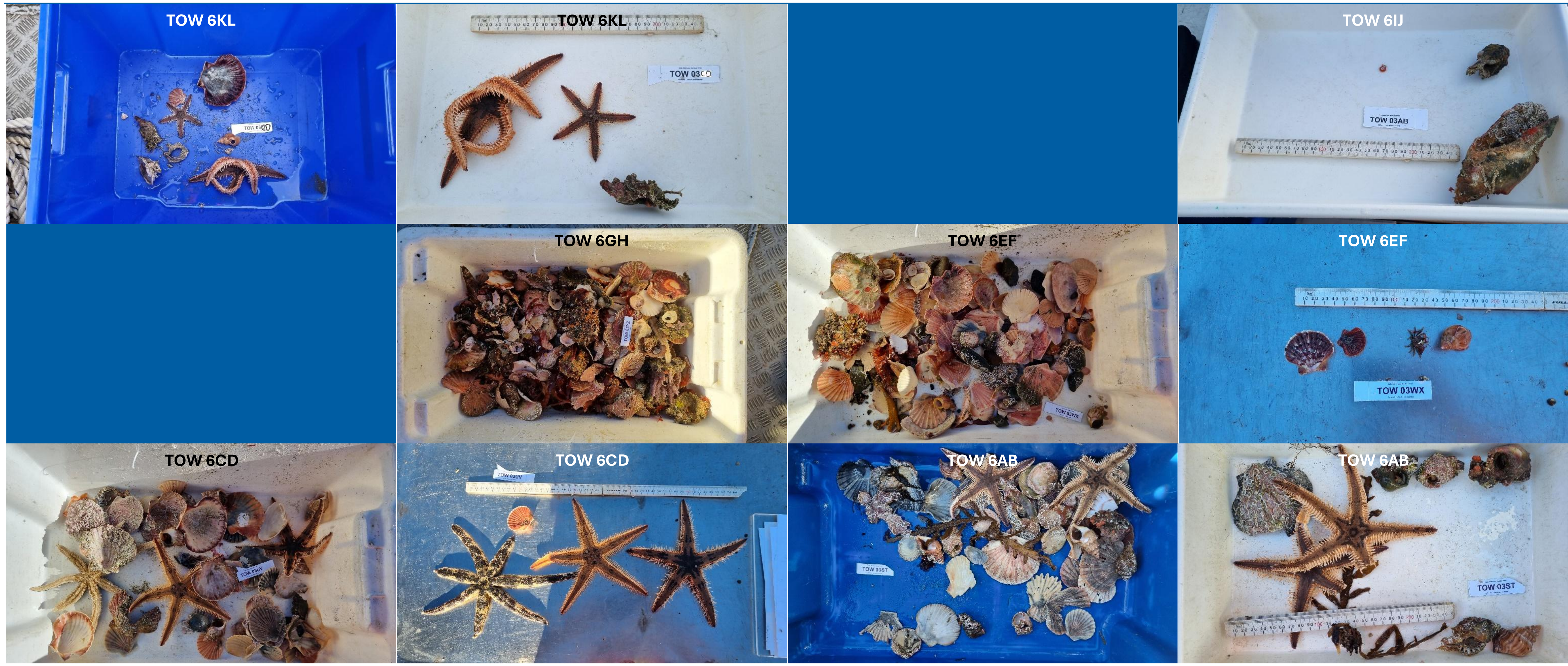

Figure E.4 Photographic records of Epibenthic Macrofauna Dredge Tow captures in Sand Extraction Area Cells 6, 2024. (Blue square indicates photo is not available for the point).

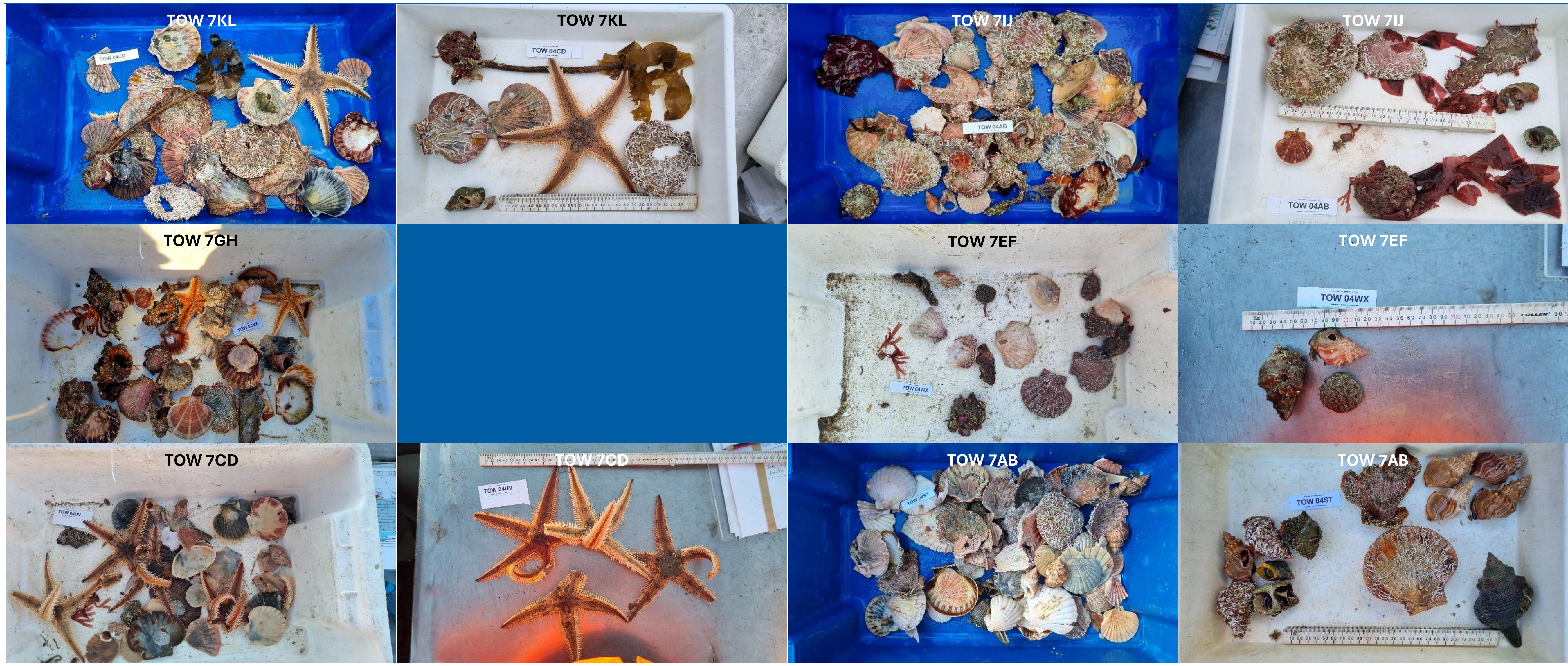

Figure E.5 Photographic records of Epibenthic Macrofauna Dredge Tow captures in Sand Extraction Area Cells 7, 2024. (Blue square indicates photo is not available for the point).

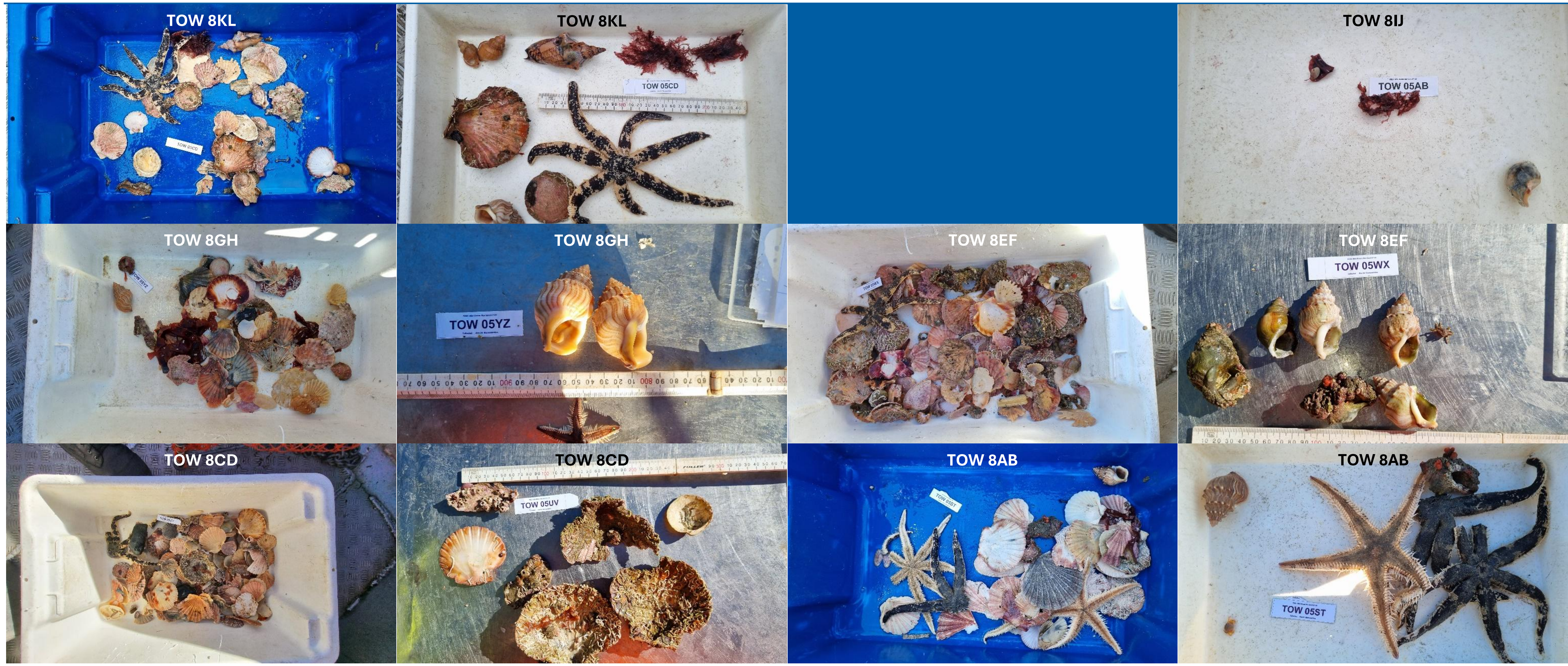

Figure E.6 Photographic records of Epibenthic Macrofauna Dredge Tow captures in Sand Extraction Area Cells 8, 2024. (Blue square indicates photo is not available for the point).

Figure E.7 Photographic records of Epibenthic Macrofauna Dredge Tow captures in Northern Control Cells, 2024. (Blue square indicates photo is not available for the point).

Figure E.8 Photographic records of Epibenthic Macrofauna Dredge Tow captures in Southern Control Cells, 2024. (Blue square indicates photo is not available for the point).

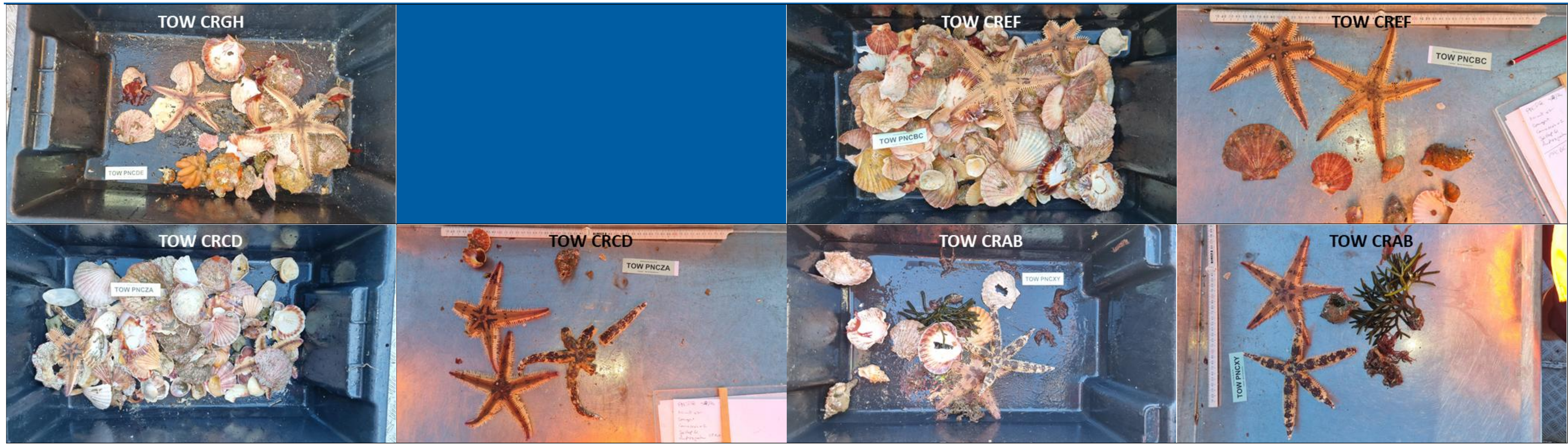

Figure E.9 Photographic records of Epibenthic Macrofauna Dredge Tow captures in Remote Control Cells, 2024. (Blue square indicates photo is not available for the point).

Table E.1 Densities (/100 m^2) of Epibenthic Macrofauna collected with the sand extraction area Dredge Tows, March 2024. (blue values estimates)

Taxa / Dredge Tow	2AB	2CD	2EF	2GH	2IK	3AB	3CD	3EF	3GH	3IK	4AB	4CD	4EF	4GH	4IJ	4KL	5AB	5CD	5EF	5GH	5IJ	5KL
Date	8 Mar	22 Mar	22 Mar	22 Mar	22 Mar	8 Mar	22 Mar	22 Mar	22 Mar	22 Mar	8 Mar	22 Mar	22 Mar	22 Mar	7 Mar	7 Mar	8 Mar	21 Mar	21 Mar	21 Mar	7 Mar	7 Mar
Annelida																						
Polychaeta																						
Serpulidae	0.83														0.83		0.83				0.83	
Platyhelminthes																						
Anonymus kaikourensis							1.67										1.67					
Arthropoda																						
Cirripedia																						
Barnacle							417										1.67					
Decapoda																						
Pagurus sp.	1.67		2.50	1.67		1.67	1.67	0.83			1.67	0.83	0.83		1.67	1.67	2.50			1.67	0.83	2.50
Nectocarcinus antarcticus	0.83							1.67			0.83								0.83			
Pyromaia tuberculata						0.83																
Notomithrax sp	0.83					0.83	0.83				0.83									0.83		
Decapoda (larvae Unid.)														0.83				1.67				
Isopoda																						
Isopod																						
Brachiopoda																						
Calloria inconspicua																						
Mollusca																						
Polyplacophora																						
Chiton		1.67	0.83																0.83			
Gastropoda																						
Maoricrypta costata																						
Maoricrypta monoxyla				0.83			2.50															
Sigapatella sp.					0.83										2.50		0.83	0.83				
Cabestana waterhousei																						
Semicassis pyrum																						0.83
Monoplex exaratus																						
Monoplex parthenopeus	0.83					0.83	0.83															0.83
Pelicaria vermis																						
Struthiolaria papulosa			0.83	1.67				0.83	1.67			0.83	0.83		1.67		0.83	0.83		4.17		0.83
Xenophora neozelanica		1.67						1.67							0.83				1.67	0.83		
Penion sulcatus																						
Cominella adspersa																						
Cominella quoyana																						
Murexsul octogonus			0.83																1.67			
Austrofusus glans												0.83										
Buccinulum pallidum												0.83										
Alcithoe arabica																						
Bivalvia																						
Myadora sp.																						
Purpurocardia purpurata		0.83															1.67					
Corbula zelandica															0.83							
Oyster								3.33														
Anomia trigonopsis			1.67	0.83																		
Pecten novaezelandiae		0.83					2.50		1.67			0.83		0.83	0.83							0.83
Talochlamys multistriata																						
Tawera spissa																						
Dosinia sp.								0.83														
Cephalopoda																						
Octopus maorum			0.83				0.83															
Echinodermata																						
Asteroidea																						
Astropecten polyacanthus		1.67	4.17	1.67	0.83		1.67	1.67	0.83			3.33	1.67				0.83	0.83	0.83	1.67	3.33	1.67
Luidia australiae				0.83					0.83												0.83	
Echinoidea																						
Echinocardium cordatum																						
Bryozoa																						
Bryozoa (discoid)	0.83	0.83				1.67	0.83	0.83							0.83		0.83				0.83	
Porifera																						
Demospongiae																						
Dysidea sp.		0.83					0.83	0.83	0.83													
Sponge (finger)							0.83		1.67								0.83	0.83	4.17			
other sponges		0.83						2.50									0.83	0.83	0.83			
Chordata																						
Leptocardii																						
Epigonichthys hectori																			4.17			
Ascidiacea																						
Ascidian															0.83							
Actinopterygii																						
Cling fish																						
Chromista																						
Ochrophyta																						
Brown algae																						
Plantae																						
Rhodophyta																						
Red algae		0.83	0.83			0.83	0.83	0.83			0.83			0.83			0.83		0.83			
Chlorophyta																						
Green algae																						
No Individuals	**5.8**	**10.0**	**12.5**	**7.5**	**1.7**	**6.7**	**433**	**15.8**	**7.5**	**0.0**	**4.2**	**7.5**	**3.3**	**2.5**	**10.8**	**1.7**	**14.2**	**5.8**	**15.8**	**9.2**	**6.7**	**7.5**
No Species	**6**	**9**	**8**	**6**	**2**	**6**	**13**	**11**	**6**	**0**	**4**	**6**	**3**	**3**	**9**	**1**	**12**	**6**	**9**	**5**	**5**	**6**

Table E.1 Densities (/100 m2) of Epibenthic Macrofauna collected with the sand extraction area Dredge Tows, March 2024. (blue values estimates)

Taxa — Dredge tow	6AB	6CD	6EF	6GH	6IJ	6KL	7AB	7CD	7EF	7GH	7IJ	7KL	8AB	8CD	8EF	8GH	8IJ	8KL
Date	8 Mar	21 Mar	21 Mar	21 Mar	7 Mar	7 Mar	8 Mar	21 Mar	21 Mar	20 Mar	7 Mar	7 Mar	8 Mar	20 Mar	20 Mar	20 Mar	7 Mar	7 Mar
Annelida																		
Polychaeta																		
Serpulidae	0.83						0.83				0.83	0.83	0.83	417				0.83
Platyhelminthes																		
Anonymus kaikourensis																		
Arthropoda																		
Cirripedia																		
Barnacle										417				417				
Decapoda																		
Pagurus sp.	2.50	3.33	3.33		1.67	0.83	4.17		2.50	1.67	0.83	1.67			5.00	0.83		1.67
Nectocarcinus antarcticus				0.83									0.83					
Pyromaia tuberculata																		
Notomithrax sp							0.83				0.83							
Decapoda (larvae Unid.)			0.83	1.67											0.83			
Isopoda																		
Isopod				0.83						0.83								
Brachiopoda																		
Calloria inconspicua																		
Mollusca																		
Polyplacophora																		
Chiton				4.17						1.67				0.83	3.33			
Gastropoda																		
Maoricrypta costata										0.83								
Maoricrypta monoxyla																		
Sigapatella sp.		0.83		5.00						1.67		0.83		2.50	5.83	2.50		
Semicassis pyrum																		
Cabestana waterhousei																		
Monoplex exaratus																		
Monoplex parthenopeus	0.83														0.83			
Pelicaria vermis																		
Struthiolaria papulosa	0.83		0.83				3.33	5.00		0.83			0.83	0.83		1.67		0.83
Xenophora neozelanica				2.50											0.83			
Penion sulcatus							0.83											
Cominella adspersa							0.83											
Cominella quoyana																		
Murexsul octogonus																		
Austrofusus glans				0.83														
Buccinulum pallidum																		
Alcithoe arabica																		0.83
Bivalvia																		
Myadora sp.																		
Purpurocardia purpurata																		
Corbula zelandica			0.83	0.83													0.83	
Oyster																		
Anomia trigonopsis										1.67								
Pecten novaezelandiae		1.67	1.67							0.83	0.83			0.83				
Talochlamys multistriata					0.83													
Tawera spissa																		
Dosinia sp.																		
Cephalopoda																		
Octopus maorum										0.83								
Echinodermata																		
Asteroidea																		
Astropecten polyacanthus	1.67	1.67				1.67		3.33		1.67		0.83	0.83		0.83	0.83		
Luidia australiae		0.83		0.83									1.67	0.83	0.83			0.83
Echinoidea																		
Echinocardium cordatum																		
Bryozoa																		
Bryozoa (discoid)	0.83			2.50			0.83			0.83	0.83		0.83	0.83	1.67			0.83
Porifera																		
Demospongiae																		
Dysidea sp.				0.83														
Sponge (finger)			0.83	1.67														
other sponges			0.83	0.83						0.83				0.83				
Chordata																		
Leptocardii																		
Epigonichthys hectori				0.83														
Ascidiacea																		
Ascidian											0.83							
Actinopterygii																		
Cling fish				1.67														
Chromista																		
Ochrophyta																		
Brown algae	0.83											0.83						
Plantae																		
Rhodophyta																		
Red algae				0.83					0.83		0.83			0.83		0.83	0.83	0.83
Chlorophyta																		
Green algae																		
No Individuals	**8.3**	**8.3**	**9.2**	**26.7**	**2.5**	**2.5**	**11.7**	**8.3**	**3.3**	**431**	**5.8**	**5.0**	**5.8**	**842**	**20.0**	**6.7**	**1.7**	**6.7**
No Species	**7**	**5**	**7**	**16**	**2**	**2**	**7**	**2**	**2**	**13**	**7**	**5**	**6**	**10**	**9**	**5**	**2**	**7**

Table E.2 Densities (/100 m^2) of Epibenthic Macrofauna collected with the control area Dredge Tows, March 2024. (blue values estimates)

Taxa — Dredge Tow	CNAB	CNCD	CNEF	CNGH	CNIK	CSAB	CSCD	CSEF	CSGH	CSIJ	CSKL	CSMN	CRAB	CRCD	CREF	CRGH
Date	8 Mar	22 Mar	22 Mar	22 Mar	22 Mar	3 Apr	3 Apr	3 Apr	3 Apr	3 Apr	3 Apr	3 Apr	4 Apr	4 Apr	4 Apr	4 Apr
Annelida																
Polychaeta																
Serpulidae	0.83		0.83													
Platyhelminthes																
Anonymus kaikourensis												0.83				
Arthropoda																
Cirripedia																
Barnacle														42		
Decapoda																
Pagurus sp.	8.33	3.33	17.50	1.67	10.00	7.50	2.50	7.50				4.17	0.83			
Nectocarcinus antarcticus	0.83		0.83			1.67	0.83		0.83			2.50				
Pyromaia tuberculata																
Notomithrax sp			0.83									3.33		0.83		
Decapoda (larvae Unid.)			0.83	0.83												
Isopoda																
Isopod	1.67															
Brachiopoda											0.83					
Calloria inconspicua																
Mollusca																
Polyplacophora																
Chiton			0.83				0.83		0.83							
Gastropoda																
Maoricrypta costata							0.83					1.67				
Maoricrypta monoxyla						0.83										
Sigapatella sp.			0.83	2.50	2.50				0.83		1.67	2.50				
Semicassis pyrum																
Cabestana waterhousei					0.83											
Monoplex exaratus						0.83										
Monoplex parthenopeus	0.83					0.83	0.83									
Pelicaria vermis												0.83				
Struthiolaria papulosa			1.67	1.67										0.83		
Xenophora neozelanica												3.33				
Penion sulcatus						1.67										
Cominella adspersa																
Cominella quoyana							0.83					0.83				
Murexsul octogonus							0.83									
Austrofusus glans	0.83															
Buccinulum pallidum				0.83	0.83							0.83		0.83		
Alcithoe arabica																
Bivalvia																
Myadora sp.																
Purpurocardia purpurata							0.83									
Corbula zelandica																
Oyster				0.83	0.83							2.50				
Anomia trigonopsis				0.83												
Pecten novaezelandiae	0.83			0.83			0.83		3.33	1.67		6.67		0.83		
Talochlamys multistriata																
Tawera spissa									0.83							
Dosinia sp.																
Cephalopoda																
Octopus maorum	*0.83*															
Echinodermata																
Asteroidea																
Astropecten polyacanthus	0.83	0.83		3.33	0.83	0.83	1.67				0.83	0.83	0.83	1.67		
Luidia australiae						0.83							0.83	0.83		
Echinoidea																
Echinocardium cordatum									0.83							
Bryozoa																
Bryozoa (discoid)	1.67															
Porifera																
Demospongiae																
Dysidea sp.																
Sponge (finger)												1.67				
other sponges			0.83	0.83								1.67				
Chordata																
Leptocardii																
Epigonichthys hectori								0.83								
Ascidiacea																
Ascidian																
Actinopterygii																
Cling fish				0.83												
Chromista																
Ochrophyta																
Brown algae																
Plantae																
Rhodophyta																
Red algae									0.83	0.83	0.83					
Chlorophyta																
Green algae													0.83			
No Individuals	**17.5**	**4.2**	**25.0**	**15.0**	**15.8**	**15.0**	**10.8**	**8.3**	**8.3**	**2.5**	**4.2**	**34.2**	**3.3**	**47.5**	**10.0**	**10.0**
No Species	**10**	**2**	**9**	**11**	**6**	**8**	**10**	**2**	**7**	**2**	**4**	**15**	**4**	**7**	**8**	**9**

Table E.3 Scallop (Pecten novaezelandiae) numbers and sizes (mm) recorded in Epibenthic macrofauna dredge tows 2024.

Cell Tow	Scallop									
	n									Average
2CD	1	55								55.0
3GH	2	80	102							91.0
3CD	3	88	89	92						89.7
4IJ	1	107								107
4CD	1	105								105
6EF	2	48	30							39
6CD	2	50	155							102.5
7IJ	1	41								41
7GH	1	48								48
8CD	1	30								30
CNGH	1	55								55.0
CNAB	1	84								84.0
CRGH	1	61								61
CRCD	1	42								42
CSMN	8	70	46	26	16	22	26	26	28	32.5
CSGH	4	55	38	78	40					52.7
CSAB	1	37								37

Table E.4 Kruskal-Wallis One Way Analysis of the Number of Macrofauna Individuals between Alongshore areas in the proposed sand area and control areas

Dependent Variable: Number of Macrofauna Individuals
Normality Test: Failed (P < 0.050)

Group	N	Missing	Median	25%	75%
2	5	0	7.500	3.750	11.250
3	5	0	7.500	3.335	224.165
4	6	0	3.750	2.292	8.332
5	6	0	8.335	6.460	14.585
6	6	0	8.330	2.500	13.545
7	6	0	7.080	4.583	116.460
8	6	0	6.670	4.790	225.417
NC	5	0	15.830	9.585	21.250
SC	7	0	8.330	4.170	15.000
CR	4	0	10.000	4.998	38.125

H = 7.136 with 9 degrees of freedom. (P = 0.623)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.623)

Table E.5 One Way Analysis of Variance of the Number of Macrofauna Taxa between Alongshore areas in the proposed sand area and control areas

Dependent Variable: Number of Macrofauna taxa
Normality Test (Shapiro-Wilk): Passed (P = 0.503)
Equal Variance Test (Brown-Forsythe): Passed (P = 0.244)

Group	N	Missing	Mean	Std Dev	SEM
2	5	0	6.200	2.683	1.200
3	5	0	7.200	5.070	2.267
4	6	0	4.333	2.805	1.145
5	6	0	7.167	2.787	1.138
6	6	0	6.500	5.167	2.110
7	6	0	6.000	4.099	1.673
8	6	0	6.500	2.881	1.176
NC	5	0	7.600	3.647	1.631
SC	7	0	6.857	4.706	1.779
CR	4	0	7.000	2.160	1.080

Source of Variation	DF	SS	MS	F	P
Between Groups	9	43.176	4.797	0.330	0.961
Residual	46	668.824	14.540		
Total	55	712.000			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.961).

Power of performed test with alpha = 0.050: 0.050

The power of the performed test (0.050) is below the desired power of 0.800.
Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

Table E.6 Kruskal-Wallis One Way Analysis of the Shannon-Wiener Macrofauna Diversity between Alongshore areas in the Temporary Sand Extraction Area

Dependent Variable: Shannon-Wiener Macrofauna Diversity index
Normality Test: Failed (P < 0.050)

Group	N	Missing	Median	25%	75%
2	5	0	1.748	1.214	1.998
3	5	0	1.733	0.122	1.998
4	6	0	1.216	0.780	1.710
5	6	0	1.712	1.407	2.062
6	6	0	1.619	0.637	2.011
7	6	0	1.117	0.478	1.737
8	6	0	1.621	0.744	1.882
NC	5	0	1.224	0.851	2.030
SC	7	0	1.638	0.637	2.205
CR	4	0	1.647	0.787	2.080

H = 4.876 with 9 degrees of freedom. (P = 0.845)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.845)

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Table E.7 PERMANOVA – Permutational Multivariate Analysis of Variation by shore perpendicular cell rows (alongshore)

Group		Samples
Sand Extraction	Alongshore 2	2AB, 2CD, 2EF, 2GH, 2IK
	Alongshore 3	3AB, 3CD, 3EF, 3GH, 3IK
	Alongshore 4	4AB, 4CD, 4EF, 4GH, 4IJ, 4KL
	Alongshore 5	5AB, 5CD, 5EF, 5GH, 5IJ, 5KL
	Alongshore 6	6AB, 6CD, 6EF, 6GH, 6IJ, 6KL
	Alongshore 7	7AB, 7CD, 7EF, 7GH, 7IJ, 7KL
	Alongshore 8	8AB, 8CD, 8EF, 8GH, 8IJ, 8KL
Control	North	NCAB, NCCD, NCEF, NCGH, NCIK
	South	SCAB, SCCD, SCEF, SCGH, SCIJ, SCKL, SCMN
	Remote	CRAB, CRCD, CREF, CRGH

PERMANOVA table of results

Source	df	SS	MS	Pseudo-F	P(perm)	Unique perms
Along	9	17002	1889.2	0.92311	0.6568	9859
Res	46	94140	2046.5			
Total	55	1.1114E+05				

Estimates of components of variation

Source	Estimate	Sq.root
S(Along)	-28.162	-5.3068
V(Res)	2046.5	45.238

Pair-Wise Tests

Groups	t	P(perm)	Unique perms
2, 3	0.59578	0.9275	126
2, 4	0.88047	0.6464	462
2, 5	0.31983	0.9879	462
2, 6	0.65074	0.8988	462
2, 7	0.54147	0.9225	462
2, 8	0.74423	0.838	462
2, NC	0.83176	0.7093	126
2, SC	0.85166	0.6706	792
2, CR	0.69754	0.9392	126
3, 4	0.94759	0.5182	461
3, 5	0.87779	0.6991	462
3, 6	0.82493	0.7279	461
3, 7	0.88015	0.6272	462
3, 8	0.93862	0.5804	462
3, NC	1.2873	0.0884	126
3, SC	0.94477	0.5542	792
3, CR	0.87585	0.6334	126
4, 5	1.2273	0.1921	462
4, 6	0.6799	0.8868	462
4, 7	0.67053	0.8611	462
4, 8	1.2193	0.1626	462
4, NC	1.1269	0.2786	462
4, SC	1.0805	0.3063	1706
4, CR	1.0857	0.3741	210
5, 6	0.78284	0.7217	462
5, 7	0.89612	0.6015	462
5, 8	1.0761	0.3238	462
5, NC	1.0555	0.3585	462
5, SC	1.2781	0.1181	1711
5, CR	0.76616	0.8329	210
6, 7	0.75443	0.8409	462
6, 8	1.0603	0.3556	462
6, NC	0.80869	0.6955	462
6, SC	1.0263	0.397	1707
6, CR	0.78371	0.7941	210
7, 8	0.89303	0.6004	462
7, NC	0.94039	0.5387	462
7, SC	1.1967	0.1801	1715
7, CR	0.99918	0.4772	210
8, NC	1.4402	0.0457	462
8, SC	1.3293	0.0908	1711
8, CR	1.1672	0.2012	210
NC, SC	1.1179	0.2892	792
NC, CR	0.92144	0.5774	126
SC, CR	0.91223	0.6063	329

Average Similarity between/within groups

	2	3	4	5	6	7	8	NC	SC	CR
2	32.586									
3	35.969	29.059								
4	38.782	35.848	41.782							
5	42.613	36.555	39.853	41.242						
6	38.802	34.639	43.433	42.186	37.455					
7	39.774	34.634	43.221	40.494	39.785	36.662				
8	38.651	34.513	37.982	39.83	37.177	39.5	38.739			
NC	40.393	31.771	42.053	42.259	43.267	41.074	36.004	44.087		
SC	34.174	30.828	35.969	33.059	34.031	32.204	31.573	36.23	32.075	
CR	40.329	36.501	40.567	44.271	42.376	38.784	37.583	44.357	37.369	41.538

Appendix F Benthic Biota Results

Table F.1 Benthic Infauna Retained on 1 mm sieve from the 02 Cells in the sand extraction area 2024 (Number per sample). Plus, Biota identified in Photographs in blue.

Taxa	Date	21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24		
	Cell	2A			2B			2C			2D			2E			2F			2G			2H			2I			2J			2K		
	Sample	2A1	2A2	2A3	2B1	2B2	2B3	2C1	2C2	2C3	2D1	2D2	2D3	2E1	2E2	2E3	2F1	2F2	2F3	2G1	2G2	2G3	2H1	2H2	2H3	2I1	2I2	2I3	2J1	2J2	2J3	2K1	2K2	2K3
	Depth	21.6	20.1	20.9	22.5	22.5	22.2	22.1	22.9	22.8	22.3	24.1	24.8	25.1	26.2	26.1	25.2	25.6	25.5	25.2	26.2	26.4	24.2	27.2	26.6	26.2	27.3	27.5	26.5	28.5	27.6	28.5	29.4	28.8
Annelida																																		
Polychaeta																																		
Lumbrineridae		1			1			1	1			1					1	1	3						1		1	2		2	2		2	
Onuphidae	*Hartmanonuphis pectinata*				1										1		1		1		1	3		2			1							
Onuphidae	*Onuphis aucklandensis*												1																					
Glyceridae																1																1		
Goniadidae				1	1		1	2			2				1		3	1	2	3	1	2	3	2	1	2	4	1	1	3	1		1	3
Hesionidae																				1			1										1	
Nephtyidae	*Aglaophamus sp.*	5	4	5	2	1	1	1	1	3	2	2			6		1		3	3	3	1	1	3	2	2		2		1	6	3	4	1
Phyllodocidae			3	1	1				2		4						3	1		2	1	1	3	1			1		1		1		1	1
Polynoidae												1			1										1									
Sigalionidae						1			1	1	1			1	3	2	2	1	1	1	1	2	3	1	1	1		2		1	1	1		4
Syllidae	Syllidae								1		1			2			1												4			3		
Sabellidae											1		1				2	1		1		1		1		2		2	1	3	2	1		
Serpulidae	*Hydroides sp*	6	1	2		1		2	9	2	1		10				1		2	1	1	1		1		49		1	4	2		3		
Spionidae	*Paraprionospio pinnata*	1									2				2				1	1		2			1								1	
Spionidae	*Prionospio sp.*														2					1												1		
Ampharetidae		24	1		36			1			27				18		21	8	23	31	8	11	15	7	3		9	6		3		1	4	1
Flabelligeridae																1													2			1		
Pectinariidae	*Lagis australis*	2			1						1									1	2		1				1						1	
Terebellidae																							1											
Capitellidae	*Barantolla lepte*																																	2
Chaetopteridae	*Phyllochaetopterus socialis*																													1				
Cossuridae	*Cossura consimilis*																																2	
Magelonidae	*Magelona dakini*				1					1	1						1			1			2	1				1		1	2	1	2	
Maldanidae		9	5	3	9	6	4	8	9	3	14	1	1	1	7	2	16	7	26	6	1	7	4	3	3	1	7	9	3	11	13	1		19
Opheliidae	*Armandia maculata*	2	14	1				1	1		7				4		5			6			2	5	3			1		3		1		
Orbiniidae	*Leitoscoloplos kerguelensis*															1	2		1	1		1	1	1	3		2	1		1			1	3
Oweniidae	*Myriochele sp.*																			3			5	5	1					1				
Oweniidae	*Myriowenia sp.*	6			2			1									1				85	7		2		1	2	3		2				
Oweniidae	*Owenia petersenae*	1														2													1			1		1
Travisiidae	*Travisia olens*												1		1													1				1		
Sipuncula																																		
	Aspidosiphon sp.						1	2					1							1						1			1			2		
Nemertea		1	1								1	1				1	2		2			1				1		1	1	1			1	1
Arthropoda																																		
Amphipoda																																		
	Ampelisca sp.	1																3	1		1	1		1			3	1		1	2		3	3
	Lysianassidae	6	7	4	2		1	1			6				12		16	9	8	13	5	13	4	5	8		13	12		15	16		25	16
	Oedicerotidae	1						3			1						3					2		1			2	1			1			
	Phoxocephalidae	4	33	19	7		14	34	3	1	18		2		10	2	12	5	7	15	5	5	6	6	7		5	5	1	6	9	4	20	10
	Urothoidae	13	31	22	11	1	6	12		1	14		1		19		33	16	16	24	16	24	16	16	20		19	28		22	24	1	9	20
	Amphipoda Unid.	1	5	2	2	4	1	3	37	10	2	1	13			9		3		2	2	2	1	1	2	6	3	4	4		1	7	2	
Cumacea																																		
	Cumacea	1	3	2	3		1	1	5		1				2		2				1		2	1	1	1	2	1		3			1	2
Decapoda																																		
	Callianassa filholi										2				3		8	3	5	7	4	3	1	7	3		2	3		1	3		3	2
	Philocheras australis								1	1																							1	1
	Halicarcinus tongi												1				1																	
	Pyromaia tuberculata								2																		1							
	Ebalia laevis																														1			
	Ogyrides sp	1																									3				1			1
	Pagurus sp.	2		1			1		4	1	3		1		1	2	1	1	2	1		1	1	2	2	13		3		1	1		1	2
	Liocarcinus corrugatus							1								1										1			1					
Isopoda																																		
	Uromunna schauinslandi																							1										
	Anthuridea	1			1			1		1		1								3	1	1		1			1	1		1		3	1	
	Eurylana cookii								3	5		2	1																2			1		
	Pseudaega secunda			1														1																
	Exosphaeroma falcatum		3	9						1				1																				
	Exosphaeroma planulum												1																					
Leptostraca																																		
	Nebalia sp.														3		4	2	2		4	2		7			1	9		3	2			3
Mysidacea		1	2	1	1	1	2	5		1				1						2		1												
Stomatopoda				1							1																							
Tanaidacea																1										1			2			1		
Ostracoda																																		
	Diasterope grisea	1					1				1																				1			1
	Parasterope quadrata																1																	
	Cypridinodes																								1				1					
	Euphilomedes agilis								1	1	1					1																		
	Scleroconcha sp.			1																		1		2				4						
	Rutiderma sp.																																	1
Thecostraca																																		
	Balanus decorus																									1								
Mollusca																																		
Polyplacophora																																		
	Ischnochiton maorianus								2	1																4								
Gastropoda																																		
	Zeacolpus vittatus												2												1					1				
	Philine sp								1	1					1		1							1									1	
	Sigapatella tenuis			1		3		3	10	3		5	5			5		1		1	2	1	1			1	1	3	8	2	2	1	2	1
	Eulimidae															1													1			1		1

Taxa	2A1	2A2	2A3	2B1	2B2	2B3	2C1	2C2	2C3	2D1	2D2	2D3	2E1	2E2	2E3	2F1	2F2	2F3	2G1	2G2	2G3	2H1	2H2	2H3	2I1	2I2	2I3	2J1	2J2	2J3	2K1	2K2	2K3
Date	21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24		
Cell	2A			2B			2C			2D			2E			2F			2G			2H			2I			2J			2K		
Depth	21.6	20.1	20.9	22.5	22.5	22.2	22.1	22.9	22.8	22.3	24.1	24.8	25.1	26.2	26.1	25.2	25.6	25.5	25.2	26.2	26.4	24.2	27.2	26.6	26.2	27.3	27.5	26.5	28.5	27.6	28.5	29.4	28.8
Pelicaria vermis																											1						
Struthiolaria papulosa												1				1				1				1			1						
Amalda mucronata				1																													
Amalda northlandica	3			1						2				1		3					1									1			
Columbellidae																										1							
Cominella adspersa								1																									
Cominella virgata					2						1	1			2	1	4	2		1								2	1	1			
Marginellidae			1																												1		
Xymene sp.								1											1									1					
Austrofusus glans										1							1										2			1			1
Pleurobranchaea maculata																																1	
Coelotrochus viridis												1															1						1
Micrelenchus sp.								1				3			3																		
Punctacteon cratericulatus																								1								2	
Pupa affinis										1						5	1	1	1			1	1	1		1	4		1	3		3	1
Adelphotectonica reevei						1													1	1			1			1			1			1	
Psilaxis oxytropis							1									1															1		
Heterobranchia Unid.																					1												
Bivalvia																																	
Hiatella arctica												1																					
Pratulum pulchellum	1																	1	2								1	1	1				
Gari convexa		1	1	3				3		1	1						2									1			2	1	2		1
Gari sp. (juvenile)	1	1			4			4	1	6		3		4	1	1		2	4		1	3			1		3	5	1	1	2	1	1
Gari stangeri						1																											
Hiatula nitida																			1			2											
Serratina charlottae																														1			
Pleuromeris sp.							1																					1					
Pleuromeris zelandica								1						1									1						1			4	
Purpurocardia purpurata								1																									
Mylitella vivens vivens																3	1	1	1		4	1											
Limatula maoria									1																								
Corbula zelandica												1													1								
Nucula nitidula	1		7	4	4	3	2	7	7		2	4	1	2	8	2		2	1		3	2		4	5		1	9	1	4	2	3	2
Pecten novaezelandiae					*1*														1														
Chlamys sp.																											1						
Oxyperas elongata												1	1		1													3					
Scalpomactra scalpellum	1		3	3	3	2	2	1	3	1				2	1	3	1	2	1		2		1	4		1	4		1	2	1	3	2
Zemysina sp.	1	2	3			2				2				2		14	10	5	5	1	17	4	7	8		3	5		5	1		2	8
Bassina yatei		1																1														1	
Dosinia subrosea	1																2				2							1			1		
Notocallista multistriata																						1				1	1						1
Tawera spissa			9		2	1	5	7	7			5			5	1									11			4			2		
Myadora antipodum				1																													
Myadora striata					1	2			1			2										1			1	1		1			1		
Thraciidae			1				1					2		1			1						2				1		1				
Echinodermata																																	
Asteroidea																																	
Astropecten polyacanthus						1													1				1										
Echinoidea																																	
Echinocardium cordatum					1			1															1		1							2	
Ophiuroidea																																	
Ophiuroidea						1			1		1	1			1		1											1				1	
Bryozoa																																	
Bryozoa (discoid)		1	8		22	2	17	27	19		7	11																6			1		
Bryozoa (encrusting)								1	1			1													1			1					
Bryozoa (solid Stalked)							1	1		1		1			1		1				1				1			1	1		1		
Porifera																																	
Demospongiae *cf Tethyopsis* sp.					2		1	1	6																								
Sponge (cream Encrusting)											2	1													2								1
Cnidaria																																	
Hexacorallia																																	
Anemone (Unid.)									1																								
Edwardsia sp.																1		1				2	1	1			1						
Kionotrochus suteri																									1								
Sphenotrochus sp.																									2								
Chordata																																	
Ascidiacea																																	
Pyura sp.												1																					
Eugyra sp.	1															1				1		2											
Leptocardii																																	
Epigonichthys hectori		1			1		6	1	1		5	2	4		31		1		1						7			4			2		1
Teleostei																																	
Limnichthys polyactis															1																		
Number of Individuals	101	120	110	95	61	50	120	153	87	130	34	85	12	110	87	182	90	124	153	150	129	93	103	85	122	94	135	80	109	108	58	114	120
Number of Species / taxa	31	20	26	23	19	22	29	35	30	33	16	34	8	26	26	40	29	28	39	25	35	31	37	27	29	30	41	33	38	31	35	36	35
Shannon-Wiener Diversity Index	2.81	2.23	2.69	2.35	2.37	2.64	2.64	2.77	2.86	2.80	2.49	3.06	1.91	2.75	2.51	3.00	2.89	2.67	2.91	1.86	2.95	2.99	3.19	2.81	2.38	2.88	3.16	3.19	3.04	2.77	3.36	2.94	2.90
Shannon-Wiener Evenness	0.82	0.74	0.82	0.75	0.81	0.85	0.78	0.78	0.84	0.80	0.90	0.87	0.92	0.84	0.77	0.81	0.86	0.80	0.79	0.58	0.83	0.87	0.88	0.85	0.71	0.85	0.85	0.91	0.83	0.81	0.94	0.82	0.81

Table F.2 Benthic Infauna Retained on 1 mm sieve from the 03 Cells in the sand extraction area 2024 (Number per sample). Plus, Biota identified in Photographs in blue.

Taxa	Date	21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24		
	Cell	3A			3B			3C			3D			3E			3F			3G			3H			3I			3J			3K		
	Sample	3A1	3A2	3A3	3B1	3B2	3B3	3C1	3C2	3C3	3D1	3D2	3D3	3E1	3E2	3E3	3F1	3F2	3F3	3G1	3G2	3G3	3H1	3H2	3H3	3I1	3I2	3I3	3J1	3J2	3J3	3K1	3K2	3K3
	Depth	20.8	21.9	21.1	23.0	21.4	23.3	23.7	23.7	24.1	25.8	25.0	24.3	26.9	26.4	24.8	26.1	26.5	25.5	26.3	26.5	25.4	26.2	26.1	25.1	27.2	26.5	26.0	27.4	28.0	27.4	28.3	28.1	28.6
Annelida																																		
Polychaeta																																		
Eunicidae					1							1			1																			
Lumbrineridae			1							1					1			1	3	1						5					2			
Onuphidae	*Hartmanonuphis pectinata*													1			2						5		1							1	1	1
Onuphidae	*Onuphis aucklandensis*																													1				
Onuphidae	*Rhamphobrachium sp.*			1																														
Aphroditidae																											1							
Goniadidae		1		2	1	1	2	2							2				2		1	1				1	1			1	1		1	1
Nephtyidae	*Aglaophamus sp.*	4		2	2	1	1	1	1	1			2	1	4	6	1		2	2	2	7	3	4	2	3	3	2	2	1	3	3	4	1
Nereidae	Nereidae (juvenile)								1																									
Nereididae	*Nereis cricognatha*	1																																
Phyllodocidae				1		1	1		1				2		1		1		2	8	6		1		11	2	2		1			1	2	
Pilargidae																											1				1			
Polynoidae																																		1
Sigalionidae		1	4	1	4	2	2	2	1	1			1	1	2		1		1	1	2	2	5	4	3	2	1	4	2	1	3			
Syllidae	Syllidae								1			2					2		1				1											
Sabellidae											1	1																			3			
Serpulidae	*Hydroides sp*			1			1		9	1		10								1						1			1					
Spionidae	*Paraprionospio pinnata*	1		1											1		1		1	1		3			1	1	1		1		1	3		
Spionidae	*Prionospio sp.*			3													1																	
Spionidae	*Spiophanes kroyeri*																			2	2	1												
Ampharetidae		1		5	11		13	19	1			2	4		9	2	23		11	5	10	39	17	20	10	8	16	1	14	7	19	12	5	8
Flabelligeridae									1			3			1				1															
Pectinariidae	*Lagis australis*	1		1	1		2										4			1			1			1	1				1	2		
Terebellidae							1																											
Capitellidae	*Heteromastus filiformis*		1																		1													
Capitellidae	*Notomastus zeylanicus*											1																						
Chaetopteridae	*Phyllochaetopterus socialis*																			1	1								1					
Magelonidae	*Magelona dakini*		1	1														1	1				1	3		2	1		7					
Maldanidae		6	4	6	3	7	4	4		2	3	2	4		20	3	4	2		3	12	4	10	3	4	11	2	2	7	2	3	7	2	1
Opheliidae	*Armandia maculata*	5		6	1		5	11	1		1	1	9		1	1	10					1	2	8	1		6	3	1	7	3	11	4	4
Orbiniidae	*Leitoscoloplos kerguelensis*						2								2					9												1		
Oweniidae	*Myriowenia sp.*	9		29	2	4	14	3				7	2		8	1	1		42	2	9	8	68	3	2	10	15	2	47	3	4	7	2	4
Oweniidae	*Owenia petersenae*											1				1		3			1	1	1											
Travisiidae	*Travisia olens*		1										1		1				1										1					
Sipuncula																																		
	Aspidosiphon sp.											18																						
Nemertea				1	1			1											1	1	1					1	1							1
Arthropoda																																		
Amphipoda																																		
	Ampelisca sp.				2			1	1						2				1	2	2		7	1		2	1		1			1	1	
	Hyperia spp.																										1	2						
	Lysianassidae	1	1	9	1	3	13	13					4		6		4		6	2	5	3	4	2	3	20	7	1	9	12	11	6	4	6
	Oedicerotidae	1			2			2	1	1			5		2				2	1	1		2	1	2	1	2	1	2	4		1	2	
	Phoxocephalidae	65	2	22	14	10	46	20	6	2	3	1	41		10	2	12	6	6	12	9	25	12	23	39	6	10	2	10	38	9	11	12	34
	Urothoidae												12		14		14	5	14	31	17	10	21	12	35	24	25	19	11	12	1	13	5	4
	Amphipoda Unid.	10	8	3	4	7	6	4	15	14	10	8	1	9	3	14	2		1	2	2	6		4	1	1			4	1	2	2		1
Cumacea																																		
	Cumacea			2			1	2	2	3	2		1	1		1	3		2	1	2	1	4	3	3		2	1		1	2	3		1
Decapoda																																		
	Callianassa filholi				4	3		3							7		3	1	4	7	7	3	5			2	2		4					1
	Philocheras sp.																			1														
	Nectocarcinus benetti								1																									
	Halicarcinus sp.																												1					
	Halicarcinus tongi				1																													
	Halicarcinus varius														1																			
	Ogyrides sp																												1					
	Pagurus sp.		2				7	3				3			11			3		5			1		4		2	9			1		1	
	Liocarcinus corrugatus								1							2																		
	Decapoda (larvae Unid.)					1																												
Isopoda																																		
	Anthuridea		1	1	1	1			2						1				3	1	1		1	1	1		1	1		1		1	1	
	Eurylana cookii		5			1		1	2	9				1		2									3									
	Pseudaega secunda	1			3		1						2												3									
	Cassidina typa																	2																
	Exosphaeroma falcatum	19																							7									
Leptostraca																																		
	Nebalia sp.					1	12	2					1		5	1	2		3	1	1	3	2	1		2	5							
Mysidacea		1		2	1		1	1		1	1	1			2	3			1					1	1	1			1		2	1		2
Tanaidacea				1			2																											
Ostracoda																																		
	Diasterope grisea	8			1	1		1					1				1						1	4		1				2		1		
	Parasterope quadrata					1																	1		1					1				
	Cypridinodes								1	2	1					2								1	2		1			1		3		
	Scleroconcha sp.	2					1						1		1		1								1									
	Rutiderma sp.					1																												
Thecostraca																																		
	Balanus decorus											1																						
Mollusca																																		
Polyplacophora																																		
	Ischnochiton maorianus								7			1				3																		
Gastropoda																																		
	Epitonium scalare					1													1															
	Maoricolpus roseus			1																														
	Zeacolpus vittatus																1		2															
	Cylichna thetidis				1	1			1							1														1	1	2	1	

Taxa	Date	21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24		
	Cell	3A			3B			3C			3D			3E			3F			3G			3H			3I			3J			3K		
	Sample	3A1	3A2	3A3	3B1	3B2	3B3	3C1	3C2	3C3	3D1	3D2	3D3	3E1	3E2	3E3	3F1	3F2	3F3	3G1	3G2	3G3	3H1	3H2	3H3	3I1	3I2	3I3	3J1	3J2	3J3	3K1	3K2	3K3
	Depth	20.8	21.9	21.1	23.0	21.4	23.3	23.7	23.7	24.1	25.8	25.0	24.3	26.9	26.4	24.8	26.1	26.5	25.5	26.3	26.5	25.4	26.2	26.1	25.1	27.2	26.5	26.0	27.4	28.0	27.4	28.3	28.1	28.6
	Philine sp													1						1		1	2			1	1		1			1		
	Relichna aupouria			1		1		4	2	1																								
	Pisinna sp.											1																						
	Sigapatella tenuis	3	6			4	2		11	5		6	1		3	10	2		1	2	2	1		3	2		2			2	2	4		2
	Eulimidae																										1							
	Naticidae																										1							
	Struthiolaria papulosa																1																	
	Amalda northlandica			1															1								1		1	1				2
	Columbellidae					1																												
	Cominella adspersa																			1														
	Cominella virgata	1			1		2		2	1					1		1							2		1							1	
	Marginellidae	2				2	2					2													4			1						
	Xymene sp.											1																						
	Austrofusus glans			1																														
	Duplicaria tristis	1										1			1	1											1							
	Micrelenchus sp.									1	1	2																						
	Punctacteon crateriuculatus																												1					
	Pupa affinis					1	2	2											3	4		1				1	3			2	2	2	1	1
	Adelphotectonica reevei	1													1				1			1			1	1		1	1					
	Psilaxis oxytropis																											1						
Bivalvia																																		
	Pratulum pulchellum							1																										
	Gari convexa	1					2	1		1		4			1				1	2	3	2	2		2		1		2		1		1	1
	Gari sp. (juvenile)	4	9	5	1	2	4	1	2	2	3	2	1	1	1	6	1		2	3	2		1	2	5			1		1	2		1	
	Gari stangeri		2										3			2									1	2		1						
	Hiatula nitida			1																						1								
	Hiatula siliquens																					1												
	Leptomya retiaria									1																								
	Pleuromeris sp.		1																														1	
	Pleuromeris zelandica																												1					
	Purpurocardia purpurata											2																						
	Myllitella vivens vivens							1																										
	Limatula maoria					1			1		1					4																		
	Corbula zelandica										2	9																						
	Nucula nitidula	1	27	9	2	28	4	3	23	15	2	11	3	2		30	2				1	2	4	4	1		4		1	1	1	1	2	
	Atrina zelandica (juvenile)		1																															
	Pecten novaezelandiae									1										1				1										
	Chlamys sp.								1																									
	Scalpomactra scalpellum	4	2	3		4							2			6	1	1	2		1	2	1	2	1	1	1	3		2	1		1	
	Zemysina sp.	4		4	22	7	4	2		3			6		3		1			8	8	3	4	4	6		5		2	3	2	5	1	
	Dosinia subrosea	1		1		1	1		2	4	1		1	1	1		1			1					1									
	Notocallista multistriata														1							1	2								1	1		
	Tawera spissa	3				6	1		9	2	2	29	1	1		5									2									
	Myadora antipodum			2	2																						1							
	Myadora striata	1		3	3	1	1	1	1	2					1									1										
	Thraciidae	3			1	1	1						1		1									1		1				1		2		
Echinodermata																																		
Asteroidea																																		
	Astropecten polyacanthus																								1									
Echinoidea																																		
	Evechinus chloroticus					1					1	2																						
	Echinocardium cordatum													1	1			1			1													
Holothuroidea																																		
	Trochodota dendyi											1																						
Ophiuroidea																																		
	Ophiuroidea		1							1	1	1	1	1				1				1												
Bryozoa																																		
	Bryozoa (discoid)	1	23			20	1		14	4	9			1		19		7														1		
	Bryozoa (encrusting)					1						1				1																		
	Bryozoa (solid Stalked)					1						1				1																		
Porifera																																		
	Sponge (cream Encrusting)				1																													
Cnidaria																																		
Hexacorallia																																		
	Anemone (Unid.)							1																										
	Arachnanthus sp.							1																										
	Sphenotrochus sp.															1																		
Chordata																																		
Ascidiacea																																		
	Pyura sp.		1																															
	Eugyra sp.																						2							1				1
Leptocardii																																		
	Epigonichthys hectori		3	2	1	1			21	2	5	17		16		5					1							3		1	1	1		
Number of Individuals		169	107	135	96	132	165	114	146	84	50	157	114	39	135	136	104	34	126	127	114	134	194	119	168	117	133	61	139	112	86	111	57	78
Number of Species / taxa		34	23	35	31	38	35	31	33	28	19	36	28	15	39	29	30	13	33	35	30	28	32	28	36	31	38	21	30	29	29	31	24	21
Shannon-Wiener Diversity Index		2.52	2.46	2.91	2.83	2.95	2.81	2.85	2.84	2.85	2.59	2.95	2.54	1.98	3.14	2.78	2.78	2.30	2.68	2.94	2.95	2.55	2.56	2.81	2.79	2.76	3.00	2.50	2.54	2.54	2.88	3.02	2.82	2.20
Shannon-Wiener Evenness		0.72	0.79	0.82	0.83	0.81	0.79	0.83	0.81	0.86	0.88	0.82	0.76	0.73	0.86	0.83	0.82	0.90	0.77	0.83	0.87	0.76	0.74	0.84	0.78	0.80	0.83	0.82	0.75	0.75	0.86	0.88	0.89	0.72

Table F.3 Benthic Infauna Retained on 1 mm sieve from the 04 Cells in the sand extraction area 2024 (Number per sample). Plus, Biota identified in Photographs in blue.

Taxa	Date	21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			6 Mar 24			6 Mar 24			6 Mar 24		
	Cell	4A			4B			4C			4D			4E			4F			4G			4H			4I			4J			4K		
	Sample	4A1	4A2	4A3	4B1	4B2	4B3	4C1	4C2	4C3	4D1	4D2	4D3	4E1	4E2	4E3	4F1	4F2	4F3	4G1	4G2	4G3	4H1	4H2	4H3	4I1	4I2	4I3	4J1	4J2	4J3	4K1	4K2	4K3
	Depth	21.5	20.8	20.4	22.1	21.2	20.9	22.9	21.4	20.9	24.1	24.0	22.4	23.8	24.1	23.6	24.3	23.7	24.5	25.2	25.9	23.7	26.1	26.1	26.7	27.0	26.0	24.9	28.5	26.6	27.5	28.9	27.9	27.8
Annelida																																		
Polychaeta																																		
Amphinomidae					1						1											1												2
Lumbrineridae													1			1							1					2	1		1		1	
Onuphidae	*Hartmanonuphis pectinata*			1		1													1			1	1							1	1		2	2
Onuphidae	*Onuphis aucklandensis*																									1	1							
Goniadidae		2	1		2	2		2			2							2			2					1	5			4		2	2	2
Hesionidae																												1		1				
Nephtyidae	*Aglaophamus sp.*		2			1	2	1	3	2	3			4			2	5	1			2	1			1						4		3
Phyllodocidae						1					1							1				1						3				3		
Sigalionidae		4	1	1	2	2	2	1			4			1	2	1	3	2	2		1	5	2	1		1	2	2		1	3	2	1	
Sphaerodoridae	*Sphaerodoropsis sp.*																										1							
Syllidae	*Syllidae*																											2	5					
Sabellidae			1		1	1								1			1								1					2	1	1		1
Serpulidae	*Hydroides sp*													2		1	34			8			1		2			5						
Spionidae	*Paraprionospio pinnata*		1			1		2										1								4	2					3	2	3
Spionidae	*Spiophanes kroyeri*							1																								1		1
Ampharetidae		18	10	1	7	15	1	15			6	2		18			1	13	2		1	26	6		4	1	18		4	3	12	54	6	13
Cirratulidae																												2	1					
Flabelligeridae																									1									
Pectinariidae	*Lagis australis*					2		1						1				3				1	1			1				2	2			1
Terebellidae						1															1													
Capitellidae	*Barantolla lepte*																								1									
Chaetopteridae	*Phyllochaetopterus socialis*																													1			1	
Magelonidae	*Magelona dakini*								1						1						1	1				1				1	1			
Maldanidae		10	5	2	3	6	1	6	1	1	4	3	1	7	1	4	3	6	2		4	4	9	1	3	4	5			27	9	15	18	12
Opheliidae	*Armandia maculata*		2			10		4	1						1				8			1		1									1	
Orbiniidae	*Leitoscoloplos kerguelensis*																	1							1							1	1	1
Oweniidae	*Myriowenia sp.*	2	3		6	3		5			1			4				1				8	29			24	12	1	1	45	10	3	2	1
Oweniidae	*Owenia petersenae*								1					1					1			1						2						1
Travisiidae	*Travisia olens*			1	1												1														1			
Sipuncula																																		
	Aspidosiphon sp.																											3	1				1	
Nemertea														1	1			1		1	1		1	1	1		1	2			1		1	
Arthropoda																																		
Amphipoda																																		
	Ampelisca sp.																						1			2				3		1	1	
	Lysianassidae	15	6	2	5	4	2	3	1	2	4	2		10		1	1	4	4		2	12	16			2	7			4	5	5	2	6
	Oedicerotidae	2				2	1	1	3	4													2				1			1				1
	Phoxocephalidae	14	11	16	25	32	9	49	21	8	20		1	7	1		5	12	47	2		7	2	2	4	8	8	2		7	7	5	4	4
	Urothoidae	24	3		29	35	4	34	20	18	22		1	3		2	5	16	24			4	14			4	6			2	3	3	4	1
	Amphipoda Unid.	1	3	1	2	1	9	5	9	5		5	4	3	3	7	9	1	5	4	3		4	7	26	2	7	462	1	1	3	7	2	5
Cumacea																																		
	Cumacea	4				5	1	5	2	1							3	4	2			4			1		1				1	1		2
Decapoda																																		
	Callianassa filholi	3				1			2		4			1									5		1		1			4			3	3
	Nectocarcinus benetti															1																		
	Halicarcinus tongi																						1			2								
	Ogyrides sp																										1						1	2
	Pagurus sp.		2		1	1			1	*1*			1	2			3	3					5	8	6	1	2	1		4	1		1	
	Palaemon affinis																								4									
	Liocarcinus corrugatus												1				2						1											
Isopoda																																		
	Anthuridea	1		1	1	2		3		2		3		1	1	1	1		2	1							1							1
	Eurylana cookii						1					5	2		1	2			1	2				1					1					
	Pseudaega secunda	1	1		2	5		4	3	1	2								4			1												
	Exosphaeroma falcatum			22		1			8	5									4															
Leptostraca																																		
	Nebalia sp.	3			1			2			3			1													2			1	1		1	1
Mysidacea			2	2			4	1	2	5			1	2			1	2				1												
Tanaidacea																												2						
Ostracoda																																		
	Diasterope grisea		1	1					3	1	2								1															
	Scleroconcha sp.			1					3		1							2										1						
	Rutiderma sp.			1																														
Mollusca																																		
Polyplacophora																																		
	Ischnochiton maorianus																			1					1			2						
	Leptochiton inquinatus																								1									
Gastropoda																																		
	Zeacolpus vittatus																																	2
	Cylichna thetidis			1				3			1			3			1		2				1											1
	Philine sp	1						1			1		2				1		2															
	Sigapatella tenuis		2	3	1		1			3	2	2	9		4	5	11	1	2		2		4	2	43	1	2	1			2		1	3
	Naticidae																					1												
	Pelicaria vermis																															1		
	Struthiolaria papulosa		1											2																				
	Amalda northlandica	2			4						2							1					2				1			1				
	Cominella virgata	1		1			1	1	1														1	1					1					
	Austromitra angulata																						1											
	Austromitra rubiginosa																							1										
	Neoguraleus sp.		1																						1								1	
	Marginellidae					1			1										1															
	Xymene sp.												1			1	1								1		1							
	Austrofusus glans																					1											3	
	Duplicaria tristis																								1		1							
	Micrelenchus sp.											1												4										

Taxa	Date	21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			6 Mar 24			6 Mar 24			6 Mar 24		
	Cell	4A			4B			4C			4D			4E			4F			4G			4H			4I			4J			4K		
	Sample	4A1	4A2	4A3	4B1	4B2	4B3	4C1	4C2	4C3	4D1	4D2	4D3	4E1	4E2	4E3	4F1	4F2	4F3	4G1	4G2	4G3	4H1	4H2	4H3	4I1	4I2	4I3	4J1	4J2	4J3	4K1	4K2	4K3
	Depth	21.5	20.8	20.4	22.1	21.2	20.9	22.9	21.4	20.9	24.1	24.0	22.4	23.8	24.1	23.6	24.3	23.7	24.5	25.2	25.9	23.7	26.1	26.1	26.7	27.0	26.0	24.9	28.5	26.6	27.5	28.9	27.9	27.8
	Punctacteon cratericulatus																										1							
	Pupa affinis	1	1		1	1					2			2			1	2				2	2				3			1	4	1		2
	Adelphotectonica reevei		1		1	1			1										4					1			1		1				2	
Bivalvia																																		
	Pratulum pulchellum																								1	1								
	Gari convexa	1	3		1		2	3			1						1					2	1		3			1		2			1	
	Gari sp. (juvenile)	1	2	1	3	4		2	3		2		2	2		2	1	2	2	1		1			3	2			1	1		1		
	Gari stangeri			1				1	3		1			1			1		1	1	1							2						
	Pleuromeris sp.											1													1			1		1			1	1
	Anisodonta alata alata																														1			
	Myllitella vivens vivens										4																							
	Limatula maoria			1								1					4								1									
	Limaria orientalis																			1					1									
	Corbula zelandica																								1			1						
	Nucula nitidula	2	3	4	3	1	1	3	7	1	4	10	4	2	2	4	5		3		3	1	3	4	11	1		8	2			1	1	1
	Atrina zelandica (juvenile)									1						1																		
	Pecten novaezelandiae																								1									
	Chlamys sp.					1							1																					
	Scalpomactra scalpellum	1	2	3	3	2	2	1	3	9	1	2	4		1	2	3	1	4		4	2	1	1	1		1						2	1
	Zemysina sp.	1		1	3	4		3	2		1	1		1					2		1	2	5				3			2	1		2	2
	Bassina yatei																																1	
	Dosinia subrosea			1						1		1					1		3	1	2													
	Notocallista multistriata																					1										1		
	Tawera spissa			2			1		3	1						1	5				1				4			1						
	Myadora striata		3	2	2	3		1									1		1		1							1						
	Thraciidae	1			1		1	1	2									1			3						2				1	1		
Echinodermata																																		
Asteroidea																																		
	Astropecten polyacanthus						1												4								1							
Echinoidea																																		
	Echinocardium cordatum														1																			
Holothuroidea																																		
	Trochodota dendyi																											1						
Ophiuroidea																																		
	Ophiuroidea														1					1	1							1						
Bryozoa																																		
	Bryozoa (discoid)			12			29		4	11		9	19		24	7	9				2		1											
	Bryozoa (encrusting)																			1					1			1						
	Bryozoa (solid Stalked)																1								1			1						
Porifera																																		
Demospongiae	*cf Tethyopsis sp.*											*1*																	*1*					
	Sponge (cream Encrusting)																								1									
Cnidaria																																		
Hexacorallia																																		
	Kionotrochus sutrei																								1									
Chordata																																		
Ascidiacea																																		
	Eugyra sp.		2														2	4																
Leptocardii																																		
	Epigonichthys hectori				1		1	1				11			2		3	1	1	12				2	5			5	5	1				
Teleostei																																		
	Ophisurus serpens																						1											
	Gobiesocidae																								1									
Number of Individuals		**116**	**76**	**86**	**113**	**153**	**77**	**166**	**115**	**83**	**102**	**60**	**55**	**83**	**47**	**44**	**127**	**93**	**143**	**37**	**37**	**94**	**126**	**38**	**142**	**65**	**101**	**520**	**26**	**124**	**72**	**117**	**73**	**82**
Number of Species / taxa		**25**	**28**	**27**	**28**	**33**	**22**	**32**	**29**	**21**	**28**	**17**	**17**	**26**	**16**	**18**	**34**	**27**	**31**	**14**	**20**	**27**	**32**	**16**	**37**	**21**	**31**	**30**	**14**	**27**	**23**	**23**	**32**	**31**
Shannon-Wiener Diversity Index		**2.57**	**3.03**	**2.58**	**2.61**	**2.69**	**2.33**	**2.57**	**2.87**	**2.59**	**2.78**	**2.47**	**2.25**	**2.82**	**1.95**	**2.60**	**2.90**	**2.84**	**2.62**	**2.13**	**2.86**	**2.67**	**2.81**	**2.44**	**2.67**	**2.38**	**2.96**	**0.70**	**2.37**	**2.32**	**2.71**	**2.14**	**3.02**	**3.04**
Shannon-Wiener Evenness		**0.80**	**0.91**	**0.78**	**0.78**	**0.77**	**0.75**	**0.74**	**0.85**	**0.85**	**0.83**	**0.87**	**0.80**	**0.86**	**0.70**	**0.90**	**0.82**	**0.86**	**0.76**	**0.81**	**0.95**	**0.81**	**0.81**	**0.88**	**0.74**	**0.78**	**0.86**	**0.21**	**0.90**	**0.70**	**0.87**	**0.68**	**0.87**	**0.89**

Table F.4 Benthic Infauna Retained on 1 mm sieve from the 05 Cells in the sand extraction area 2024 (Number per sample). Plus, Biota identified in Photographs in blue.

Taxa	Date	21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			6 Mar 24			6 Mar 24			6 Mar 24		
	Cell	5A			5B			5C			5D			5E			5F			5G			5H			5I			5J			5K		
	Sample	5A1	5A2	5A3	5B1	5B2	5B3	5C1	5C2	5C3	5D1	5D2	5D3	5E1	5E2	5E3	5F1	5F2	5F3	5G1	5G2	5G3	5H1	5H2	5H3	5I1	5I2	5I3	5J1	5J2	5J3	5K1	5K2	5K3
	Depth	21.7	22.0	22.1	22.1	24.0	21.2	21.9	23.2	22.8	24.5	24.3	23.7	24.4	24.6	23.9	25.9	25.7	25.2	26.2	25.0	25.7	26.6	27.4	27.0	28.0	27.3	28.4	28.3	28.5	29.0	28.5	28.3	30.7
Annelida																																		
Polychaeta																																		
Amphinomidae																		1							1									
Eunicidae																															1			
Lumbrineridae				1								1		1									1		2		2				1	1	1	1
Onuphidae	*Hartmanonuphis pectinata*																			1	1		2											
Onuphidae	*Onuphis aucklandensis*																										1		1				1	
Glyceridae																				1				1					1					
Goniadidae				1			1			1			4			2		2									1	1		1		1	2	2
Nephtyidae	*Aglaophamus sp.*	1		1	1		3	1				1	2			3		1	1		3	1	1				4			1	1	5	3	3
Phyllodocidae											1		1					1	1		1			1			1			1		1	1	
Polynoidae				1																														
Sigalionidae		1	1			1	1	1		4	3		4	2	1	2		2	2	1				1	4	1	5	1		1	1	3		3
Syllidae	Syllidae			1											1									1		2		1						
Sabellidae				1		1			1		1		1	1			1	1									1			1				
Serpulidae	*Hydroides sp*			55		181	1				1						120	2		3			44	12		7			141	1				
Spionidae	*Paraprionospio pinnata*												3			2																1	1	2
Spionidae	*Spiophanes kroyeri*																	1														1	1	
Ampharetidae				1						14	1		12	1	10	32		25	2				1	2	21	1	20	1	2	1		37	4	43
Flabelligeridae				1													1	1					1			3			2					
Pectinariidae	*Lagis australis*									1					1			1															1	
Terebellidae																							1											
Capitellidae	*Barantolla lepte*																									2								
Capitellidae	*Heteromastus filiformis*	1															1																	
Chaetopteridae	*Phyllochaetopterus socialis*																																1	
Magelonidae	*Magelona dakini*										1	1																						
Maldanidae		3	1	2	5	2	3	2	2	4	2	6	4	2	6	8		10	4	7	2	5	2		3	1	6	1	3	1		10	12	4
Opheliidae	*Armandia maculata*			6	4		1	1		1			4	1		5			4		4	2	1				1	1	1	1	1	5		
Orbiniidae	*Leitoscoloplos kerguelensis*																	2														1		
Oweniidae	*Myriowenia sp.*									7			1		2	4		2	3		2	1			12	2	2					5	37	8
Oweniidae	*Owenia petersenae*																			1			3	7		7			1				1	1
Travisiidae	*Travisia olens*											1		1			1							1			1		1				1	
Sipuncula																																		
	Aspidosiphon sp.						1		1			1				1	6						1			2		9	5					
Nemertea		1	1					1	1	1	2		1					1				2				1			2	1	1	1	1	2
Arthropoda																																		
Amphipoda																																		
	Ampelisca sp.														1			2	1													1	3	1
	Lysianassidae		1		2	2	4	4	8	7			5		5	2		11	2		1	2			6		4	1						2
	Oedicerotidae		2		1		2	2					2			1		1	1															
	Phoxocephalidae	4	8	2	26	1	12	23	8	9	4	5	15	2	19	9		16	6	10	11	14	1	1	6	5	11	7	1	5	5	10	8	21
	Urothoidae	5	6		28		24	50	5	18	6	6	39		16	23		11	21	1	7	4	1	1	4		5	4	1	1		9	4	9
	Amphipoda Unid.	4	15	34	1	20	8	2	4	2	5	12	1	6	3		4	11	3	5		3	9		1	5	5		18	1	6	2	2	1
Cumacea																																		
	Cumacea	1	1	2	2	3			1				4	1	1	3	1	1	6			1			4	1	2	1			1	1		1
Decapoda																																		
	Alpheus sp.																						1											
	Callianassa filholi				1	2					1	1	1					20				2									1		6	
	Philocheras australis	1		1		1																					1		2					
	Nectocarcinus benetti																							1										
	Halicarcinus tongi									1																	1						1	
	Pyromaia tuberculata																									1								
	Notomithrax minor													1									1											
	Ogyrides sp																	1															2	
	Pagurus sp.			4		15	1			5	1	1	*1*	1				8		63				1	1	1	3		36		2	1	2	2
	Palaemon affinis					1					1												1	1										
	Liocarcinus corrugatus			1		2						1											3	1						1				
Isopoda																																		
	Anthuridea	1	2	1					1	1			3		1										2					1	1	2		1
	Eurylana cookii			4		1					1						2			1		1		1	1				1		3			
	Pseudaega secunda				4			1		1			1		1				1															
	Exosphaeroma falcatum	1			72			38											3															
Leptostraca																																		
	Nebalia sp.									3			1		1	2		7									2					3		
Mysidacea				1	3		1	1					1																					
Tanaidacea				1																						3		1						
Ostracoda																																		
	Diasterope grisea		2			1	2	6						1		1			1			3					1							
	Leuroleberis zealandica			2																														
	Parasterope quadrata									1																								
	Cypridinodes	1					1					1								1										1				
	Euphilomedes agilis																											1	1					
	Scleroconcha sp.												1								1													
Mollusca																																		
Polyplacophora																																		
	Ischnochiton maorianus			1		6								1			2						3	3					4					
Gastropoda																																		
	Zeacolpus vittatus																1			3														
	Cylichna thetidis	3	1				2			1									1		1													
	Philine sp	1					2	1					1	2				1	2			1							2	1				
	Sigapatella tenuis	16	11	15		6	1	1	3		13	5		1			5		1	1		5	9	3	2	4		2	7	13	1	3		3
	Eulimidae																												1					
	Pelicaria vermis										1																							
	Amalda northlandica								1																2		1						1	
	Cominella adspersa				1		1																											
	Cominella virgata	1									1						2				1			1			1		2	1			1	
	Marginellidae				1																													

Taxa	Date	21Mar24			21Mar24			21Mar24			21Mar24			21Mar24			21Mar24			21Mar24			21Mar24			6Mar24			6Mar24			6Mar24		
	Cell	5A			5B			5C			5D			5E			5F			5G			5H			5I			5J			5K		
	Sample	5A1	5A2	5A3	5B1	5B2	5B3	5C1	5C2	5C3	5D1	5D2	5D3	5E1	5E2	5E3	5F1	5F2	5F3	5G1	5G2	5G3	5H1	5H2	5H3	5I1	5I2	5I3	5J1	5J2	5J3	5K1	5K2	5K3
	Depth	21.7	22.0	22.1	22.1	24.0	21.2	21.9	23.2	22.8	24.5	24.3	23.7	24.4	24.6	23.9	25.9	25.7	25.2	26.2	25.0	25.7	26.6	27.4	27.0	28.0	27.3	28.4	28.3	28.5	29.0	28.5	28.3	30.7
	Xymene sp.	1																1																
	Austrofusus glans			1						2			1					1											1				1	
	Duplicaria tristis																															1		
	Onchidella nigricans																												1					
	Micrelenchus sp.			1																2						1			2					
	Punctacteon crateriiculatus																																1	
	Pupa affinis									3			1					4			1				1		1					1	1	3
	Adelphotectonica reevei																								1									
Bivalvia																																		
	Pratulum pulchellum										1			1				1				1			1			1	2	1	1	2		
	Gari convexa										1		5			3							1		1		1			1				
	Gari sp. (juvenile)	7	2	10		4	1		3	3	2	1	4	2	1	3	2	2	3	1		1	1	1		1	5		2		1			1
	Gari stangeri	2		7		1					1			1	2		1		1				2			1	1	1						1
	Hiatula siliquens														1	2																		
	Pleuromeris sp.	2												1														1	1					
	Pleuromeris zelandica													1						1		1								2				
	Myllitella vivens vivens						1						1																					
	Limatula maoria	2							1																					2				
	Limaria orientalis			1																														
	Corbula zelandica			2										1			1						1	2					1	1				
	Nucula nitidula	69	38	17	1	26	2	2	12	1	14	9	3		3	3	8	3	7		2	3	8	12		9	2		3	12	3	1		1
	Pecten novaezelandiae																														1			
	Chlamys sp.											1																						
	Scalpomactra scalpellum	1	4		5		2	6	9		2	6	6	1	2	2		2	4		2	8					3	1			5	4	1	2
	Zemysina sp.		1				2		2						2	2		8	1		3		1				3					3	7	6
	Bassina yatei																																	1
	Dosinia subrosea	2	1	1	1						1	1		1	1		1													1				
	Notocallista multistriata												1			1																1		1
	Tawera spissa	18	3	19		4	2	1	4								6					2	6	6					1	2				
	Myadora striata	1					1		2	1	2		1		2	2			4															3
	Thraciidae		1	2			1	1		2			4		1	2		1																3
Echinodermata																																		
Asteroidea																																		
	Astropecten polyacanthus							1											1													1		
Holothuroidea																																		
	Trochodota dendyi			1																						1	1				1			
Ophiuroidea																																		
	Ophiuroidea			1							1						1												1	1				
Bryozoa																																		
	Bryozoa (discoid)	127	71	5	8	74	33	5	10		17	30		5					2			5			1					1	2			
	Bryozoa (encrusting)					1											1			1			1	1		1		1	1	1			1	
	Bryozoa (solid Stalked)					1											1						1	3		1		1	1	1				
Porifera																																		
Demospongiae	*cf Tethyopsis sp.*	3		1							1															1	*1*	1		1				
Cnidaria																																		
Hydrozoa																																		
	Hydroida (thecate)																1																	
Chordata																																		
Ascidiacea																																		
	Pyura sp.										1				1																			
	Eugyra sp.					1							1						3															
Leptocardii																																		
	Epigonichthys hectori	1	1	3		2		1		1	2	2	3	2			18	3		34		7	12	9		14		10	10	6	2			
Teleostei																																		
	Ophisurus serpens																																1	
	Gobiesocidae			1																														
Number of Individuals		**282**	**174**	**213**	**167**	**360**	**117**	**152**	**79**	**95**	**92**	**93**	**144**	**41**	**85**	**120**	**188**	**169**	**92**	**138**	**43**	**75**	**121**	**74**	**77**	**79**	**100**	**49**	**263**	**68**	**42**	**118**	**111**	**132**
Number of Species/taxa		**30**	**22**	**40**	**19**	**26**	**29**	**23**	**20**	**26**	**31**	**21**	**37**	**26**	**25**	**25**	**24**	**37**	**29**	**19**	**16**	**23**	**30**	**25**	**21**	**27**	**33**	**22**	**36**	**33**	**22**	**30**	**32**	**29**
Shannon-Wiener Diversity Index		**1.91**	**2.00**	**2.72**	**1.91**	**1.75**	**2.53**	**2.09**	**2.65**	**2.77**	**2.84**	**2.37**	**2.92**	**3.05**	**2.61**	**2.59**	**1.60**	**3.02**	**2.95**	**1.79**	**2.42**	**2.80**	**2.50**	**2.73**	**2.52**	**2.88**	**3.03**	**2.60**	**1.97**	**2.95**	**2.84**	**2.68**	**2.66**	**2.56**
Shannon-Wiener Evenness		**0.56**	**0.65**	**0.74**	**0.65**	**0.54**	**0.75**	**0.67**	**0.88**	**0.85**	**0.83**	**0.78**	**0.81**	**0.94**	**0.81**	**0.81**	**0.50**	**0.84**	**0.88**	**0.61**	**0.87**	**0.89**	**0.74**	**0.85**	**0.83**	**0.87**	**0.87**	**0.84**	**0.55**	**0.84**	**0.92**	**0.79**	**0.77**	**0.76**

Table F.5 Benthic Infauna Retained on 1 mm sieve from the 06 Cells in the sand extraction area 2024 (Number per sample).

Taxa	Date	21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			20 Mar 24			20 Mar 24			20 Mar 24			7 Mar 24			7 Mar 24			7 Mar 24		
	Cell	6A			6B			6C			6D			6E			6F			6G			6H			6I			6J			6K		
	Sample	6A1	6A2	6A3	6B1	6B2	6B3	6C1	6C2	6C3	6D1	6D2	6D3	6E1	6E2	6E3	6F1	6F2	6F3	6G1	6G2	6G3	6H1	6H2	6H3	6I1	6I2	6I3	6J1	6J2	6J3	6K1	6K2	6K3
	Depth	20.3	21.3	20.8	21.1	21.2	21.8	22.6	21.9	22.7	22.9	22.9	23.4	23.6	22.6	24.6	24.5	25.8	25.7	26.0	26.9	27.4	27.2	27.5	27.5	28.4	27.9	28.1	30.0	27.8	28.1	29.8	25.8	28.7
Annelida																																		
Polychaeta																																		
Amphinomidae																							2				1				1			1
Eunicidae																		1																
Lumbrineridae											1				1					1			1				3							2
Onuphidae	*Hartmanonuphis pectinata*																										1		2				1	
Glyceridae																																1		
Goniadidae													1										2		1	1	1	2		1	1		1	3
Nephtyidae	*Aglaophamus sp.*	2		1	2		1	1			1	1	1				2	1	1		1	1	4	1	2	3	3	2	2	2	3	1	1	4
Phyllodocidae					1								1												1			4						
Sigalionidae			1	1	1	1		1	1	1	2	2	1	1		2	1	1		1	1	3		3		1	1	1	1	2	1	4	3	2
Syllidae	Syllidae							1				1													1			2						
Sabellidae					3		1			1				1		1	2	1	5	1	2	3	2		1		1	4		2	1	2	1	1
Serpulidae	*Hydroides sp*																	76								1								
Spionidae	*Paraprionospio pinnata*									1													2		3		2	7	1	4	3		5	3
Spionidae	*Spiophanes kroyeri*																													1				
Ampharetidae					1																	1	4		8		3	31	16	11	11	1	16	14
Cirratulidae																												1						
Flabelligeridae			1																					1								2		
Pectinariidae	*Lagis australis*																																	1
Terebellidae																									1									
Capitellidae	*Barantolla lepte*																															1		
Capitellidae	*Notomastus zeylanicus*																										1							
Magelonidae	*Magelona dakini*									1									2		1							3						1
Maldanidae		1	2	1	4	1	2	6	1	1	2		1		1	1	1	2	2	1	2	1	9		1	5	7	8	4	10	1	1	12	12
Opheliidae	*Armandia maculata*	4			6								5															3	1		4	1		
Orbiniidae	*Leitoscoloplos kerguelensis*																														1			
Orbiniidae	*Orbinia papillosa*																															2		
Oweniidae	*Myriochele sp.*			1							1					1						2		2	1	1								
Oweniidae	*Myriowenia sp.*				1																				9		5	9	2	30	1		7	51
Oweniidae	*Owenia petersenae*																									1				1				
Sabellariidae	*Neosabellaria kaiparaensis*																															1		
Travisiidae	*Travisia olens*																		1		2			2								2		
Sipuncula																																		
	Aspidosiphon sp.		1							1			1															1						
	Nephasoma sp.							1						1																				
Nemertea			1			5	1			1	2	1	1		1	1				2		1	2	1	1			2		1	1			1
Arthropoda																																		
Amphipoda																																		
	Ampelisca sp.				1																					1	7			1	1		3	3
	Hyperia sp.	1		1						1																								
	Lysianassidae				6																		2		1	2	1	1		2	3		1	2
	Oedicerotidae		1	1			1																1					2	1		1			1
	Phoxocephalidae	21	7	10	28	11	14	17	2	6	1	4	5	2	3	6	1	1		2		3	9	2	1	2	1	5	3	1	1	5	4	4
	Urothoidae	37	3	46	45	8	33	4		7		2	24	3	1	2	1		1				21		3	4	8	2	11	6	9	1	10	2
	Amphipoda Unid.	2	3	2	2	1	4	10	8	11	14	6	2	1	2	5	6	8	6	3	1		4	2		1	3	1	3	8	1	24	1	2
Cumacea																																		
	Cumacea	1	1		3			1	1	1	1		1	2		2	2	1						3	2			2		1	1	1	1	1
Decapoda																																		
	Callianassa filholi		1									1				2	1	1					9	1	6	3	4	3	9	6				2
	Philocheras australis																		1		1	1												
	Halicarcinus tongi																										1							
	Pyromaia tuberculata				1							1									5											2		
	Ebalia laevis																	1					1						1					
	Notomithrax minor																	1																
	Ogyrides sp																											1						
	Pagurus sp.	1					*1*											2				2				4	6	2	1	9		5		2
	Liocarcinus corrugatus			1				1									1					1										2		
Isopoda																																		
	Munna neozelanica				1																													
	Anthuridea	1		1	2			2			2		4			1				1													1	
	Eurylana cookii	1										1								4	1	3										1		
	Pseudaega secunda	7		2																														
	Cassidina typa				1	1																												
	Exosphaeroma falcatum	56			25																													
Leptostraca																																		
	Nebalia sp.																									1	2							
Mysidacea		1	1	1	1	2	1			1				1						1			1	1								1		
Ostracoda																																		
	Diasterope grisea	1					1	1					1															2	1					
	Cypridinodes	2		1						1			2			1								4										
	Euphilomedes agilis		1		1																													
	Scleroconcha sp.																														1			
Mollusca																																		
Polyplacophora																																		
	Ischnochiton maorianus																2	2				1										1		
Gastropoda																																		
	Cylichna thetidis		2	1		1			1														1											
	Philine sp		2	1	3	3	2	1		1	1			1	1	2	1			1			1											
	Sigapatella tenuis	1	4			7	4	1	3	1	4		1	5	3	3	5	5	13	5	7	3	5	2		2	2		2	2		44	5	2
	Pelicaria vermis																						1											
	Struthiolaria papulosa							1																			1							
	Amalda northlandica																						1		1	1								1
	Columbellidae																1	1																
	Cominella adspersa										1																							
	Cominella virgata		2						1								1			1				1				1			2	1		
	Marginellidae		2	1	1	1	1					1	3	1	1																			

Taxa	Date	21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24			20 Mar 24			20 Mar 24			20 Mar 24			7 Mar 24			7 Mar 24			7 Mar 24		
	Cell	6A			6B			6C			6D			6E			6F			6G			6H			6I			6J			6K		
	Sample	6A1	6A2	6A3	6B1	6B2	6B3	6C1	6C2	6C3	6D1	6D2	6D3	6E1	6E2	6E3	6F1	6F2	6F3	6G1	6G2	6G3	6H1	6H2	6H3	6I1	6I2	6I3	6J1	6J2	6J3	6K1	6K2	6K3
	Depth	20.3	21.3	20.8	21.1	21.2	21.8	22.6	21.9	22.7	22.9	22.9	23.4	23.6	22.6	24.6	24.5	25.8	25.7	26.0	26.9	27.4	27.2	27.5	27.5	28.4	27.9	28.1	30.0	27.8	28.1	29.8	25.8	28.7
	Xymene sp.																	3																
	Austrofusus glans	2																									1		1	1				1
	Spectamen tryphenense																							1										
	Micrelenchus sp.																				1	1												
	Pupa affinis																						6						1	1	1			
	Adelphotectonica reevei																										1	2			1		1	1
	Psilaxis oxytropis						1	1						2													2		1		3			
Bivalvia																																		
	Hiatella arctica																	1									1							
	Pratulum pulchellum									1							1			1			1		1		1			1				
	Gari convexa					1											1	1	1							1	1			4	1			
	Gari sp. (juvenile)	2	5	3	4	1	3	3		1	2					1	1	2		2	1	2		1				2						1
	Gari stangeri																2	1		1	1													
	Moerella huttoni																									1								
	Pleuromeris sp.		2								1					1	1				1			1			1					2		
	Pleuromeris zelandica														1			1													1	2	1	1
	Purpurocardia purpurata																							1										
	Myllitella vivens vivens															2										2								
	Limatula maoria											1					1				1													
	Corbula zelandica																1				1	3	1	2										
	Nucula nitidula	2	18	1	2	2	6	6	3	8	2	1	2	2		5	6	11	4	8	8	4	2	8	5	3	1	1	1	3	3	17		1
	Atrina zelandica (juvenile)																		1															
	Pecten novaezelandiae																	2			1											1		
	Chlamys sp.																	1																
	Oxyperas elongata																1																	
	Scalpomactra scalpellum	4	1	2	8	4	7	2	4	1	3	4	10	5	2	1	1		1	1			1	3	2		2	1	3	1			2	1
	Zemysina sp.			1	4		4	1	1														6		7		6		2	5	3		4	6
	Dosinia subrosea	2			1		1	1	1	1			1					1		1								1				1	1	
	Notocallista multistriata																										2	1			1		2	
	Tawera spissa	1	2	4	2	3	1	1		2	2				1	2	2	6	1		1	2					1					4		
	Myadora antipodum				1	2		2																										
	Myadora striata										1	1		2		2							2	3								2		
	Thraciidae				2			3	2														1										1	3
Echinodermata																																		
Asteroidea																																		
	Astropecten polyacanthus									*1*																					1			
Holothuroidea																																		
	Trochodota dendyi												1																					
Ophiuroidea																																		
	Ophiuroidea																			1	1			1								1		1
Bryozoa																																		
	Bryozoa (discoid)	5	32	19		16	5	19	15	9	16	5	5	10	16	14	9	14	7	3	4			15						1		45		
	Bryozoa (encrusting)																	1																
	Bryozoa (solid Stalked)																	1		1												1		
Porifera																																		
Demospongiae	*cf Tethyopsis sp.*											*1*		1		1	2	1			1	*1*		2								1		
Cnidaria																																		
Hexacorallia																																		
	Anemone (Unid.)																		1															
	Edwardsia sp.																											1					1	1
	Sphenotrochus sp.																		1															
Hydrozoa																																		
	Hydroida (thecate)																	1																
Chordata																																		
Ascidiacea																																		
	Eugyra sp.	1							1		1			1					1	1														
Leptocardii																																		
	Epigonichthys hectori	1						2	1	1		1	2		1	1	4	2	2	4	1	10		1	2							9		
Number of Individuals		**160**	**96**	**103**	**164**	**71**	**95**	**90**	**46**	**62**	**61**	**35**	**76**	**42**	**35**	**60**	**61**	**155**	**52**	**48**	**47**	**49**	**105**	**65**	**61**	**41**	**85**	**111**	**70**	**118**	**64**	**193**	**86**	**135**
Number of Species / taxa		**26**	**24**	**23**	**31**	**19**	**22**	**26**	**16**	**25**	**21**	**18**	**23**	**18**	**14**	**24**	**29**	**33**	**19**	**24**	**24**	**21**	**30**	**26**	**23**	**21**	**35**	**33**	**23**	**28**	**30**	**36**	**25**	**34**
Shannon-Wiener Diversity Index		**2.17**	**2.41**	**2.03**	**2.55**	**2.50**	**2.37**	**2.65**	**2.26**	**2.70**	**2.47**	**2.62**	**2.52**	**2.56**	**2.02**	**2.79**	**3.05**	**2.21**	**2.50**	**2.90**	**2.83**	**2.79**	**2.93**	**2.86**	**2.78**	**2.87**	**3.26**	**2.90**	**2.64**	**2.75**	**3.02**	**2.56**	**2.74**	**2.58**
Shannon-Wiener Evenness		**0.66**	**0.76**	**0.65**	**0.74**	**0.85**	**0.77**	**0.81**	**0.82**	**0.84**	**0.81**	**0.91**	**0.80**	**0.89**	**0.77**	**0.88**	**0.91**	**0.63**	**0.85**	**0.91**	**0.89**	**0.92**	**0.86**	**0.88**	**0.89**	**0.94**	**0.92**	**0.83**	**0.84**	**0.82**	**0.89**	**0.71**	**0.85**	**0.73**

Bioresearches
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Table F.6 Benthic Infauna Retained on 1 mm sieve from the 07 Cells in the sand extraction area 2024 (Number per sample).

Taxa	Date	20 Mar 24			20 Mar 24			20 Mar 24			20 Mar 24			20 Mar 24			20 Mar 24			20 Mar 24			20 Mar 24			7 Mar 24			7 Mar 24			7 Mar 24		
	Cell	7A			7B			7C			7D			7E			7F			7G			7H			7I			7J			7K		
	Sample	7A1	7A2	7A3	7B1	7B2	7B3	7C1	7C2	7C3	7D1	7D2	7D3	7E1	7E2	7E3	7F1	7F2	7F3	7G1	7G2	7G3	7H1	7H2	7H3	7I1	7I2	7I3	7J1	7J2	7J3	7K1	7K2	7K3
	Depth	21.4	20.2	19.3	21.3	21.4	19.9	22.9	20.6	20.4	24.0	21.1	21.3	24.8	24.1	23.2	26.8	22.5	22.5	27.2	24.1	26.3	28.2	27.9	24.0	28.2	26.8	26.3	27.7	27.2	22.7	28.4	27.5	27.1
Annelida																																		
Polychaeta																																		
Amphinomidae															1											1	1						1	
Eunicidae																							1	1										1
Lumbrineridae			1			1								1	4		1						1										1	2
Onuphidae	*Hartmanonuphis pectinata*														1		1						2			1	1							4
Glyceridae																				1														
Goniadidae					1										2						1		3	5						2	1		1	3
Nephtyidae	*Aglaophamus sp.*	2	2	1		2	1	2	1	1	1	1		1	5		4			1	1		3	3	2	4	2		3	2	2	1	1	3
Phyllodocidae			1		1								1				1						1	1								1		1
Sigalionidae		1	1	1	1			1	2			1		2	3	1	1	1	2		1	2		1		1	1		2	3		3	3	1
Syllidae	Syllidae																		1															
Sabellidae						1	1	1	2	1				1	2		1			7	2		5	3					1					1
Serpulidae	*Hydroides sp*							45	2								1		1												10			
Spionidae	*Paraprionospio pinnata*				1	5									9		2						5	1		2	1		1					1
Spionidae	*Spiophanes kroyeri*																												1				1	1
Ampharetidae			1		5	15			1	2					48	1	30		1		1		2	12	1	7	18	1	15	19		1	23	44
Pectinariidae	*Lagis australis*									1													1	2									1	
Capitellidae	*Barantolla lepte*																							1										
Chaetopteridae	*Phyllochaetopterus socialis*																						1											2
Magelonidae	*Magelona dakini*					1			2										1					2									1	
Maldanidae		3	5	6	3	5	2	6	7	1	3	9	4	2	7	2	3	3	2		1		12	6	2	6	4		7	19	2	6	12	18
Opheliidae	*Armandia maculata*	1	6	1	5	3	10	2	2	11		10	1	2	4		11	1	1				1	1	1									
Orbiniidae	*Leitoscoloplos kerguelensis*																						1	1										
Oweniidae	*Myriochele sp.*																1															3	1	1
Oweniidae	*Myriowenia sp.*		1	1	3	1				2	1				4		5						1	4		4	2		2	3		1	4	79
Oweniidae	*Owenia petersenae*	1		1																														
Sabellariidae	*Neosabellaria kaiparaensis*							2																										
Travisiidae	*Travisia olens*																																1	
Sipuncula																																		
	Aspidosiphon sp.	1		1	1				1											1			1											
Nemertea				1		1		2	2		1	3	1			1			2	1	1			1		1				1				
Arthropoda																																		
Amphipoda																																		
	Ampelisca sp.														1									1		4	3		5	2			4	3
	Lysianassidae				1	4																	5	3		1	1					1		
	Oedicerotidae				1	1						1					1						1	3			1							
	Phoxocephalidae	29	19	7	11	20	16	6		34	11	3	4		15	2	10	2		5	1		11	17	14	4	3	3	10	6	2	1	5	10
	Urothoidae	43	45	13	39	29	20	22	2	23	15	40	5	2	4	2	19	1	1				11	2	15	11	8	4	7			2	8	12
	Amphipoda Unid.	3	6		1	3		7	7	3	2	5	4	1	1	2	2	4	8	12			6	2	9	12	3	1	3	1	1	1	3	6
Cumacea																																		
	Cumacea		4	1	7	1		1	1	3			3		2	2	3	2	1				2		2		1	1	2		1		2	1
Decapoda																																		
	Callianassa filholi					2	1										1						7	2		2			5	4		2		7
	Philocheras australis							1																										
	Nectocarcinus benetti							1																										1
	Halicarcinus tongi													1																				
	Ebalia laevis																						1											
	Notomithrax minor								1																									
	Pagurus sp.		1	2	1	2	1	1		4	1				1	*1*	2					2	2	1		3			*1*			3	3	1
	Liocarcinus corrugatus							1								1																		
Isopoda																																		
	Anthuridea								1			1					2		2				1					1						
	Eurylana cookii								1				1			2			3	6		1												
	Pseudaega secunda	2	3	1			1																											
	Cassidina typa			1				1																										
	Exosphaeroma falcatum		1																						1									
Leptostraca																																		
	Nebalia sp.					5																					1		1					2
Mysidacea		1	1	1	3				2	5		1			2			2																
Tanaidacea																			1															
Ostracoda																																		
	Diasterope grisea	1	2	1			2		1	2					5		3	1					2	2										
	Leuroleberis zealandica																						1											
	Cypridinodes			1			1		3			1							5											1				
	Euphilomedes agilis																							1										
	Scleroconcha sp.		2																															
Mollusca																																		
Polyplacophora																																		
	Ischnochiton maorianus								1																									
Gastropoda																																		
	Zeacolpus vittatus																									1						1		1
	Cylichna thetidis		1						1			1																						
	Philine sp	1			1	1		1	2	2									3						1					1	1			2
	Pisinna sp.																	1	2															
	Sigapatella tenuis	1	2	6		1	1	5	13	2	1	1	6	7	2	8	3		6	26	5	4	2	4	1	1	3	2		1	7	1	2	5
	Struthiolaria papulosa					2																												
	Xenophora neozelanica																					*1*												
	Amalda mucronata														1																			
	Amalda northlandica																1												1					
	Cominella adspersa																										1							
	Cominella virgata	1													1		1	1	1		2	1	1						1		1		1	1
	Drilliidae																1																	
	Neoguraleus sp.													1																				
	Marginellidae	1	1							4		1																						
	Xymene sp.																													1				
	Austrofusus glans														2											1						1	1	

Taxa	Date	20 Mar 24			20 Mar 24			20 Mar 24			20 Mar 24			20 Mar 24			20 Mar 24			20 Mar 24			20 Mar 24			7 Mar 24			7 Mar 24			7 Mar 24		
	Cell	7A			7B			7C			7D			7E			7F			7G			7H			7I			7J			7K		
	Sample	7A1	7A2	7A3	7B1	7B2	7B3	7C1	7C2	7C3	7D1	7D2	7D3	7E1	7E2	7E3	7F1	7F2	7F3	7G1	7G2	7G3	7H1	7H2	7H3	7I1	7I2	7I3	7J1	7J2	7J3	7K1	7K2	7K3
	Depth	21.4	20.2	19.3	21.3	21.4	19.9	22.9	20.6	20.4	24.0	21.1	21.3	24.8	24.1	23.2	26.8	22.5	22.5	27.2	24.1	26.3	28.2	27.9	24.0	28.2	26.8	26.3	27.7	27.2	22.7	28.4	27.5	27.1
	Micrelenchus sp.								2	1												2												
	Punctacteon cratericulatus																																	1
	Pupa affinis					2									1		2						1			5	1		1			1		1
	Adelphotectonica reevei														1									1						1		1		
	Psilaxis oxytropis		2			1																										1		
Bivalvia																																		
	Hiatella arctica							3																										
	Pratulum pulchellum					1		1												1						1	2	1	1				1	
	Gari convexa				1						1													2		1	1	1						
	Gari sp. (juvenile)	1	3		4	1	7	3	2	8	1	3	2	2	3	2	1	2	2	3	1	1	1		3			1		1	1			
	Gari stangeri	1								1		1			1				2		1													
	Hiatula siliquens				1					1																								
	Leptomya retiaria													1																				
	Serratina charlottae																						1											
	Pleuromeris sp.															1																		
	Pleuromeris zelandica					1																	1											
	Purpurocardia purpurata								1						1					1														
	Mylitella vivens vivens											1			1											2								
	Limatula maoria															1			2	1								1						
	Limaria orientalis																			1														
	Corbula zelandica													1									1											
	Nucula nitidula	1	2	2	4	3	3		3	3		1	1	15	7	2		3	3	18	2	2	2	6	1	6	2	4	7	3	12		2	1
	Atrina zelandica (juvenile)																	1																
	Chlamys sp.													1						1				1										1
	Scalpomactra scalpellum	6	4	3	1		1	6	4	6	2	4	2	2		4	2	2			2	1	1	1	3	1		1	1	1	2		4	2
	Zemysina sp.	3	2		9	3	2		1	1	2			1	8		1	1					14		3	9	6		4	2		1	3	10
	Dosinia subrosea	1								3		1		1				1	1									5			2	1		
	Notocallista multistriata																1										1							
	Tawera spissa		3	1	1				3	2		2			1	1		1	3		1			1				1			4			
	Myadora antipodum	1	1									1																						
	Myadora striata					2	2								1		1								1	1					1			
	Thraciidae				1	2					2		1					1										1	2	1			2	
Echinodermata																																		
Asteroidea																																		
	Astropecten polyacanthus																															1		
Holothuroidea																																		
	Trochodota dendyi			1								1						1		1										1				
	Heterothyone alba																						1											
Ophiuroidea																																		
	Ophiuroidea																			1	1													
Bryozoa																																		
	Bryozoa (discoid)	8	12	2	1	1	4	6	25	3										7	8	15	1					7			16			1
	Bryozoa (encrusting)							1												1				1										
	Bryozoa (solid Stalked)										3	16	18	9	4	13	2	6	11	1			1	1	1			1						
Porifera																																		
Demospongiae	*cf Tethyopsis* sp.								1										1															
Cnidaria																																		
Hexacorallia																																		
	Edwardsia sp.																										1							
	Sphenotrochus sp.																														1			
Chordata																																		
Ascidiacea																																		
	Eugyra sp.		1		1			1	4	1						1		1																
Leptocardii																																		
	Epigonichthys hectori	1		1				2		1			1	3		1		2	2	4				5	1	1					1			
Number of Individuals		115	136	57	110	123	76	131	104	132	47	110	55	57	156	51	121	41	71	101	32	32	119	102	62	94	69	37	84	76	68	35	92	231
Number of Species / taxa		25	30	24	28	32	18	27	33	29	15	25	16	21	35	21	33	23	28	22	17	11	41	36	18	28	25	18	24	22	19	22	27	35
Shannon-Wiener Diversity Index		2.14	2.58	2.71	2.52	2.77	2.29	2.45	2.94	2.69	2.17	2.34	2.31	2.54	2.81	2.63	2.78	2.95	3.03	2.42	2.52	1.85	3.23	3.16	2.33	2.96	2.73	2.60	2.78	2.44	2.41	2.89	2.76	2.44
Shannon-Wiener Evenness		0.67	0.76	0.85	0.76	0.80	0.79	0.74	0.84	0.80	0.80	0.73	0.83	0.83	0.79	0.86	0.80	0.94	0.91	0.78	0.89	0.77	0.87	0.88	0.81	0.89	0.85	0.90	0.88	0.79	0.82	0.93	0.84	0.69

Table F.7 Benthic Infauna Retained on 1 mm sieve from the 08 Cells in the sand extraction area 2024 (Number per sample).

Taxa	Date	20 Mar 24			20 Mar 24			20 Mar 24			20 Mar 24			20 Mar 24			20 Mar 24			20 Mar 24			20 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24		
	Cell	8A			8B			8C			8D			8E			8F			8G			8H			8I			8J			8K		
	Sample	8A1	8A2	8A3	8B1	8B2	8B3	8C1	8C2	8C3	8D1	8D2	8D3	8E1	8E2	8E3	8F1	8F2	8F3	8G1	8G2	8G3	8H1	8H2	8H3	8I1	8I2	8I3	8J1	8J2	8J3	8K1	8K2	8K3
	Depth	20.3	21.1	21.0	20.7	21.5	21.9	22.0	22.9	22.6	22.6	23.8	22.6	22.7	24.3	22.9	25.3	25.3	25.3	26.4	25.9	23.8	26.4	26.2	26.8	27.0	28.3	25.9	26.2	29.1	27.3	26.3	29.1	28.0
Annelida																																		
Polychaeta																																		
Eunicidae																											1			3	1			
Lumbrineridae								1														1												
Onuphidae	*Onuphis aucklandensis*													1					1	1	1			1				2						1
Aphroditidae																			1			1								1				
Goniadidae				1		1	1			3				1		5	1			1		2		1	1		1	1		1	3		3	3
Nephtyidae	*Aglaophamus sp.*		1	1		1		1	1	3	1	4	3		5	3			2	1	1	1	2	1	2		4	4		3	3		3	6
Phyllodocidae										2		1	2									1			1						2		1	3
Sigalionidae			3	1			1	8	3	1		1		1		1			4	3		4	2		1		2	2	3	5		6	5	3
Syllidae	Syllidae																						1											1
Sabellidae	*Euchone pallida*									1	1																							
Serpulidae	*Hydroides sp*		6							1	5	1							2				8				1		2					
Spionidae	*Boccardia sp.*									1																								
Spionidae	*Paraprionospio pinnata*									2		2	5		2	4						5			2		1	5			2		2	2
Ampharetidae		1		6		7	1			35	1	15	13		7	24			10			13		1	19		4	17		25	20		6	5
Pectinariidae	*Lagis australis*					3				1			2						2			1									2		2	
Terebellidae			1																															
Capitellidae	*Barantolla lepte*																											2	1					
Capitellidae	*Heteromastus filiformis*															1						1	1											
Capitellidae	*Notomastus zeylanicus*																									1				1	1			
Magelonidae	*Magelona dakini*		1						1							2						2			2	1	1	2		1	5		2	3
Maldanidae		2	4	4	3	3	2	1	1	8	1	7	2	1		2	1	1	4	1	1	5	1		5		2	2		23	7		10	14
Opheliidae	*Armandia maculata*			7			1			1	1		1		2			1	1			1			3			8	1		2			
Orbiniidae	*Leitoscoloplos kerguelensis*																														2		1	
Oweniidae	*Myriochele sp.*																										4	6	1	7	2			
Oweniidae	*Myriowenia sp.*			4		2				45		2	23			15			37			23			25								13	14
Travisiidae	*Travisia olens*		1						1																				1		1			
Sipuncula																																		
	Aspidosiphon sp.																											1	2					
	Nephasoma sp.																								1									
Chaetognatha											1						1																	
Nemertea		1	1						1	1	1						1								1	1	1			1			1	
Phoronida																																		
	Phoronus sp.																										1							
Arthropoda																																		
Amphipoda																																		
	Ampelisca sp.															2									2		3			3	2		3	
	Lysianassidae			13		18			7	32		7	8			7	1		29			4		3	7		1	7		6	8		1	9
	Oedicerotidae			1	2								1															3		1	3			
	Phoxocephalidae	13		9	18		4			10	1	12	11	4	15	9	7	5	18	6	24	21		8	20		2	14	1	2	13		8	25
	Urothoidae	14		26	32	11	2	16	4	30	1	17	21	6	11	2	8	7	15	6	8	5		9	30		6	11		14	30	7	8	12
	Amphipoda Unid.		82	1	1	2	8	1	2	3	14	1		1	3	1	8	4	4	8	4	3	5	2	5	3	8	10	9	10	15	2	9	3
Cumacea																																		
	Cumacea	1		2	3	3			1	1				2	1	4	1		4			2					1	1		1	3		1	1
Decapoda																																		
	Callianassa filholi	1							1				3				1		2							2	4	1	1	5	1		3	3
	Philocheras australis		1																															
	Philocheras sp.									1																								
	Halicarcinus sp.																		1															
	Pyromaia tuberculata		2																															
	Notomithrax minor										1																							
	Ogyrides sp																										1						1	
	Pagurus sp.		4	*1*		2		*1*		1		*1*	4		1	*1*			1			*1*			4	*1*	11		1	3			*1*	1
	Palaemon affinis																	1																
	Nepinnotheres atrinicola																	1																
	Liocarcinus corrugatus		1								2												1											
	Upogebia sp.																								1									
Isopoda																																		
	Anthuridea		2	3	1		1		1	1			1				1	1								1							1	
	Eurylana cookii										2	1											2					1	2			6		
	Pseudaega secunda	1		1																														
	Exosphaeroma falcatum	30		1																														
Leptostraca																																		
	Nebalia sp.			1						6		1	2			7			5								3	6	1		3			1
Mysidacea						2				1				2		1				1	2													
Tanaidacea		2																					1						1					
Ostracoda																																		
	Diasterope grisea	1		1	1	1	2								1		1		1									5					1	
	Leuroleberis zealandica										1																							
	Cypridinodes		1	1			1		1	1								2		1		1		1								2		
	Scleroconcha sp.																								3	1					1			1
	Rutiderma sp.																					1												
Mollusca																																		
Polyplacophora																																		
	Ischnochiton maorianus		5								6												2											
Gastropoda																																		
	Zeacolpus vittatus									1																								
	Cylichna thetidis		2																				1		1					2			1	
	Philine sp		2					1		1								1					3						4					
	Pisinna sp.																									2								
	Sigapatella tenuis		27	1	1	5	8	2	12	4	5	2	1	3	3		4	6	5	1	1	1	10	1	4	12	4	1	9	2			4	2
	Monoplex parthenopeus																													1				
	Struthiolaria papulosa														1																			
	Amalda northlandica									1					1	1			1	1								1		1			1	1
	Columbellidae									1	1																							
	Cominella adspersa			1				2								1																		

Taxa	Date	20 Mar 24			20 Mar 24			20 Mar 24			20 Mar 24			20 Mar 24			20 Mar 24			20 Mar 24			20 Mar 24			21 Mar 24			21 Mar 24			21 Mar 24		
	Cell	8A			8B			8C			8D			8E			8F			8G			8H			8I			8J			8K		
	Sample	8A1	8A2	8A3	8B1	8B2	8B3	8C1	8C2	8C3	8D1	8D2	8D3	8E1	8E2	8E3	8F1	8F2	8F3	8G1	8G2	8G3	8H1	8H2	8H3	8I1	8I2	8I3	8J1	8J2	8J3	8K1	8K2	8K3
	Depth	20.3	21.1	21.0	20.7	21.5	21.9	22.0	22.9	22.6	22.6	23.8	22.6	22.7	24.3	22.9	25.3	25.3	25.3	26.4	25.9	23.8	26.4	26.2	26.8	27.0	28.3	25.9	26.2	29.1	27.3	26.3	29.1	28.0
	Cominella virgata					1			1	1			1				1		2		1		1	1			1	1				1		
	Marginellidae		1		1	1																												
	Xymene sp.										3												1											
	Austrofusus glans									2									3						1								1	1
	Micrelenchus sp.																						1			1								
	Roseaplagis rufozona		9												1																			
	Pupa affinis					2				1									5			1					1						1	
	Adelphotectonica reevei	1				1				1									1								2			1				
Bivalvia																																		
	Hiatella arctica																									1			2					
	Pratulum pulchellum									1		1														1	2			1				1
	Gari convexa	1											1			1										1	1	3					2	3
	Gari sp. (juvenile)	4	9	6	2	5	2	1	3	3	3	3		1		2			5	2	5	1	2	1		7		1	2		1	2	1	
	Gari stangeri		1					1				1						1					2		1				1					
	Hiatula nitida																									16	5	4	11	5	5			
	Hiatula siliquens																							1										
	Pleuromeris sp.		2				2																	1	1									1
	Pleuromeris zelandica																								2		1			1				
	Purpurocardia purpurata													1																				
	Mylitella vivens vivens																			1														
	Limatula maoria		1								1									1						1								
	Limaria orientalis							1																										
	Musculus impactus								1																									
	Nucula nitidula		44	7	2	4	31	10	15		23	7		4		2	2	2	1	9	11	1	8	1	1							4	1	3
	Atrina zelandica (juvenile)																	2		2														
	Anomiidae										1																							
	Pecten novaezelandiae																			*1*			*1*			*1*			1					
	Scalpomactra scalpellum	6	2	4	1	4	2	1	3	1		2	1	5	2		2	4		3	5	1	3	3			1		1	1	2		4	2
	Zemysina sp.	5		9	3	3	3		1	2	3	3	1	2		5		3	4	1	2	1			5		8	1		6	2		11	1
	Bassina yatei																																	3
	Dosinia subrosea	2	1		1	1		1	2			1		5	1		1						3			2			1					
	Notocallista multistriata																													1			1	
	Tawera spissa	1	9		5		1		1		8			1			4		1	1	2		1			1								
	Myadora antipodum			1						1																1								
	Myadora striata					1	1	1	1						1								2									1		
	Thraciidae					1		2	2																									
Echinodermata																																		
Asteroidea																																		
	Astropecten polyacanthus											2			1	*1*									1			1			1			
Echinoidea																																		
	Echinocardium cordatum								1																									
Ophiuroidea																																		
	Ophiuroidea		1							1																								
Bryozoa																																		
	Bryozoa (bushy)																									1		1						1
	Bryozoa (discoid)	1	82		4		9	26	6		19			14			16	7		5	16		8	24		3		1	9			3	1	
	Bryozoa (encrusting)						1																1						1			1		
Porifera																																		
Demospongiae	*cf Tethyopsis sp.*		3				1				2	1											1											
	Sponge (cream Encrusting)			1							1																							
	Sponge (finger)																											1						
Cnidaria																																		
Hexacorallia																																		
	Sphenotrochus sp.		1																													1		
Hydrozoa																																		
	Hydroida (thecate)					1																												
Chordata																																		
Ascidiacea																																		
	Pyura sp.										1																							
	Eugyra sp.												1																					
Leptocardii																																		
	Epigonichthys hectori		1			1	2			1		3		1			5	6		1			1	2	2	3		1		1	1	1	1	1
Teleostei																																		
	Tewara cranwellae																									1								
Number of Individuals		88	314	115	81	87	87	78	74	215	111	99	108	56	59	104	67	55	172	58	84	105	76	62	154	66	89	128	69	139	144	37	116	131
Number of Species/taxa		19	34	28	17	27	23	19	26	41	29	26	22	19	18	25	20	18	30	23	15	28	29	18	30	25	32	34	25	32	30	13	36	32
Shannon-Wiener Diversity Index		2.20	2.30	2.77	2.04	2.86	2.42	2.14	2.76	2.66	2.70	2.76	2.48	2.56	2.39	2.70	2.52	2.64	2.72	2.76	2.18	2.63	3.01	2.16	2.69	2.65	3.14	3.08	2.76	2.85	2.81	2.31	3.16	2.92
Shannon-Wiener Evenness		0.75	0.65	0.83	0.72	0.87	0.77	0.73	0.85	0.72	0.80	0.85	0.80	0.87	0.83	0.84	0.84	0.91	0.80	0.88	0.80	0.79	0.89	0.75	0.79	0.82	0.91	0.87	0.86	0.82	0.83	0.90	0.88	0.84

Table F.8 *Benthic Infauna Retained on 1 mm sieve from the Northern Control Cells in the sand extraction area 2024 (Number per sample). Plus, Biota identified in Photographs in blue.*

Taxa	Date	22 Mar 24			22 Mar 24			22 Mar 24			22 Mar 24			22 Mar 24			22 Mar 24			22 Mar 24			22 Mar 24			22 Mar 24			22 Mar 24			22 Mar 24		
	Cell	CNA			CNB			CNC			CND			CNE			CNF			CNG			CNH			CNI			CNJ			CNK		
	Sample	CNA1	CNA2	CNA3	CNB1	CNB2	CNB3	CNC1	CNC2	CNC3	CND1	CND2	CND3	CNE1	CNE2	CNE3	CNF1	CNF2	CNF3	CNG1	CNG2	CNG3	CNH1	CNH2	CNH3	CNI1	CNI2	CNI3	CNJ1	CNJ2	CNJ3	CNK1	CNK2	CNK3
	Depth	21.1	21.9	21.2	20.5	22.1	23.0	20.6	21.9	23.2	21.3	22.5	23.2	20.6	21.9	23.2	20.1	21.8	23.1	21.3	22.2	23.4	21.9	21.8	22.7	22.2	24.0	23.4	23.0	24.4	25.8	23.7	24.0	26.3
Annelida																																		
Polychaeta																																		
Eunicidae																			1															
Lumbrineridae					1	1	2	2		1	1	2		1		1				1		1			3		1							
Onuphidae	*Hartmanonuphis pectinata*		1											1		4	1				1	2							2					
Glyceridae										1																								
Goniadidae		8	2	2	1	3	3	4	2		3	2		2	4	1	2				2	2	3			1	1	1	4	3	1			2
Hesionidae																																1		
Nephtyidae	*Aglaophamus sp.*	2	2	1	3	1	3	2	5			2		1	2		2	2		1	1	1	3	1	3		5	1	4	5	1	2	3	1
Phyllodocidae		1		1	2			2			1	1			1	1	1		2	3		1	2				2		4	4		2	2	
Polynoidae																					1	1			1									
Sigalionidae		1		1	3	2	2	2			1	1	1		1	1	1				2	2	1	2	1	2	1	1		1	2	1	1	2
Syllidae	Syllidae									5			3					2	1						1			1	1	1				1
Sabellidae				3	1	1	1	2	1		4	2	1		1	2	1		3	1						2	3		1	1	1	3	1	1
Serpulidae	*Hydroides sp*	1		6		1		2		6		1	102	1	1				140		3						1		5		1	3	1	
Spionidae	*Paraprionospio pinnata*	3		3	1		2	2			1	1		2	1		1						1		1		2			1		1		1
Spionidae	*Prionospio sp.*			1															1				1											
Ampharetidae		11	10	11	5	24	26	23	12		7	22		12	16	33	16		17	1	29	33	11		14	2	34	1	21	14	2	23	31	21
Cirratulidae																1										1			1					
Flabelligeridae													1																					
Pectinariidae	*Lagis australis*	1			1			2	1		1	1			1				1			3				1				1			2	
Terebellidae																															1			
Chaetopteridae	*Phyllochaetopterus socialis*																																1	
Magelonidae	*Magelona dakini*	2						2			2	1						2					1	2	2			1					3	
Maldanidae		4	5	3	10	11	5	7	5		3	7		8	6	9	4	4	10	4	5	7	5	2	6		5	2	9	6	2	10	10	20
Opheliidae	*Armandia maculata*		3	7		1		10	2		11			4	4	7	1			2	1	4	6		5	12	8	2		8		2	4	1
Orbiniidae	*Leitoscoloplos kerguelensis*	1		3				1			1	4			1	1	1					2	2		2		1		1	1		1	2	2
Oweniidae	*Myriochele sp.*										4	2		3	1	3	4				5	3												
Oweniidae	*Myriowenia sp.*	1																					3		21	2	2		1			3	2	
Oweniidae	*Owenia petersenae*						1															3					1				2			
Sabellariidae	*Neosabellaria kaipiaraensis*																		16															
Travisiidae	*Travisia olens*	1								1	1																							
Sipuncula																																		
	Aspidosiphon sp.									3			23					2	1									1						
	Nephasoma sp.												1																					
Nemertea		1					1				1	1	1			2	1	1		4	1		1		1		1	3	2			1	1	
Arthropoda																																		
Amphipoda																																		
	Ampelisca sp.				2	1			1							1						2			1		1						1	1
	Hyperia spp.																													2				
	Lysianassidae	8	2	4		3	2	6	3		8	6		13	7	12	10				1	21	16		13	8	6		3	3		6	1	11
	Oedicerotidae															1		1				1										1		1
	Phoxocephalidae	15	3	5	1	8	8	4	5	3	18	7		4	6	4	14	2	5	4	5	11	4	2	5	41	18	12	3	14	4	8	7	1
	Urothoidae	11	6	7	5	18	2	16	3	2	13	21	1	14	9	28	11		6	2	6	28	21		15	35	11	4	12	11		22	8	15
	Amphipoda Unid.	1			1			1		13			13	1				1	2	8		2	1	3	2			2		2	8			
Cumacea																																		
	Cumacea	2	1				1		1					1	1		1	1		1	1					1	1					1		
Decapoda																																		
	Callianassa filholi	3			1	2		1				2		1		5			1			5			3				1			3	1	4
	Philocheras australis												1																					
	Halicarcinus tongi										1								1						1				1					1
	Pyromaia tuberculata				1																					1						2		1
	Notomithrax minor																		1															
	Ogyrides sp													1			1				1													
	Pagurus sp.			1	*1*		2	1			26		1	1			*1*		6	*1*	10	*1*		1	1	*1*	2	*1*	1	3		3	*1*	

Taxa																																	
Date	22 Mar 24			22 Mar 24			22 Mar 24			22 Mar 24			22 Mar 24			22 Mar 24			22 Mar 24			22 Mar 24			22 Mar 24			22 Mar 24			22 Mar 24		
Cell	CNA			CNB			CNC			CND			CNE			CNF			CNG			CNH			CNI			CNJ			CNK		
Sample	CNA1	CNA2	CNA3	CNB1	CNB2	CNB3	CNC1	CNC2	CNC3	CND1	CND2	CND3	CNE1	CNE2	CNE3	CNF1	CNF2	CNF3	CNG1	CNG2	CNG3	CNH1	CNH2	CNH3	CNI1	CNI2	CNI3	CNJ1	CNJ2	CNJ3	CNK1	CNK2	CNK3
Depth	21.1	21.9	21.2	20.5	22.1	23.0	20.6	21.9	23.2	21.3	22.5	23.2	20.6	21.9	23.2	20.1	21.8	23.1	21.3	22.2	23.4	21.9	21.8	22.7	22.2	24.0	23.4	23.0	24.4	25.8	23.7	24.0	26.3
Nepinnotheres atrinicola											1																						
Liocarcinus corrugatus												1																					
Isopoda																																	
Anthuridea	1				1		1	1			1		2	1		2			1					1				1					4
Eurylana cookii																	5		3		1		1							3			
Pseudaega secunda																									1								
Cassidina typa																		6		1													
Cilicaea dolorosa												3																					
Exosphaeroma falcatum		1															1								19								
Leptostraca																																	
Nebalia sp.	5	1	1	2	3	8	3			5	8			1	4	4				5	4			1	1	2			3				3
Mysidacea	1	2	2	1	1		1	1		1	2					1		2			1	1			1		1	1	5				
Tanaidacea									1			2																					
Ostracoda																																	
Diasterope grisea		1					1			1			1							1		1			1								
Leuroleberis zealandica						1											1																
Euphilomedes agilis																					1												
Scleroconcha sp.	1				1		2			1														1	1	1							3
Rutiderma sp.															1										1								
Mollusca																																	
Polyplacophora																																	
Ischnochiton maorianus												2																					
Leptochiton inquinatus												2																					
Gastropoda																																	
Cylichna thetidis										1	2				1	1			1					1		1					1		
Philine sp	1			1	1					1				1		2		1		2		1	3				1					2	2
Sigapatella tenuis		1				2	2										4		2				2	1			2	1	2	7			2
Eulimidae									1																								
Pelicaria vermis				1																													
Struthiolaria papulosa	1			1																1													
Amalda mucronata				1																													
Amalda northlandica			2		1								1		1									2	1	1		1	1			1	
Columbellidae																				1													
Cominella virgata				1	2		1							3														1	1		1	1	
Drilliidae															1																		
Neoguraleus sp.																				1													
Xymene sp.						1		1				2								1													
Duplicaria tristis				1			1							1										1									
Pleurobranchaea maculata																											1						
Berthella sp.																		1															
Micrelenchus sp.												1																					
Punctacteon crateriulatus	1																																
Pupa affinis				3				1		2			2		1					1	2	1			1			1			4		
Adelphotectonica reevei					1		1						1					2			1												
Bivalvia																																	
Hiatella arctica																		3															
Pratulum pulchellum			1					1							1														1		1		
Gari convexa			2		2	1		2							1	1		1			1			2		1	1	1		1	1	1	
Gari sp. (juvenile)		2			1		2			2	1	1			1	1		2	1		1			1	2	2					1		2
Gari stangeri												1					1						1										
Hiatula nitida																					1	1											
Hiatula siliquens													2			2																	
Pleuromeris sp.												1																					
Pleuromeris zelandica											1																						
Purpurocardia purpurata												1																					
Myllitella vivens vivens					2	5		1					1		4			1						3									
Limatula maoria																			1											1			
Corbula zelandica									2			3																					
Musculus impactus																		1															

Bioresearches
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Taxa	Date	22Mar24			22Mar24			22Mar24			22Mar24			22Mar24			22Mar24			22Mar24			22Mar24			22Mar24			22Mar24			22Mar24		
	Cell	CNA			CNB			CNC			CND			CNE			CNF			CNG			CNH			CNI			CNJ			CNK		
	Sample	CNA1	CNA2	CNA3	CNB1	CNB2	CNB3	CNC1	CNC2	CNC3	CND1	CND2	CND3	CNE1	CNE2	CNE3	CNF1	CNF2	CNF3	CNG1	CNG2	CNG3	CNH1	CNH2	CNH3	CNI1	CNI2	CNI3	CNJ1	CNJ2	CNJ3	CNK1	CNK2	CNK3
	Depth	21.1	21.9	21.2	20.5	22.1	23.0	20.6	21.9	23.2	21.3	22.5	23.2	20.6	21.9	23.2	20.1	21.8	23.1	21.3	22.2	23.4	21.9	21.8	22.7	22.2	24.0	23.4	23.0	24.4	25.8	23.7	24.0	26.3
	Arcuatula senhousia																		1															
	Nucula nitidula	1			1	1	3			1	1	1	3	1	4		3	4	1	5	2	3		4	3	2	1	7			1	5	2	
	Saccostrea glomerata																		1															
	Atrina zelandica (juvenile)											1																						
	Chlamys sp.																		1															
	Scalpomactra scalpellum	1	1	1	2	2		1			4			1		1	1	2	2	1	2	4	1	2		4	1	3	1				2	2
	Zemysina sp.		1			2	4	2	7		3	11		2	2	20	2		5		5	4			4	2	2			2		2		4
	Bassina yatei											1		1																				
	Dosinia subrosea									1	2				1	1		1	1								1				1			
	Notocallista multistriata																																1	
	Tawera spissa									2			17													1		5						
	Myadora striata		1					2	1		1	3		1		1	2		2			1				1	1				2	1		
	Thraciidae						2		2		1						1	1		1		1						1						1
Echinodermata																																		
Asteroidea																																		
	Astropecten polyacanthus												*1*													1							1	2
Echinoidea																																		
	Echinocardium cordatum													1														1			2			
Holothuroidea																																		
	Trochodota dendyi																												1			1		
Ophiuroidea																																		
	Ophiuroidea												1																					
Bryozoa																																		
	Bryozoa (discoid)			1														1		2	1							11		1	1			
	Bryozoa (encrusting)									1			1						1															
	Bryozoa (solid Stalked)								1	1			1						1															
Porifera																																		
Demospongiae	*cf Tethyopsis sp.*			*1*					*1*				1																					
	Sponge (cream Encrusting)																		1															1
Cnidaria																																		
Hexacorallia																																		
	Anemone (Unid.)													3	1		1															5		
	Edwardsia sp.					1																			1									
Chordata																																		
Ascidiacea																																		
	Eugyra sp.						1	1	2		1							1			1	2				1	1							
	Molgula sp.																		7															
Leptocardii																																		
	Epigonichthys hectori	3	1	1					1	8	2		30					2		1		1		2				1		1	3		1	
Number of Individuals		**94**	**47**	**71**	**55**	**99**	**89**	**113**	**64**	**53**	**137**	**119**	**224**	**91**	**78**	**156**	**98**	**42**	**259**	**52**	**100**	**165**	**88**	**28**	**124**	**151**	**122**	**68**	**86**	**98**	**47**	**122**	**95**	**113**
Number of Species / taxa		**30**	**20**	**25**	**28**	**29**	**25**	**34**	**26**	**18**	**36**	**31**	**32**	**32**	**26**	**33**	**33**	**22**	**40**	**24**	**31**	**38**	**23**	**14**	**34**	**31**	**33**	**26**	**28**	**27**	**21**	**32**	**29**	**29**
Shannon-Wiener Diversity Index		**2.90**	**2.67**	**2.90**	**3.02**	**2.67**	**2.68**	**2.98**	**2.89**	**2.47**	**2.96**	**2.82**	**2.08**	**2.94**	**2.79**	**2.69**	**2.95**	**2.92**	**2.14**	**2.92**	**2.79**	**2.88**	**2.53**	**2.55**	**2.96**	**2.41**	**2.72**	**2.81**	**2.74**	**2.87**	**2.77**	**2.87**	**2.64**	**2.73**
Shannon-Wiener Evenness		**0.85**	**0.89**	**0.90**	**0.90**	**0.79**	**0.83**	**0.84**	**0.89**	**0.85**	**0.83**	**0.82**	**0.60**	**0.85**	**0.86**	**0.77**	**0.84**	**0.94**	**0.58**	**0.92**	**0.81**	**0.79**	**0.81**	**0.97**	**0.84**	**0.70**	**0.78**	**0.86**	**0.82**	**0.87**	**0.91**	**0.83**	**0.78**	**0.81**

Table F.9 *Benthic Infauna Retained on 1 mm sieve from the Southern Control inner Cells 2024 (Number per sample). Plus, Biota identified in Photographs in blue.*

Taxa	Date	22 Mar 24					22 Mar 24					22 Mar 24					22 Mar 24					22 Mar 24					22 Mar 24					22 Mar 24				
	Cell	CSA					CSB					CSC					CSD					CSE					CSF					CSG				
	Sample	CSA1	CSA2	CSA3	CSA4	CSA5	CSB1	CSB2	CSB3	CSB4	CSB5	CSC1	CSC2	CSC3	CSC4	CSC5	CSD1	CSD2	CSD3	CSD4	CSD5	CSE1	CSE2	CSE3	CSE4	CSE5	CSF1	CSF2	CSF3	CSF4	CSF5	CSG1	CSG2	CSG3	CSG4	CSG5
	Depth	20.6	21.3	21.1	20.5	20.2	19.4	20.8	21.0	20.8	19.7	20.1	19.5	22.5	21.9	19.8	20.7	20.2	21.9	23.5	21.2	20.2	21.1	22.4	22.8	21.9	22.6	22.1	22.3	23.2	23.0	23.8	23.0	22.8	24.5	24.0
Annelida																																				
Polychaeta																																				
Amphinomidae																																				
Eunicidae																																				
Eunicidae	*Marphysa sp.*																																			
Lumbrineridae															1																	1				
Onuphidae	*Onuphis aucklandensis*		1																	1																
Glyceridae							1													1					1			1			1					1
Goniadidae			1		1	1				1	1						1											1								
Nephtyidae	*Aglaophamus sp.*			2	6			1	2		3		1		1		1	2		2		1						2	1							1
Nereidae	Nereidae (juvenile)																																			
Phyllodocidae			1					1	2				1	2	2	2				3				1	1					1			1			
Pilargidae									1																											
Sigalionidae		1	1	2		4	1			1		3	2	2	2	2	1	1	2	1	2	2	2	3		3	1	2	1	3	2	2	5	2	1	
Syllidae	Exogoninae																													1					1	
Syllidae	Syllidae			1	1														1	1					2	2			1	1						1
Sabellidae	*Euchone pallida*		1						1																											
Sabellidae		1			1		1	1			1	1	1	2				1	3	2		1		2	2		1	1	1	2		2		1	3	1
Serpulidae	*Hydroides sp*	10		2			1						1	3	1	1		5	5	3					46	2	3	27	8	43	1	5	3	6	144	4
Spionidae	*Prionospio sp.*			1		3			1			1																		1					2	
Spionidae	*Spio sp.*																				1															
Ampharetidae			1	6	1	1		1					1				1		1											1					3	1
Cirratulidae																																				1
Flabelligeridae																																	1		1	
Terebellidae														1				1	1						1					1				1		
Capitellidae	*Barantolla lepte*																				1				2			1		2						3
Capitellidae	*Heteromastus filiformis*																																			
Magelonidae	*Magelona dakini*	1				2		1		1			1	1		2		1		1		1			1		1		1	1						2
Maldanidae		30	15	5	6	3	3	3	10	3	10	18	5	7	8	6	5	7	13	8	4	4	2	5	6	5	11	3	8	4	13	6	7	8	2	14
Opheliidae	*Armandia maculata*			11	2					3	1		1				1							1					1							
Orbiniidae	*Leitoscoloplos kerguelensis*																														1				1	
Oweniidae	*Myriochele sp.*																																			
Oweniidae	*Myriowenia sp.*		2	4	2	2		1	2		6			2	1		2	1	1														1			
Oweniidae	*Owenia petersenae*															1				2	1		1		1	1					1					
Travisiidae	*Travisia olens*																												1							
Sipuncula																																				
	Aspidosiphon sp.				1																				1				1						3	1
Chaetognatha																	1																			
Nemertea			1	1		1	1				2		1	1	1	1	2	1	1		1				1	2	1			1	1		1			1
Phoronida																																				
	Phoronus sp.					1																														
Arthropoda																																				
Amphipoda																																				
	Ampelisca sp.	1																																		
	Lysianassidae				3												2					1					1		1							
	Oedicerotidae	1		1	1	2			3	2	1						1																		1	
	Phoxocephalidae	4	13	27	58	44	2	5	25	76	4	11		1	9	2	8	2	2	3		2			5	3	3	3	8		2		3	1	1	1
	Urothoidae		63	27	34	47	2	1	67	67	34	6		4	3	4	26	2		2		3		2	3	2		2					2			
	Amphipoda Unid.	7	2	3	10	4	2	3	3		5	4	6	1	4	1	7	11	21	38	4	5	4	3	8	9	8	7	21	15	8	6	7	7	32	7
Cumacea																																				
	Cumacea			1	1	1			4	3							2	3					1	1			1		3		1				3	4
Decapoda																																				
	Alpheus sp.				1														1																	
	Callianassa filholi																																			
	Philocheras australis																										2								1	
	Philocheras sp.												1												1											
	Nectocarcinus benetti																																			
	Halicarcinus tongi				1																															
	Pyromaia tuberculata															1														1						
	Ebalia laevis																																			
	Notomithrax minor																																			
	Pagurus sp.	1			*1*	1		1	2			2				1		8		3	1			5	3	5	13		1	1			2	1	4	2
	Palaemon affinis													1																						2

Taxa / Date	22 Mar 24					22 Mar 24					22 Mar 24					22 Mar 24					22 Mar 24					22 Mar 24					22 Mar 24				
Cell	CSA					CSB					CSC					CSD					CSE					CSF					CSG				
Sample	CSA1	CSA2	CSA3	CSA4	CSA5	CSB1	CSB2	CSB3	CSB4	CSB5	CSC1	CSC2	CSC3	CSC4	CSC5	CSD1	CSD2	CSD3	CSD4	CSD5	CSE1	CSE2	CSE3	CSE4	CSE5	CSF1	CSF2	CSF3	CSF4	CSF5	CSG1	CSG2	CSG3	CSG4	CSG5
Depth	20.6	21.3	21.1	20.5	20.2	19.4	20.8	21.0	20.8	19.7	20.1	19.5	22.5	21.9	19.8	20.7	20.2	21.9	23.5	21.2	20.2	21.1	22.4	22.8	21.9	22.6	22.1	22.3	23.2	23.0	23.8	23.0	22.8	24.5	24.0
Liocarcinus corrugatus												1	1									1		1			1	2	2	1		1			
Decapoda (larvae Unid.)							1																												
Isopoda																																			
Anthuridea	2	1	1		1	2	1	1	1							1		2		5								1		1		1	2		
Eurylana cookii													1						1		1	1	1	1	1					1		1		1	2
Pseudaega secunda		1			1																														
Cassidina typa																									1										
Exosphaeroma falcatum			1	2	3																														
Exosphaeroma planulum																																		1	
Leptostraca																																			
Nebalia sp.									1																										
Mysidacea										1	1			1					1						1		2								1
Stomatopoda																																			
Tanaidacea												2						3										2	1				1		1
Ostracoda																																			
Diasterope grisea		2	1		1			1			1					3															1				
Cypridinodes														1		1								1							1				
Scleroconcha sp.																															1			4	
Cymbicopia sp.																																			
Thecostraca																																			
Balanus decorus																																		2	
Brachiopoda																																			
Calloria inconspicua																													1						
Mollusca																																			
Polyplacophora																																			
Ischnochiton maorianus						1										1		4			2	1	1				1		2	1		2		10	2
Leptochiton inquinatus																		1						1					1	1				1	
Gastropoda																																			
Epitonium scalare																														1					
Zeacolpus pagoda																																			
Zeacolpus vittatus																																			
Cylichna thetidis		1	1																				1												
Philine sp			2	1				1	1				1	1	1		2	5	1	1						1		1		1			2	1	1
Sigapatella tenuis	13	4	4	1	1	23	3	5		2	17	8	4	10	5	6	18	13	5	9	11	8	8	3	1	10	7	11	6	11	6	7	3	11	5
Eulimidae																		2			3			1							1				
Pelicaria vermis																																			
Struthiolaria papulosa																				1															
Amalda australis		1																																	
Amalda northlandica																				1															
Cominella adspersa				1				1			2			1																1					
Cominella nassoides																											1								
Cominella quoyana																1																			
Cominella virgata		1					1							1																		1			
Splendrillia aoteana																1																			
Neoguraleus sp.																	1																		
Marginellidae																																			
Xymene sp.																1	1				1				1	3						1		2	
Austrofusus glans																1																			
Duplicaria tristis																																			
Berthella sp.																																			
Spectamen tryphenense																																			
Micrelenchus sp.						2						2							2				2	4		1	1	2						2	1
Pupa affinis																																			
Psilaxis oxytropis		1				1	1	1																											
Bivalvia																																			
Hiatella arctica	1																									1									
Glycymeris modesta						1					1																							1	
Pratulum pulchellum																																			
Gari convexa						1								1																					
Gari sp. (juvenile)	3	1	1	1	1			1		2	3	1	2	1		1	1	4	2	1	1	1	2	3		1	1	7		1	1	1	1	1	2
Gari stangeri			2	1	2					1		2									2		1	1			2		1	1	1			1	
Pleuromeris sp.											1							1									1		1	1		1		1	
Pleuromeris zelandica																																			
Purpurocardia purpurata							1								1																				
Limatula maoria																	1						2	1				1	1				1		
Limaria orientalis							1									1																			
Corbula zelandica																		1			1						1						1	1	
Nucula nitidula	4		2	1		5	11	1		1	4	9	8	4	3	4	6	16	8	12	3	4	10	3	7	2	1	4	3	8	2	1	3	12	6
Atrina zelandica (juvenile)																													1						

Taxa	Date	22 Mar 24					22 Mar 24					22 Mar 24					22 Mar 24					22 Mar 24					22 Mar 24					22 Mar 24				
	Cell	CSA					CSB					CSC					CSD					CSE					CSF					CSG				
	Sample	CSA1	CSA2	CSA3	CSA4	CSA5	CSB1	CSB2	CSB3	CSB4	CSB5	CSC1	CSC2	CSC3	CSC4	CSC5	CSD1	CSD2	CSD3	CSD4	CSD5	CSE1	CSE2	CSE3	CSE4	CSE5	CSF1	CSF2	CSF3	CSF4	CSF5	CSG1	CSG2	CSG3	CSG4	CSG5
	Depth	20.6	21.3	21.1	20.5	20.2	19.4	20.8	21.0	20.8	19.7	20.1	19.5	22.5	21.9	19.8	20.7	20.2	21.9	23.5	21.2	20.2	21.1	22.4	22.8	21.9	22.6	22.1	22.3	23.2	23.0	23.8	23.0	22.8	24.5	24.0
	Pecten novaezelandiae														1						1			1			2	1							2	*1*
	Scalpomactra scalpellum	7	3	2	3	3	5	1	3	3	3	4	4	1	4	2	4	7	1	1	1	1		3		2	2		2		3			1		1
	Zemysina sp.				4				1									1				1			1											
	Dosinia subrosea		2	1						1		1	1						1							1							1			1
	Notocallista multistriata																																			
	Tawera spissa	7	5	1		1	1		4		1	3	5				2	5	9		1	1	2	4	1	1	1	2	2		2	1			2	1
	Myadora antipodum			1	1																															
	Myadora striata	1						1								1								3		1	3	1							2	
	Thraciidae			1			1			1				1			1														1					
Echinodermata																																				
Asteroidea																																				
	Astropecten polyacanthus				1															1				1							*1*		1			
Echinoidea																																				
	Evechinus chloroticus																								1											
	Echinocardium cordatum			1		1					1			1					1								1	1					2	1	1	
Holothuroidea																																				
	Trochodota dendyi																			1																
Ophiuroidea																																				
	Ophiuroidea																													2					3	
Bryozoa																																				
	Bryozoa (bushy)																																			
	Bryozoa (discoid)	13	20	18	1		39	33	25	4	35	21	6	20	25	18	32	10	104	22	61	17	15	22	23	32	28	25	30	26	56	41	12	18	60	40
	Bryozoa (encrusting)	1						1									1		1					1	1		1						1		1	
	Bryozoa (solid Stalked)																					1			1										1	
Porifera																																				
Demospongiae	*cf Tethyopsis sp.*			1			3							2	1	1			4			1	1	2	5	1		1	1	1	1	2			2	1
	Sponge (bread)																																			
	Sponge (cream Encrusting)																																			
Cnidaria																																				
Hydrozoa																																				
	Hydroida (athecate)																																		1	
	Hydroida (thecate)																																			
Chordata																																				
Ascidiacea																																				
	Eugyra sp.						1																													
Leptocardii																																				
	Epigonichthys hectori									4	1		3	2		1	2		1	2		1	1		3	2	2		1	1						1
Teleostei																																				
	Limnichthys polyactis																																			
Number of Individuals		**109**	**145**	**135**	**149**	**132**	**100**	**75**	**168**	**173**	**116**	**105**	**66**	**72**	**85**	**57**	**125**	**99**	**226**	**118**	**109**	**68**	**45**	**88**	**141**	**86**	**105**	**100**	**125**	**129**	**125**	**79**	**67**	**61**	**330**	**114**
Number of Species / taxa		**20**	**25**	**32**	**30**	**25**	**23**	**23**	**25**	**17**	**21**	**20**	**24**	**25**	**24**	**21**	**33**	**25**	**31**	**27**	**19**	**25**	**15**	**26**	**36**	**23**	**27**	**28**	**29**	**31**	**29**	**16**	**26**	**19**	**42**	**33**
Shannon-Wiener Diversity Index		**2.41**	**2.10**	**2.69**	**2.21**	**2.02**	**2.16**	**2.19**	**2.15**	**1.47**	**2.15**	**2.46**	**2.85**	**2.69**	**2.53**	**2.52**	**2.69**	**2.77**	**2.22**	**2.48**	**1.75**	**2.70**	**2.20**	**2.76**	**2.67**	**2.42**	**2.63**	**2.49**	**2.66**	**2.40**	**2.22**	**1.86**	**2.85**	**2.41**	**2.19**	**2.63**
Shannon-Wiener Evenness		**0.81**	**0.65**	**0.78**	**0.65**	**0.63**	**0.69**	**0.70**	**0.67**	**0.52**	**0.70**	**0.82**	**0.90**	**0.84**	**0.80**	**0.83**	**0.77**	**0.86**	**0.65**	**0.75**	**0.59**	**0.84**	**0.81**	**0.85**	**0.75**	**0.77**	**0.80**	**0.75**	**0.79**	**0.70**	**0.66**	**0.67**	**0.87**	**0.82**	**0.59**	**0.75**

Table F.10 Benthic Infauna Retained on 1 mm sieve from the Southern Control outer Cells 2024 (Number per sample). Plus, Biota identified in Photographs in blue.

Taxa	Date	22 Mar 24					22 Mar 24					22 Mar 24					22 Mar 24					22 Mar 24					22 Mar 24					22 Mar 24				
	Cell	CSH					CSI					CSJ					CSK					CSL					CSM					CSN				
	Sample	CSH1	CSH2	CSH3	CSH4	CSH5	CSI1	CSI2	CSI3	CSI4	CSI5	CSJ1	CSJ2	CSJ3	CSJ4	CSJ5	CSK1	CSK2	CSK3	CSK4	CSK5	CSL1	CSL2	CSL3	CSL4	CSL5	CSM1	CSM2	CSM3	CSM4	CSM5	CSN1	CSN2	CSN3	CSN4	CSN5
	Depth	23.2	24.2	24.5	24.6	23.1	24.8	24.8	25.9	26.3	24.7	23.9	25.1	27.0	28.5	27.5	24.8	26.8	29.7	28.9	27.6	25.9	27.0	30.6	30.9	29.5	27.3	28.2	30.0	27.1	30.4	32.3	29.9	30.1	32.0	30.8
Annelida																																				
Polychaeta																																				
Amphinomidae																				1																
Eunicidae																								1												
Eunicidae	*Marphysa sp.*																			1																
Lumbrineridae													1												1							1				
Onuphidae	*Onuphis aucklandensis*																																1			
Glyceridae				1	1	1									1		1									2					2	2	1	2		1
Goniadidae						1															2						2		1		1			1	1	1
Nephtyidae	*Aglaophamus sp.*								1	1		1				3	2	1		1	1			3	2		2	1		1	1	3	1		4	1
Nereidae	Nereidae (juvenile)		1																																	
Phyllodocidae												1			5		1		1				1	1	1	3					5	2	1			
Pilargidae						1																														
Sigalionidae			1	1	2	1	1	2	1		2	1	3	2	1		1	2	4	1		2	2	3	3	1	1	32	3	3	3	4	3	2	2	1
Syllidae	Exogoninae																																			
Syllidae	Syllidae	1													1			1	1		3			1	1	3	1					1	1			
Sabellidae	*Euchone pallida*																				1															
Sabellidae		1					1		2		2		1	1	2		1	1	1	1	2			2	1	2		1	1	4	1		3		1	
Serpulidae	*Hydroides sp*	1	278	1	1		2	3	1		1			1			1	1						1	1											
Spionidae	*Prionospio sp.*																				1										8					2
Spionidae	*Spio sp.*																														1					
Ampharetidae							3			1	1	1	1		1		2			1	2		1		1					1						
Cirratulidae																															2			1		
Flabelligeridae						1																				2			1		1	1		1		1
Terebellidae						1		1							1									1							1		1	1		
Capitellidae	*Barantolla lepte*									1														1					1	1	11		1	1		2
Capitellidae	*Heteromastus filiformis*														1																					
Magelonidae	*Magelona dakini*				1	1		1	1	1	1	1		1			2			1	1		3	1			1		1		4		1			1
Maldanidae		2		1	3	2	5	1	3	3	2	4	1	1	4	4	5	4		5	6	4	3	2	2	5	3	1		3	3		2	2	2	4
Opheliidae	*Armandia maculata*		1												1						2					1	1								3	
Orbiniidae	*Leitoscoloplos kerguelensis*																														1			1		
Oweniidae	*Myriochele sp.*											1																								
Oweniidae	*Myriowenia sp.*														2		1	1		1							2				3	3	3		1	1
Oweniidae	*Owenia petersenae*																																			
Travisiidae	*Travisia olens*						1																							1						
Sipuncula																																				
	Aspidosiphon sp.									1	1															1					1					
Chaetognatha																																				
Nemertea						1			1	1		1	1			1	1						1		1	3			1		4		1			1
Phoronida																																				
	Phoronus sp.				1																							1								
Arthropoda																																				
Amphipoda																																				
	Ampelisca sp.																														1					1
	Lysianassidae					3			1			1		1	1	2				2	1		1	1			2	8	2		2	2	1		3	2
	Oedicerotidae	1												1			1							1												
	Phoxocephalidae	2		2		3	2		1	1	2	22	4	3	13	7	8	3	2	12	25	1	2	3	5		3	3	4	2	7	9	3		5	7
	Urothoidae			1						4	4	3	1	3	9	7	2	5	9	18	11	2	2	2	6		4	7		3	3	3	1		6	
	Amphipoda Unid.	5	3	13	1	4		5	11	5	21	2	5	5	6	2	18	18	4	8	2			4	3	23	4	3	4	7	11	15	3	1	2	5
Cumacea																																				
	Cumacea			2							2	1		1	1			1		5	2			1	1	3	5			1	1	7			1	
Decapoda																																				
	Alpheus sp.																								1											
	Callianassa filholi																	1		1																
	Philocheras australis																																			
	Philocheras sp.														2																					
	Nectocarcinus benetti	1																																		
	Halicarcinus tongi																																			
	Pyromaia tuberculata												1													2	1									
	Ebalia laevis																														1					
	Notomithrax minor																								3											
	Pagurus sp.			1							1		1	4		1	4			3				1	12	1			1			3			14	1
	Palaemon affinis																1									1					1	1				

Taxa	Date	22 Mar 24					22 Mar 24					22 Mar 24					22 Mar 24					22 Mar 24					22 Mar 24					22 Mar 24				
	Cell	CSH					CSI					CSJ					CSK					CSL					CSM					CSN				
	Sample	CSH1	CSH2	CSH3	CSH4	CSH5	CSI1	CSI2	CSI3	CSI4	CSI5	CSJ1	CSJ2	CSJ3	CSJ4	CSJ5	CSK1	CSK2	CSK3	CSK4	CSK5	CSL1	CSL2	CSL3	CSL4	CSL5	CSM1	CSM2	CSM3	CSM4	CSM5	CSN1	CSN2	CSN3	CSN4	CSN5
	Depth	23.2	24.2	24.5	24.6	23.1	24.8	24.8	25.9	26.3	24.7	23.9	25.1	27.0	28.5	27.5	24.8	26.8	29.7	28.9	27.6	25.9	27.0	30.6	30.9	29.5	27.3	28.2	30.0	27.1	30.4	32.3	29.9	30.1	32.0	30.8
	Liocarcinus corrugatus								1								1	1													1	1				
	Decapoda (larvae Unid.)														1																					
Isopoda																																				
	Anthuridea				2		1		4	2					1		2	1		1	1	2		3			1	2	1							2
	Eurylana cookii	1	1	2	1		1		2								5			1	1	2	1	1	1	3	1	4	1	5	2	7	3	2		3
	Pseudaega secunda																																			
	Cassidina typa																																			
	Exosphaeroma falcatum																																			
	Exosphaeroma planulum																																			
Leptostraca																																				
	Nebalia sp.																																			1
Mysidacea				1					1													1			1	3					1	1				
Stomatopoda													1																							
Tanaidacea		3					1	3					1													1			1	1			2			
Ostracoda																																				
	Diasterope grisea											1	1		1					2	3										1					
	Cypridinodes												1	1			2	1		1					3						1	8			1	
	Scleroconcha sp.																													3						
	Cymbicopia sp.																									2										
Thecostraca																																				
	Balanus decorus		56																																	
Brachiopoda																																				
	Calloria inconspicua																																			
Mollusca																																				
Polyplacophora																																				
	Ischnochiton maorianus	2	1	3		1																				1					1					
	Leptochiton inquinatus																																			
Gastropoda																																				
	Epitonium scalare																																			
	Zeacolpus pagoda																						1													
	Zeacolpus vittatus			1																									2							
	Cylichna thetidis										1					1																				
	Philine sp	1			1	1									1		2								1		1		2	2			1	1	1	
	Sigapatella tenuis	10		6	1	1	3		3	6	12	1	8	2	3	1	6	5	7	2	2	6	5	1	3	13	4	7	1	4	4	4	9	10	2	
	Eulimidae		1	1																																
	Pelicaria vermis														1																					
	Struthiolaria papulosa																																			
	Amalda australis																																			
	Amalda northlandica								1				1	1					1						1					1						
	Cominella adspersa		1																																	
	Cominella nassoides																																			
	Cominella quoyana																																			
	Cominella virgata						1			1			2							1																
	Splendrillia aoteana																																			
	Neoguraleus sp.																																			
	Marginellidae			1																																
	Xymene sp.		1																	1					2	1		1								
	Austrofusus glans													1																						
	Duplicaria tristis																						1													
	Berthella sp.																																			1
	Spectamen tryphenense																							1				1	1		1		1			
	Micrelenchus sp.			4	1																					5					1					
	Pupa affinis													1																		1				
	Psilaxis oxytropis									1												1														
Bivalvia																																				
	Hiatella arctica		3							1																										
	Glycymeris modesta																																			
	Pratulum pulchellum														1						1					1		1		2				1		
	Gari convexa										1				1											2		1				1		1		2
	Gari sp. (juvenile)	2	3	1	1	1	1	1						1	1		1	1		1			1		1	3	1			1		4	2		2	
	Gari stangeri	1	2	4	1	1	1	2				3								1					1				1	1	2	1	1			
	Pleuromeris sp.		1	1			2	1			1		1																							
	Pleuromeris zelandica												1																							
	Purpurocardia purpurata																																			
	Limatula maoria		1																											1						
	Limaria orientalis																		1					1		4						1	1	1	2	
	Corbula zelandica	1	1				2																1		1						1					
	Nucula nitidula	3	1	2	1	3	2		2	4	1			3	1		2	2	5		3	2	1	2	2	5			1	6	1	6	3	4	4	1
	Atrina zelandica (juvenile)																																			

Bioresearches
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Taxa	Date	22 Mar 24					22 Mar 24					22 Mar 24					22 Mar 24					22 Mar 24					22 Mar 24					22 Mar 24				
	Cell	CSH					CSI					CSJ					CSK					CSL					CSM					CSN				
	Sample	CSH1	CSH2	CSH3	CSH4	CSH5	CSI1	CSI2	CSI3	CSI4	CSI5	CSJ1	CSJ2	CSJ3	CSJ4	CSJ5	CSK1	CSK2	CSK3	CSK4	CSK5	CSL1	CSL2	CSL3	CSL4	CSL5	CSM1	CSM2	CSM3	CSM4	CSM5	CSN1	CSN2	CSN3	CSN4	CSN5
	Depth	23.2	24.2	24.5	24.6	23.1	24.8	24.8	25.9	26.3	24.7	23.9	25.1	27.0	28.5	27.5	24.8	26.8	29.7	28.9	27.6	25.9	27.0	30.6	30.9	29.5	27.3	28.2	30.0	27.1	30.4	32.3	29.9	30.1	32.0	30.8
	Pecten novaezelandiae							*1*		*1*			2	1									*1*				*1*	1	*1*	*1*						
	Scalpomactra scalpellum					1				1		5		3	6			1	2	1	4	1		1	3	2		1			1	1	2		1	1
	Zemysina sp.											1		3	2						1						1								1	
	Dosinia subrosea							1	1	1	1					2		1	1	1				2		1				1		1				
	Notocallista multistriata																1																			
	Tawera spissa	1	5	2		1					1																			2	1		1		2	
	Myadora antipodum																																			1
	Myadora striata	1																			1		1			1		1	1							
	Thraciidae									1	1	1	1				2					1	1	1			2	1							2	
Echinodermata																																				
Asteroidea																																				
	Astropecten polyacanthus																																1		1	
Echinoidea																																				
	Evechinus chloroticus																																			
	Echinocardium cordatum	1				1										1					1	1								1						
Holothuroidea																																				
	Trochodota dendyi																																			
Ophiuroidea																																				
	Ophiuroidea				1						1								1		1			1	1	2	1			1	3	1		1		
Bryozoa																																				
	Bryozoa (bushy)																1																			
	Bryozoa (discoid)	19	14	31	8	21	27	4	13	19	40	13	25	16	8	13	33	8	7	19	17	21	9	18	16	52	5	13	4	32	8	2	10	3	5	
	Bryozoa (encrusting)	10	1							1			1				1								1							1				
	Bryozoa (solid Stalked)		1																		1				1					1		1	1	1	1	
Porifera																																				
Demospongiae	*cf Tethyopsis sp.*		2		1		1			2							1		1					1	1	2	1		2	2	2			1		1
	Sponge (bread)																															1				
	Sponge (cream Encrusting)		1																															1		
Cnidaria																																				
Hydrozoa																																				
	Hydroida (athecate)		10																																	
	Hydroida (thecate)		1																																	
Chordata																																				
Ascidiacea																																				
	Eugyra sp.																																			
Leptocardii																																				
	Epigonichthys hectori	2	2	4	1	5			1	1	1			2				1	1	1					1	1	2		2	2	2	1	1	2	1	2
Teleostei																																				
	Limnichthys polyactis					1																														
Number of Individuals		**72**	**394**	**87**	**30**	**58**	**58**	**26**	**52**	**61**	**101**	**65**	**66**	**59**	**80**	**45**	**112**	**61**	**49**	**95**	**99**	**47**	**39**	**63**	**86**	**158**	**53**	**91**	**41**	**97**	**114**	**101**	**67**	**42**	**71**	**47**
Number of Species / taxa		**23**	**27**	**24**	**19**	**24**	**19**	**13**	**20**	**24**	**23**	**20**	**24**	**24**	**30**	**13**	**31**	**22**	**17**	**29**	**28**	**14**	**20**	**30**	**35**	**35**	**26**	**21**	**25**	**31**	**44**	**34**	**32**	**23**	**27**	**26**
Shannon-Wiener Diversity Index		**2.56**	**1.23**	**2.43**	**2.64**	**2.53**	**2.15**	**2.38**	**2.49**	**2.60**	**2.10**	**2.28**	**2.42**	**2.75**	**2.96**	**2.17**	**2.67**	**2.53**	**2.49**	**2.68**	**2.67**	**2.00**	**2.67**	**2.91**	**3.08**	**2.68**	**3.07**	**2.29**	**3.06**	**2.76**	**3.42**	**3.13**	**3.14**	**2.81**	**2.96**	**3.02**
Shannon-Wiener Evenness		**0.82**	**0.37**	**0.76**	**0.90**	**0.80**	**0.73**	**0.93**	**0.83**	**0.82**	**0.67**	**0.76**	**0.76**	**0.86**	**0.87**	**0.85**	**0.78**	**0.82**	**0.88**	**0.80**	**0.80**	**0.76**	**0.89**	**0.86**	**0.87**	**0.75**	**0.94**	**0.75**	**0.95**	**0.80**	**0.90**	**0.89**	**0.91**	**0.90**	**0.90**	**0.93**

Table F.11 Benthic Infauna Retained on 1 mm sieve from the Remote Control Cells 2024 (Number per sample). Plus, Biota identified in Photographs in blue.

Taxa	Date	23 Mar 24					23 Mar 24					23 Mar 24					23 Mar 24					23 Mar 24					23 Mar 24					23 Mar 24					23 Mar 24				
	Cell	CRA					CRB					CRC					CRD					CRE					CRF					CRG					CRH				
	Sample	CRA1	CRA2	CRA3	CRA4	CRA5	CRB1	CRB2	CRB3	CRB4	CRB5	CRC1	CRC2	CRC3	CRC4	CRC5	CRD1	CRD2	CRD3	CRD4	CRD5	CRE1	CRE2	CRE3	CRE4	CRE5	CRF1	CRF2	CRF3	CRF4	CRF5	CRG1	CRG2	CRG3	CRG4	CRG5	CRH1	CRH2	CRH3	CRH4	CRH5
	Depth	20.9	21.8	19.7	20.2	21.7	21.8	21.8	21.8	22.0	22.1	22.9	28.2	25.8	24.0	25.3	24.2	25.0	27.4	27.4	27.1	28.3	28.0	27.5	28.2	28.8	30.1	29.3	29.9	29.1	29.7	30.9	30.9	31.7	31.4	31.2	33.8	33.6	32.8	32.9	33.7
Annelida																																									
Polychaeta																																									
Dorvilleidae		2																																							
Eunicidae																								1		1	1														
Lumbrineridae			2			1	1				1				1			1	1			1				1				1	1	1				2	1				
Onuphidae	*Onuphis aucklandensis*							1																																	
Glyceridae		1			2				1						1												1					2		1		1			1	1	2
Goniadidae												1											1																		
Hesionidae		1																																1							1
Nephtyidae	*Aglaophamus sp.*	1																				1		1	1			1	2						2	1		1	1		
Phyllodocidae			2			2		6	1	1	2		1		1	2		1	2	1	1		1			2	1	2		1						1	1				
Sigalionidae		2	1		2	1	2	1	1				2		1		1	2	2	1			1		1	2	1	2	2	1	1	1	1	1		1	4	1	1	1	1
Syllidae	Syllidae	8		1				1		1						1		1					1											2							
Sabellidae		1	2		3		1			1				1	1	2	1	1	1	1	1	1	1	3	1	2	4	1	2	1	1	1	2	2	2		1	1	2	1	2
Serpulidae	*Hydroides sp*	4	2		1	1		2		1	1																									1		1			1
Spionidae	*Prionospio sp.*		1			1							1			2			3	2	2			3		1										1	1		1		
Spionidae	*Spio sp.*							1																																	
Ampharetidae																							2					1													
Cirratulidae																																				1					
Flabelligeridae		1																																			1		1		
Pectinariidae	*Lagis australis*														1																										
Terebellidae																									1	1				1	1				1				1		
Capitellidae	*Barantolla lepte*				4	1		2	1		2		1		1	2			3	1	2	1	2	1		2					1				2		1	1	1		2
Capitellidae	*Notomastus zeylanicus*																									1		1													
Magelonidae	*Magelona dakini*		1			1					5			2		1		1			3			1	1	4		1		1			1	1	1	2		5			5
Maldanidae			19	33	39	13		76	8	15	18	7	16	9	33	31	3	2	5	2	2		5	8	3	5	2	2	2	1	1	1				2	1			1	
Opheliidae	*Armandia maculata*	1		1										1			1							1										2							
Orbiniidae	*Leitoscoloplos kerguelensis*	2																									1									2	1	1		1	2
Oweniidae	*Owenia petersenae*	1	2	6	13	1	2	2	8	4	2	11	10	23	9	8	24	13	14	9	7	14	80	7	9	25	31	17	26	7	21	14	24	15	19	31	37	10	20	5	13
Sipuncula																																									
	Aspidosiphon sp.			1																																					
Nemertea		1		2	1			1	1		1		1			1	1		1			1	2			2	1				1						1	1			1
Arthropoda																																									
Amphipoda																																									
	Lysianassidae							1	1		1				2		1	1						1			1				1				1						
	Oedicerotidae			3		1		1	2	5	3	1			3		3		1	1			3	2	2	1		2	1		1					1				2	
	Phoxocephalidae	2	1	4	6	7	6	2	8	15	9	10	4	1	15	4	9	1	3	3	1	3	3	7	5	3	1	3	6	3	7	2		6	3	1	1	3	1	2	5
	Urothoidae	2	12	7	5	8	2	15	8	6	1	7	6	3	8	12	24	3	7	9	8	4	15	6	11	1	7	7	2	2	12		8	8	5	3	2			6	
	Amphipoda Unid.	19	1	1	4	1		3	5	5	4	3	1	2		5	6	2	6	4	1	3	16	7		6	9	5	6	6	4	4	3	7	1	10	8	3	14	8	8
Cumacea																																									
	Cumacea			1	1	1				2		1	3	2	2	1	1		3	1	2	3		3		2	3	2		1	3	1		1		2			1	1	
Decapoda																																									
	Callianassa filholi						1			1	1	2			1		1	1			2	1						1	1			4	1	4		2		3		2	
	Halicarcinus sp.																																1								
	Pyromaia tuberculata									2							2												1												
	Pagurus sp.	3				1		1	1														2				3			1	3				1	3				4	
	Liocarcinus corrugatus	3						2						1			1							1					2				1						1	1	
	Ibacus alticrenatus																																			1					
	Decapoda (larvae Unid.)								1																																
Isopoda																																									
	Anthuridea														1	1		1								1					1	1	1	1		1					
	Eurylana cookii	2								1				1								1					1		2	2	1	5	4	3		6		4	4	2	3
	Cassidina typa															1																				1					
	Valvifera																																1								
Leptostraca																																									
	Nebalia sp.		1																																						
Mysidacea													1		1		1								2			1			1					2					
Stomatopoda																		1																							
Tanaidacea																																						1			1
Ostracoda																																									
	Cypridinodes	1																																1				1			

Taxa	Date	23 Mar 24					23 Mar 24					23 Mar 24					23 Mar 24					23 Mar 24					23 Mar 24					23 Mar 24					23 Mar 24				
	Cell	CRA					CRB					CRC					CRD					CRE					CRF					CRG					CRH				
	Sample	CRA1	CRA2	CRA3	CRA4	CRA5	CRB1	CRB2	CRB3	CRB4	CRB5	CRC1	CRC2	CRC3	CRC4	CRC5	CRD1	CRD2	CRD3	CRD4	CRD5	CRE1	CRE2	CRE3	CRE4	CRE5	CRF1	CRF2	CRF3	CRF4	CRF5	CRG1	CRG2	CRG3	CRG4	CRG5	CRH1	CRH2	CRH3	CRH4	CRH5
	Depth	20.9	21.8	19.7	20.2	21.7	21.8	21.8	21.8	22.0	22.1	22.9	28.2	25.8	24.0	25.3	24.2	25.0	27.4	27.4	27.1	28.3	28.0	27.5	28.2	28.8	30.1	29.3	29.9	29.1	29.7	30.9	30.9	31.7	31.4	31.2	33.8	33.6	32.8	32.9	33.7
Mollusca																																									
Gastropoda																																									
	Cylichna thetidis							1	1		1												1													1					
	Philine sp	1	2		3		2	2	1	4	1					1			3			1	3	1						1				1	1			1			1
	Sigapatella tenuis	7	2	9	11	1	4	4	4	5	7	4		7	3	1	2	2	4		2	4	3	2	1	9	6	2	1		3	1	4	2	6	3	2	1	4	3	2
	Eulimidae	1																																						1	
	Naticidae	1																																							
	Struthiolaria papulosa								1																																
	Amalda northlandica							1					1																						4						
	Cominella virgata							2																					1						1						
	Neoguraleus sp.																																				1				
	Xymene sp.							1																									1		1	1					
	Austrofusus glans				1																1																				
	Micrelenchus sp.	1																								1	1										1			2	
	Psilaxis oxytropis							1																																	
Bivalvia																																									
	Pratulum pulchellum	1																																			1				1
	Gari convexa																																			1	2				
	Gari sp. (juvenile)	6								1		1					1								1				3	1		1		3	1	1	1	1	4	2	2
	Gari stangeri	2						1			3			1	1				1													1	2	1	2	1		1	2	1	1
	Pleuromeris sp.																										1														
	Myllitella vivens vivens								2	1	1		1	2		2											1	1				1		1							
	Limatula maoria													1																								1			
	Corbula zelandica																1										1	1	2				2	3	5	2	3	2	5	5	2
	Nucula nitidula	4				1			6	1	2			1	1	2	2		2			1				1	1	1				1					1		1		1
	Atrina zelandica (juvenile)													1																											
	Pecten novaezelandiae																				*1*			*1*									*1*				*1*				
	Scalpomactra scalpellum		1	6	5	2	1	1	3	6	7	3	1		3	4	1	2	4		2	1	3	6	1	3	1	1	5		1	2	4	1		1	1	1	2	2	2
	Zemysina sp.				1																												1								
	Dosinia subrosea	2							1		1		2			1		1										1	1				1	1	2	2					
	Tawera spissa	6		2	1	1		4	4		1	1	2	2	4				2	2				1								1		1	2	4	3	1	1		
	Myadora striata							1						1			1	1				2	1				1	2													
	Thraciidae													1																											
Echinodermata																																									
Asteroidea																																									
	Astropecten polyacanthus						1																																		
Echinoidea																																									
	Echinocardium cordatum				1	2		1			2						1								1	1		1								1	1	1			
Ophiuroidea																																									
	Ophiuroidea						1	1		1		1																		1	1		2				1		1		1
Bryozoa																																									
	Bryozoa (discoid)	1	19	28	38	7	4	64	47	46	49	4	3	12	8	11	1	7	2	6	1	1	9			2	1	2	3		2										
	Bryozoa (encrusting)																																			1					
	Bryozoa (solid Stalked)	1																									1								1	1	1		1		1
Porifera																																									
Demospongiae	*cf Tethyopsis sp.*		1		1					1				1								1					3								1			1	1		2
	Sponge (bread)				1																																				
	Sponge (cream Encrusting)								1								1																								
Cnidaria																																									
Hexacorallia																																									
	Anemone (Unid.)															1																									
	Arachnanthus sp.			1																																					
	Sphenotrochus sp.																																						1		
Chordata																																									
Ascidiacea																																									
	Eugyra sp.			2	3			3		4		1	1		2	1									1	1															
Leptocardii																																									
	Epigonichthys hectori	20		1						2	1						1					1	2		1		2	1	1	1	1			3	1		2	2		2	
Number of Individuals		**112**	**72**	**109**	**147**	**55**	**28**	**206**	**118**	**132**	**127**	**58**	**58**	**76**	**104**	**98**	**92**	**45**	**70**	**43**	**39**	**46**	**157**	**64**	**43**	**81**	**88**	**62**	**72**	**33**	**70**	**45**	**66**	**73**	**66**	**99**	**83**	**50**	**73**	**56**	**63**
Number of Species / taxa		**34**	**18**	**18**	**23**	**21**	**13**	**32**	**25**	**25**	**26**	**16**	**19**	**22**	**24**	**24**	**26**	**20**	**21**	**14**	**17**	**20**	**22**	**21**	**17**	**26**	**28**	**26**	**21**	**18**	**23**	**19**	**21**	**26**	**24**	**37**	**29**	**26**	**25**	**23**	**25**
Shannon-Wiener Diversity Index		**2.97**	**2.17**	**2.15**	**2.33**	**2.53**	**2.35**	**2.06**	**2.37**	**2.43**	**2.35**	**2.41**	**2.43**	**2.42**	**2.45**	**2.48**	**2.42**	**2.54**	**2.76**	**2.29**	**2.55**	**2.54**	**1.96**	**2.73**	**2.36**	**2.66**	**2.56**	**2.77**	**2.44**	**2.57**	**2.47**	**2.47**	**2.40**	**2.84**	**2.68**	**2.90**	**2.40**	**2.93**	**2.57**	**2.89**	**2.84**
Shannon-Wiener Evenness		**0.84**	**0.75**	**0.75**	**0.74**	**0.83**	**0.92**	**0.59**	**0.74**	**0.75**	**0.72**	**0.87**	**0.83**	**0.78**	**0.77**	**0.78**	**0.74**	**0.85**	**0.91**	**0.87**	**0.90**	**0.85**	**0.63**	**0.90**	**0.83**	**0.81**	**0.77**	**0.85**	**0.80**	**0.89**	**0.79**	**0.84**	**0.79**	**0.87**	**0.84**	**0.80**	**0.71**	**0.90**	**0.80**	**0.92**	**0.88**

Appendix G Statistical Results – Benthic Biota Infauna

Univariate Statistics

Table G.1 Kruskal-Wallis One Way Analysis of the Number of Individuals between the sand extraction area and control areas

Dependent Variable: Number of Individuals
Normality Test: Failed (P < 0.050)

Group	N	Missing	Median	25%	75%
Control	143	0	88.000	62.000	115.000
Sand	231	0	95.000	67.000	126.000

H = 4.083 with 1 degrees of freedom. (P = 0.043)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.043)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

Table G.2 Kruskal-Wallis One Way Analysis of the Number of Individuals between Alongshore areas in the sand area and control areas

Dependent Variable: Number of Individuals
Normality Test: Failed (P < 0.050)

Group	N	Missing	Median	25%	75%
Control North (CN)	33	0	95.000	66.000	122.000
2	33	0	108.000	86.000	123.000
3	33	0	117.000	91.000	135.500
4	33	0	86.000	62.500	120.500
5	33	0	111.000	78.000	159.500
6	33	0	70.000	50.500	104.000
7	33	0	84.000	56.000	117.000
8	33	0	88.000	68.000	122.000
Control Southern (CS)	70	0	86.500	61.000	114.500
Control Remote (CR)	40	0	71.000	55.250	98.750

H = 30.663 with 9 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks	Q	P	P<0.050
3 vs CR	103.144	4.057	0.002	Yes
3 vs 6	95.061	3.572	0.016	Yes
3 vs 7	76.652	2.880	0.179	No
3 vs CS	66.746	2.924	0.156	Do Not Test
3 vs 4	61.985	2.329	0.894	Do Not Test
3 vs CN	49.212	1.849	1.000	Do Not Test
3 vs 8	46.955	1.764	1.000	Do Not Test
3 vs 2	27.015	1.015	1.000	Do Not Test
3 vs 5	13.242	0.498	1.000	Do Not Test
5 vs CR	89.902	3.536	0.018	Yes
5 vs 6	81.818	3.074	0.095	No
5 vs 7	63.409	2.382	0.774	Do Not Test
5 vs CS	53.504	2.344	0.859	Do Not Test
5 vs 4	48.742	1.831	1.000	Do Not Test
5 vs CN	35.970	1.352	1.000	Do Not Test
5 vs 8	33.712	1.267	1.000	Do Not Test
5 vs 2	13.773	0.517	1.000	Do Not Test
2 vs CR	76.129	2.994	0.124	No
2 vs 6	68.045	2.557	0.476	Do Not Test
2 vs 7	49.636	1.865	1.000	Do Not Test
2 vs CS	39.731	1.740	1.000	Do Not Test
2 vs 4	34.970	1.314	1.000	Do Not Test
2 vs CN	22.197	0.834	1.000	Do Not Test
2 vs 8	19.939	0.749	1.000	Do Not Test
8 vs CR	56.190	2.210	1.000	Do Not Test
8 vs 6	48.106	1.808	1.000	Do Not Test
8 vs 7	29.697	1.116	1.000	Do Not Test
8 vs CS	19.792	0.867	1.000	Do Not Test
8 vs 4	15.030	0.565	1.000	Do Not Test
8 vs CN	2.258	0.0848	1.000	Do Not Test
CN vs CR	53.932	2.121	1.000	Do Not Test
CN vs 6	45.848	1.723	1.000	Do Not Test
CN vs 7	27.439	1.031	1.000	Do Not Test
CN vs CS	17.534	0.768	1.000	Do Not Test
CN vs 4	12.773	0.480	1.000	Do Not Test
4 vs CR	41.159	1.619	1.000	Do Not Test
4 vs 6	33.076	1.243	1.000	Do Not Test
4 vs 7	14.667	0.551	1.000	Do Not Test
4 vs CS	4.761	0.209	1.000	Do Not Test
CS vs CR	36.398	1.699	1.000	Do Not Test
CS vs 6	28.315	1.240	1.000	Do Not Test
CS vs 7	9.905	0.434	1.000	Do Not Test
7 vs CR	26.493	1.042	1.000	Do Not Test
7 vs 6	18.409	0.692	1.000	Do Not Test
6 vs CR	8.084	0.318	1.000	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

Table G.3 Kruskal-Wallis One Way Analysis of the Number of Individuals between Offshore areas in the Sand Extraction Area

Dependent Variable: Number of Individuals
Normality Test: Failed (P < 0.050)

Group	N	Missing	Median	25%	75%
A	21	0	115.000	98.500	164.500
B	21	0	96.000	79.000	142.500
C	21	0	104.000	81.000	139.000
D	21	0	92.000	55.000	110.500
E	21	0	59.000	43.000	107.000
F	21	0	104.000	64.000	149.000
G	21	0	84.000	45.000	128.000
H	21	0	102.000	69.500	123.500
I	21	0	94.000	65.500	119.500
J	21	0	84.000	68.500	121.000
K	21	0	111.000	75.500	125.500

H = 23.364 with 10 degrees of freedom. (P = 0.009)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.009)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparison	Diff of Ranks	q	P	P<0.050
A vs E	1676.500	5.474	0.004	Yes
A vs G	1292.500	4.220	0.097	No
A vs D	1270.000	4.147	0.112	Do Not Test
A vs I	1006.000	3.285	0.417	Do Not Test
A vs J	991.000	3.236	0.441	Do Not Test
A vs H	748.500	2.444	0.819	Do Not Test
A vs K	675.500	2.206	0.899	Do Not Test
A vs F	599.000	1.956	0.954	Do Not Test
A vs B	489.500	1.598	0.989	Do Not Test
A vs C	480.500	1.569	0.991	Do Not Test
C vs E	1196.000	3.905	0.172	No
C vs G	812.000	2.651	0.731	Do Not Test
C vs D	789.500	2.578	0.764	Do Not Test
C vs I	525.500	1.716	0.982	Do Not Test
C vs J	510.500	1.667	0.986	Do Not Test
C vs H	268.000	0.875	1.000	Do Not Test
C vs K	195.000	0.637	1.000	Do Not Test
C vs F	118.500	0.387	1.000	Do Not Test
C vs B	9.000	0.0294	1.000	Do Not Test
B vs E	1187.000	3.876	0.181	Do Not Test
B vs G	803.000	2.622	0.744	Do Not Test

Comparison	Diff of Ranks	q	P	P<0.050
B vs D	780.500	2.549	0.777	Do Not Test
B vs I	516.500	1.687	0.984	Do Not Test
B vs J	501.500	1.638	0.987	Do Not Test
B vs H	259.000	0.846	1.000	Do Not Test
B vs K	186.000	0.607	1.000	Do Not Test
B vs F	109.500	0.358	1.000	Do Not Test
F vs E	1077.500	3.518	0.310	Do Not Test
F vs G	693.500	2.265	0.882	Do Not Test
F vs D	671.000	2.191	0.903	Do Not Test
F vs I	407.000	1.329	0.998	Do Not Test
F vs J	392.000	1.280	0.998	Do Not Test
F vs H	149.500	0.488	1.000	Do Not Test
F vs K	76.500	0.250	1.000	Do Not Test
K vs E	1001.000	3.269	0.425	Do Not Test
K vs G	617.000	2.015	0.944	Do Not Test
K vs D	594.500	1.941	0.956	Do Not Test
K vs I	330.500	1.079	1.000	Do Not Test
K vs J	315.500	1.030	1.000	Do Not Test
K vs H	73.000	0.238	1.000	Do Not Test
H vs E	928.000	3.030	0.544	Do Not Test
H vs G	544.000	1.776	0.977	Do Not Test
H vs D	521.500	1.703	0.983	Do Not Test
H vs I	257.500	0.841	1.000	Do Not Test
H vs J	242.500	0.792	1.000	Do Not Test
J vs E	685.500	2.238	0.890	Do Not Test
J vs G	301.500	0.985	1.000	Do Not Test
J vs D	279.000	0.911	1.000	Do Not Test
J vs I	15.000	0.0490	1.000	Do Not Test
I vs E	670.500	2.189	0.904	Do Not Test
I vs G	286.500	0.936	1.000	Do Not Test
I vs D	264.000	0.862	1.000	Do Not Test
D vs E	406.500	1.327	0.998	Do Not Test
D vs G	22.500	0.0735	1.000	Do Not Test
G vs E	384.000	1.254	0.998	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

Table G.4 One Way Analysis of Variance of the Number of Taxa between the sand extraction area and control areas

Dependent Variable: Number of taxa
Normality Test (Shapiro-Wilk): Passed (P = 0.513)
Equal Variance Test (Brown-Forsythe): Passed (P = 0.100)

Group Name	N	Missing	Mean	Std Dev	SEM
Control	143	0	25.825	6.103	0.510
Sand	231	0	26.710	6.629	0.436

Source of Variation	DF	SS	MS	F	P
Between Groups	1	69.143	69.143	1.671	0.197
Residual	372	15394.196	41.382		
Total	373	15463.340			

The differences in the mean values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.197).

Power of performed test with alpha = 0.050: 0.129

The power of the performed test (0.129) is below the desired power of 0.800.
Less than desired power indicates you are less likely to detect a difference when one actually exists. Negative results should be interpreted cautiously.

Table G.5 One Way Analysis of Variance of the Number of Taxa between Alongshore areas in the sand area and control areas

Dependent Variable: Number of taxa
Normality Test (Shapiro-Wilk): Passed (P = 0.971)
Equal Variance Test (Brown-Forsythe): Passed (P = 0.674)

Group Name	N	Missing	Mean	Std Dev	SEM
Control North (CN)	33	0	28.485	5.718	0.995
2	33	0	29.606	7.258	1.264
3	33	0	29.485	6.350	1.105
4	33	0	25.364	6.324	1.101
5	33	0	26.909	5.870	1.022
6	33	0	24.970	5.570	0.970
7	33	0	25.091	6.889	1.199
8	33	0	25.545	6.643	1.156
Control Southern (CS)	70	0	25.314	6.199	0.741
Control Remote (CR)	40	0	22.875	5.014	0.793

Source of Variation	DF	SS	MS	F	P
Between Groups	9	1552.685	172.521	4.498	<0.001
Residual	364	13960.067	38.352		
Total	373	15512.751			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001).

Power of performed test with alpha = 0.050: 0.989

All Pairwise Multiple Comparison Procedures (Holm-Sidak method): Overall significance level = 0.05

Comparisons for factor: Alongshore cells

Comparison	Diff of Means	t	P	P<0.050
2 vs. CR	6.731	4.622	<0.001	Yes
3 vs. CR	6.610	4.539	<0.001	Yes
CN vs. CR	5.610	3.852	0.006	Yes
2 vs. CS	4.292	3.282	0.046	Yes
3 vs. CS	4.171	3.189	0.062	No
2 vs. 6	4.636	3.041	0.096	No
2 vs. 7	4.515	2.962	0.120	No
3 vs. 6	4.515	2.962	0.117	No
3 vs. 7	4.394	2.882	0.144	No
2 vs. 4	4.242	2.783	0.185	No
5 vs. CR	4.034	2.770	0.187	No
3 vs. 4	4.121	2.703	0.218	No
2 vs. 8	4.061	2.663	0.235	No
3 vs. 8	3.939	2.584	0.279	No
CN vs. CS	3.171	2.425	0.390	No
CN vs. 6	3.515	2.306	0.482	No
CN vs. 7	3.394	2.226	0.543	No
CN vs. 4	3.121	2.047	0.693	No
CS vs. CR	2.439	1.987	0.732	No
CN vs. 8	2.939	1.928	0.768	No
8 vs. CR	2.670	1.834	0.826	No
2 vs. 5	2.697	1.769	0.857	No
4 vs. CR	2.489	1.709	0.881	No
3 vs. 5	2.576	1.689	0.880	No
7 vs. CR	2.216	1.522	0.945	No
6 vs. CR	2.095	1.438	0.962	No
5 vs. 6	1.939	1.272	0.987	No
5 vs. CS	1.595	1.220	0.989	No
5 vs. 7	1.818	1.193	0.989	No
CN vs. 5	1.576	1.034	0.997	No
5 vs. 4	1.545	1.014	0.996	No
5 vs. 8	1.364	0.894	0.999	No
2 vs. CN	1.121	0.735	1.000	No
3 vs. CN	1.000	0.656	1.000	No
8 vs. 6	0.576	0.378	1.000	No
8 vs. 7	0.455	0.298	1.000	No
CS vs. 6	0.345	0.264	1.000	No
4 vs. 6	0.394	0.258	1.000	No
4 vs. 7	0.273	0.179	1.000	No
8 vs. CS	0.231	0.177	1.000	No
CS vs. 7	0.223	0.171	1.000	No
8 vs. 4	0.182	0.119	1.000	No
2 vs. 3	0.121	0.0795	1.000	No
7 vs. 6	0.121	0.0795	0.996	No
4 vs. CS	0.0494	0.0377	0.970	No

Table G.6 One Way Analysis of Variance of the Number of Taxa between Offshore areas in the Sand Extraction Area

Dependent Variable: Number of taxa
Normality Test (Shapiro-Wilk): Passed (P = 0.477)
Equal Variance Test (Brown-Forsythe): Passed (P = 0.945)

Group Name	N	Missing	Mean	Std Dev	SEM
A	21	0	27.333	5.304	1.157
B	21	0	25.810	6.063	1.323
C	21	0	27.571	5.836	1.273
D	21	0	24.381	7.046	1.538
E	21	0	22.571	7.068	1.542
F	21	0	28.000	6.588	1.438
G	21	0	23.619	7.283	1.589
H	21	0	28.714	6.835	1.491
I	21	0	28.810	6.063	1.323
J	21	0	27.524	5.802	1.266
K	21	0	29.476	6.169	1.346

Source of Variation	DF	SS	MS	F	P
Between Groups	10	843.106	84.311	2.051	0.029
Residual	253	10399.667	41.105		
Total	263	11242.773			

The differences in the mean values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.029).

Power of performed test with alpha = 0.050: 0.800

All Pairwise Multiple Comparison Procedures (Holm-Sidak method): Overall significance level = 0.05

Comparisons for factor: Offshore cells

Comparison	Diff of Means	t	P	P<0.050
K vs. E	6.905	3.497	0.031	Yes
I vs. E	6.238	3.160	0.093	No
H vs. E	6.143	3.111	0.106	No
K vs. G	5.857	2.967	0.160	No
F vs. E	5.429	2.750	0.282	No
I vs. G	5.190	2.629	0.369	No
K vs. D	5.095	2.581	0.404	No
H vs. G	5.095	2.581	0.398	No
C vs. E	5.000	2.533	0.434	No
J vs. E	4.952	2.508	0.448	No
A vs. E	4.762	2.412	0.531	No
I vs. D	4.429	2.243	0.685	No
F vs. G	4.381	2.219	0.699	No
H vs. D	4.333	2.195	0.712	No
C vs. G	3.952	2.002	0.858	No
J vs. G	3.905	1.978	0.867	No
A vs. G	3.714	1.881	0.915	No
K vs. B	3.667	1.857	0.921	No
F vs. D	3.619	1.833	0.927	No
B vs. E	3.238	1.640	0.980	No
C vs. D	3.190	1.616	0.981	No
J vs. D	3.143	1.592	0.983	No
I vs. B	3.000	1.520	0.990	No
A vs. D	2.952	1.495	0.991	No
H vs. B	2.905	1.471	0.992	No
F vs. B	2.190	1.109	1.000	No
B vs. G	2.190	1.109	1.000	No
K vs. A	2.143	1.085	1.000	No
K vs. J	1.952	0.989	1.000	No
K vs. C	1.905	0.965	1.000	No
D vs. E	1.810	0.917	1.000	No
C vs. B	1.762	0.892	1.000	No
J vs. B	1.714	0.868	1.000	No
A vs. B	1.524	0.772	1.000	No
K vs. F	1.476	0.748	1.000	No
I vs. A	1.476	0.748	1.000	No
B vs. D	1.429	0.724	1.000	No
H vs. A	1.381	0.699	1.000	No
I vs. J	1.286	0.651	1.000	No
I vs. C	1.238	0.627	1.000	No
H vs. J	1.190	0.603	1.000	No
H vs. C	1.143	0.579	1.000	No
G vs. E	1.048	0.531	1.000	No
I vs. F	0.810	0.410	1.000	No
D vs. G	0.762	0.386	1.000	No
K vs. H	0.762	0.386	1.000	No
H vs. F	0.714	0.362	1.000	No
F vs. A	0.667	0.338	1.000	No
K vs. I	0.667	0.338	1.000	No
F vs. J	0.476	0.241	1.000	No
F vs. C	0.429	0.217	1.000	No
C vs. A	0.238	0.121	1.000	No
J vs. A	0.190	0.0965	1.000	No
I vs. H	0.0952	0.0482	0.999	No
C vs. J	0.0476	0.0241	0.981	No

Table G.7 Kruskal-Wallis One Way Analysis of the Shannon-Wiener Diversity between the sand extraction area and control areas

Dependent Variable: Shannon-Wiener Diversity index
Normality Test: Failed (P < 0.050)

Group	N	Missing	Median	25%	75%
Control	143	0	2.554	2.343	2.767
Sand	231	0	2.682	2.465	2.857

H = 9.566 with 1 degrees of freedom. (P = 0.002)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.002)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

Table G.8 Kruskal-Wallis One Way Analysis of the Shannon-Wiener Diversity between Alongshore areas in the Temporary Sand Extraction Area

Dependent Variable: Shannon-Wiener Diversity index
Normality Test: Failed (P < 0.050)

Group	N	Missing	Median	25%	75%
Control North (CN)	33	0	2.793	2.670	2.910
2	33	0	2.806	2.571	2.972
3	33	0	2.791	2.541	2.894
4	33	0	2.608	2.377	2.826
5	33	0	2.611	2.227	2.843
6	33	0	2.636	2.486	2.842
7	33	0	2.599	2.414	2.799
8	33	0	2.686	2.406	2.787
Control Southern (CS)	70	0	2.529	2.219	2.709
Control Remote (CR)	40	0	2.471	2.375	2.670

H = 33.701 with 9 degrees of freedom. (P = <0.001)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Dunn's Method) :

Comparison	Diff of Ranks	Q	P	P<0.050
CN vs CR	98.616	3.879	0.005	Yes
CN vs CS	85.610	3.750	0.008	Yes
CN vs 5	66.803	2.510	0.543	No
CN vs 4	60.833	2.286	1.000	Do Not Test
CN vs 7	57.985	2.179	1.000	Do Not Test
CN vs 8	51.318	1.928	1.000	Do Not Test
CN vs 6	49.394	1.856	1.000	Do Not Test
CN vs 3	14.000	0.526	1.000	Do Not Test
CN vs 2	2.636	0.0991	1.000	Do Not Test
2 vs CR	95.979	3.775	0.007	Yes
2 vs CS	82.974	3.635	0.013	Yes
2 vs 5	64.167	2.411	0.716	Do Not Test
2 vs 4	58.197	2.187	1.000	Do Not Test
2 vs 7	55.348	2.080	1.000	Do Not Test
2 vs 8	48.682	1.829	1.000	Do Not Test
2 vs 6	46.758	1.757	1.000	Do Not Test
2 vs 3	11.364	0.427	1.000	Do Not Test
3 vs CR	84.616	3.328	0.039	Yes
3 vs CS	71.610	3.137	0.077	No
3 vs 5	52.803	1.984	1.000	Do Not Test
3 vs 4	46.833	1.760	1.000	Do Not Test
3 vs 7	43.985	1.653	1.000	Do Not Test
3 vs 8	37.318	1.402	1.000	Do Not Test
3 vs 6	35.394	1.330	1.000	Do Not Test
6 vs CR	49.222	1.936	1.000	No
6 vs CS	36.216	1.586	1.000	Do Not Test
6 vs 5	17.409	0.654	1.000	Do Not Test
6 vs 4	11.439	0.430	1.000	Do Not Test
6 vs 7	8.591	0.323	1.000	Do Not Test
6 vs 8	1.924	0.0723	1.000	Do Not Test
8 vs CR	47.297	1.860	1.000	Do Not Test
8 vs CS	34.292	1.502	1.000	Do Not Test
8 vs 5	15.485	0.582	1.000	Do Not Test
8 vs 4	9.515	0.358	1.000	Do Not Test
8 vs 7	6.667	0.250	1.000	Do Not Test
7 vs CR	40.631	1.598	1.000	Do Not Test
7 vs CS	27.625	1.210	1.000	Do Not Test
7 vs 5	8.818	0.331	1.000	Do Not Test
7 vs 4	2.848	0.107	1.000	Do Not Test
4 vs CR	37.782	1.486	1.000	Do Not Test
4 vs CS	24.777	1.085	1.000	Do Not Test
4 vs 5	5.970	0.224	1.000	Do Not Test
5 vs CR	31.813	1.251	1.000	Do Not Test
5 vs CS	18.807	0.824	1.000	Do Not Test
CS vs CR	13.005	0.607	1.000	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

Table G.9 Kruskal-Wallis One Way Analysis of the Shannon-Wiener Diversity between Offshore areas in the Sand Extraction Area

Dependent Variable: Shannon-Wiener Diversity index
Normality Test: Failed (P < 0.050)

Group	N	Missing	Median	25%	75%
A	21	0	2.524	2.181	2.714
B	21	0	2.521	2.337	2.734
C	21	0	2.688	2.577	2.842
D	21	0	2.536	2.419	2.791
E	21	0	2.604	2.449	2.786
F	21	0	2.780	2.566	2.951
G	21	0	2.667	2.298	2.879
H	21	0	2.791	2.539	2.963
I	21	0	2.879	2.599	3.019
J	21	0	2.764	2.490	2.868
K	21	0	2.761	2.560	2.980

H = 27.030 with 10 degrees of freedom. (P = 0.003)

The differences in the median values among the treatment groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.003)

To isolate the group or groups that differ from the others use a multiple comparison procedure.

All Pairwise Multiple Comparison Procedures (Tukey Test):

Comparison	Diff of Ranks	q	P	P<0.050
I vs A	1494.000	4.878	0.023	Yes
I vs B	1441.000	4.705	0.034	Yes
I vs D	1092.000	3.566	0.291	No
I vs E	1073.000	3.504	0.317	Do Not Test
I vs G	897.000	2.929	0.596	Do Not Test
I vs C	727.500	2.376	0.845	Do Not Test
I vs J	499.500	1.631	0.988	Do Not Test
I vs F	343.000	1.120	0.999	Do Not Test
I vs K	279.000	0.911	1.000	Do Not Test
I vs H	250.000	0.816	1.000	Do Not Test
H vs A	1244.000	4.062	0.131	No
H vs B	1191.000	3.889	0.177	Do Not Test
H vs D	842.000	2.749	0.685	Do Not Test
H vs E	823.000	2.687	0.714	Do Not Test
H vs G	647.000	2.113	0.923	Do Not Test
H vs C	477.500	1.559	0.991	Do Not Test
H vs J	249.500	0.815	1.000	Do Not Test
H vs F	93.000	0.304	1.000	Do Not Test
H vs K	29.000	0.0947	1.000	Do Not Test
K vs A	1215.000	3.967	0.155	Do Not Test
K vs B	1162.000	3.794	0.206	Do Not Test

Comparison	Diff of Ranks	q	P	P<0.050
K vs D	813.000	2.655	0.730	Do Not Test
K vs E	794.000	2.593	0.758	Do Not Test
K vs G	618.000	2.018	0.943	Do Not Test
K vs C	448.500	1.465	0.995	Do Not Test
K vs J	220.500	0.720	1.000	Do Not Test
K vs F	64.000	0.209	1.000	Do Not Test
F vs A	1151.000	3.758	0.218	Do Not Test
F vs B	1098.000	3.585	0.283	Do Not Test
F vs D	749.000	2.446	0.819	Do Not Test
F vs E	730.000	2.384	0.842	Do Not Test
F vs G	554.000	1.809	0.974	Do Not Test
F vs C	384.500	1.256	0.998	Do Not Test
F vs J	156.500	0.511	1.000	Do Not Test
J vs A	994.500	3.247	0.435	Do Not Test
J vs B	941.500	3.074	0.522	Do Not Test
J vs D	592.500	1.935	0.957	Do Not Test
J vs E	573.500	1.873	0.966	Do Not Test
J vs G	397.500	1.298	0.998	Do Not Test
J vs C	228.000	0.745	1.000	Do Not Test
C vs A	766.500	2.503	0.796	Do Not Test
C vs B	713.500	2.330	0.861	Do Not Test
C vs D	364.500	1.190	0.999	Do Not Test
C vs E	345.500	1.128	0.999	Do Not Test
C vs G	169.500	0.553	1.000	Do Not Test
G vs A	597.000	1.949	0.955	Do Not Test
G vs B	544.000	1.776	0.977	Do Not Test
G vs D	195.000	0.637	1.000	Do Not Test
G vs E	176.000	0.575	1.000	Do Not Test
E vs A	421.000	1.375	0.997	Do Not Test
E vs B	368.000	1.202	0.999	Do Not Test
E vs D	19.000	0.0620	1.000	Do Not Test
D vs A	402.000	1.313	0.998	Do Not Test
D vs B	349.000	1.140	0.999	Do Not Test
B vs A	53.000	0.173	1.000	Do Not Test

Note: The multiple comparisons on ranks do not include an adjustment for ties.

A result of "Do Not Test" occurs for a comparison when no significant difference is found between the two rank sums that enclose that comparison. For example, if you had four rank sums sorted in order, and found no significant difference between rank sums 4 vs. 2, then you would not test 4 vs. 3 and 3 vs. 2, but still test 4 vs. 1 and 3 vs. 1 (4 vs. 3 and 3 vs. 2 are enclosed by 4 vs. 2: 4 3 2 1). Note that not testing the enclosed rank sums is a procedural rule, and a result of Do Not Test should be treated as if there is no significant difference between the rank sums, even though one may appear to exist.

Table G.10 Kruskal-Wallis One Way Analysis of the depths at replicate sample locations between the sand extraction area and control areas

Dependent Variable: Depth
Normality Test: Failed (P < 0.050)

Group	N	Missing	Median	25%	75%
Control	143	0	21.700	20.100	25.800
Sand	231	0	23.400	20.900	25.200

H = 2.044 with 1 degrees of freedom. (P = 0.153)

The differences in the median values among the treatment groups are not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.153)

Multivariate Statistics

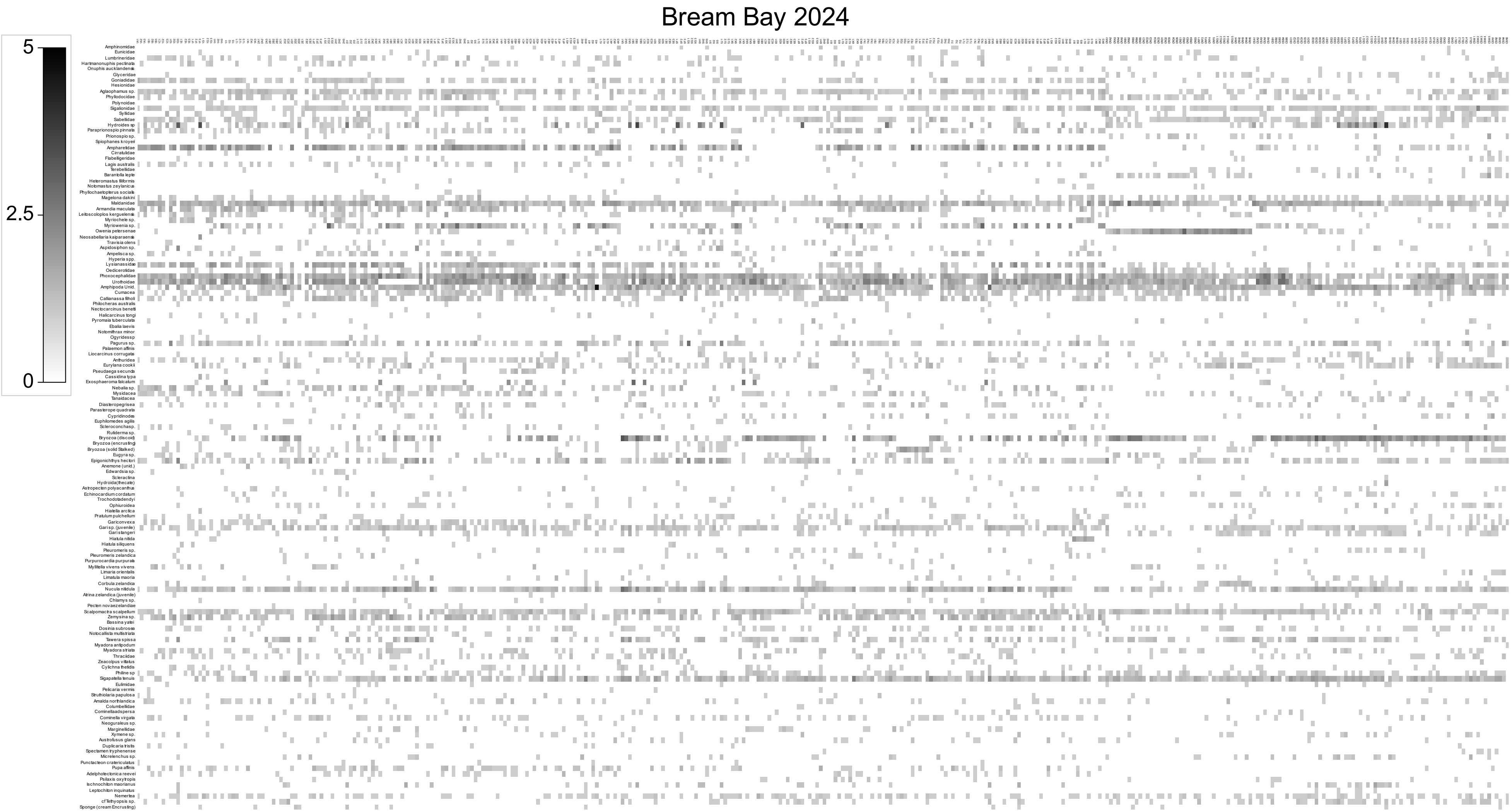

Figure G.1 Shade plot of fourth root transformed species (rows) by samples (columns) matrix of abundance for replicate samples in each cell. The (linear) grey scale is shown in the key.

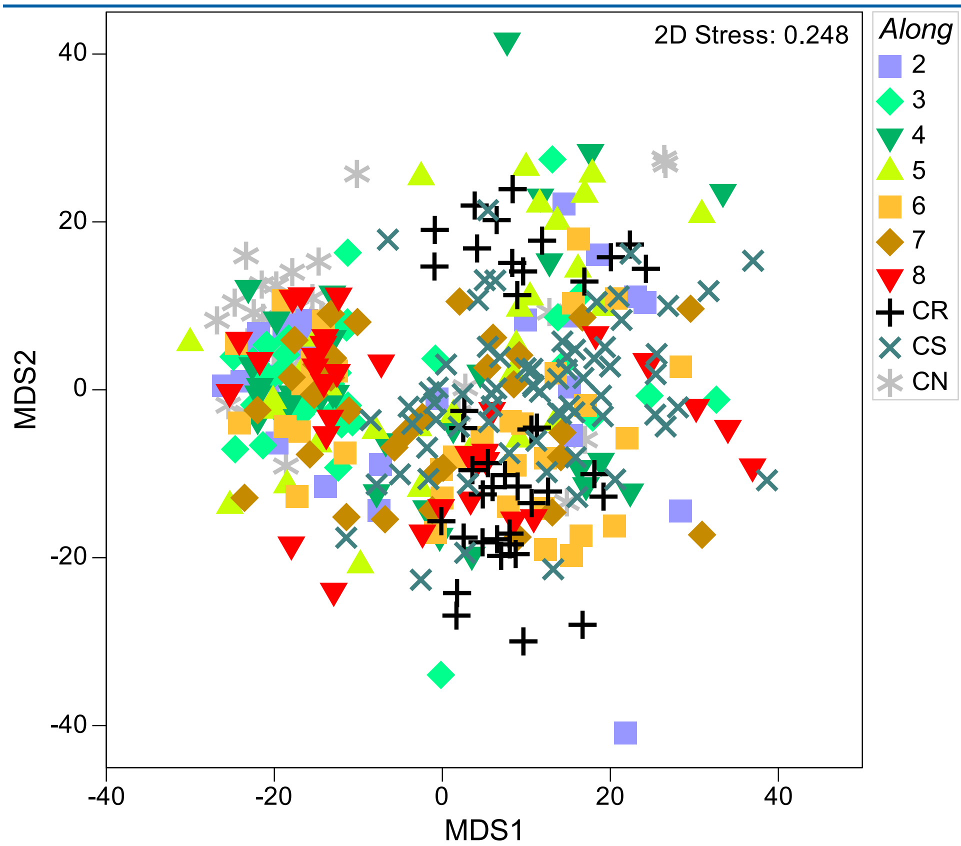

Figure G.2 2 dimensional Threshold metric Multi-Dimensional Scaling (tmMDS) of fourth-root transformed replicate sample benthic biota data, with symbol grouping by alongshore cells.

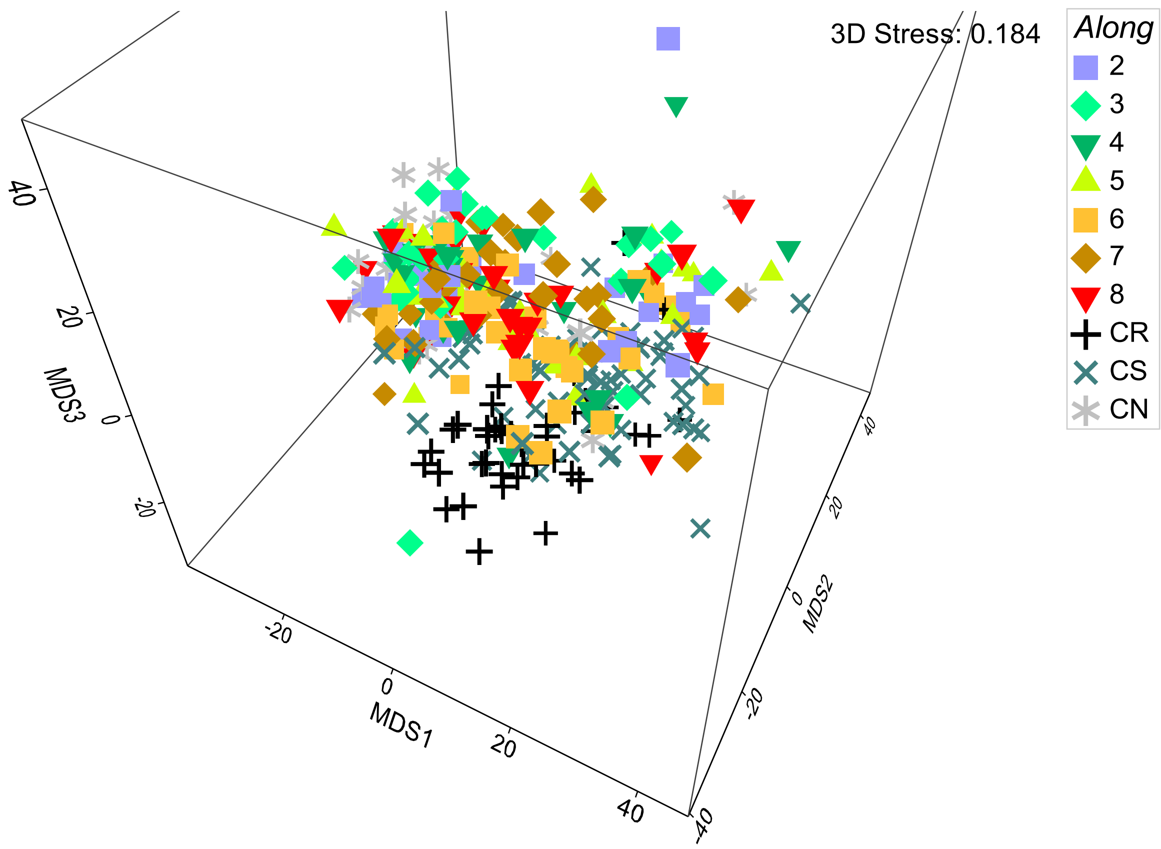

Figure G.3 3 dimensional Threshold metric Multi-Dimensional Scaling (tmMDS) of fourth-root transformed replicate sample benthic biota data, with symbol grouping by alongshore cells.

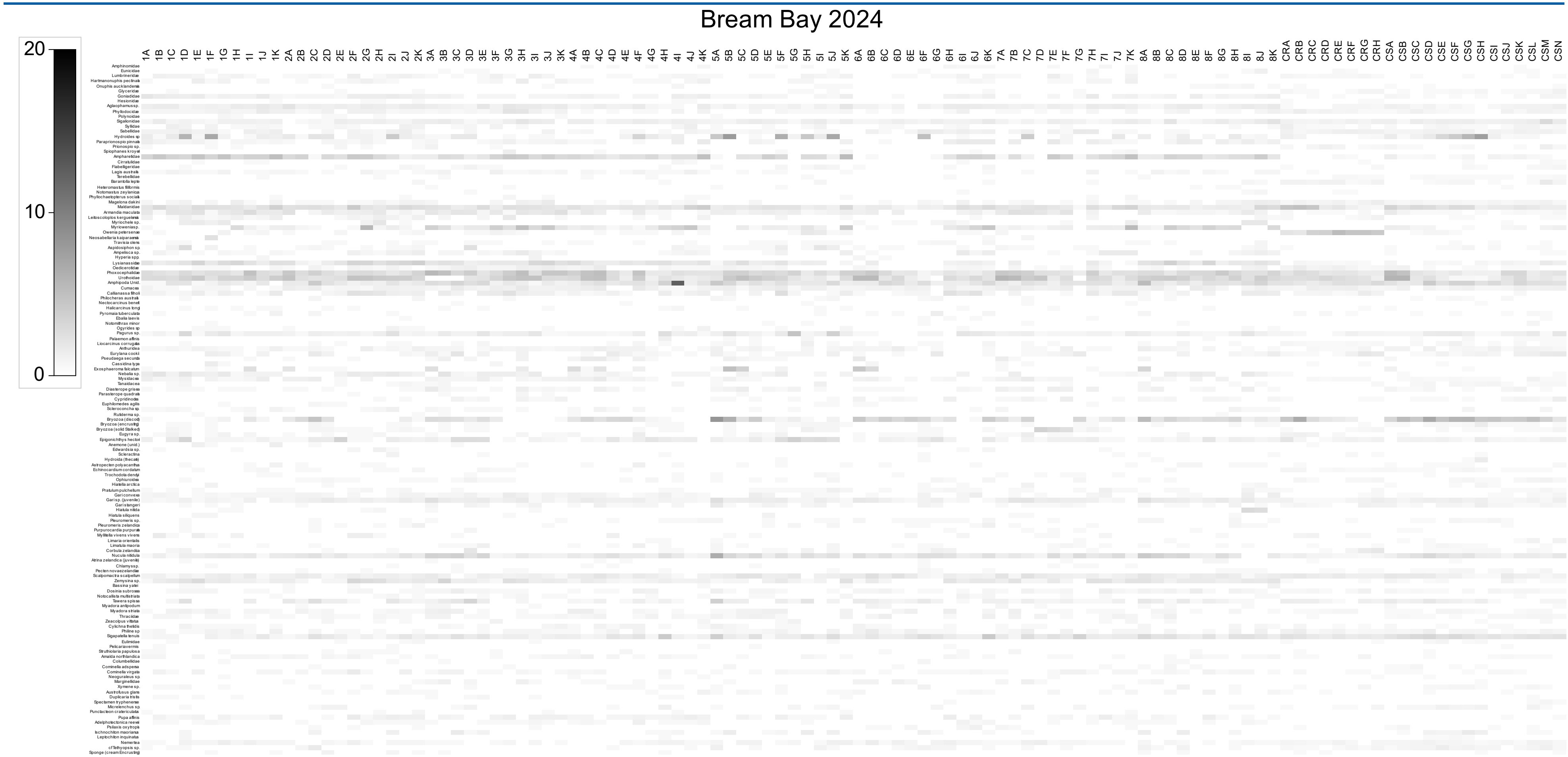

Figure G.4 Shade plot of square root transformed species (rows) by samples (columns) matrix of abundance for averaged replicate samples per cell. The (linear) grey scale is shown in the key.

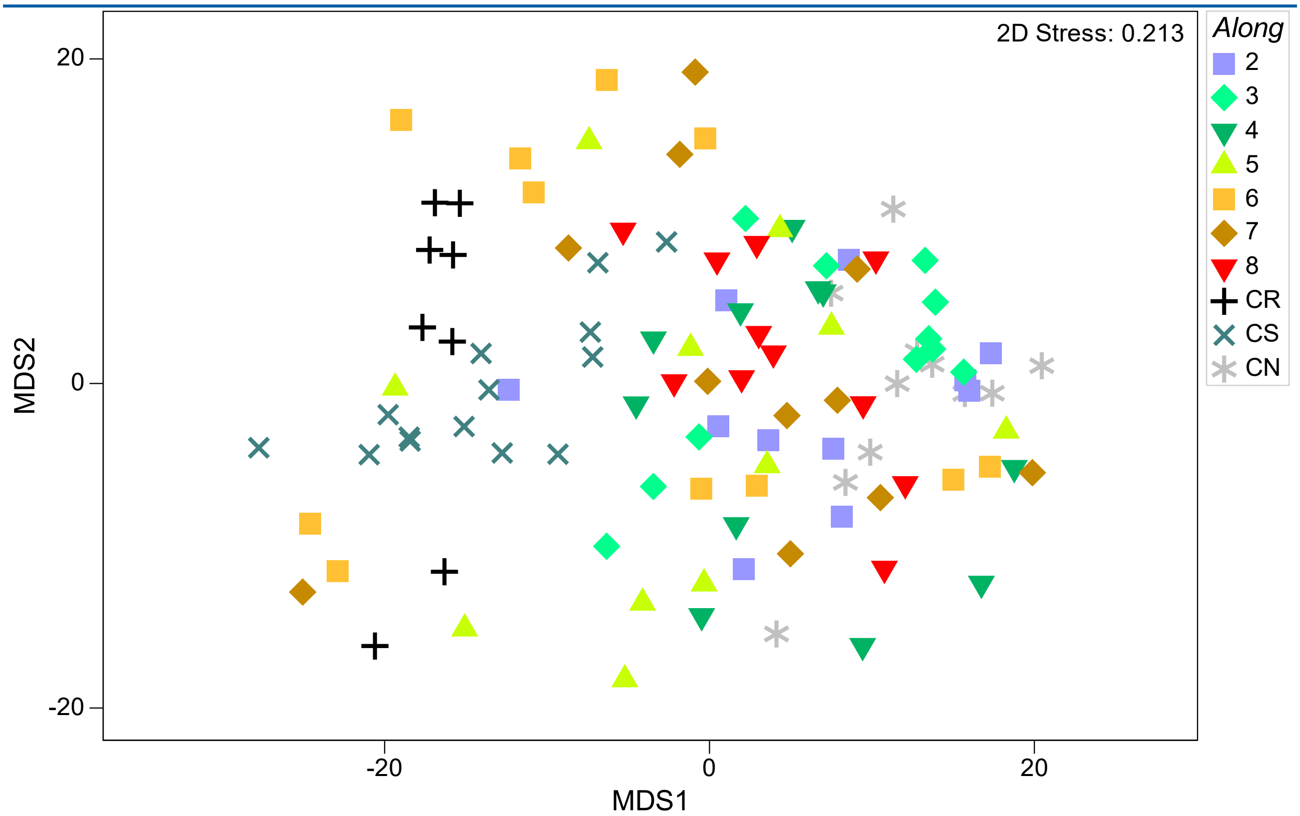

Figure G.5 2 dimensional Threshold metric Multi-Dimensional Scaling (tmMDS) of square-root transformed cell averaged benthic biota data, with symbol grouping by alongshore cells.

Table G.11 PERMANOVA – Permutational Multivariate Analysis of Variation by Area

Group	Samples
Sand Extraction	2A, 2B, 2C, 2D, 2E, 2F, 2G, 2H, 2I, 2J, 2K, 3A, 3B, 3C, 3D, 3E, 3F, 3G, 3H, 3I, 3J, 3K, 4A, 4B, 4C, 4D, 4E, 4F, 4G, 4H, 4I, 4J, 4K, 5A, 5B, 5C, 5D, 5E, 5F, 5G, 5H, 5I, 5J, 5K, 6A, 6B, 6C, 6D, 6E, 6F, 6G, 6H, 6I, 6J, 6K, 7A, 7B, 7C, 7D, 7E, 7F, 7G, 7H, 7I, 7J, 7K, 8A, 8B, 8C, 8D, 8E, 8F, 8G, 8H, 8I, 8J, 8K
Control	CNA, CNB, CNC, CND, CNE, CNF, CNG, CNH, CNI, CNJ, CNK, CSA, CSB, CSC, CSD, CSE, CSF, CSG, CSH, CSI, CSJ, CSK, CSL, CSM, CSN CRA, CRB, CRC, CRD, CRE, CRF, CRG, CRH

Resemblance worksheet

Data type: Similarity
Selection: All
Transform: Square root
Resemblance: S17 Bray-Curtis similarity

PERMANOVA table of results

Source	df	SS	MS	Pseudo-F	P(perm)	Unique perms
AREA	1	29135	29135	15.114	0.0001	9915
Res	372	7.2179E+05	1940.3			
Total	373	7.5092E+05				

Estimates of components of variation

Source	Estimate	Sq.root
S(AREA)	154.02	12.41
V(Res)	1940.3	44.049

Table G.12 SIMPER - Similarity Percentages - species contributions by Area

Parameters
Resemblance: S17 Bray-Curtis similarity
Cut off for low contributions: 70.00%

Group Control Average similarity: 39.29

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Maldanidae	2.14	3.62	1.57	9.21	9.21
Bryozoa (discoid)	2.74	3.61	0.82	9.18	18.39
Phoxocephalidae	2.11	3.54	1.64	9.01	27.39
Amphipoda Unid.	1.93	3.15	1.25	8.01	35.40
Urothoidae	2.19	3.04	1.06	7.75	43.15
Sigapatella tenuis	1.67	2.75	1.15	6.99	50.14
Sigalionidae	1.05	1.87	1.21	4.76	54.89
Nucula nitidula	1.19	1.64	0.90	4.18	59.07
Scalpomactra scalpellum	1.07	1.63	0.99	4.16	63.23
Sabellidae	0.83	1.27	0.92	3.23	66.46
Gari sp. (juvenile)	0.69	0.82	0.66	2.08	68.54
Owenia petersenae	1.07	0.73	0.32	1.85	70.40

Group Sand **Average similarity: 38.64**

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Phoxocephalidae	2.62	3.94	1.49	10.19	10.19
Urothoidae	2.57	3.30	1.01	8.55	18.74
Maldanidae	1.86	2.91	1.70	7.53	26.27
Amphipoda Unid.	1.93	2.87	1.46	7.42	33.68
Nucula nitidula	1.73	2.47	1.19	6.38	40.06
Sigapatella tenuis	1.44	1.97	1.00	5.10	45.16
Ampharetidae	1.85	1.69	0.67	4.37	49.53
Scalpomactra scalpellum	1.13	1.66	0.99	4.29	53.81
Gari sp. (juvenile)	1.03	1.36	0.91	3.52	57.33
Aglaophamus sp.	1.02	1.36	0.96	3.51	60.84
Sigalionidae	0.96	1.34	0.97	3.48	64.32
Bryozoa (discoid)	1.44	1.20	0.44	3.11	67.43
Lysianassidae	1.24	1.07	0.61	2.78	70.21

Groups Control & Sand **Average dissimilarity = 63.74**

Species	Control Av.Abund	Sand Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Bryozoa (discoid)	2.74	1.44	3.19	1.26	5.00	5.00
Urothoidae	2.19	2.57	2.60	1.30	4.08	9.08
Ampharetidae	0.98	1.85	2.32	1.09	3.63	12.71
Phoxocephalidae	2.11	2.62	2.08	1.20	3.26	15.97
Amphipoda Unid.	1.93	1.93	1.72	0.96	2.70	18.67
Maldanidae	2.14	1.86	1.63	1.12	2.55	21.22
Hydroides sp	1.02	0.70	1.60	0.58	2.51	23.73
Nucula nitidula	1.19	1.73	1.59	1.13	2.49	26.23
Sigapatella tenuis	1.67	1.44	1.56	1.24	2.45	28.68
Lysianassidae	0.71	1.24	1.55	1.09	2.43	31.11
Myriowenia sp.	0.32	1.21	1.46	0.75	2.29	33.40
Owenia petersenae	1.07	0.15	1.44	0.65	2.26	35.66
Zemysina sp.	0.37	1.05	1.26	1.06	1.98	37.64
Epigonichthys hectori	0.69	0.85	1.21	0.91	1.90	39.54
Pagurus sp.	0.70	0.81	1.15	0.92	1.80	41.34
Scalpomactra scalpellum	1.07	1.13	1.09	1.19	1.71	43.05
Armandia maculata	0.49	0.77	1.09	0.93	1.70	44.75
Aglaophamus sp.	0.63	1.02	1.06	1.23	1.66	46.41
Tawera spissa	0.61	0.65	1.05	0.97	1.65	48.06
Gari sp. (juvenile)	0.69	1.03	1.04	1.19	1.63	49.69
Cumacea	0.61	0.79	0.95	1.14	1.49	51.18
Sabellidae	0.83	0.37	0.93	1.21	1.46	52.64
Sigalionidae	1.05	0.96	0.90	1.00	1.42	54.06
Callianassa filholi	0.31	0.65	0.88	0.86	1.38	55.44
Eurylana cookii	0.53	0.30	0.82	0.84	1.29	56.72
Goniadidae	0.38	0.56	0.78	0.96	1.23	57.95
Phyllodocidae	0.54	0.37	0.76	0.94	1.20	59.15
Magelona dakini	0.52	0.27	0.73	0.89	1.15	60.29
Nemertea	0.53	0.44	0.71	0.99	1.11	61.41
Philine sp	0.49	0.31	0.70	0.91	1.10	62.50
Anthuridea	0.42	0.41	0.70	0.91	1.10	63.60
Nebalia sp.	0.25	0.41	0.63	0.68	0.99	64.59
Oedicerotidae	0.33	0.36	0.62	0.80	0.98	65.57
Mysidacea	0.30	0.38	0.62	0.81	0.97	66.53
Dosinia subrosea	0.31	0.34	0.60	0.80	0.94	67.47
Gari stangeri	0.37	0.23	0.58	0.78	0.92	68.39
Myadora striata	0.29	0.31	0.56	0.76	0.88	69.27
Gari convexa	0.20	0.37	0.55	0.76	0.86	70.13

Table G.13 PERMANOVA – Permutational Multivariate Analysis of Variation by shore perpendicular cell rows (alongshore)

Group		Samples
Sand Extraction	Alongshore 2	2A, 2B, 2C, 2D, 2E, 2F, 2G, 2H, 2I, 2J, 2K,
	Alongshore 3	3A, 3B, 3C, 3D, 3E, 3F, 3G, 3H, 3I, 3J, 3K,
	Alongshore 4	4A, 4B, 4C, 4D, 4E, 4F, 4G, 4H, 4I, 4J, 4K,
	Alongshore 5	5A, 5B, 5C, 5D, 5E, 5F, 5G, 5H, 5I, 5J, 5K,
	Alongshore 6	6A, 6B, 6C, 6D, 6E, 6F, 6G, 6H, 6I, 6J, 6K,
	Alongshore 7	7A, 7B, 7C, 7D, 7E, 7F, 7G, 7H, 7I, 7J, 7K,
	Alongshore 8	8A, 8B, 8C, 8D, 8E, 8F, 8G, 8H, 8I, 8J, 8K
Control	North	CNA, CNB, CNC, CND, CNE, CNF, CNG, CNH, CNI, CNJ, CNK,
	South	CSA, CSB, CSC, CSD, CSE, CSF, CSG, CSH, CSI, CSJ, CSK, CSL, CSM, CSN
	Remote	CRA, CRB, CRC, CRD, CRE, CRF, CRG, CRH

Resemblance worksheet
Data type: Similarity
Selection: All
Transform: Square root
Resemblance: S17 Bray-Curtis similarity

PERMANOVA table of results

Source	df	SS	MS	Pseudo-F	P(perm)	Unique perms
Alongshore	9	1.2058E+05	13397	7.5627	0.0001	9795
Res	364	6.3035E+05	1731.7			
Total	373	7.5092E+05				

Estimates of components of variation

Source	Estimate	Sq.root
S(Along)	313.9	17.717
V(Res)	1731.7	41.614

Pairwise Tests

Groups	t	P(perm)	Unique perms
2, 3	1.5185	0.0241	9925
2, 4	1.3555	0.0591	9911
2, 5	1.5014	0.0237	9909
2, 6	2.1224	0.0005	9919
2, 7	1.6839	0.007	9901
2, 8	1.6163	0.0126	9903
2, CN	1.4077	0.0423	9915
2, CS	3.5755	0.0001	9912
2, CR	3.9005	0.0001	9916
3, 4	1.3439	0.0574	9914
3, 5	1.7521	0.0054	9929
3, 6	2.4808	0.0002	9927
3, 7	1.9613	0.0005	9908
3, 8	1.748	0.0058	9910
3, CN	2.0419	0.0001	9919
3, CS	4.1566	0.0001	9926
3, CR	4.5023	0.0001	9921
4, 5	1.3001	0.0753	9921
4, 6	1.8867	0.0011	9917
4, 7	1.6016	0.0067	9906
4, 8	1.4701	0.0232	9928
4, CN	1.9891	0.0003	9925
4, CS	3.1216	0.0001	9919
4, CR	3.7876	0.0001	9912
5, 6	1.6504	0.007	9910
5, 7	1.338	0.0502	9906
5, 8	1.4359	0.0303	9917
5,CN	2.3221	0.0003	9917
5, CS	2.6906	0.0001	9903
5, CR	3.4603	0.0001	9923
6, 7	1.4079	0.0337	9922
6, 8	1.6828	0.0096	9920
6, CN	2.9199	0.0001	9927
6, CS	2.3536	0.0001	9926
6, CR	3.2433	0.0001	9925
7, 8	1.4614	0.0225	9925
7, CN	2.4304	0.0002	9912
7, CS	3.1569	0.0001	9905
7, CR	3.7229	0.0001	9928
8, CN	2.4482	0.0002	9924
8, CS	3.1406	0.0001	9915
8, CR	3.8818	0.0001	9922
CN, CS	4.6756	0.0001	9924
CN, CR	4.6119	0.0001	9916
CR, CS	4.1058	0.0001	9931

Average Similarity between/within groups

	2	3	4	5	6	7	8	CN	CS	CR
2	40.36									
3	40.304	43.188								
4	38.33	39.904	38.439							
5	37.477	38.292	37.319	37.675						
6	36.502	36.614	36.635	37.166	40.081					
7	38.849	39.495	38.318	38.686	39.714	41.426				
8	38.623	39.768	38.218	37.899	38.379	39.689	40.367			
CN	41.066	40.438	38.158	36.444	34.931	37.987	37.372	43.95		
CS	35.154	34.396	36.063	37.486	39.979	37.981	37.321	32.23	46.288	
CR	32.81	31.462	32.495	33.947	36.504	35.032	33.319	31.23	39.421	48.526

Table G.14 SIMPER - Similarity Percentages - species contributions by shore perpendicular cell rows (alongshore)

Parameters
Resemblance: S17 Bray-Curtis similarity
Cut off for low contributions: 70.00%

Group 2 Average similarity: 40.36

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Urothoidae	3.09	4.06	1.13	10.06	10.06
Maldanidae	2.33	3.62	2.26	8.98	19.03
Phoxocephalidae	2.49	3.37	1.43	8.36	27.39
Lysianassidae	2.02	2.18	0.87	5.39	32.78
Nucula nitidula	1.44	2.13	1.20	5.28	38.06
Amphipoda Unid.	1.57	2.03	1.22	5.03	43.09
Aglaophamus sp.	1.25	1.77	1.24	4.40	47.48
Ampharetidae	1.99	1.70	0.67	4.20	51.68
Scalpomactra scalpellum	1.04	1.38	1.05	3.43	55.11
Zemysina sp.	1.33	1.24	0.75	3.08	58.18
Sigapatella tenuis	1.04	1.15	0.78	2.84	61.03
Goniadidae	0.91	1.08	0.93	2.67	63.70
Pagurus sp.	0.93	1.03	0.92	2.56	66.26
Gari sp. (juvenile)	0.96	1.03	0.82	2.55	68.81
Sigalionidae	0.79	0.97	0.84	2.40	71.21

Group 3 Average similarity: 43.19

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Phoxocephalidae	3.52	5.03	1.97	11.64	11.64
Ampharetidae	2.48	2.97	1.13	6.88	18.52
Maldanidae	1.90	2.84	1.93	6.58	25.11
Myriowenia sp.	2.31	2.38	1.14	5.51	30.62
Amphipoda Unid.	1.77	2.30	1.17	5.32	35.94
Urothoidae	2.23	2.20	0.70	5.10	41.04
Lysianassidae	1.79	2.12	1.08	4.91	45.95
Aglaophamus sp.	1.32	1.94	1.62	4.48	50.44
Nucula nitidula	1.75	1.83	0.99	4.24	54.67
Gari sp. (juvenile)	1.17	1.51	1.17	3.51	58.18
Armandia maculata	1.38	1.50	0.87	3.47	61.65
Sigalionidae	1.09	1.43	1.16	3.32	64.96
Zemysina sp.	1.38	1.38	0.84	3.20	68.16
Sigapatella tenuis	1.17	1.19	0.83	2.75	70.92

Group 4 Average similarity: 38.44

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Phoxocephalidae	2.68	3.83	1.45	9.95	9.95
Amphipoda Unid.	2.49	3.59	1.75	9.33	19.29
Maldanidae	2.00	3.24	1.65	8.42	27.71
Ampharetidae	2.13	2.53	0.92	6.57	34.28
Nucula nitidula	1.46	2.44	1.29	6.36	40.64
Urothoidae	2.20	2.43	0.88	6.33	46.97
Lysianassidae	1.62	2.27	1.14	5.92	52.89
Scalpomactra scalpellum	1.09	1.65	1.03	4.28	57.17
Sigapatella tenuis	1.26	1.61	0.86	4.18	61.35
Sigalionidae	1.03	1.57	1.08	4.09	65.43
Myriowenia sp.	1.40	1.15	0.58	2.98	68.41
Gari sp. (juvenile)	0.85	1.12	0.77	2.90	71.31

Group 5 Average similarity: 37.67

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Phoxocephalidae	2.69	4.54	1.89	12.05	12.05
Urothoidae	2.43	3.03	1.08	8.04	20.09
Maldanidae	1.74	2.74	1.74	7.28	27.37
Amphipoda Unid.	2.02	2.73	1.41	7.25	34.62
Nucula nitidula	2.24	2.70	1.20	7.18	41.79
Sigapatella tenuis	1.54	1.79	0.93	4.75	46.55
Scalpomactra scalpellum	1.19	1.45	0.80	3.85	50.40
Gari sp. (juvenile)	1.14	1.43	1.09	3.81	54.20
Epigonichthys hectori	1.45	1.39	0.67	3.70	57.90
Ampharetidae	1.70	1.28	0.57	3.39	61.29
Sigalionidae	0.94	1.19	0.91	3.17	64.46
Bryozoa (discoid)	1.92	1.14	0.45	3.01	67.47
Lysianassidae	1.01	0.94	0.60	2.49	69.96
Cumacea	0.82	0.93	0.78	2.47	72.43

Group 6 Average similarity: 40.08

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Phoxocephalidae	2.02	3.56	1.77	8.87	8.87
Nucula nitidula	1.87	3.51	1.79	8.75	17.62
Amphipoda Unid.	1.85	3.40	1.75	8.48	26.10
Bryozoa (discoid)	2.24	3.28	0.78	8.20	34.30
Urothoidae	2.24	2.89	0.98	7.20	41.50
Sigapatella tenuis	1.65	2.77	1.19	6.92	48.42
Maldanidae	1.51	2.56	1.73	6.40	54.81
Scalpomactra scalpellum	1.29	2.27	1.17	5.65	60.47
Sigalionidae	0.98	1.85	1.31	4.60	65.07
Aglaophamus sp.	0.97	1.55	1.09	3.88	68.94
Sabellidae	0.78	0.96	0.72	2.40	71.35

Group 7 Average similarity: 41.43

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Urothoidae	2.87	4.07	1.15	9.82	9.82
Phoxocephalidae	2.51	4.00	1.46	9.66	19.48
Maldanidae	2.01	3.52	1.79	8.51	27.99
Sigapatella tenuis	1.69	3.00	1.44	7.23	35.22
Nucula nitidula	1.64	2.87	1.45	6.93	42.15
Amphipoda Unid.	1.66	2.73	1.48	6.59	48.74
Scalpomactra scalpellum	1.25	2.21	1.23	5.35	54.09
Gari sp. (juvenile)	1.10	1.82	1.06	4.39	58.48
Aglaophamus sp.	1.08	1.71	1.20	4.13	62.60
Ampharetidae	1.80	1.52	0.64	3.67	66.27
Sigalionidae	0.85	1.31	0.88	3.16	69.43
Zemysina sp.	1.17	1.28	0.75	3.09	72.52

Group 8 Average similarity: 40.37

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Urothoidae	2.93	4.87	1.44	12.06	12.06
Phoxocephalidae	2.42	3.49	1.04	8.65	20.72
Amphipoda Unid.	2.15	3.34	1.84	8.27	28.99
Sigapatella tenuis	1.74	2.65	1.39	6.56	35.55
Maldanidae	1.55	2.10	1.43	5.20	40.75
Nucula nitidula	1.72	1.98	0.78	4.92	45.67
Scalpomactra scalpellum	1.20	1.94	1.09	4.81	50.47
Bryozoa (discoid)	1.81	1.93	0.59	4.79	55.26
Gari sp. (juvenile)	1.23	1.80	1.03	4.45	59.71
Zemysina sp.	1.28	1.64	0.94	4.06	63.77
Ampharetidae	1.86	1.64	0.65	4.05	67.82
Aglaophamus sp.	1.07	1.37	0.97	3.38	71.20

Group CN **Average similarity: 43.95**

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Ampharetidae	3.37	4.94	1.41	11.24	11.24
Urothoidae	2.95	4.40	1.69	10.01	21.26
Phoxocephalidae	2.50	4.21	2.60	9.59	30.85
Maldanidae	2.23	3.87	1.94	8.80	39.65
Lysianassidae	1.83	2.13	0.95	4.85	44.50
Aglaophamus sp.	1.17	1.89	1.28	4.31	48.82
Goniadidae	1.10	1.48	0.99	3.38	52.19
Armandia maculata	1.36	1.48	0.80	3.37	55.56
Nucula nitidula	1.09	1.47	0.91	3.33	58.89
Sigalionidae	0.89	1.33	1.07	3.02	61.91
Scalpomactra scalpellum	0.91	1.22	0.90	2.78	64.69
Zemysina sp.	1.16	1.10	0.72	2.49	67.18
Sabellidae	0.84	1.01	0.86	2.29	69.47
Nebalia sp.	1.00	0.94	0.65	2.14	71.61

Group CS Average similarity: 46.29

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Bryozoa (discoid)	4.28	8.44	2.27	18.24	18.24
Amphipoda Unid.	2.40	4.34	2.06	9.38	27.62
Sigapatella tenuis	2.20	4.15	1.84	8.96	36.58
Maldanidae	2.05	3.96	2.11	8.56	45.14
Phoxocephalidae	2.03	2.93	1.26	6.34	51.47
Nucula nitidula	1.60	2.70	1.38	5.84	57.31
Sigalionidae	1.23	2.31	1.42	4.99	62.30
Urothoidae	1.79	1.89	0.73	4.08	66.37
Scalpomactra scalpellum	1.00	1.35	0.84	2.91	69.28
Gari sp. (juvenile)	0.85	1.26	0.94	2.72	72.00

Group CR Average similarity: 48.53

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Owenia petersenae	3.52	7.62	2.38	15.69	15.69
Urothoidae	2.25	4.65	1.57	9.59	25.28
Phoxocephalidae	1.93	4.19	2.20	8.64	33.92
Amphipoda Unid.	2.02	4.04	1.85	8.33	42.25
Sigapatella tenuis	1.69	3.49	1.94	7.19	49.44
Maldanidae	2.21	2.98	0.95	6.15	55.59
Scalpomactra scalpellum	1.33	2.62	1.55	5.41	61.00
Bryozoa (discoid)	2.07	2.33	0.73	4.80	65.80
Sabellidae	0.95	1.98	1.26	4.08	69.87
Sigalionidae	0.87	1.67	1.06	3.44	73.32

Groups 2 & 5 **Average dissimilarity = 62.52**

Species	Group 2 Av.Abund	Group 5 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Urothoidae	3.09	2.43	2.54	1.42	4.06	4.06
Hydroides sp	1.07	1.90	2.41	0.73	3.85	7.91
Bryozoa (discoid)	1.00	1.92	2.41	0.89	3.85	11.76
Ampharetidae	1.99	1.70	2.39	1.16	3.82	15.58
Lysianassidae	2.02	1.01	1.86	1.38	2.98	18.56
Phoxocephalidae	2.49	2.69	1.75	1.14	2.80	21.36
Nucula nitidula	1.44	2.24	1.70	1.10	2.72	24.07
Epigonichthys hectori	0.81	1.45	1.67	1.02	2.67	26.74
Amphipoda Unid.	1.57	2.02	1.53	1.20	2.45	29.19
Sigapatella tenuis	1.04	1.54	1.40	1.25	2.24	31.44
Myriowenia sp.	0.75	0.91	1.39	0.69	2.23	33.67
Zemysina sp.	1.33	0.66	1.35	1.19	2.16	35.82
Pagurus sp.	0.93	1.21	1.33	0.77	2.13	37.95
Maldanidae	2.33	1.74	1.31	1.27	2.10	40.06
Tawera spissa	0.76	0.85	1.24	0.97	1.98	42.04
Armandia maculata	0.81	0.80	1.09	1.08	1.74	43.78
Scalpomactra scalpellum	1.04	1.19	1.09	1.18	1.74	45.52
Callianassa filholi	0.93	0.45	1.07	1.05	1.71	47.22
Aglaophamus sp.	1.25	0.77	1.02	1.25	1.64	48.86
Gari sp. (juvenile)	0.96	1.14	0.99	1.22	1.59	50.45
Goniadidae	0.91	0.44	0.87	1.25	1.39	51.84
Cumacea	0.79	0.82	0.85	1.15	1.36	53.20
Exosphaeroma falcatum	0.23	0.53	0.82	0.40	1.31	54.51
Sigalionidae	0.79	0.94	0.82	1.16	1.30	55.81
Nebalia sp.	0.65	0.33	0.80	0.85	1.28	57.09
Phyllodocidae	0.64	0.30	0.68	1.01	1.08	58.17
Pupa affinis	0.54	0.35	0.67	0.93	1.07	59.24
Anthuridea	0.47	0.42	0.63	0.97	1.01	60.26
Nemertea	0.45	0.54	0.63	1.01	1.00	61.26
Aspidosiphon sp.	0.24	0.43	0.62	0.66	0.99	62.24
Lumbrineridae	0.50	0.33	0.62	0.95	0.99	63.23
Gari convexa	0.45	0.27	0.61	0.85	0.97	64.20
Myadora striata	0.30	0.41	0.59	0.83	0.95	65.15
Cominella virgata	0.41	0.30	0.59	0.84	0.94	66.09
Eurylana cookii	0.27	0.37	0.58	0.74	0.92	67.01
Ampelisca sp.	0.46	0.22	0.57	0.82	0.92	67.93
Sabellidae	0.47	0.30	0.56	0.93	0.90	68.83
Mysidacea	0.41	0.17	0.55	0.75	0.88	69.72
Thraciidae	0.27	0.39	0.54	0.81	0.86	70.57

Groups 5 & 8 **Average dissimilarity = 62.10**

Species	Group 5 Av.Abund	Group 8 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Bryozoa (discoid)	1.92	1.81	2.84	1.07	4.57	4.57
Ampharetidae	1.70	1.86	2.39	1.19	3.85	8.42
Urothoidae	2.43	2.93	2.34	1.38	3.76	12.18
Nucula nitidula	2.24	1.72	2.17	1.22	3.49	15.66
Hydroides sp	1.90	0.40	2.15	0.60	3.46	19.12
Phoxocephalidae	2.69	2.42	1.92	1.33	3.10	22.22
Myriowenia sp.	0.91	1.32	1.85	0.92	2.99	25.21
Lysianassidae	1.01	1.51	1.71	1.21	2.75	27.96
Amphipoda Unid.	2.02	2.15	1.62	1.16	2.61	30.56
Epigonichthys hectori	1.45	0.74	1.57	1.01	2.53	33.09
Sigapatella tenuis	1.54	1.74	1.53	1.33	2.47	35.56
Pagurus sp.	1.21	0.74	1.39	0.75	2.23	37.80
Zemysina sp.	0.66	1.28	1.31	1.29	2.11	39.91
Maldanidae	1.74	1.55	1.27	1.23	2.04	41.95
Tawera spissa	0.85	0.59	1.16	0.97	1.87	43.82
Scalpomactra scalpellum	1.19	1.20	1.15	1.27	1.86	45.68
Gari sp. (juvenile)	1.14	1.23	1.06	1.26	1.71	47.39
Sigalionidae	0.94	1.02	1.06	1.20	1.71	49.11
Aglaophamus sp.	0.77	1.07	1.00	1.21	1.61	50.72
Armandia maculata	0.80	0.55	0.99	1.07	1.60	52.32
Cumacea	0.82	0.71	0.90	1.16	1.45	53.76
Callianassa filholi	0.45	0.55	0.83	0.86	1.34	55.10
Exosphaeroma falcatum	0.53	0.20	0.82	0.35	1.32	56.42
Goniadidae	0.44	0.65	0.78	1.07	1.26	57.67
Nebalia sp.	0.33	0.57	0.76	0.81	1.22	58.90
Paraprionospio pinnata	0.20	0.59	0.71	0.80	1.15	60.04
Dosinia subrosea	0.32	0.49	0.68	0.88	1.09	61.14
Diasterope grisea	0.36	0.35	0.63	0.80	1.01	62.15
Nemertea	0.54	0.33	0.63	0.98	1.01	63.16
Anthuridea	0.42	0.37	0.62	0.92	1.00	64.16
Eurylana cookii	0.37	0.26	0.61	0.70	0.98	65.14
Gari stangeri	0.48	0.22	0.60	0.86	0.97	66.11
Myadora striata	0.41	0.22	0.58	0.79	0.94	67.05
Aspidosiphon sp.	0.43	0.07	0.55	0.55	0.89	67.94
Cominella virgata	0.30	0.38	0.55	0.88	0.89	68.83
Hiatula nitida	0.00	0.49	0.55	0.43	0.89	69.72
Philine sp	0.35	0.25	0.54	0.75	0.88	70.59

Groups 2 & 8 **Average dissimilarity = 61.38**

Species	Group 2 Av.Abund	Group 8 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Ampharetidae	1.99	1.86	2.40	1.21	3.92	3.92
Urothoidae	3.09	2.93	2.40	1.31	3.91	7.83
Bryozoa (discoid)	1.00	1.81	2.32	1.05	3.79	11.62
Lysianassidae	2.02	1.51	2.11	1.29	3.44	15.06
Phoxocephalidae	2.49	2.42	2.10	1.20	3.43	18.49
Myriowenia sp.	0.75	1.32	1.80	0.75	2.93	21.42
Nucula nitidula	1.44	1.72	1.67	1.20	2.72	24.14
Maldanidae	2.33	1.55	1.59	1.28	2.59	26.73
Amphipoda Unid.	1.57	2.15	1.57	1.07	2.56	29.30
Sigapatella tenuis	1.04	1.74	1.43	1.19	2.33	31.63
Zemysina sp.	1.33	1.28	1.41	1.26	2.30	33.93
Hydroides sp	1.07	0.40	1.25	0.81	2.04	35.97
Epigonichthys hectori	0.81	0.74	1.17	0.88	1.90	37.87
Tawera spissa	0.76	0.59	1.13	0.96	1.84	39.71
Gari sp. (juvenile)	0.96	1.23	1.11	1.19	1.81	41.53
Callianassa filholi	0.93	0.55	1.06	1.12	1.72	43.25
Armandia maculata	0.81	0.55	1.03	0.96	1.68	44.93
Sigalionidae	0.79	1.02	1.02	1.16	1.66	46.60
Aglaophamus sp.	1.25	1.07	1.01	1.16	1.65	48.24
Pagurus sp.	0.93	0.74	0.97	1.05	1.58	49.82
Scalpomactra scalpellum	1.04	1.20	0.95	1.08	1.55	51.37
Nebalia sp.	0.65	0.57	0.94	0.94	1.54	52.91
Goniadidae	0.91	0.65	0.89	1.20	1.44	54.35
Cumacea	0.79	0.71	0.88	1.14	1.43	55.78
Paraprionospio pinnata	0.28	0.59	0.74	0.85	1.20	56.99
Phyllodocidae	0.64	0.30	0.74	1.02	1.20	58.19
Magelona dakini	0.40	0.49	0.66	0.94	1.08	59.27
Dosinia subrosea	0.18	0.49	0.66	0.79	1.07	60.34
Pupa affinis	0.54	0.23	0.64	0.88	1.04	61.38
Ampelisca sp.	0.46	0.29	0.64	0.83	1.04	62.43
Cominella virgata	0.41	0.38	0.64	0.90	1.04	63.47
Gari convexa	0.45	0.30	0.63	0.87	1.03	64.50
Anthuridea	0.47	0.37	0.63	0.94	1.02	65.52
Mysidacea	0.41	0.22	0.60	0.77	0.98	66.50
Hiatula nitida	0.07	0.49	0.60	0.46	0.98	67.48
Nemertea	0.45	0.33	0.57	0.93	0.92	68.40
Lumbrineridae	0.50	0.06	0.57	0.84	0.92	69.33
Eurylana cookii	0.27	0.26	0.55	0.58	0.89	70.22

Groups CN & 2 **Average dissimilarity = 58.93**

Species	Group CN Av.Abund	Group 2 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Ampharetidae	3.37	1.99	2.83	1.37	4.80	4.80
Urothoidae	2.95	3.09	2.30	1.29	3.90	8.70
Lysianassidae	1.83	2.02	1.91	1.29	3.23	11.93
Hydroides sp	1.27	1.07	1.72	0.70	2.92	14.85
Phoxocephalidae	2.50	2.49	1.69	1.13	2.86	17.72
Amphipoda Unid.	0.84	1.57	1.52	1.18	2.58	20.29
Armandia maculata	1.36	0.81	1.43	1.20	2.42	22.72
Zemysina sp.	1.16	1.33	1.42	1.20	2.41	25.13
Bryozoa (discoid)	0.29	1.00	1.31	0.72	2.22	27.34
Maldanidae	2.23	2.33	1.30	1.27	2.20	29.55
Epigonichthys hectori	0.73	0.81	1.23	0.85	2.08	31.63
Nebalia sp.	1.00	0.65	1.14	1.13	1.94	33.57
Sigapatella tenuis	0.53	1.04	1.11	1.13	1.88	35.45
Nucula nitidula	1.09	1.44	1.11	1.25	1.88	37.33
Myriowenia sp.	0.43	0.75	1.05	0.55	1.78	39.11
Callianassa filholi	0.62	0.93	1.04	1.13	1.77	40.89
Pagurus sp.	0.94	0.93	1.00	0.97	1.70	42.58
Tawera spissa	0.27	0.76	1.00	0.77	1.69	44.27
Gari sp. (juvenile)	0.57	0.96	0.93	1.15	1.58	45.85
Goniadidae	1.10	0.91	0.92	1.14	1.56	47.41
Aglaophamus sp.	1.17	1.25	0.88	1.16	1.49	48.90
Scalpomactra scalpellum	0.91	1.04	0.84	1.14	1.42	50.33
Phyllodocidae	0.72	0.64	0.83	1.10	1.40	51.73
Sabellidae	0.84	0.47	0.82	1.18	1.39	53.12
Cumacea	0.41	0.79	0.78	1.12	1.33	54.45
Mysidacea	0.60	0.41	0.73	1.01	1.24	55.70
Leitoscoloplos kerguelensis	0.63	0.46	0.73	1.04	1.24	56.94
Sigalionidae	0.89	0.79	0.71	1.07	1.21	58.15
Pupa affinis	0.42	0.54	0.70	0.96	1.19	59.34
Nemertea	0.59	0.45	0.68	0.99	1.15	60.49
Gari convexa	0.50	0.45	0.68	1.00	1.15	61.64
Paraprionospio pinnata	0.58	0.28	0.67	0.97	1.14	62.79
Lumbrineridae	0.45	0.50	0.66	1.00	1.13	63.91
Anthuridea	0.42	0.47	0.64	0.96	1.08	64.99
Magelona dakini	0.40	0.40	0.63	0.88	1.07	66.07
Myadora striata	0.50	0.30	0.62	0.92	1.05	67.12
Ampelisca sp.	0.30	0.46	0.60	0.87	1.03	68.14
Cominella virgata	0.28	0.41	0.60	0.81	1.01	69.15
Myriochele sp.	0.42	0.25	0.59	0.67	1.00	70.15

***Groups CN & 5* Average dissimilarity = 63.56**

Species	Group CN Av.Abund	Group 5 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Ampharetidae	3.37	1.70	3.00	1.53	4.73	4.73
Hydroides sp	1.27	1.90	2.64	0.71	4.15	8.87
Urothoidae	2.95	2.43	2.25	1.36	3.54	12.41
Bryozoa (discoid)	0.29	1.92	2.14	0.75	3.36	15.77
Nucula nitidula	1.09	2.24	1.82	1.11	2.86	18.63
Amphipoda Unid.	0.84	2.02	1.81	1.41	2.85	21.48
Lysianassidae	1.83	1.01	1.69	1.35	2.65	24.13
Epigonichthys hectori	0.73	1.45	1.63	1.02	2.57	26.70
Sigapatella tenuis	0.53	1.54	1.52	1.29	2.39	29.09
Phoxocephalidae	2.50	2.69	1.48	1.29	2.33	31.42
Pagurus sp.	0.94	1.21	1.42	0.79	2.23	33.65
Armandia maculata	1.36	0.80	1.34	1.30	2.10	35.76
Zemysina sp.	1.16	0.66	1.24	1.13	1.96	37.71
Maldanidae	2.23	1.74	1.23	1.26	1.93	39.64
Myriowenia sp.	0.43	0.91	1.18	0.78	1.86	41.50
Scalpomactra scalpellum	0.91	1.19	1.10	1.25	1.74	43.24
Nebalia sp.	1.00	0.33	1.10	1.09	1.73	44.96
Goniadidae	1.10	0.44	1.06	1.26	1.67	46.63
Tawera spissa	0.27	0.85	1.03	0.78	1.62	48.25
Gari sp. (juvenile)	0.57	1.14	1.00	1.23	1.57	49.82
Aglaophamus sp.	1.17	0.77	0.97	1.27	1.53	51.36
Callianassa filholi	0.62	0.45	0.85	0.89	1.33	52.69
Sabellidae	0.84	0.30	0.81	1.19	1.28	53.96
Cumacea	0.41	0.82	0.81	1.10	1.27	55.23
Sigalionidae	0.89	0.94	0.79	1.14	1.24	56.47
Exosphaeroma falcatum	0.19	0.53	0.78	0.37	1.22	57.69
Phyllodocidae	0.72	0.30	0.77	1.05	1.21	58.90
Aspidosiphon sp.	0.30	0.43	0.72	0.61	1.13	60.03
Nemertea	0.59	0.54	0.70	1.03	1.11	61.14
Mysidacea	0.60	0.17	0.69	0.96	1.08	62.22
Myadora striata	0.50	0.41	0.69	0.95	1.08	63.30
Leitoscoloplos kerguelensis	0.63	0.07	0.68	0.96	1.07	64.38
Paraprionospio pinnata	0.58	0.20	0.68	0.96	1.07	65.44
Philine sp	0.47	0.35	0.65	0.89	1.02	66.46
Gari convexa	0.50	0.27	0.64	0.94	1.00	67.46
Anthuridea	0.42	0.42	0.64	0.94	1.00	68.46
Pupa affinis	0.42	0.35	0.63	0.86	0.99	69.45
Lumbrineridae	0.45	0.33	0.60	0.92	0.94	70.39

***Groups CN & 8* Average dissimilarity = 62.63**

Species	Group CN Av.Abund	Group 8 Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Ampharetidae	3.37	1.86	2.93	1.40	4.68	4.68
Bryozoa (discoid)	0.29	1.81	2.19	0.96	3.49	8.18
Urothoidae	2.95	2.93	2.08	1.26	3.32	11.50
Lysianassidae	1.83	1.51	2.00	1.30	3.19	14.69
Phoxocephalidae	2.50	2.42	1.92	1.40	3.07	17.76
Amphipoda Unid.	0.84	2.15	1.92	1.31	3.07	20.83
Nucula nitidula	1.09	1.72	1.70	1.13	2.72	23.55
Sigapatella tenuis	0.53	1.74	1.65	1.38	2.64	26.18
Myriowenia sp.	0.43	1.32	1.58	0.77	2.52	28.70
Maldanidae	2.23	1.55	1.56	1.36	2.50	31.20
Hydroides sp	1.27	0.40	1.50	0.60	2.39	33.59
Armandia maculata	1.36	0.55	1.44	1.23	2.30	35.89
Zemysina sp.	1.16	1.28	1.36	1.22	2.17	38.06
Nebalia sp.	1.00	0.57	1.18	1.12	1.89	39.94
Gari sp. (juvenile)	0.57	1.23	1.16	1.20	1.86	41.80
Epigonichthys hectori	0.73	0.74	1.06	0.93	1.70	43.50
Goniadidae	1.10	0.65	1.06	1.24	1.69	45.18
Pagurus sp.	0.94	0.74	1.05	0.98	1.68	46.86
Sigalionidae	0.89	1.02	1.01	1.19	1.61	48.48
Scalpomactra scalpellum	0.91	1.20	0.98	1.19	1.56	50.04
Aglaophamus sp.	1.17	1.07	0.96	1.19	1.54	51.58
Sabellidae	0.84	0.06	0.92	1.27	1.47	53.05
Paraprionospio pinnata	0.58	0.59	0.88	1.06	1.40	54.45
Callianassa filholi	0.62	0.55	0.87	1.03	1.39	55.85
Tawera spissa	0.27	0.59	0.87	0.76	1.38	57.23
Phyllodocidae	0.72	0.30	0.83	1.03	1.33	58.56
Cumacea	0.41	0.71	0.79	1.07	1.26	59.82
Mysidacea	0.60	0.22	0.73	0.97	1.16	60.98
Magelona dakini	0.40	0.49	0.72	0.90	1.15	62.13
Leitoscoloplos kerguelensis	0.63	0.07	0.71	0.96	1.13	63.26
Nemertea	0.59	0.33	0.69	0.95	1.10	64.36
Dosinia subrosea	0.25	0.49	0.67	0.85	1.08	65.44
Philine sp	0.47	0.25	0.66	0.83	1.06	66.50
Gari convexa	0.50	0.30	0.66	0.96	1.05	67.55
Myriochele sp.	0.42	0.29	0.64	0.68	1.03	68.58
Anthuridea	0.42	0.37	0.62	0.91	1.00	69.57
Myadora striata	0.50	0.22	0.62	0.90	0.99	70.56

Groups 2 & CS **Average dissimilarity = 64.85**

Species	Group 2 Av.Abund	Group CS Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Bryozoa (discoid)	1.00	4.28	4.16	1.75	6.41	6.41
Urothoidae	3.09	1.79	3.06	1.52	4.72	11.14
Phoxocephalidae	2.49	2.03	2.16	1.13	3.33	14.47
Ampharetidae	1.99	0.38	2.16	1.05	3.33	17.79
Lysianassidae	2.02	0.43	2.11	1.36	3.26	21.05
Hydroides sp	1.07	1.32	1.83	0.69	2.82	23.87
Sigapatella tenuis	1.04	2.20	1.76	1.32	2.72	26.59
Amphipoda Unid.	1.57	2.40	1.74	1.22	2.68	29.26
Zemysina sp.	1.33	0.19	1.44	1.13	2.22	31.49
Maldanidae	2.33	2.05	1.38	1.26	2.13	33.62
Nucula nitidula	1.44	1.60	1.21	1.24	1.87	35.49
Epigonichthys hectori	0.81	0.71	1.18	0.87	1.82	37.31
Tawera spissa	0.76	0.70	1.18	1.02	1.82	39.13
Aglaophamus sp.	1.25	0.58	1.17	1.29	1.80	40.92
Pagurus sp.	0.93	0.77	1.10	1.07	1.69	42.62
Myriowenia sp.	0.75	0.44	1.08	0.56	1.66	44.27
Callianassa filholi	0.93	0.03	1.02	0.97	1.57	45.84
Scalpomactra scalpellum	1.04	1.00	1.00	1.16	1.55	47.39
Armandia maculata	0.81	0.27	0.97	0.85	1.50	48.89
Gari sp. (juvenile)	0.96	0.85	0.95	1.17	1.47	50.36
Goniadidae	0.91	0.23	0.95	1.29	1.47	51.83
Sigalionidae	0.79	1.23	0.94	0.95	1.46	53.29
Cumacea	0.79	0.59	0.94	1.14	1.44	54.73
Eurylana cookii	0.27	0.63	0.82	0.94	1.27	56.00
Sabellidae	0.47	0.76	0.82	1.14	1.27	57.27
Phyllodocidae	0.64	0.41	0.79	1.04	1.22	58.49
Anthuridea	0.47	0.53	0.76	0.97	1.17	59.66
cf Tethyopsis sp.	0.18	0.57	0.74	0.90	1.13	60.79
Nebalia sp.	0.65	0.03	0.72	0.73	1.11	61.90
Magelona dakini	0.40	0.52	0.69	0.97	1.06	62.96
Nemertea	0.45	0.53	0.66	1.00	1.02	63.98
Mysidacea	0.41	0.22	0.60	0.78	0.93	64.92
Lumbrineridae	0.50	0.07	0.59	0.85	0.90	65.82
Gari convexa	0.45	0.14	0.58	0.79	0.90	66.72
Pupa affinis	0.54	0.03	0.58	0.81	0.90	67.62
Philine sp	0.18	0.47	0.58	0.86	0.89	68.51
Gari stangeri	0.03	0.47	0.57	0.76	0.88	69.39
Cominella virgata	0.41	0.12	0.56	0.73	0.86	70.25

Groups 5 & CS **Average dissimilarity = 62.51**

Species	Group 5 Av.Abund	Group CS Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Bryozoa (discoid)	1.92	4.28	4.22	1.81	6.75	6.75
Hydroides sp	1.90	1.32	2.81	0.71	4.50	11.25
Urothoidae	2.43	1.79	2.61	1.21	4.17	15.42
Phoxocephalidae	2.69	2.03	2.09	1.26	3.35	18.77
Ampharetidae	1.70	0.38	1.91	0.88	3.05	21.82
Nucula nitidula	2.24	1.60	1.84	1.12	2.94	24.76
Sigapatella tenuis	1.54	2.20	1.70	1.39	2.73	27.49
Amphipoda Unid.	2.02	2.40	1.68	1.25	2.68	30.17
Epigonichthys hectori	1.45	0.71	1.61	1.00	2.57	32.74
Pagurus sp.	1.21	0.77	1.51	0.79	2.41	35.15
Scalpomactra scalpellum	1.19	1.00	1.24	1.23	1.99	37.14
Maldanidae	1.74	2.05	1.21	1.15	1.94	39.08
Tawera spissa	0.85	0.70	1.21	1.03	1.93	41.01
Myriowenia sp.	0.91	0.44	1.20	0.80	1.92	42.93
Lysianassidae	1.01	0.43	1.20	1.08	1.92	44.84
Armandia maculata	0.80	0.27	0.99	1.00	1.58	46.42
Cumacea	0.82	0.59	0.97	1.16	1.54	47.96
Sigalionidae	0.94	1.23	0.96	1.00	1.53	49.50
Gari sp. (juvenile)	1.14	0.85	0.96	1.21	1.53	51.03
Aglaophamus sp.	0.77	0.58	0.92	1.11	1.48	52.51
Zemysina sp.	0.66	0.19	0.84	0.83	1.34	53.84
Eurylana cookii	0.37	0.63	0.81	0.99	1.30	55.14
Sabellidae	0.30	0.76	0.80	1.14	1.28	56.42
Anthuridea	0.42	0.53	0.76	0.97	1.21	57.63
Gari stangeri	0.48	0.47	0.73	0.97	1.17	58.80
cf Tethyopsis sp.	0.23	0.57	0.70	0.97	1.12	59.93
Nemertea	0.54	0.53	0.70	1.05	1.11	61.04
Exosphaeroma falcatum	0.53	0.07	0.69	0.32	1.11	62.15
Philine sp	0.35	0.47	0.66	0.94	1.05	63.20
Magelona dakini	0.06	0.52	0.64	0.90	1.02	64.22
Ischnochiton maorianus	0.34	0.34	0.62	0.74	1.00	65.22
Phyllodocidae	0.30	0.41	0.61	0.87	0.97	66.19
Aspidosiphon sp.	0.43	0.14	0.60	0.59	0.95	67.14
Myadora striata	0.41	0.23	0.59	0.77	0.95	68.09
Goniadidae	0.44	0.23	0.59	0.85	0.94	69.04
Thraciidae	0.39	0.26	0.58	0.82	0.93	69.97
Diasterope grisea	0.36	0.22	0.56	0.70	0.90	70.87

Groups 8 & CS **Average dissimilarity = 62.68**

Species	Group 8 Av.Abund	Group CS Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Bryozoa (discoid)	1.81	4.28	3.70	1.68	5.90	5.90
Urothoidae	2.93	1.79	2.91	1.44	4.65	10.55
Phoxocephalidae	2.42	2.03	2.41	1.29	3.84	14.39
Ampharetidae	1.86	0.38	2.07	1.10	3.30	17.69
Nucula nitidula	1.72	1.60	1.84	1.23	2.94	20.64
Lysianassidae	1.51	0.43	1.73	1.08	2.77	23.40
Amphipoda Unid.	2.15	2.40	1.70	1.15	2.71	26.11
Myriowenia sp.	1.32	0.44	1.66	0.81	2.64	28.76
Hydroides sp	0.40	1.32	1.62	0.60	2.59	31.34
Sigapatella tenuis	1.74	2.20	1.58	1.27	2.52	33.86
Maldanidae	1.55	2.05	1.52	1.21	2.43	36.29
Zemysina sp.	1.28	0.19	1.47	1.30	2.34	38.63
Sigalionidae	1.02	1.23	1.19	1.09	1.89	40.52
Scalpomactra scalpellum	1.20	1.00	1.14	1.19	1.81	42.33
Gari sp. (juvenile)	1.23	0.85	1.11	1.23	1.78	44.11
Pagurus sp.	0.74	0.77	1.11	1.02	1.76	45.87
Aglaophamus sp.	1.07	0.58	1.10	1.24	1.76	47.63
Tawera spissa	0.59	0.70	1.05	1.02	1.67	49.30
Epigonichthys hectori	0.74	0.71	0.96	1.07	1.54	50.84
Cumacea	0.71	0.59	0.96	1.10	1.53	52.37
Sabellidae	0.06	0.76	0.91	1.21	1.44	53.81
Eurylana cookii	0.26	0.63	0.87	0.90	1.40	55.20
Magelona dakini	0.49	0.52	0.80	1.04	1.27	56.47
Goniadidae	0.65	0.23	0.78	1.00	1.25	57.72
Anthuridea	0.37	0.53	0.76	0.94	1.22	58.94
Armandia maculata	0.55	0.27	0.76	0.81	1.22	60.16
Dosinia subrosea	0.49	0.32	0.74	0.88	1.18	61.34
cf Tethyopsis sp.	0.19	0.57	0.73	0.95	1.17	62.51
Paraprionospio pinnata	0.59	0.00	0.68	0.70	1.09	63.60
Philine sp	0.25	0.47	0.68	0.88	1.08	64.68
Nemertea	0.33	0.53	0.66	0.97	1.06	65.74
Callianassa filholi	0.55	0.03	0.66	0.77	1.06	66.80
Gari stangeri	0.22	0.47	0.65	0.86	1.04	67.84
Phyllodocidae	0.30	0.41	0.64	0.83	1.03	68.86
Nebalia sp.	0.57	0.03	0.64	0.67	1.02	69.89
Hiatula nitida	0.49	0.00	0.59	0.42	0.94	70.83

Groups 2 & CR **Average dissimilarity = 67.19**

Species	Group 2 Av.Abund	Group CR Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Owenia petersenae	0.16	3.52	4.20	2.01	6.26	6.26
Bryozoa (discoid)	1.00	2.07	2.63	1.10	3.92	10.17
Urothoidae	3.09	2.25	2.54	1.59	3.78	13.96
Ampharetidae	1.99	0.06	2.31	1.00	3.43	17.39
Lysianassidae	2.02	0.26	2.25	1.34	3.35	20.74
Maldanidae	2.33	2.21	2.24	1.31	3.34	24.08
Phoxocephalidae	2.49	1.93	1.80	1.17	2.68	26.76
Amphipoda Unid.	1.57	2.02	1.57	1.22	2.34	29.09
Zemysina sp.	1.33	0.05	1.52	1.12	2.27	31.36
Nucula nitidula	1.44	0.55	1.47	1.32	2.18	33.54
Sigapatella tenuis	1.04	1.69	1.37	1.27	2.04	35.59
Aglaophamus sp.	1.25	0.27	1.34	1.44	2.00	37.59
Hydroides sp	1.07	0.30	1.26	0.78	1.88	39.47
Epigonichthys hectori	0.81	0.62	1.26	0.81	1.87	41.34
Tawera spissa	0.76	0.74	1.24	1.09	1.85	43.18
Callianassa filholi	0.93	0.53	1.13	1.15	1.69	44.87
Gari sp. (juvenile)	0.96	0.52	1.08	1.18	1.61	46.48
Pagurus sp.	0.93	0.38	1.06	1.13	1.58	48.06
Goniadidae	0.91	0.05	1.05	1.36	1.56	49.62
Scalpomactra scalpellum	1.04	1.33	1.01	1.10	1.50	51.12
Sabellidae	0.47	0.95	0.97	1.23	1.45	52.57
Armandia maculata	0.81	0.16	0.97	0.82	1.44	54.01
Cumacea	0.79	0.81	0.94	1.13	1.40	55.41
Myriowenia sp.	0.75	0.00	0.89	0.42	1.32	56.73
Eurylana cookii	0.27	0.62	0.89	0.84	1.32	58.05
Oedicerotidae	0.34	0.67	0.87	1.01	1.29	59.34
Phyllodocidae	0.64	0.61	0.86	1.09	1.28	60.62
Magelona dakini	0.40	0.61	0.84	0.94	1.24	61.86
Barantolla lepte	0.04	0.65	0.81	0.98	1.20	63.06
Sigalionidae	0.79	0.87	0.78	1.07	1.15	64.21
Nebalia sp.	0.65	0.03	0.75	0.73	1.11	65.32
Philine sp	0.18	0.56	0.71	0.88	1.06	66.38
Lumbrineridae	0.50	0.37	0.70	0.97	1.04	67.42
Nemertea	0.45	0.48	0.67	0.99	1.00	68.42
Corbula zelandica	0.06	0.51	0.65	0.67	0.96	69.38
Mysidacea	0.41	0.20	0.63	0.76	0.94	70.32

Groups 5 & CR **Average dissimilarity = 66.05**

Species	Group 5 Av.Abund	Group CR Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Owenia petersenae	0.33	3.52	4.03	1.95	6.10	6.10
Bryozoa (discoid)	1.92	2.07	3.13	1.08	4.74	10.84
Nucula nitidula	2.24	0.55	2.32	1.16	3.51	14.36
Hydroides sp	1.90	0.30	2.23	0.58	3.38	17.73
Urothoidae	2.43	2.25	2.15	1.30	3.26	20.99
Maldanidae	1.74	2.21	2.08	1.19	3.15	24.14
Ampharetidae	1.70	0.06	2.03	0.84	3.08	27.22
Epigonichthys hectori	1.45	0.62	1.75	0.98	2.65	29.87
Phoxocephalidae	2.69	1.93	1.65	1.35	2.50	32.37
Amphipoda Unid.	2.02	2.02	1.59	1.27	2.40	34.77
Sigapatella tenuis	1.54	1.69	1.49	1.42	2.25	37.03
Pagurus sp.	1.21	0.38	1.47	0.72	2.22	39.25
Tawera spissa	0.85	0.74	1.26	1.09	1.91	41.16
Scalpomactra scalpellum	1.19	1.33	1.23	1.33	1.87	43.02
Lysianassidae	1.01	0.26	1.23	1.03	1.86	44.88
Gari sp. (juvenile)	1.14	0.52	1.17	1.34	1.77	46.65
Myriowenia sp.	0.91	0.00	1.14	0.67	1.73	48.38
Armandia maculata	0.80	0.16	0.99	0.98	1.50	49.88
Sabellidae	0.30	0.95	0.99	1.31	1.50	51.38
Cumacea	0.82	0.81	0.95	1.19	1.43	52.81
Aglaophamus sp.	0.77	0.27	0.92	1.06	1.39	54.21
Eurylana cookii	0.37	0.62	0.90	0.93	1.36	55.57
Callianassa filholi	0.45	0.53	0.89	0.88	1.35	56.92
Sigalionidae	0.94	0.87	0.87	1.17	1.31	58.23
Oedicerotidae	0.29	0.67	0.86	1.01	1.30	59.53
Zemysina sp.	0.66	0.05	0.82	0.77	1.25	60.78
Barantolla lepte	0.04	0.65	0.81	1.00	1.22	62.00
Magelona dakini	0.06	0.61	0.78	0.83	1.18	63.18
Philine sp	0.35	0.56	0.77	0.97	1.17	64.34
Phyllodocidae	0.30	0.61	0.75	1.01	1.14	65.48
Gari stangeri	0.48	0.43	0.74	0.97	1.12	66.60
Corbula zelandica	0.24	0.51	0.73	0.79	1.11	67.71
Nemertea	0.54	0.48	0.71	1.03	1.08	68.79
Exosphaeroma falcatum	0.53	0.00	0.66	0.29	1.00	69.79
Lumbrineridae	0.33	0.37	0.62	0.88	0.94	70.72

Groups 8 & CR **Average dissimilarity = 66.68**

Species	Group 8 Av.Abund	Group CR Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Owenia petersenae	0.00	3.52	4.61	2.25	6.91	6.91
Bryozoa (discoid)	1.81	2.07	2.94	1.23	4.41	11.32
Maldanidae	1.55	2.21	2.28	1.12	3.41	14.73
Ampharetidae	1.86	0.06	2.20	1.03	3.29	18.03
Urothoidae	2.93	2.25	2.11	1.31	3.17	21.19
Phoxocephalidae	2.42	1.93	2.09	1.52	3.13	24.33
Nucula nitidula	1.72	0.55	2.04	1.04	3.07	27.39
Lysianassidae	1.51	0.26	1.78	1.02	2.67	30.06
Amphipoda Unid.	2.15	2.02	1.60	1.12	2.41	32.47
Zemysina sp.	1.28	0.05	1.58	1.33	2.38	34.85
Myriowenia sp.	1.32	0.00	1.50	0.63	2.25	37.10
Sigapatella tenuis	1.74	1.69	1.37	1.21	2.06	39.15
Gari sp. (juvenile)	1.23	0.52	1.36	1.31	2.04	41.20
Sabellidae	0.06	0.95	1.23	1.61	1.84	43.04
Aglaophamus sp.	1.07	0.27	1.20	1.29	1.80	44.84
Sigalionidae	1.02	0.87	1.13	1.22	1.69	46.53
Tawera spissa	0.59	0.74	1.10	1.09	1.65	48.18
Scalpomactra scalpellum	1.20	1.33	1.07	1.21	1.60	49.78
Epigonichthys hectori	0.74	0.62	1.05	0.99	1.58	51.35
Cumacea	0.71	0.81	1.00	1.16	1.50	52.85
Pagurus sp.	0.74	0.38	0.98	1.01	1.48	54.33
Eurylana cookii	0.26	0.62	0.94	0.82	1.41	55.74
Magelona dakini	0.49	0.61	0.94	1.00	1.41	57.15
Callianassa filholi	0.55	0.53	0.93	1.01	1.39	58.54
Oedicerotidae	0.24	0.67	0.90	0.99	1.35	59.89
Barantolla lepte	0.07	0.65	0.84	1.00	1.26	61.15
Phyllodocidae	0.30	0.61	0.83	1.01	1.24	62.39
Philine sp	0.25	0.56	0.81	0.91	1.21	63.60
Goniadidae	0.65	0.05	0.80	0.96	1.20	64.81
Dosinia subrosea	0.49	0.34	0.79	0.88	1.19	65.99
Armandia maculata	0.55	0.16	0.73	0.79	1.09	67.08
Paraprionospio pinnata	0.59	0.00	0.71	0.70	1.07	68.15
Hydroides sp	0.40	0.30	0.68	0.72	1.03	69.17
Nebalia sp.	0.57	0.03	0.66	0.67	1.00	70.17

***Groups CR & CS* Average dissimilarity = 60.58**

Species	Group CR Av.Abund	Group CS Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Owenia petersenae	3.52	0.11	4.64	2.18	7.65	7.65
Bryozoa (discoid)	2.07	4.28	4.17	1.68	6.89	14.54
Urothoidae	2.25	1.79	2.53	1.27	4.17	18.71
Maldanidae	2.21	2.05	2.31	1.27	3.81	22.53
Phoxocephalidae	1.93	2.03	1.84	1.02	3.03	25.56
Nucula nitidula	0.55	1.60	1.72	1.36	2.83	28.39
Hydroides sp	0.30	1.32	1.66	0.57	2.74	31.13
Amphipoda Unid.	2.02	2.40	1.65	1.19	2.72	33.85
Sigapatella tenuis	1.69	2.20	1.51	1.23	2.49	36.34
Scalpomactra scalpellum	1.33	1.00	1.22	1.25	2.01	38.35
Tawera spissa	0.74	0.70	1.12	1.14	1.85	40.21
Pagurus sp.	0.38	0.77	1.10	0.93	1.81	42.02
Cumacea	0.81	0.59	1.09	1.18	1.80	43.82
Eurylana cookii	0.62	0.63	1.08	1.07	1.79	45.60
Epigonichthys hectori	0.62	0.71	1.04	1.03	1.71	47.32
Gari sp. (juvenile)	0.52	0.85	1.03	1.23	1.70	49.01
Sigalionidae	0.87	1.23	0.96	0.90	1.58	50.59
Magelona dakini	0.61	0.52	0.93	1.04	1.54	52.13
Oedicerotidae	0.67	0.21	0.91	0.99	1.50	53.63
Barantolla lepte	0.65	0.25	0.91	1.03	1.50	55.14
Phyllodocidae	0.61	0.41	0.89	1.04	1.47	56.61
Sabellidae	0.95	0.76	0.87	1.10	1.43	58.04
Philine sp	0.56	0.47	0.86	1.03	1.41	59.45
Aglaophamus sp.	0.27	0.58	0.82	0.94	1.36	60.81
cf Tethyopsis sp.	0.28	0.57	0.81	0.98	1.33	62.14
Gari stangeri	0.43	0.47	0.80	0.96	1.32	63.46
Anthuridea	0.23	0.53	0.78	0.88	1.29	64.75
Nemertea	0.48	0.53	0.76	1.03	1.26	66.01
Callianassa filholi	0.53	0.03	0.76	0.79	1.25	67.26
Corbula zelandica	0.51	0.16	0.75	0.75	1.24	68.50
Lysianassidae	0.26	0.43	0.71	0.80	1.18	69.68
Dosinia subrosea	0.34	0.32	0.64	0.84	1.06	70.74

***Groups CN & CS* Average dissimilarity = 67.77**

Species	Group CN Av.Abund	Group CS Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Bryozoa (discoid)	0.29	4.28	4.79	2.23	7.07	7.07
Ampharetidae	3.37	0.38	3.62	1.78	5.34	12.42
Urothoidae	2.95	1.79	2.76	1.45	4.07	16.49
Amphipoda Unid.	0.84	2.40	2.20	1.61	3.24	19.73
Hydroides sp	1.27	1.32	2.14	0.66	3.15	22.88
Sigapatella tenuis	0.53	2.20	2.13	1.68	3.14	26.02
Lysianassidae	1.83	0.43	1.92	1.36	2.84	28.86
Phoxocephalidae	2.50	2.03	1.91	1.13	2.81	31.67
Armandia maculata	1.36	0.27	1.54	1.21	2.27	33.94
Zemysina sp.	1.16	0.19	1.29	1.07	1.91	35.85
Nucula nitidula	1.09	1.60	1.27	1.25	1.88	37.72
Maldanidae	2.23	2.05	1.27	1.20	1.87	39.59
Goniadidae	1.10	0.23	1.21	1.32	1.78	41.37
Pagurus sp.	0.94	0.77	1.18	1.02	1.74	43.12
Nebalia sp.	1.00	0.03	1.15	1.04	1.70	44.82
Aglaophamus sp.	1.17	0.58	1.12	1.30	1.65	46.47
Epigonichthys hectori	0.73	0.71	1.06	0.93	1.57	48.03
Scalpomactra scalpellum	0.91	1.00	1.00	1.22	1.48	49.52
Tawera spissa	0.27	0.70	0.95	0.88	1.40	50.92
Phyllodocidae	0.72	0.41	0.88	1.07	1.30	52.21
Gari sp. (juvenile)	0.57	0.85	0.86	1.16	1.27	53.48
Sigalionidae	0.89	1.23	0.86	0.87	1.26	54.75
Eurylana cookii	0.23	0.63	0.85	0.92	1.25	56.00
Sabellidae	0.84	0.76	0.83	1.15	1.22	57.22
Myriowenia sp.	0.43	0.44	0.79	0.75	1.16	58.38
Cumacea	0.41	0.59	0.78	1.00	1.15	59.53
Anthuridea	0.42	0.53	0.77	0.96	1.13	60.66
Magelona dakini	0.40	0.52	0.76	1.02	1.12	61.78
Nemertea	0.59	0.53	0.75	1.02	1.10	62.89
Mysidacea	0.60	0.22	0.73	0.97	1.08	63.97
Philine sp	0.47	0.47	0.73	0.96	1.07	65.04
Leitoscoloplos kerguelensis	0.63	0.06	0.72	0.96	1.07	66.11
Callianassa filholi	0.62	0.03	0.70	0.81	1.03	67.14
cf Tethyopsis sp.	0.09	0.57	0.68	0.91	1.01	68.14
Paraprionospio pinnata	0.58	0.00	0.68	0.90	1.00	69.15
Myadora striata	0.50	0.23	0.64	0.90	0.95	70.09

Groups CN & CR **Average dissimilarity = 68.77**

Species	Group CN Av.Abund	Group CR Av.Abund	Av.Diss	Diss/SD	Contrib%	Cum.%
Owenia petersenae	0.16	3.52	4.28	2.10	6.22	6.22
Ampharetidae	3.37	0.06	4.04	1.87	5.88	12.10
Bryozoa (discoid)	0.29	2.07	2.45	0.99	3.57	15.67
Maldanidae	2.23	2.21	2.22	1.36	3.23	18.90
Lysianassidae	1.83	0.26	2.07	1.36	3.01	21.91
Urothoidae	2.95	2.25	2.04	1.33	2.96	24.87
Amphipoda Unid.	0.84	2.02	1.96	1.61	2.85	27.72
Sigapatella tenuis	0.53	1.69	1.64	1.62	2.38	30.11
Armandia maculata	1.36	0.16	1.60	1.21	2.33	32.44
Hydroides sp	1.27	0.30	1.52	0.57	2.21	34.65
Phoxocephalidae	2.50	1.93	1.43	1.21	2.08	36.73
Zemysina sp.	1.16	0.05	1.36	1.05	1.97	38.70
Goniadidae	1.10	0.05	1.35	1.39	1.96	40.66
Aglaophamus sp.	1.17	0.27	1.31	1.45	1.90	42.56
Nebalia sp.	1.00	0.03	1.20	1.04	1.75	44.31
Nucula nitidula	1.09	0.55	1.20	1.16	1.74	46.05
Pagurus sp.	0.94	0.38	1.13	1.00	1.65	47.70
Epigonichthys hectori	0.73	0.62	1.13	0.86	1.64	49.34
Tawera spissa	0.27	0.74	1.04	0.97	1.51	50.84
Scalpomactra scalpellum	0.91	1.33	1.04	1.22	1.51	52.35
Callianassa filholi	0.62	0.53	0.93	1.04	1.36	53.71
Phyllodocidae	0.72	0.61	0.92	1.11	1.34	55.04
Cumacea	0.41	0.81	0.91	1.15	1.32	56.37
Eurylana cookii	0.23	0.62	0.91	0.83	1.32	57.69
Magelona dakini	0.40	0.61	0.90	0.98	1.31	59.00
Gari sp. (juvenile)	0.57	0.52	0.84	1.04	1.22	60.22
Oedicerotidae	0.15	0.67	0.84	0.97	1.22	61.44
Philine sp	0.47	0.56	0.83	1.00	1.20	62.64
Sabellidae	0.84	0.95	0.83	1.13	1.20	63.84
Barantolla lepte	0.00	0.65	0.81	0.98	1.18	65.02
Leitoscoloplos kerguelensis	0.63	0.21	0.78	0.99	1.13	66.15
Nemertea	0.59	0.48	0.77	1.00	1.12	67.28
Mysidacea	0.60	0.20	0.77	0.97	1.12	68.40
Sigalionidae	0.89	0.87	0.73	1.01	1.07	69.46
Paraprionospio pinnata	0.58	0.00	0.71	0.90	1.03	70.49

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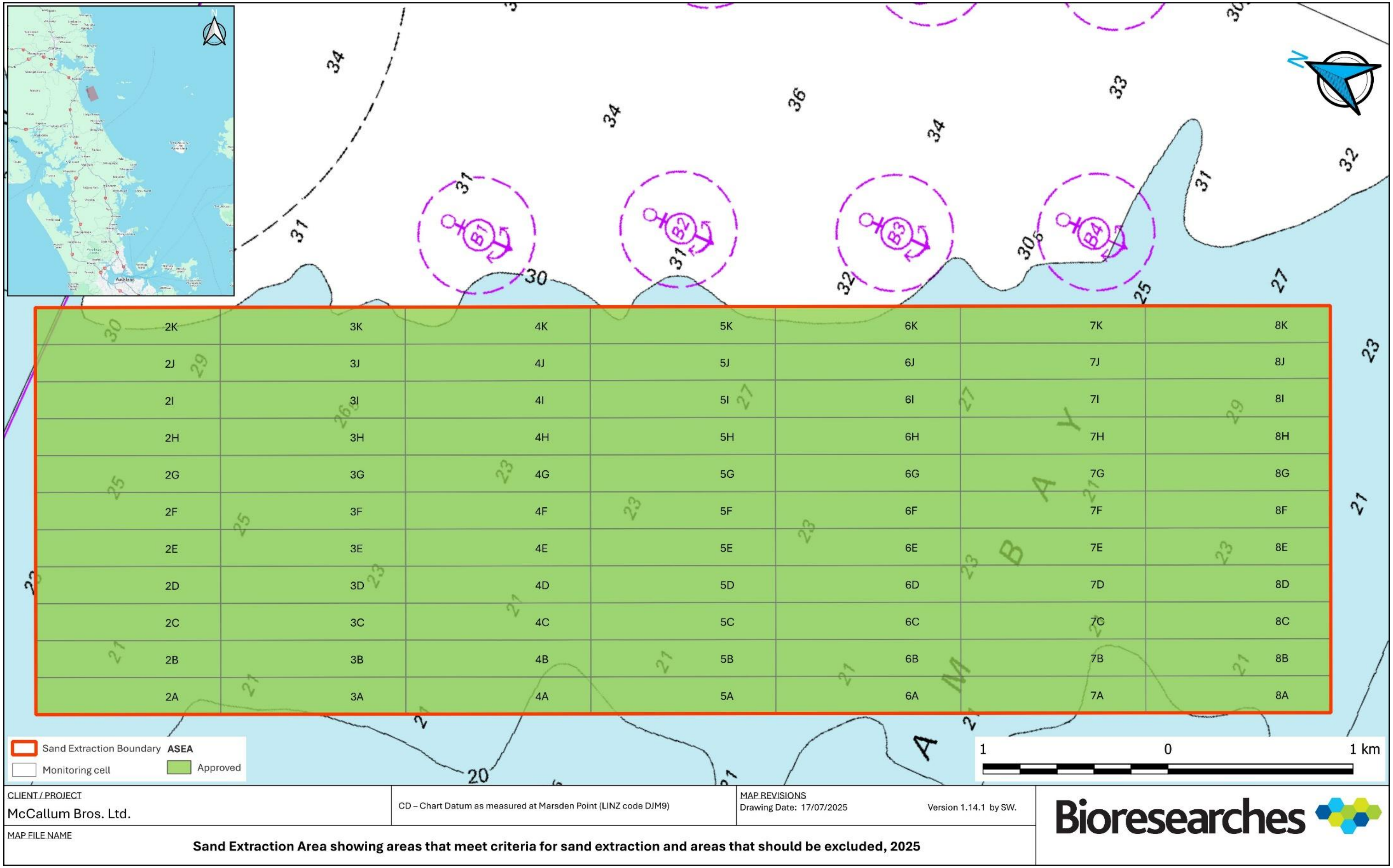
Appendix D Sand Extraction Monitoring Reports (SEMR)

To be appended as per the delivery timeframes set out in Section 2.5.

Appendix E Approved Sand Extraction Area (ASEA)



Appendix F Sensitive Benthic Communities

Habitat	Primary indicators
Beds of large bivalve molluscs	A bed of large bivalves exists where living specimens of bivalve species: • are estimated to cover 30% or more of the seabed on average in visual images of either $1m^2$ or lateral view; or • comprise 30% or more by average weight or volume in grab samples. Large bivalves include: Horse mussels (*Atrina zelandica*) Scallops (*Pecten novaezelandiae*) Large dog cockle, (*Tucetona laticostata*) Dredge oysters (*Ostrea Chilenis*) Green lipped mussels (*Perna canaliculus*) Geoducks (*Panopea zelandica* and *P. smithae*) Trough Shells (*Spisula discors* and S. *murchisoni*) Triangle Shell (*Crassula aequilatera*) Shellfish known to pass through dredge alive at greater than 90% are excluded; Clam (*Dosinia anus*, *D. subrosea*, *Bassina yatei*) *Myadora sp.*
Brachiopod beds	A brachiopod bed exists if: • one live brachiopod occurs per m^2 of seabed sampled using seabed photographs; or • one or more live specimens occur in grab samples.
Bryozoan thicket	A bryozoan thicket (here the term thicket is used synonymously with the terms bed, reef, meadow, etc.) is present if: • colonies of large frame-building bryozoan species cover at least 50% of the seabed in visual imaging surveys; • one or more colonies of large frame building bryozoan species occur per m^2 of seabed sampled using towed sampling gear; or • one or more large frame building bryozoan species is found in grab samples.
Calcareous tube worm thickets	A sensitive tube worm thicket is present if: • 2 or more colonies of a mound forming species of tube worm are found in any grab sample; or • 2 or more colonies are observed at a greater than 10% coverage in a visual image, either $1m^2$ or lateral view.
Chaetopteridae worm fields	A sensitive Chaetopteridae worm field is present if worm tubes and/or epifaunal species: • contribute 25% or more of the volume of a sample collected in a grab sample; or • colonies of tube worm species cover at least 50% of the seabed in visual imaging surveys.
Macro-algae beds	Detection of a single occurrence of any fixed specimen of a red, green or brown macroalga at greater than 30% cover is sufficient to indicate that this habitat has been encountered.
Rhodolith (maerl) beds	A rhodolith bed exists if: • a single specimen of a rhodolith species is found in grab sample; or • there is more than 10% cover of living coralline thalli in visual images.
Sea pen field	A sea pen field exists if: • one or more specimens of any species of sea pen is found in a grab sample; or • two or more specimens per m^2 are found in seabed imaging surveys.
Sponge gardens	A sponge garden exists if metazoans of Class Demospongiae, Class Hexactinellida, Class Calcarea or Class Homoscleromorpha: • are estimated to cover 25% or more of the seabed in visual images of either $1m^2$ or lateral view.

Adapted from: MacDiarmid, A. et al (2013). *Sensitive marine benthic habitats defined*. NIWA client report number WLG2013-18. National Institute of Water and Atmospheric Research, Wellington, New Zealand. Available at: https://environment.govt.nz/publications/sensitive-marine-benthic-habitats-defined/

Appendix G Seabird Interaction Log

Date		Location (e.g. inshore)	Trip Number	Time	Observer Initials and Designation	Dredge Activity (dredging or in transit)	Species	Number of Individuals
1								
2								
3								
4								
5								
6								

Continue on Next Page

Approx. Distance from Vessel		Heading of Animal from Vessel	Animal Behaviour (e.g. feeding, underway, breaching etc.)	Avoidance/Mitigation Method	Incidents or Mortality (report to Council and DOC if so)	GPS Coordinates
1						
2						
3						
4						
5						
6						

Appendix H Marine Reptiles Sighting Log

Date		Location (e.g. inshore)	Trip Number	Time	Observer Initials and Designation	Dredge Activity (dredging or in transit)	Species	Number of Individuals
1								
2								
3								
4								
5								
6								
Continue on Next Page								

Approx. Distance from Vessel		Heading of Animal from Vessel	Animal Behaviour (e.g. feeding, underway, breaching etc.)	Avoidance/Mitigation Method	Incidents or Mortality (report to Council and DOC if so)	GPS Coordinates
1						
2						
3						
4						
5						
6						

Appendix I   Marine Mammals Sighting Log

Date		Location (e.g. inshore)	Trip Number	Time	Observer Initials and Designation	Dredge Activity (dredging or in transit)	Species	Number of Individuals
1								
2								
3								
4								
5								
6								

Continue on Next Page

Approx. Distance from Vessel		Heading of Animal from Vessel	Animal Behaviour (e.g. feeding, underway, breaching etc.)	Avoidance/Mitigation Method	Incidents or Mortality (report to Council and DOC if so)	GPS Coordinates
1						
2						
3						
4						
5						
6						

Appendix J Marine Mammals Incident Log

Date		Location (e.g. inshore)	Trip Number	Time	Observer Initials and Designation	Dredge Activity (dredging or in transit)	Species	Number of Individuals
1								
2								
3								
4								
5								
6								
Continue on Next Page								

Approx. Distance from Vessel		Heading of Animal from Vessel	Animal Behaviour (e.g. feeding, underway, breaching etc.)	Avoidance/Mitigation Method	Incidents or Mortality (report to Council and DOC if so)	GPS Coordinates
1						
2						
3						
4						
5						
6						

Appendix K Applications for Change of Vessel or Extraction and/or Discharge Methodology and the NRC Approval