



## Cell 1 Regional Coastal Monitoring Programme Analytical Report 13: Full Measures Survey 2020



*A great place to live, work & play*

**Scarborough Council  
March 2021**

## Contents

Disclaimer .....	ii
Abbreviations and Acronyms.....	iii
Water Levels Used in Interpretation of Changes .....	iii
Glossary of Terms.....	iv
Preamble .....	v
1. Introduction .....	1
1.1 Study Area.....	1
1.2 Methodology .....	1
2. Analysis of Survey Data .....	16
2.1 Staithes.....	16
2.2 Runswick Bay .....	18
2.3 Sandsend Beach, Upgang Beach and Whitby Sands.....	19
2.4 Robin Hood's Bay .....	22
2.5 Scarborough North Bay .....	24
2.6 Scarborough South Bay.....	27
2.7 Cayton Bay.....	30
2.8 Filey Bay.....	33
3. Problems Encountered and Uncertainty in Analysis .....	37
4. Recommendations for 'Fine-tuning' the Monitoring Programme .....	37
5. Conclusions and Areas of Concern .....	38

## Appendices

Appendix A	Beach Profiles
Appendix B	Topographic Survey
Appendix C	Cliff Top Survey

## List of Figures

Figure 1	Sediment Cells in England and Wales
Figure 2	Survey Location Maps
Figure 3	Cliff Top Survey Locations

## List of Tables

Table 1	Analytical, Update and Overview Reports Produced to Date
Table 2	Sub-division of the Cell 1 Coastline

Authors	
Ewan Richardson	Royal HaskoningDHV
Dr Nick Cooper – Review & Approval	Royal HaskoningDHV

## **Disclaimer**

Royal HaskoningDHV has prepared this report in accordance with the instructions of our client Scarborough Borough Council (SBC) for the client's sole and specific use. Any other persons who use any information contained herein do so at their own risk. Royal HaskoningDHV has used reasonable skill, care and diligence in the interpretation of data provided to them and accepts no responsibility for the content, quality or accuracy of any Third-party reports, monitoring data or further information provided either to them by SBC or, via SBC from a Third-party source, for analysis under this term contract.

Data and reports collected as part of the Cell 1 Regional Coastal Monitoring Programme are available to download via the North East Coastal Observatory via the webpage:

[www.northeastcoastalobservatory.org.uk](http://www.northeastcoastalobservatory.org.uk).

The North East Coastal Observatory does not "license" the use of images or data or sign license agreements. The North East Coastal Observatory generally has no objection to the reproduction and use of these materials (aerial photography, wave data, beach surveys, bathymetric surveys, reports), subject to the following conditions:

1. North East Coastal Observatory material may not be used to state or imply the endorsement by North East Coastal Observatory or by any North East Coastal Observatory employee of a commercial product, service, or activity, or used in any manner that might mislead.
2. North East Coastal Observatory should be acknowledged as the source of the material in any use of images and data accessed through this website, please state "Image/Data courtesy of North East Coastal Observatory". We recommend that the caption for any image and data published includes our website, so that others can locate or obtain copies when needed. We always appreciate notification of beneficial uses of images and data within your applications. This will help us continue to maintain these freely available services. Send e-mail to [Robin.Siddle@scarborough.gov.uk](mailto:Robin.Siddle@scarborough.gov.uk)
3. It is unlawful to falsely claim copyright or other rights in North East Coastal Observatory material.
4. North East Coastal Observatory shall in no way be liable for any costs, expenses, claims, or demands arising out of the use of North East Coastal Observatory material by a recipient or a recipient's distributees.
5. North East Coastal Observatory does not indemnify nor hold harmless users of North East Coastal Observatory material, nor release such users from copyright infringement, nor grant exclusive use rights with respect to North East Coastal Observatory material.
6. North East Coastal Observatory material is not protected by copyright unless noted (in associated metadata). If copyrighted, permission should be obtained from the copyright owner prior to use. If not copyrighted, North East Coastal Observatory material may be reproduced and distributed without further permission from North East Coastal Observatory.

## Abbreviations and Acronyms

Acronym / Abbreviation	Definition
AONB	Area of Outstanding Natural Beauty
DGM	Digital Ground Model
HAT	Highest Astronomical Tide
LAT	Lowest Astronomical Tide
MHWN	Mean High Water Neap
MHWS	Mean High Water Spring
MLWS	Mean Low Water Neap
MLWS	Mean Low Water Spring
m	metres
ODN	Ordnance Datum Newlyn

## Water Levels Used in Interpretation of Changes

Water Level Parameter	Water Level (m AOD)			
	Hartlepool Headland to Saltburn Scar	Skinningrove	Hummersea Scar to Sandsend Ness	Sandsend Ness to Saltwick Nab
1 in 200 year	3.87	3.86	4.1	3.88
HAT	3.25	3.18	3.15	3.10
MHWS	2.65	2.68	2.65	2.60
MLWS	-1.95	-2.13	-2.15	-2.20

Water Level Parameter	Water Level (m AOD)			
	Saltwick Nab to Hundale Point	Hundale Point to White Nab	White Nab to Filey Brigg	Filey Brigg to Flamborough Head
1 in 200 year	3.88	3.93	3.93	4.04
HAT	3.10	3.05	3.05	3.10
MHWS	2.60	2.45	2.45	2.50
MLWS	-2.20	-2.35	-2.35	-2.30

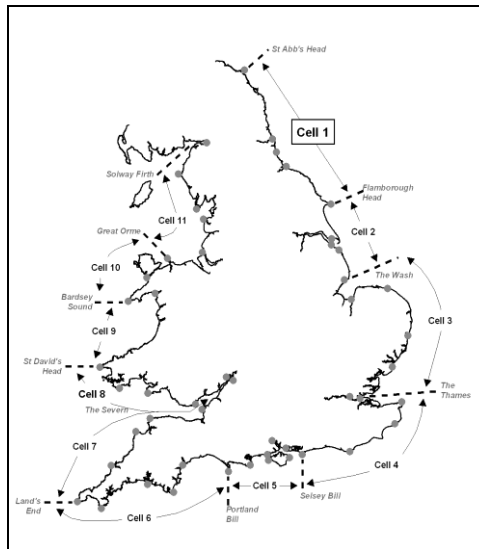
**Source:** *River Tyne to Flamborough Head Shoreline Management Plan 2.*  
Royal Haskoning, February 2007.

## Glossary of Terms

Term	Definition
Beach nourishment	Artificial process of replenishing a beach with material from another source.
Berm crest	Ridge of sand or gravel deposited by wave action on the shore just above the normal high-water mark.
Breaker zone	Area in the sea where the waves break.
Coastal squeeze	The reduction in habitat area which can arise if the natural landward migration of a habitat under sea level rise is prevented by the fixing of the high-water mark, e.g. a sea wall.
Downdrift	Direction of alongshore movement of beach materials.
Ebb-tide	The falling tide, part of the tidal cycle between high water and the next low water.
Fetch	Length of water over which a given wind has blown that determines the size of the waves produced.
Flood-tide	Rising tide, part of the tidal cycle between low water and the next high water.
Foreshore	Zone between the high water and low water marks, also known as the intertidal zone.
Geomorphology	The branch of physical geography/geology which deals with the form of the Earth, the general configuration of its surface, the distribution of the land, water, etc.
Groyne	Shore protection structure built perpendicular to the shore; designed to trap sediment.
Mean High Water (MHW)	The average of all high waters observed over a sufficiently long period.
Mean Low Water (MLW)	The average of all low waters observed over a sufficiently long period.
Mean Sea Level (MSL)	Average height of the sea surface over a 19-year period.
Offshore zone	Extends from the low water mark to a water depth of about 15 m and is permanently covered with water.
Storm surge	A rise in the sea surface on an open coast, resulting from a storm.
Swell	Waves that have travelled out of the area in which they were generated.
Tidal prism	The volume of water within the estuary between the level of high and low tide, typically taken for mean spring tides.
Tide	Periodic rising and falling of large bodies of water resulting from the gravitational attraction of the moon and sun acting on the rotating earth.
Topography	Configuration of a surface including its relief and the position of its natural and man-made features.
Transgression	The landward movement of the shoreline in response to a rise in relative sea level.
Updrift	Direction opposite to the predominant movement of longshore transport.
Wave direction	Direction from which a wave approaches.
Wave refraction	Process by which the direction of approach of a wave changes as it moves into shallow water.

## Preamble

The Cell 1 Regional Coastal Monitoring Programme covers approximately 300km of the northeast England coastline, from the Scottish Border (just south of St. Abb's Head) to Flamborough Head in East Yorkshire. This coastline is often referred to as 'Coastal Sediment Cell 1' in England and Wales (Figure 1). Within this frontage the coastal landforms vary considerably, comprising low-lying tidal flats with fringing salt marshes, hard rock cliffs that are mantled with glacial sediment to varying thicknesses, softer rock cliffs and extensive landslide complexes.



**Figure 1 Sediment Cells in England and Wales**

The work commenced with a three-year monitoring programme in September 2008 that was managed by Scarborough Borough Council on behalf of the North East Coastal Group. This initial phase has been followed by a five-year programme of work, which started in October 2011. The work is funded by the Environment Agency, working in partnership with the following organisations:



The main elements of the Cell 1 Regional Coastal Monitoring Programme involve:

- beach profile surveys
- topographic surveys
- cliff top recession surveys
- real-time wave data collection
- bathymetric and sea bed characterisation surveys
- aerial photography
- LiDAR Surveys
- walk-over cliff and coastal defence asset surveys

The beach profile surveys, topographic surveys and cliff top recession surveys are undertaken as a 'Full Measures' survey in autumn/early winter every year. Some of these surveys are then repeated the following spring as part of a Partial Measures survey.

Each year, an Analytical Report is produced for each individual authority, providing a detailed analysis and interpretation of the Full Measures surveys. This is followed by a brief Update Report for each individual authority, providing ongoing findings from the Partial Measures surveys. A Cell 1 Overview Report is also produced regularly to provide a region-wide summary of the main findings relating to trends and interactions along the entire Cell 1 frontage.

To date the following reports have been produced:

**Table 1 Analytical, Update and Overview Reports Produced to Date**

Year		Full Measures		Partial Measures		Cell 1 Overview Report
		Survey	Analytical Report	Survey	Update Report	
1	2008/09	Sep-Dec 08	May 09	Mar-May 09		-
2	2009/10	Sep-Dec 09	Mar 10	Feb-Mar 10	Jul 10	-
3	2010/11	Aug-Nov 10	Feb 11	Feb-Apr 11	Aug 11	Sep 11
4	2011/12	Sep 11	Aug 12	Mar-May 12	Feb 13	
5	2012/13	Sep 12	Mar 13	Apr-May 13	May 13	
6	2013/14	Sep 13	Feb 14	Mar-Apr 14	Jul 14	
7	2014/15	Sep 14	Feb 15	Mar 15	Jul 15	
8	2015/16	Sep 15	Feb 16	Mar – Apr 16	Jul 16	Jun 16
9	2016/17	Sep–Nov16	Feb 17	Feb-Apr 17	Jul 17	
10	2017/18	Sep-Oct 16	Jan 17	Mar-May 18	Jun 18	
11	2018/19	Sep-Oct 18	Mar 19	Mar-Apr 19	July 19	
12	2019/20	Sep-Nov 19	Jan 20	Feb-Apr 20	June 20	
13	2020/21	Nov-Dec 20	Mar 21 (*)			

(\*) The present report is **Analytical Report 13** and provides an analysis of the autumn/winter 2020 Full Measures survey for Scarborough Borough Council's frontage.

In addition, separate reports are produced for other elements of the programme as and when specific components are undertaken, such as wave data collection, bathymetric and sea bed sediment data collection, aerial photography, and walk-over visual inspections.

For purposes of analysis, the Cell 1 frontage has been split into the sub-sections listed in Table 2. Areas covered in the current report are highlighted.

**Table 2 Sub-divisions of the Cell 1 Coastline**

<b>Authority</b>	<b>Zone</b>
Northumberland County Council	Spittal A
	Spittal B
	Goswick Sands
	Holy Island
	Bamburgh
	Beadnell Village
	Beadnell Bay
	Embelton Bay
	Boulmer
	Alnmouth Bay
	High Hauxley and Druridge Bay
	Lynemouth Bay
	Newbiggin Bay
	Cambois Bay
Blyth South Beach	
North Tyneside Council	Whitley Sands
	Cullercoats Bay
	Tynemouth Long Sands
	King Edward's Bay
South Tyneside Council	Littehaven Beach
	Herd Sands
	Trow Quarry (incl. Frenchman's Bay)
	Marsden Bay
Sunderland Council	Whitburn Bay
	Harbour and Docks
	Hendon to Ryhope (incl. Halliwell Banks)
Durham County Council	Featherbed Rocks
	Seaham
	Blast Beach
	Hawthorn Hive
	Blackhall Colliery
Hartlepool Borough Council	North Sands
	Headland
	Middleton
	Hartlepool Bay
Redcar & Cleveland Borough Council	Coatham Sands
	Redcar Sands
	Marske Sands
	Saltburn Sands
	Cattersty Sands (Skinningrove)
Scarborough Borough Council	Staithes
	Runswick Bay
	Sandsend Beach, Upgang Beach and Whitby Sands
	Robin Hood's Bay
	Scarborough North Bay
	Scarborough South Bay
	Cayton Bay
	Filey Bay



## 1. Introduction

### 1.1 Study Area

Scarborough Borough Council's frontage extends from Staithes Harbour to Speeton, in Filey Bay. For the purposes of this report, the Scarborough frontage has been sub-divided into eight areas, namely:

- Staithes
- Runswick Bay
- Sandsend Beach, Uppang Beach and Whitby Sands
- Robin Hood's Bay
- Scarborough North Bay
- Scarborough South Bay
- Cayton Bay
- Filey Bay

### 1.2 Methodology

Along Scarborough Borough Council's frontage, the following surveying is undertaken:

- Full Measures survey annually each autumn/early winter comprising:
  - Beach profile surveys along 20 transect lines
  - Topographic survey at Runswick Bay
  - Topographic survey along the Sandsend to Whitby frontage
  - Topographic survey at Robin Hood's Bay
  - Topographic survey at Scarborough North Bay
  - Topographic survey at Scarborough South Bay
  - Topographic survey at Cayton Bay
  - Topographic survey at Filey Bay
- Partial Measures survey annually each spring comprising:
  - Beach profile surveys along 20 transect lines
  - Topographic survey at Runswick Bay
  - Topographic survey at Robin Hood's Bay
  - Topographic survey at Filey Bay (Town coverage)
- Cliff top survey bi-annually at:
  - Staithes
  - Robin Hood's Bay (added Spring 2010)
  - Scarborough South Bay (added Spring 2010)
  - Cayton Bay
  - Filey

The location of these surveys is shown in Figure 2. Full Measures surveys were undertaken along this frontage between 20<sup>th</sup> October 2020 and 2<sup>nd</sup> December 2020. The weather and sea state varied greatly in that time, for details of the survey conditions refer to the Academy Geomatics survey reports for each location.

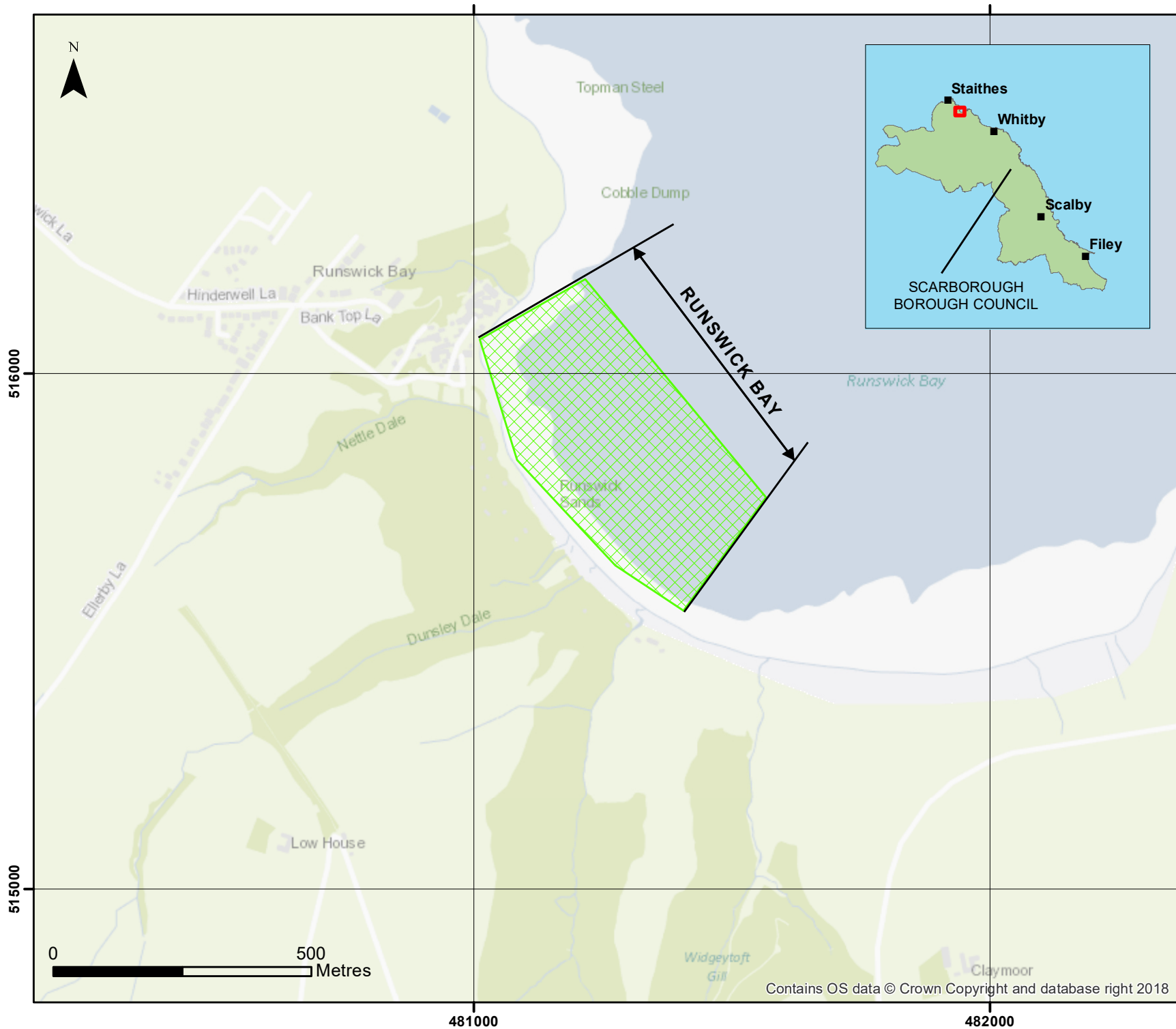
All data have been captured in a manner commensurate with the principles of the Environment Agency's *National Standard Contract and Specification for Surveying Services* and stored in a file format compatible with the software systems being used for the data analysis, namely SANDS and ArcGIS. This data collection approach and file format is comparable to that being used on other regional coastal monitoring programmes, such as in the South East and South West of England.

Upon receipt of the data from the survey team, they are quality assured and then uploaded onto the programme's website for storage and availability to others and also input to SANDS and GIS for subsequent analysis.

The Analytical Report is then produced following a standard structure for each authority. This involves:

- description of the changes observed since the previous survey and an interpretation of the drivers of these changes (Section 2);
- documentation of any problems encountered during surveying or uncertainties inherent in the analysis (Section 3);
- recommendations for 'fine-tuning' the programme to enhance its outputs (Section 4); and
- providing key conclusions and highlighting any areas of concern (Section 5).

Data from the present survey are presented in a processed form in the Appendices.



Key

**SURVEY LOCATIONS**

**Topographic Profiles**

- Annual
- Bi-Annual

**Topographic Surveys**

- 6 monthly
- yearly
- 5 yearly

*(Indicative Survey Extents shown)*

Client: North East Coastal Group  
 Project: Cell 1 Regional Coastal Monitoring Programme

**Figure 2 - Map 1**

**Scarborough Borough Council Frontage**

Analytical Report  
 Topo Surveys

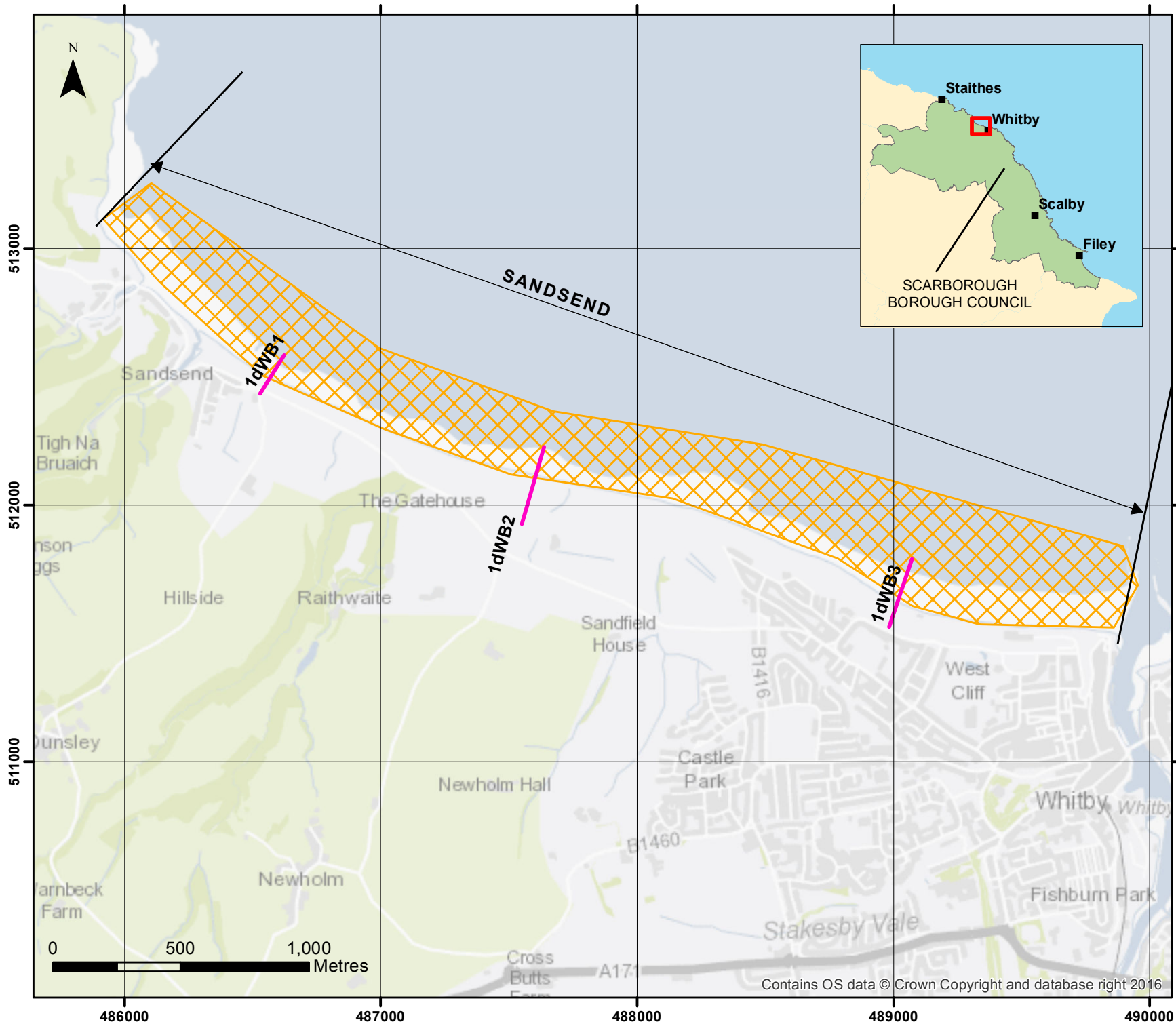
Drawing Scale at A4 1:10,000

**WATER**  
 Royal HaskoningDHV  
 Marlborough House  
 Marlborough Crescent  
 Newcastle upon Tyne  
 NE1 4EE

Tel: +44 (0)191 211 1300  
 Fax: +44 (0)191 211 1313  
 www.royalhaskoningdhv.com



Contains OS data © Crown Copyright and database right 2018



Key

**SURVEY LOCATIONS**

**Topographic Profiles**

- Annual
- Bi-Annual

**Topographic Surveys**

- 6 monthly
- yearly
- 5 yearly

*(Indicative Survey Extents shown)*

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

**Figure 2 - Map 2**

**Scarborough Borough Council Frontage**

Analytical Report  
Topo Surveys

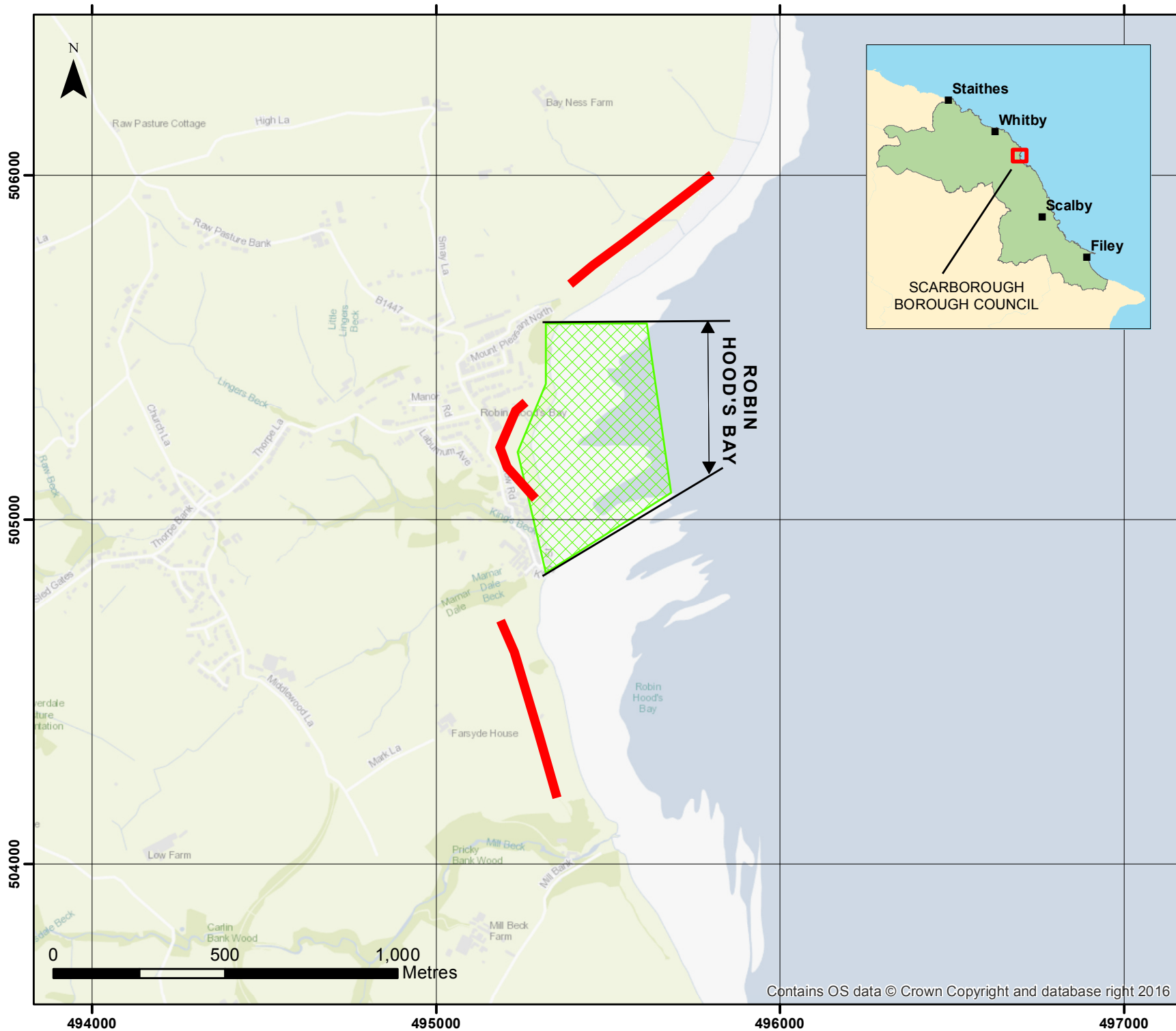
Drawing Scale at A4 1:20,000

**WATER**  
Royal HaskoningDHV  
Marlborough House  
Marlborough Crescent  
Newcastle upon Tyne  
NE1 4EE

Tel: +44 (0)191 211 1300  
Fax: +44 (0)191 211 1313  
www.royalhaskoningdhv.com



Contains OS data © Crown Copyright and database right 2016



Key

**SURVEY LOCATIONS**

**Topographic Profiles**

- Annual (Blue line)
- Bi-Annual (Pink line)

**Topographic Surveys**

- 6 monthly (Green hatched area)
- yearly (Orange hatched area)

**Cliff Top Monitoring Pegs**

- @ 300 centres (Red line)

*(Indicative Survey Extents shown)*

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

**Figure 2 - Map 3**

**Scarborough Borough Council Frontage**

Analytical Report  
Topo Surveys

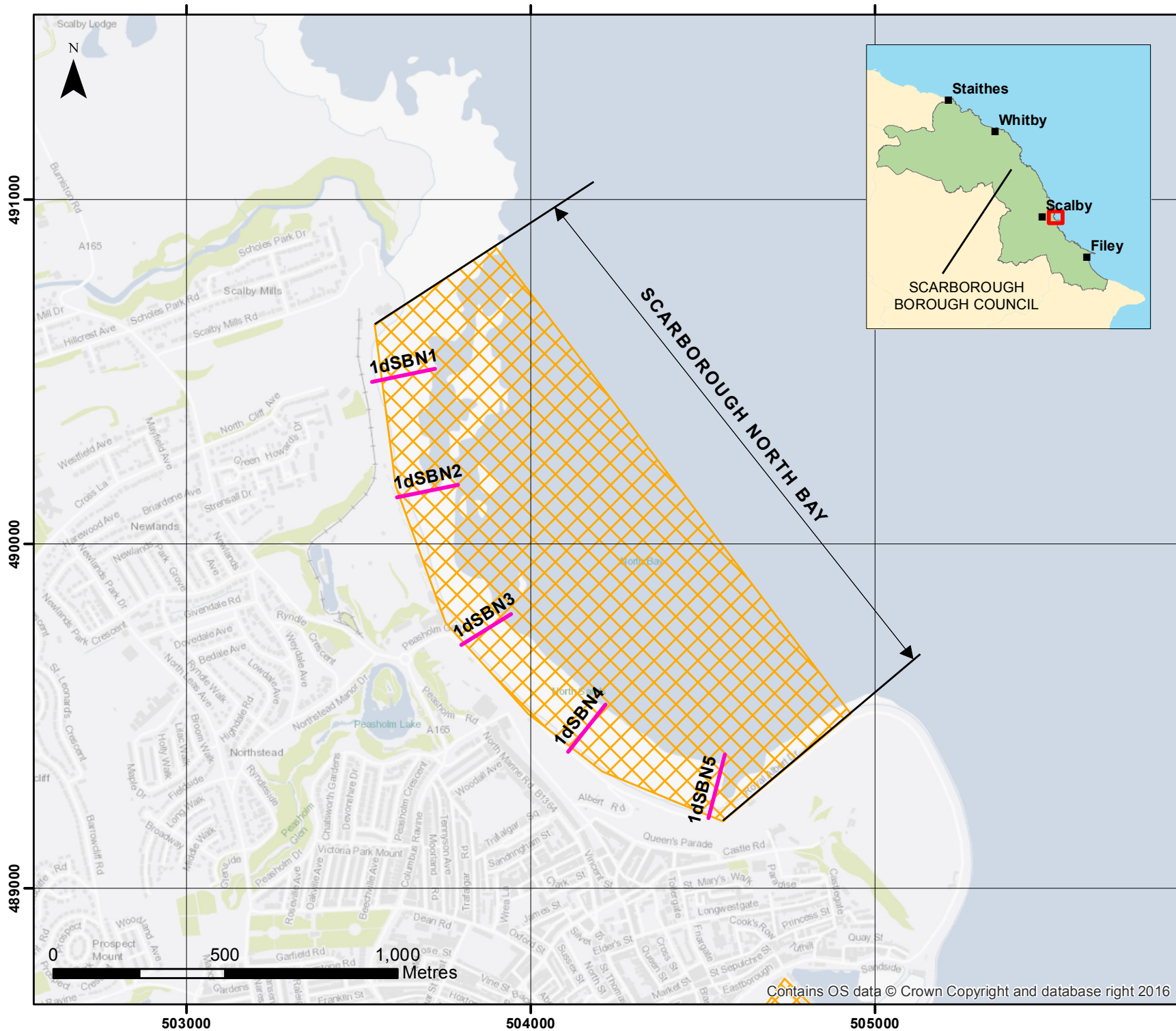
Drawing Scale at A4 1:15,000

**WATER**  
 Royal HaskoningDHV  
 Marlborough House  
 Marlborough Crescent  
 Newcastle upon Tyne  
 NE1 4EE

Tel: +44 (0)191 211 1300  
 Fax: +44 (0)191 211 1313  
 www.royalhaskoningdhv.com



Contains OS data © Crown Copyright and database right 2016



Key

**SURVEY LOCATIONS**

**Topographic Profiles**

- Annual
- Bi-Annual

**Topographic Surveys**

- 6 monthly
- yearly
- 5 yearly

*(Indicative Survey Extents shown)*

Client: North East Coastal Group  
 Project: Cell 1 Regional Coastal Monitoring Programme

**Figure 2 - Map 4**

**Scarborough Borough Council Frontage Analytical Report Topo Surveys**

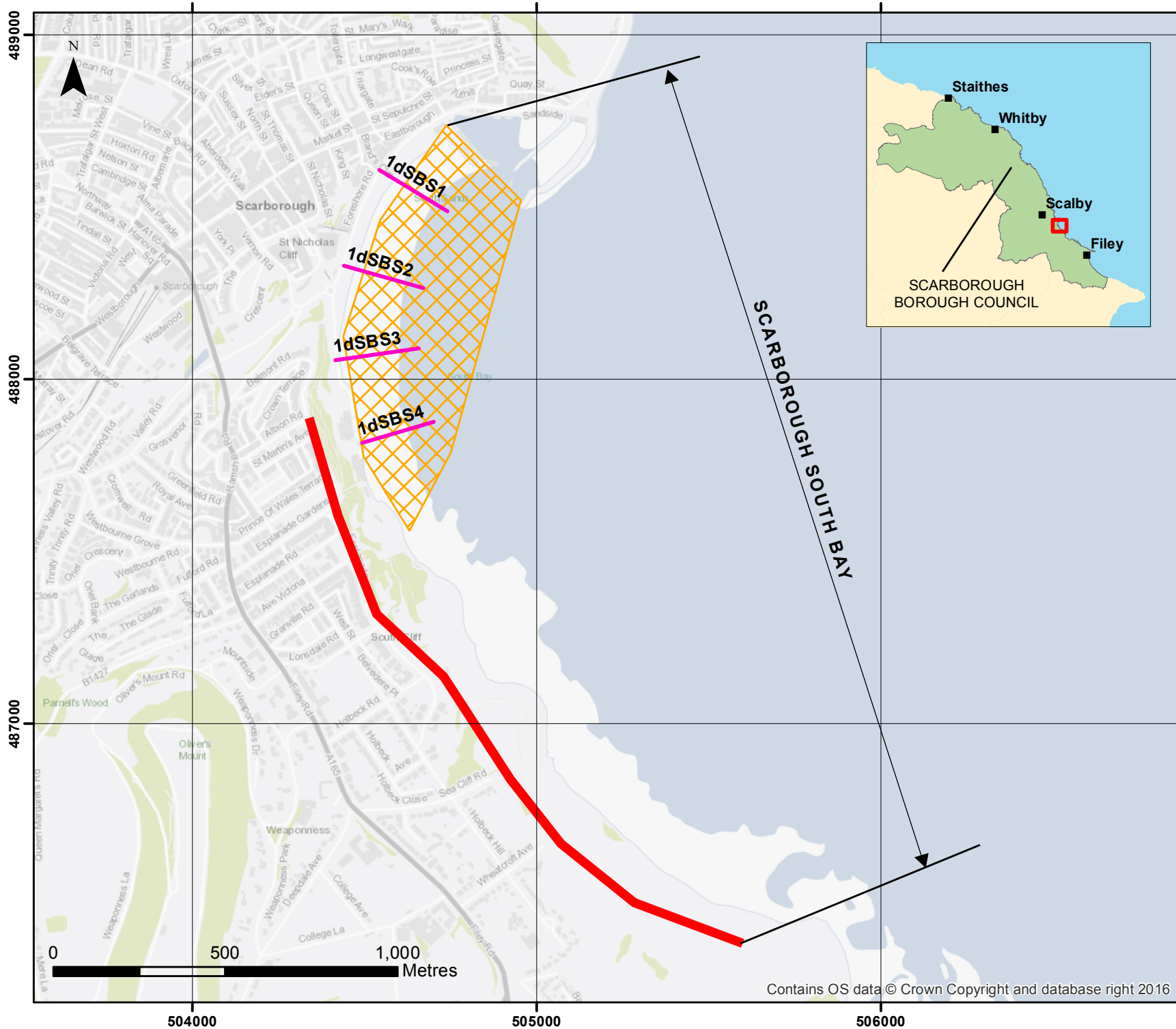
Drawing Scale at A4 1:15,000

**WATER**  
 Royal HaskoningDHV  
 Marlborough House  
 Marlborough Crescent  
 Newcastle upon Tyne  
 NE1 4EE

Tel: +44 (0)191 211 1300  
 Fax: +44 (0)191 211 1313  
 www.royalhaskoningdhv.com



Contains OS data © Crown Copyright and database right 2016



Key

**SURVEY LOCATIONS**

**Topographic Profiles**

- Annual (Blue line)
- Bi-Annual (Pink line)

**Topographic Surveys**

- 6 monthly (Green grid)
- yearly (Yellow grid)

**Cliff Top Monitoring Pegs**

- @ 300 centres (Red line)

*(Indicative Survey Extents shown)*

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

**Figure 2 - Map 5**

**Scarborough Borough Council Frontage**

Analytical Report  
Topo Surveys

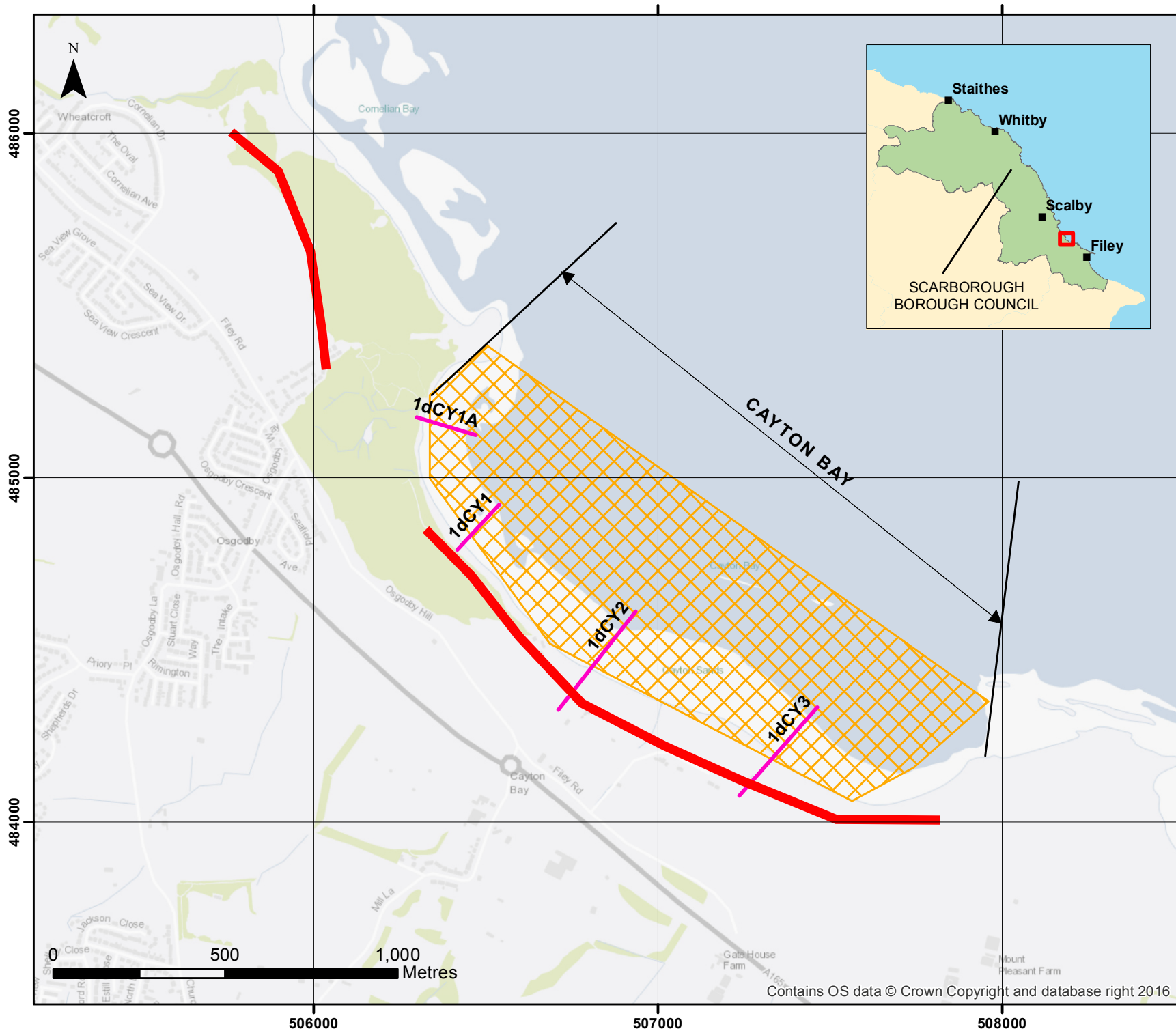
Drawing Scale at A4 1:15,000

**WATER**  
Royal HaskoningDHV  
Marlborough House  
Marlborough Crescent  
Newcastle upon Tyne  
NE1 4EE

Tel: +44 (0)191 211 1300  
Fax: +44 (0)191 211 1313  
www.royalhaskoningdhv.com



Contains OS data © Crown Copyright and database right 2016



Key

**SURVEY LOCATIONS**  
**Cliff Top Monitoring Pegs**  
 @ 300 centres

**Topographic Profiles**  
 Annual  
 Bi-Annual

**Topographic Surveys**  
 6 monthly  
 yearly  
*(Indicative Survey Extents shown)*

Client: North East Coastal Group  
 Project: Cell 1 Regional Coastal Monitoring Programme

**Figure 2 - Map 6**

**Scarborough Borough Council Frontage**

Analytical Report  
 Topo Surveys

Drawing Scale at A4 1:15,000

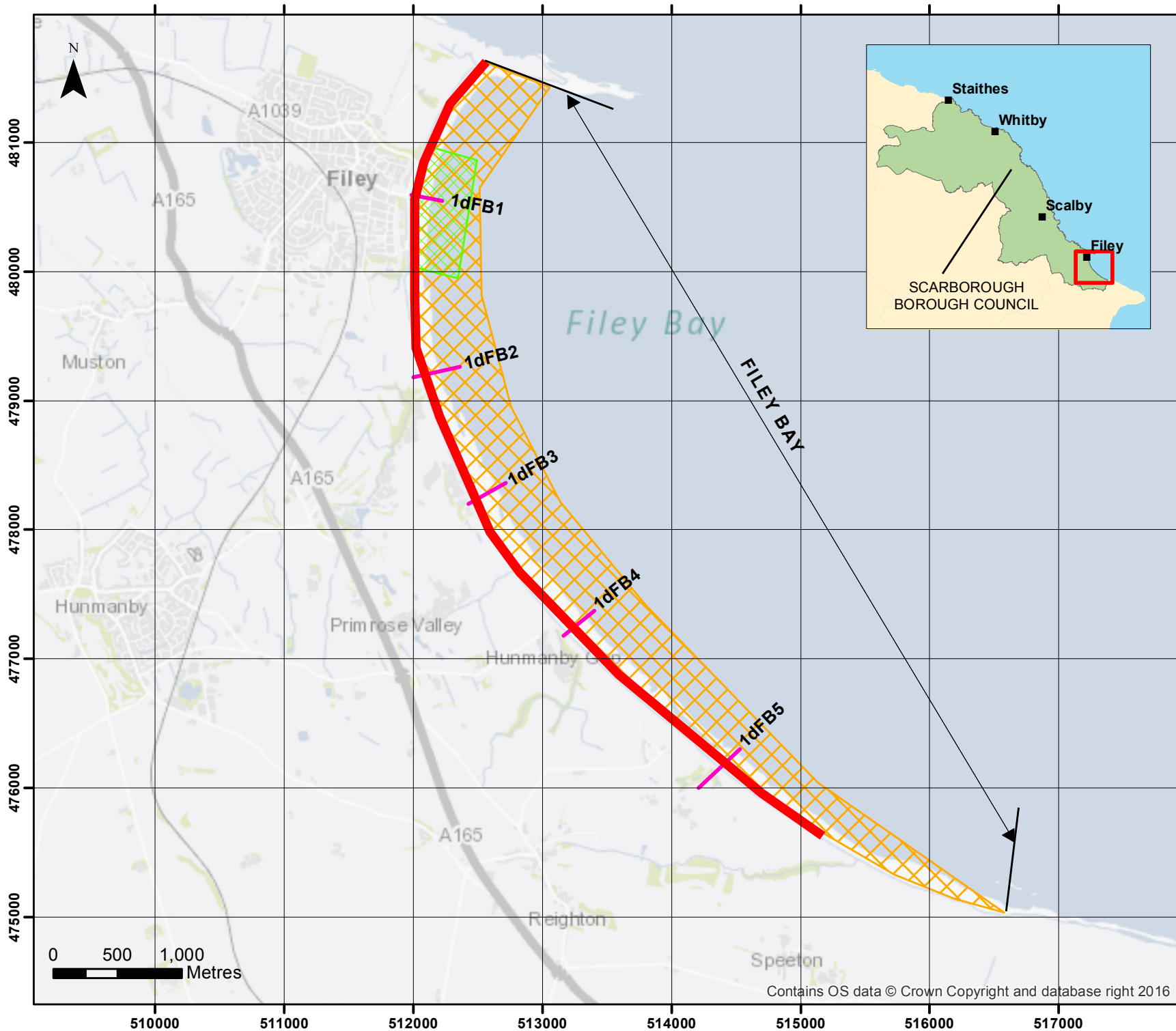
**WATER**  
 Royal HaskoningDHV  
 Marlborough House  
 Marlborough Crescent  
 Newcastle upon Tyne  
 NE1 4EE

Tel: +44 (0)191 211 1300  
 Fax: +44 (0)191 211 1313  
 www.royalhaskoningdhv.com



Contains OS data © Crown Copyright and database right 2016





Key

**SURVEY LOCATIONS**

**Topographic Profiles**

- Annual
- Bi-Annual

**Topographic Surveys**

- 6 monthly
- yearly

**Cliff Top Monitoring Pegs**

- @ 300 centres

*(Indicative Survey Extents shown)*

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

**Figure 2 - Map 7**

**Scarborough Borough Council Frontage**

Analytical Report  
Topo Surveys

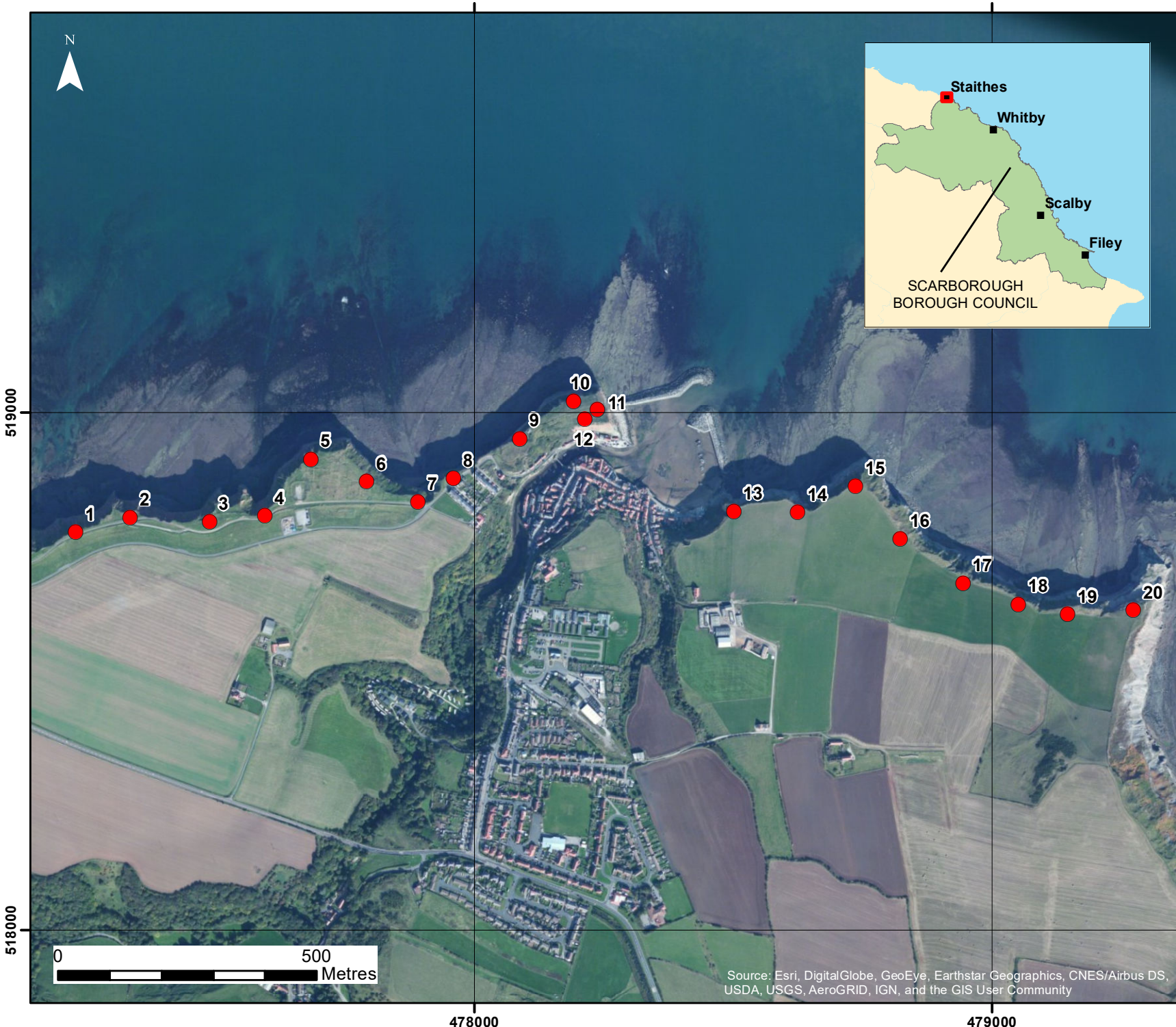
Drawing Scale at A4 1:40,000

**WATER**  
Royal HaskoningDHV  
Marlborough House  
Marlborough Crescent  
Newcastle upon Tyne  
NE1 4EE

Tel: +44 (0)191 211 1300  
Fax: +44 (0)191 211 1313  
www.royalhaskoningdhv.com



Contains OS data © Crown Copyright and database right 2016



**Key**  
 ● Cliff Top Survey Locations

Client: North East Coastal Group  
 Project: Cell 1 Regional Coastal Monitoring Programme

**Figure 3 - Map 1**

**STAITHES**  
**Scarborough Borough Council Council Frontage**

Cliff Top Survey Locations

Drawing Scale at A4 1:10,000

**WATER**  
 Royal HaskoningDHV  
 Marlborough House  
 Marlborough Crescent  
 Newcastle upon Tyne  
 NE1 4EE

Tel: +44 (0)191 211 1300  
 Fax: +44 (0)191 211 1313  
[www.royalhaskoningdhv.com](http://www.royalhaskoningdhv.com)



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



**Key**  
 ● Cliff Top Survey Locations

Client: North East Coastal Group  
 Project: Cell 1 Regional Coastal Monitoring Programme

**Figure 3 - Map 2**

**ROBIN HOOD'S BAY**

**Scarborough  
 Borough Council  
 Council Frontage**

Cliff Top Survey Locations

Drawing Scale at A4 1:10,000

**WATER**  
 Royal HaskoningDHV  
 Marlborough House  
 Marlborough Crescent  
 Newcastle upon Tyne  
 NE1 4EE

Tel: +44 (0)191 211 1300  
 Fax: +44 (0)191 211 1313  
[www.royalhaskoningdhv.com](http://www.royalhaskoningdhv.com)



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



**Key**

● Cliff Top Survey Locations

Client: North East Coastal Group  
 Project: Cell 1 Regional Coastal Monitoring Programme

**Figure 3 - Map 3**  
**SCARBOROUGH SOUTH BAY**

**Scarborough Borough Council Council Frontage**

Cliff Top Survey Locations

Drawing Scale at A4 1:15,000

**WATER**  
 Royal HaskoningDHV  
 Marlborough House  
 Marlborough Crescent  
 Newcastle upon Tyne  
 NE1 4EE

Tel: +44 (0)191 211 1300  
 Fax: +44 (0)191 211 1313  
 www.royalhaskoningdhv.com





**Key**  
 ● Cliff Top Survey Locations

Client: North East Coastal Group  
 Project: Cell 1 Regional Coastal Monitoring Programme

**Figure 3 - Map 4**

**CAYTON BAY**  
**Scarborough Borough Council Council Frontage**

Cliff Top Survey Locations

Drawing Scale at A4 1:10,000

**WATER**  
 Royal HaskoningDHV  
 Marlborough House  
 Marlborough Crescent  
 Newcastle upon Tyne  
 NE1 4EE

Tel: +44 (0)191 211 1300  
 Fax: +44 (0)191 211 1313  
 www.royalhaskoningdhv.com



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



**Key**  
 ● Cliff Top Survey Locations

Client: North East Coastal Group  
 Project: Cell 1 Regional Coastal Monitoring Programme

**Figure 3 - Map 5**

**FILEY BAY NORTH**

**Scarborough  
 Borough Council  
 Council Frontage**

Cliff Top Survey Locations

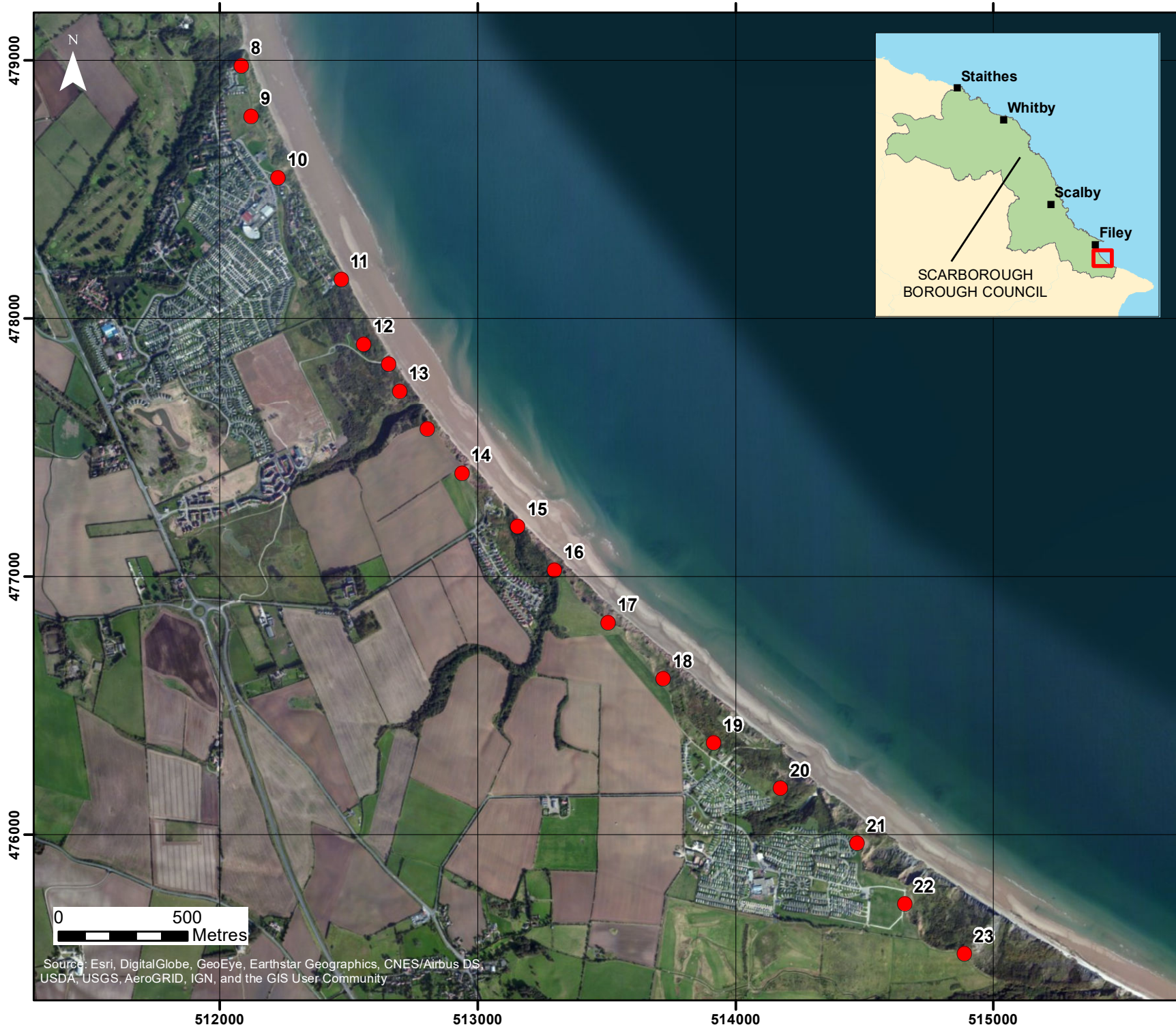
Drawing Scale at A4 1:15,000

**WATER**  
 Royal HaskoningDHV  
 Marlborough House  
 Marlborough Crescent  
 Newcastle upon Tyne  
 NE1 4EE

Tel: +44 (0)191 211 1300  
 Fax: +44 (0)191 211 1313  
[www.royalhaskoningdhv.com](http://www.royalhaskoningdhv.com)



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



**Key**  
 ● Cliff Top Survey Locations

Client: North East Coastal Group  
 Project: Cell 1 Regional Coastal Monitoring Programme

**Figure 3 - Map 6**

**FILEY BAY SOUTH**

**Scarborough Borough Council Council Frontage**

Cliff Top Survey Locations

Drawing Scale at A4 1:20,000

**WATER**  
 Royal HaskoningDHV  
 Marlborough House  
 Marlborough Crescent  
 Newcastle upon Tyne  
 NE1 4EE

Tel: +44 (0)191 211 1300  
 Fax: +44 (0)191 211 1313  
 www.royalhaskoningdhv.com



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

## 2. Analysis of Survey Data

### 2.1 Staithes

Survey Date	Description of Changes Since Last Survey	Interpretation
Nov 2020	<p><b>Cliff-top Survey:</b></p> <p>Twenty ground control points have been established at Cowbar and Staithes for biannual cliff top monitoring. Locations 12 to 20 are in the Scarborough Borough Council area (although all twenty are included in this report for completeness). The separation between any two points is around 100m. Data collection involves a distance offset measurement from the ground control point to the cliff edge along a fixed bearing.</p> <p>Between March 2020 and November 2020, nine of the twenty ground control points experienced retreat of over 0.1m. Of these, a total of five points, namely Locations 6, 9, 13, 16 and 20, experienced between 0.1m and 0.2m of erosion (0.18m, 0.13m, 0.18m, 0.16m and 0.11m respectively). One point (point 18) experienced between 0.2m and 0.3m of erosion (0.22m). Two points (point 1 and point 17) experienced between 0.3m and 0.4m of erosion (0.31m and 0.38m respectively). Only 1 point (point 10) experienced significant retreat of 1.11m.</p> <p>Points 5, 12 and 19 appeared to show advancements of 0.13m, 0.27m and 0.30m respectively. This is caused by slumping on the upper cliff face (points 5 and 19) and due to vegetation cover (point 12) inhibiting a clear measurement to the cliff edge.</p> <p>It is particularly notable that point 10 has experienced 1.11m of retreat, as this brings the present measurement at this point back to within 0.1m of the original baseline (November 2008) survey. This follows readings which indicated that the point was advancing. Points 9 to 12 were in fact not measurable between autumn 2016 and spring 2020 due to restricted access onto Cowbar Nab due to activity in the cliff units.</p> <p>Calculation of longer-term erosion rates based on the recorded change between 2008 and 2020 indicates that 17 of the 20 posts on the frontage recorded a change rate within a range of <math>\pm 0.1</math>m/year, which is considered to be within the error of the measurement.</p> <p>Points 1, 4, and 13 (near the eastern breakwater) show average erosion rate of above 0.1m/yr.;</p>	<p>Nine stations showed erosion of between 0.1 and 1.1m between the Spring and Autumn of 2020. Four stations which prior to spring 2020 had been inaccessible for several years were surveyed again.</p> <p><b>Longer term trends:</b> Table C1 shows that survey location 1 has shown the greatest total erosion with a loss of 7.11m (<math>\pm 0.3</math>m) between the November 2008 baseline and November 2020, resulting in a long-term average recession rate of 0.59m/yr.</p> <p>Location 4 has also showed progressive erosion with an average recession rate of 0.18m/year. Both of these stations are located adjacent the old Cowbar Lane which in places has now collapsed entirely.</p> <p>Location 13 has also experienced ongoing erosion with an average recession rate of 0.24m/year. This area is above the eastern breakwater and is known to have experienced rock falls previously. The coastal path is now at risk of being undermined at this point.</p>



Survey Date	Description of Changes Since Last Survey	Interpretation
	0.59m/yr., 0.18m/yr. and 0.24m/yr. respectively. Appendix C provides results from the November 2020 survey, showing the distance from the ground control point to the edge of the cliff top along the defined bearing and changes in position since the November 2008 baseline survey.	

## 2.2 Runswick Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
<p style="text-align: center;"><b>15<sup>th</sup> November 2020</b></p>	<p><b>Topographic Survey:</b></p> <p>Runswick Bay is covered by a 6-monthly topographic survey. A consistently applied GIS processing routine has been used to create a digital ground model (DGM) (Appendix B - Map 1) and to calculate the differences between the current topographic survey (Autumn 2020) and the previous survey (Spring 2020) to highlight areas and amounts of erosion and deposition. In all cases, a 5m resolution raster grid has been used to identify areas of erosion and accretion. (Appendix B – Map 8).</p> <p>Appendix B – Map 1 shows that the beach contours follow a broadly shore parallel pattern. The beach is shallower at its northern and central extents, with a steeper section fronting the Runswick Bay Sailing Club and boathouse in the south of the survey area. A shallow sand bank protrudes into the bay from the centre of the survey extent.</p> <p>Appendix B - Map 8 shows a diverse mixture of erosion and accretion. The upper beach along the full survey extent is largely dominated by lowering of up to 1.25m. This is particularly prevalent in the north of the bay near the RNLI slipway and in the centre of the bay. There are some localised patches of accretion on the upper beach, particularly south of the southernmost rock armour breakwater. The mid beach is largely dominated by accretion of up to 1.25m. On the lower beach levels remain more stable with a mixture of low levels of both accretion and erosion. The most notable area of erosion on the lower beach appears on the southern side of the sand bank the most notable area of accretion is in the centre of the bay around the shallow sand bank in the centre of the bay. The southern reaches of the survey extent continue to show a less significant degree of change, with the most significant areas of change being concentrated in the central and northern sections of the bay.</p> <p>In the previous survey report it was noted that there was continued evidence of accretion in the far north of the survey extent in front of the recently constructed rock armour revetment. The Autumn 2020 survey does not corroborate this trend.</p>	<p>Between March and November 2020. Runswick Bay experienced a varied pattern of change, with the north and centre of the bay showing erosion (lowering) on the upper and lower beach and accretion on the mid beach. The south of the bay has also experienced a similar trend of erosion on the upper and lower beach with accretion on the mid beach, however the magnitude of change here is smaller. The exceptions to this trend are: (i) a small area of accretion to the south of the southern breakwater on the upper beach; and (ii) some accretion around the sailing club. The pattern of change in the Autumn 2020 survey is indicative of drawdown of material from the upper beach. There does not appear to be significant lateral movement of beach material throughout the bay as has been experienced in some previous years.</p> <p><b>Longer term trends:</b> The changes in the bay are no more than <math>\pm 1.25\text{m}</math> in beach level. The data collected since 2008 indicate a general pattern of winter drawdown and spring recovery with no net long term change. The previously observed longer-term pattern of erosion in front of the village has paused since 2015, however erosion in this location over between Spring and Autumn 2020 may be indicative of this trend restarting. Future surveys will be able to verify if this is the case.</p>

## 2.3 Sandsend Beach, Upgang Beach and Whitby Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
20 <sup>th</sup> & 21 <sup>st</sup> October 2020	<p><b>Beach Profiles:</b></p> <p>The frontage spanning Sandsend Beach, Upgang Beach, and Whitby Sands is covered by three beach profile lines, spaced between Sandsend and Whitby West Cliff (Appendix A).</p> <p>The beach immediately in front of the recently replaced defences at Profile <b>1dWB1</b> (located around 400m south of Sandsend Village) has experienced an increase in level of up to 0.4m on the upper beach, between chainage 37m and chainage 70m. Between chainage 70m and chainage 85m there has been no change in level. Across the mid-beach from chainage 85m to chainage 132m there has been a slight increase in level by up to 0.2m. Seawards from this point, from chainage 132m to the end of the survey at chainage 195m the lower beach has decreased in level by between 0.1m and 0.2m. Overall the majority of beach profile is at a medium level when compared with the range recorded in previous surveys, with the exception of the lower beach where the current level is low. The section of the lower beach from chainage 175m to 195m is the lowest on record.</p> <p>At <b>1dWB2</b>, located in the centre of Upgang Beach, the cliff section at the top of the profile could not be measured due to dense Gorse bushes preventing access. Further down the profile, the cliff face could not be measured due to the unsafe ground conditions. The October 2020 survey indicates that beach levels on the upper beach have risen since the preceding survey. Between chainage 140m at the toe of the cliffs, to chainage 180m the levels have increased by up to 0.7m. Seawards from this point, across the mid-beach to chainage 240m the beach level has decreased by up to 0.5m. Between chainage 240m and chainage 285m levels have risen by up to 0.2m, this has resulted in a wide shallow berm forming on the lower-mid beach. Seawards from this point until the end of the survey at chainage 312m the toe of the beach profile has dropped by 0.4m. Overall the beach is at a medium level on the upper and lower beach with the mid-beach being at a low level when compared against the range of previously recorded surveys.</p> <p>At profile <b>1dWB3</b>, fronting the stabilised face of Whitby West Cliff, no change has occurred as far as 90m chainage. At the toe of the seawall at chainage 90m there has been a reduction in level of 1.4m which has resulted in the toe of the wall being re-exposed and returning to the low levels recorded in</p>	<p>The October 2020 survey indicates that generally upper and mid beach levels across the Sandsend Beach, Upgang Beach and Whitby Sands remain in the mid-range from previously recorded surveys, whilst lower beach levels are low (and in some places are at the lowest recorded values). Consequently, there appears to have been some movement of material across part of the beaches from lower to upper beach sections.</p> <p>The topographic difference plot (calculated difference over the last 12 months) show a more complex spatial pattern but do broadly reflect the trends expressed within the beach profile data. The difference plot indicates that there has been more change in the north west of the survey area towards Sandsend whereas Whitby Sands has generally remained more stable.</p> <p>The cliffs of Upgang Beach in the central part of the study area are undefended and erosion provides an important source of material to the beach. It is likely that sediment released by erosion over the winter months is subsequently redistributed across the beach as migrating sand bars.</p> <p><b>Longer term trends:</b> the beach profiles show seasonal variation but no linear trend of accretion or erosion. The annual topographic difference plots show similar patterns of accretion and erosion in the all</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>March 2017. Seawards from toe of the seawall to chainage 110m there is a reduction in level of between 0.2m and 1m. Between chainage 110m and 135m the beach level has dropped by between 0.1m and 0.2m. Seawards from this point a slight increase in level of up to 0.2m between chainage 135m and 185m has resulted in a shallower gradient across the upper and mid sections of this profile. The lower beach has experienced a reduction in level from less than 0.1m at chainage 185m increasing to 0.3m at chainage 234m at the end of the survey. Overall, the upper and mid sections of this beach profile are at a medium level whilst the lower beach is a low level when compared with the range recorded from previous surveys. Notably, the toe of the beach from chainage 197m to the end of the survey at chainage 234m is the lowest on record.</p>	<p>surveys although the magnitude of change is generally modest.</p>
	<p><b>Topographic Survey:</b></p> <p>The Sandsend to Whitby frontage is covered by an annual topographic survey, providing continuous data for Sandsend Beach, Upgang Beach, and Whitby Sands. Data have been used to create a DGM (Appendix B – Maps 2) using GIS.</p> <p>The GIS has also been used to calculate the differences between the current topographic survey DGM (Autumn 2020) and the earlier topographic survey DGM (Autumn 2019), with 5m resolution raster grids (as shown in Appendix B – Maps 9), to identify areas of erosion and accretion.</p> <p>Appendix B – Maps 9 show a varied picture of erosion and accretion. At the western end of the frontage (west of the East Row Beck at Sandsend), erosion has caused reduction in levels on the upper and lower beach. The erosion is most notable directly fronting the A174 on the north side of the Beck. Fronting the village and recent defences directly to the east of the Beck there has been a narrow band of erosion across the upper beach, whilst the mid-beach has experienced a low level of accretion. The trend is then reversed to the east of the village along the remainder of the defence line. Here, a narrow band of accretion has increased the beach levels at the foot of the defences whilst the mid and lower beach has experienced a wider band of erosion. To the east along Upgang Beach, fronting the cliffs at Whitby Golf Club, the recorded changes is more varied with erosion being the dominant process. Some localised areas of accretion do still occur. Along this stretch of the frontage the magnitude of change is greatest, with up to a change in level of -1.5m (due to erosion) and +1.25m (due to accretion). Further eastwards on Whitby Sands the magnitude of change diminishes, with changes in level due to erosion and accretion limited to <math>\pm 0.75\text{m}</math>. On Whitby Sands neither accretion or erosion is dominant, and whilst the majority of the erosion is limited to the lower beach some isolated patches appear on the upper</p>	

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>beach, most notably fronting the Beach Huts. The majority of the mid and upper beach has experienced little change or some slight accretion and at the West Pier, there has been a low level of accretion raising beach levels along its entire western face.</p>	

## 2.4 Robin Hood's Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
<p>19<sup>th</sup> November 2020</p>	<p><b>Topographic Survey:</b></p> <p>Robin Hood's Bay is covered by a six-monthly topographic survey. Data have been used to create a DGM (Appendix B - Map 3) using GIS. The GIS has also been used to calculate the differences between the current topographic survey DGM (Autumn 2020) and the earlier topographic survey DGM (Spring 2020), with 5m resolution raster grids (as shown in Appendix B – Map 10), to identify areas of erosion and accretion.</p> <p>Appendix B - Map 10 shows a very patchy distribution of areas of accretion and erosion between Spring and Autumn 2020. The majority of the bay has seen negligible change (<math>\pm 0.1\text{m}</math>) due to the presence of already exposed rocky outcrops which run perpendicular to the shore. The main areas of sand erosion are centred in the north of survey area on the upper beach, in centre of the survey area fronting the rock armour revetment, and in the south of the survey area at the main beach access point from the village. Areas of accretion are slightly more sporadic with isolated patches on the upper beach, notably fronting the cliffs north of the northernmost slipway. Changes on the upper beach, particularly in the north of the survey area, are associated with minor rockfall and slips from the cliffs fronting the northern part of the village. This process locally recharges beach levels on the upper beach before the material is redistributed by wave action across the remainder of the beach.</p> <p>The overall magnitude of change across the survey area is low and the range of change in levels is limited to <math>\pm 0.75\text{m}</math> with the vast majority of the survey area experiencing change within the range of <math>\pm 0.1\text{m}</math>.</p>	<p>The topographic change plot shows that there has been very little change across the frontage between Spring and Autumn 2020.</p> <p>Cliff top monitoring shows that four control points have experienced erosion with two of these (control points 1 and 5) having recorded changes greater than 0.8m. Elsewhere there has been little notable change and the long term recession rates remain unchanged with control point 1 experiencing average recession rate of 0.5m/yr.</p> <p><b>Longer term trends:</b> The limited change recorded in Robin Hoods Bay is due to the resistant rock platforms and thin, patchy cover of sand.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p><b>Cliff-top Survey:</b></p> <p>Thirteen ground control points have been established at Robin Hood's Bay since March 2010 to monitor cliff recession. The separation between any two points is around 200m.</p> <p>Table C2 shows that four locations experienced a reduction in the distance to the cliff edge between April and November 2020. At ground control point 1 the recorded retreat was 0.84m, and at control point 5 the recorded retreat was 0.82m over that period. Further south in the Bay, control point 10 experienced 0.19m of retreat and control point 12 experienced 0.28m of retreat. Inspection of the survey photographs indicates that at control point 1 the cliff edge does appear to have slumped. At control point 5 dense vegetation is present at the cliff edge meaning the measurement in this location may be erroneous. Control point 10 is located adjacent the Cleveland Way footpath, at the headscarp of a large rotational slide. The retreat in this area can be attributed to erosion of this headscarp. At control point 12 grass and vegetation are present on the cliff edge which could make accurate definition of the cliff top open to interpretation by the surveyor.</p> <p>Using data recorded between March 2010 and November 2020, calculated erosion rates show little change in all markers except Marker 1 which shows long term recession of 0.5m/yr. Since March 2012 control point 1 appeared to have somewhat stabilised, however the 0.84m of retreat between Spring and Autumn 2020 is indicative of renewed activity in this area.</p>	

## 2.5 Scarborough North Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
<p style="text-align: center;"><b>30<sup>th</sup> November 2020</b></p>	<p><b>Beach Profiles:</b></p> <p>Scarborough North Bay is covered by five beach profile lines, distributed between the Sealife Centre at Scalby Mills and Clarence Gardens (Appendix A).</p> <p>The November 2020 survey shows that along Profile <b>1dSBN1</b> there has been a reduction in level across the upper beach of up to 0.6m between chainage 10m (at the toe of the defence) and chainage 62m. This has been caused by flattening of an upper beach berm that was recorded in the April 2020 survey. Seawards from this point, between chainage 62m and the end of the survey at chainage 155m, there has been an increase in beach level of between 0.1 and 0.8m. This has caused the length of the surveyed profile to extend seawards at low water from chainage 76m (April 2020) to chainage 155m (November 2020); a distance of approximately 78m. The November 2020 survey indicates that the beach profile has seen a large redistribution of material from the upper beach across the lower beach. Overall, the beach remains at a medium to low level when compared with the range of previously recorded results.</p> <p>At <b>1dSBN2</b> the beach is characterised by a shifting berm in the profile, which can form on the upper or lower beach. In November 2020, the beach level from the toe of the seawall at chainage 9m to chainage 18m had decreased by up to 0.8m compared to the previous survey. The remainder of the upper beach from chainage 18m to chainage 65m has increased in level by 0.2m to 0.4m, resulting in a shallower gradient from the seawall to this point. On the mid-beach from chainage 65m to chainage 90m the profile has decreased in level by up to 0.2m with the shallow berm recorded in the previous survey being flattened entirely. From chainage 90m to chainage 118m there has been an increase in level of between 0.2m and 0.4m, due to a small degree of accretion on the landward side of the rock outcrops on the lower beach. From chainage 118m to the end of the survey at chainage 158m the rocky outcrops are exposed. Overall, the November 2020 profile is at a medium level when compared with the range recorded from previous survey. Uncharacteristically for this profile, there are no berms present, with the profile following a steady, consistent gradient landward of the rock outcrops</p> <p>The November 2020 survey shows that at profile <b>1dSBN3</b> there has been a decrease in the beach level of 0.7m at the toe of defences from chainage 14m. This reduction in level progressively reduces in</p>	<p>The beach profiles in November 2020 all show that reductions in level on the upper beach have resulted in increases in level on the lower beach. Generally, the profiles appear shallower and smoother in gradient than in the Spring 2020 survey and the prominence of berms has reduced significantly. All the profiles experience some degree of accretion and generally remain at medium levels compared to the range of previously recorded surveys.</p> <p><b>Longer term trends:</b> The observed trends in the topographic plots and beach profiles point to overall stability with seasonal fluctuations.</p>



Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>magnitude across a short section of the upper beach to chainage 24m. Between chainage 24m and chainage 35m there has been a slight increase in level of up to 0.1m to 0.2m. Seawards from this point across the mid beach up to chainage 65m levels have decreased by 0.1m. The remainder of the profile from chainage 65m until the end of the survey at chainage 175m has experienced a rise in beach levels of up to 0.3m. This has resulted in a wide shallow berm forming across the lower beach. The November 2020 profile is at a medium to high level when compared with the range recorded from previous surveys. The lower beach between chainage 152m and 175m is at the highest level on record.</p> <p>At profile <b>1dSBN4</b> the beach level has increased by approximately 0.2m at the toe of the defences from chainage 25m to chainage 33m. Between chainage 34m and 40m the rocky outcrops remain exposed. Seawards of this point there has been a slight increase in level of up to 0.5m between rock outcrops at around chainage 45m. Across the mid-beach from chainage 50m to 100m the profile remains relatively unchanged with small fluctuations in level limited to less than <math>\pm 0.1</math>m. Between chainage 100m and chainage 135m beach levels have dropped by up to 0.2m causing a lower beach berm, recorded in the previous survey, to be flattened. The toe of the beach has seen the most marked change. From chainage 135m to the end of the survey at chainage 177m there has been an increase in level of up to 0.4m. This has resulted in the length of the surveyed profile extending seawards by approximately 15m when compared with the previous survey. Overall, the November 2020 profile is generally at a medium level compared to the range recorded by previous surveys with the lower beach being notably high. The exposed rocky outcrops on the upper beach indicate consistently low beach levels in this location.</p> <p>On profile <b>1dSBN5</b> there has been a decrease in level of 0.2m from the toe of the defences at chainage 30m, across the upper beach to chainage 90m. Seawards from this point to chainage 130m there has been a reduction in level of up to 0.1m. The toe of the profile from chainage 130m to the end of the survey at chainage 161m has experienced a slight increase in level of up to 0.2m. The November 2020 survey is at a high to medium level when compared with the recorded range along most of its length.</p>	
	<p><b>Topographic Survey:</b></p> <p>Scarborough North Bay is covered by an annual topographic survey, which was carried out in November 2020. Data have been used to create a DGM (Appendix B - Map 4 and 16) with GIS for both surveys. The GIS has also been used to calculate the differences between the Full Measures</p>	

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>topographic survey DGM (Autumn 2020) and the earlier topographic survey DGM (Autumn 2019), with 5m resolution raster grids (as shown in Appendix B – Map 11 and 17), to identify areas of erosion and accretion.</p> <p>Appendix B - Map 11 (September 2019 to November 2020) shows a trend of erosion on the upper beach and accretion on the mid and lower beach in the north of the north bay. In the central section of the survey area fronting The Sands Hotel and Royal Albert Drive the beach has experienced accretion on the upper and lower beach with negligible change on the mid beach. In the southern part of the survey extent beach lowering has dominated, particularly on the upper and mid beach.</p> <p>The magnitude of changes has varied with the north of the survey area experiencing a decrease in beach level of up to 0.75m on the upper beach fronting the promenade, whilst the lower and mid beach in this area has experienced an increase in level of up to 1.5m. In the south of the survey area the range of changes decreases with the maximum decrease in beach level limited to less than 0.75m and the maximum increase in level limited to 0.5m. de</p>	

## 2.6 Scarborough South Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
1 <sup>st</sup> December 2020	<p><b>Beach Profiles:</b></p> <p>Scarborough South Bay is monitored by four beach profiles, between the harbour in the north and the Spa Complex in the south (Appendix A). The comparisons of short-term change are between April and December 2020.</p> <p>At profile <b>1dSBS1</b> the beach level has decreased by 0.8m at chainage 14m at the toe of the seawall. Across the upper beach between chainage 14m and chainage 33m the change in level progressively decreases to zero. From chainage 33m to chainage 85m the upper-mid beach has experienced an increase in level of 0.4m, with a wide shallow berm forming from accreted material. The trend is reversed again between chainage 85m and chainage 135m, however the magnitude of change here is limited to a reduction in level of less than 0.1m. Between 135m and 170m levels have again decreased by up to 0.2m with a steepening of the lower beach evident. The most seaward toe of the profile between chainage 170m and the end of the survey at chainage 210m has been characterised by an increase in level of up to 0.2m. The December 2020 profile is at a medium to high level compared with the range recorded by previous surveys. Between chainage 50m and 85m, the profile is at its highest recorded level.</p> <p>The beach at profile <b>1dSBS2</b> has demonstrated a far less variable trend than 1dSBS2. On the upper beach, between chainage 5m and chainage 70m the beach level has increased by 0.2m. The remainder of the profile (between chainage 70m and chainage 190m) has experienced increases in level by up to 0.1m. The December 2020 profile is at a; medium level on the upper beach, a high level on the mid beach and a low level on the lower beach when compared to the range from previously recorded surveys.</p> <p>At profile <b>1dSBS3</b> the beach level has risen 1.2m at the toe of sea defences at chainage 7m. Moving across the upper beach from this point to chainage 60m the level of change diminishes to +0.1m. The mid-beach from chainage 60m to chainage 160m has been characterised by a small increases in level of up to 0.2m Seawards from chainage 160m to the end of the survey at chainage 185m there has been a very small decrease in beach level of less than 0.1m. . Overall, the December 2020 profile is generally at a medium level compared with the range recorded by previous surveys with the exception of the</p>	<p>The level of the beach in the profiles is generally in the mid-range recorded in previous years. All the profiles show that accretion is the more dominant process, however areas of erosion exist, primarily across the mid beach and in places the lower beach.</p> <p>The short-term change plot also shows variable erosion and accretion, matching the profiles. The accumulations in the mid-beach at the northern end is likely to be due to the action of constructive waves through the summer.</p> <p>Four of the cliff top monitoring control points have experienced change greater than 0.1m since the previous survey, with negligible change at eight of the remaining control points. One control point has experienced an apparent advancement however this may be due to some localised damage to the hand railing and concrete kerb stone.</p> <p><b>Longer term trends:</b> The beach is regularly re-profiled with sediment moved from near the harbour to the frontage of The Spa, but sediment naturally moves northwards towards the harbour.</p> <p>Table C3 shows that since March 2010 most of the cliff erosion profiles have shown negligible recession. Profiles 11 and 12 show erosion of 0.4 m/year and 0.3m/year respectively. These points are at the rear of a mudslide system which experiences periodic reactivation or head scarp collapse, however, there</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>upper beach at the toe of the defences where the beach level is high.</p> <p>Profile <b>1dSBS4</b> shows an increase in level of 0.7m at the toe of the seawall at chainage 7m. Between the toe of the seawall and chainage 25m a narrow depression recorded in the previous (April 2020) survey has been infilled. From chainage 25m to chainage 60m there has been a small decrease in level of 0.1m. Between chainage 60m and chainage 90m there has been a slight increase in level of up to 0.1m. Seawards from this point until the end of the survey at chainage 142m there has been a decrease in level of up to 0.2m. Overall, the December 2020 profile is generally at a medium level when compared with the range recorded by previous surveys with the upper beach at the base of the defences being at a higher level.</p> <p><b>Topographic Survey:</b></p> <p>Scarborough South Bay is covered by an annual topographic survey. Data have been used to create a DGM (Appendix B - Map 5) using GIS. The GIS has also been used to calculate the differences between the current topographic survey DGM (Autumn 2020) and the earlier topographic survey DGM (Autumn 2019), with 5m resolution raster grids (as shown in Appendix B – Map 12), to identify areas of erosion and accretion.</p> <p>Appendix B - Map 12 shows that in the north of the bay beach levels have increased on the upper beach fronting Foreshore Road with the exception of the area around the beach access ramp adjacent the lifeboat station where they have decreased. Across the mid beach in the northern part of the bay there has been negligible change whilst the lower beach has largely experienced erosion. In the south of the bay the pattern of change is more sporadic with the upper beach tending to have increased in level or remained stable and the lower beach tending to have experienced a reduction in level. The overall magnitude of the changes recorded when comparing the Autumn 2020 and Autumn 2019 surveys is relatively low with the maximum decrease in level being limited to -0.5m and the maximum increase in level being +1.25m, albeit in a highly localised area directly to the north of the Scarborough Spa</p>	<p>has been little movement in the last two years.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p><b>Cliff-top Survey:</b></p> <p>Thirteen ground control points have been established at Scarborough South Bay, extending from South Bay to Cayton Bay for the purposes of cliff top monitoring. The separation between any two points is around 300 m. The cliff top surveys at Scarborough South Bay are undertaken bi-annually. Data collection involves a distance offset measurement from the ground control point to the cliff edge along a fixed bearing.</p> <p>Between April and November 2020 four of the thirteen control points experienced recession greater than or equal to 0.1m. At control point 2, some 0.26m of retreat was recorded in November 2020. Further south at control points 6, 7 and 8, some 0.25m, 0.16m and 0.17m of retreat was recorded respectively.</p> <p>Notably, at point 3 there was an advancement of 0.36m recorded. This control point is located on the Esplanade above the Scarborough Spa and the recently completed slope stabilisation scheme. The survey photographs appear to indicate movement in the wrought iron fence and the concrete kerb edge that is located beneath the fence appears to have been displaced. Similarly, control point 2 located along the Esplanade has experienced recession of 0.26m. There is no obvious movement evidenced in the survey photographs. The recession rates calculated for the period from March 2010 to December 2020 indicated that only two of the thirteen markers have experienced an average recession rate of greater than or equal to 0.1m/yr. At control point 11 the average rate of recession is 0.4m/yr. whilst at point 12 the rate is 0.2m/yr. Appendix C provides results from the December 2020 survey, showing the distance from the ground control point to the edge of the cliff top along the defined bearing and changes in position since the March 2010 baseline survey. Short-term and long-term average recession rates are also provided.</p>	

## 2.7 Cayton Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
<p style="text-align: center;">2<sup>nd</sup> December 2020</p>	<p><b>Beach Profiles:</b></p> <p>Cayton Bay is covered by four beach profile lines, distributed between Tenants' Cliff and the south of Cayton Sands (Appendix A). The survey report states that <i>'the cliff face could not be measure on Sections 1, 2 and 3 due to unsafe ground conditions'</i>.</p> <p>Profile <b>1dCY1A</b>, (Clayton Cliff) has been surveyed since November 2015. The latest survey (December 2020) reports that there has been a decreased in levels of 0.4m between chainage 0m and chainage 4m. This trend is reversed between chainage 4m and chainage 8m where there has been an increase of 0.4m. Between chainage 8m and 18m there has been a low degree of change limited to <math>\pm 0.05</math>m. Between chainage 18m and 24m a shallow berm has formed due to an increase in level of up to 0.2m. From chainage 24m to chainage 75m recorded changes are limited to <math>\pm 0.1</math>m and are associated with movement of boulders and rocks across the mid beach. Between chainage 70m and 105m levels have increased by 0.2m forming a small berm. Seawards from this point until the end of the survey at chainage 165m beach levels have decreased by 0.2m. The profile is generally at a medium level compared with the range of previously recorded results, with the exception of the lower beach from 117m to 160m being the lowest on record.</p> <p>The cliff face at profile <b>1dCY1</b> (Tenant's Cliff) is heavily vegetated and the survey report states that <i>'the top of section 1 cannot be measured due to dense vegetation'</i>. There have been some changes in level of up to <math>\pm 0.2</math>m from the toe of the cliff until chainage 220m. These changes appear to be due to the redistribution of boulders and material released onto the upper beach from the cliff face itself. From this point to chainage 55m levels have dropped by 0.2m. Between chainage 55m and chainage 80m levels have increased by the same amount. The lower beach from chainage 80m to chainage 105m has experienced a decrease in level of up to 0.5m. At the seaward toe of the profile, between chainage 105m to the end of the survey at chainage 132m, the rocky outcrops remain exposed. Overall, the December 2020 profile is at a medium to low level compared to the range recorded in previous surveys.</p> <p>At profile <b>1dCY2</b> (close to the former pumping station) the surveyors were unable to measure the cliff face due to unsafe ground conditions. Furthermore, the survey report states that <i>'the vegetated area at the bottom of the cliff face on Section 2 could not be measured due to soft mudslides preventing</i></p>	<p>The beach profiles have been stable overall with accretion being the more dominant process with all the profiles experiencing modest increases in level with some localised areas where levels have decreased.</p> <p>The plot of difference between Autumn 2019 to Autumn 2020 surveys shows variability in the erosion and accretion in the bay with little consistent pattern, although the changes are typically more extreme in the northern half of the bay.</p> <p>The cliff top survey data shows that two control points (namely 1 and 8) showed recession of greater than or equal to 0.1m. No other significant recession has occurred at any of the marker points during the summer of 2020.</p> <p><b>Longer term trends:</b> The pattern of migrating sand bars has remained consistent since 2010 indicating seasonal variation in beach level with no net change.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>access'. At the toe of the cliffs from chainage 117m to chainage 140m beach levels have decreased by up to 0.5m. Between chainage 140m and chainage 205m there has been a decrease in levels of less than 0.1m. This trend is reversed from chainage 205m to chainage 265m where there has been an increase in level of up to 0.1m. Across the lower beach from chainage 265m to the end of the survey at chainage 315m there has been a decrease in level of up to 0.5m. The December 2020 profile is at a medium to high level when compared with the range recorded in previous surveys.</p> <p>At profile <b>1dCY3</b> (600m southeast of the pumping station) the surveyors were unable to measure the cliff face due to unsafe ground conditions. At the toe of the cliffs there has been no change from chainage 123m to 130m. The remainder of the profile has experienced an increase in beach levels which has covered two previously recorded beach berms and smoothed the profile. From chainage 130m to 170m the increase is limited to 0.1m. Between chainage 170m and 230m there has been increases of 0.1m to 0.2m. Between chainage 230m and 250m, in the location of the crest of the previously recorded lower beach berm, there has been no change. The seaward toe of the profile has experienced an increase in level of up to 0.5m between chainage 150m and the end of the survey at chainage 300m. Overall the December 2020 profile is at a medium level compared to the range recorded from previous surveys.</p>	
	<p><b>Topographic Survey:</b></p> <p>Cayton Bay is covered by an annual topographic survey. Data have been used to create a DGM (Appendix B - Map 6) using GIS. The GIS has also been used to calculate the differences between the current topographic survey DGM (Autumn 2020) and the earlier topographic survey DGM (Autumn 2019), with 5m raster grids (as shown in Appendix B – Map 13), to identify areas of erosion and accretion.</p> <p>Appendix B - Map 13 shows a patchy mixture of changes throughout the entire survey area. In the north of the survey area levels on the upper beach have increased, the mid-beach has remained stable with negligible change and the lower beach has experienced some decreases in level. This trend is somewhat reversed on the upper beach at the toe of Tenants' Cliff in the centre of the bay where erosion has been the dominant process and caused a decrease in beach levels across the upper and mid-beach. There has been some isolated patches of accretion between the rocky outcrops in the centre of the bay. Moving southwards to the area fronting the old pumping station and main beach access point, the upper beach has experienced an increase in levels associated with accretion and the</p>	

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>mid and lower beach tending to have experienced a decrease in level associated with erosion. At the southernmost end of the survey area erosion has been the dominant process and beach levels have dropped across the upper, mid and lower beach. The magnitude of changes is moderate with changes in level limited to <math>\pm 1.0\text{m}</math> with parts of the mid beach experiencing negligible change.</p> <p><b>Cliff-top Survey:</b></p> <p>Eight ground control points have been established within Cayton Bay for the purposes of cliff top monitoring. The separation between any two points is typically around 200 m. The cliff top surveys at Cayton Bay are undertaken bi-annually. Data collection involves a distance offset measurement from the ground control point to the cliff edge along a fixed bearing.</p> <p>The results of the cliff top survey are shown in Table C4. Between April and December 2020 two of the eight monitoring points (points 1 and 8) showed erosion of greater than 0.1m. Control point 1 in the north of the Bay experienced a retreat of 0.2m whilst control point 8 in the south of the Bay experienced 0.44m of retreat. The survey report notes that there was no access to point 2 due to dense vegetation.</p> <p>Long-term erosion rates calculated using data collected since November 2008 show change either within the margin of error. Markers 4 and 6 show erosion rates of 0.3m/yr. and 0.1m/yr. respectively.</p> <p>Appendix C provides results from the December 2020 survey showing the distance from the ground control point to the edge of the cliff top along the defined bearing and changes in position since the November 2008 baseline survey.</p>	



## 2.8 Filey Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
18 <sup>th</sup> November 2020	<p><b>Beach Profiles:</b></p> <p>Filey Bay is covered by five beach profiles between Filey Sands and Speeton Sands (Appendix A).</p> <p>At profile <b>1dFB1</b> fronting Filey seawall, there has been a decrease in level of 0.7m. From chainage 30m to chainage 85m there has been an increase in levels of between 0.1m and 0.2m. Across the mid beach from chainage 85m to chainage 130m there has been a small decrease in level of up to 0.1m. The lower beach seawards from chainage 130m to the end of the survey at chainage 220m has experienced negligible change. The November 2020 profile is at a medium to high level compared to the range recorded from previous surveys, with chainage 67m to 85m being the highest recorded result in this location.</p> <p>At profile <b>1dFB2</b> (located to the north of Primrose Valley Holiday Village) there has been a loss of up to 0.3m at the toe of the cliff. The survey report notes that <i>'an area of section 2 from approx. chainage 11m to 23m is unable to be measured, due to undergrowth and bushes'</i>. From chainage 80m to the end of the survey at chainage 340m there has been an increase in levels of between 0.2m and 0.5m the profile is a medium to high level compared to the range recorded from previous surveys. The lower beach between chainage 272m and chainage 340m is at its highest recorded level when compared with the range recorded from previous surveys.</p> <p>At profile <b>1dFB3</b>, near Flat Cliffs, there has been a small decrease in level at the base of the cliff between chainage 34m and chainage 45m. From chainage 45m to chainage 160m beach levels have increased by 0.2m. On the mid-beach between chainage 160m and chainage 200m beach levels have decreased by 0.1m. Changes on the lower beach are characterised by the formation of two berms. Between chainage 200m and 280m levels have increased by up to 1m at the crest of the berm. Between chainage 280m and the end of the survey at chainage 359m a second, shallower, berm has formed with an increase in level of up to 0.3m. Notably the November 2020 survey extends an additional 60m seawards from the March 2020 survey. The November 2020 profile is at a medium-high level compared to the range recorded from previous surveys., On the upper-mid beach between chainage 123m and chainage 160m and on the lower beach between chainage 305m and 359m the</p>	<p>The beach profiles are dominated by shifting bands of accretion and erosion, which form shore-parallel berms. Each profile has experienced some erosion and some accretion, however the magnitude of change increases in the southern profiles. The beach levels are generally high-medium compared with the range recorded from the previous surveys with some localised notably low and high spots.</p> <p>The topographic change map shows Filey Bay, particularly the south of the bay, has shore parallel bands of accretion and erosion in the associated with migrating berms with little change in the north.</p> <p>The cliff top survey data provided in Table C5 shows erosion at four of the twenty-eight control points. The largest change was at marker 9 where 0.64m of erosion was recorded. At control points 8, 14 and 27 retreat of between 0.1m and 0.2m was recorded. The Flat Cliffs (temporary) slope stabilisation scheme was undertaken in Summer 2018 with the aim to slow down recession in the location of monitoring point 10. The long term average rate of erosion is <b>0.14m/yr</b>.</p> <p><b>Longer term trends:</b> Past trends dominated by migrating sand bars continue to the present day.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>beach is at its highest recorded level.</p> <p>Profile <b>1dFB4</b> at Hunmanby Gap has experienced similar changes to those recorded at 1dFB3. On the upper beach from chainage 30m to chainage 105m a sand veneer has increased beach levels by between 0.1m and 0.4m. On the mid-beach from chainage 105m to 155m a shallow berm has formed with a small increase in level of up to 0.2m. Between chainage 155m and 210m there has been a decrease in levels of up to 0.7m. The lower beach is dominated by formation of a wide berm from chainage 210m to the end of the survey at chainage 310m. Levels here have increased by up to 0.8m. The November 2020 profile is at a medium-high level compared to the range recorded from previous surveys. The crest of the lower beach berm, between the chainages of 215m and 305m, is the highest recorded level in this location.</p> <p>At profile <b>1dFB5</b> (located close to Reighton Gap) there has been a varied pattern of accretion and erosion across the profile. The survey report notes that the <i>'middle of section 5 is unable to be measured from chainage 65m to approx. 204m, due to undergrowth and bushes'</i>. At the toe of cliff from 220m to 235m there has been an increase in level of 0.2m. Between chainage 235m and 252m there has been a decrease in level by the same amount. From this point across the mid-beach to chainage 352m a berm has formed, and levels have increased by between 0.1m and 0.4m. Seaward of this point from chainage 352m to chainage 420m there has been a decrease in level of 0.8m. The toe of the profile, from chainage 420m until the end of the survey at chainage 445m, has experienced an increase in level of 0.1m. Overall, the November 2020 profile is at a medium level compared to the range recorded from previous surveys, with the exception of chainage 390m to chainage 404m where the profile is at its lowest recorded level in this location.</p>	
	<p><b>Topographic Survey (Filey Bay):</b></p> <p>Filey Bay is covered by an annual topographic survey. In addition to the annual survey of Filey Bay, a smaller area fronting Filey Town is re-surveyed every six months to document seasonal patterns.</p> <p>Data have been used to create a DGM (Appendix B – Map 7) using GIS. The GIS has also been used to calculate the differences between the current topographic survey DGM (Autumn 2020) and the earlier topographic survey DGM (Autumn 2020), with 5m resolution raster grids (as shown in Appendix B – Map 15) to identify areas of erosion and accretion.</p> <p>Appendix B - Map 15 shows that in the north of the bay, accretion is the dominant process with beach</p>	

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>levels typically having increased particularly on the upper and mid beach from Filey Brigg in the north to the southern end of the defences in Filey itself. There is one area of erosion on the lower beach in the north of the bay approximately fronting the sailing club. Moving southwards, from the southern end of the defences at Filey across Muston Sands, accretion remains the dominant process on the upper, mid and lower beach with the exception of two isolated areas of erosion on the upper beach. Moving southwards still, across Hunmanby Sands, the pattern of change becomes more fragmented with the upper beach remaining stable, the mid beach generally having experienced some increases in level whilst the lower beach has experienced decreases in level. The changes across Hunmanby Sands are broadly shore-parallel and this is a trend which continues onto Reighton Sands with broken strips of erosion and accretion across the full beach. The southern end of the survey extent at Speeton Sands has experienced a more regular pattern of change with increases in level on the upper beach and decreases in level on the mid and lower beach.</p> <p>The magnitude of change is lowest in the north of the survey extent where change is limited to <math>\pm 0.75\text{m}</math>. In the central and southern reaches of the survey area the magnitude of the changes in level increases to <math>\pm 1.25\text{m}</math>. Notably at Flat Cliffs, an area of long-standing concern there has been limited change and even a small increase in level on the upper beach, slightly off the toe of the cliffs. The difference plot calculated between March 2020 and November 2020 shows negligible change. On the upper beach there has been a very narrow band of erosion at the toe of the seawall. This is most prevalent in the section of beach fronting The Beach Promenade and Paddling Pool. Elsewhere the beach has experienced negligible change and two largely shore parallel bands of accretion of up to <math>0.25\text{m}</math>. In the north of the survey area there are two isolated patches where levels have dropped slightly due to erosion. Recorded increases in beach level are limited to <math>+0.25\text{m}</math> whereas decreases in level due to erosion have been experienced up to <math>1.25\text{m}</math>.</p> <p>Overall, the difference plot calculate between October 2019 and November 2020 shows accretion to be the dominant process across most of the bay with beach levels generally remaining stable or increasing slightly over the majority of the survey area. Decreases in beach level due to erosion are more sporadic but typically located on the lower beach and particularly in the south of the survey area where erosion appears to play a more significant role. The area of greatest change continues to be between Hunmanby Gap and Reighton Gap. The short term difference plot calculated over the summer of 2020 shows that the magnitude of change on the beach fronting the Filey Town seawall is more marginal than when considering the long term (12 month) difference plot.</p>	

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p><b>Cliff-top Survey:</b></p> <p>Twenty-eight ground control points have been established within Filey Bay for the purposes of cliff top monitoring. This includes the installation of three additional locations in September 2010: points 12A (as a replacement for point 13 which can no longer be accessed due to vegetation growth), 24 &amp; 25 (to the north of Filey Bay at Filey Brigg). A further replacement for monitoring point 13, 13A, has been added in 2014.</p> <p>The maximum separation between any two points is nominally 300 m. The cliff top surveys at Filey Bay are undertaken every six months. Data collection involves a distance offset measurement from the ground control point to the cliff edge along a fixed bearing.</p> <p>Between March and November 2020 four of the twenty-eight ground control points showed erosion of greater than or equal to 0.1m. Control point 8 and 9 experienced 0.1m and 0.64m of retreat respectively. Further south at control point 14, some 0.18m of retreat was recorded. The southernmost control point (point 27) experienced 0.1m of retreat. Three of the control points (point 5, 12 and 13) were not surveyed due to access constraints. When compared with previous surveys the magnitude and frequency of change throughout the bay is low, indicating a period of relative stability.</p> <p>Long term rates of change calculated between November 2008 and November 2020 show that only six markers have erosion with rates greater or equal to 0.1m/yr. Control points 10, 14, 16 and 23 have all experienced average recession rates of 0.1m/yr. Control point 13A has recorded an average recession rate of 0.3m/yr. whilst at control point 8 an average rate of 0.4m/yr. has been recorded. Appendix C provides results from the November 2020 survey showing the distance from the ground control point to the edge of the cliff top along the defined bearing and changes in position since the baseline survey.</p>	

### **3. Problems Encountered and Uncertainty in Analysis**

#### **Survey accuracy of beach/ cliff profiles**

The aim of cliff monitoring data is to gain a reliable record of the frequency and magnitude of cliff top failures. Data are collected every six months, but previous surveys have had a low accuracy, meaning that survey error is typically greater than any measured short-term change. It is possible that a more reliable pattern of change will be determined over the longer term. However, in the short term, more reliable assessments of cliff recession can be derived from analysis of time-series remote sensing data. Under this programme a high-quality baseline survey, comprising LiDAR and aerial photography, was collected in 2010, with repeat surveys completed in 2012/13, 2015, 2017 and 2019/20. These data can be analysed to give more accurate information on the behaviour of the cliffs. More accurate estimates of long-term cliff top change would be possible by comparing results from the current programme to historical aerial photography over the last 50 years.

At Staithes cliff top monitoring points 9 to 12, which were inaccessible for several years due to a landslip at Cowbar Nab, were surveyed. They had been surveyed in the previous Partial Measures survey following the reopening of the footpath by the National Trust in Spring 2020.

At Robin Hood's Bay the surveyors noted there was continuous rock and gravel falls along the cliffs, and that cliff top monitoring point 5 was located on a pile of deposited garden waste.

At Whitby the cliff top at point 2 could not be measured due to dense gorse bushes preventing access. Also, the cliff face of Section 2 could not be measured due to unsafe ground conditions.

At Scalby in Scarborough North Bay the cliff edge was very overgrown resulting in areas that were unable to be surveyed.

At Scarborough South Bay, cliff top monitoring point 1 was measured after having been inaccessible due to the Scarborough Spa Slope Stabilisation Scheme.

At Cayton Bay the surveyors could not measure the top of profile 1dCY1 due to dense vegetation. Furthermore, cliff face of profiles 1dCY1, 1dCY2 and 1dCY3 could not be measured due unsafe ground conditions and the vegetated area at the bottom of the cliff face on profile 1dCY2 could not be measured due to soft mudslides restricting access. There was no access to measure the cliff top monitoring point 2 due to dense vegetation.

At Filey an area of profile 1dFB2 from approximate chainage 11m to 23m was unable to be measured due to the undergrowth and dense vegetation. Additionally, the mid-section of 1dFB5 between chainage 65m and 204m was not surveyed due to the presence of undergrowth and bushes. Cliff top monitoring point 5 was inaccessible due to heavy vegetation and an unstable cliff edge. Cliff top monitoring points 12 and 13 were inaccessible due to heavy vegetation. There was noticeable erosion at cliff top monitoring point 13A.

#### **Cliff top erosion errors & data capture techniques**

The cliff top surveys are in general assumed to have a limit of accuracy of  $\pm 0.1\text{m}$  due to the techniques used and problems have been experienced in precisely locating the cliff edge, due to vegetation growth and the convex profile. Most profiles have now been monitored for six years, and a more reliable picture of change is now emerging that indicates very low rates of erosion, with only occasional and localised examples of erosion exceeding  $0.5\text{m/yr}$ .

### **4. Recommendations for 'Fine-tuning' the Monitoring Programme**

No changes are recommended at the present time.

## 5. Conclusions and Areas of Concern

The following points have been observed:

- The measurements of the Cowbar and Staithes cliff top show erosion of between 0.1 and 1.1m over the summer of 2020 at nine stations. The largest amount of erosion occurred at cliff top monitoring point 10 (1.1m) as a result of ongoing cliff failure. Points 6, 9, 13, 16 and 20 all experienced erosion of between 0.1m and 0.2m, whilst Points 1, 17 and 18 experienced erosion of between 0.2m and 0.4m. Point 1 is an area of longstanding concern, and the erosion recorded in 2020 is in keeping with the general trend of retreat. Points 9 to 12 were surveyed in Spring and Autumn 2020, having not been surveyed since Autumn 2016. The high level of retreat recorded at Station 10 in Autumn 2020 is likely to be attributed to an anomalous reading in the spring when the cliff top at this point was reported to have advanced. However, given the previous activity along Cowbar Nab this area should be monitored for further cliff failures and addressed in the next Partial Measures Survey Report. The long term trends indicate that it is only Points 1, 4 and 13 which are experiencing a sustained average recession rate of over 0.1m/yr. This frontage is the subject of the ongoing Staithes Coastal Strategy which seeks to address issues relating to coastal erosion.
- Runswick Bay experienced a varied pattern of change, with the north and south centre of the bay showing erosion on the upper and lower beach and accretion on the mid beach. The south of the bay has also experienced a similar trend of erosion on the upper and lower beach with accretion on the mid beach, however the magnitude of change here is smaller. There are some exceptions, most notably accretion on the upper beach to the south of the southern breakwater and on the upper beach fronting the sailing club.
- At Sandsend Beach, Upgang Beach and Whitby Sands the changes have been characteristic of material being moved across the beach. Neither erosion or accretion has dominated, and the recorded changes are generally within the range recorded from previous surveys. As recorded in previous surveys, the magnitude of change is greater in the north west at Sandsend and decreases along the frontage with a less variable pattern of change at Whitby.
- At Robin Hoods Bay the beach has remained stable with little change over the summer of 2020. The cliff top monitoring points have recorded more change with four of the thirteen control points experiencing retreat greater than 0.1m. Notably two of these (VMP 1 and 5) have recorded a retreat greater than 0.8m. Despite this, long term recession rates remain unchanged with only control point 1 experiencing a consistent significant retreat.
- For Scarborough North Bay the November 2020 survey shows the beach profiles are generally at medium levels compared to the range of previously recorded surveys. All profiles experienced some degree of erosion particularly in their upper reaches, this appears to have been compensated with increases in level on the mid-beach.
- At Scarborough South Bay all the beach profiles have experienced some degree of accretion over the summer of 2020 and remain at medium level when compared with the range recorded from previous surveys. There are isolated areas of erosion restricted to the mid-beach and in some places on the lower beach.
- The Cayton Bay beach profiles show stability overall with evidence of the formation of beach berms. The pattern of migrating sand bars has remained consistent since 2010 indicating seasonal variation in beach level with no net change. The cliff monitoring showed recession at two of the control points.
- The profiles at Filey Bay show accretion to be the predominant coastal process. The profiles have all seen accretion, with some erosion at the toe of the beach, and in places in the mid beach. The profiles remain high to medium when compared with the range of previously recorded results. The topographic difference plot shows little change in the north but evidence of migrating berms in the south and central Bay. There has been significant recession recorded at four control points. Most notably at control point 7 which has experienced 0.64m of retreat since the previous survey.



## **Appendices**



**Appendix A**  
**Beach Profiles**

The following sediment feature codes are used on some profile plots:

<b>Code</b>	<b>Description</b>
S	Sand
M	Mud
G	Gravel
GS	Gravel & Sand
MS	Mud & Sand
B	Boulders
R	Rock
SD	Sea Defence
SM	Saltmarsh
W	Water Body
GM	Gravel & Mud
GR	Grass
D	Dune (non-vegetated)
DV	Dune (vegetated)
F	Forested
X	Mixture
FB	Obstruction
CT	Cliff Top
CE	Cliff Edge
CF	Cliff Face
SH	Shell
ZZ	Unknown

# Beach Profile

Location: 1dWB1

Date: 21/10/2020

Inspector: AG

Low Tide:

Low Tide Time:

Wind

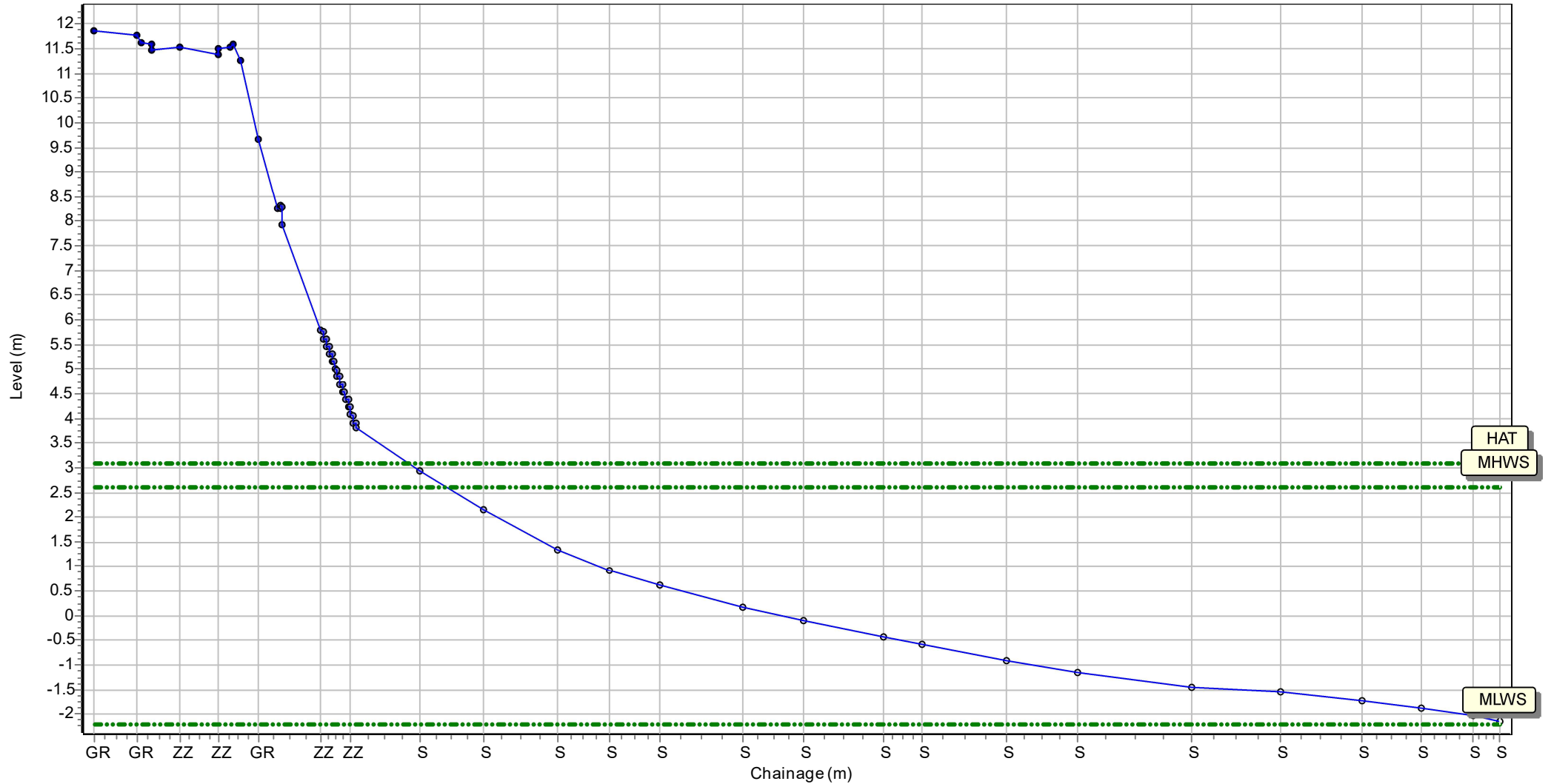
Sea State:

Visibility:

Rain:

Summary: 2020 Full Measures Topo Survey

Easting: 486535.075 Northing: 512437.797 Profile Bearing: 32 ° from North



# Beach Profile

Location: 1dWB2

Date: 21/10/2020

Inspector: AG

Low Tide:

Low Tide Time:

Wind

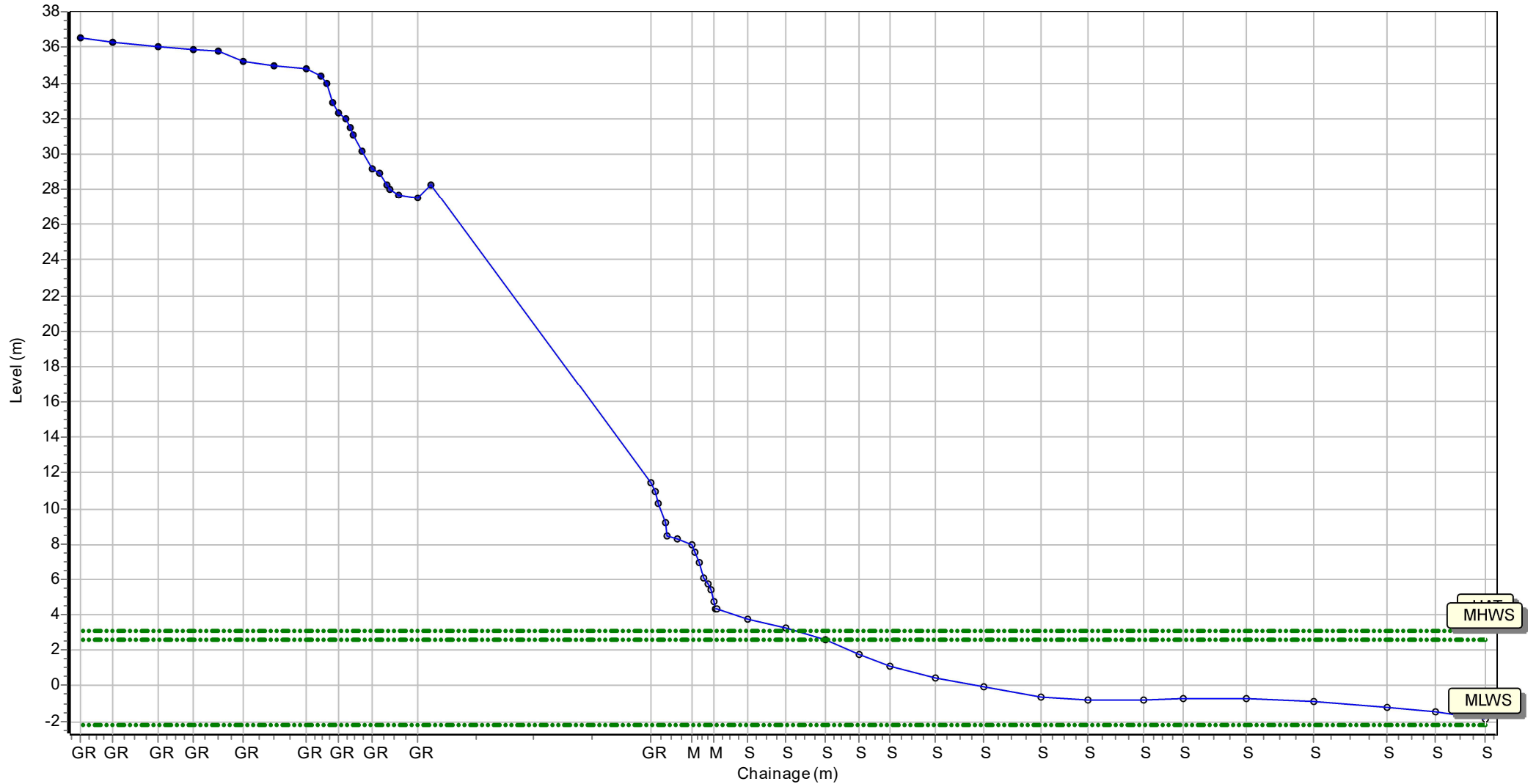
Sea State:

Visibility:

Rain:

Summary: 2020 Full Measures Topo Survey

Easting: 487550.221 Northing: 511927.902 Profile Bearing: 16 ° from North



# Beach Profile

Location: 1dWB3

Date: 21/10/2020

Inspector: AG

Low Tide:

Low Tide Time:

Wind

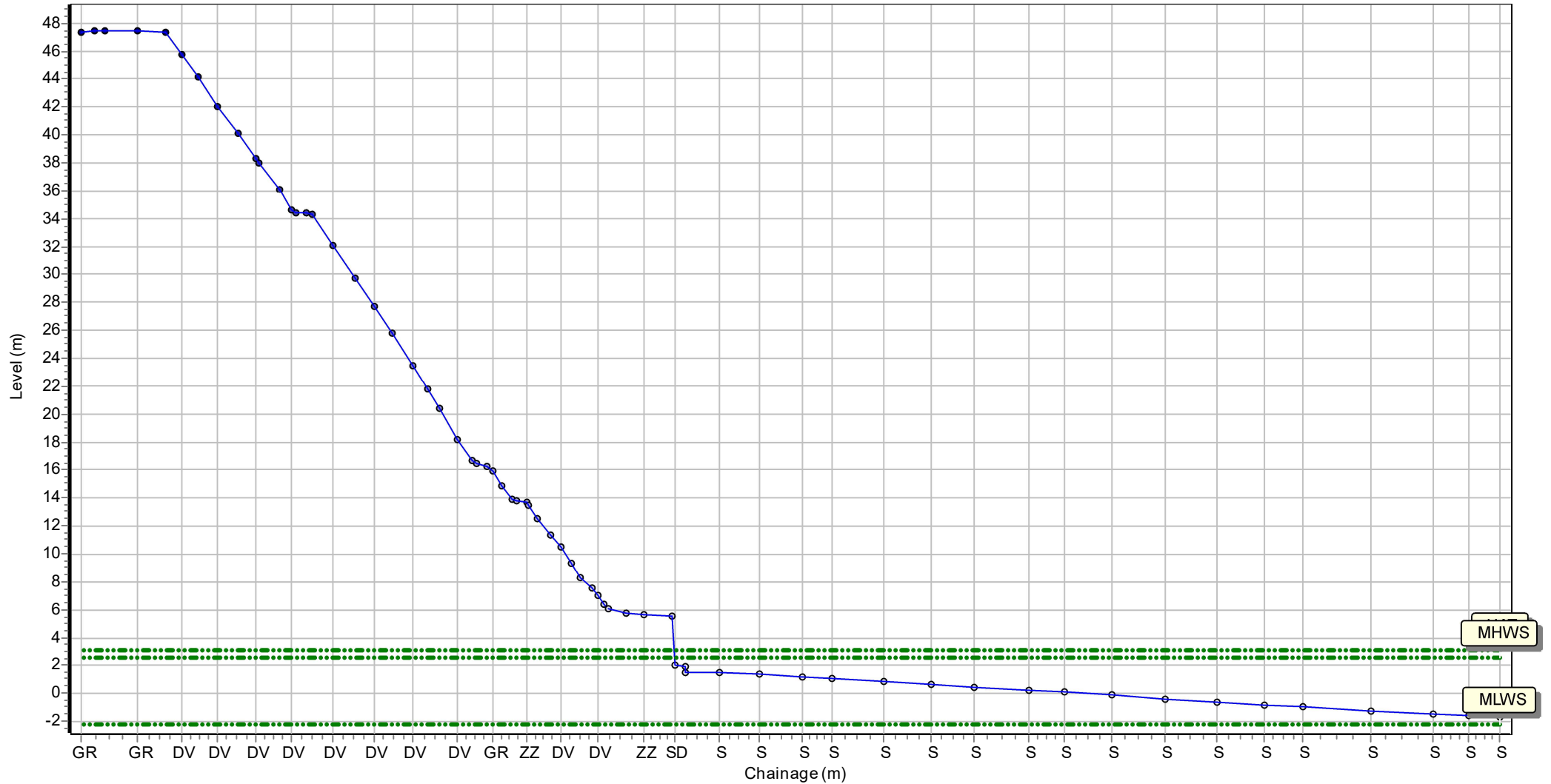
Sea State:

Visibility:

Rain:

Summary: 2020 Full Measures Topo Survey

Easting: 488983.57 Northing: 511527.047 Profile Bearing: 19 ° from North



# Beach Profile

Location: 1dSBN1

Date: 30/11/2020

Inspector: AG

Low Tide:

Low Tide Time:

Wind

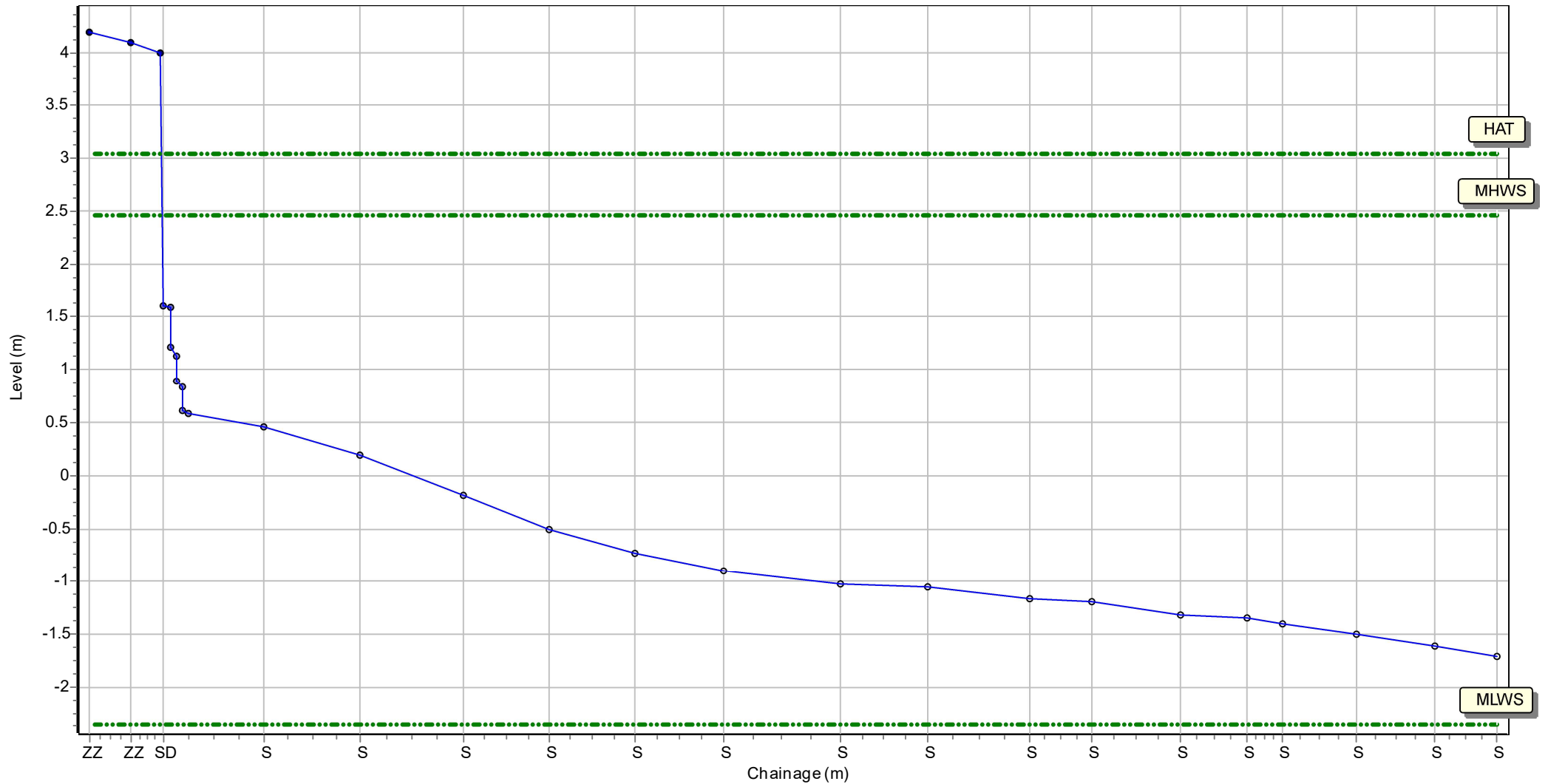
Sea State:

Visibility:

Rain:

Summary: 2020 Full Measures Topo Survey

Easting: 503543.363 Northing: 490470.74 Profile Bearing: 79 ° from North





# Beach Profile

Location: 1dSBN3

Date: 30/11/2020

Inspector: AG

Low Tide:

Low Tide Time:

Wind

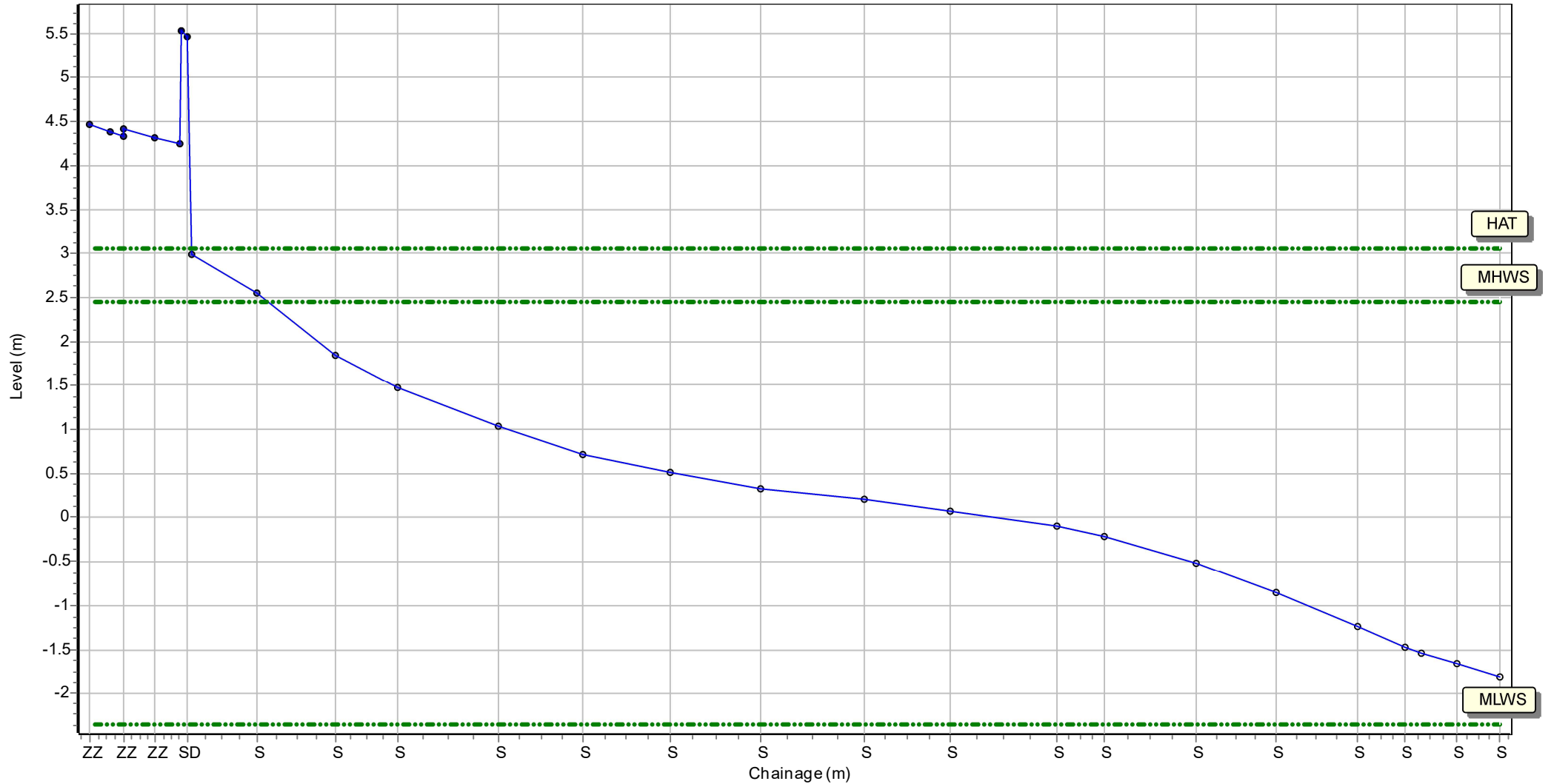
Sea State:

Visibility:

Rain:

Summary: 2020 Full Measures Topo Survey

Easting: 503803.958 Northing: 489708.315 Profile Bearing: 58 ° from North





# Beach Profile

Location: 1dSBN4

Date: 30/11/2020

Inspector: AG

Low Tide:

Low Tide Time:

Wind

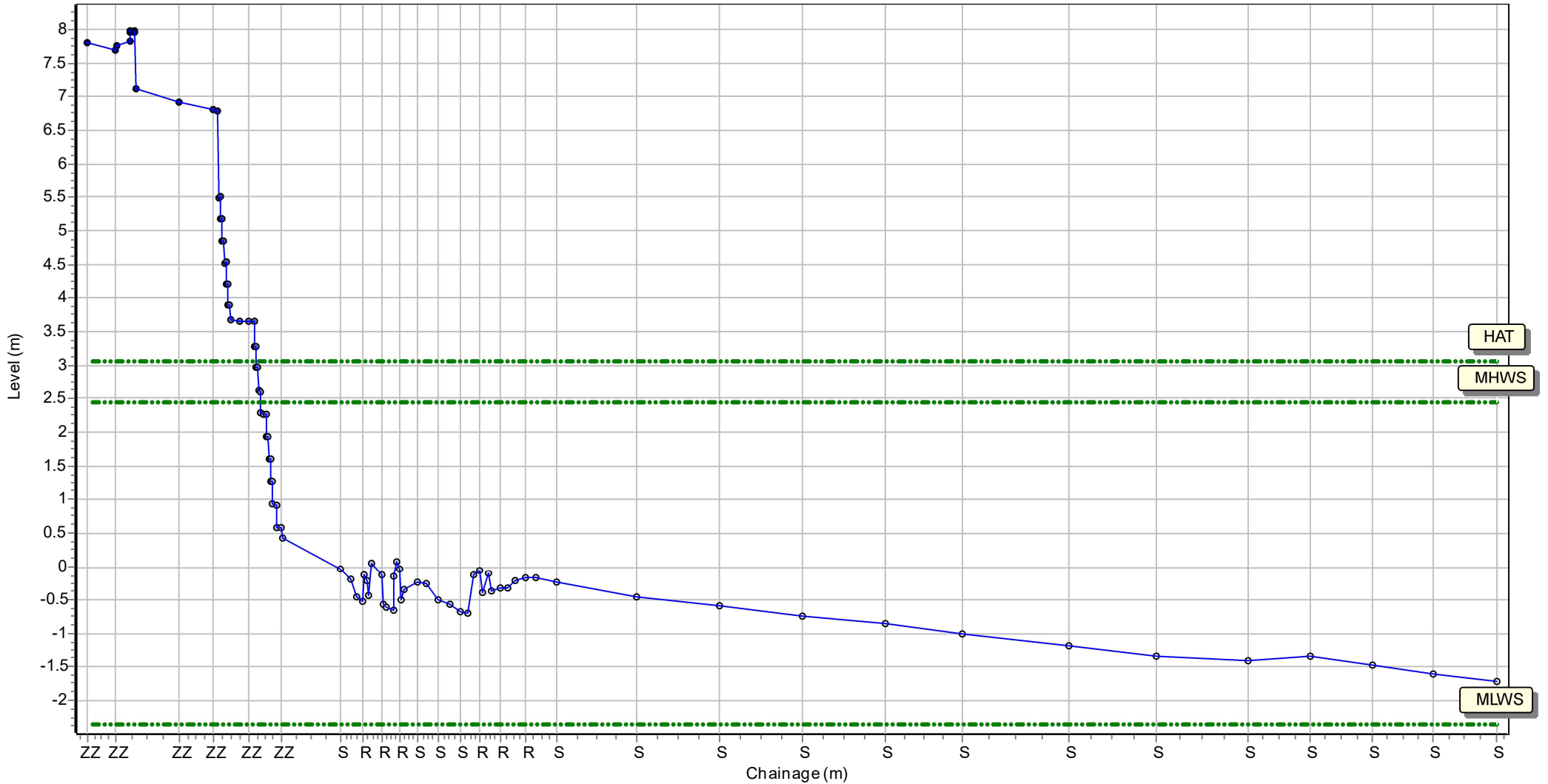
Sea State:

Visibility:

Rain:

Summary: 2020 Full Measures Topo Survey

Easting: 504111.79 Northing: 489397.699 Profile Bearing: 38 ° from North



# Beach Profile

Location: 1dSBS1

Date: 01/12/2020

Inspector: AG

Low Tide:

Low Tide Time:

Wind

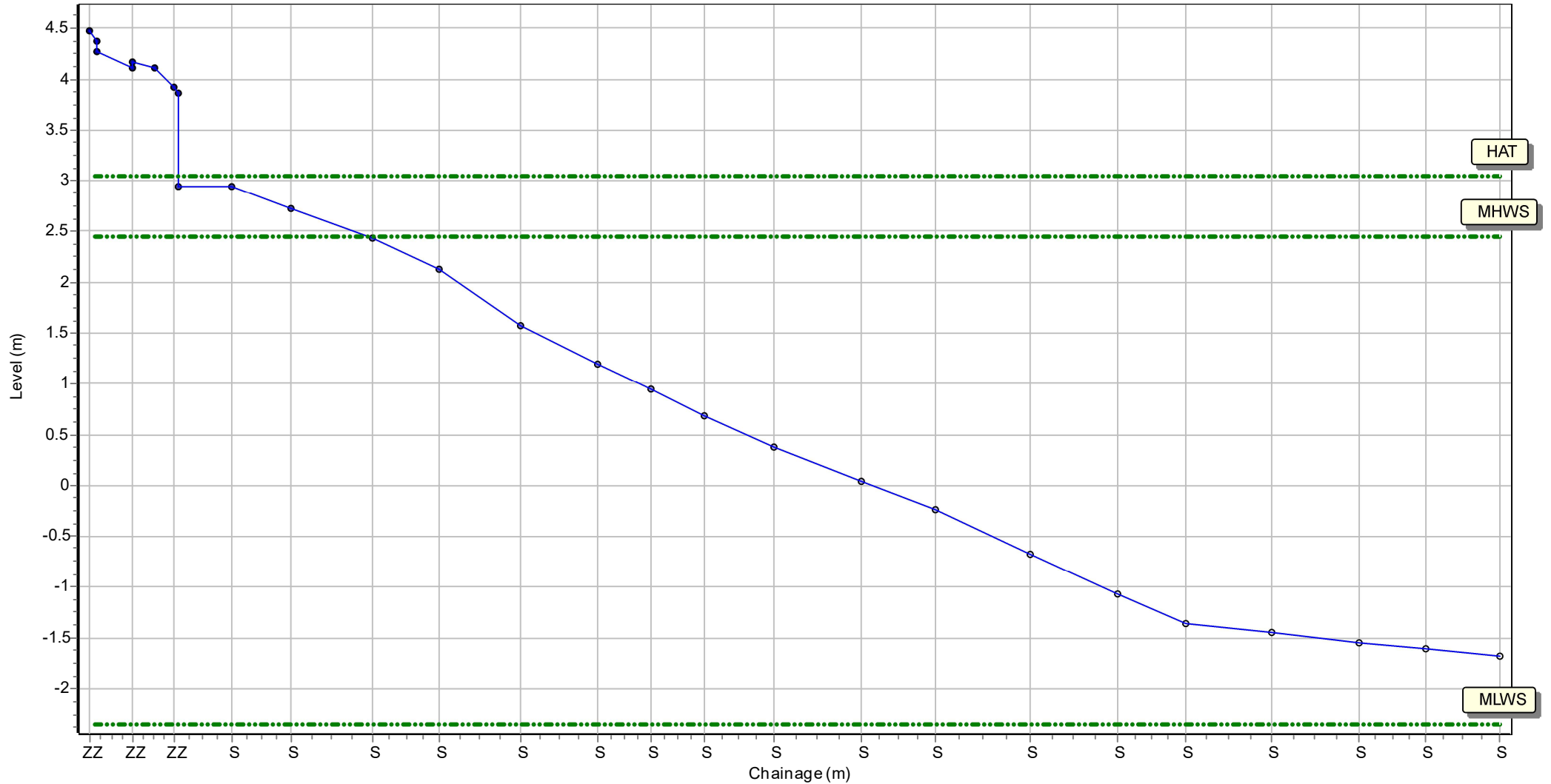
Sea State:

Visibility:

Rain:

Summary: 2020 Full Measures Topo Survey

Easting: 504544.727 Northing: 488604.814 Profile Bearing: 120 ° from North



# Beach Profile

Location: 1dSBS2

Date: 01/12/2020

Inspector: AG

Low Tide:

Low Tide Time:

Wind

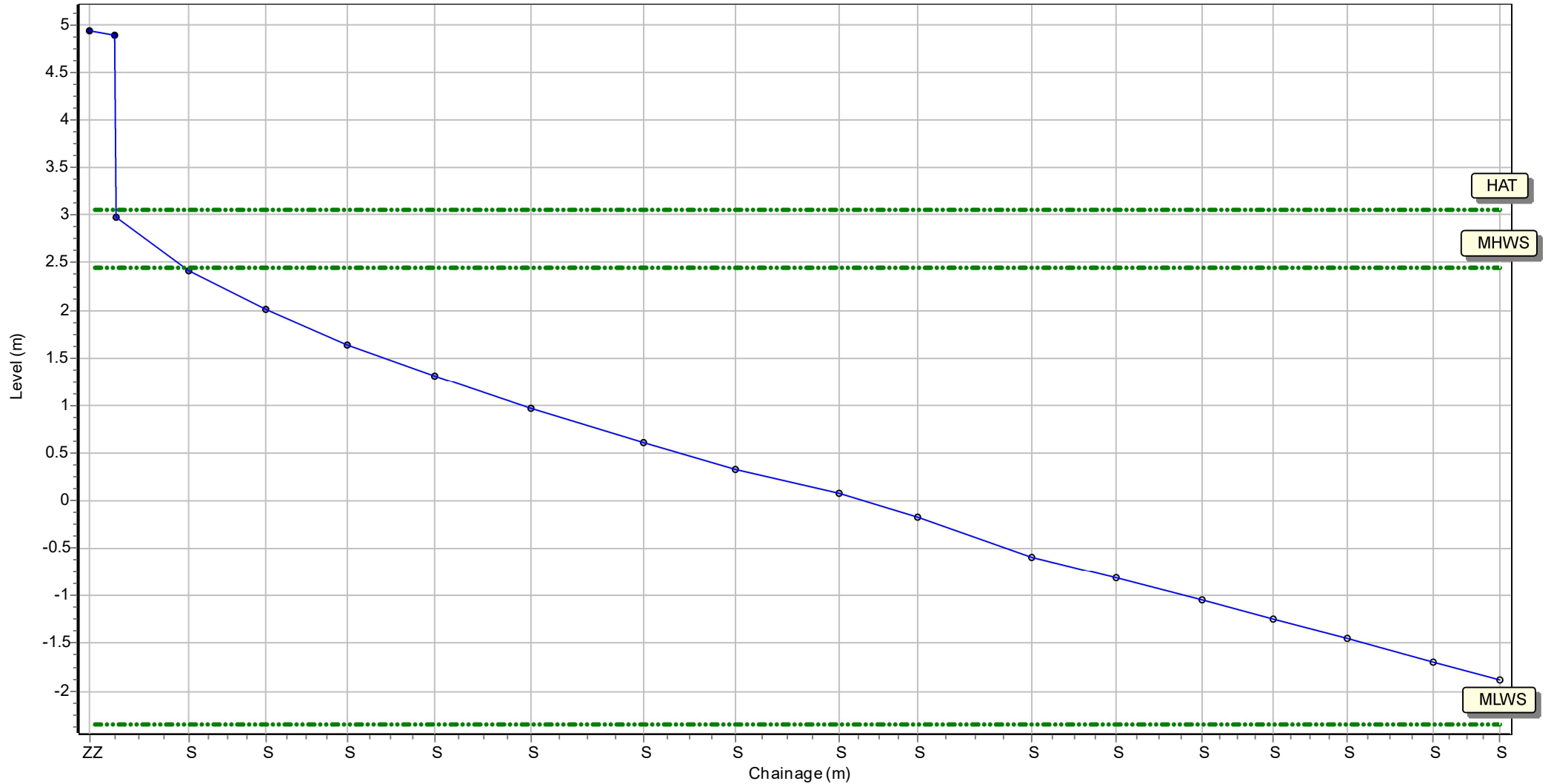
Sea State:

Visibility:

Rain:

Summary: 2020 Full Measures Topo Survey

Easting: 504443.218 Northing: 488326.371 Profile Bearing: 105 ° from North



# Beach Profile

Location: 1dSBS3

Date: 01/12/2020

Inspector: AG

Low Tide:

Low Tide Time:

Wind

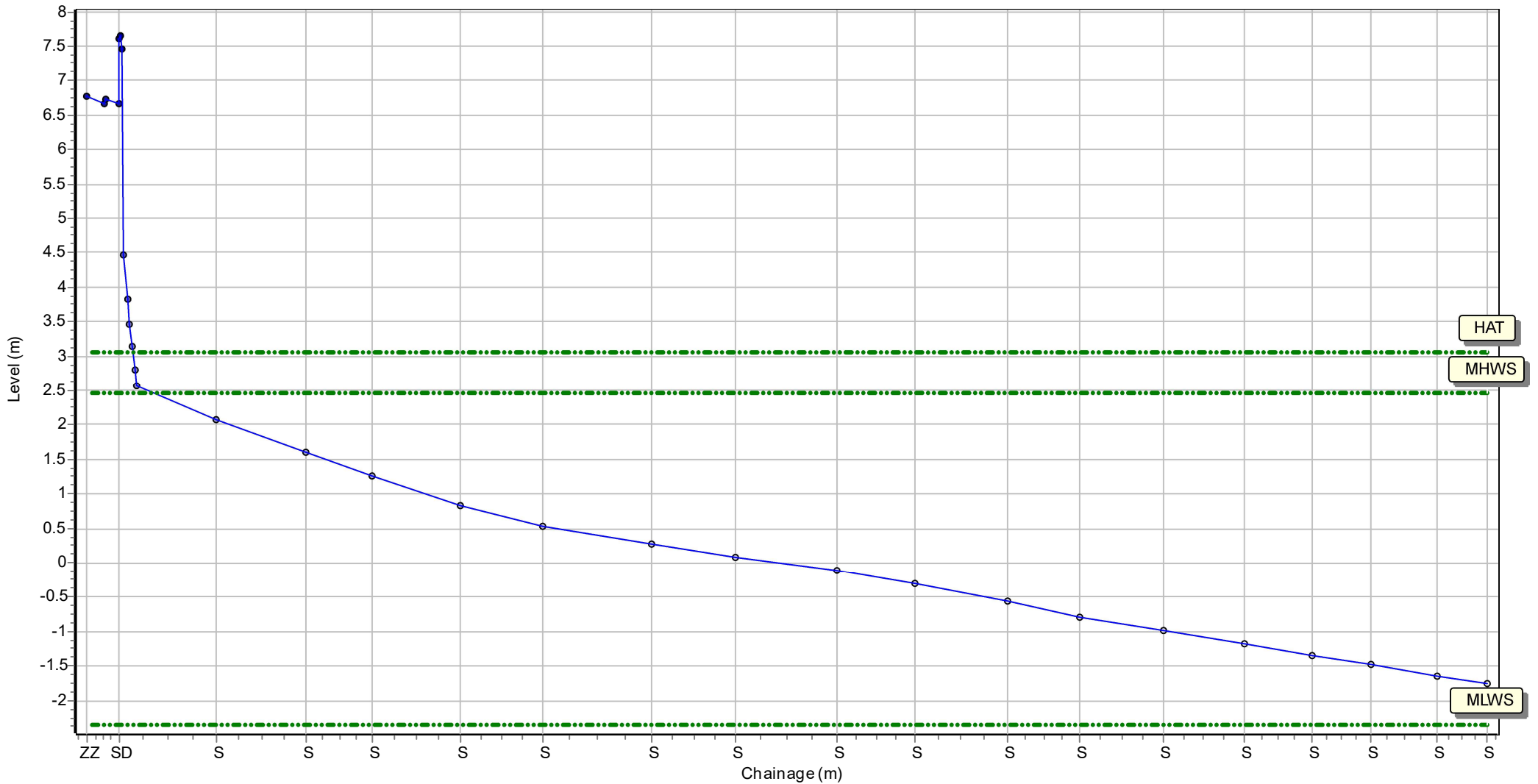
Sea State:

Visibility:

Rain:

Summary: 2020 Full Measures Topo Survey

Easting: 504423.086 Northing: 488057.66 Profile Bearing: 83 ° from North



# Beach Profile

Location: 1dSBS4

Date: 01/12/2020

Inspector: AG

Low Tide:

Low Tide Time:

Wind

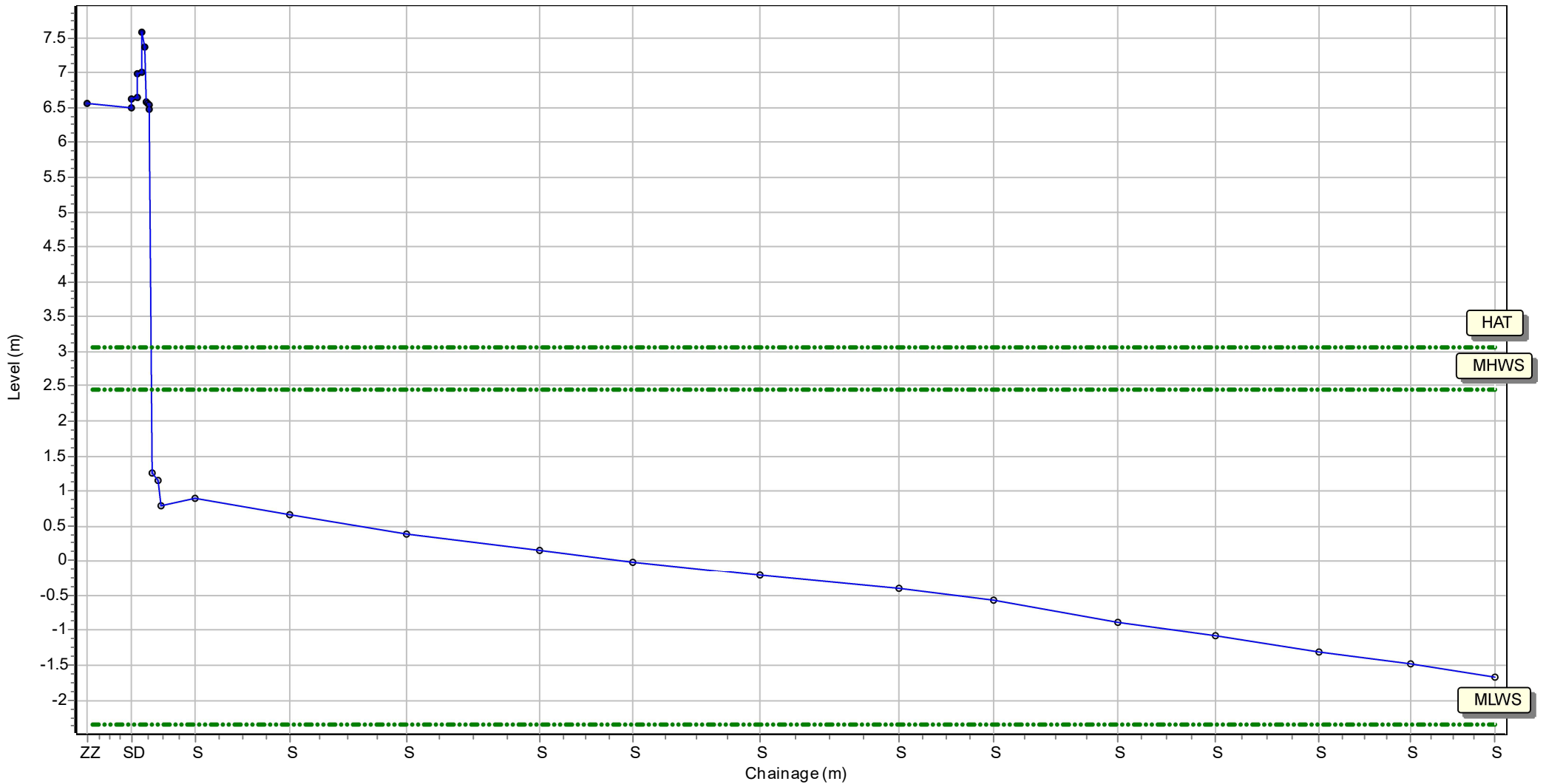
Sea State:

Visibility:

Rain:

Summary: 2020 Full Measures Topo Survey

Easting: 504494.785 Northing: 487816.983 Profile Bearing: 74 ° from North





# Beach Profile

Location: 1dCY1A

Date: 02/12/2020

Inspector: AG

Low Tide:

Low Tide Time:

Wind

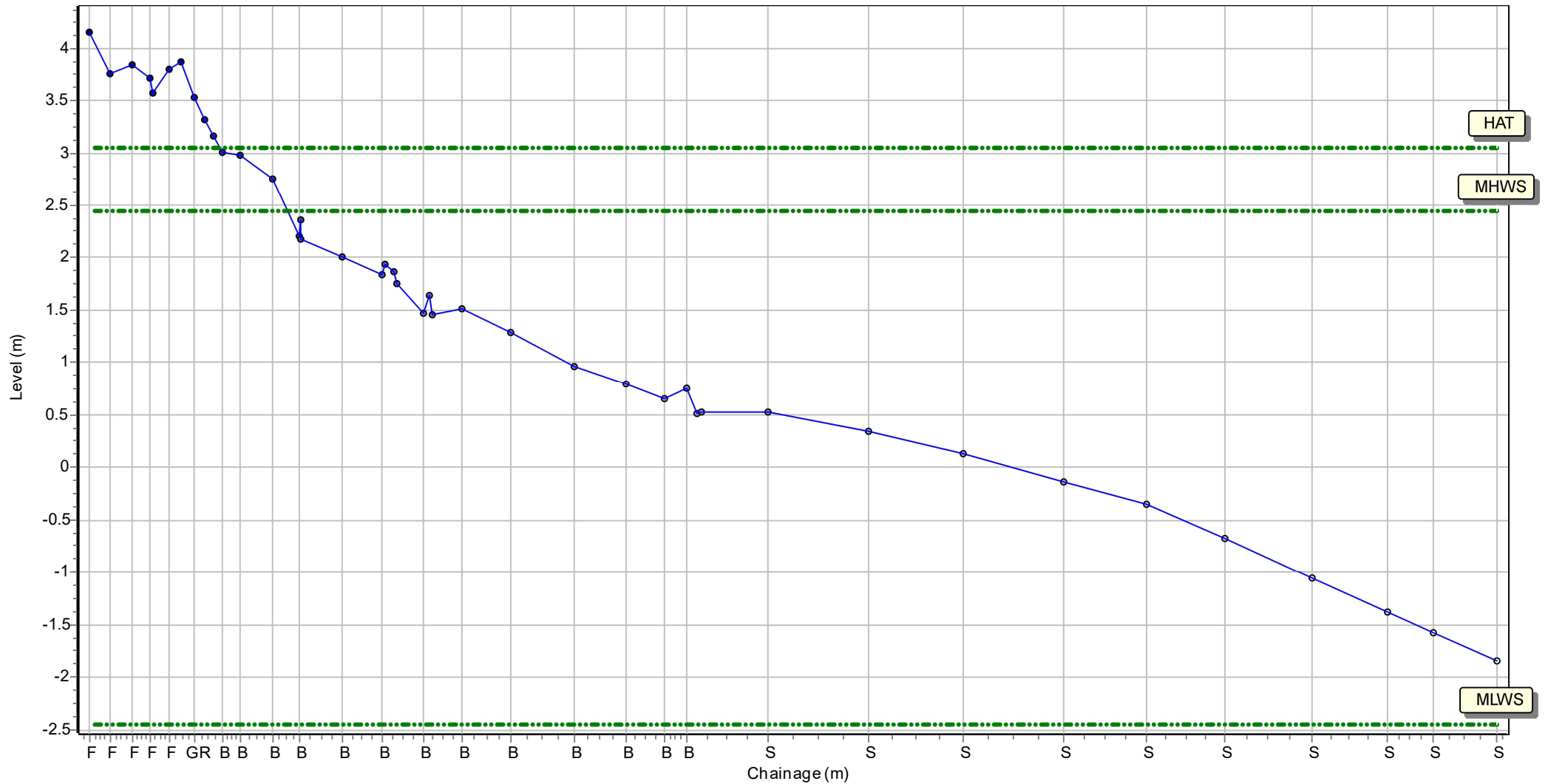
Sea State:

Visibility:

Rain:

Summary: 2020 Full Measures Topo Survey

Easting: 506298.519 Northing: 485175.932 Profile Bearing: 107 ° from North



# Beach Profile

Location: 1dCY2

Date: 02/12/2020

Inspector: AG

Low Tide:

Low Tide Time:

Wind

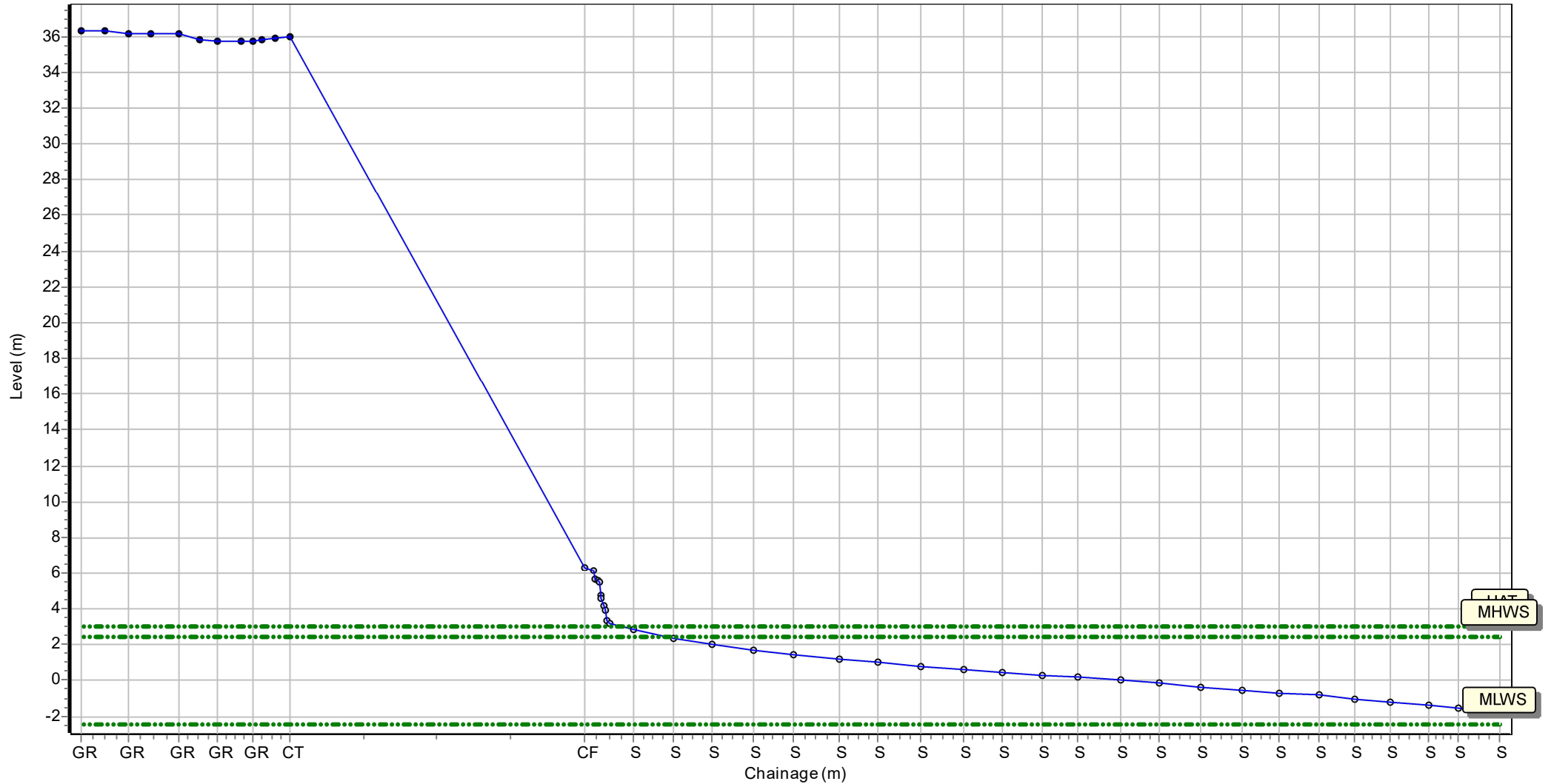
Sea State:

Visibility:

Rain:

Summary: 2020 Full Measures Topo Survey

Easting: 506712.583 Northing: 484325.966 Profile Bearing: 38 ° from North





# Beach Profile

Location: 1dCY3

Date: 02/12/2020

Inspector: AG

Low Tide:

Low Tide Time:

Wind

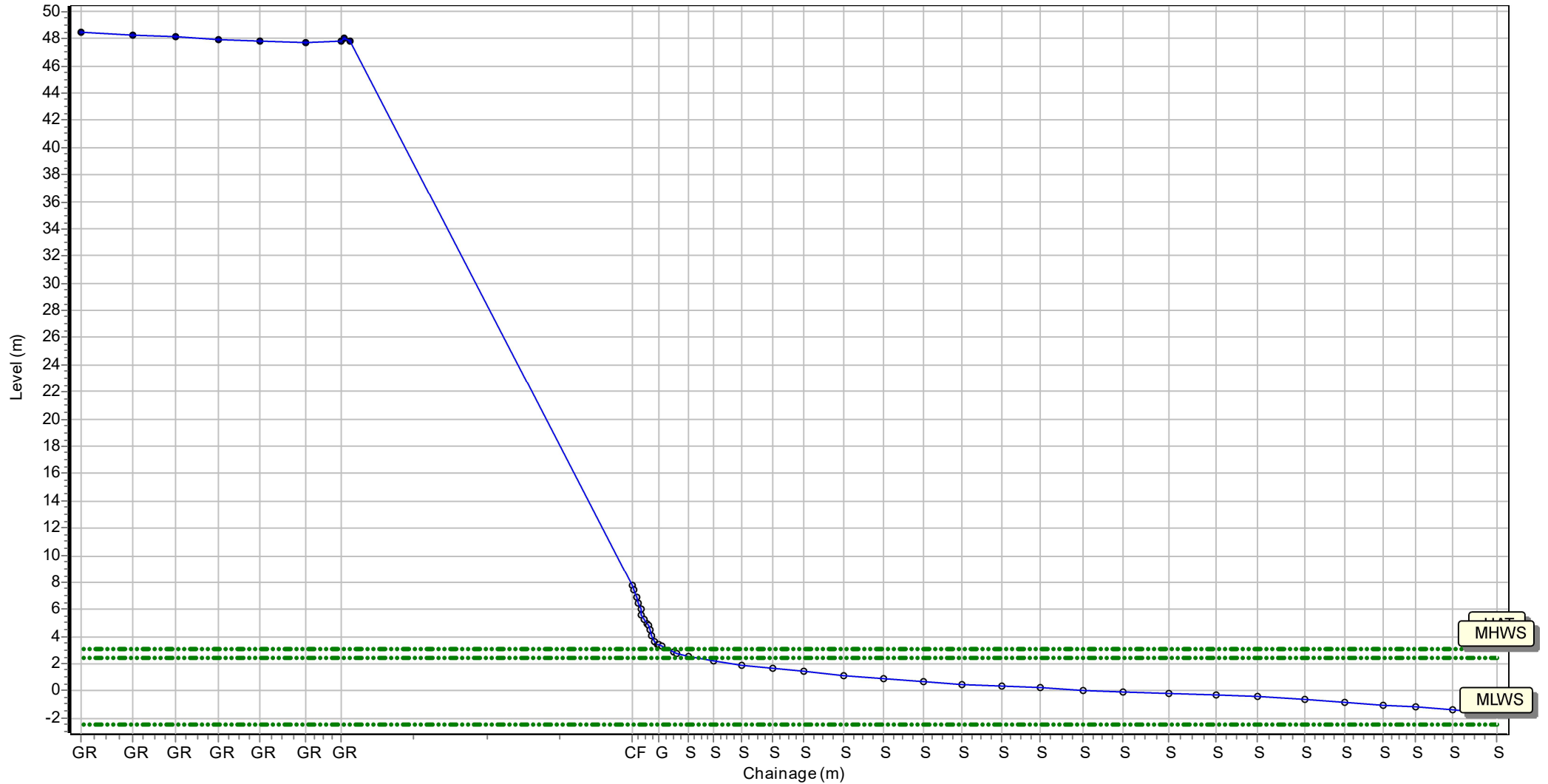
Sea State:

Visibility:

Rain:

Summary: 2020 Full Measures Topo Survey

Easting: 507242.203 Northing: 484080.896 Profile Bearing: 42 ° from North



# Beach Profile

Location: 1dFB1

Date: 18/11/2020

Inspector: AG

Low Tide:

Low Tide Time:

Wind

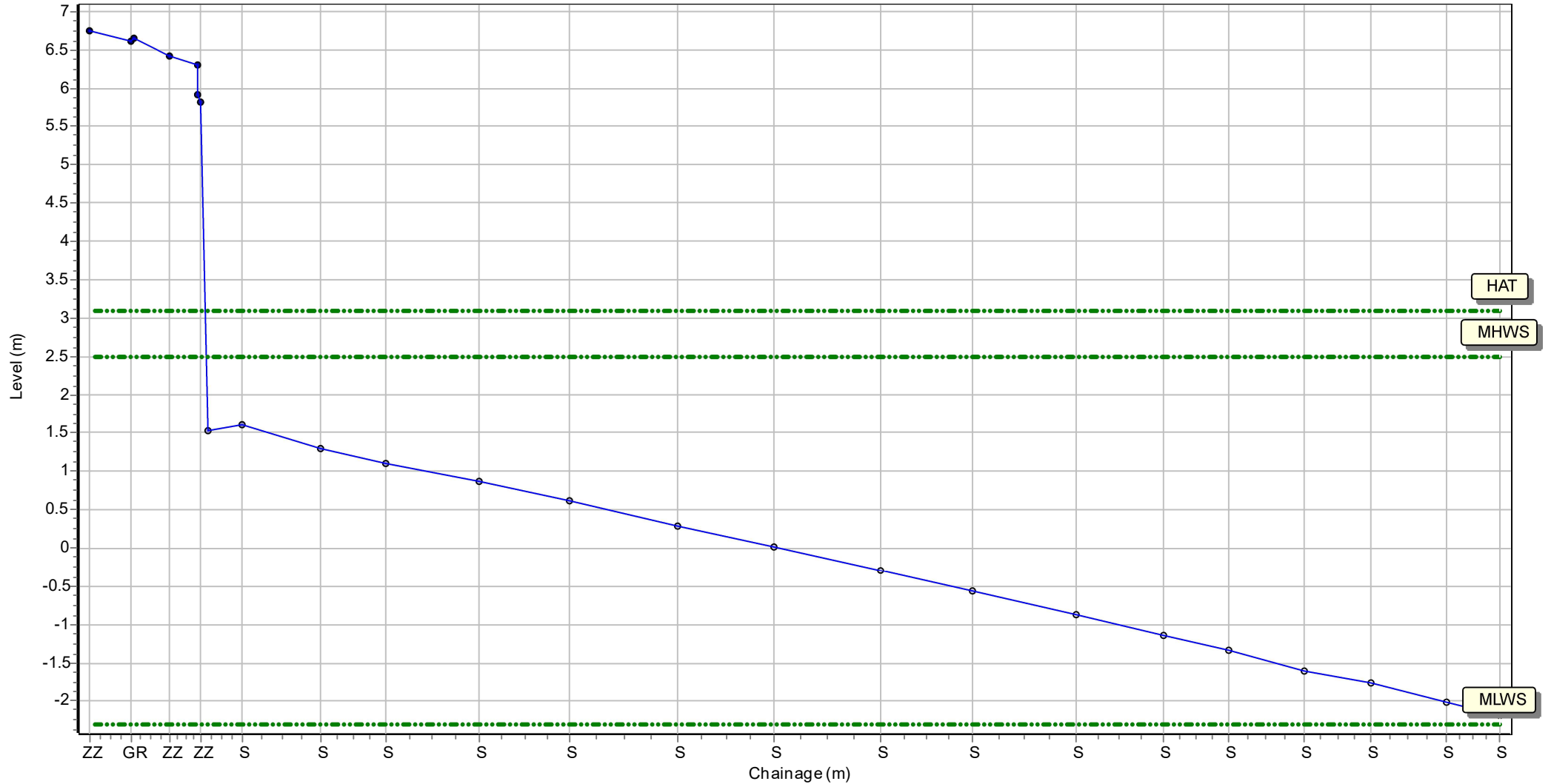
Sea State:

Visibility:

Rain:

Summary: 2020 Full Measures Topo Survey

Easting: 511989.528 Northing: 480590.964 Profile Bearing: 100 ° from North



# Beach Profile

Location: 1dFB2

Date: 18/11/2020

Inspector: AG

Low Tide:

Low Tide Time:

Wind

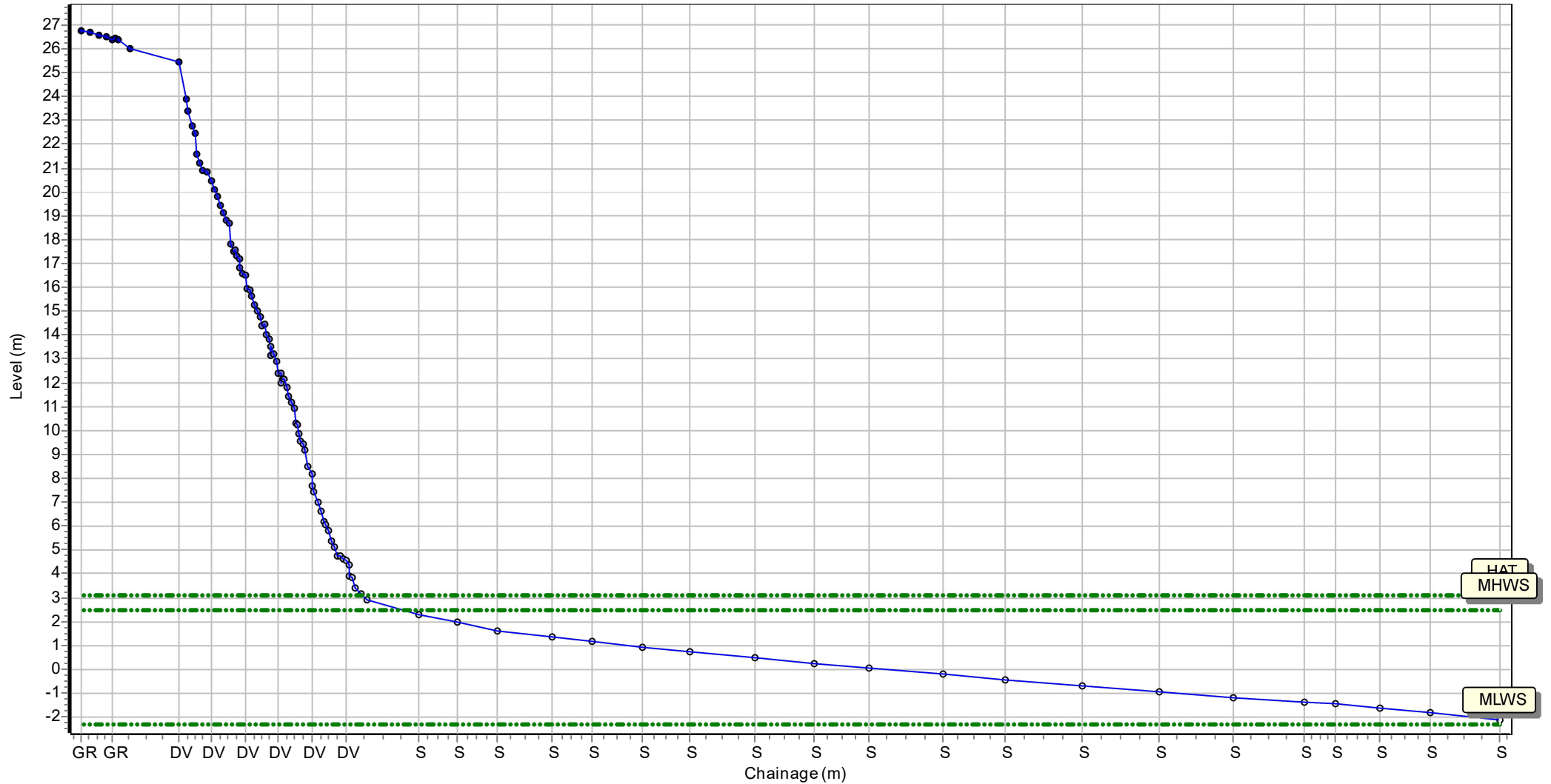
Sea State:

Visibility:

Rain:

Summary: 2020 Full Measures Topo Survey

Easting: 512005.564 Northing: 479181.575 Profile Bearing: 77 ° from North



# Beach Profile

Location: 1dFB3

Date: 18/11/2020

Inspector: AG

Low Tide:

Low Tide Time:

Wind

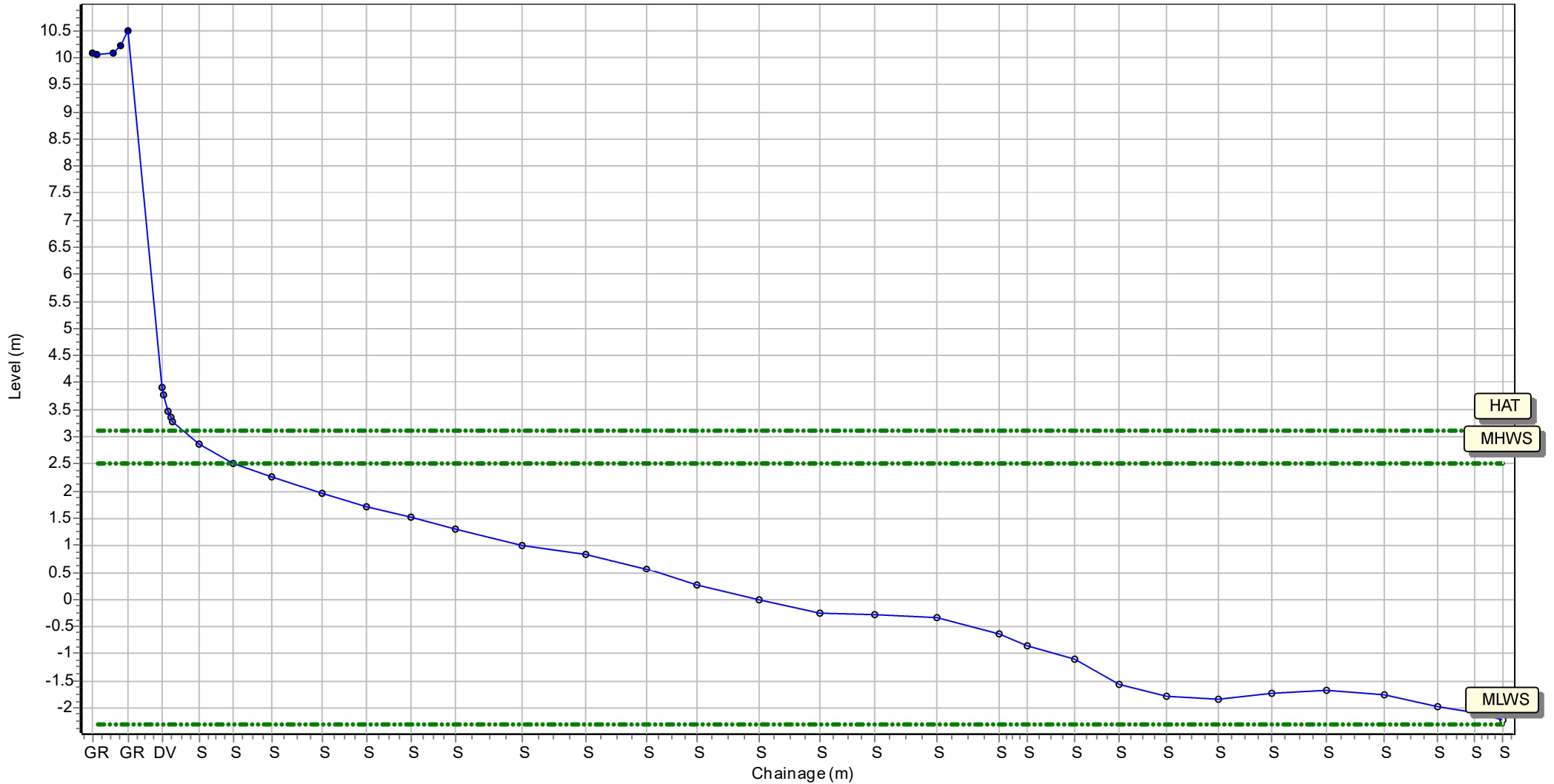
Sea State:

Visibility:

Rain:

Summary: 2020 Full Measures Topo Survey

Easting: 512429.303 Northing: 478202.148 Profile Bearing: 61 ° from North



# Beach Profile

Location: 1dFB4

Date: 18/11/2020

Inspector: AG

Low Tide:

Low Tide Time:

Wind

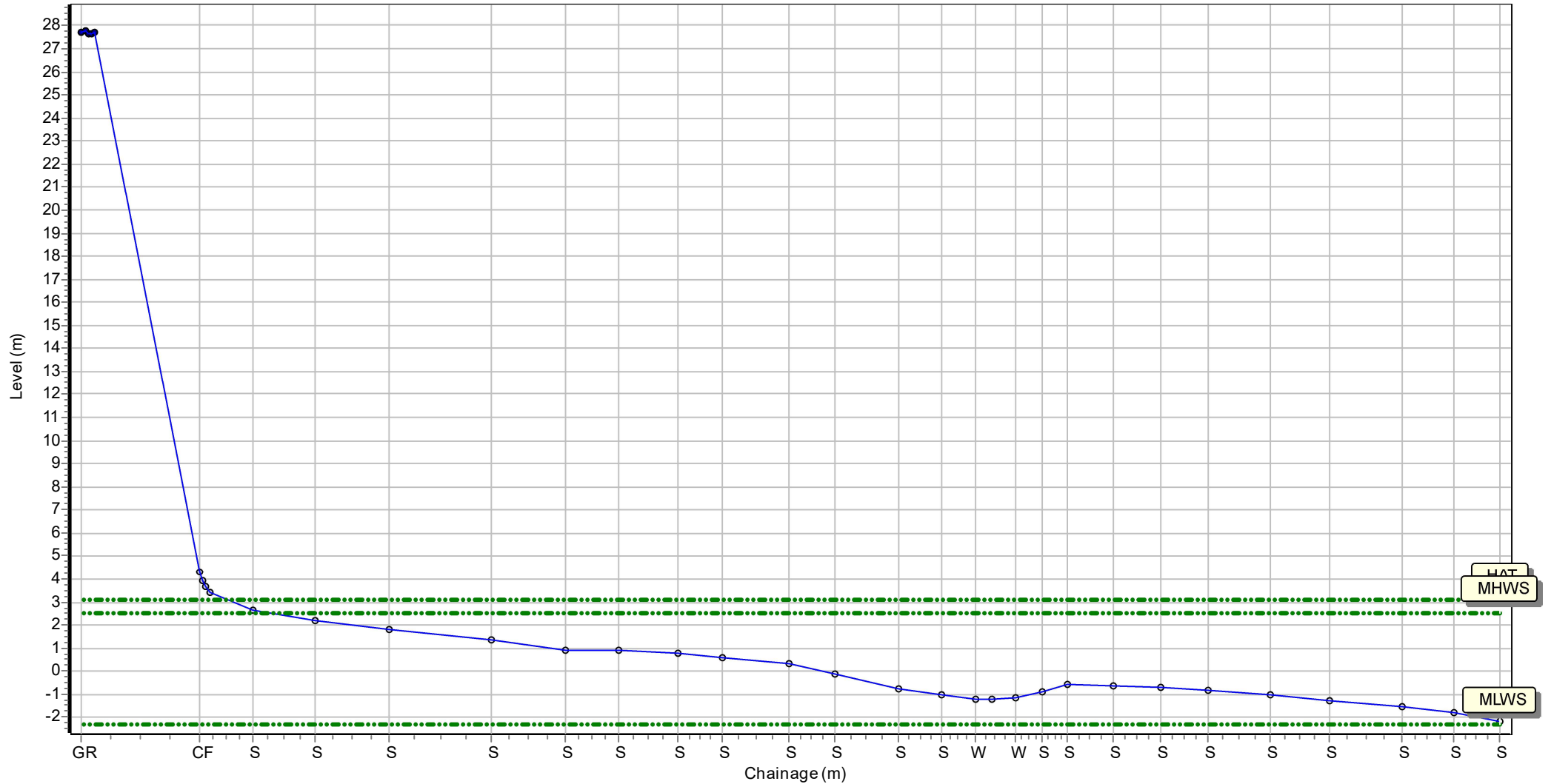
Sea State:

Visibility:

Rain:

Summary: 2020 Full Measures Topo Survey

Easting: 513165.53 Northing: 477182.418 Profile Bearing: 51 ° from North



# Beach Profile

Location: 1dFB5

Date: 18/11/2020

Inspector: AG

Low Tide:

Low Tide Time:

Wind

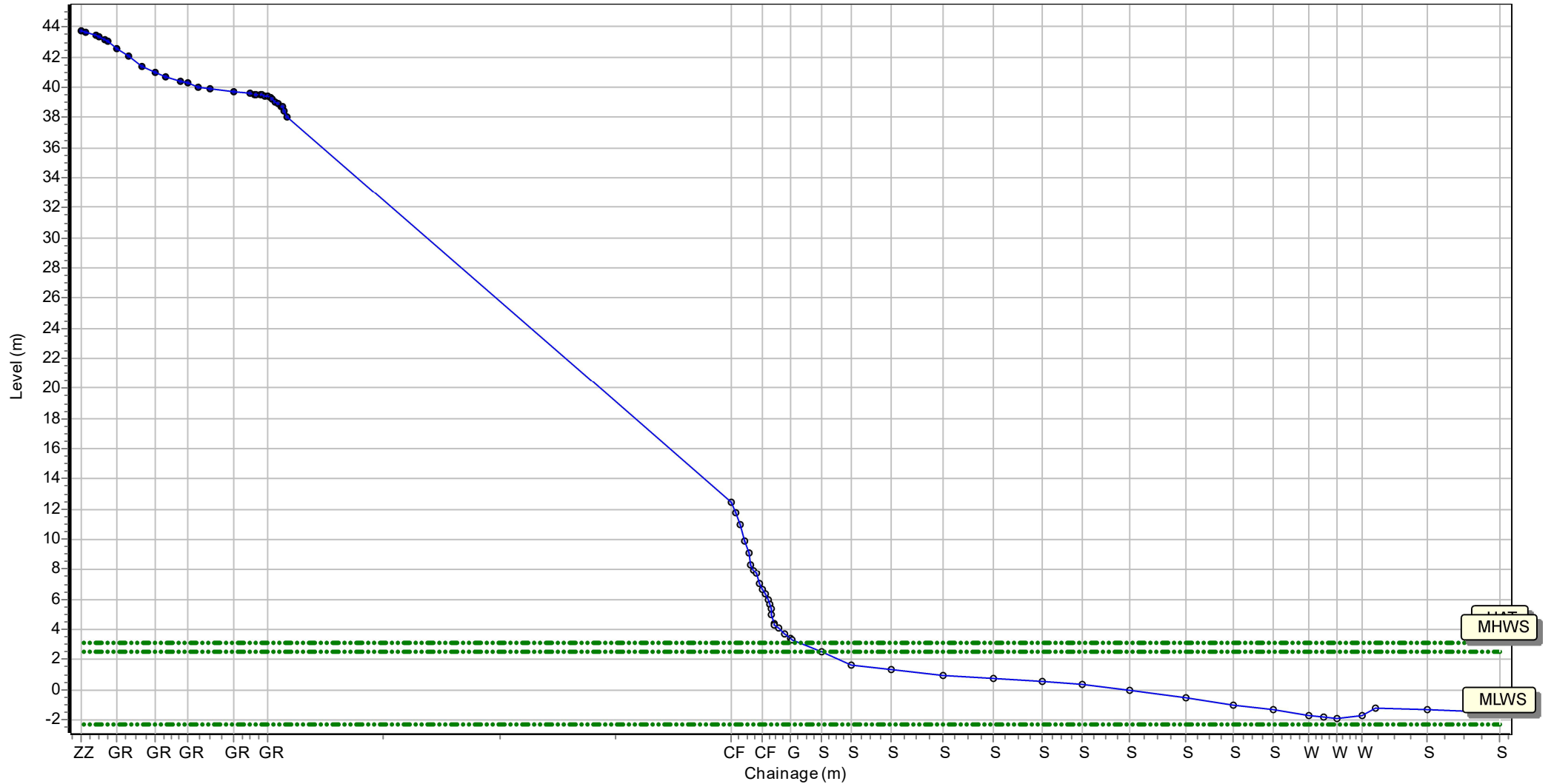
Sea State:

Visibility:

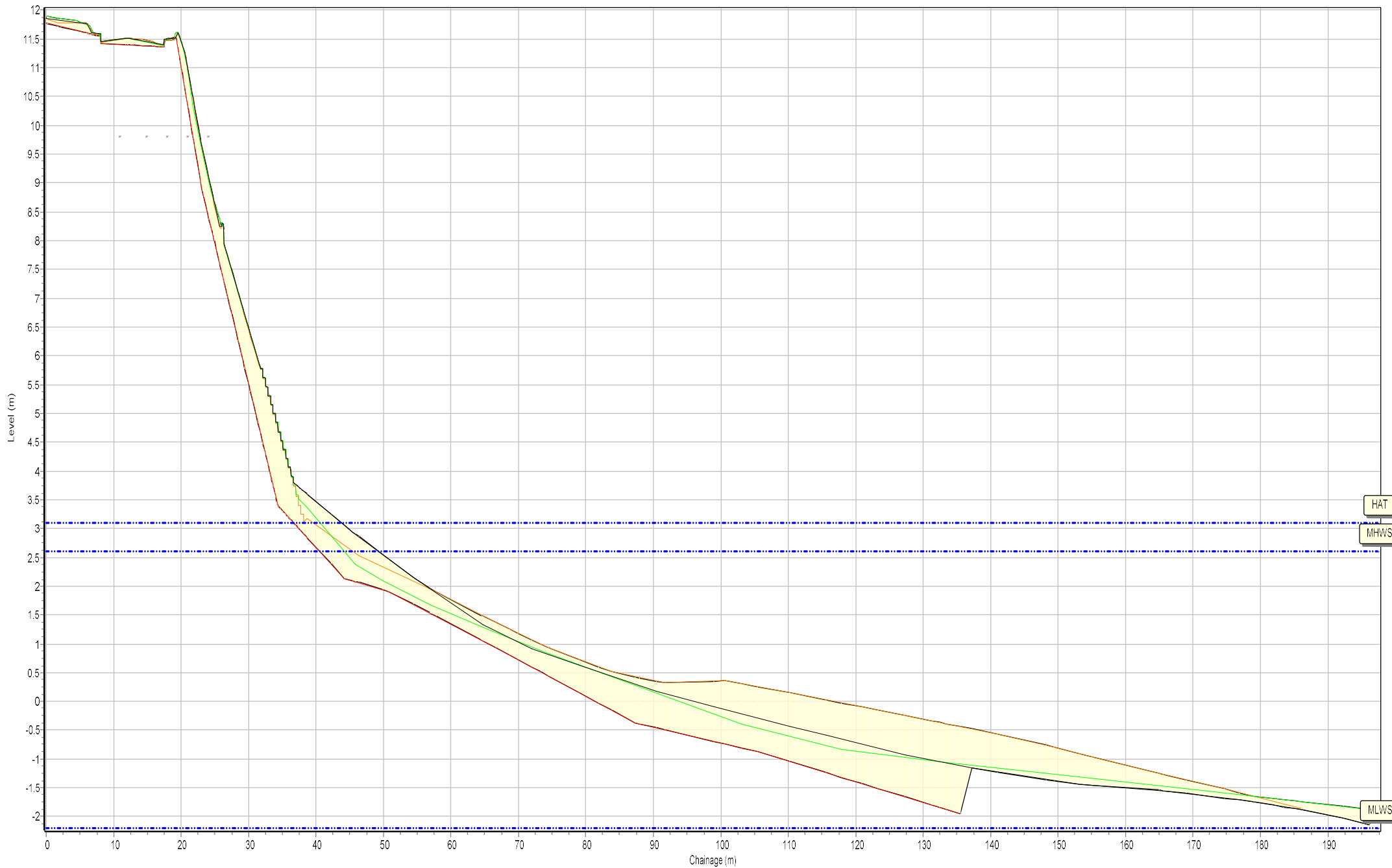
Rain:

Summary: 2020 Full Measures Topo Survey

Easting: 514207.792 Northing: 476001.334 Profile Bearing: 47 ° from North



Beach Profiles: 1dWB1



Profiles Envelope 26/11/2008 29/11/2019 25/04/2020 21/10/2020

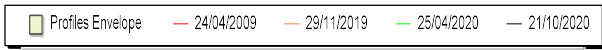
HAT

MHWS

MLWS

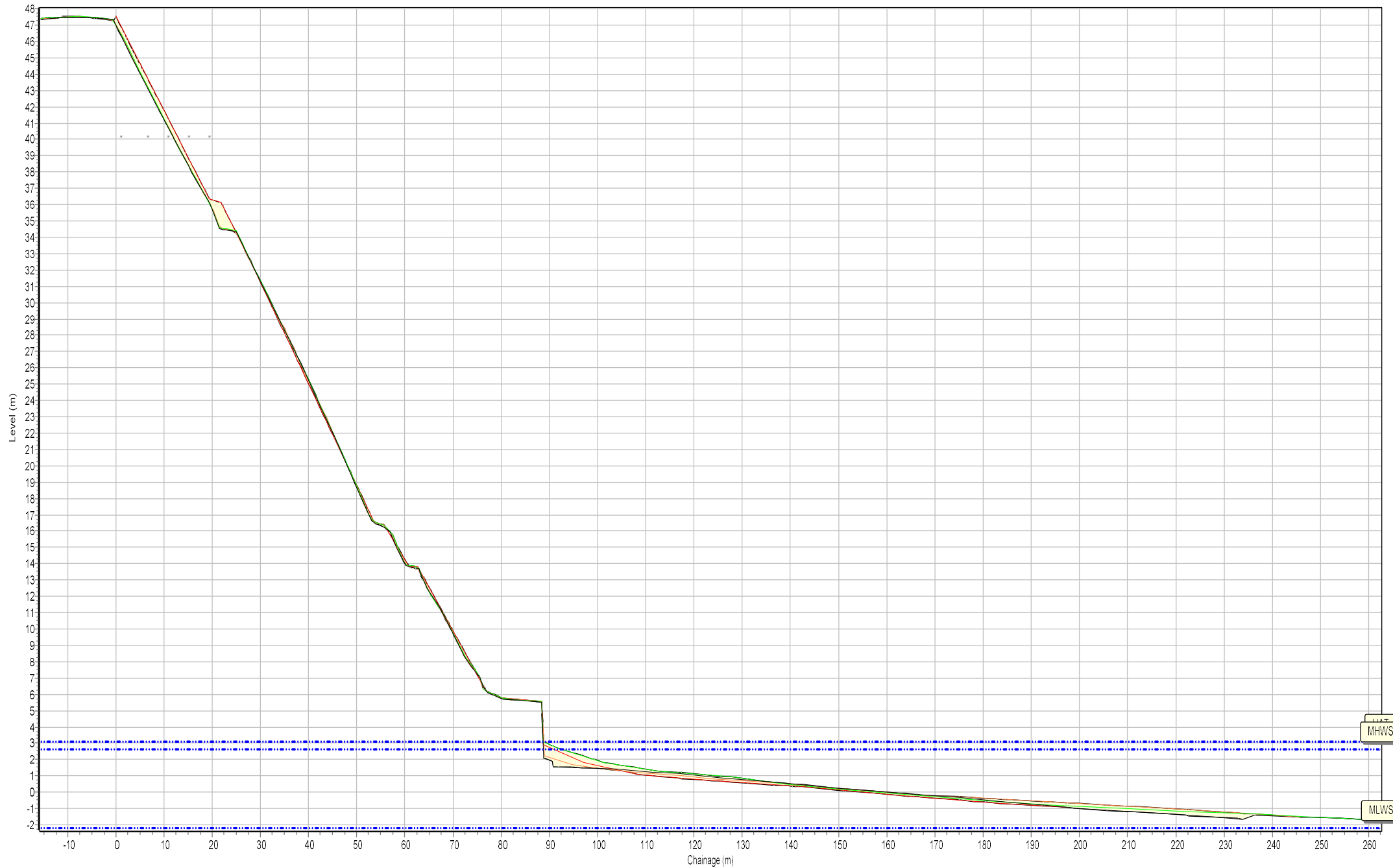
SANDS

Beach Profiles: 1dWB2





Beach Profiles: 1dWB3



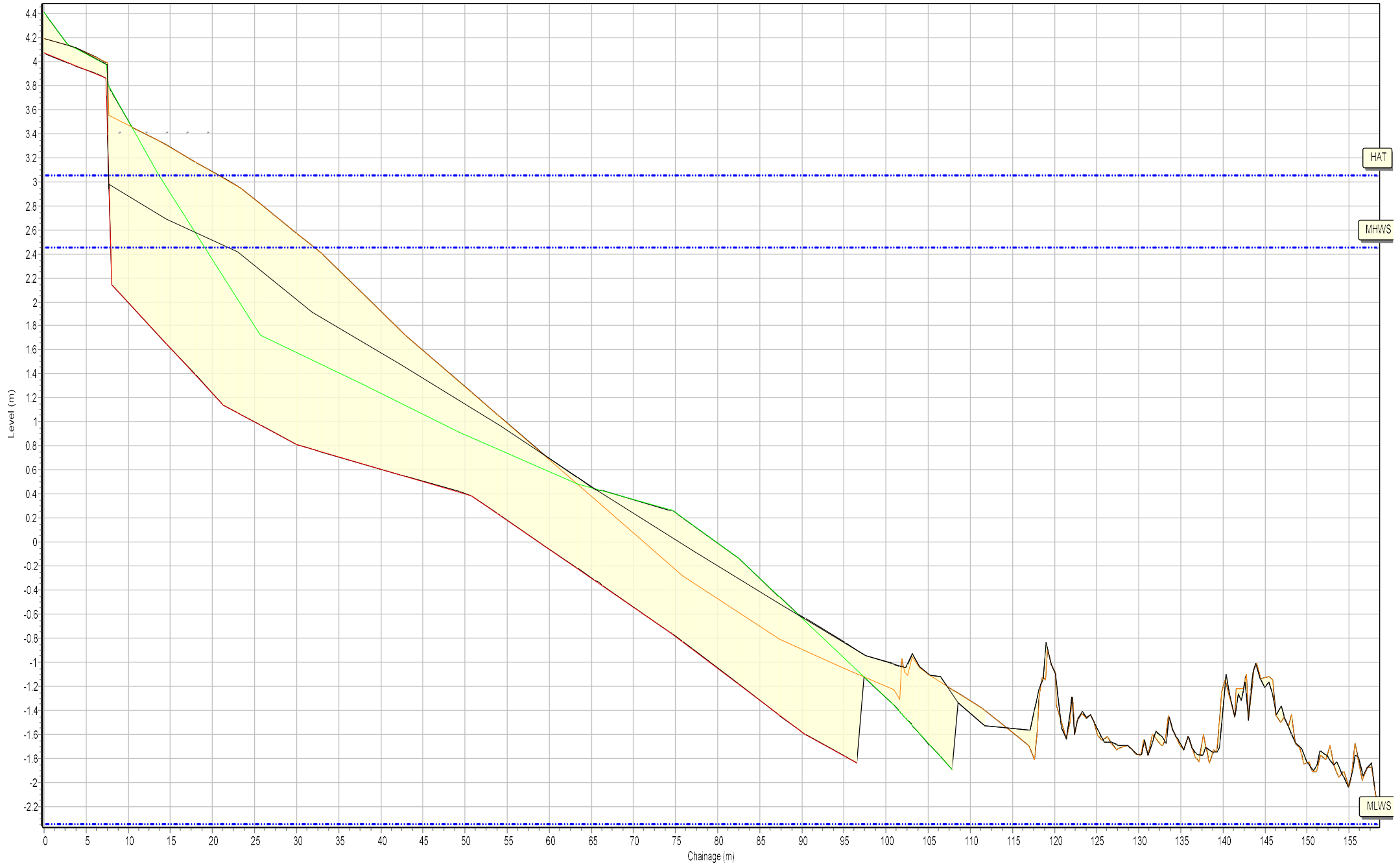
Profiles Envelope 26/11/2008 29/11/2019 25/04/2020 21/10/2020

SANDS

# Beach Profiles: 1dSBN1



# Beach Profiles: 1dSBN2



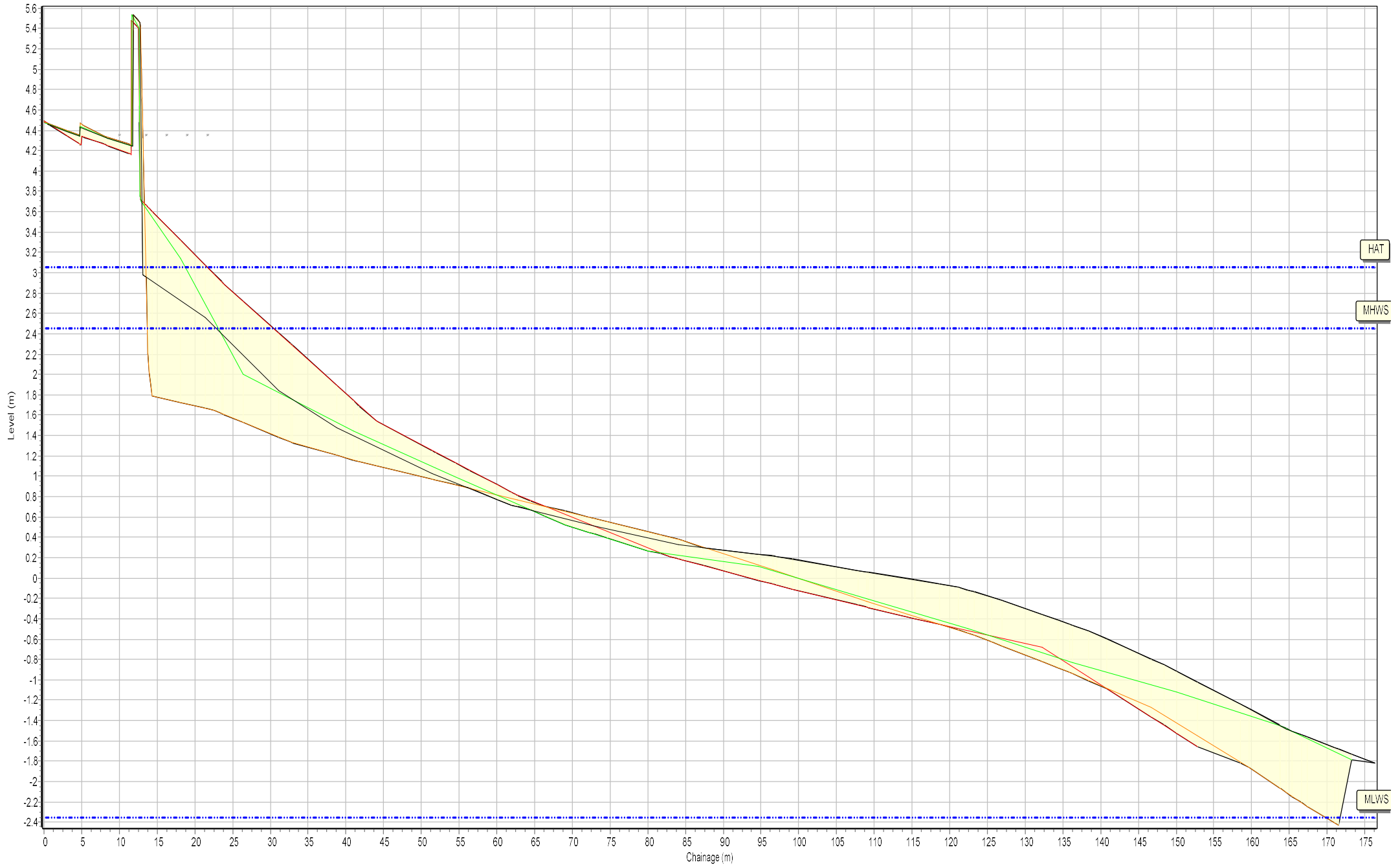
HAT

MHWS

MLWS

SANDS

# Beach Profiles: 1dSBN3



Beach Profiles: 1dSBN4



HAT

MHWS

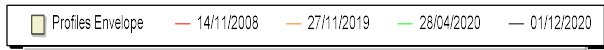
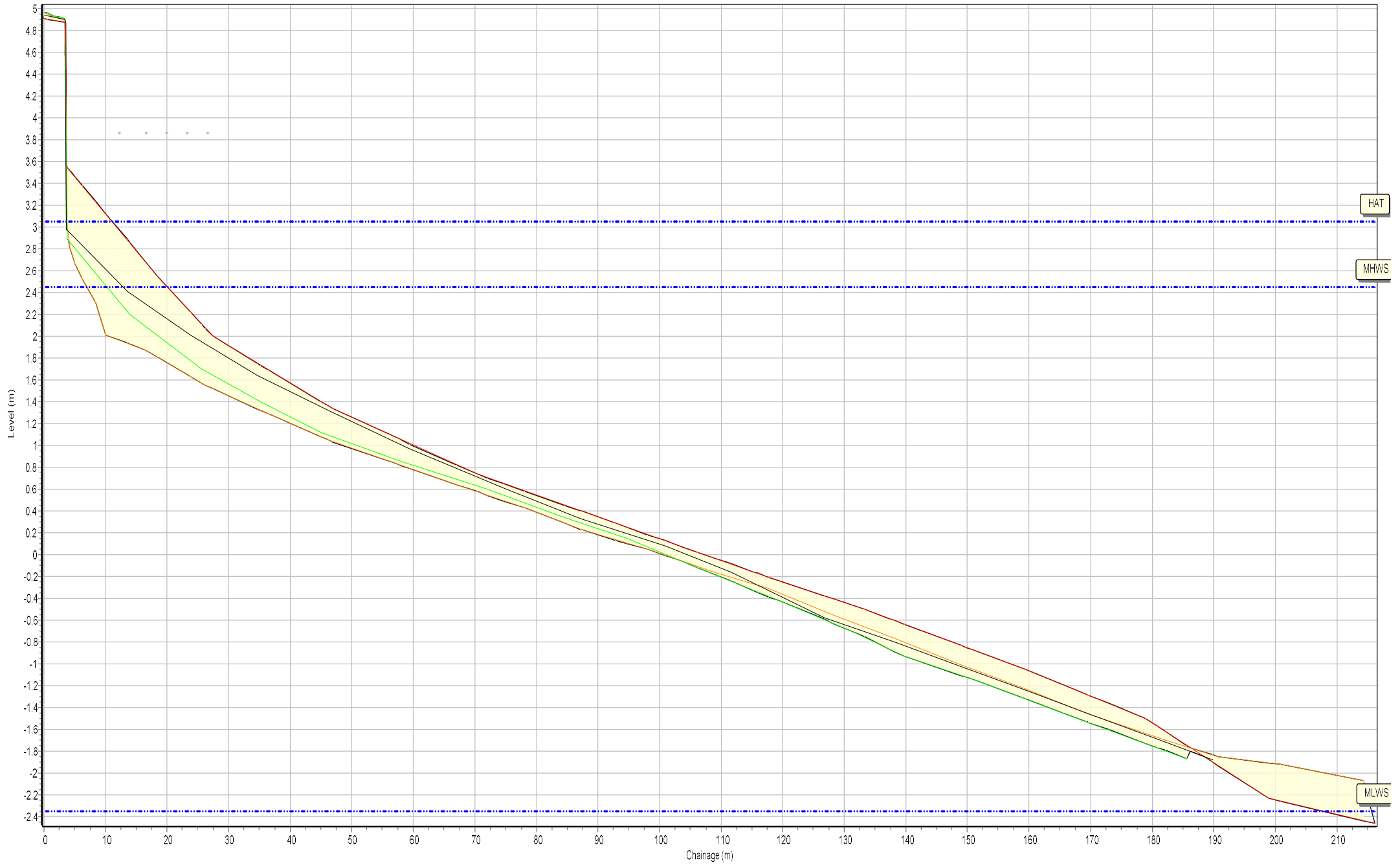
MLWS

SANDS

# Beach Profiles: 1dSBS1



# Beach Profiles: 1dSBS2



Beach Profiles: 1dSBS3



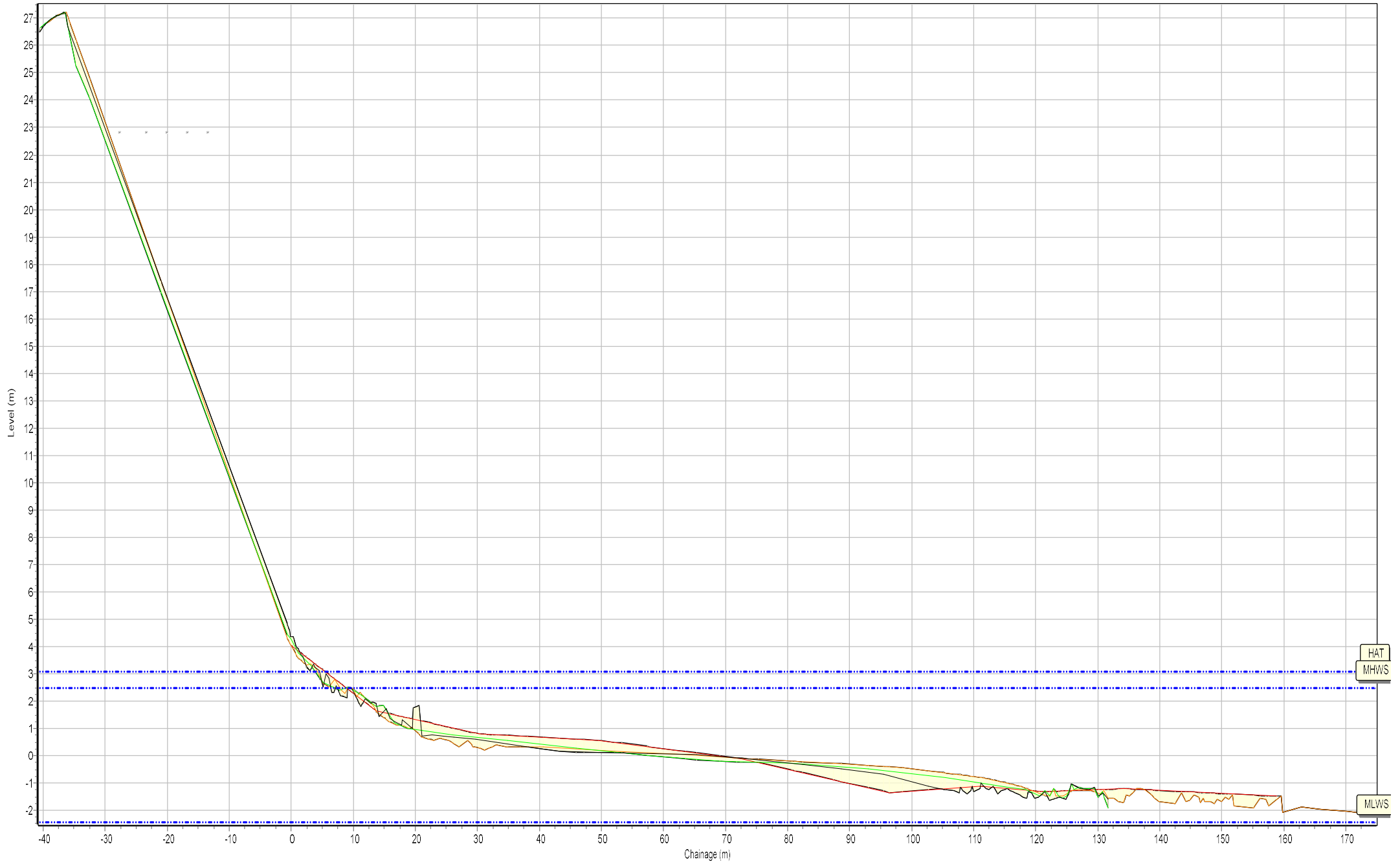


Beach Profiles: 1dSBS4



Profiles Envelope 14/11/2008 27/11/2019 28/04/2020 01/12/2020

Beach Profiles: 1dCY1



Profiles Envelope 17/11/2008 26/11/2019 26/04/2020 02/12/2020

HAT  
MHWS

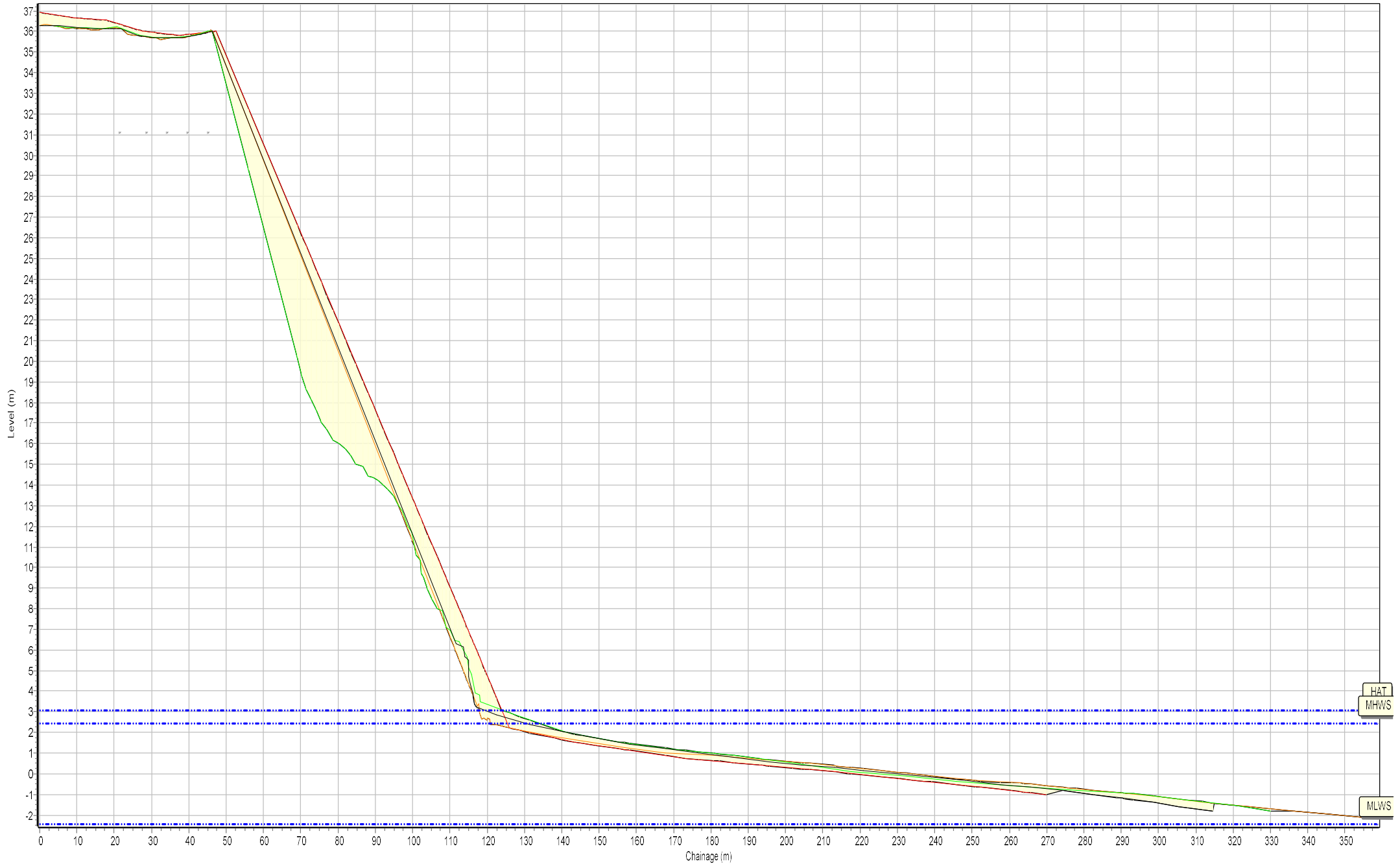
MLWS

SANDS

Beach Profiles: 1dCY1A



Beach Profiles: 1dCY2

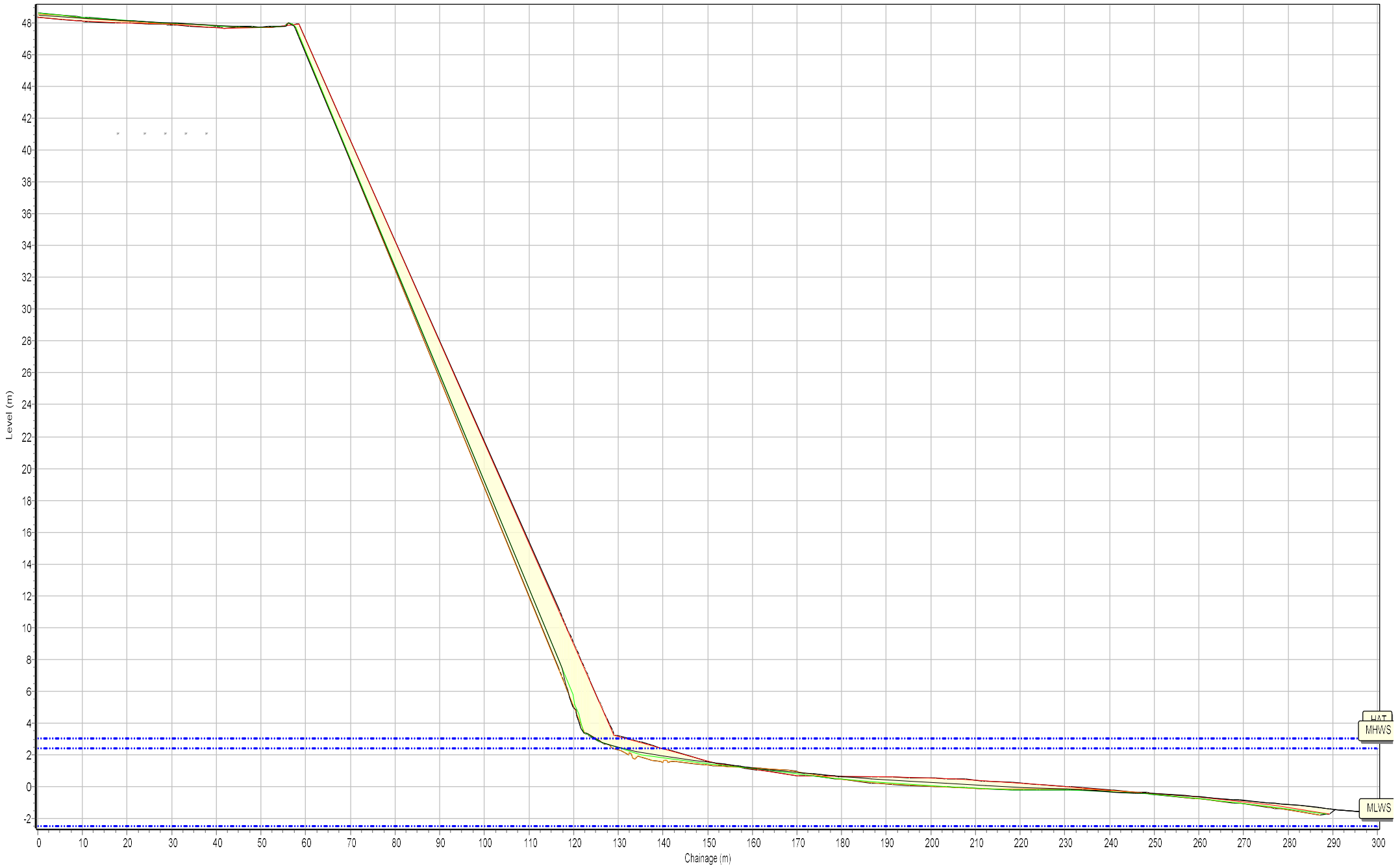


HAT  
MHWS

MLWS

SANDS

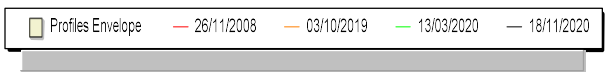
Beach Profiles: 1dCY3



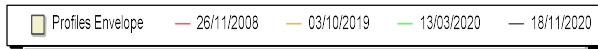
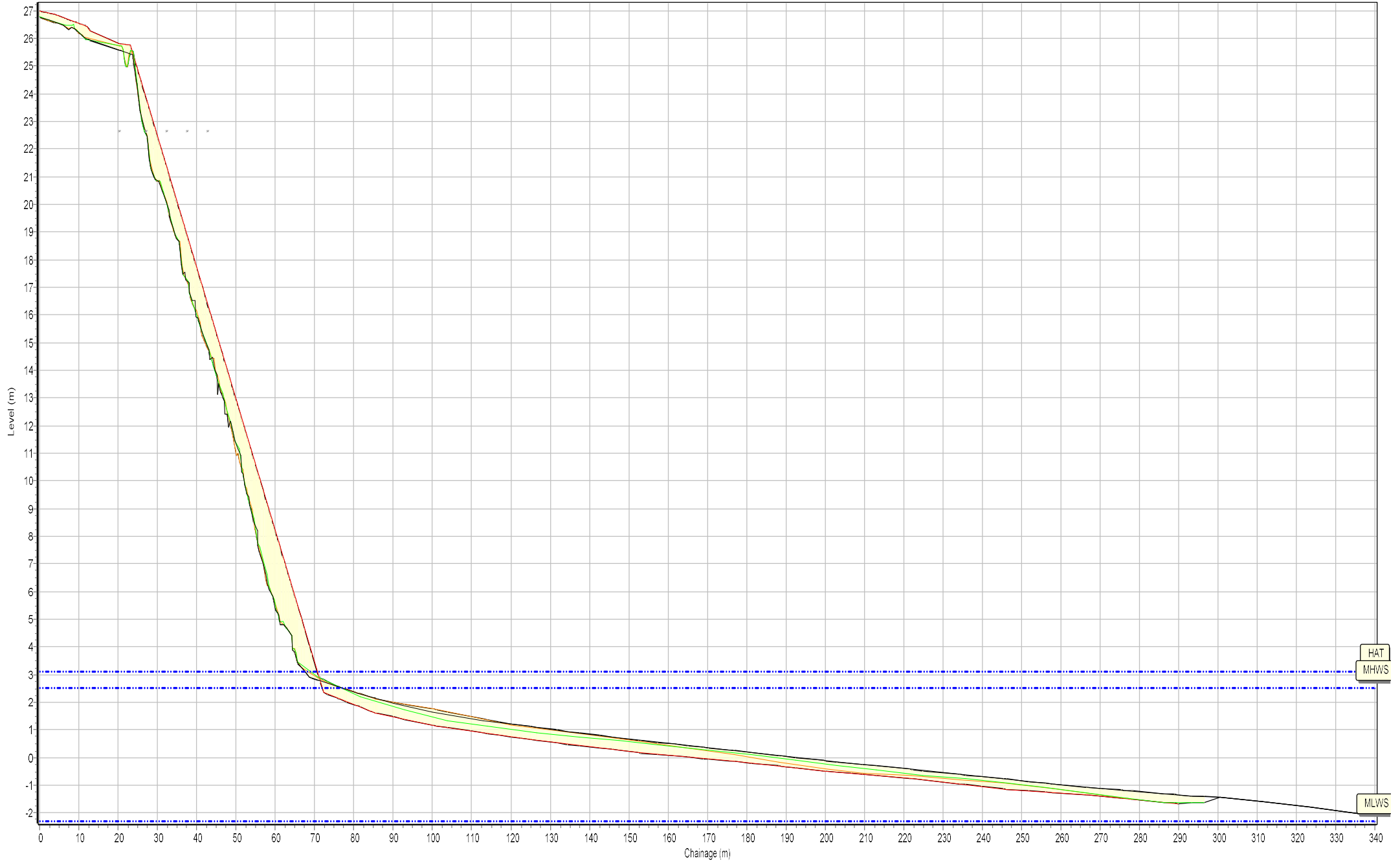
Profiles Envelope 17/11/2008 26/11/2019 26/04/2020 02/12/2020

SANDS

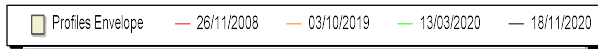
Beach Profiles: 1dFB1



Beach Profiles: 1dFB2



# Beach Profiles: 1dFB3



HAT

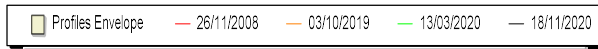
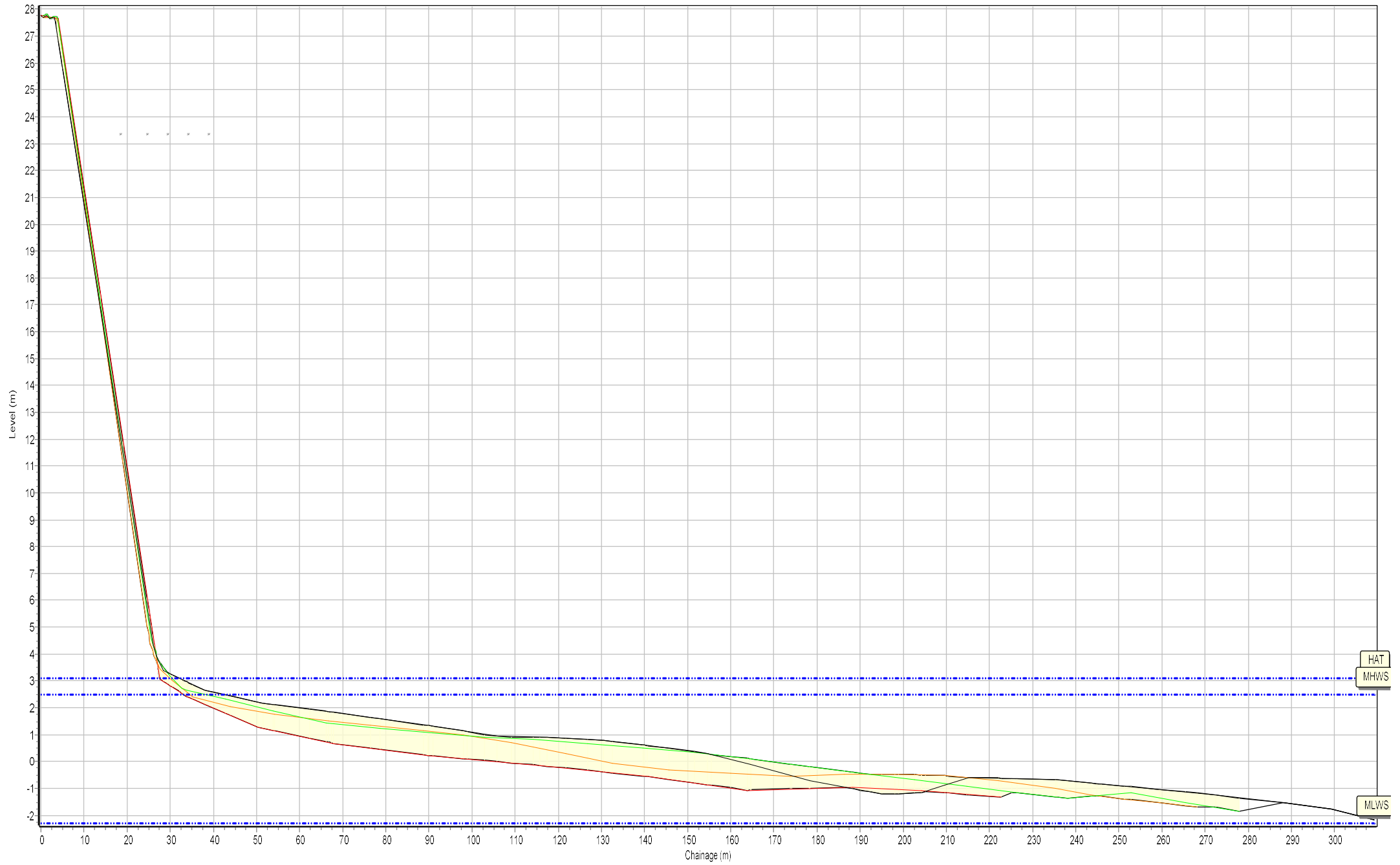
MHWS

MLWS

SANDS



Beach Profiles: 1dFB4

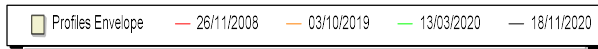
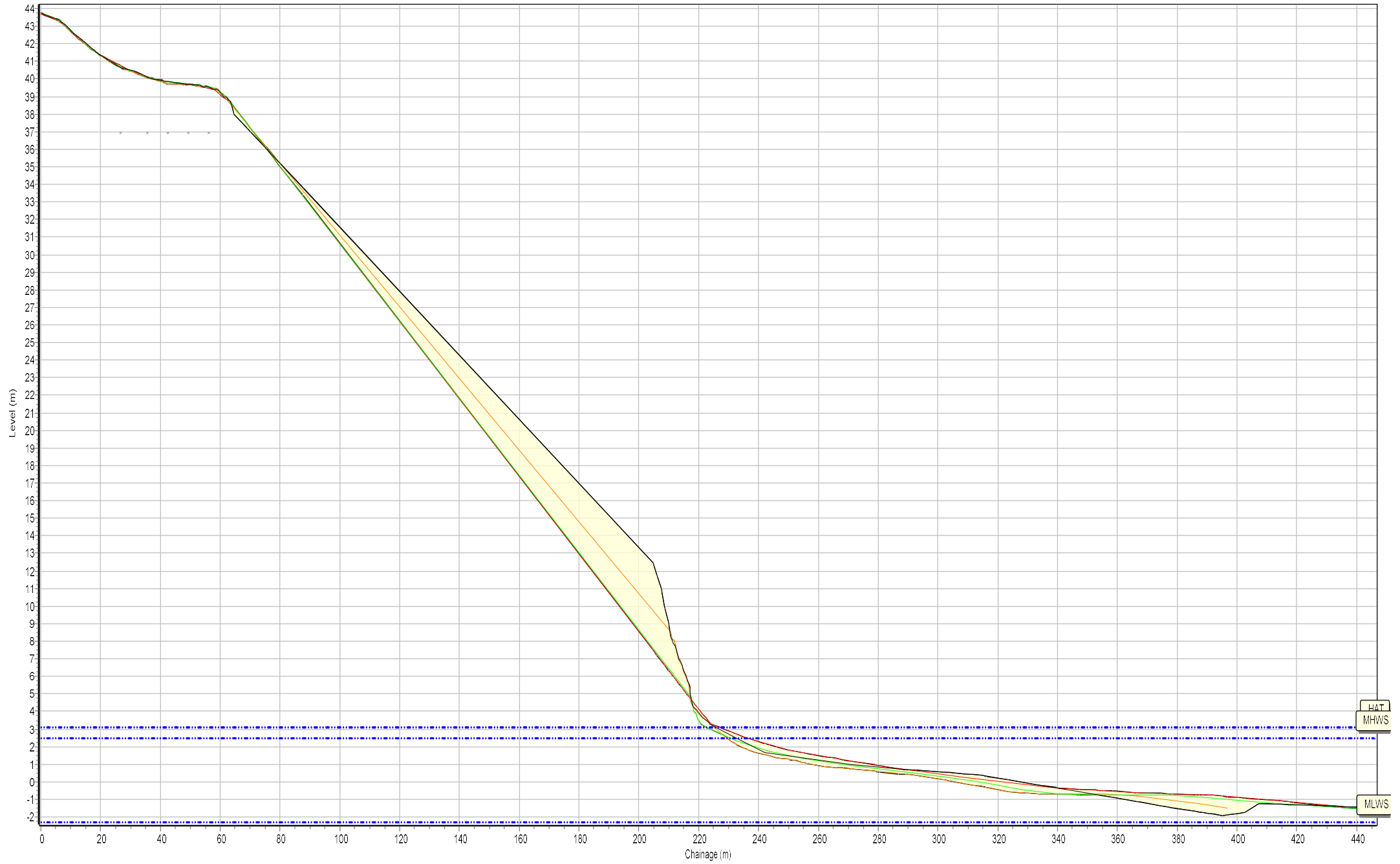


HAT  
MHWS

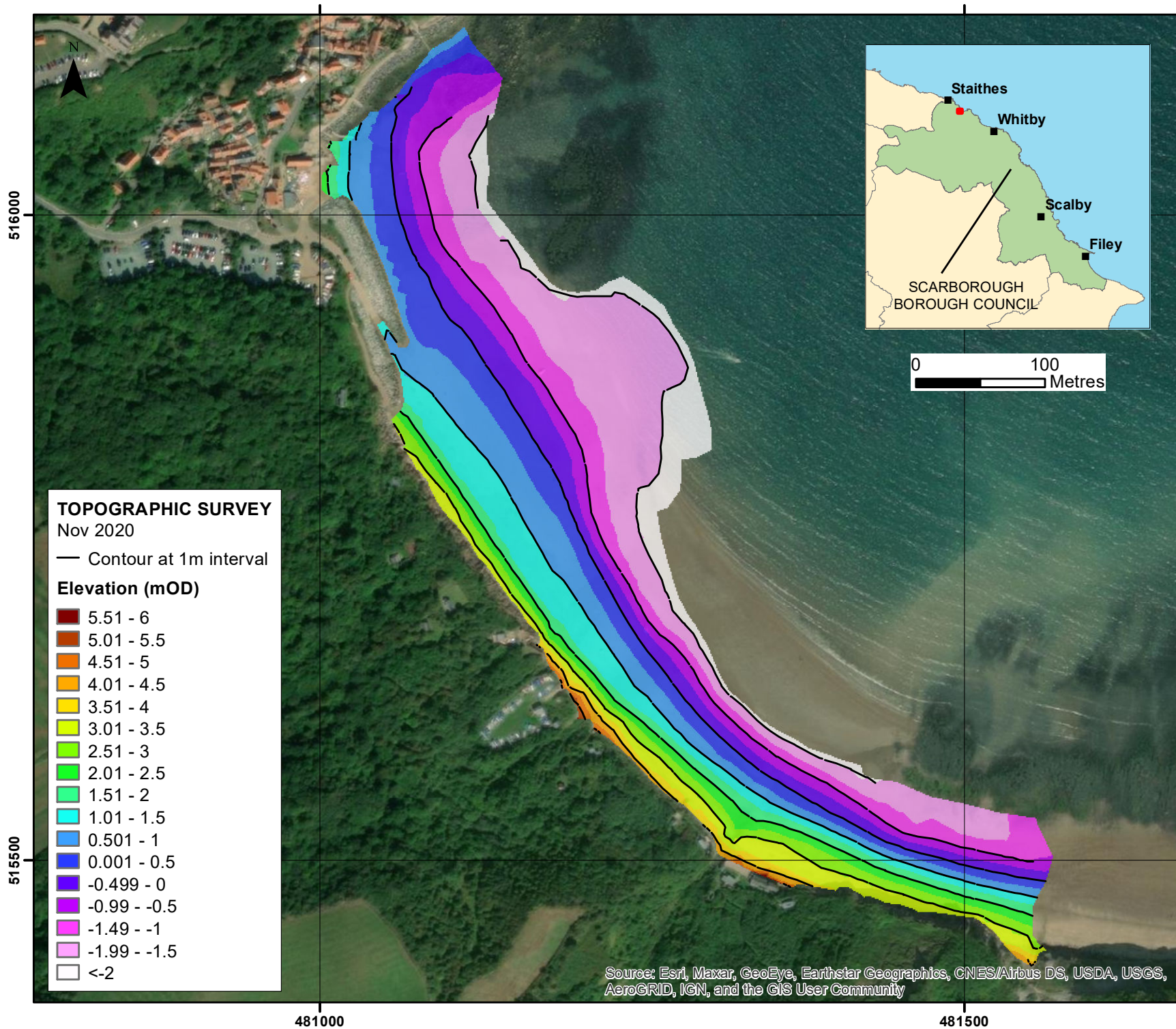
MLWS

SANDS

Beach Profiles: 1dFB5



**Appendix B**  
**Topographic Survey**



Key

Client: North East Coastal Group  
Project: Cell 1 Regional Coastal Monitoring Programme

**Appendix B - Map 1**  
**RUNSWICK BAY**

**Scarborough Borough Council Frontage**

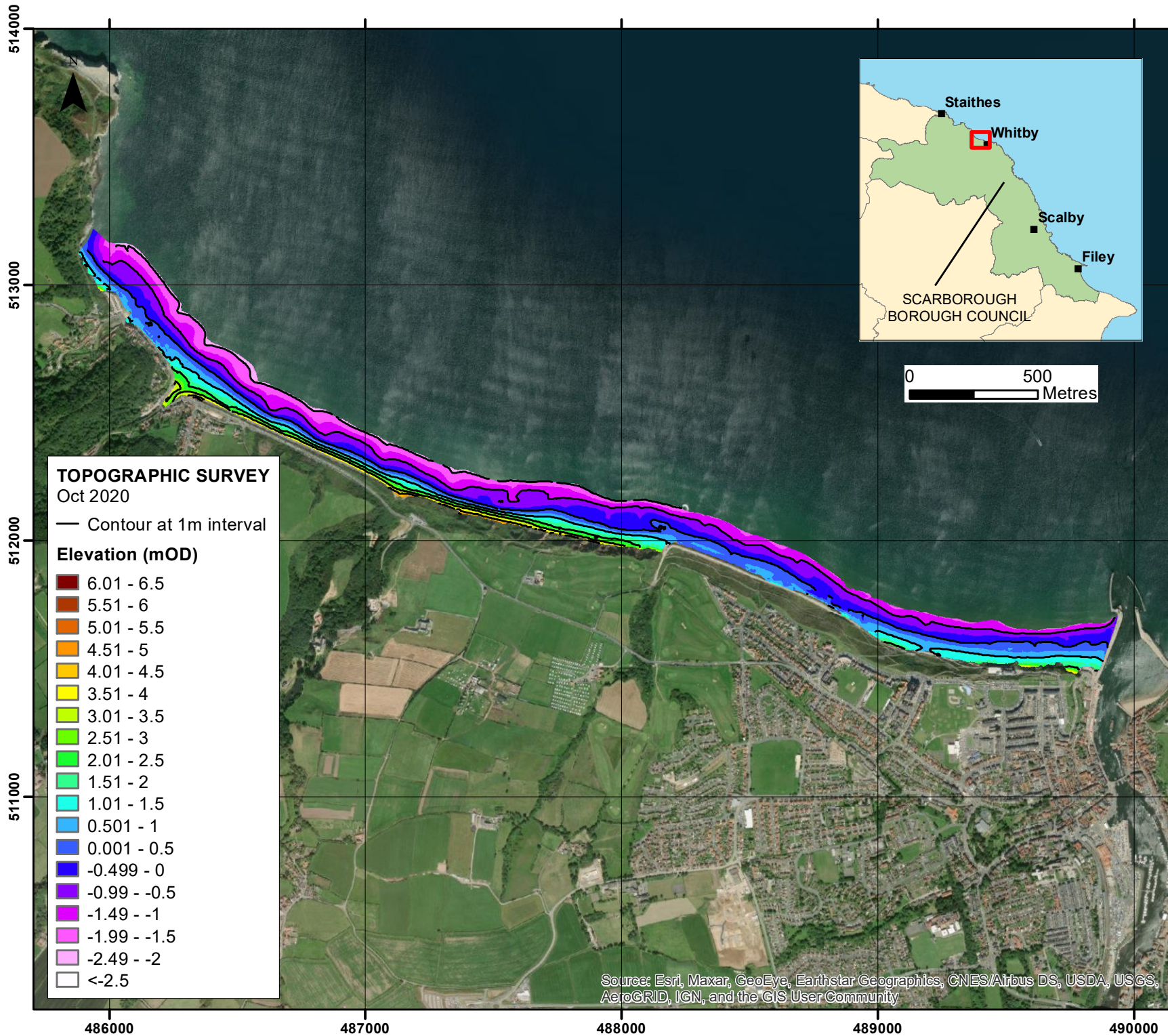
Analytical Report  
'Full Measures' Survey 2020

Drawing Scale at A4 1:4,000

**WATER**  
Royal HaskoningDHV  
Marlborough House  
Marlborough Crescent  
Newcastle upon Tyne  
NE1 4EE

Tel: +44 (0)191 211 1300  
Fax: +44 (0)191 211 1313  
www.royalhaskoningdhv.com



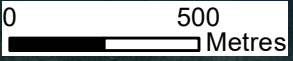


**TOPOGRAPHIC SURVEY**  
Oct 2020

— Contour at 1m interval

**Elevation (mOD)**

6.01 - 6.5
5.51 - 6
5.01 - 5.5
4.51 - 5
4.01 - 4.5
3.51 - 4
3.01 - 3.5
2.51 - 3
2.01 - 2.5
1.51 - 2
1.01 - 1.5
0.501 - 1
0.001 - 0.5
-0.499 - 0
-0.99 - -0.5
-1.49 - -1
-1.99 - -1.5
-2.49 - -2
<-2.5



Key

Client: North East Coastal Group  
Project: Cell 1 Regional Coastal Monitoring Programme

**Appendix B - Map 2**

**SANDESEND**

**Scarborough Borough Council Frontage**

Analytical Report  
'Full Measures' Survey 2020

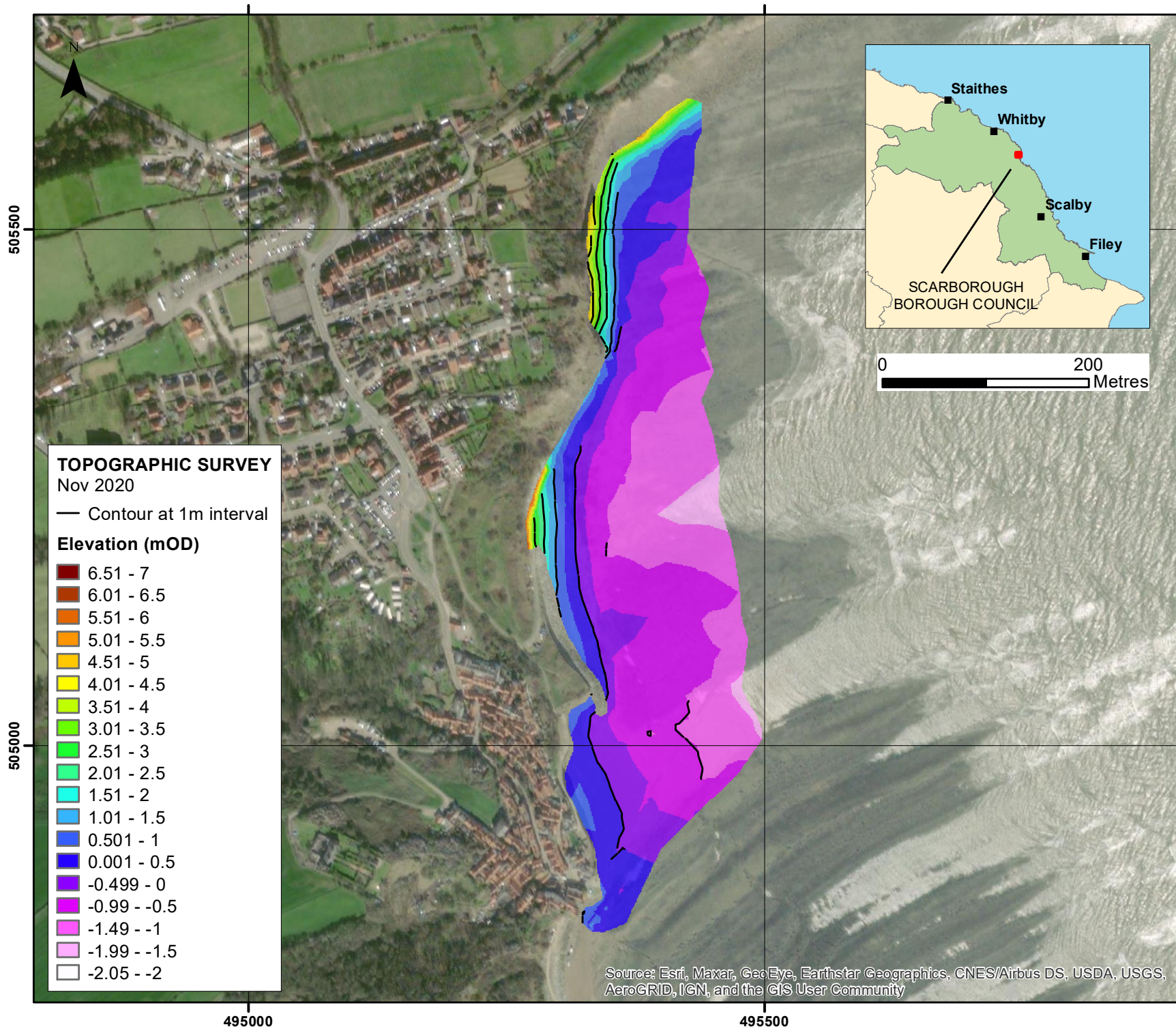
Drawing Scale at A4 1:20,000

**WATER**  
Royal HaskoningDHV  
Marlborough House  
Marlborough Crescent  
Newcastle upon Tyne  
NE1 4EE

Tel: +44 (0)191 211 1300  
Fax: +44 (0)191 211 1313  
www.royalhaskoningdhv.com



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



Key

Client: North East Coastal Group  
Project: Cell 1 Regional Coastal Monitoring Programme

**Appendix B - Map 3**

**ROBIN HOOD'S BAY**

**Scarborough Borough Council Frontage**

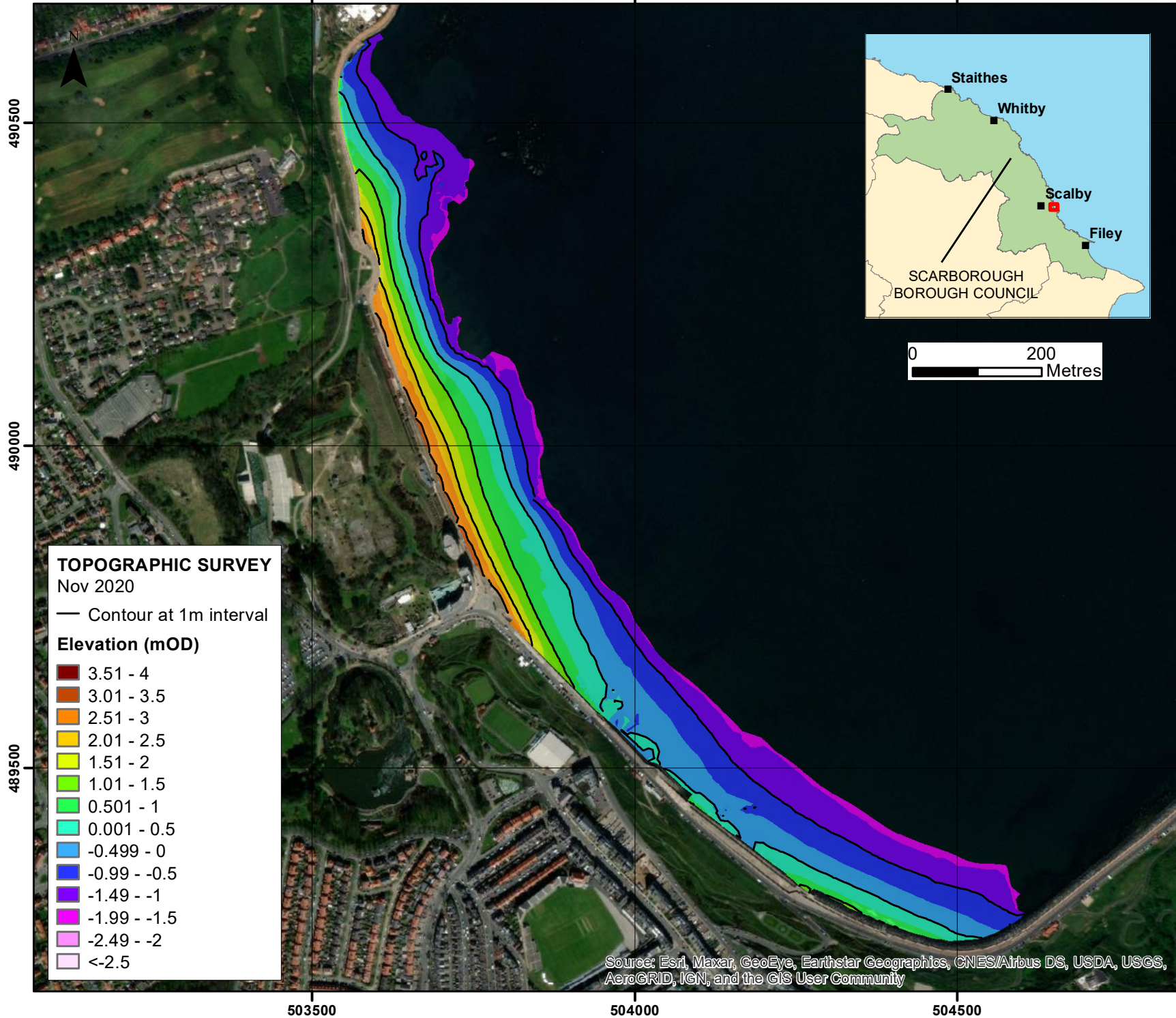
Analytical Report  
'Full Measures' Survey 2020

Drawing Scale at A4 1:5,000

**WATER**  
Royal HaskoningDHV  
Marlborough House  
Marlborough Crescent  
Newcastle upon Tyne  
NE1 4EE

Tel: +44 (0)191 211 1300  
Fax: +44 (0)191 211 1313  
www.royalhaskoningdhv.com





**TOPOGRAPHIC SURVEY**

Nov 2020

— Contour at 1m interval

**Elevation (mOD)**

- 3.51 - 4
- 3.01 - 3.5
- 2.51 - 3
- 2.01 - 2.5
- 1.51 - 2
- 1.01 - 1.5
- 0.501 - 1
- 0.001 - 0.5
- 0.499 - 0
- 0.99 - -0.5
- 1.49 - -1
- 1.99 - -1.5
- 2.49 - -2
- <math><-2.5</math>

Key

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

**Appendix B - Map 4**

**SCARBOROUGH NORTH BAY**

**Scarborough Borough Council Frontage**

Analytical Report  
'Full Measures' Survey 2020

Drawing Scale at A4 1:8,000

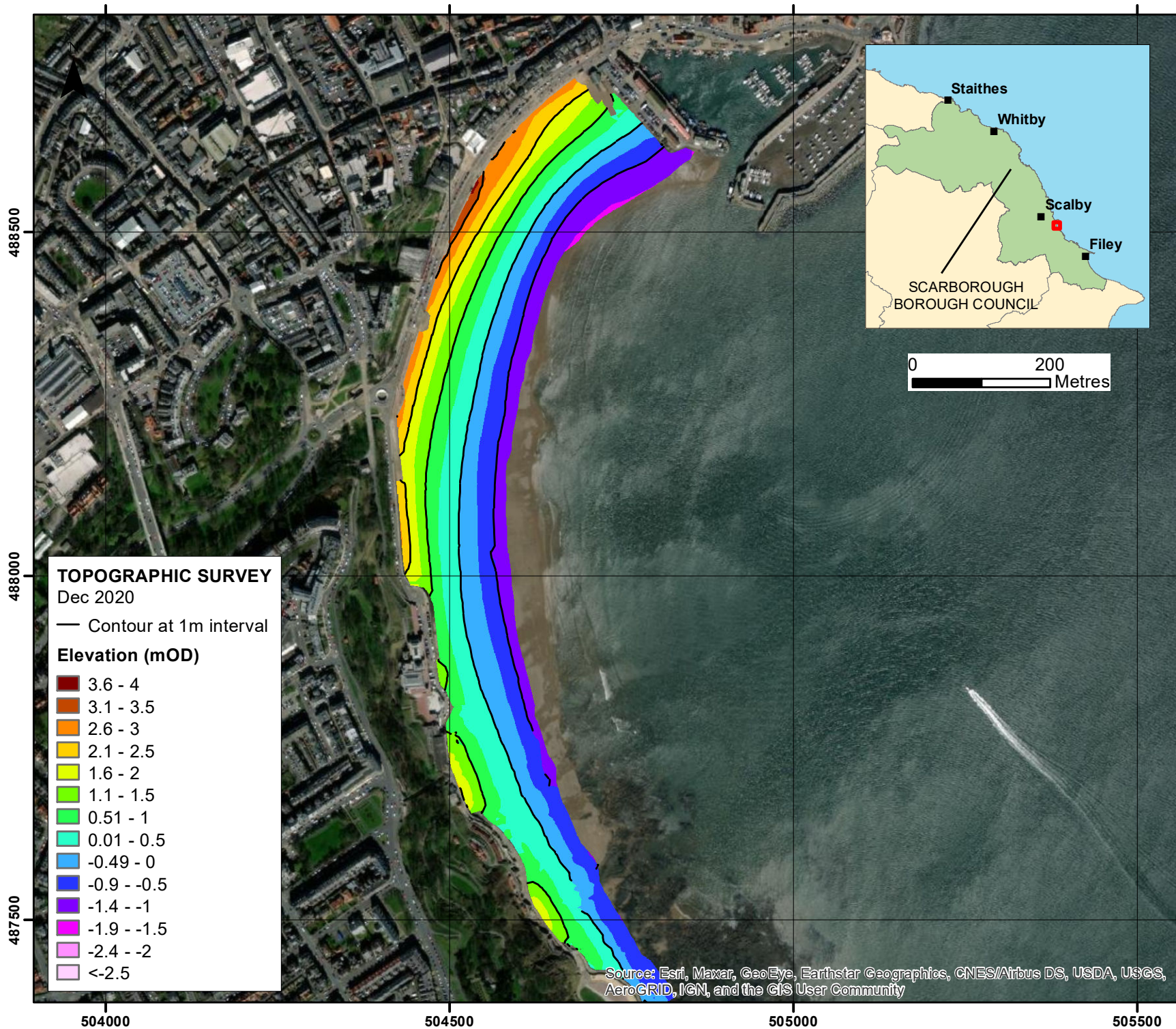
**WATER**

Royal HaskoningDHV  
Marlborough House  
Marlborough Crescent  
Newcastle upon Tyne  
NE1 4EE

Tel: +44 (0)191 211 1300  
Fax: +44 (0)191 211 1313  
[www.royalhaskoningdhv.com](http://www.royalhaskoningdhv.com)



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

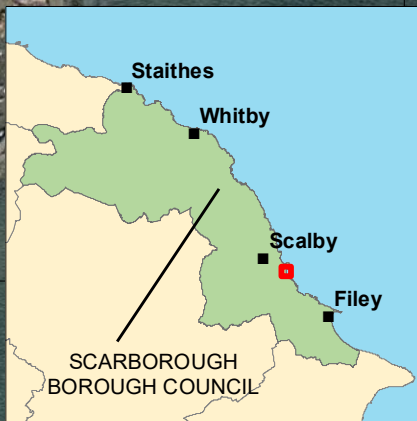


**TOPOGRAPHIC SURVEY**  
Dec 2020

— Contour at 1m interval

**Elevation (mOD)**

3.6 - 4
3.1 - 3.5
2.6 - 3
2.1 - 2.5
1.6 - 2
1.1 - 1.5
0.51 - 1
0.01 - 0.5
-0.49 - 0
-0.9 - -0.5
-1.4 - -1
-1.9 - -1.5
-2.4 - -2
<-2.5



Key

---

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

---

**Appendix B - Map 5**

**SCARBOROUGH SOUTH BAY**

**Scarborough Borough Council Frontage**

Analytical Report  
'Full Measures' Survey 2020

Drawing Scale at A4 1:7,500

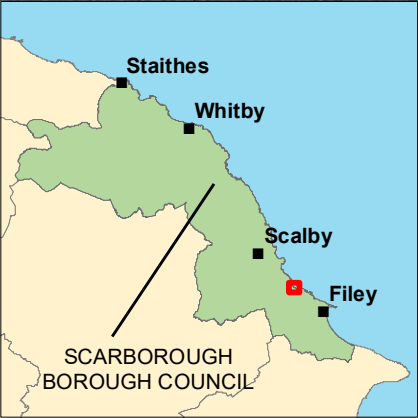
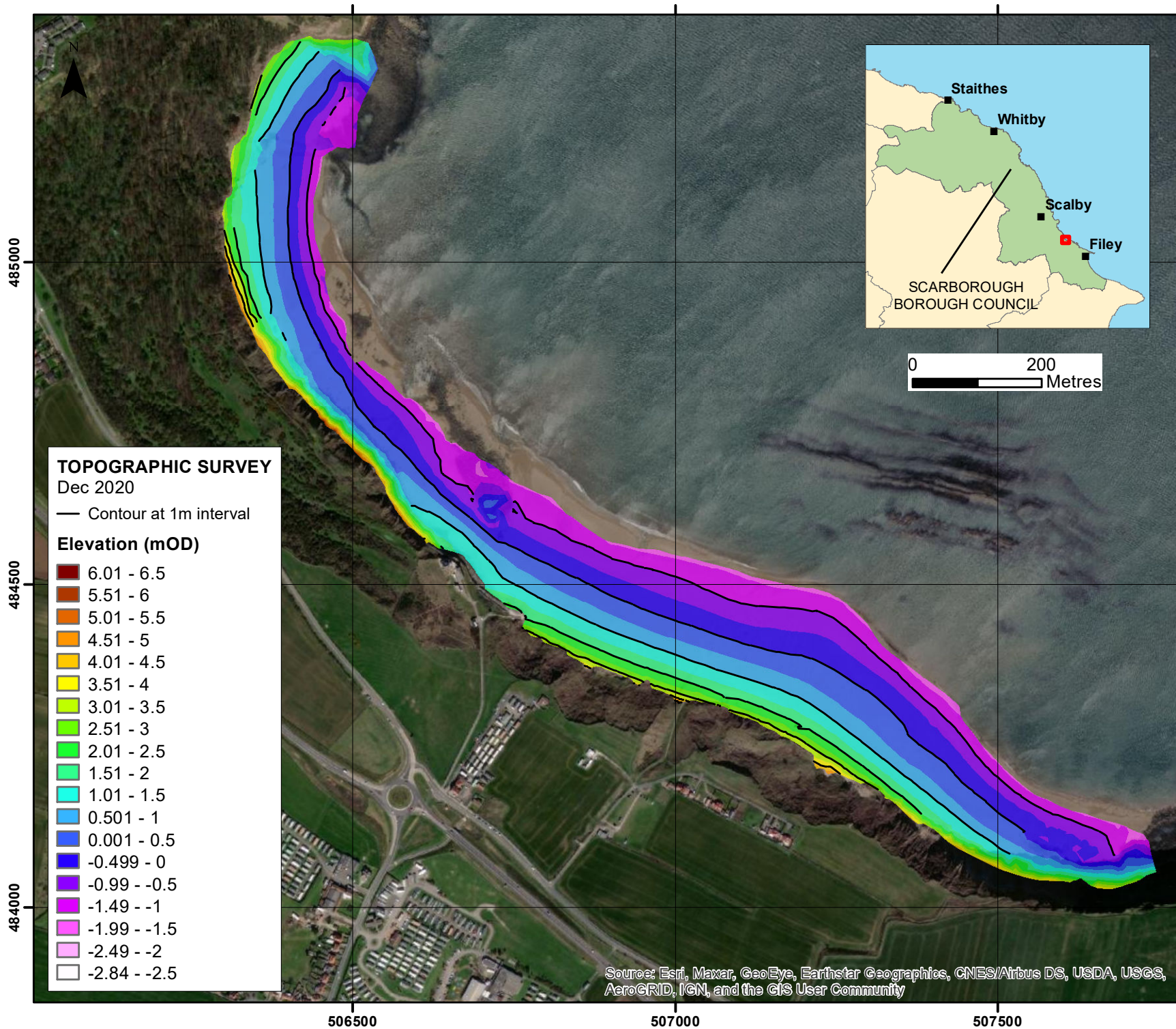
**WATER**  
Royal HaskoningDHV  
Marlborough House  
Marlborough Crescent  
Newcastle upon Tyne  
NE1 4EE

Tel: +44 (0)191 211 1300  
Fax: +44 (0)191 211 1313  
[www.royalhaskoningdhv.com](http://www.royalhaskoningdhv.com)

**Royal HaskoningDHV**  
Enhancing Society Together

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





Key

Client: North East Coastal Group  
Project: Cell 1 Regional Coastal Monitoring Programme

**Appendix B - Map 6**

**CAYTON BAY**

**Scarborough Borough Council Frontage**

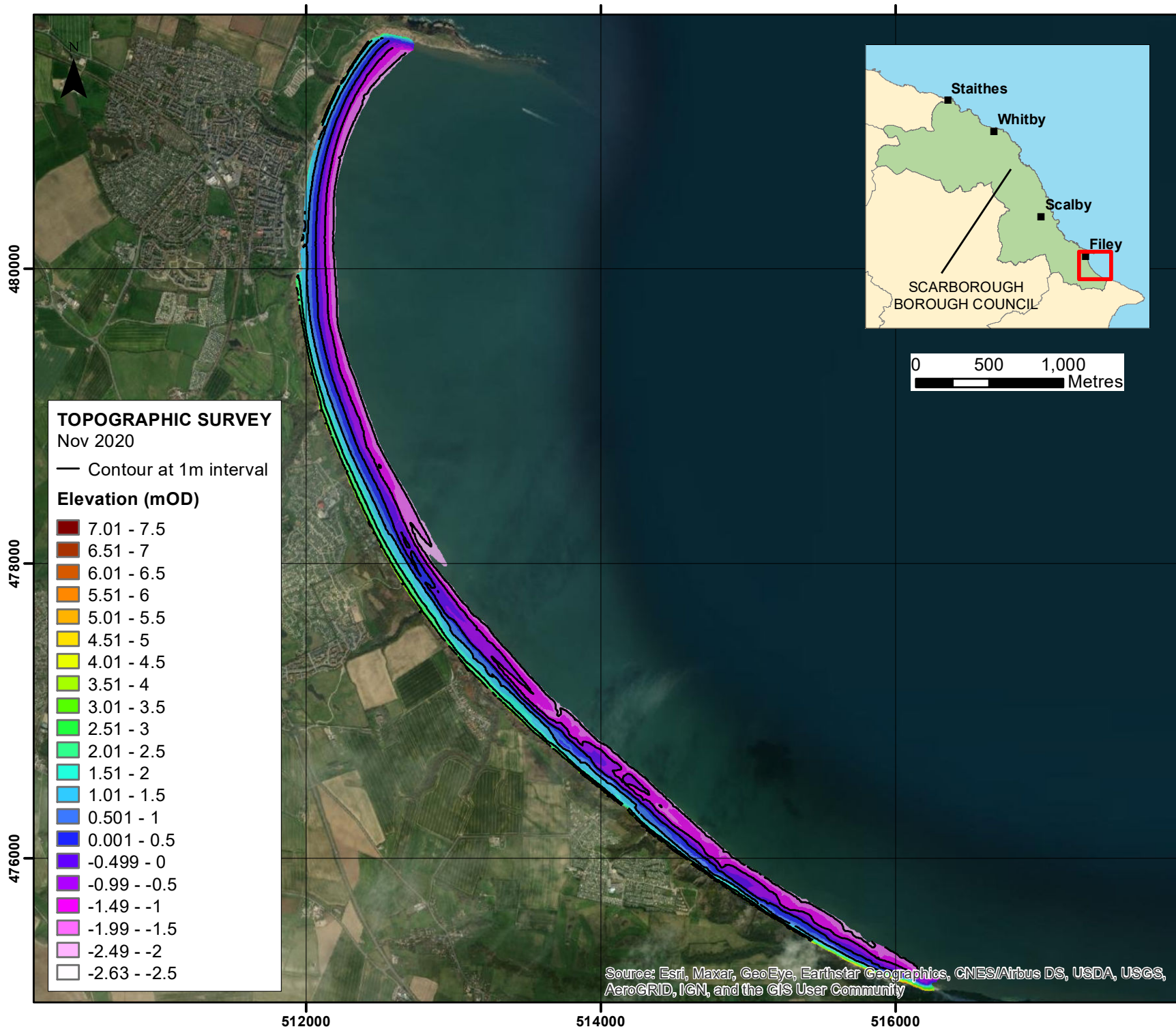
Analytical Report  
'Full Measures' Survey 2020

Drawing Scale at A4 1:8,000

**WATER**  
Royal HaskoningDHV  
Marlborough House  
Marlborough Crescent  
Newcastle upon Tyne  
NE1 4EE

Tel: +44 (0)191 211 1300  
Fax: +44 (0)191 211 1313  
www.royalhaskoningdhv.com





Key



Client: North East Coastal Group  
Project: Cell 1 Regional Coastal Monitoring Programme

**Appendix B - Map 7**

**FILEY BAY**

**Scarborough Borough Council Frontage**

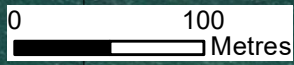
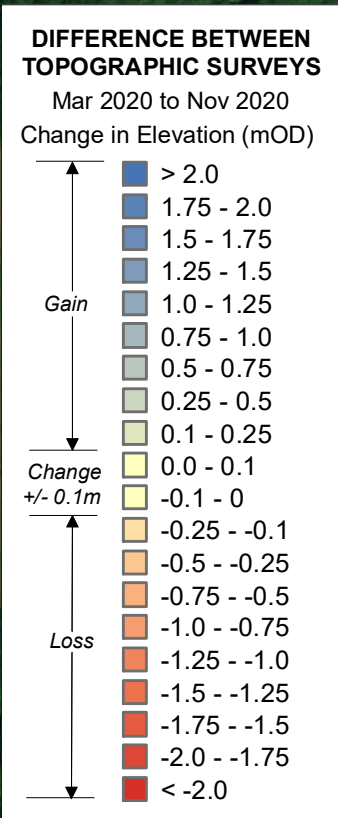
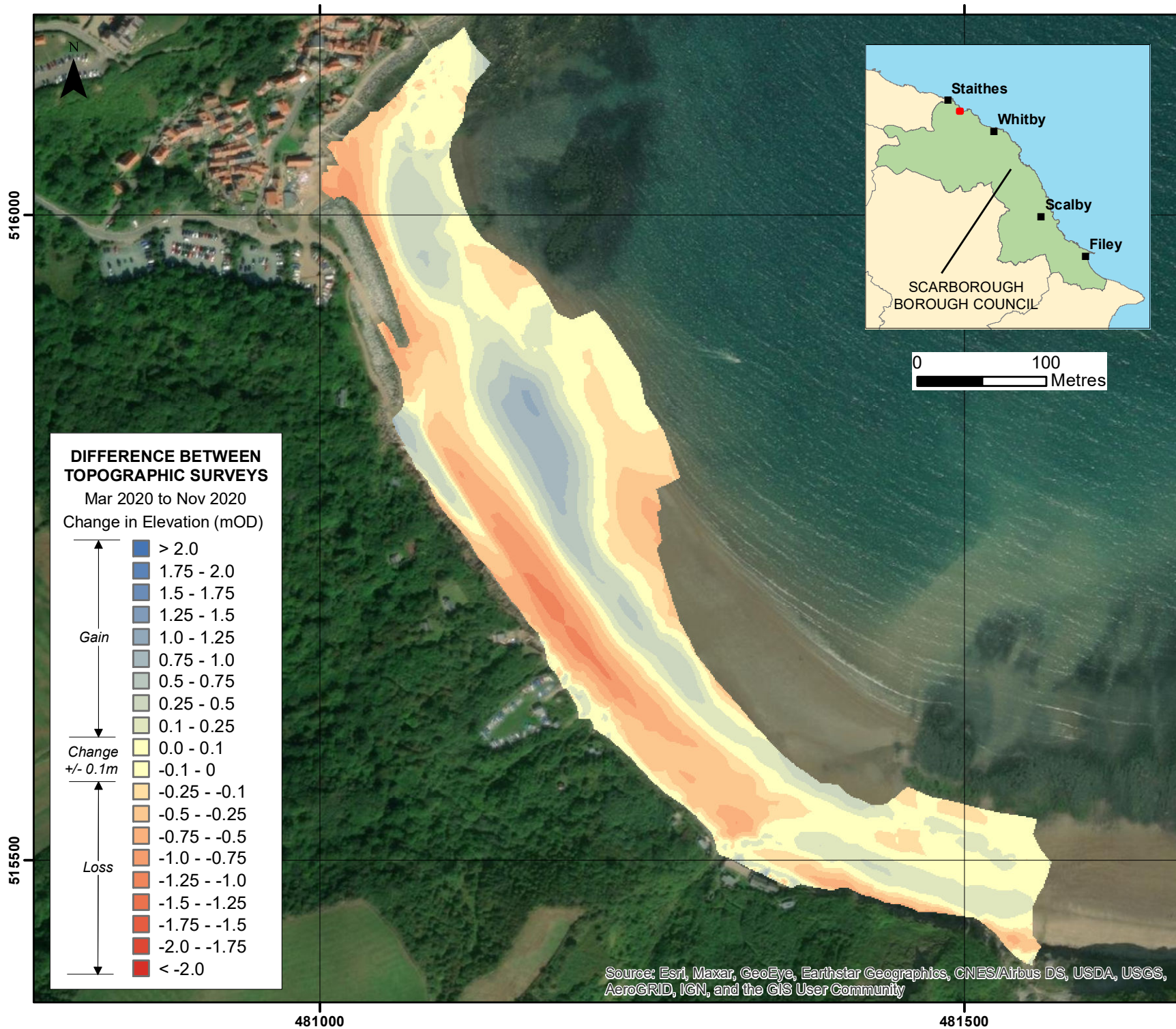
Analytical Report  
'Full Measures' Survey 2020

Drawing Scale at A4 1:35,000

**WATER**  
Royal HaskoningDHV  
Marlborough House  
Marlborough Crescent  
Newcastle upon Tyne  
NE1 4EE

Tel: +44 (0)191 211 1300  
Fax: +44 (0)191 211 1313  
[www.royalhaskoningdhv.com](http://www.royalhaskoningdhv.com)





Key

Client: North East Coastal Group  
 Project: Cell 1 Regional Coastal Monitoring Programme

**Appendix B - Map 8**  
**RUNSWICK BAY**

**Scarborough Borough Council Frontage**  
 Analytical Report  
 'Full Measures' Survey 2020

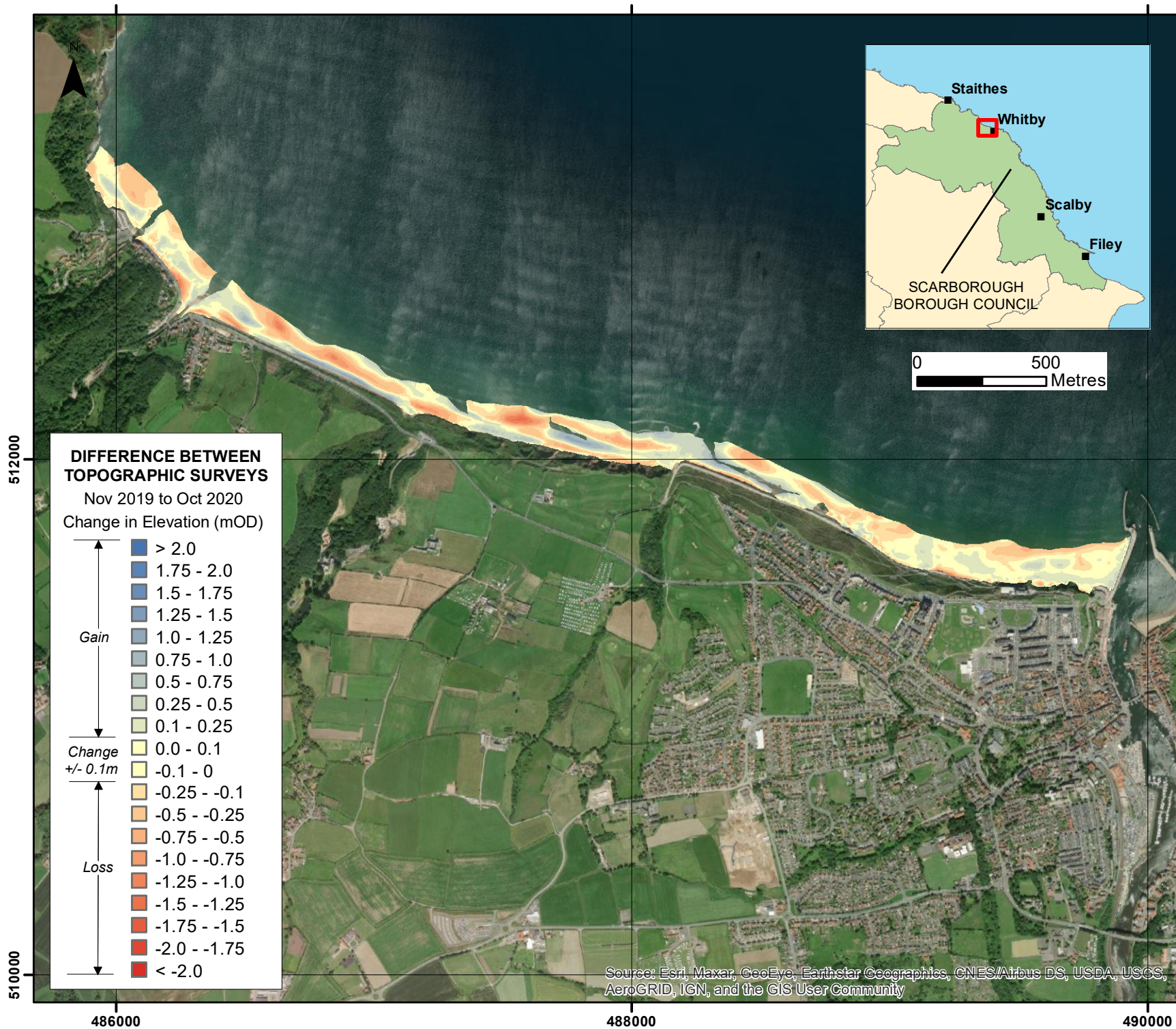
Drawing Scale at A4 1:4,000

**WATER**  
 Royal HaskoningDHV  
 Marlborough House  
 Marlborough Crescent  
 Newcastle upon Tyne  
 NE1 4EE

Tel: +44 (0)191 211 1300  
 Fax: +44 (0)191 211 1313  
 www.royalhaskoningdhv.com



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



**DIFFERENCE BETWEEN TOPOGRAPHIC SURVEYS**  
 Nov 2019 to Oct 2020  
 Change in Elevation (mOD)

Gain	> 2.0
	1.75 - 2.0
	1.5 - 1.75
	1.25 - 1.5
	1.0 - 1.25
	0.75 - 1.0
	0.5 - 0.75
	0.25 - 0.5
	0.1 - 0.25
	0.0 - 0.1
Change +/- 0.1m	-0.1 - 0
	-0.25 - -0.1
	-0.5 - -0.25
	-0.75 - -0.5
	-1.0 - -0.75
	-1.25 - -1.0
	-1.5 - -1.25
	-1.75 - -1.5
	-2.0 - -1.75
	< -2.0
Loss	



Key

Client: North East Coastal Group  
 Project: Cell 1 Regional Coastal Monitoring Programme

**Appendix B - Map 9**  
**SANDESEND**

**Scarborough Borough Council Frontage**  
 Analytical Report  
 'Full Measures' Survey 2020

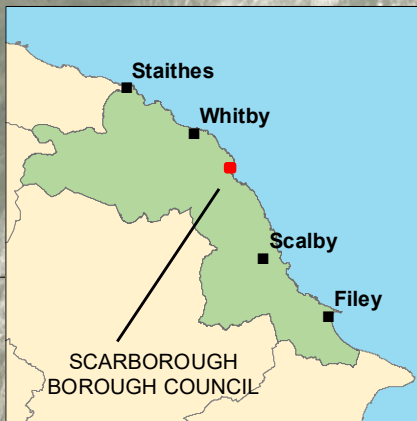
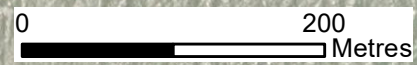
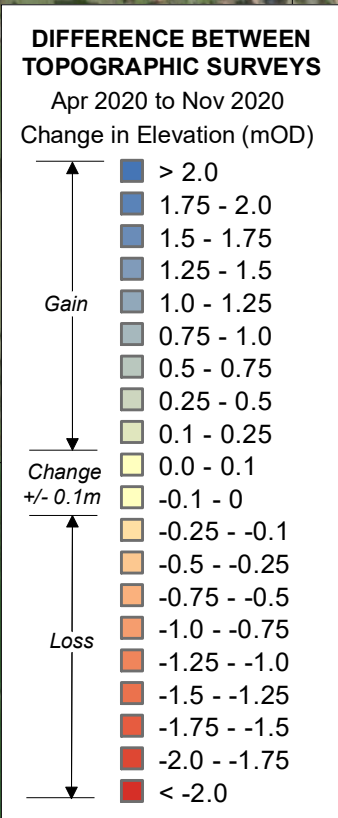
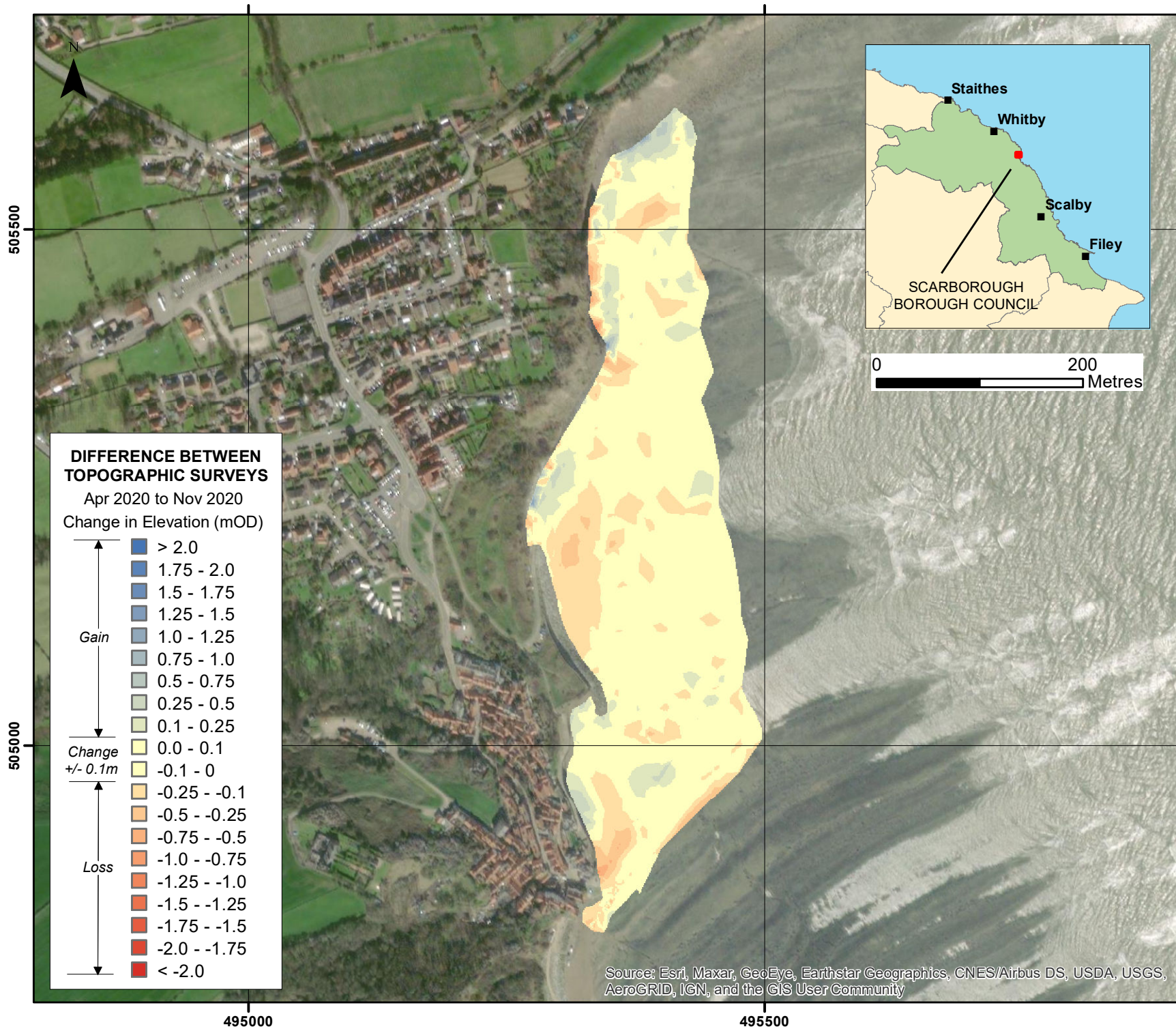
Drawing Scale at A4 1:20,000

**WATER**  
 Royal HaskoningDHV  
 Marlborough House  
 Marlborough Crescent  
 Newcastle upon Tyne  
 NE1 4EE

Tel: +44 (0)191 211 1300  
 Fax: +44 (0)191 211 1313  
 www.royalhaskoningdhv.com



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



Key

Client: North East Coastal Group  
 Project: Cell 1 Regional Coastal Monitoring Programme

**Appendix B - Map 10**  
**ROBIN HOOD'S BAY**  
**Scarborough Borough Council Frontage**  
 Analytical Report  
 'Full Measures' Survey 2020

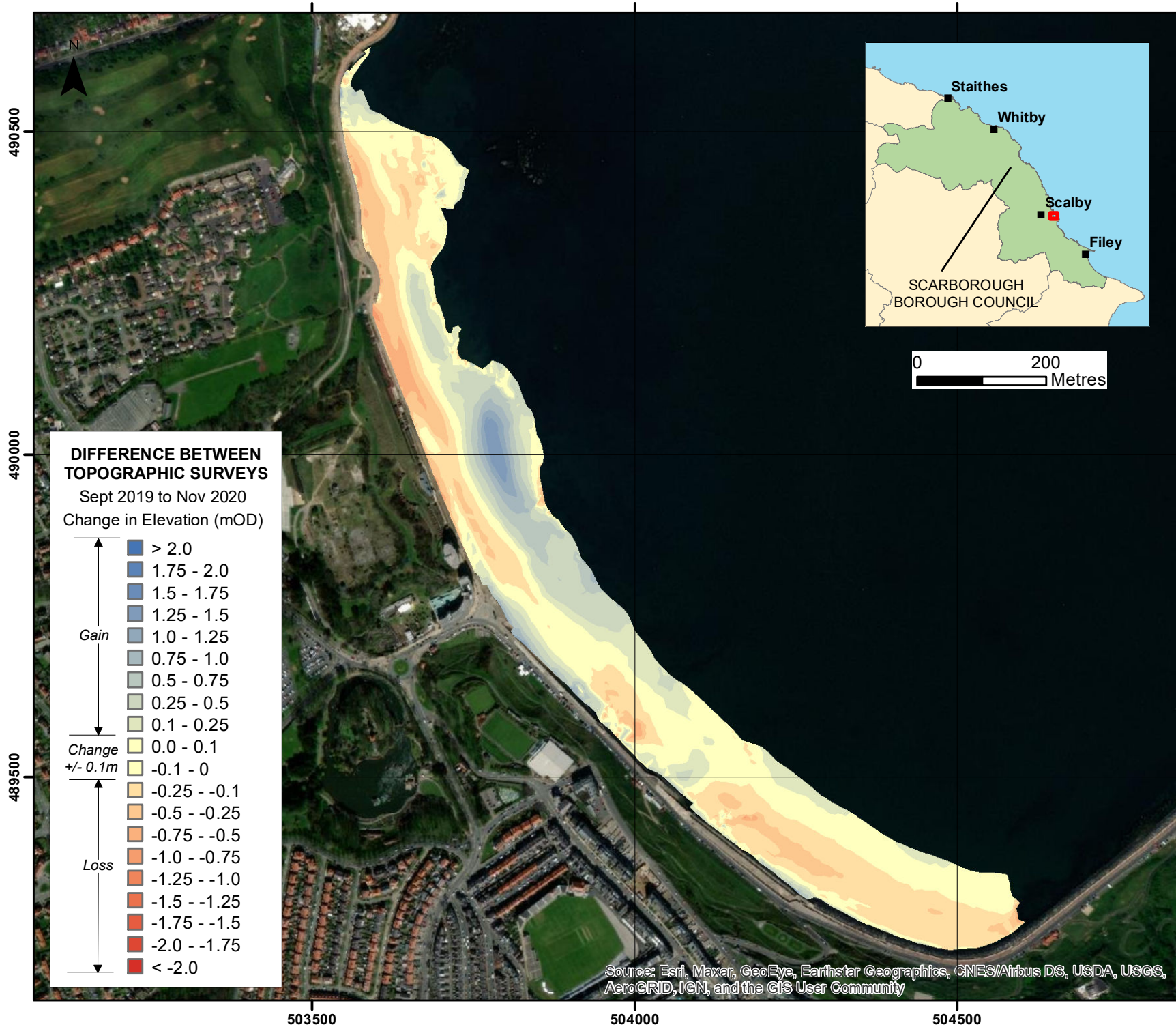
Drawing Scale at A4 1:5,000

**WATER**  
 Royal HaskoningDHV  
 Marlborough House  
 Marlborough Crescent  
 Newcastle upon Tyne  
 NE1 4EE

Tel: +44 (0)191 211 1300  
 Fax: +44 (0)191 211 1313  
[www.royalhaskoningdhv.com](http://www.royalhaskoningdhv.com)



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



**DIFFERENCE BETWEEN TOPOGRAPHIC SURVEYS**  
 Sept 2019 to Nov 2020  
 Change in Elevation (mOD)

Gain	> 2.0	
	1.75 - 2.0	
	1.5 - 1.75	
	1.25 - 1.5	
	1.0 - 1.25	
	0.75 - 1.0	
	0.5 - 0.75	
Change +/- 0.1m	0.25 - 0.5	
	0.1 - 0.25	
	0.0 - 0.1	
	-0.1 - 0	
	Loss	-0.25 - -0.1
		-0.5 - -0.25
		-0.75 - -0.5
-1.0 - -0.75		
-1.25 - -1.0		
-1.5 - -1.25		
-1.75 - -1.5		
-2.0 - -1.75		
< -2.0		



Key

Client: North East Coastal Group  
 Project: Cell 1 Regional Coastal Monitoring Programme

**Appendix B - Map 11**

**SCARBOROUGH NORTH BAY**

**Scarborough Borough Council Frontage**

Analytical Report  
 'Full Measures' Survey 2020

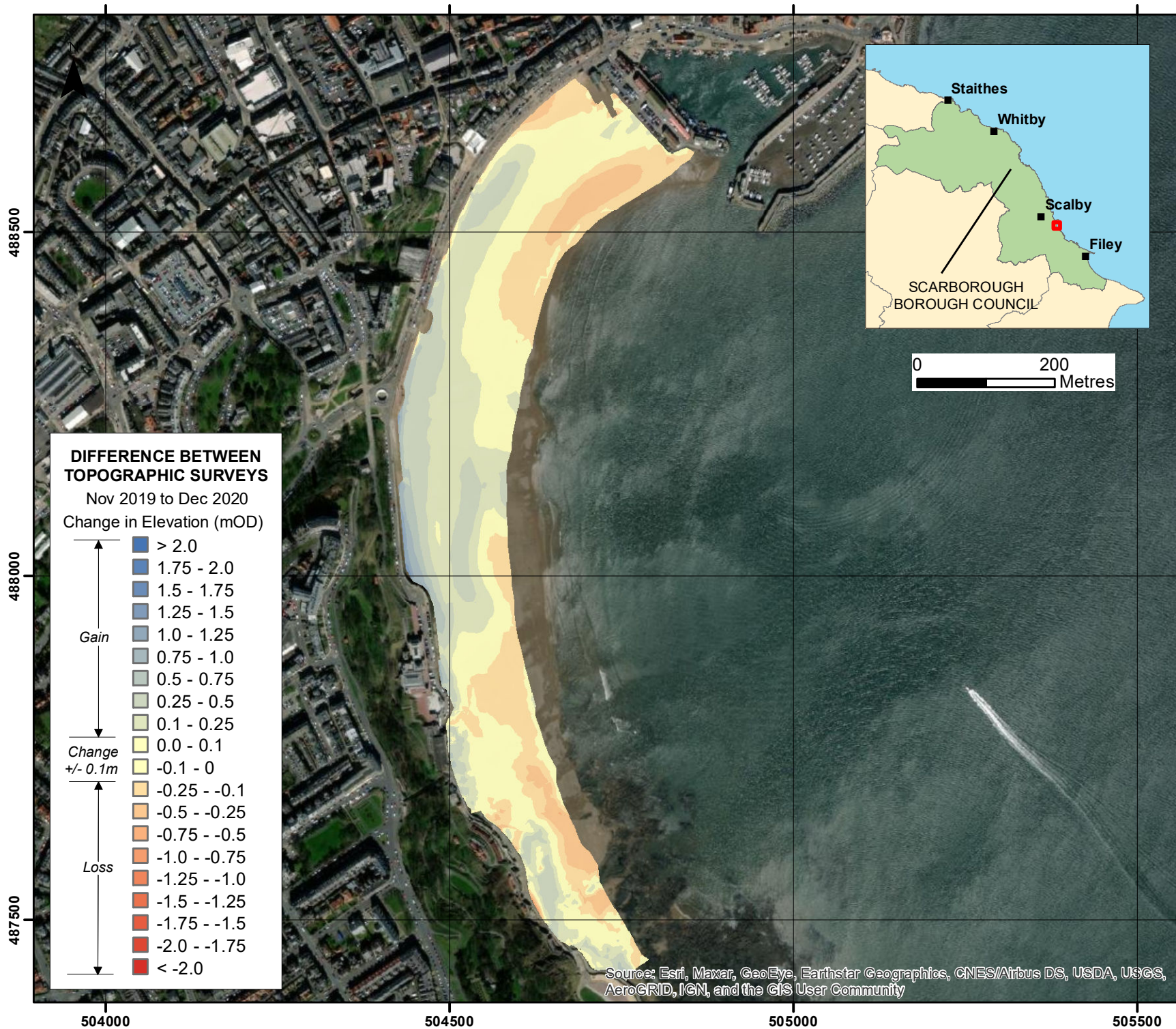
Drawing Scale at A4 1:8,000

**WATER**  
 Royal HaskoningDHV  
 Marlborough House  
 Marlborough Crescent  
 Newcastle upon Tyne  
 NE1 4EE

Tel: +44 (0)191 211 1300  
 Fax: +44 (0)191 211 1313  
 www.royalhaskoningdhv.com



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



**DIFFERENCE BETWEEN TOPOGRAPHIC SURVEYS**  
 Nov 2019 to Dec 2020  
 Change in Elevation (mOD)

Gain	> 2.0
	1.75 - 2.0
	1.5 - 1.75
	1.25 - 1.5
	1.0 - 1.25
	0.75 - 1.0
	0.5 - 0.75
	0.25 - 0.5
	0.1 - 0.25
	0.0 - 0.1
Change +/- 0.1m	-0.1 - 0
	-0.25 - -0.1
	-0.5 - -0.25
	-0.75 - -0.5
	-1.0 - -0.75
	-1.25 - -1.0
	-1.5 - -1.25
	-1.75 - -1.5
	-2.0 - -1.75
	< -2.0
Loss	



Key

---

Client: North East Coastal Group  
 Project: Cell 1 Regional Coastal Monitoring Programme

---

**Appendix B - Map 12**

**SCARBOROUGH SOUTH BAY**

**Scarborough Borough Council Frontage**

Analytical Report  
 'Full Measures' Survey 2020

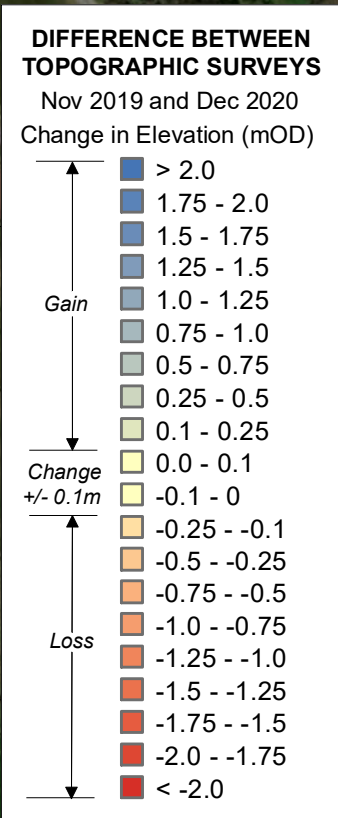
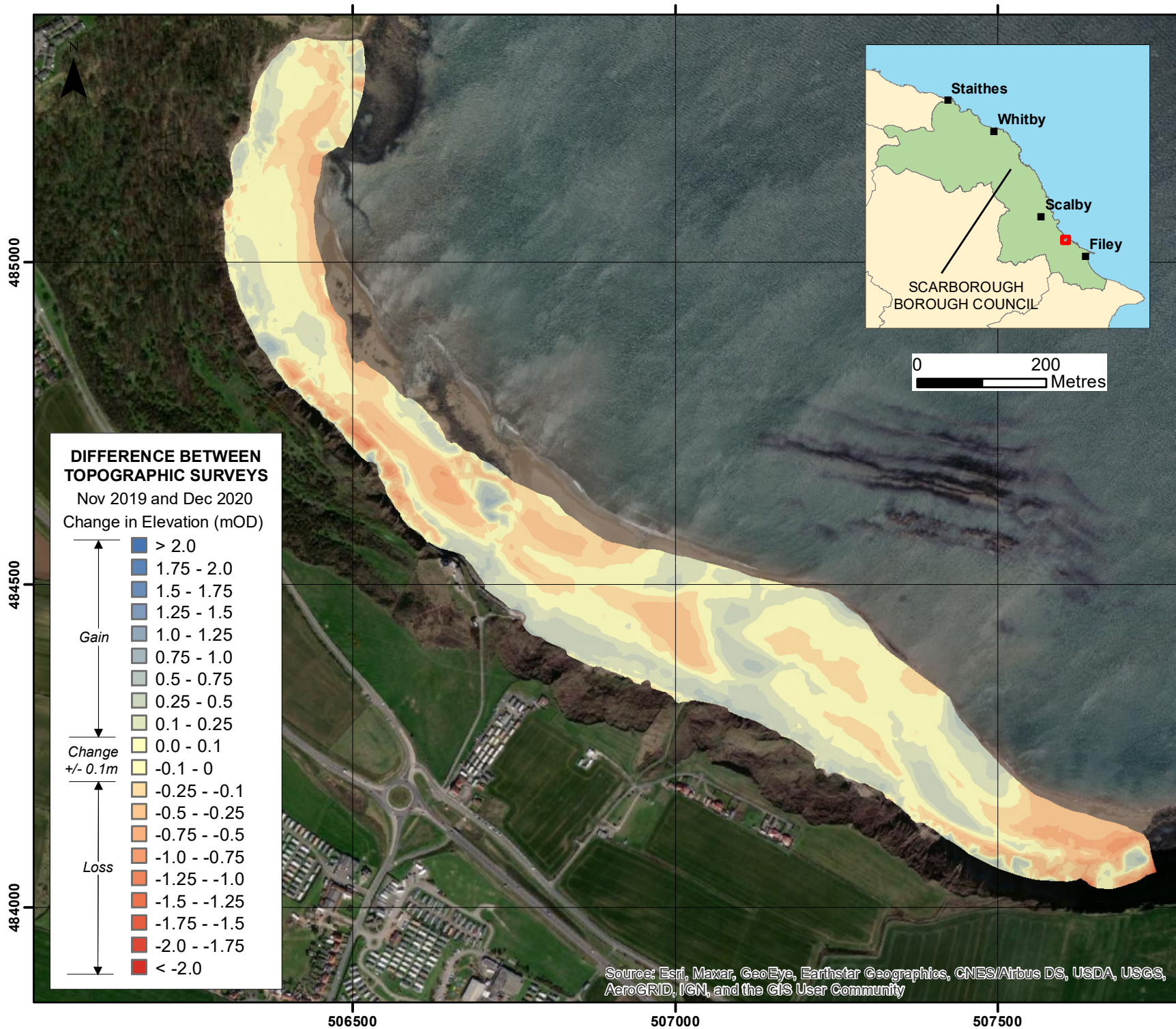
Drawing Scale at A4 1:7,500

**WATER**  
 Royal HaskoningDHV  
 Marlborough House  
 Marlborough Crescent  
 Newcastle upon Tyne  
 NE1 4EE

Tel: +44 (0)191 211 1300  
 Fax: +44 (0)191 211 1313  
 www.royalhaskoningdhv.com

**Royal HaskoningDHV**  
 Enhancing Society Together

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



Key

Client: North East Coastal Group  
 Project: Cell 1 Regional Coastal Monitoring Programme

**Appendix B - Map 13**

**CAYTON BAY**

**Scarborough Borough Council Frontage**

Analytical Report  
 'Full Measures' Survey 2020

Drawing Scale at A4 1:8,000

**WATER**  
 Royal HaskoningDHV  
 Marlborough House  
 Marlborough Crescent  
 Newcastle upon Tyne  
 NE1 4EE

Tel: +44 (0)191 211 1300  
 Fax: +44 (0)191 211 1313  
 www.royalhaskoningdhv.com

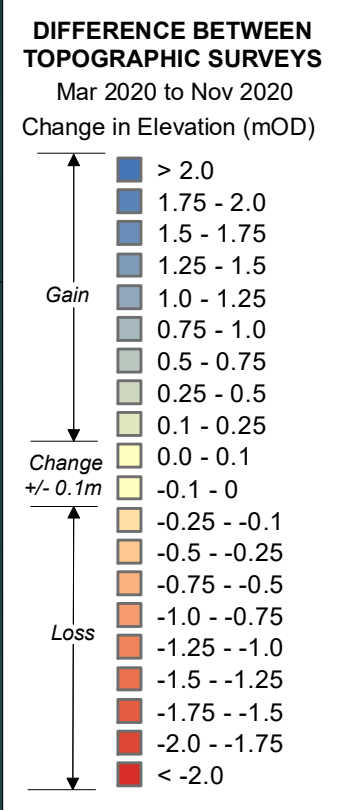
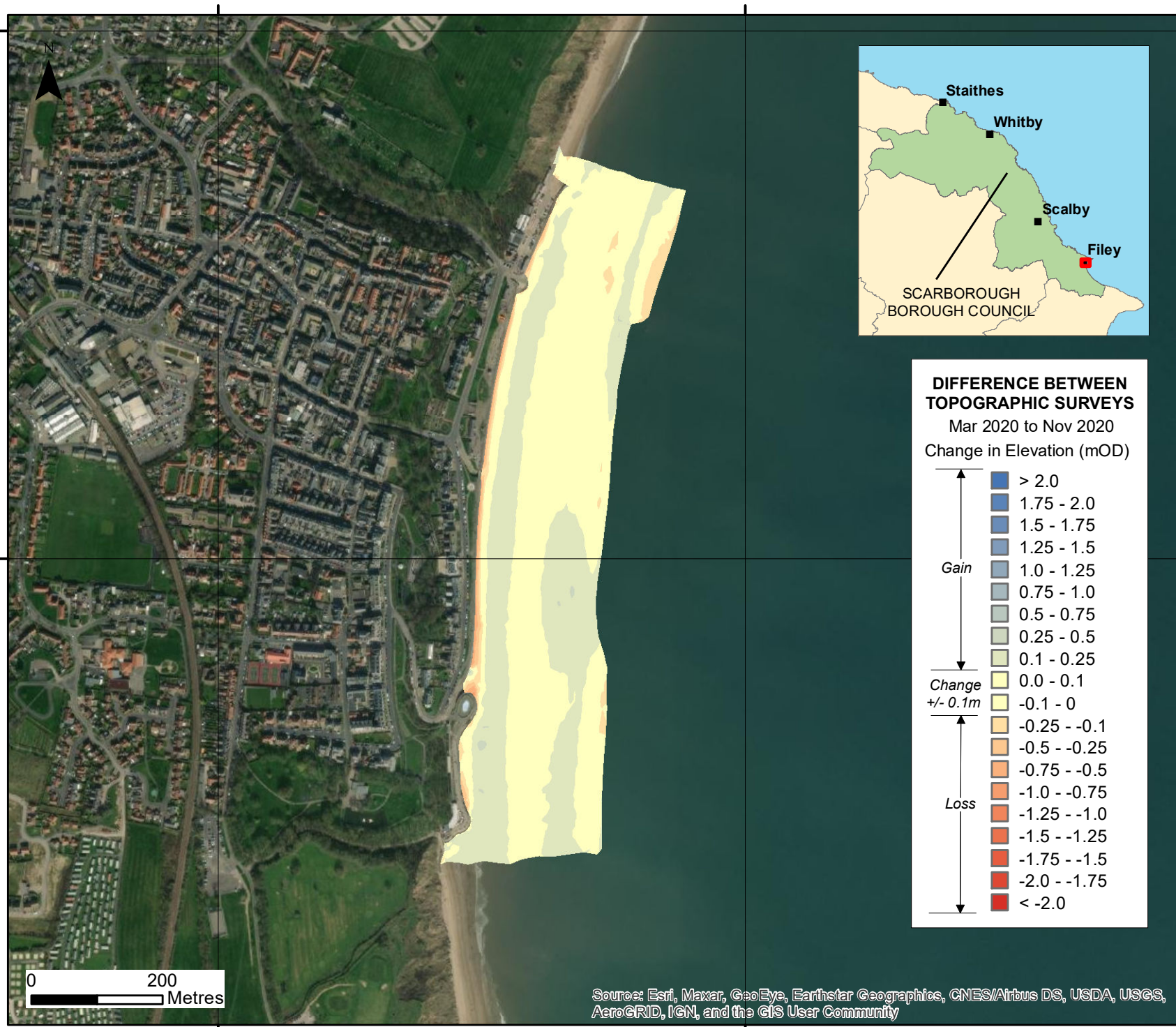


Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



481200

480400



Key

Client: North East Coastal Group  
Project: Cell 1 Regional Coastal Monitoring Programme

**Appendix B - Map 14**  
**FILEY BAY**

**Scarborough Borough Council Frontage**

Analytical Report  
'Full Measures' Survey 2020

Drawing Scale at A4 1:8,000

**WATER**  
Royal HaskoningDHV  
Marlborough House  
Marlborough Crescent  
Newcastle upon Tyne  
NE1 4EE

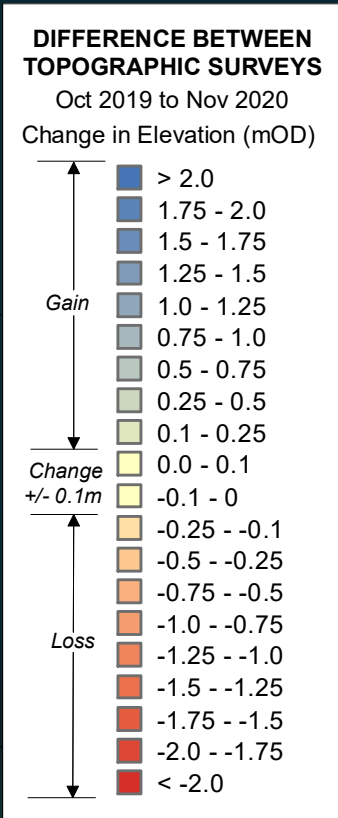
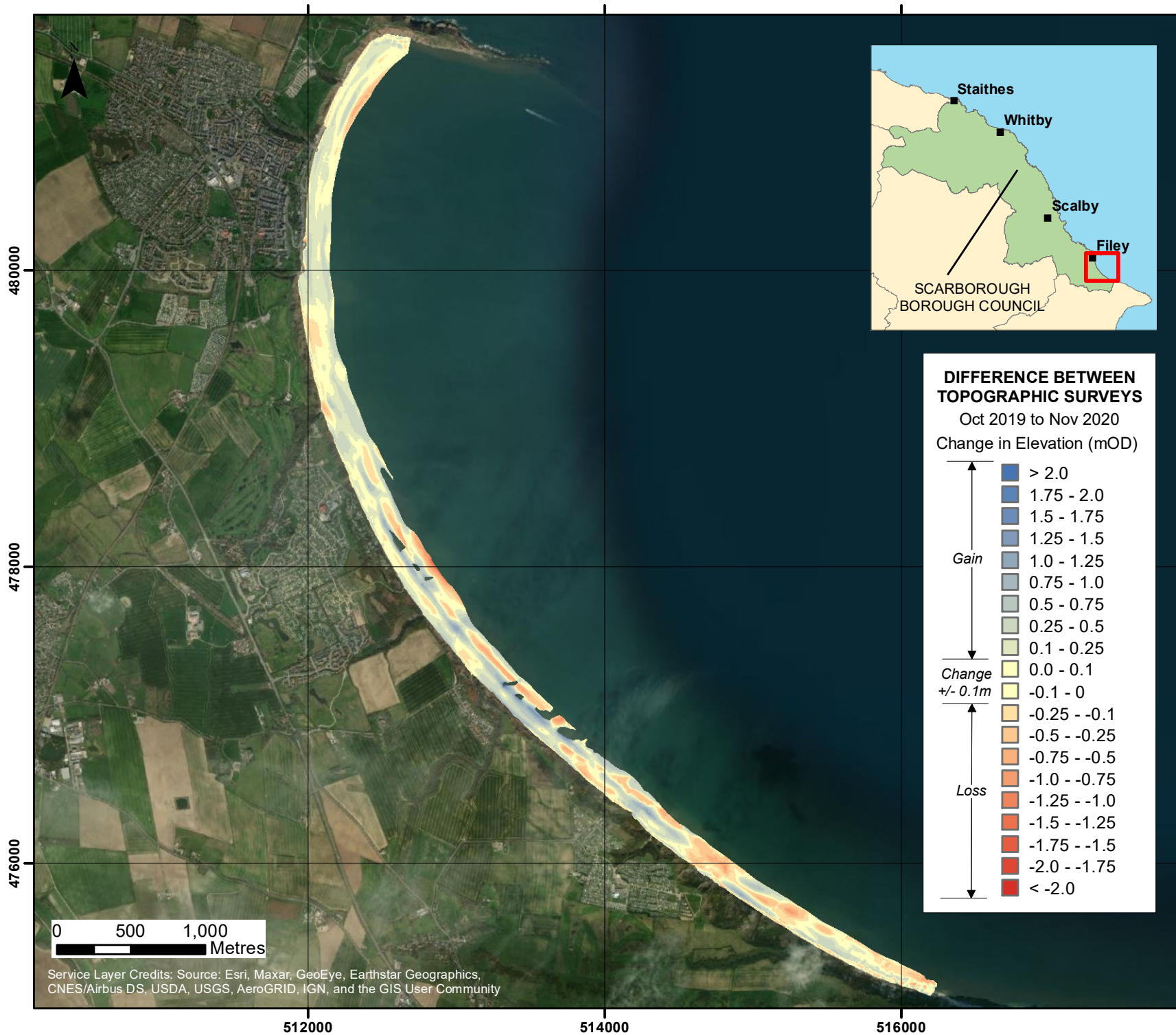
Tel: +44 (0)191 211 1300  
Fax: +44 (0)191 211 1313  
www.royalhaskoningdhv.com



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

511600

512400



Key

Client: North East Coastal Group  
 Project: Cell 1 Regional Coastal Monitoring Programme

**Appendix B - Map 15**  
**FILEY BAY**

**Scarborough Borough Council Frontage**

Analytical Report  
 'Full Measures' Survey 2020

Drawing Scale at A4 1:35,000

**WATER**  
 Royal HaskoningDHV  
 Marlborough House  
 Marlborough Crescent  
 Newcastle upon Tyne  
 NE1 4EE

Tel: +44 (0)191 211 1300  
 Fax: +44 (0)191 211 1313  
 www.royalhaskoningdhv.com



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

**Appendix C**  
**Cliff Top Survey**

## Cliff Top Survey

### Staithes

Twenty ground control points have been established within Staithes (Figure C1). The maximum separation between any two points is nominally 100m. The cliff top surveys at Staithes are undertaken bi-annually. Measurements are taken from a fixed ground control point along a fixed bearing to the edge of the cliff top. Table C1 provides baseline information about these ground control points and results from the 2008 (baseline) survey showing the position from the ground control point to the edge of the cliff top along the defined bearing. Future reports will show results from subsequent surveys and provide a means of assessing erosion since the baseline survey.

**Table C1 – Cliff Top Surveys at Staithes**

Ground Control Points				Distance to Cliff Top (m)			Total Erosion (m)		Erosion Rate (m/year)
Ref	Easting	Northing	Bearing (°)	Baseline Survey	Previous Survey	Present Survey	Baseline to Present	Previous to Present	Baseline to Present
STAITHES				Nov 2008	March 2020	Nov 2020	Nov 2008 - Nov 2020	March 2020 - Nov 2020	Nov 2008 - Nov 2020
1	477228	518769	320	1.90	-4.90	-5.21	7.11	0.31	0.59
2	477334	518798	0	10.90	10.66	10.57	0.33	0.09	0.03
3	477487	518789	350	7.10	8.00	7.99	-0.89	0.01	0.00
4	477594	518801	340	5.90	3.79	3.72	2.18	0.07	0.18
5	477683	518911	350	8.40	8.11	8.24	0.16	-0.13	0.01
6	477792	518867	30	8.60	8.50	8.32	0.28	0.18	0.02
7	477891	518828	60	7.70	7.29	7.20	0.50	0.09	0.04
8	477959	518873	350	8.70	9.50	9.43	-0.73	0.07	0.00
9	478088	518950	350	7.60	8.07	7.94	-0.34	0.13	0.00
10	478191	519023	340	8.40	9.59	8.48	-0.08	1.11	0.00
11	478237	519007	60	6.90	6.60	6.59	0.31	0.01	0.03
12	478213	518988	150	6.10	6.07	6.34	-0.24	-0.27	0.00
13	478501	518809	15	11.40	8.65	8.47	2.93	0.18	0.24
14	478624	518807	20	7.50	7.47	7.45	0.05	0.02	0.00
15	478737	518858	60	6.10	6.32	6.28	-0.18	0.04	0.00
16	478823	518757	60	8.00	8.46	8.30	-0.30	0.16	0.00

Ground Control Points				Distance to Cliff Top (m)			Total Erosion (m)		Erosion Rate (m/year)
Ref	Easting	Northing	Bearing (°)	Baseline Survey	Previous Survey	Present Survey	Baseline to Present	Previous to Present	Baseline to Present
STAITHES				Nov 2008	March 2020	Nov 2020	Nov 2008 - Nov 2020	March 2020 - Nov 2020	Nov 2008 - Nov 2020
17	478944	518671	30	9.30	9.13	8.75	0.55	0.38	0.05
18	479052	518630	20	9.20	9.25	9.03	0.17	0.22	0.01
19	479147	518610	0	14.20	14.04	14.34	-0.14	-0.30	0.00
20	479274	518618	20	11.40	11.14	11.03	0.37	0.11	0.03

**Note:** It is assumed that the accuracy of cliff top monitoring using this technique is  $\pm 0.1$ m. Therefore, observed changes have been altered by this amount prior to calculation of an erosion rate. Erosion rates are not calculated where the cliff line shows advance. This is likely to be the product of differing survey interpretation, and far less likely to be a toppling cliff edge.

**Note:** Shaded cells use the April 2016 Partial measures survey data for calculations as access was unavailable for the 2016 full measures survey.

### Robin Hoods Bay

Thirteen ground control points have been established within Robin Hoods Bay (Figure C1). The maximum separation between any two points is nominally 200m. The cliff top surveys at Robin Hoods Bay are undertaken annually. Measurements are taken from a fixed ground control point along a fixed bearing to the edge of the cliff top. Table C2 provides baseline information about these ground control points and results from the 2008 (baseline) survey showing the position from the ground control point to the edge of the cliff top along the defined bearing. Future reports will show results from subsequent surveys and provide a means of assessing erosion since the baseline survey.

**Table C2 – Cliff Top Surveys at Robin Hoods Bay**

Ground Control Points				Distance to Cliff Top (m)			Total Erosion (m)		Erosion Rate (m/year)
Ref	Easting	Northing	Bearing (°)	Baseline Survey	Previous Survey	Present Survey	Baseline to Present	Previous to Present	Baseline to Present
STAITHES				Nov 2008	March 2020	Nov 2020	Nov 2008 - Nov 2020	March 2020 - Nov 2020	Nov 2008 - Nov 2020
ROBIN HOODS BAY				Mar 2010	Apr 2020	Nov 2020	Nov 2008 - Nov 2020	April 2020 - Nov 2020	Nov 2008 - Nov 2020
1	495799.5	506002.2	130	11.60	7.22	6.38	5.22	0.84	0.52
2	495549.2	505807.3	135	9.30	9.02	9.02	0.28	0.00	0.03
3	495456.3	505740	130	5.00	4.87	5.24	-0.24	-0.37	0.00
4	495389.9	505683.7	140	6.30	6.31	6.51	-0.21	-0.20	0.00
5	495259.4	505342.5	130	11.30	14.00	13.18	-1.88	0.82	0.00
6	495231.2	505315.7	95	5.90	5.73	5.71	0.19	0.02	0.02
7	495184.8	505210.7	85	6.40	7.14	7.13	-0.73	0.01	0.00
8	495206.5	505153	75	5.00	5.01	5.01	-0.01	0.00	0.00
9	495287.8	505060.5	80	4.30	4.30	4.25	0.05	0.05	0.00
10	495187.8	504708.8	70	3.10	2.39	2.20	0.90	0.19	0.09
11	495226.2	504615.7	120	3.80	3.97	3.90	-0.10	0.07	0.00
12	495297.5	504380.2	80	11.00	10.99	10.71	0.29	0.28	0.03
13	495350.4	504193	55	3.70	3.75	3.66	0.04	0.09	0.00

**Note:** It is assumed that the accuracy of cliff top monitoring using this technique is  $\pm 0.1$ m. Therefore, observed changes have been altered by this amount prior to calculation of an erosion rate. Erosion rates are not calculated where the cliff line shows advance. This is likely to be the product of differing survey interpretation, and far less likely to be a toppling cliff edge.

### Scarborough South Bay

Thirteen ground control points have been established between Scarborough South Bay and Cayton Bay (Figure C1). The maximum separation between any two points is nominally 300m. The cliff top surveys at Scarborough South Bay are undertaken annually. Measurements are taken from a fixed ground control point along a fixed bearing to the edge of the cliff top. Table C3 provides baseline information about these ground control points and results from the 2010 (baseline) survey showing the position from the ground control point to the edge of the cliff top along the defined bearing. Future reports will show results from subsequent surveys and provide a means of assessing erosion since the baseline survey.

**Table C3 – Cliff Top Surveys at Scarborough South**

Ground Control Points				Distance to Cliff Top (m)			Total Erosion (m)		Erosion Rate (m/year)
Ref	Easting	Northing	Bearing (°)	Baseline Survey	Previous Survey	Present Survey	Baseline to Present	Previous to Present	Baseline to Present
<b>SCARBOROUGH SOUTH BAY</b>				<b>Mar 2010</b>	<b>Apr 2020</b>	<b>Dec 2020</b>	<b>Nov 2008 - Dec 2020</b>	<b>Apr 2020 - Dec 2020</b>	<b>Nov 2008 - Dec 2020</b>
1	504339.5	487887.3	70	7.00	6.96	6.96	0.04	0.00	0.00
2	504422.3	487603.7	80	4.80	4.82	4.56	0.24	0.26	0.02
3	504534.8	487318.3	40	15.10	14.88	15.24	-0.14	-0.36	0.00
4	504730.2	487137.9	55	9.60	9.65	9.60	0.00	0.05	0.00
5	504922.9	486837.8	60	8.80	8.57	8.58	0.22	-0.01	0.02
6	50571.1	486652.1	75	3.80	3.86	3.61	0.19	0.25	0.02
7	505284.3	486480	35	7.00	6.83	6.67	0.33	0.16	0.03
8	505597.9	486363.4	30	8.60	8.56	8.39	0.21	0.17	0.02
9	505758.6	486005.1	45	9.10	8.50	8.50	0.60	0.00	0.06
10	505896	485889.6	15	14.80	14.68	14.70	0.10	-0.02	0.01
11	505990	485657.1	80	4.70	1.10	1.12	3.58	-0.02	0.36
12	506024.9	485421.8	55	6.10	3.19	3.16	2.94	0.03	0.29
13	506036	485315.3	90	7.00	7.06	6.99	0.01	0.07	0.00

**Note:** It is assumed that the accuracy of cliff top monitoring using this technique is  $\pm 0.1$ m. Therefore, observed changes have been altered by this amount prior to calculation of an erosion rate. Erosion rates are not calculated where the cliff line shows advance. This is likely to be the product of differing survey interpretation, and far less likely to be a toppling cliff edge

### Cayton Bay

Eight ground control points have been established within Cayton Bay (Figure C1). The maximum separation between any two points is nominally 300m. The cliff top surveys at Cayton Bay are undertaken annually. Measurements are taken from a fixed ground control point along a fixed bearing to the edge of the cliff top. Table C4 provides baseline information about these ground control points and results from the 2008 (baseline) survey showing the position from the ground control point to the edge of the cliff top along the defined bearing. Future reports will show results from subsequent surveys and provide a means of assessing erosion since the baseline survey.

**Table C4 – Cliff Top Surveys at Cayton Bay**

Ground Control Points				Distance to Cliff Top (m)			Total Erosion (m)		Erosion Rate (m/year)
Ref	Easting	Northing	Bearing (°)	Baseline Survey	Previous Survey	Present Survey	Baseline to Present	Previous to Present	Baseline to Present
<b>CAYTON BAY</b>				<b>Nov 2008</b>	<b>Apr 2020</b>	<b>Dec 2020</b>	<b>Nov 2008 - Dec 2020</b>	<b>Apr 2020 - Dec 2020</b>	<b>Nov 2008 - Dec 2020</b>
1	506325.5	484849.7	50	4.00	3.91	3.71	0.29	0.20	0.02
2	506459.4	484715.9	65	5.00	UTS	UTS	UTS	UTS	UTS
3	506597.4	484538.6	65	5.00	5.52	5.51	-0.51	0.01	0.00
4	506778.1	484345.5	21	9.00	5.86	5.88	3.12	-0.02	0.26
5	507018.6	484221.6	342	7.70	8.06	8.06	-0.36	0.00	0.00
6	507242.3	484121.7	2	7.40	5.91	5.82	1.58	0.09	0.13
7	507518.2	484008.2	25	7.50	7.56	7.56	-0.06	0.00	0.00
8	507818.7	484006	1	5.50	5.78	5.34	0.16	0.44	0.01

**Note:** It is assumed that the accuracy of cliff top monitoring using this technique is  $\pm 0.1$ m. Therefore, observed changes have been altered by this amount prior to calculation of an erosion rate. Erosion rates are not calculated where the cliff line shows advance. This is likely to be the product of differing survey interpretation, and far less likely to be a toppling cliff edge.



## Filey Bay

Twenty-seven ground control points have been established within Filey Bay (Figure C1). The maximum separation between any two points is nominally 300m. The cliff top surveys at Filey Bay are undertaken annually. Measurements are taken from a fixed ground control point along a fixed bearing to the edge of the cliff top. Table C5 provides baseline information about these ground control points and results from the 2008 (baseline) survey showing the position from the ground control point to the edge of the cliff top along the defined bearing. Future reports will show results from subsequent surveys and provide a means of assessing erosion since the baseline survey.

**Table C5 – Cliff Top Surveys at Filey Bay**

Ground Control Points				Distance to Cliff Top (m)			Total Erosion (m)		Erosion Rate (m/year)
Ref	Easting	Northing	Bearing (°)	Baseline Survey	Previous Survey	Present Survey	Baseline to Present	Previous to Present	Baseline to Present
FILEY				Nov 2008	March 2020	Nov 2020	Nov 2008 - Nov 2020	March 2020 - Nov 2020	Nov 2008 - Nov 2020
1	512444.9	481630.9	130	8.70	8.44	8.42	0.28	0.02	0.02
2	512306.7	481490.3	144	7.60	7.58	7.59	0.01	-0.01	0.00
3	512153.6	481234.6	122	8.30	8.02	8.01	0.29	0.01	0.02
4	512029.2	480959.9	115	7.40	7.25	7.17	0.23	0.08	0.02
5	511895.4	479888	89	7.10	UTS	UTS	UTS	UTS	UTS
6	511908.5	479597.1	48	6.70	5.63	5.59	1.11	0.04	0.09
7	511991.4	479310.4	69	6.70	1.69	1.59	5.11	0.10	0.43
8	512083.4	478981.5	66	10.20	10.29	9.65	0.55	0.64	0.05
9	512121.3	478786.3	76	8.30	8.37	8.43	-0.13	-0.06	0.00
10	512226.2	478547.9	74	7.50	5.75	5.83	1.67	-0.08	0.14
11	512471.4	478153.5	53	6.60	6.67	6.86	-0.26	-0.19	0.00
12*	512558.9	477901.9	66	7.70	UTS	UTS	UTS	UTS	UTS
12A*	512655.8	477822.4	67	13.90	13.02	13.00	0.90	0.02	0.08
13**	512697.6	477719	34	4.20	UTS	UTS	UTS	UTS	UTS
13A*	512805.5	477572.1	32	13.42	10.49	10.48	2.94	0.01	0.25
14	512939.4	477400.9	66	8.00	6.51	6.33	1.67	0.18	0.14
15	513157	477192.7	51	5.20	4.57	4.60	0.60	-0.03	0.05
16	513299.5	477024.6	30	7.70	6.40	6.51	1.19	-0.11	0.10

Ground Control Points				Distance to Cliff Top (m)			Total Erosion (m)		Erosion Rate (m/year)
Ref	Easting	Northing	Bearing (°)	Baseline Survey	Previous Survey	Present Survey	Baseline to Present	Previous to Present	Baseline to Present
FILEY				Nov 2008	March 2020	Nov 2020	Nov 2008 - Nov 2020	March 2020 - Nov 2020	Nov 2008 - Nov 2020
17	513507.7	476821.1	34	10.70	10.20	10.25	0.45	-0.05	0.04
18	513721	476602.3	31	7.20	6.12	6.09	1.11	0.03	0.09
19	513916.6	476354.1	51	6.60	6.22	6.47	0.13	-0.25	0.01
20	514174.8	476179.4	32	7.00	6.91	6.96	0.04	-0.05	0.00
21	514471.5	475965.7	66	7.60	7.42	7.39	0.21	0.03	0.02
22	514656.2	475728.8	101	8.10	7.66	7.68	0.42	-0.02	0.04
23	514889.5	475537.6	60	9.10	7.77	7.78	1.32	-0.01	0.11
24*	512603.7	481665.9	14	19.90	19.86	19.85	0.05	0.01	0.00
25*	512607.1	481648.9	184	17.20	16.93	16.93	0.27	0.00	0.02
26*	512301.9	481825.5	18	11.00	10.87	10.79	0.21	0.08	0.02
27*	512475.8	481712.1	20	11.60	11.61	11.51	0.09	0.10	0.01

**Note:** It is assumed that the accuracy of cliff top monitoring using this technique is  $\pm 0.1$ m. Therefore, observed changes have been altered by this amount prior to calculation of an erosion rate. Erosion rates are not calculated where the cliff line shows advance. This is likely to be the product of differing survey interpretation, and far less likely to be a toppling cliff edge.

\*baseline for 12A and 24-27 is March 2011.