



**Cell 1 Regional Coastal Monitoring Programme
Update Report 10: 'Partial Measures' Survey 2018**



**Scarborough Borough Council
June 2018**

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Authors	
Emma Hick	Royal HaskoningDHV
Dr Nick Cooper – Approval	Royal HaskoningDHV

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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 north east 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).

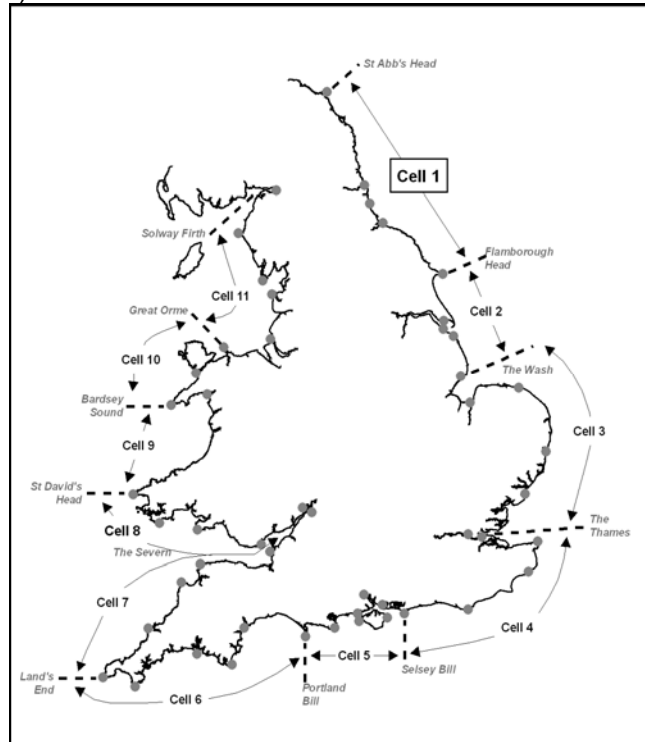


Figure 1 Sediment Cells in England and Wales

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
- walk-over 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.

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	Jun 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	Oct-Nov 11	Feb 12	Mar-May 12	Jul 13	-
5	2012/13	Sep 12	Mar 13	Apr-May 13	May 13	-
6	2013/14	Oct-Nov 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 17	Jan 17		Jun 18 (*)	

(*) The present report is **Update Report 10** and provides an analysis of the 2018 Partial Measures survey for Scarborough Council's frontage.

1. Introduction

1.1 Study Area

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

- Staithes¹
- 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:

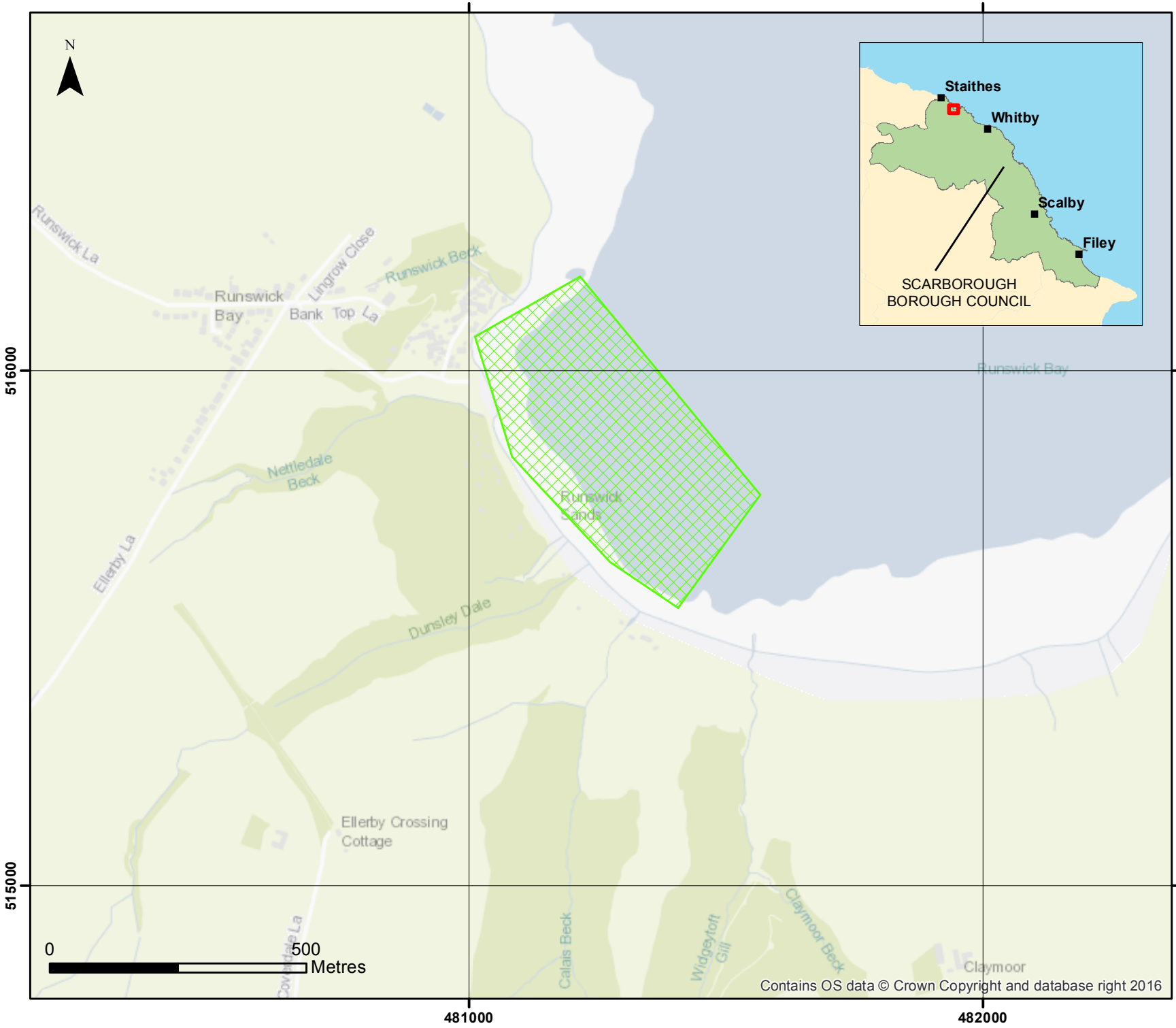
- Full Measures survey annually each autumn/early winter comprising:
 - Beach profile surveys along 20 transect lines
 - Topographic survey at Runswick Bay
 - Topographic survey along the Sandsend to Whitby frontage
 - Topographic survey at Robin Hood's Bay
 - Topographic survey at Scarborough North 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 Hoods Bay (new addition Spring 2010)
 - Scarborough South Bay (new addition Spring 2010)
 - Cayton Bay
 - Filey

The location of these surveys is shown in Figure 2. The Partial Measures survey was undertaken along this frontage between 20th March and 1st May 2018, more specifically:

- Runswick Bay – 29th April 2018;
- Whitby – 3rd May 2018;
- Robin Hood's Bay – 1st May 2018;
- Scarborough – 21st March 2018;
- Cayton Bay – 20th March 2018; and
- Filey – 22nd March 2018.

During this time weather conditions varied considerably; refer to the survey reports for details of the weather conditions over this survey period. Data from the present survey are presented in a processed form in the Appendices.

¹ The Staithes frontage straddles the boundary of jurisdiction of both Redcar & Cleveland Borough Council and Scarborough Borough Council.



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

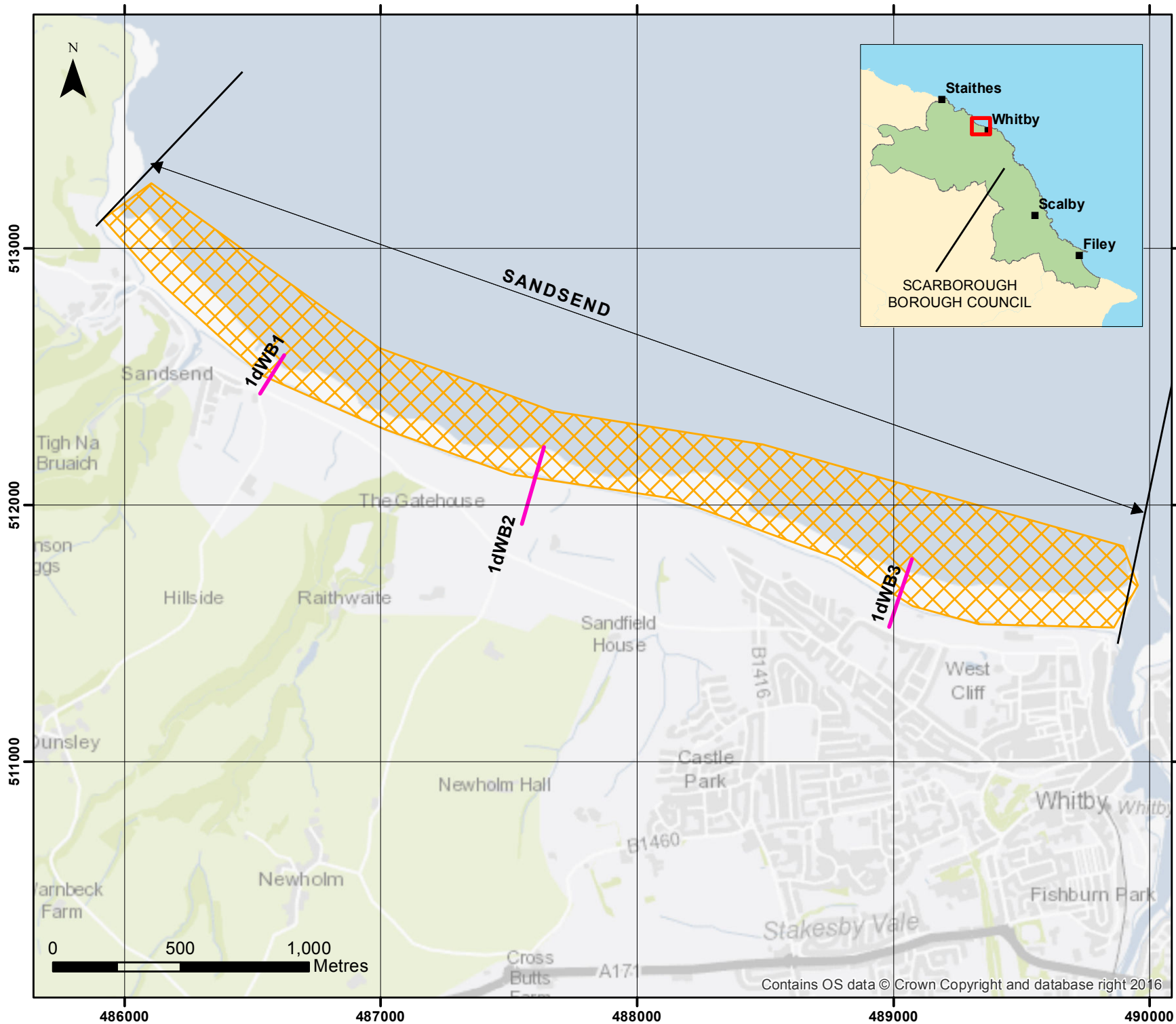
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WATER
Royal HaskoningDHV
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

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



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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

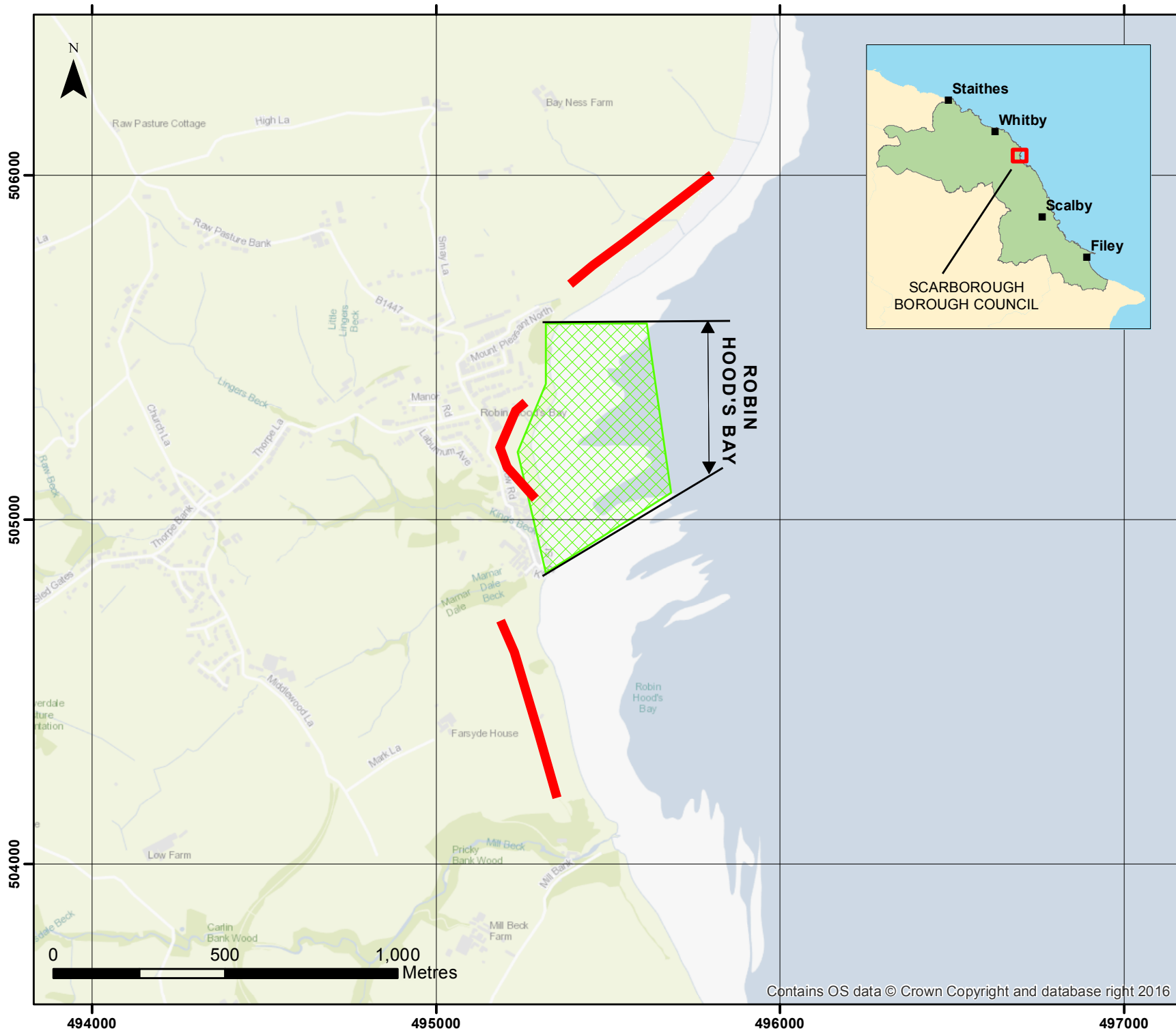
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WATER
Royal HaskoningDHV
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

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



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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 3

Scarborough Borough Council Frontage

Analytical Report
Topo Surveys

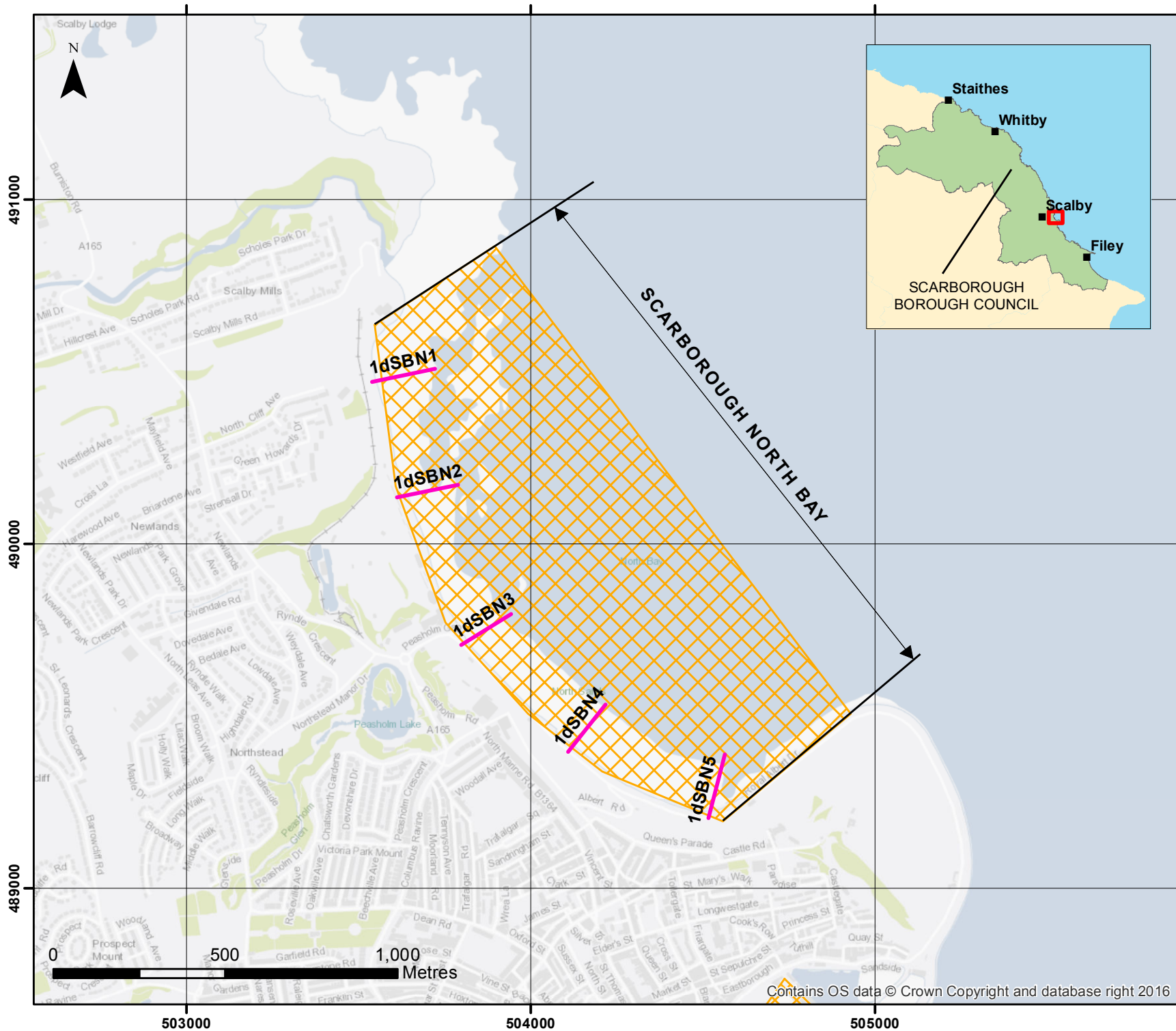
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WATER
Royal HaskoningDHV
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

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



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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

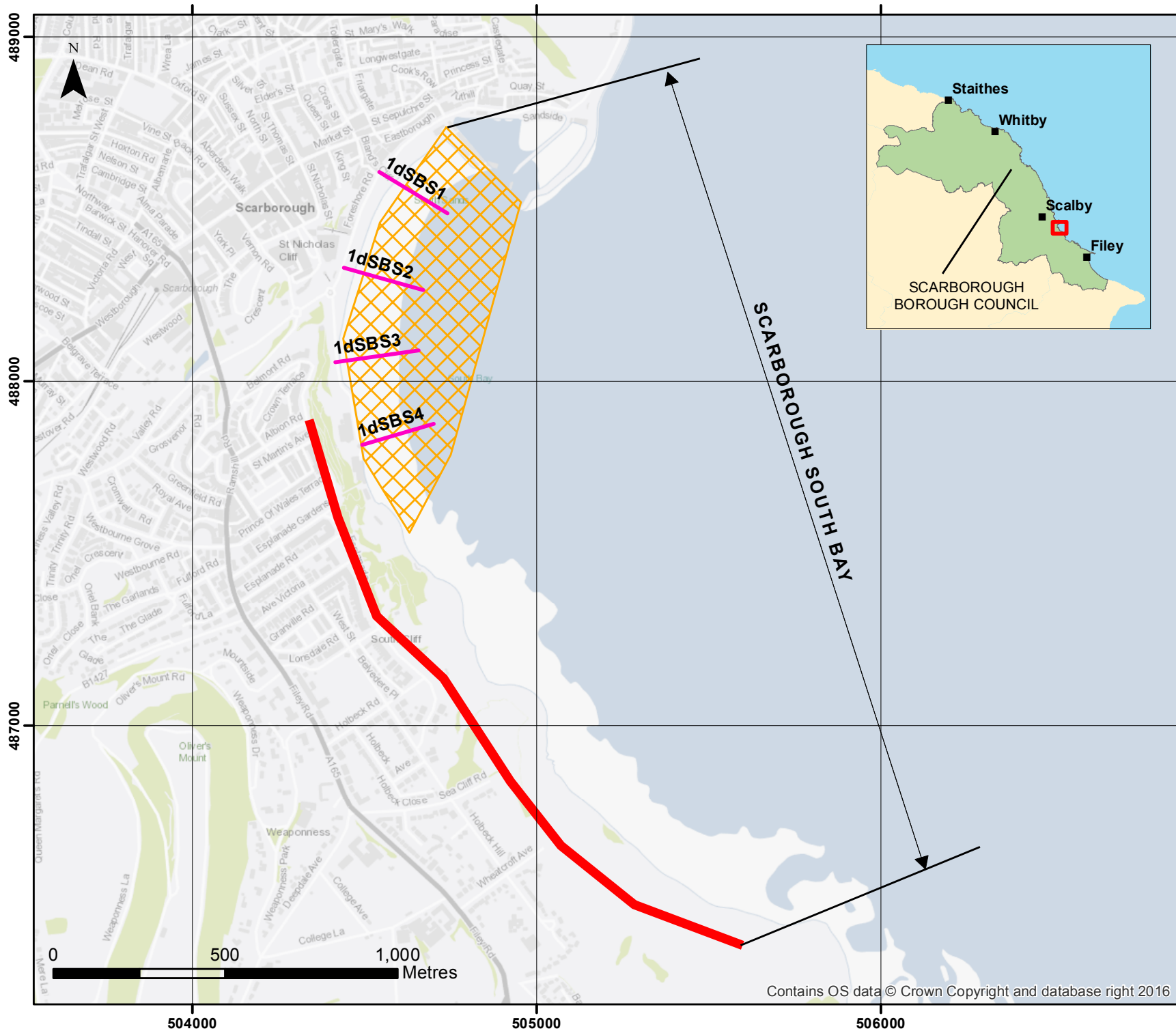
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WATER
Royal HaskoningDHV
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

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



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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

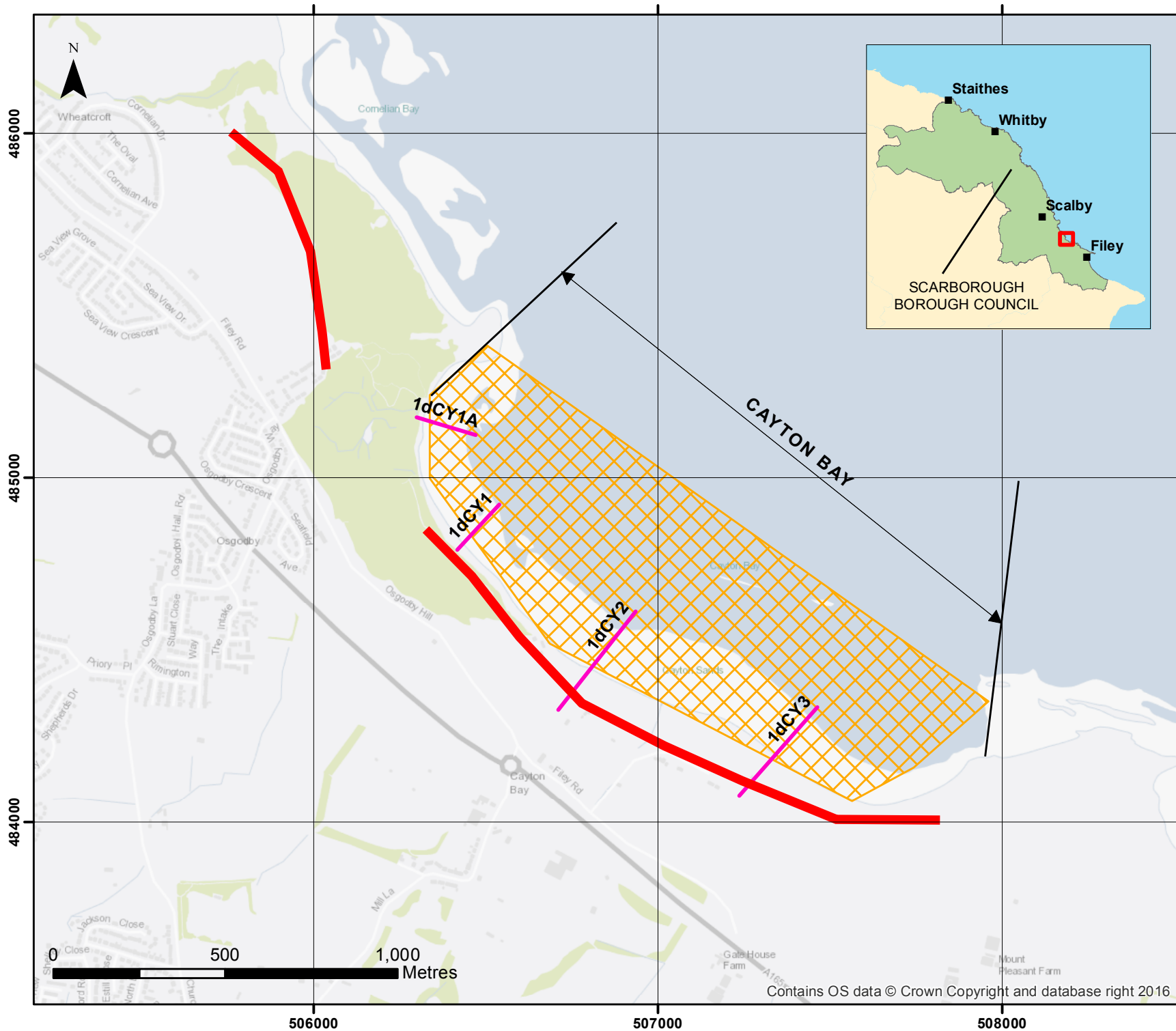
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WATER
Royal HaskoningDHV
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
Fax: +44 (0)191 211 1313
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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

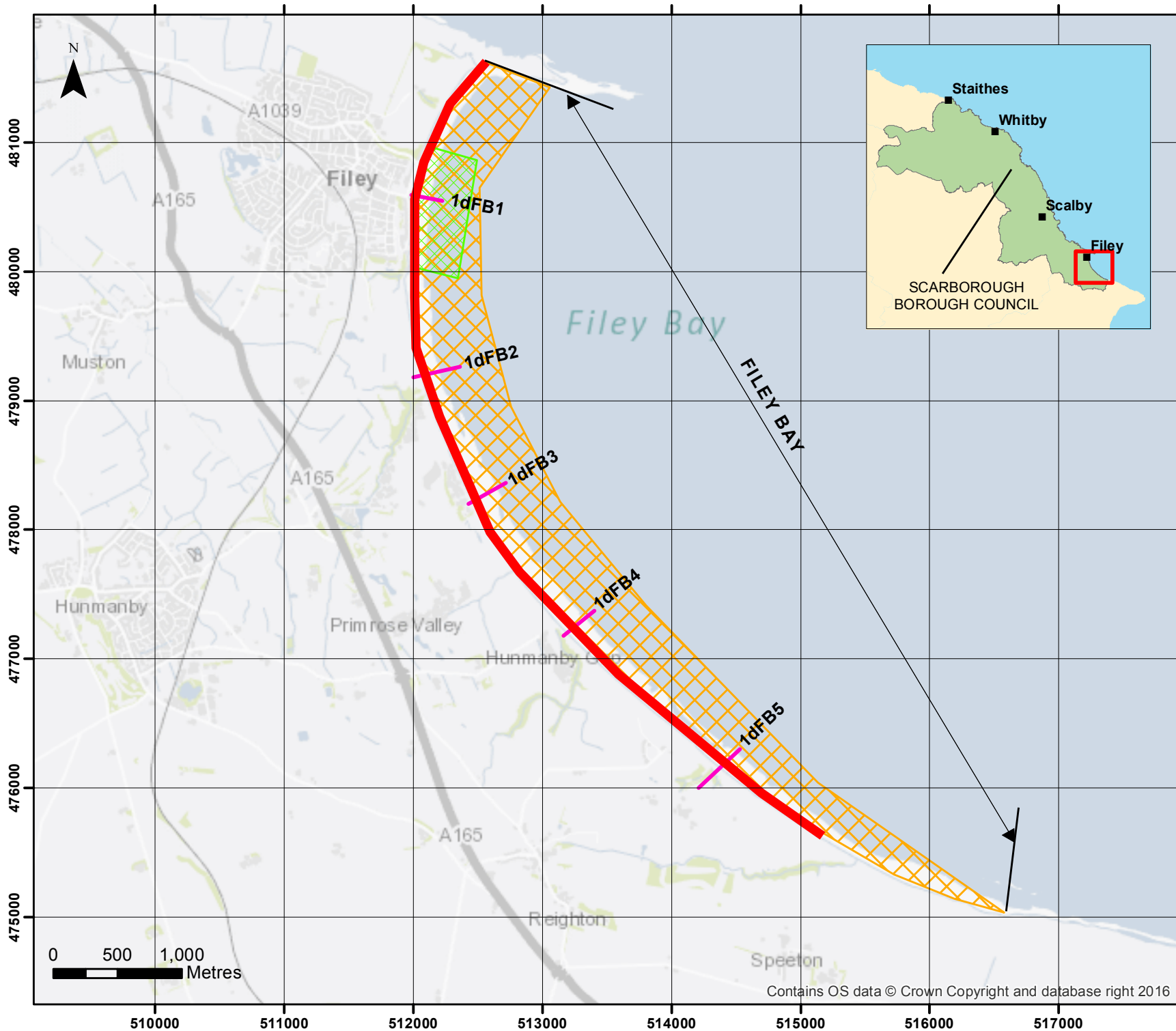
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WATER
 Royal HaskoningDHV
 Marlborough House
 Marlborough Crescent
 Newcastle upon Tyne
 NE1 4EE

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



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Key

SURVEY LOCATIONS

Topographic Profiles

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

Topographic Surveys

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

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 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



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2. Analysis of Survey Data

2.1 Staithes

Survey Date	Description of Changes Since Last Survey	Interpretation
<p>23rd March 2018</p>	<p>Cliff-top Survey:</p> <p>Twenty ground control points have been established at Staithes for the purposes of cliff top monitoring. The separation between any two points is a nominal 100m. The cliff top surveys at Staithes 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>Appendix C provides results from the March 2018 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 and the previous September 2017 survey.</p> <p>The results provided in Appendix C show that the majority of the profiles show little or no erosion, <0.1m. The exception is at Point 17, where retreat of 0.12m was recorded. Several points (1, 2, 3, 14, 15, and 20) have recorded negative movement; this is likely to be due to difficulties in accurately identifying the cliff edge through vegetation.</p>	<p>The recorded changes to the cliff top between September 2017 and March 2018 are generally small. There has been only one point which shows minor retreat.</p> <p>Longer term trends: Table C1 in Appendix C presents the erosion rates calculated from the data collected since 2008. Points 1, 4 and 13 are the only locations with a significant recession rate, which is 0.2m/yr for all three points.</p>

2.2 Runswick Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
1 st May 2018	<p>Topographic Survey:</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 1a) and to calculate the differences between the current topographic survey (Spring 2018) and the previous survey (Autumn 2017) 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 1b).</p> <p>Appendix B - Map 1b shows changes that are primarily shore-parallel, with erosion dominating on the upper beach and accretion on the lower beach. There is a narrow discontinuous band of accretion at the very top of the beach in the middle of the bay near the sailing club. The entire beach at the northern end of the bay, in front of the village, is dominated by erosion. The greatest magnitude of change is at the southern end of the survey area.</p>	<p>Material appears to have been moved from the top of the beach to the bottom of the beach. The pattern indicates seasonal draw down, with material moving down the beach and temporary stored below MLW.</p> <p>Longer term trends: The data collected since 2008 indicate a general pattern of winter drawdown and spring recovery with no net change. The trends from this survey are comparable with observations since 2013.</p>

2.3 Sandsend Beach, Upgang Beach and Whitby Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
3 rd May 2018	<p>Beach Profiles:</p> <p>The Sandsend, Upgang and Whitby frontage is covered by three beach profile lines for the Partial Measures survey (Appendix A). The profiles were surveyed in September 2017 (2017 Full Measures) and in May 2018.</p> <p>Profile 1dWB1 is located around 400m south of Sandsend village. There has been accretion of up to 1.0m from the toe of the new coastal defence to chainage 85m. Between chainage 85m and 135m there has been erosion of up to 0.4m. Between chainage 135m and 160m there has been accretion of 0.2m. From chainage 160m to the end of the survey at chainage 170m there has been erosion of 0.3m, which appears to show the removal of the lower beach berm (previous survey extended to chainage 250m). Overall the profile is at a medium-high level compared to the range recorded from previous surveys, with the section between chainage 55m and 85m being the highest on record.</p> <p>Profile 1dWB2 is located in the centre of Upgang beach. The profile remained stable to the face of the cliff at 142m chainage. From 142m to 180m chainage there is has been a drop in the beach of up to 0.4m since the previous survey. Between chainage 180m and 235m there has been accretion of up to 0.9m, creating a berm at chainage 200m. Seawards of chainage 235m there has been erosion of up to 0.9m. Overall the beach is at a medium level compared to the range recorded from previous surveys, with a low spot at chainage 175m and a high spot at chainage 220m.</p> <p>Profile 1dWB3 is located on Whitby Sands and showed erosion of 0.2m across the majority of the profile, with 0.4m erosion at the toe of the seawall. The exception is between chainage 105m and 135m which shows accretion of up to 0.3m. Overall the beach is at a medium level compared to the range recorded from previous surveys.</p>	<p>All of the profiles are in the middle of the range of previous profiles, which shows that this frontage is dominated by seasonal fluctuation of the beach levels.</p> <p>Anecdotal evidence from observations following the March 2018 severe storms ('Beast from the East') suggest that beach levels did drop at the new Sandsend defences, exposing the toe beam. However, the survey would suggest that beach levels quickly recovered.</p> <p>Longer term trends:</p> <p>The beach profiles appear to be reasonably stable showing only seasonal fluctuations. The long term difference plot for Autumn 2008 to Autumn 2016 show accretion in the eastern and western ends of the bay and erosion in the centre.</p>

2.4 Robin Hood's Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
1 st May 2018	<p>Topographic Survey:</p> <p>Data from the most recent topographic survey (Partial Measures, Spring 2017) have been used to create a digital ground model (DGM) (Appendix B – Map 2a) using a Geographical Information System (GIS). A difference plot has also been produced using the DGM (Appendix B – Map 2b) from the last topographic survey (Full Measures, Autumn 2017) and the present survey.</p> <p>The difference plot shows changes in level between Autumn 2017 and Spring 2018 and highlights a patchy distribution of erosion and accretion. The majority of the bay has seen very little change ($\pm 0.25\text{m}$) over the winter of 2017/18, associated with rocky outcrops that run perpendicular to the shore. The main patches of erosion are on the upper beach.</p>	<p>The distribution of change is very patchy. There has been little change over the rock promontories in the bay, although there has been localised erosion and accretion. The loss of 1m of material at the bottom of the cliff is likely to be due to erosion of debris from earlier cliff failures</p> <p>Longer term trends: The difference plots show a continuation of the trend of patchy distribution of erosion and accretion. Overall, the observed changes are of limited magnitude and within the range of changes previously seen. The long term difference between Autumn 2008 and Autumn 2016 shows stability with accretion limited to the defended part of the frontage.</p>
1 st May 2018	<p>Cliff-top Survey:</p> <p>Thirteen ground control points have been established at Robin Hood's Bay since 3rd March 2010 to monitor cliff top recession. The separation between any two points is a nominal 200m and monitoring is undertaken bi-annually. Appendix C provides results from the May 2018 survey showing change since the last survey in October 2017 and the baseline survey in March 2010 (Appendix C- Map 2). The accuracy of the survey technique means change of less than 0.1m is assumed to be error. Only one of the monitoring points show erosion since the last survey: Point 10 shows erosion of 0.2m. Only Point 1 shows significant long term erosion, with total erosion of 4.4m since the baseline survey in 2010 and a rate of 0.6m/yr.</p>	<p>The cliff top has been largely stable since the previous survey in October 2017, with significant erosion only recorded at one point to the south of the main village.</p> <p>Longer term trends: The erosion rates calculated from the changes since March 2010 show stability at most of the monitoring locations. The longer term rates show that point 1 has a recession rate of 0.6m/yr with other points having a rate of less than 0.1m/yr. This reflects localised and episodic cliff failure through rock fall.</p>

2.5 Scarborough North Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
21 st March 2018	<p>Beach Profiles:</p> <p>Scarborough North Bay is covered by five beach profile lines for the Partial Measures survey (Appendix A) that are monitored biannually. The previous Full Measures survey was undertaken in September 2017.</p> <p>Profile 1dSBN1 is located around 200m south of the Sea Life Centre. There has been a drop in beach level of 0.4m immediately in front of the seawall. From chainage 25m to chainage 95m there has been accretion of up to 0.4m. From chainage 95m seawards the beach level has eroded by up to 0.2m. Overall the beach is at a high-medium level compared to the range recorded from previous surveys.</p> <p>Profile 1dSBN2 is located close to the former chair lift. There has been erosion across the upper beach, with 1.4m at the toe of the seawall tapering to 0.2m by chainage 75m. Seawards of chainage 75m there has been accretion of up to 1.0m, covering some of the rock exposures. The upper beach is at lowest recorded level, whilst the lower beach is at a relatively high level compared to the range recorded from previous surveys.</p> <p>Profile 1dSBN3 is located near Royal Albert Drive. There has been erosion of up to 0.7m across the majority of the profile, with the exception of the toe of the beach seawards of chainage 135m where there has been accretion of 0.2m. Overall the beach is at a medium level compared to the range recorded from previous surveys.</p> <p>Profile 1dSBN4 is located at the northern end of Clarence Gardens. The profile is dominated by erosion, with up to 1.1m between the seawall and the exposed rock at chainage 35m. Seawards of the rock exposure there has been erosion of up to 1.3m, but more typically 0.4m. The length of rock exposed has increased by around 18m. Beach levels are at a relatively low level compared to the range recorded from previous surveys.</p> <p>Profile 1dSBN5 is located southern of Clarence Gardens. There has been erosion across the whole profile of up to 0.6m. Overall the profile is at a relatively low level compared to the range recorded from previous surveys.</p>	<p>The beach in North Bay has been dominated by erosion, this is likely to be partially due to the March 2018 severe storms. The northern profiles show some accretion on the lower beach indicative of draw-down processes, whilst the southern profiles show erosion across the full beach suggesting material has moved off-shore.</p> <p>Longer term trends: The beach is towards the lower end of the range of profiles with changes typical of seasonal drawdown and recovery.</p>

2.6 Scarborough South Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
21 st March 2018	<p>Beach Profiles:</p> <p>Scarborough South Bay is covered by four beach profile lines for the Partial Measures survey (Appendix A). The profiles were surveyed during the Full Measures survey of November 2017.</p> <p>Profile 1dSBS1 is located around 250m south of the West Pier. The profile is unchanged to the upper edge of the sea defences at 15m chainage. Between the sea wall and chainage 120m there has been erosion of up to 0.5m. Seawards of chainage 120m there has been accretion of up to 0.6m.. Overall the profile is at a medium-high level compared to the range recorded from previous surveys, with the section seawards of chainage 155m being the highest on record.</p> <p>Profile 1dSBS2 is located on the shore fronting St Nicholas Cliff. Between the sea wall and chainage 145m there has been erosion of up to 0.7m. Seawards of chainage 145m there has been accretion of up to 0.4m. The profile is at its lowest recorded level across the upper beach to chainage 70m, at a relatively medium level in the middle beach compared to the range recorded from previous surveys, and at its highest recorded level seawards of chainage 175m.</p> <p>Profile 1dSBS3 is located 250m north of the Scarborough Spa complex. There has been erosion of up to 1.2m, but more typically 0.3m, across the whole beach profile. The levels at the toe of the seawall are low enough to reveal the top of the wooden toe piles. The profile is relatively low compared to the range recorded from previous surveys, with the section from the seawall to chainage 65m being the lowest on record.</p> <p>Profile 1dSBS4 is located on the beach in front of the Scarborough Spa Complex. There has been erosion across the whole profile of up to 2.0m but more typically up to 1.0m. The erosion has exposed rock outcrops from the seawall to chainage 55m. Overall the beach is at a relatively low level compared to the range recorded from previous surveys, with the area of exposed rock being the lowest recorded levels in that area.</p>	<p>All of the profiles show erosion, particularly across the upper beach, this is likely to be partially due to the March 2018 severe storms ('Beast from the East'). The lower beach in profiles SBS1 and SBS2 show slight accretion on the lower beach indicative of beach draw-down processes.</p> <p>Longer term trends: The observed changes in the profiles in South Bay are consistent with the seasonal fluctuations of sediment with a bay system.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
19 th March 2018	<p>Cliff-top Survey:</p> <p>Thirteen cliff top monitoring control points have been established at Scarborough South Bay and from Cornelian Bay to Knipe Point. The separation between points is around 300m. The cliff top surveys at Scarborough South Bay are undertaken bi-annually. Appendix C provides results from the March 2010 baseline survey to March 2018, showing the distance from the ground control point to the edge of the cliff top along the defined bearing (Appendix C- Map 3). Error in the technique means change of less than 0.1m cannot be relied on. Calculated advances of the cliff line are also assumed to be error associated with difficulty precisely identify the cliff top, particularly where vegetation is present.</p> <p>The recorded changes between September 2017 and March 2018 were within the survey error of 0.1 for all points, except for Point 12 (to the north of Knipe Point) which showed erosion of 0.12m. Only Points 11 and 12 show significant erosion since the baseline survey in March 2010 of 3.25m and 2.95m respectively, this is equivalent to long term erosion rates of 0.5m/yr and 0.4m/yr.</p>	<p>Only Point 12 has shown erosion over the winter of 2017/18. Points 11 and 12 show recession rates of 0.5 and 0.4m/yr respectively.</p> <p>Longer term trends: The recession rates for the longer term only show erosion at Points 11 and 12 of between 0.4 and 0.5m/yr. The rest of the study area has remained stable.</p>

2.7 Cayton Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
20 th March 2018	<p>Beach Profiles:</p> <p>Cayton Bay is covered by four beach profile lines for the Partial Measures survey (Appendix A). The previous survey was undertaken in September 2017.</p> <p>Profile 1dCY1A is located on the beach below Knipe Point at the north of the bay, and was added to the programme in November 2015. There has been very little change along the profile until chainage 70m. Seawards of chainage 70m the beach level has dropped by 0.6m. Overall the profile is at a low level compared to the range recorded from previous surveys.</p> <p>Profile 1dCY1 is located on the beach in front of Tenants' Cliff in the north of the Bay. The profile to 20m chainage is similar to the previous surveys. From 20m chainage to chainage 80m there has been erosion of up to 1.1m, exposing rocks on the upper beach. From 80m to 125m chainage the beach has accreted by a up to 0.4m. From 125m to the end of the survey at 160m chainage the rocks on the lower beach are exposed. The profile is at a medium-high level in the middle, but low where the rocks are exposed on the upper and lower beach.</p> <p>Profile 1dCY2 is close to the former pumping station in the middle of Cayton Bay. The cliffed part of the profile has not changed a great deal. From the toe of the cliff at 120m chainage to chainage 260m there has been slight erosion of up to 0.2m. Seawards of chainage 260m there has been accretion of up to 0.4m. Overall the profile is at a relatively medium level compared to the range recorded from previous surveys, except for the toe which is relatively high.</p> <p>Profile 1dCY3 is located around 600m southeast of the pumping station. The cliffed part of the profile has not changed a great deal. From the toe of the cliff at 120m chainage to chainage 280m there has been erosion of up to 0.5m. The toe of the beach seawards of chainage 280m has accreted by 0.2m. The majority of the beach is at a relatively low level compared to the range recorded from previous surveys, however the toe of the beach is at a relatively high level.</p>	<p>The profiles show erosion on the upper beach with accretion on the lower beach, typical of draw-down processes. The profiles remain within the bounds of the range from the previous surveys.</p> <p>Longer term trends:</p> <p>The beach close to the toe of the cliff was comparatively low in March 2018, which means that the destabilisation of the cliff continues. Additional cliff failures will feed additional material onto the beach and drive erosion of the cliff top.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
20 th March 2018	<p>Cliff-top Survey:</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 300m. The cliff top surveys at Cayton Bay are undertaken bi-annually. Appendix C provides results from the March 2018 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 and the previous September 2017 survey. The accuracy of the technique means results of less than 0.1m are not considered reliable.</p> <p>Points 2 and 6 show cliff recession since September 2017, where there has been 0.1m and 0.2m of erosion respectively over the winter. Little change was recorded at other locations.</p>	<p>Only points 2 and 6 have shown erosion, the rest of the locations have been stable since September 2017.</p> <p>Longer term trends: The recession rates show that locations 2,4 and 6 all have significant rates of 0.2 to 0.6m/yr.</p>

2.8 Filey Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
22 nd March 2018	<p>Beach Profiles:</p> <p>Filey Bay is covered by five beach profile lines for the Partial Measures survey (Appendix A). The previous programmed survey (Full Measures 2016) was undertaken in September 2017.</p> <p>Profile 1dFB1 is located in front of Filey town in the north of the bay. There has been accretion of up to 1m immediately at the base of the sea wall. Between chainage 25m and 170m there has been erosion of up to 0.6m. Seawards of chainage 170m there has been accretion at the toe of the beach of up to 0.2m. The upper beach is at a relatively low level compared to the range recorded from previous surveys, with the section between chainage 35m and 115m being the lowest on record,, and the lower beach is at a relatively high level.</p> <p>Profile 1dFB2 is located north of Primrose Valley Holiday Village. The surveyor noted it was not possible to measure the beginning of the profile due to vegetation. There has been accretion of 0.2m at the toe of the cliff. Seawards of chainage 85m there has been erosion of up to 1.0m, with a lower beach berm forming at chainage 265m. Overall the profile is at a medium level relative to the range recorded from previous surveys, with the exception of chainage 195m to 255m which has the lowest recorded levels.</p> <p>Profile 1dFB3 is located in front of Flat Cliffs hamlet. Erosion of up to 1.0m dominates the profile with the exception of chainage 240m to 285m where there has been accretion of up to 0.4m. The upper beach berm at chainage 90m has been removed, and the lower beach berm previously at chainage 190m has moved seawards by around 50m to chainage 240m. Overall the profile is at a medium-high level relative to the range recorded from previous surveys.</p> <p>Profile 1dFB4 is located near Humanby Gap. There has been variable erosion of 0.1m to 2.2m between chainages 30m and 195m. This has created a stepped profile with the upper beach berm previously recorded at chainage 130m moving landwards by around 50m and dropping in height. In addition, a lower beach berm has formed at chainage 200m. There has been accretion between chainage 195m and 265m of up to 0.3m. The upper beach is at a low level compared to the range recorded from previous surveys, whilst the lower beach is at a relatively high level.</p>	<p>All of the profiles are dominated by erosion over the winter of 2017/18 but with areas of accretion suggesting cross-shore movement of material. All remain largely within the range recorded from the previous surveys, with a few isolated spots particularly on the upper beach being the lowest on record.</p> <p>Anecdotal evidence from visual observations following the March 2018 severe storms ('Beast from the East') suggest that beach levels in the Flat Cliffs area were lowered enough that the Yorkshire Water pipeline on the foreshore was exposed.</p> <p>Longer term trends:</p> <p>Past trends dominated by migrating sand bars continue to the present day.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>Profile 1dFB5 is located close to Reighton Gap. The surveyor noted that the middle of profile 1dFB5 was unable to be measured from 65m to c. 204m chainage due to vegetation. There has been erosion across the whole beach profile of up to 1.0m. Overall the profile is at a relatively low level compared to the range recorded from previous surveys, with the section between chainage 245m and 290m the lowest on record.</p>	
<p>March 2018</p>	<p>Topographic Survey:</p> <p>Data from the most recent topographic survey (Partial Measures, Spring 2018) have been used to create a digital ground model (DGM) (Appendix B – Map 5a) using a Geographical Information System (GIS). The topographic plot shows the gently sloping shore parallel bathymetry in front of Filey town. A difference plot has also been produced using the DGM (Appendix B – Map 5b) comparing the last topographic survey (Full Measures, Autumn 2017) to the present survey.</p> <p>The difference plot is dominated by a wide band of erosion across the majority of the beach. There is however, a very narrow band of accretion at the base of the seawall. The toe of the beach shows a narrow band of very little change.</p>	<p>The erosion at the top of the beach next to the sea wall was observed in the previous partial measures report. The erosion of this part of the beach is probably due to the reflection of wave energy on the hard defences through the winter. Overall the beach has flattened with some of the material lost on the upper beach being held on the lower beach close to the extent of the survey.</p> <p>Longer term trends:</p> <p>The erosion of the upper beach, close to the sea wall is observed over the winter of 2014/15, 2015/16, and 2016/17 does not reflect the long-term trend between Autumn 2008 and Autumn 2016 that shows with accretion on the upper beach and erosion on the lower beach. The atypical pattern seen in recent years probably reflects changes in wave climate.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
<p>22nd March 2018</p>	<p>Cliff-top Survey:</p> <p>Twenty-three ground control points were established within Filey Bay for the purposes of cliff top monitoring in November 2008. Additional points were added in September 2010 and March 2011 (as shown in Appendix C – Maps 5 and 6) taking the total number of ground control points in Filey Bay to 28. The maximum separation between points is 300m. The cliff top surveys at Filey Bay are undertaken bi-annually. Appendix C provides results from the March 2018 survey. The accuracy of the technique means results of less than 0.1m are not reliable. Furthermore, indications of an advancing cliff are erroneous and related to problems in precise identification of the cliff edge, particularly where vegetation is present.</p> <p>Between the September 2017 and the current survey only one of the 28 markers showed erosion greater than the survey error; Point 16 showed erosion of 0.5m.</p>	<p>Over the winter of 2017/18 only one of the monitoring points showed erosion, of 0.5m.</p> <p>Longer term trends: Greatest long-term recession rates are seen at Point 5, south of the Filey town defences, where 0.7m/yr is recorded; Points 6 and 7 at Muston Sands shows recession of 0.1 and 0.3m/yr respectively. Points 14 and 18 near Hunmanby Gap and Point 23 near Reighton Gap have eroded by 0.1 to 0.2m/yr.</p>

3. Problems Encountered and Uncertainty in Analysis

Individual Profiles

At Runswick Bay work was about to start on layering the new rock revetment. The rocks were stockpiled on the beach at the time of the survey.

At Whitby two areas of profile 1dWB2 were not measured due to dense vegetation on an area of the cliff face.

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

At Cayton Bay:

- the top of profile 1dCY1 cannot be measured due to dense vegetation;
- The middle of profile 1dCY2 could not be measured due to the ground make-up, soft mud flows, and unstable grass;
- The middle of profile 1dCY3 could not be measured due to the ground make-up, soft mud flows, unstable grass, and landslips;
- Profile 1dCY3 was measured to cliff edge on top and as close to the cliff face at the bottom as possible.

At Filey Bay:

- The surveyor was unable to measure the middle of section 1dFB2 between chainage 12m and 20m due to dense vegetation.
- The middle of profile 5 was unable to be measured from chainage 65m to c. 204m, due to undergrowth and bushes.

Cliff Top Surveys

At Staithes:

- Survey points 9 to 12 at Staithes have been cordoned off by the National Trust due to a landslide on the headland and could not be surveyed, as was the case for the September 2017 survey.

At Robin Hoods Bay:

- The dumping of waste vegetation at monitoring point 5 is a known source of error.
- Constant rock/gravel falls were noted by the surveyor along the cliff.

At Filey Bay:

- Points 12 and 13 were inaccessible due to heavy vegetation.

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

No changes are recommended at the present time.

5. Conclusions and Areas of Concern

- At Staithes, the recorded changes to the cliff top between September 2017 and March 2018 are generally small. Only one point has shown recession greater than the survey error. The long-term erosion rates calculated from the data collected since 2008 show that points 1, 4, and 13 have a recession rate of 0.2m/yr. Runswick Bay shows shore-parallel changes, with erosion at the top of the beach and accretion at the bottom. This may be due to beach draw-down over the winter.

- At Sandsend, Upgang and Whitby, the profiles show seasonal fluctuation. Beach levels dropped at the toe of the new defence at Sandsend following the March 2018 severe storms ('Beast from the East'), exposing the concrete toe beam, but the upper beach levels had recovered by the time of this survey. At profile B2, where the frontage is undefended there was the formation of a beach berm through the winter. Profile B3 at Whitby Sands is dominated by erosion. All profiles are at a medium level compared to the range recorded from previous surveys.
- At Robin Hoods Bay, there was a patchy distribution of accretion and erosion with the majority of the beach showing very little change. Overall the cliff top has been stable since the previous survey in October 2017. The longer term rates show that only point 1 shows a recession rate, which was 0.6m/yr.
- At Scarborough North Bay, the profiles are dominated by erosion which is likely to be due to the March 2018 severe storm. The March 2018 profiles remain within the range of the previous recording of beach levels, but are towards their lower end.
- The profiles at Scarborough South Bay show erosion, particularly on the upper beach, which is likely to be a result of the March 2018 severe storm. Profiles BS1 and BS2 around Foreshore Road remain at a medium level, compared to the range recorded from previous surveys, whilst profiles BS3 and BS4 around the Spa area are at a low level. Beach levels dropped at the toe of the Spa seawall after the March 2018 severe storms ('Beast from the East'), exposing the toe apron, but the upper beach levels had recovered by the time of this survey. Only one location has shown erosion over the winter of 2017/18 in the cliff monitoring, which was point 12 to the north of Knipe Point. Points 11 and 12 show long term recession rates of 0.5 and 0.4m/yr respectively
- The beach profiles in Cayton Bay show erosion on the upper beach and accretion on the lower, typical of draw-down. All profiles remained within the range recorded from previous surveys. The cliff monitoring shows that two points, 2 and 6, underwent recession of 0.1-0.2m over the winter of 2017/18. Locations 2, 4 and 6 all have significant rates of 0.1 to 0.6m/yr.
- At Filey all of the profiles are dominated by erosion over the winter of 2017/18 but with areas of accretion suggesting cross-shore movement of material. All remain largely within the range recorded from the previous surveys, with a few isolated spots particularly on the upper beach being the lowest on record. Beach levels did drop at the upper beach along Flat Cliffs after the March 2018 severe storms ('Beast from the East'), exposing the Yorkshire Water pipeline on the foreshore, but levels had recovered by the time of this survey. The topographic difference plot showed erosion across the majority of the beach with a very narrow band of accretion at the base of the seawall. Only one point in the cliff monitoring showed any movement; Point 16 with 0.5m of recession. The highest long term recession rates are seen at Point 5, south of the Filey town defences, where 0.7m/yr is recorded; Points 6 and 7 at Muston Sands show recession of 0.1 and 0.3m/yr respectively. Points 14 and 18 near Hunmanby Gap, and point 23 near Reighton Gap show recession rates of 0.1-0.2m/yr.

Appendices

Appendix A
Beach Profiles

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

Code	Description
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: 03/05/2018

Inspector: AG

Low Tide:

Low Tide Time:

Wind

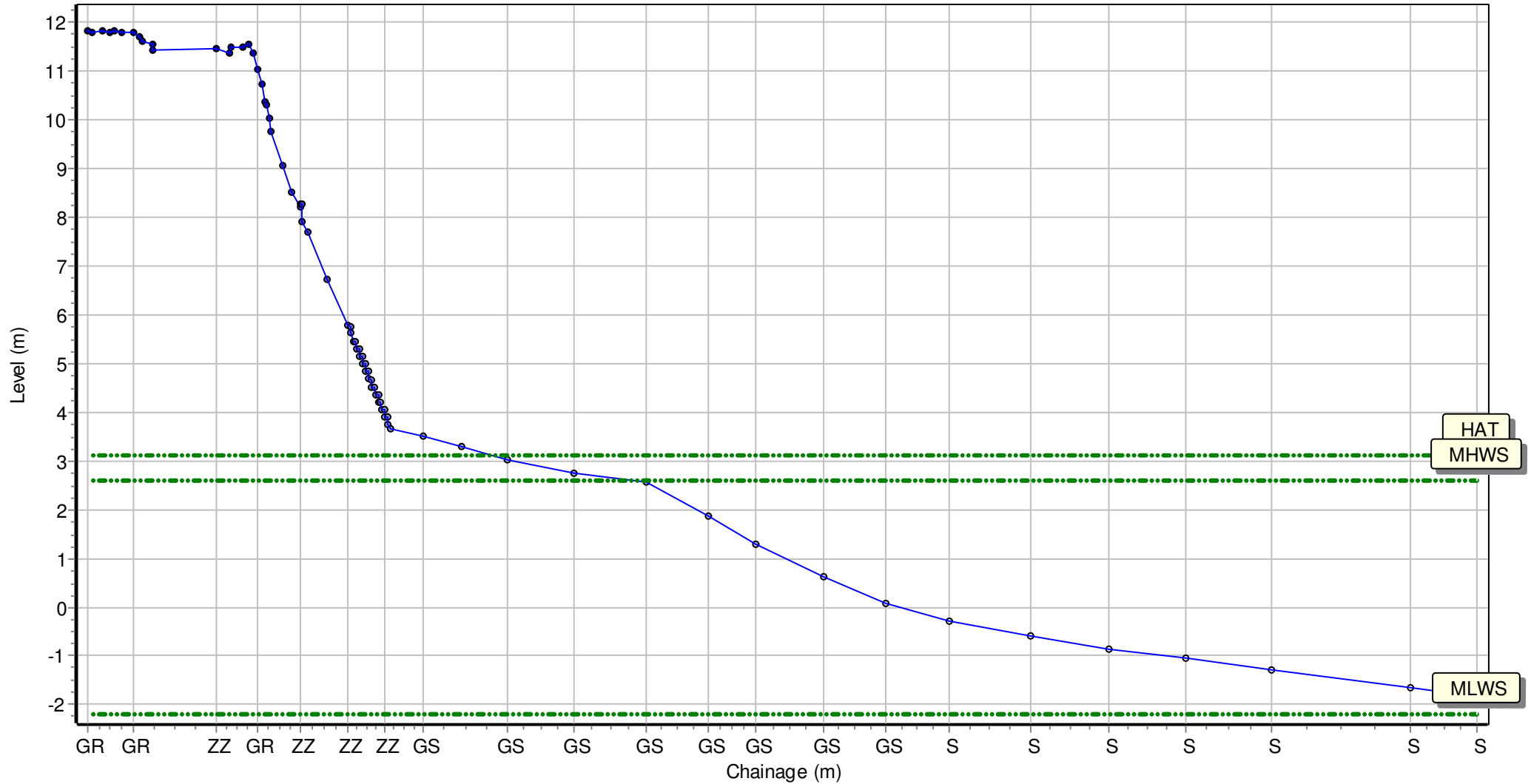
Sea State:

Visibility:

Rain:

Summary: 2018 Partial Measures Topo Survey

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



Beach Profile

Location: 1dWB2

Date: 03/05/2018

Inspector: AG

Low Tide:

Low Tide Time:

Wind

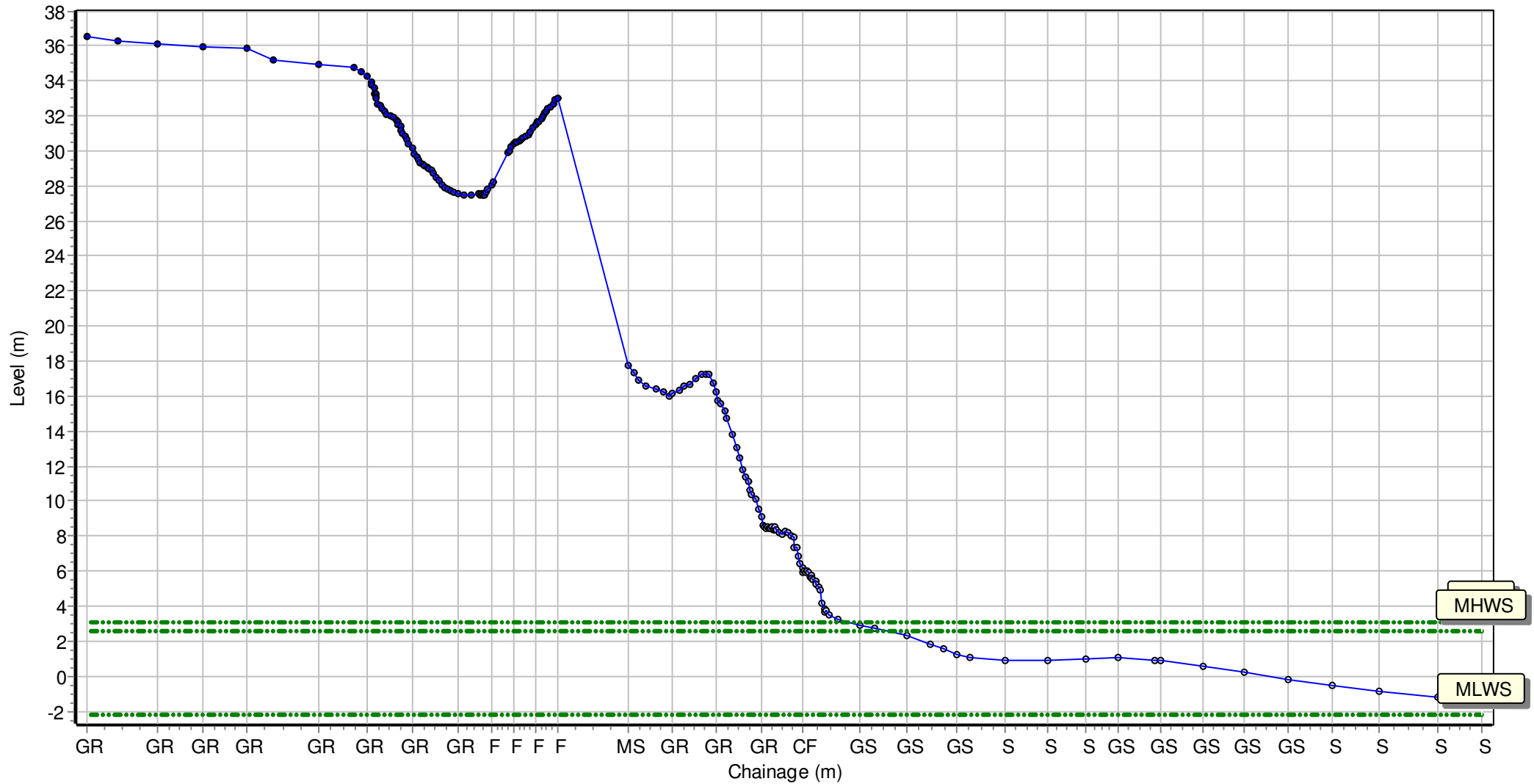
Sea State:

Visibility:

Rain:

Summary: 2018 Partial Measures Topo Survey

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



Beach Profile

Location: 1dWB3

Date: 03/05/2018

Inspector: AG

Low Tide:

Low Tide Time:

Wind

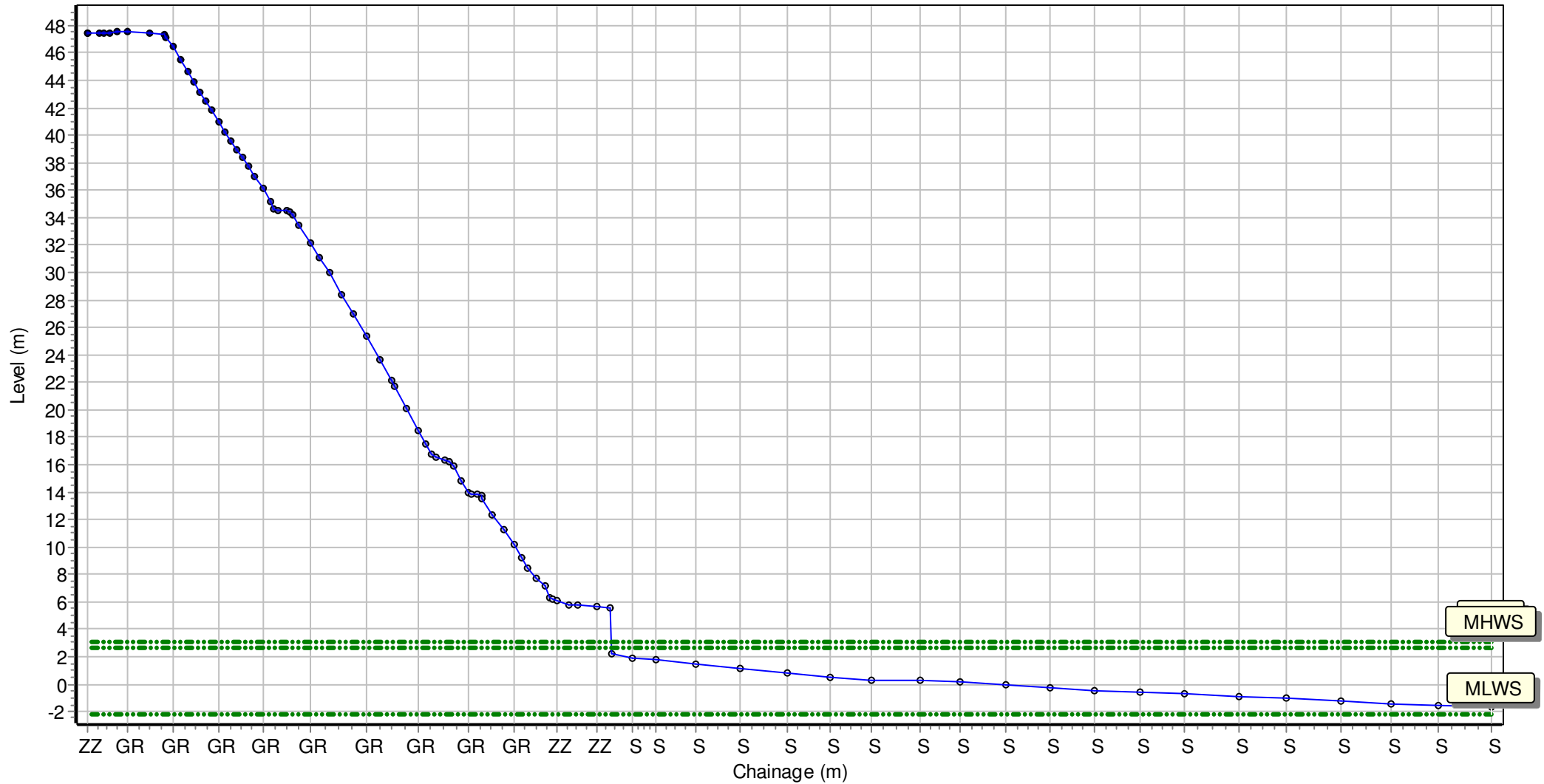
Sea State:

Visibility:

Rain:

Summary: 2018 Partial Measures Topo Survey

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



Beach Profile

Location: 1dSBN1

Date: 21/03/2018

Inspector: AG

Low Tide:

Low Tide Time:

Wind

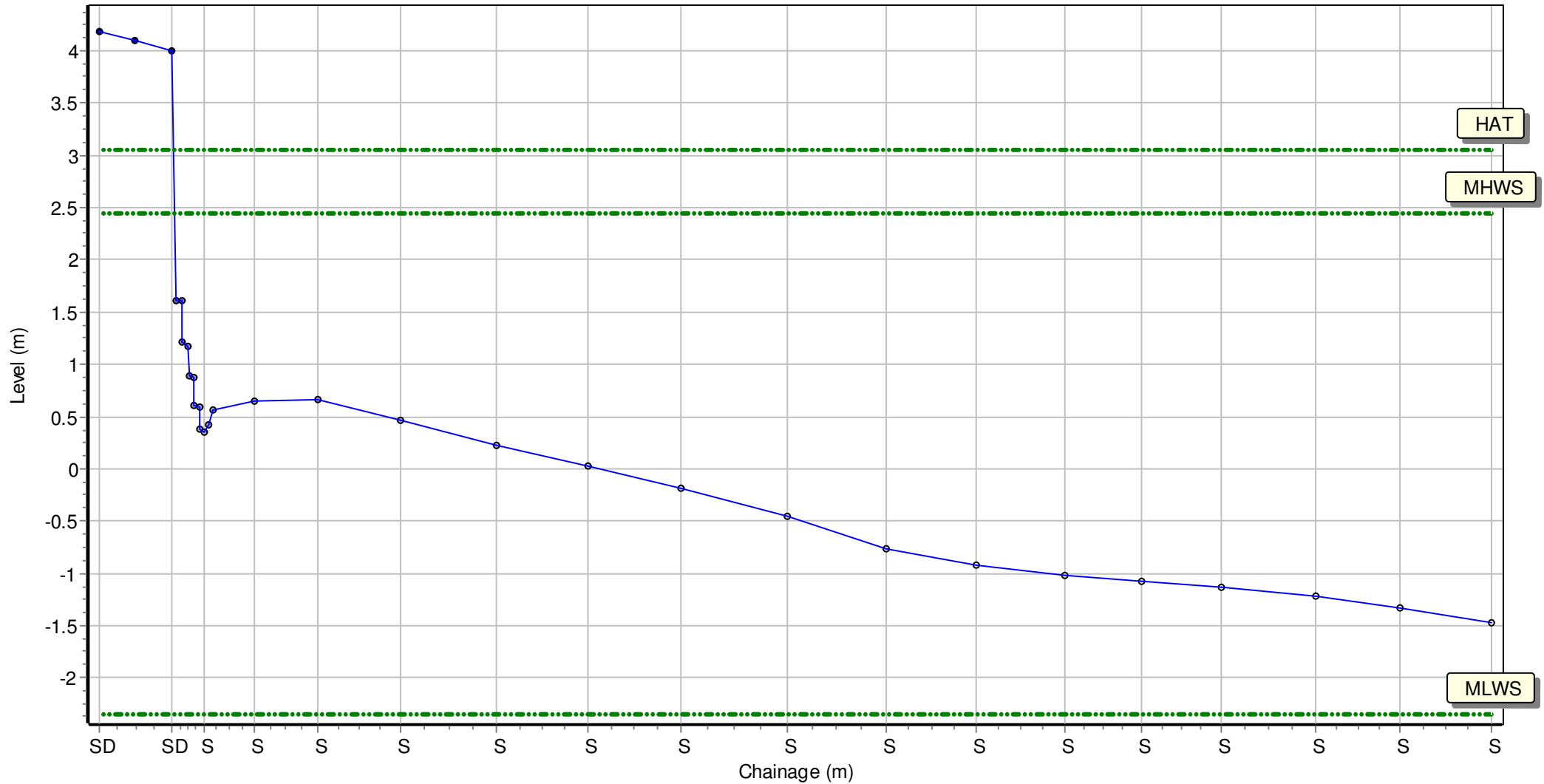
Sea State:

Visibility:

Rain:

Summary: 2018 Partial Measures Topo Survey

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



Beach Profile

Location: 1dSBN2

Date: 21/03/2018

Inspector: AG

Low Tide:

Low Tide Time:

Wind

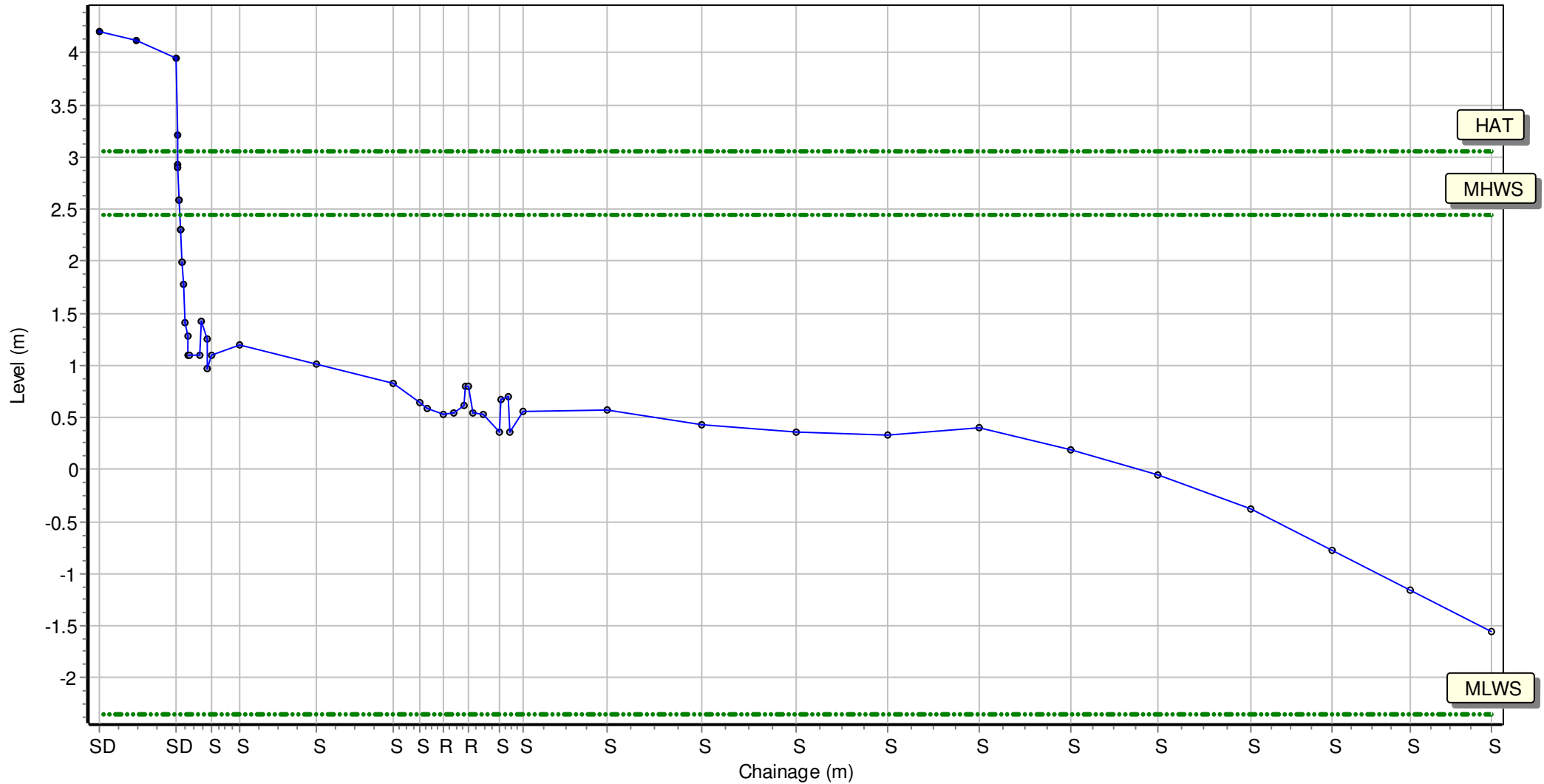
Sea State:

Visibility:

Rain:

Summary: 2018 Partial Measures Topo Survey

Easting: 503616.346 Northing: 490135.674 Profile Bearing: 78 ° from North



Beach Profile

Location: 1dSBN3

Date: 21/03/2018

Inspector: AG

Low Tide:

Low Tide Time:

Wind

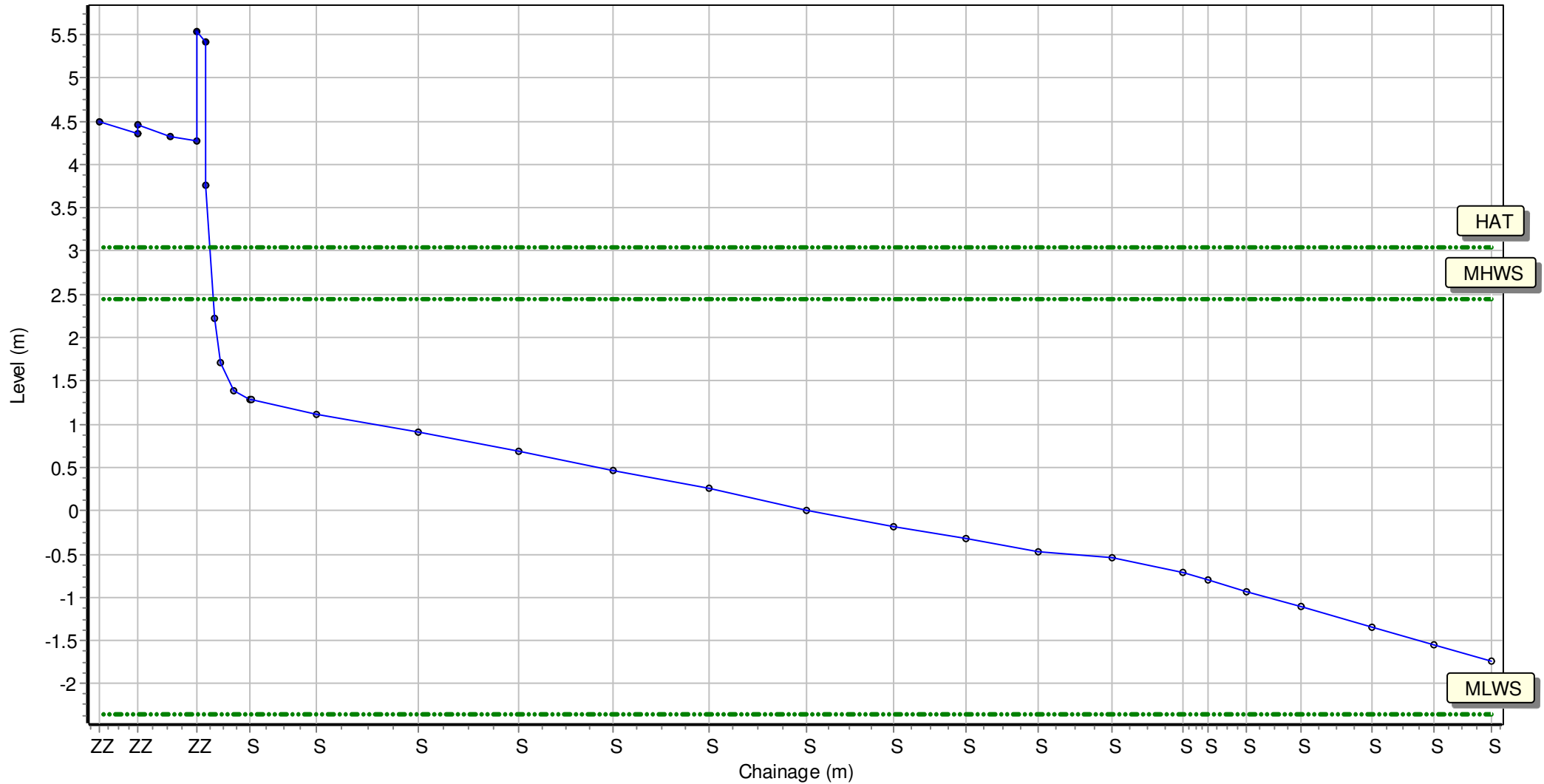
Sea State:

Visibility:

Rain:

Summary: 2018 Partial Measures Topo Survey

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



Beach Profile

Location: 1dSBN4

Date: 21/03/2018

Inspector: AG

Low Tide:

Low Tide Time:

Wind

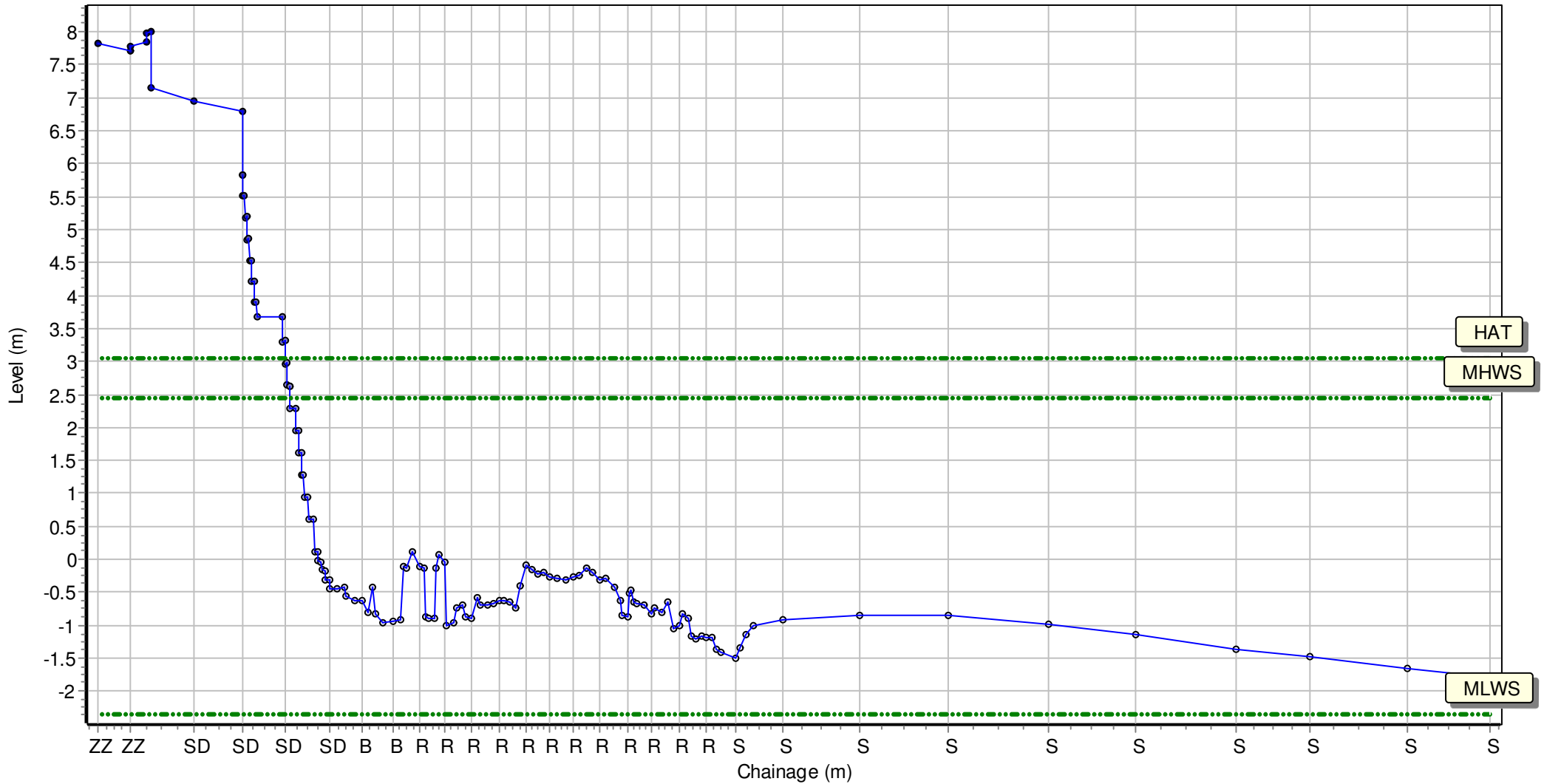
Sea State:

Visibility:

Rain:

Summary: 2018 Partial Measures Topo Survey

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



Beach Profile

Location: 1dSBN5

Date: 21/03/2018

Inspector: AG

Low Tide:

Low Tide Time:

Wind

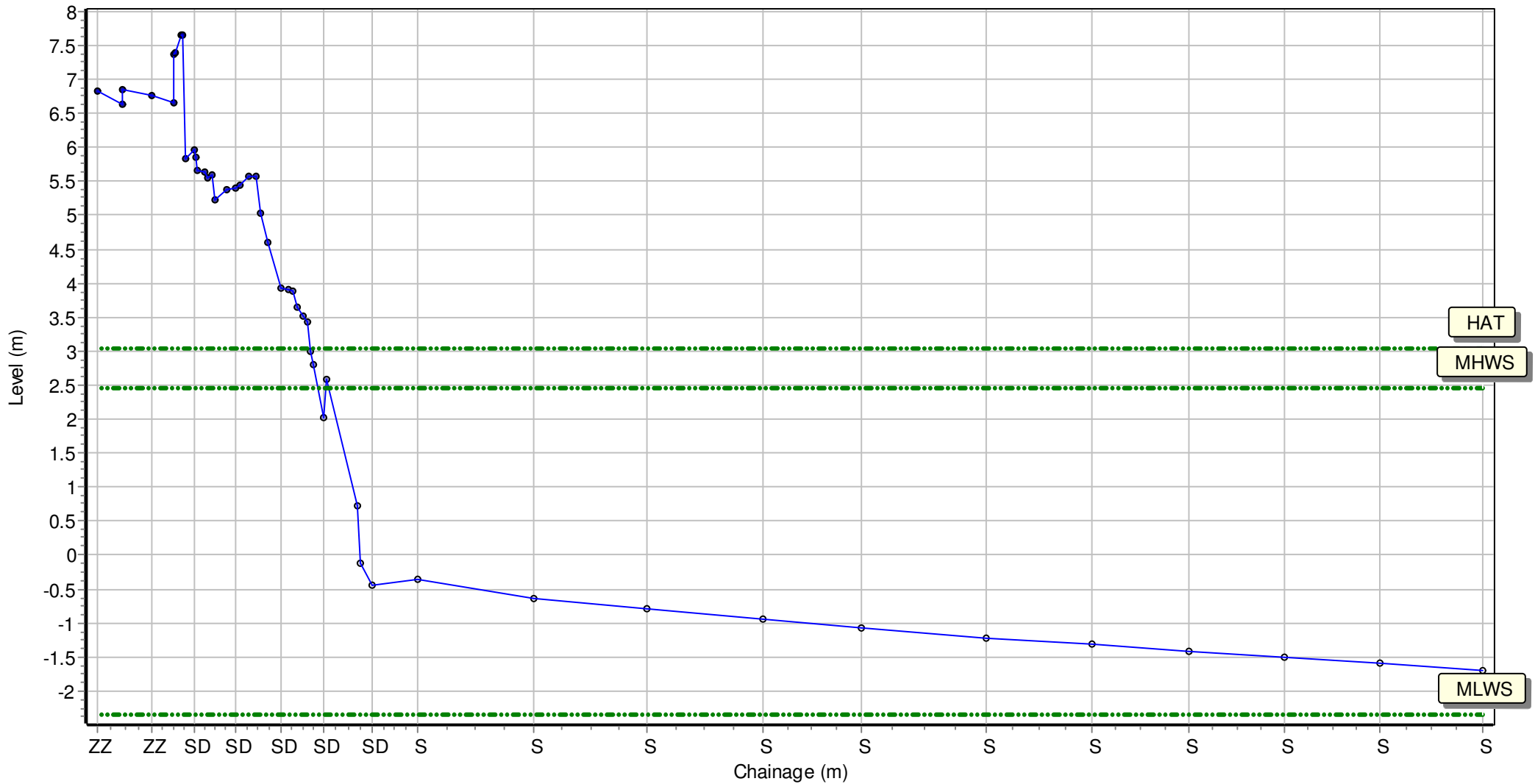
Sea State:

Visibility:

Rain:

Summary: 2018 Partial Measures Topo Survey

Easting: 504515.599 Northing: 489205.724 Profile Bearing: 14 ° from North



Beach Profile

Location: 1dSBS1

Date: 21/03/2018

Inspector: AG

Low Tide:

Low Tide Time:

Wind

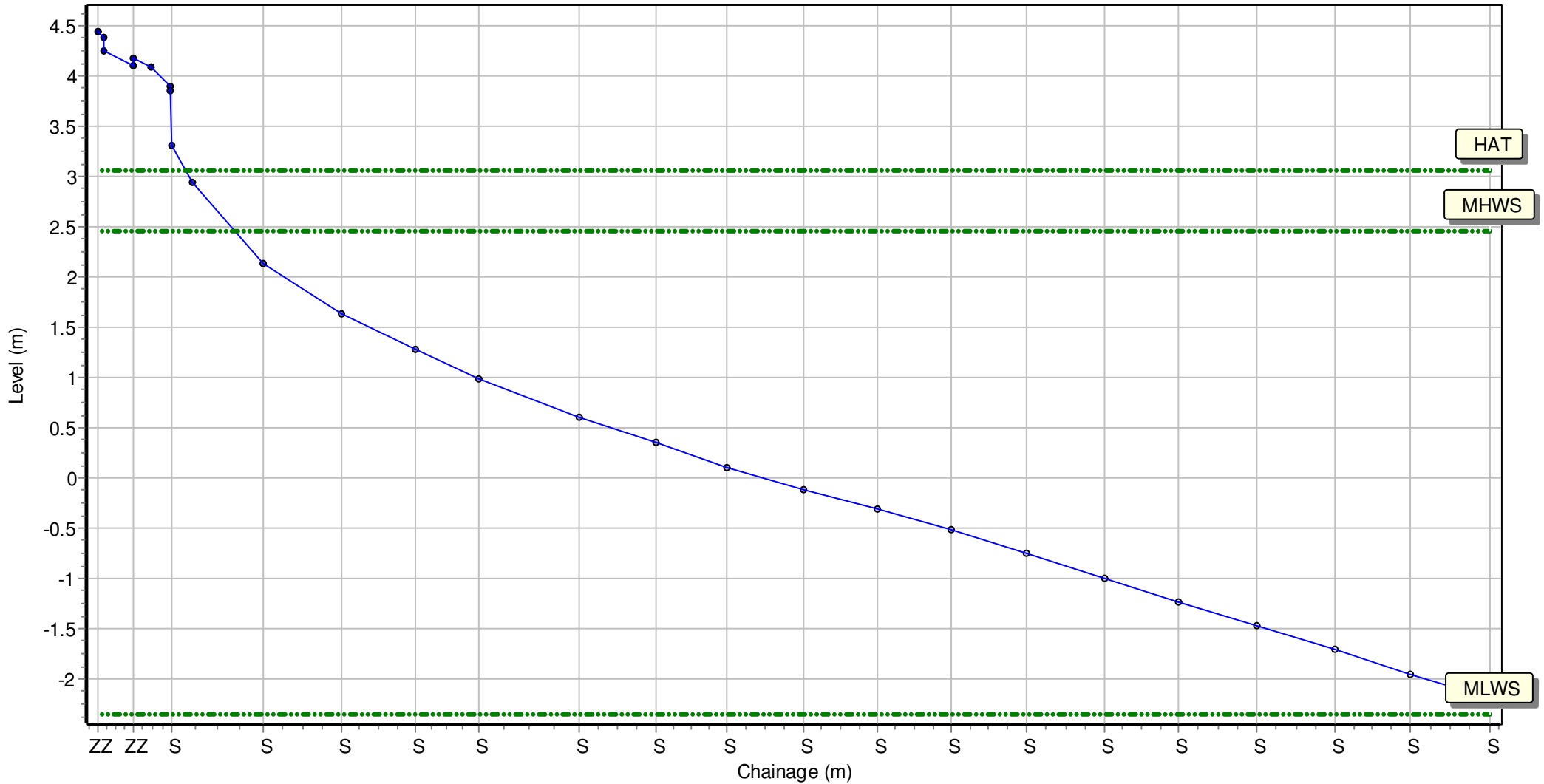
Sea State:

Visibility:

Rain:

Summary: 2018 Partial Measures Topo Survey

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



Beach Profile

Location: 1dSBS2

Date: 21/03/2018

Inspector: AG

Low Tide:

Low Tide Time:

Wind

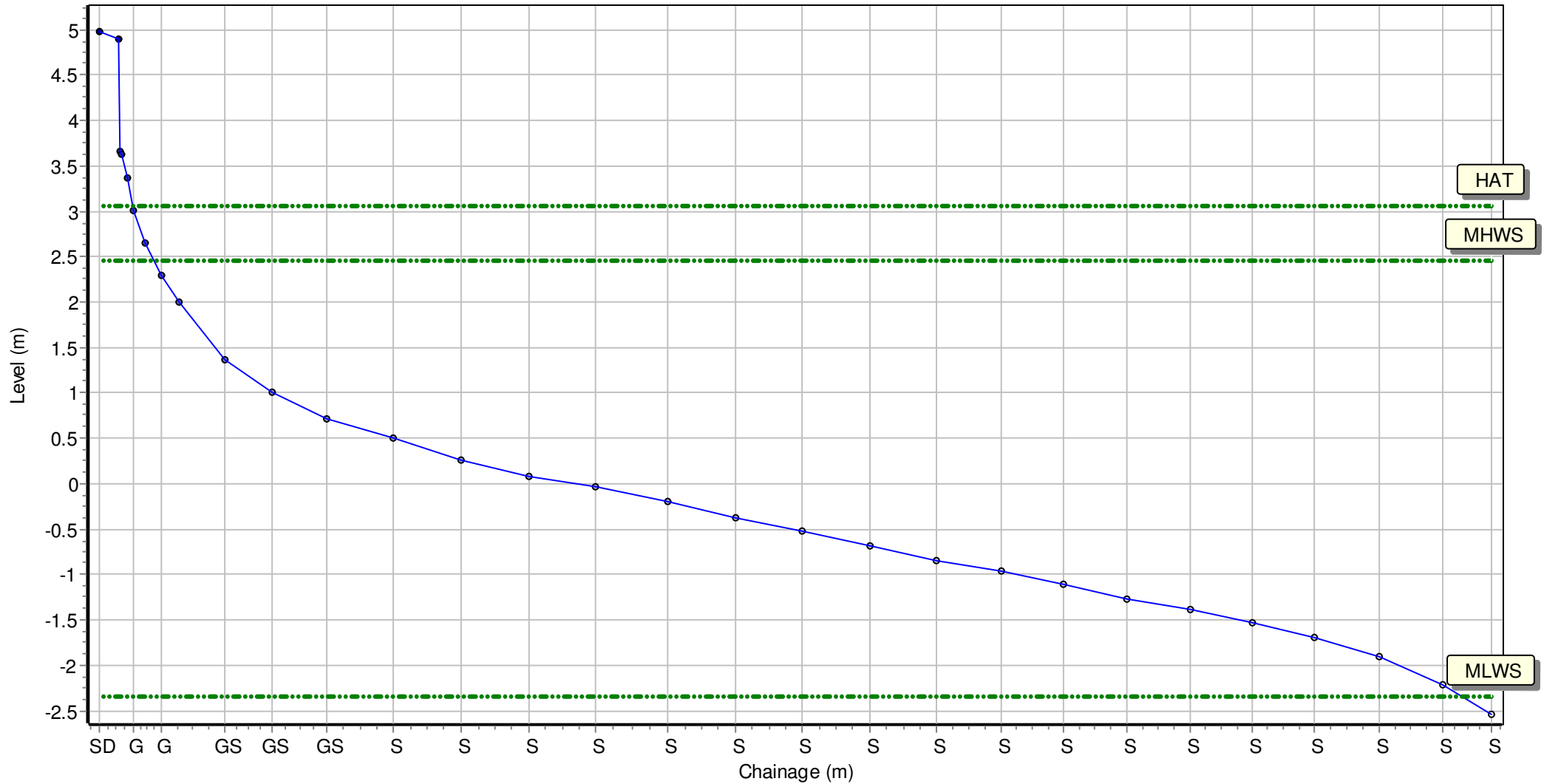
Sea State:

Visibility:

Rain:

Summary: 2018 Partial Measures Topo Survey

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



Beach Profile

Location: 1dSBS3

Date: 21/03/2018

Inspector: AG

Low Tide:

Low Tide Time:

Wind

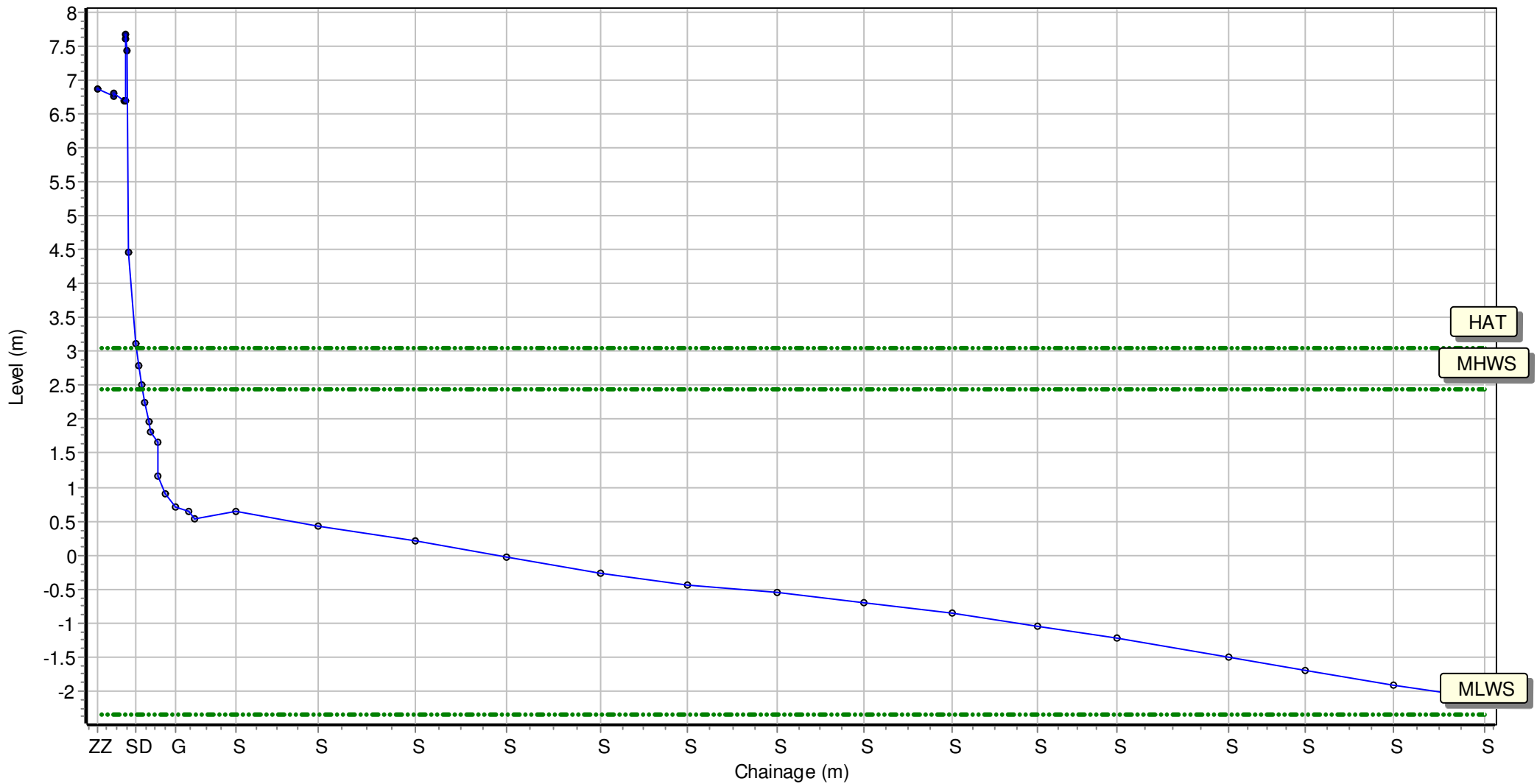
Sea State:

Visibility:

Rain:

Summary: 2018 Partial Measures Topo Survey

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



Beach Profile

Location: 1dSBS4

Date: 21/03/2018

Inspector: AG

Low Tide:

Low Tide Time:

Wind

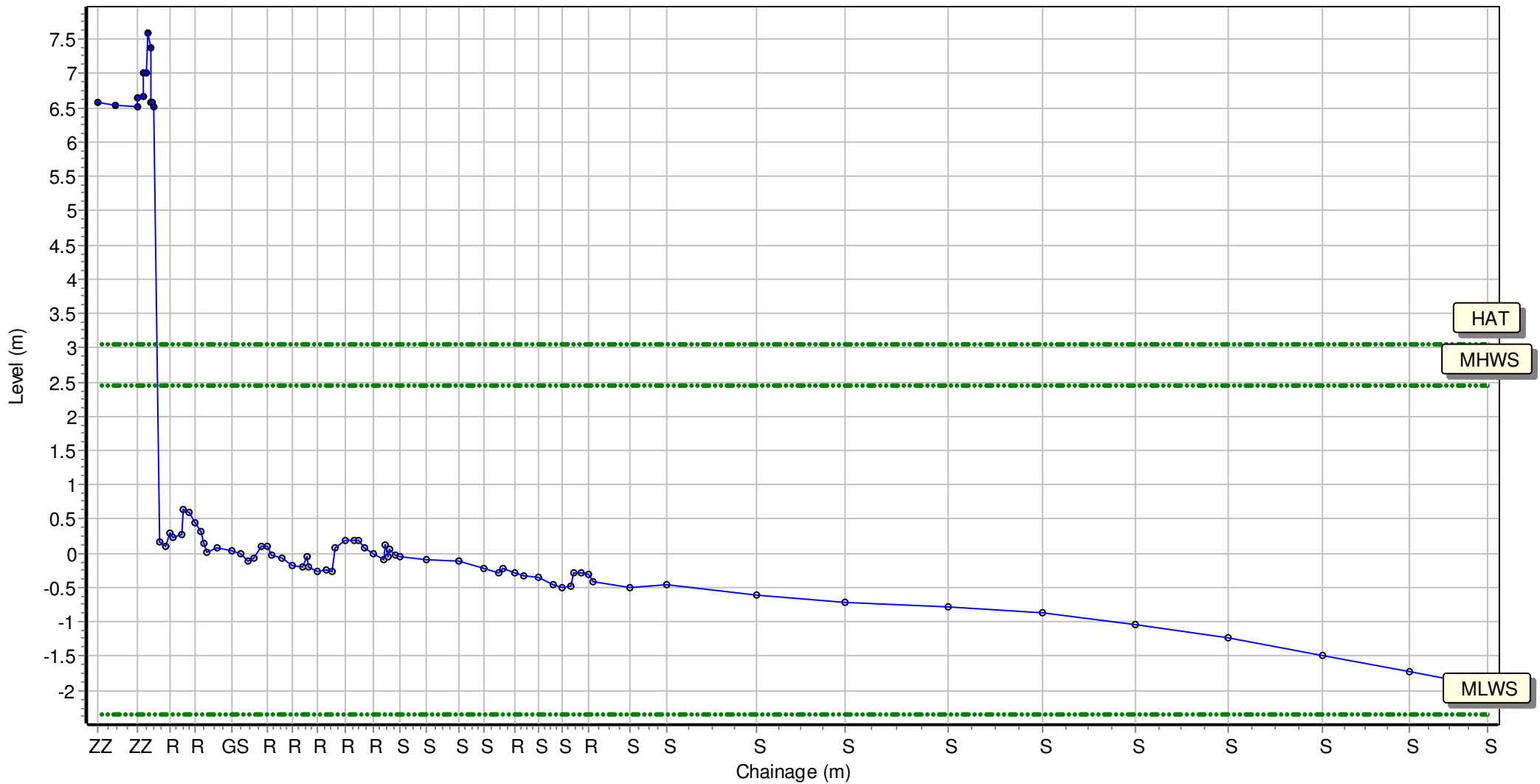
Sea State:

Visibility:

Rain:

Summary: 2018 Partial Measures Topo Survey

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



Beach Profile

Location: 1dCY1

Date: 20/03/2018

Inspector: AG

Low Tide:

Low Tide Time:

Wind

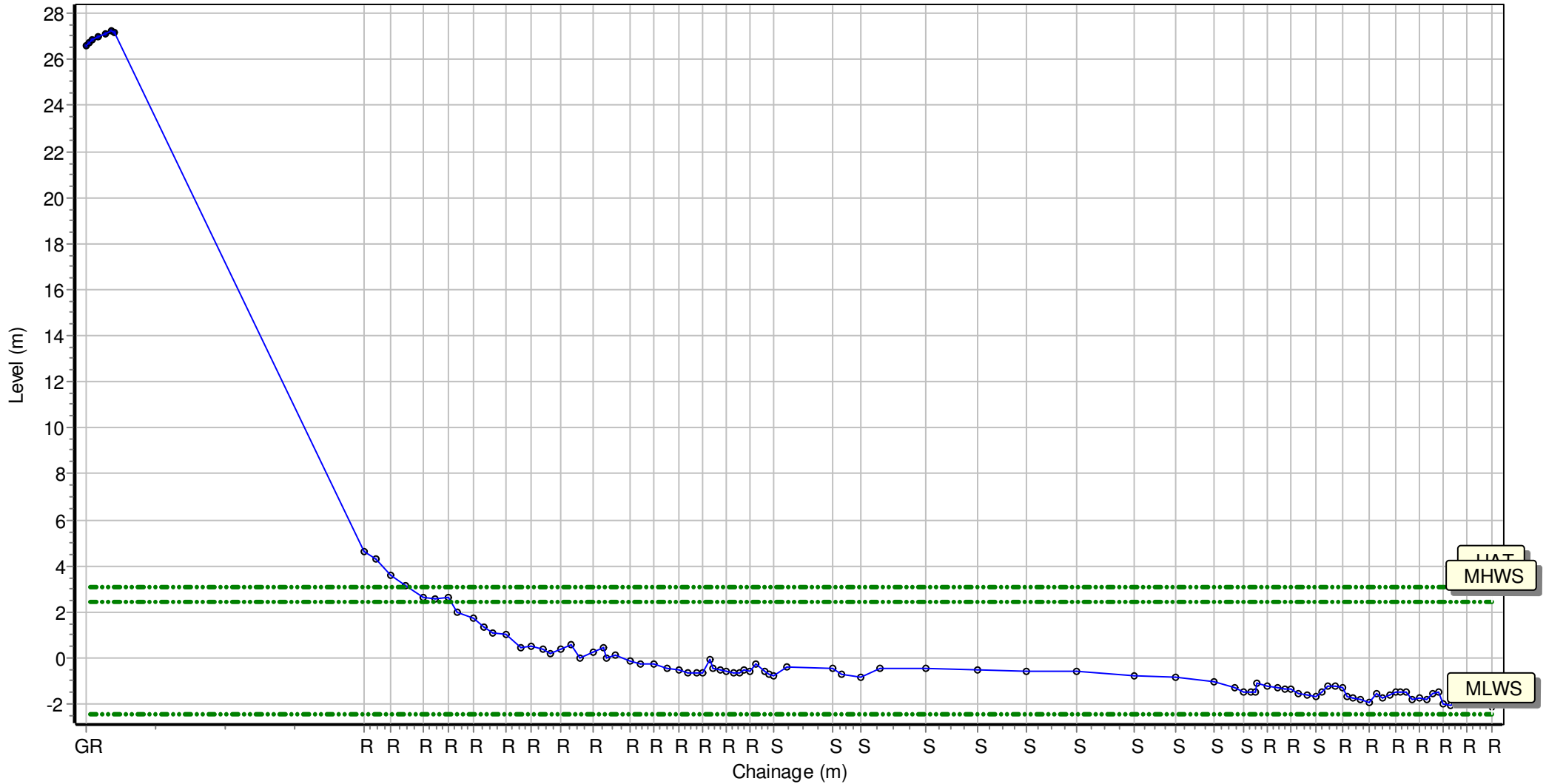
Sea State:

Visibility:

Rain:

Summary: 2018 Partial Measures Topo Survey

Easting: 506420.411 Northing: 484793.941 Profile Bearing: 43 ° from North



Beach Profile

Location: 1dCY1A

Date: 20/03/2018

Inspector: AG

Low Tide:

Low Tide Time:

Wind

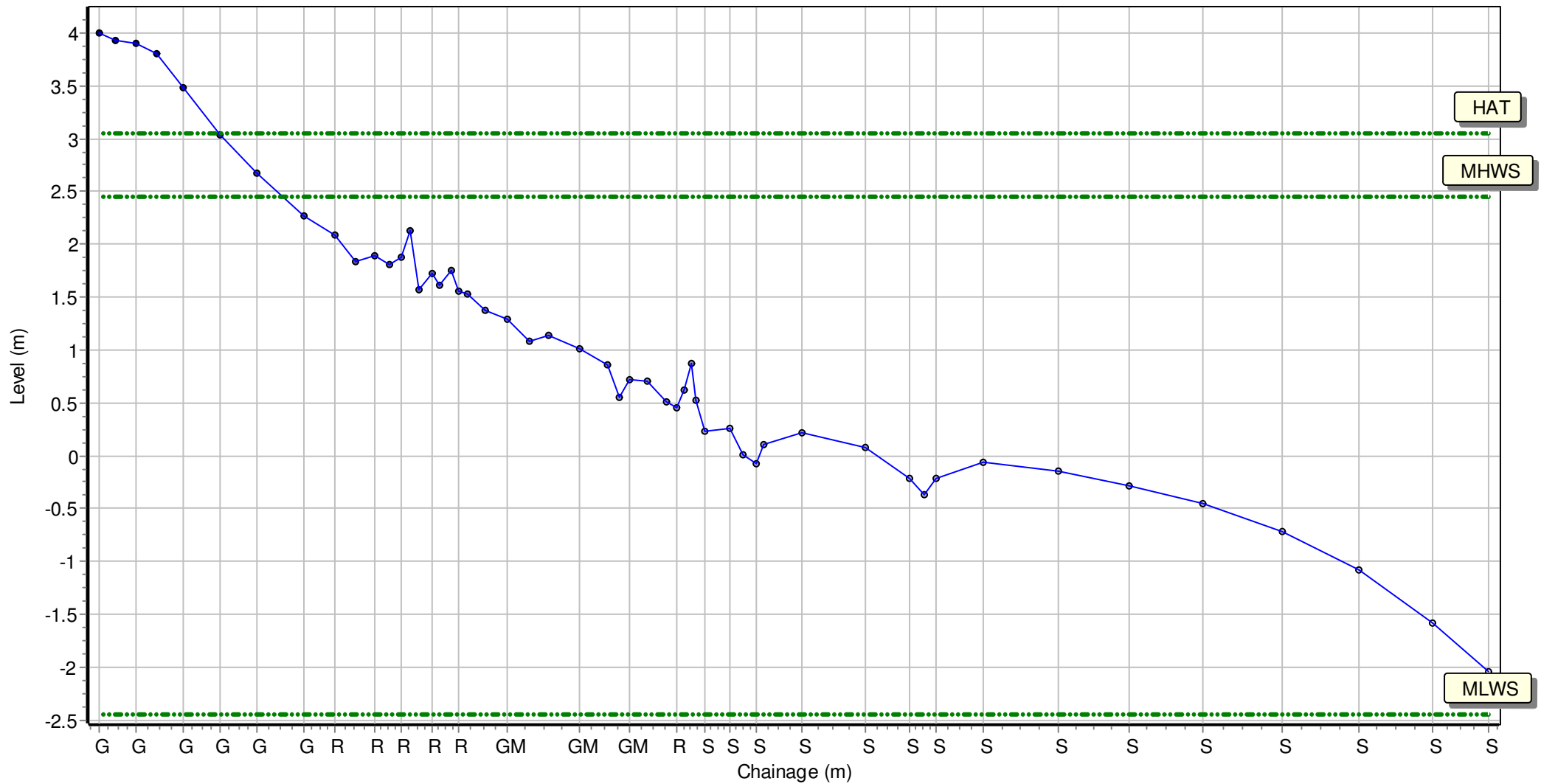
Sea State:

Visibility:

Rain:

Summary: 2018 Partial Measures Topo Survey

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



Beach Profile

Location: 1dCY2

Date: 20/03/2018

Inspector: AG

Low Tide:

Low Tide Time:

Wind

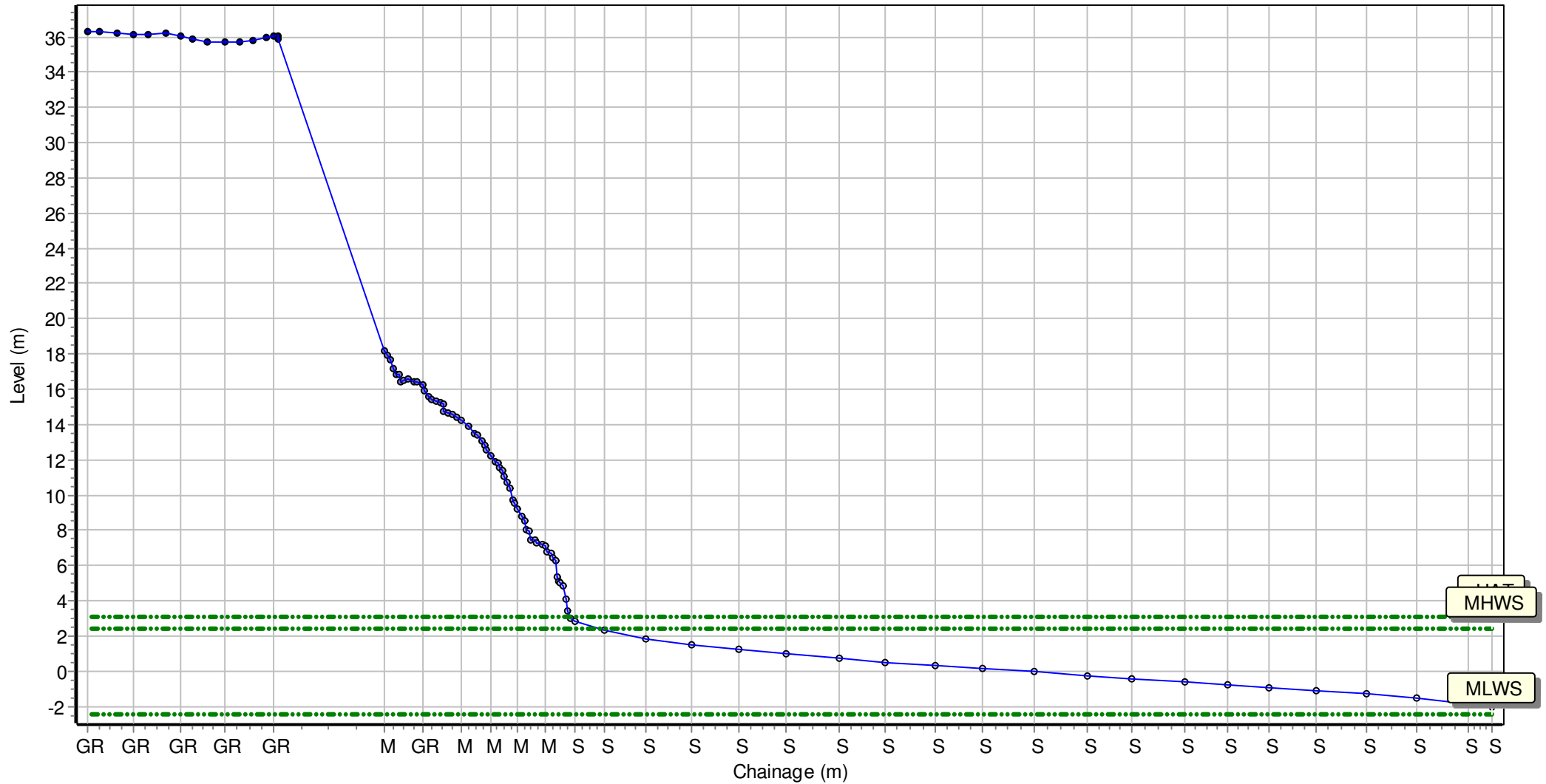
Sea State:

Visibility:

Rain:

Summary: 2018 Partial Measures Topo Survey

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



Beach Profile

Location: 1dCY3

Date: 20/03/2018 Inspector: AG

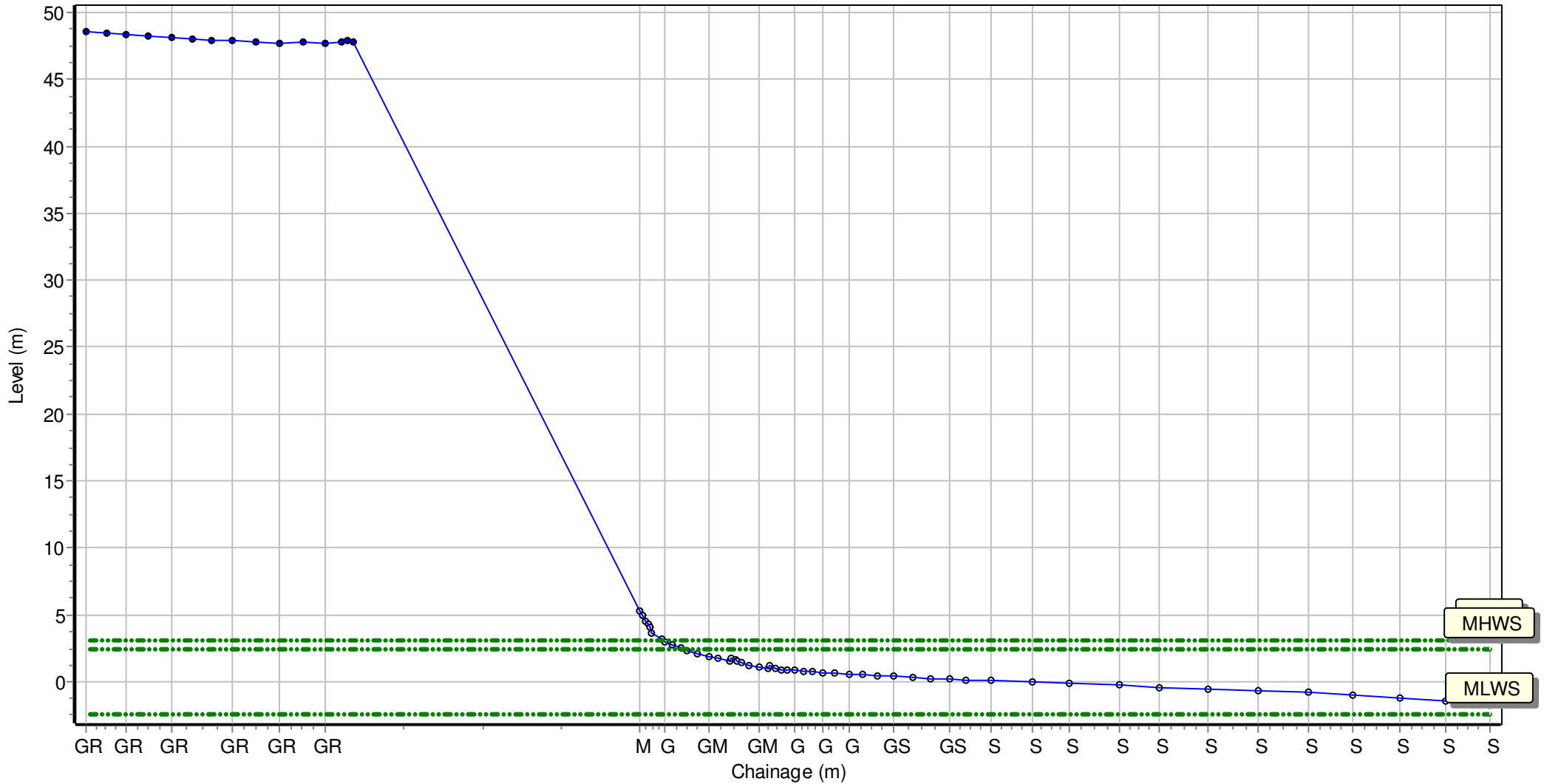
Low Tide: Low Tide Time:

Wind Sea State:

Visibility: Rain:

Summary: 2018 Partial Measures Topo Survey

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



Beach Profile

Location: 1dFB1

Date: 22/03/2018

Inspector: AG

Low Tide:

Low Tide Time:

Wind

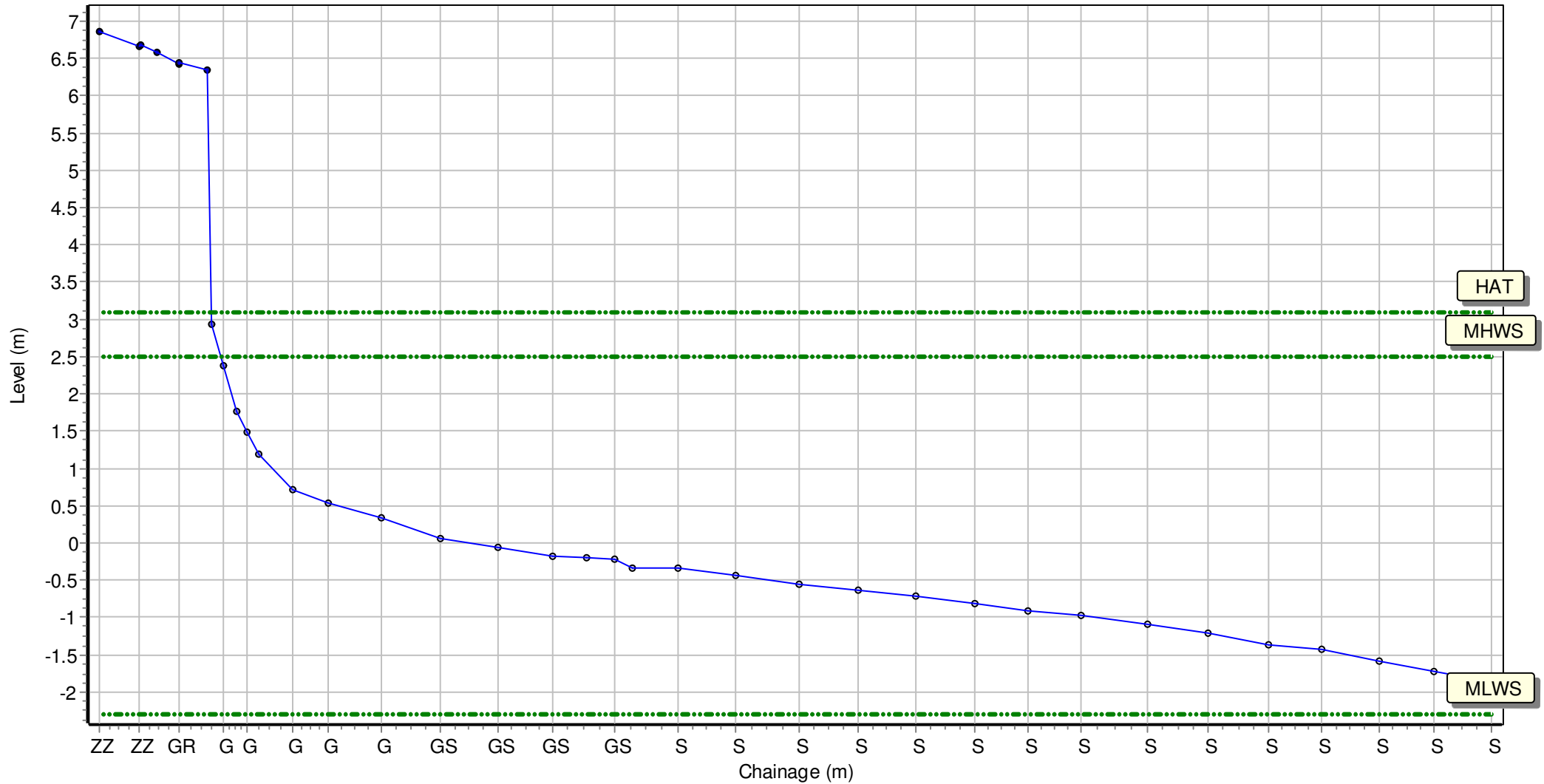
Sea State:

Visibility:

Rain:

Summary: 2018 Partial Measures Topo Survey

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



Beach Profile

Location: 1dFB2

Date: 22/03/2018

Inspector: AG

Low Tide:

Low Tide Time:

Wind

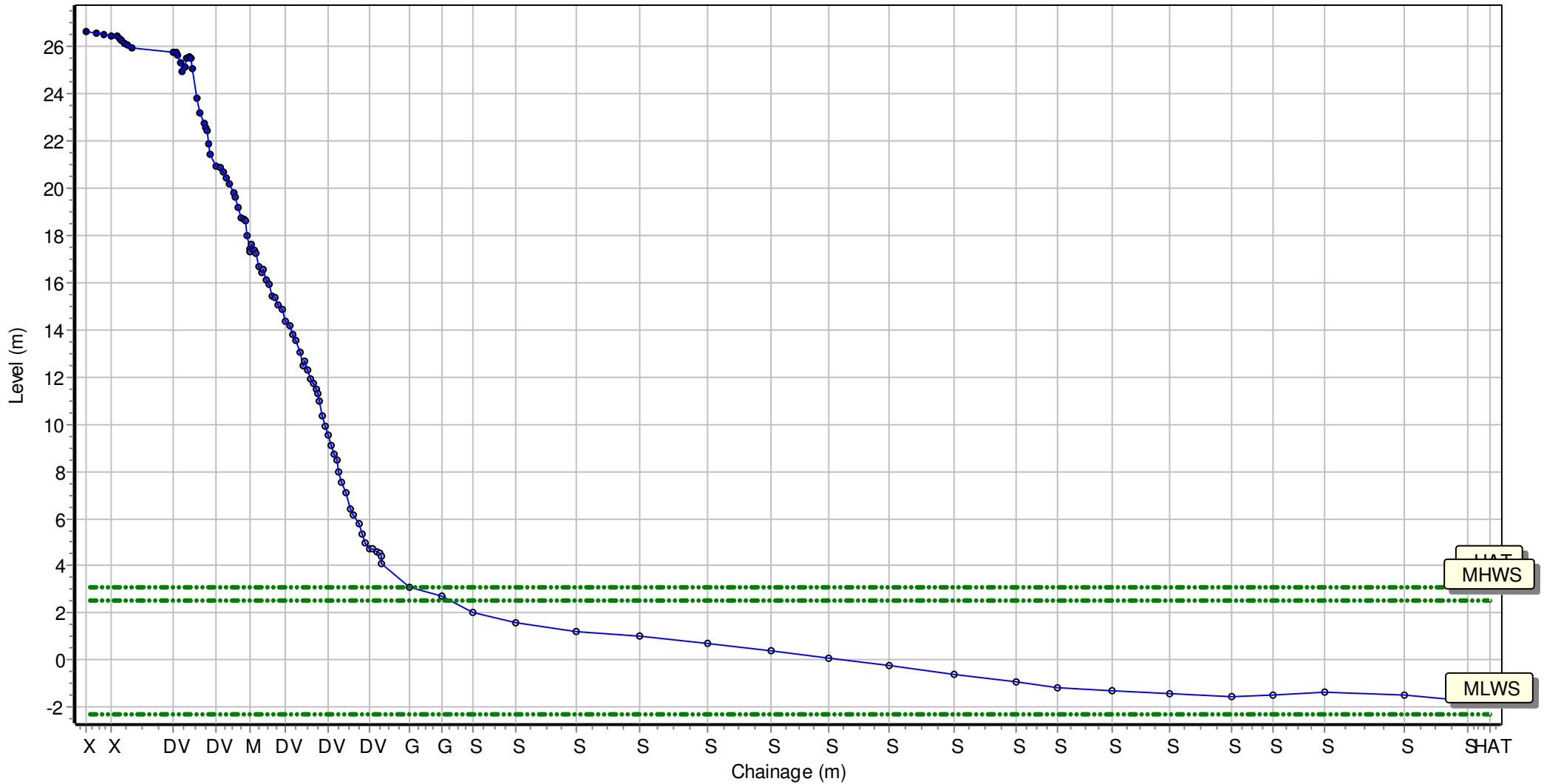
Sea State:

Visibility:

Rain:

Summary: 2018 Partial Measures Topo Survey

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



Beach Profile

Location: 1dFB3

Date: 22/03/2018

Inspector: AG

Low Tide:

Low Tide Time:

Wind

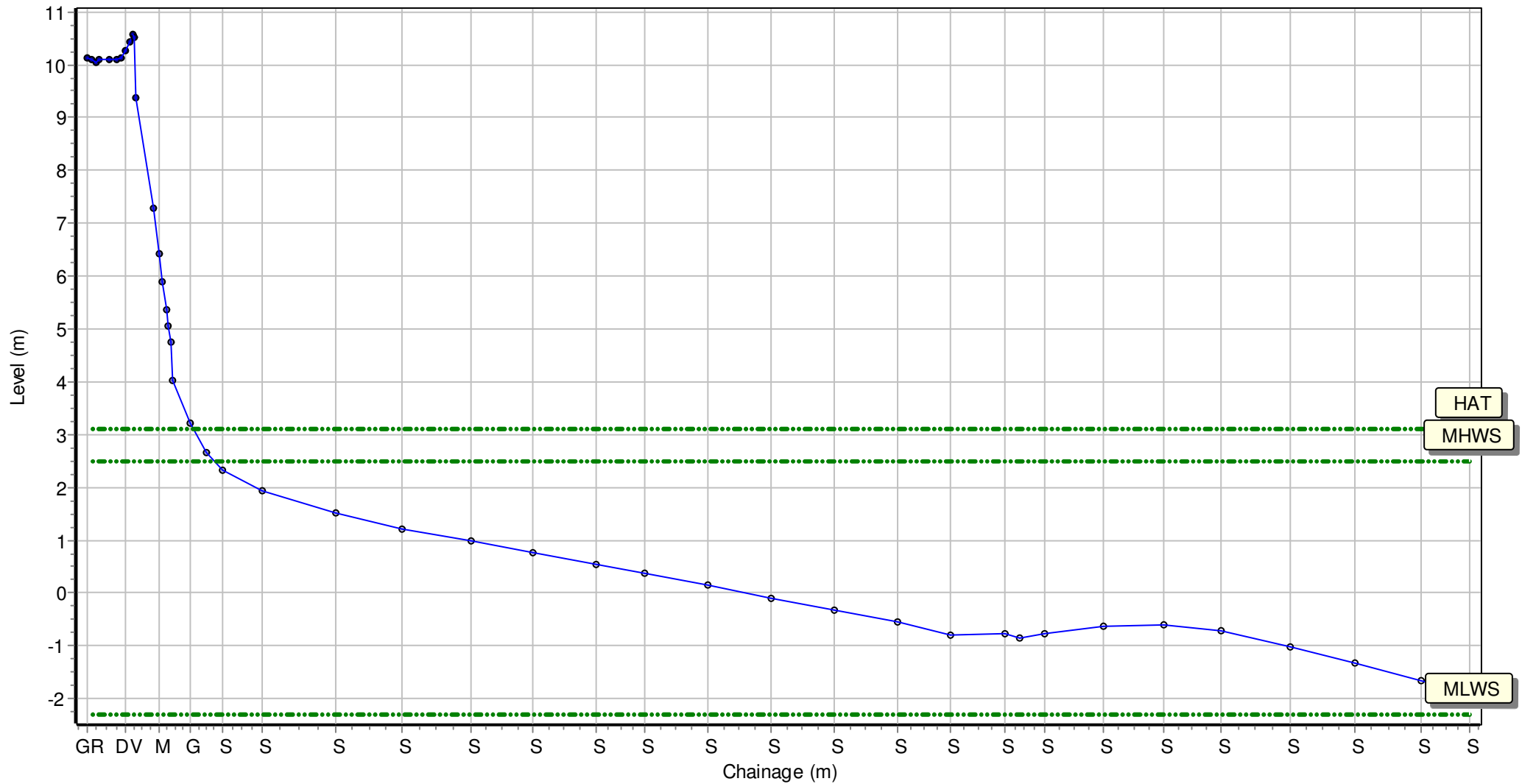
Sea State:

Visibility:

Rain:

Summary: 2018 Partial Measures Topo Survey

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



Beach Profile

Location: 1dFB4

Date: 22/03/2018

Inspector: AG

Low Tide:

Low Tide Time:

Wind

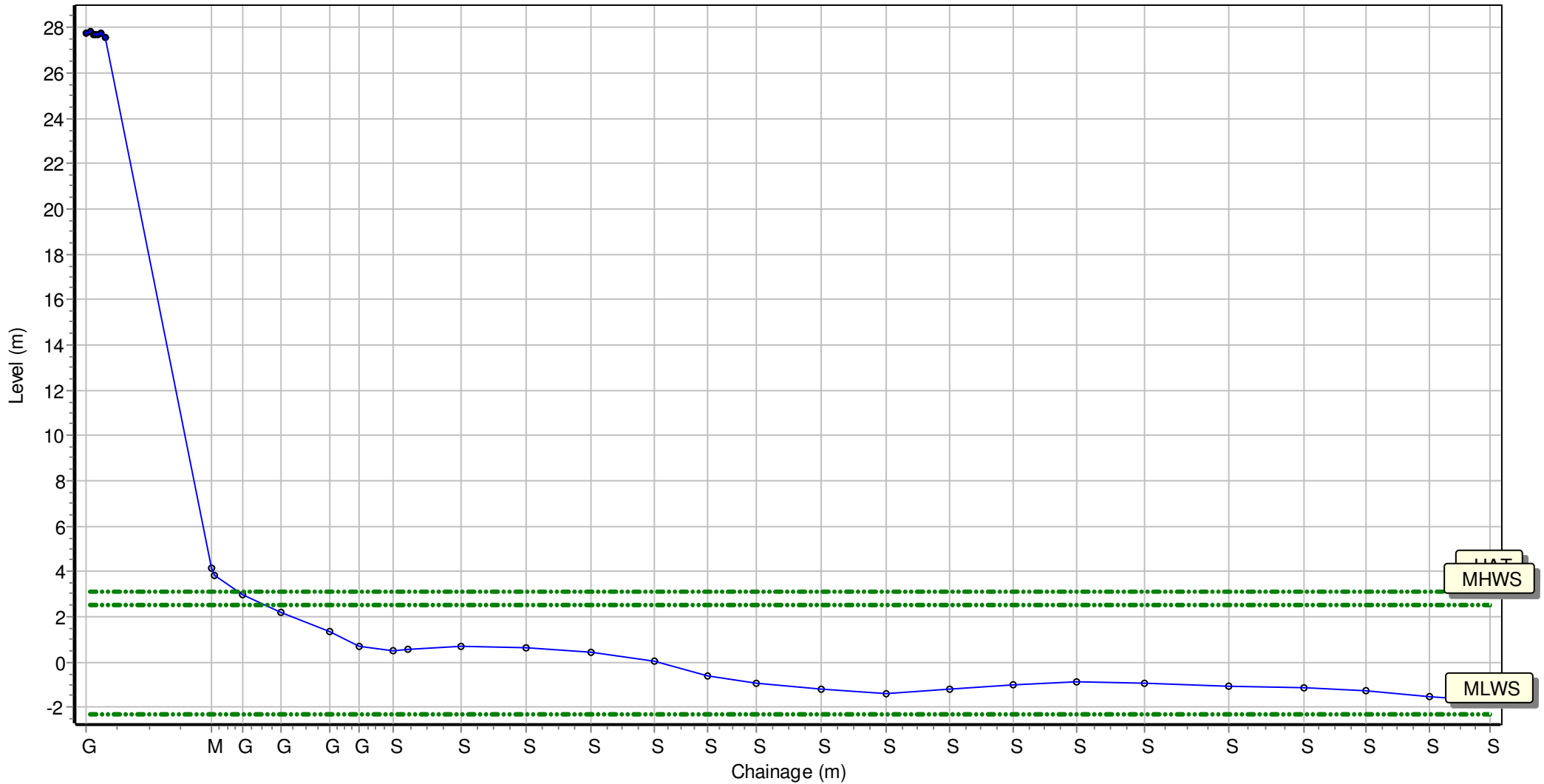
Sea State:

Visibility:

Rain:

Summary: 2018 Partial Measures Topo Survey

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



Beach Profile

Location: 1dFB5

Date: 22/03/2018

Inspector: AG

Low Tide:

Low Tide Time:

Wind

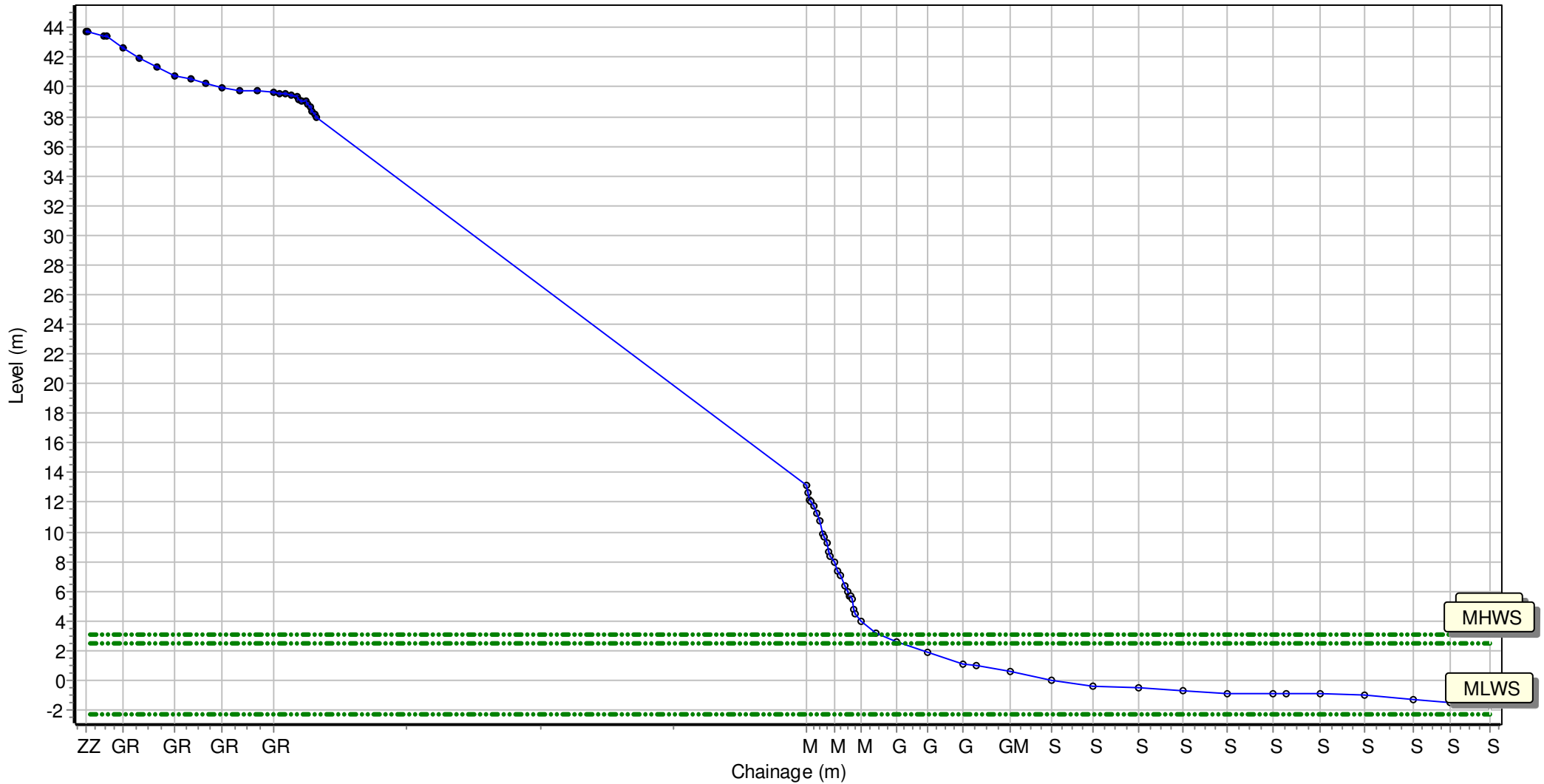
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Visibility:

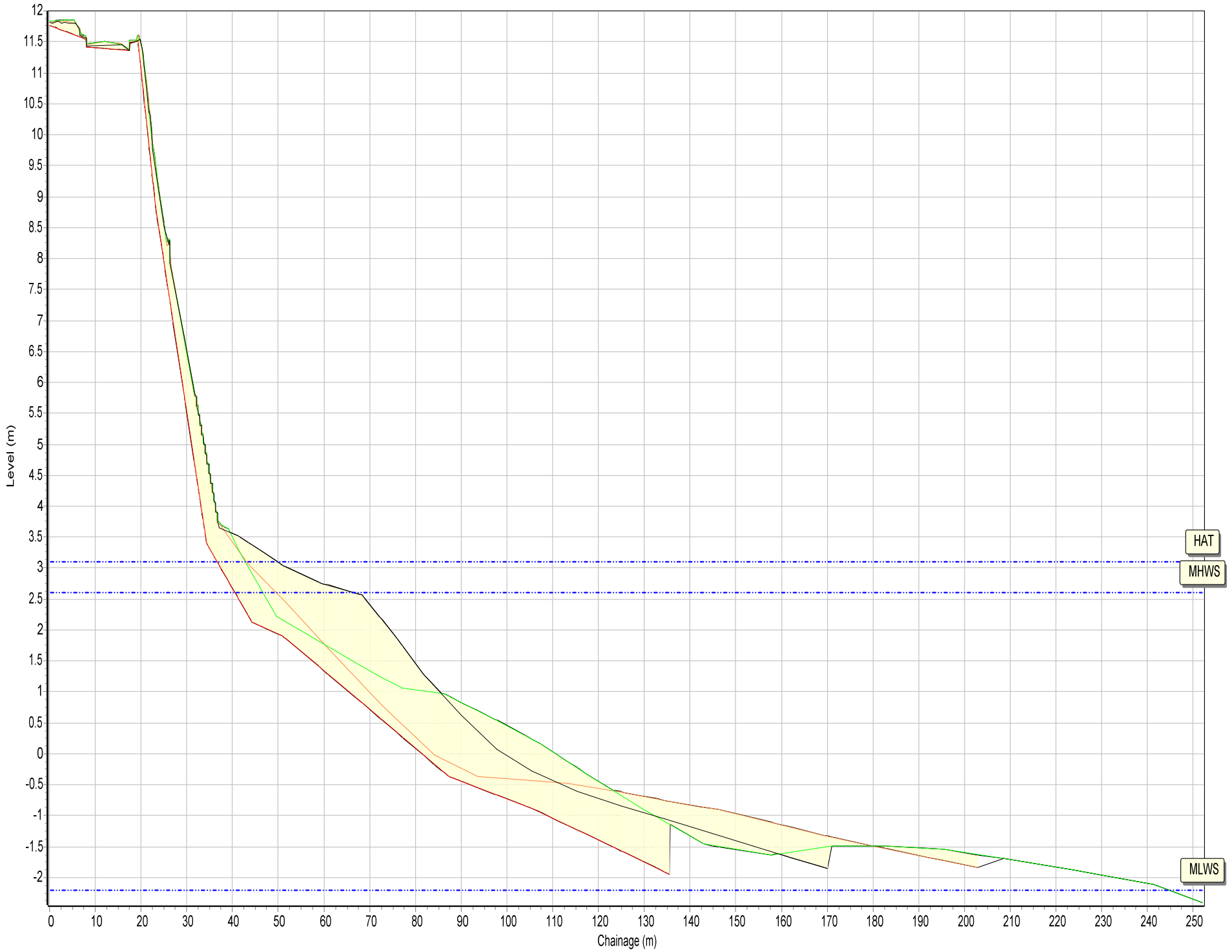
Rain:

Summary: 2018 Partial Measures Topo Survey

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



Beach Profiles: 1dWB1



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03/03/2017
22/09/2017
03/05/2018

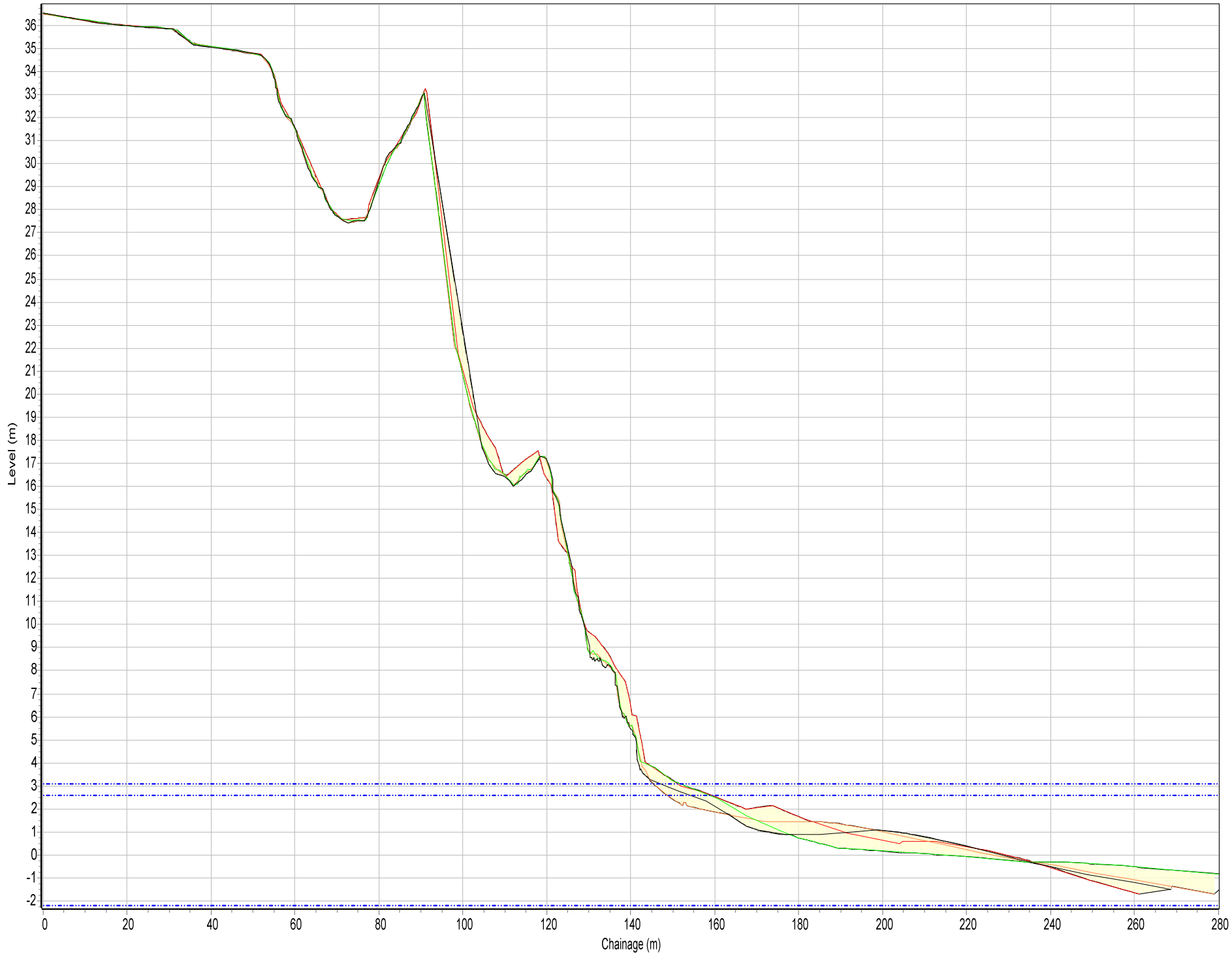
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MHWS

MLWS

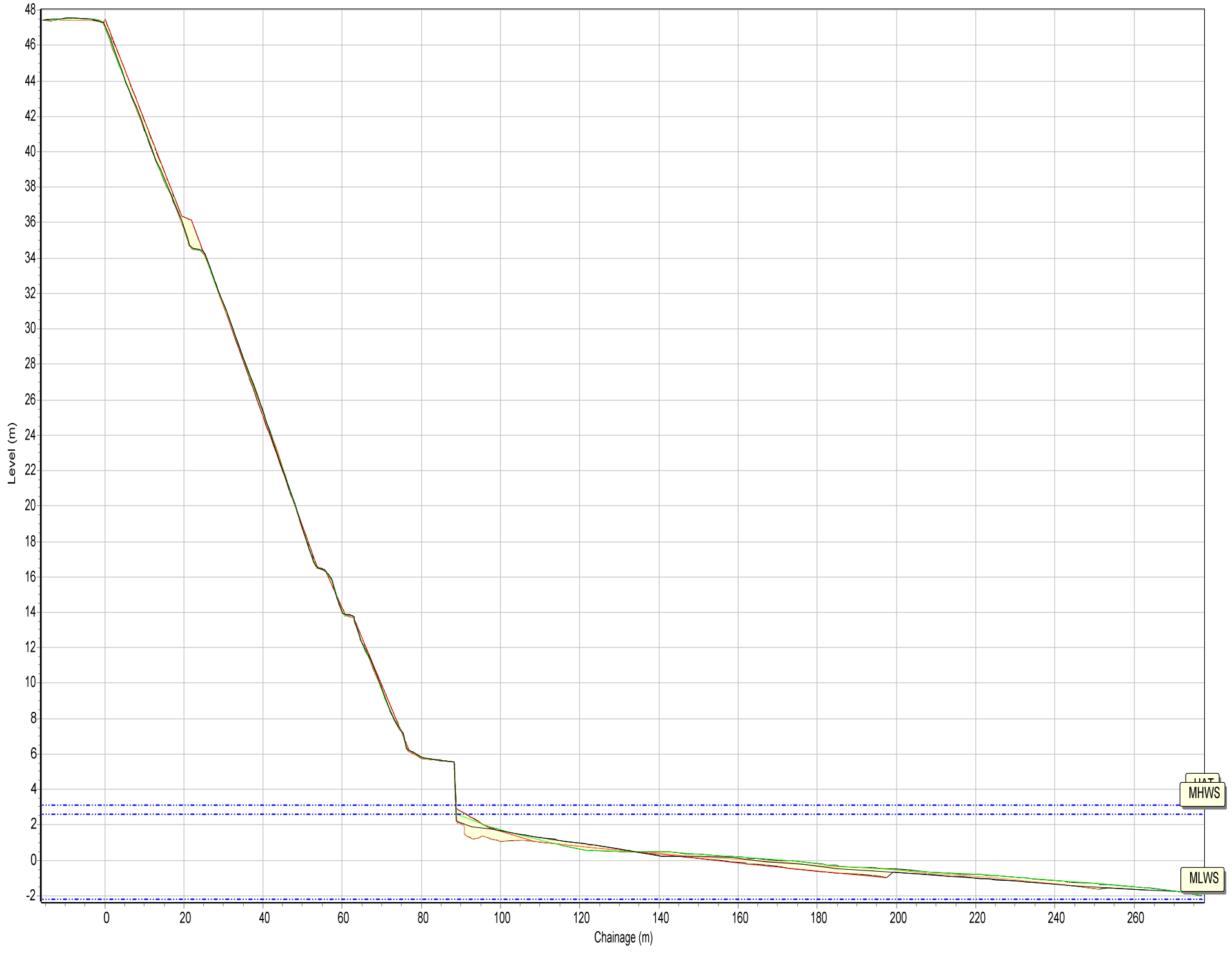
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Beach Profiles: 1dWB2



Profiles Envelope
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03/03/2017
22/09/2017
03/05/2018

Beach Profiles: 1dWB3



Profiles Envelope
26/11/2008
03/03/2017
22/09/2017
03/05/2018

LAT
MHWS

MLWS

SANDS

Beach Profiles: 1dSBN1



Profiles Envelope
15/11/2008
02/03/2017
19/09/2017
21/03/2018

HAT

MHWS

MLWS

SANDS

Beach Profiles: 1dSBN2



Profiles Envelope
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19/09/2017
21/03/2018

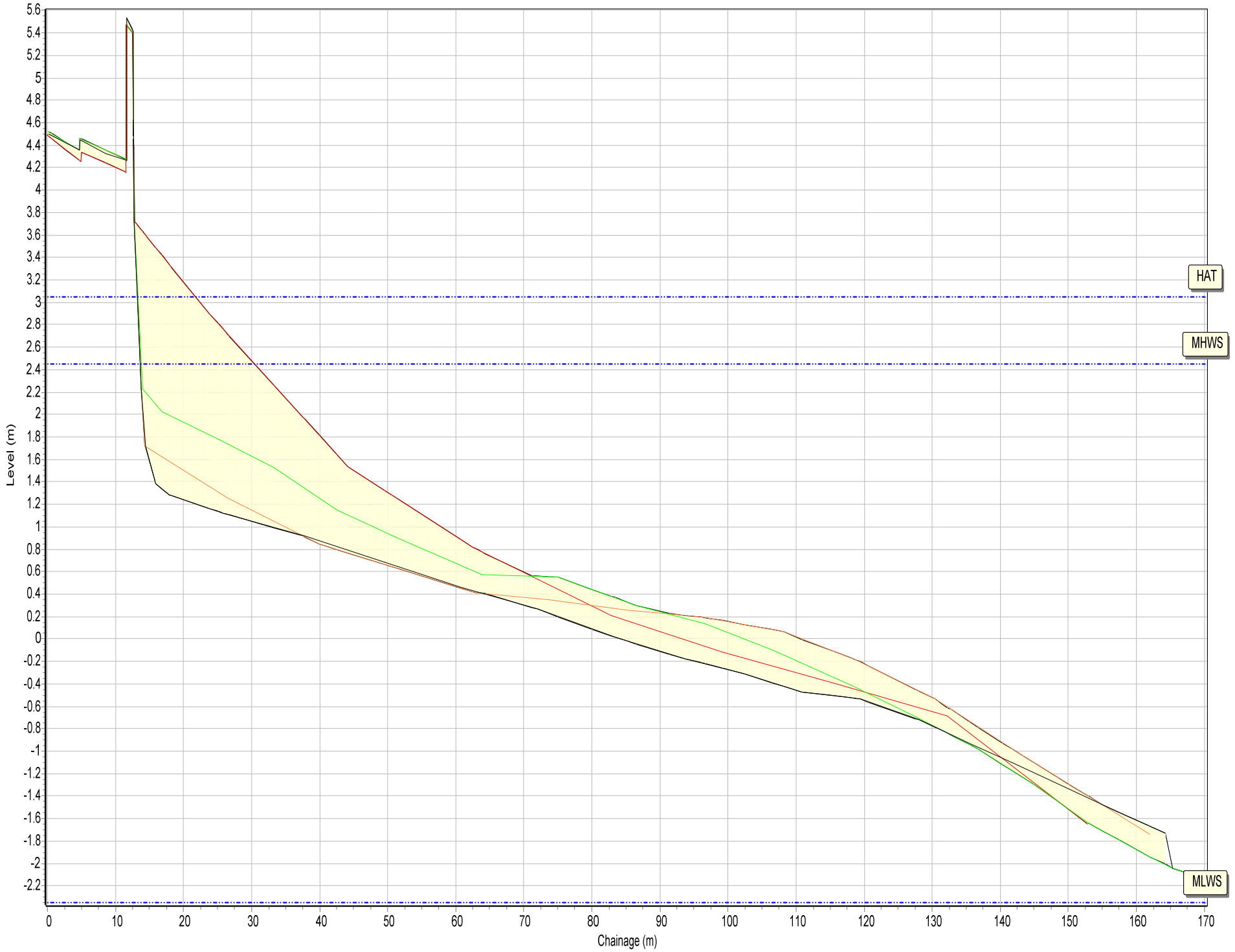
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MLWS

SANDS

Beach Profiles: 1dSBN3



Profiles Envelope
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21/03/2018

HAT

MHWS

MLWS

SANDS

Beach Profiles: 1dSBN4



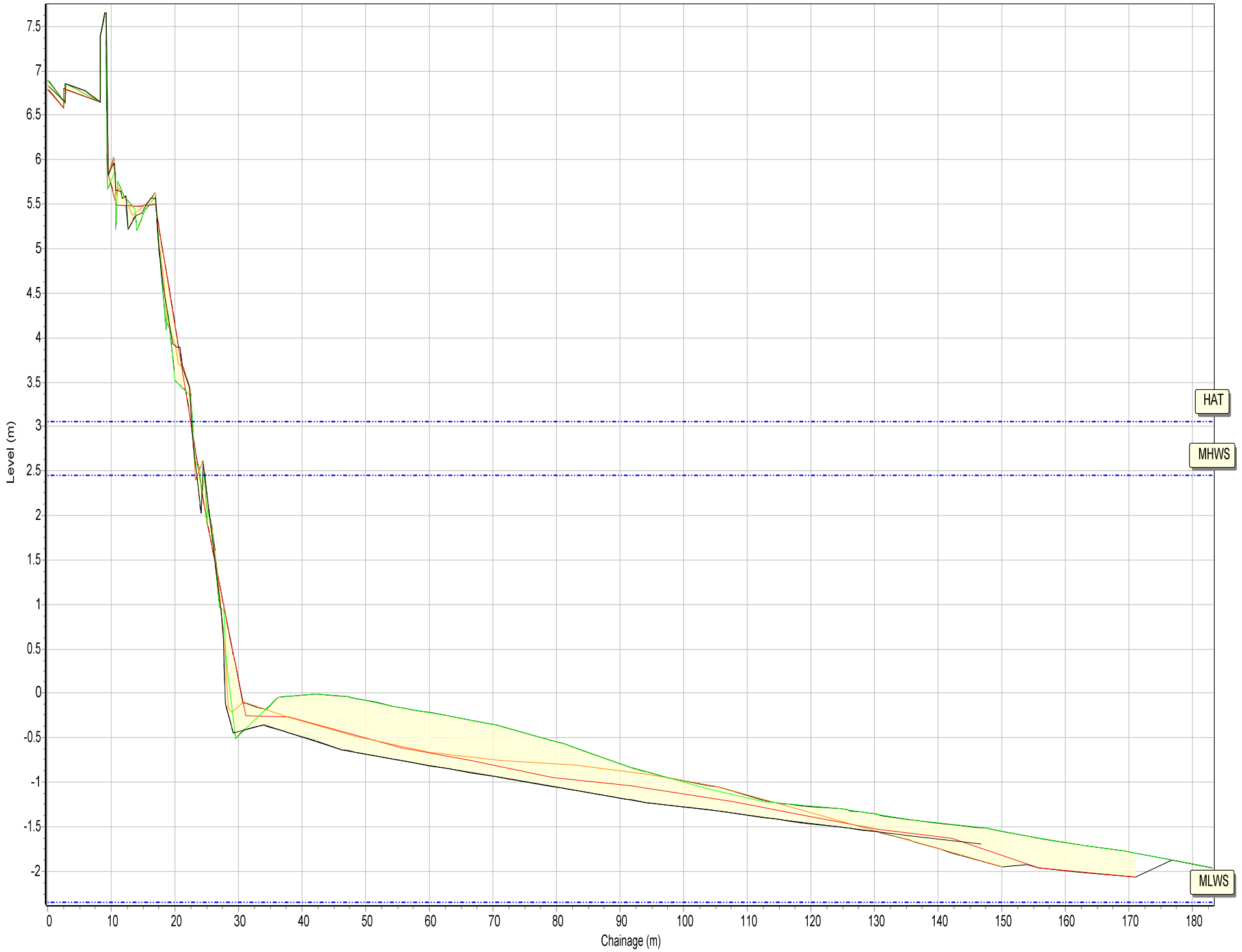
HAT

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MLWS

SANDS

Beach Profiles: 1dSBN5



Profiles Envelope
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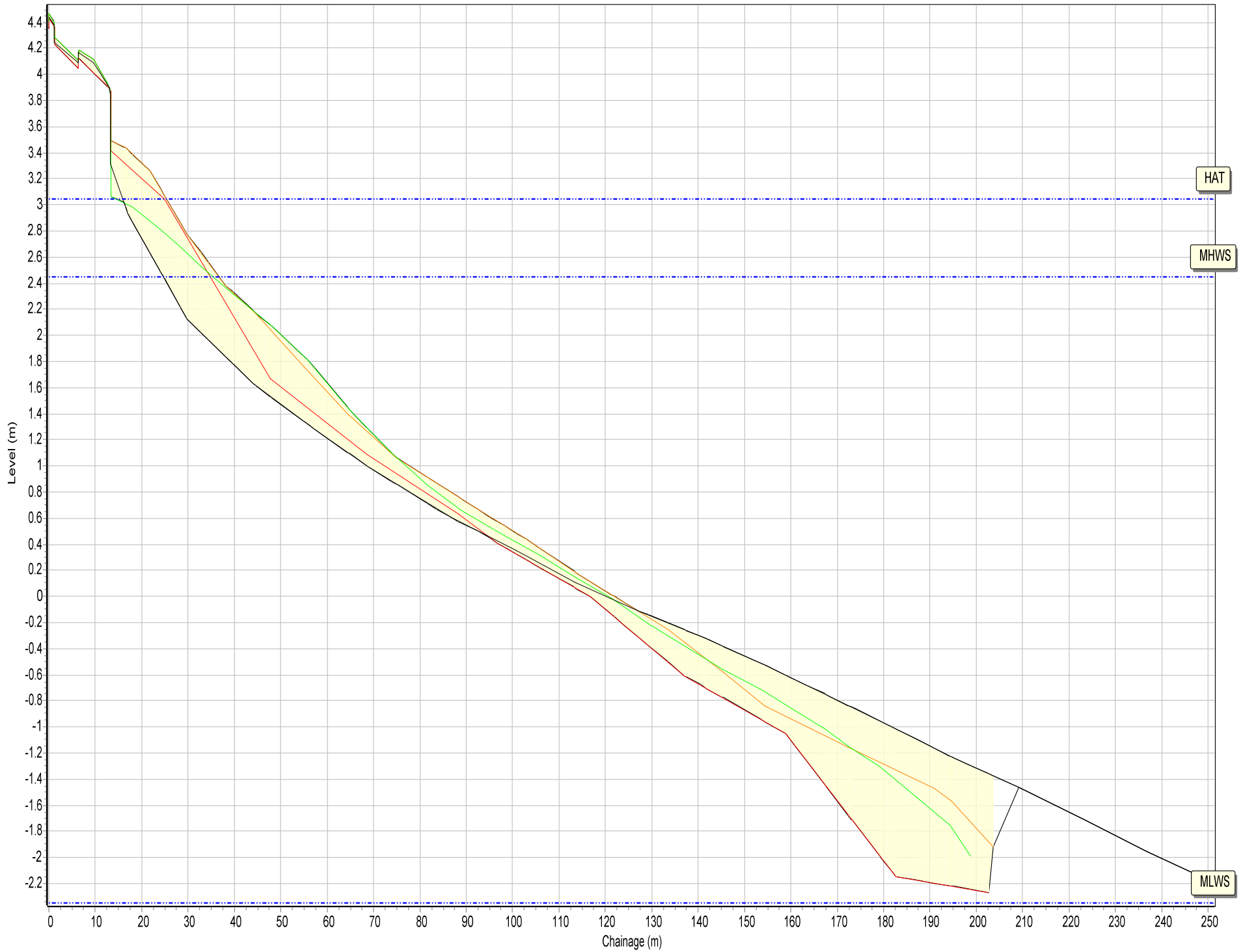
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MLWS

SANDS

Beach Profiles: 1dSBS1



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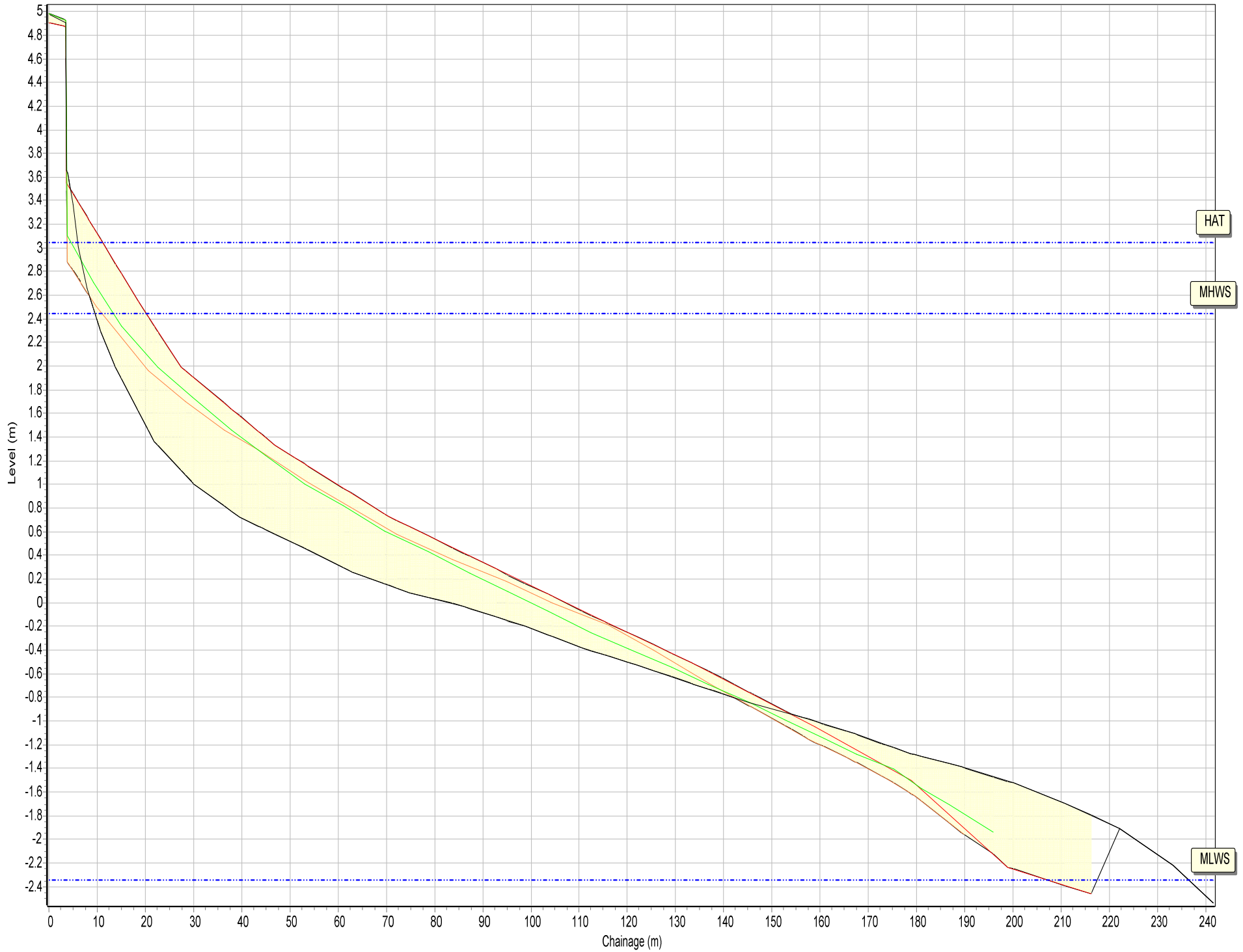
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MLWS

SANDS

Beach Profiles: 1dSBS2



Profiles Envelope
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21/03/2018

HAT

MHWS

MLWS

SANDS

Beach Profiles: 1dSBS3



Beach Profiles: 1dSBS4



Profiles Envelope
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18/09/2017
20/11/2017
21/03/2018

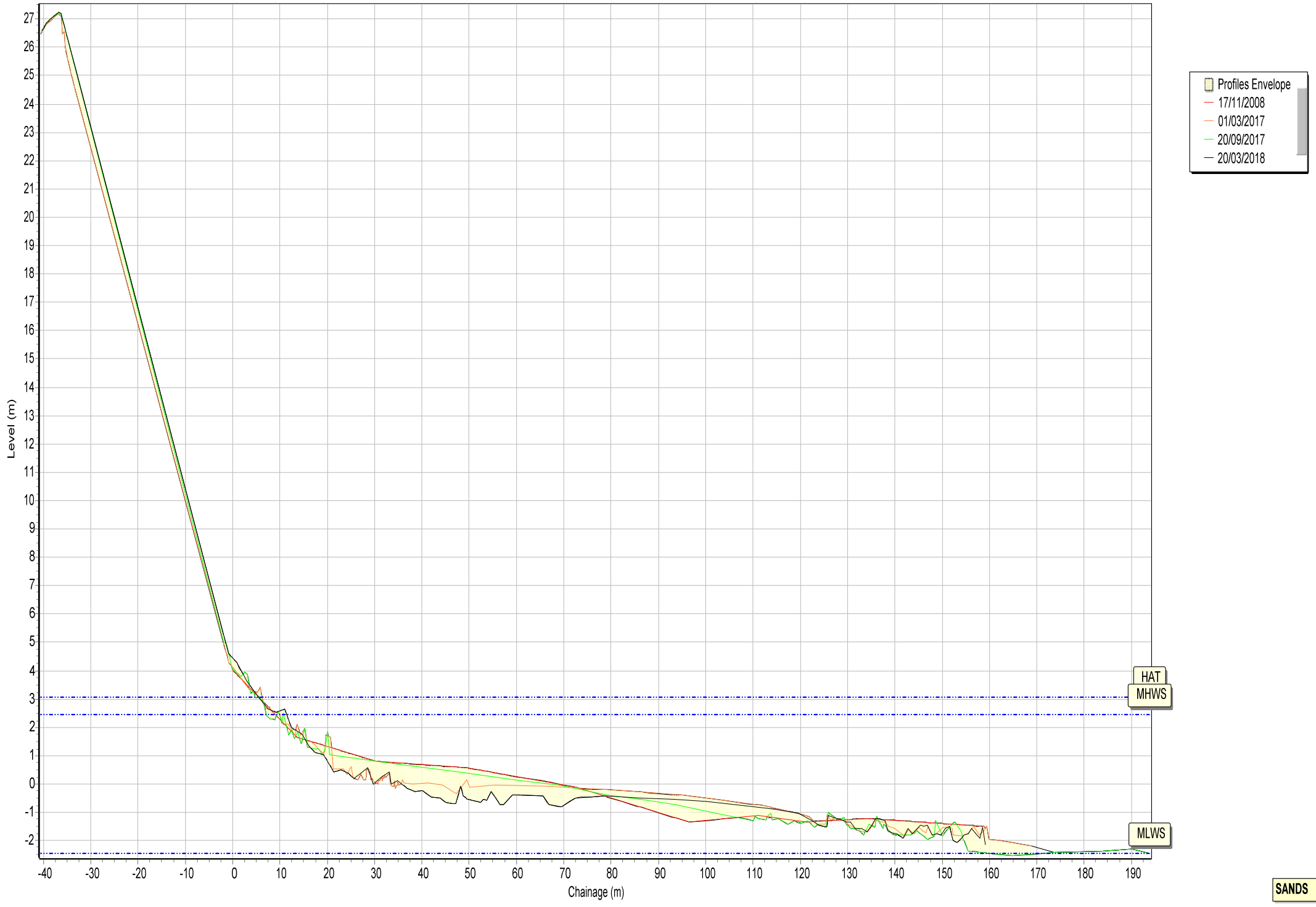
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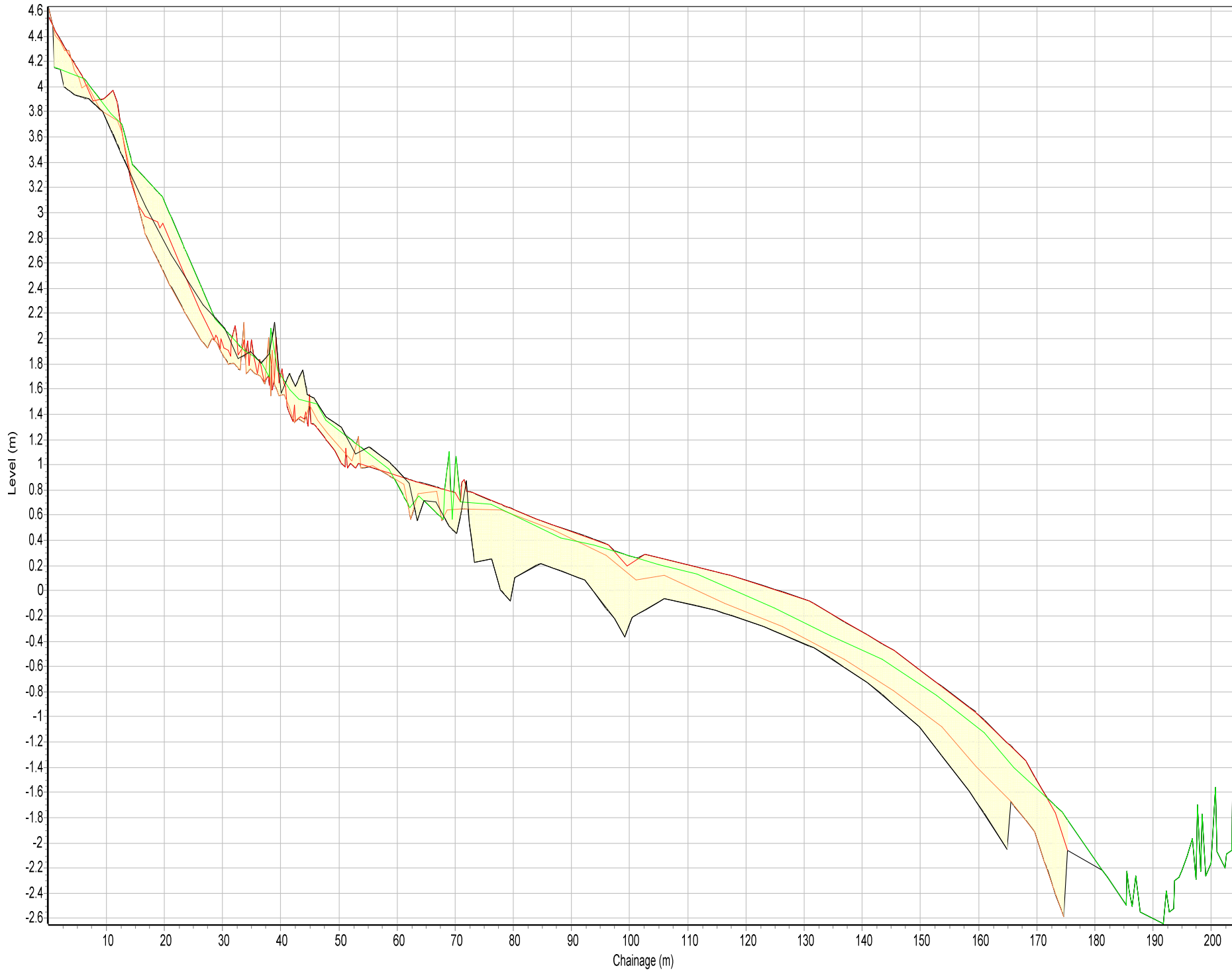
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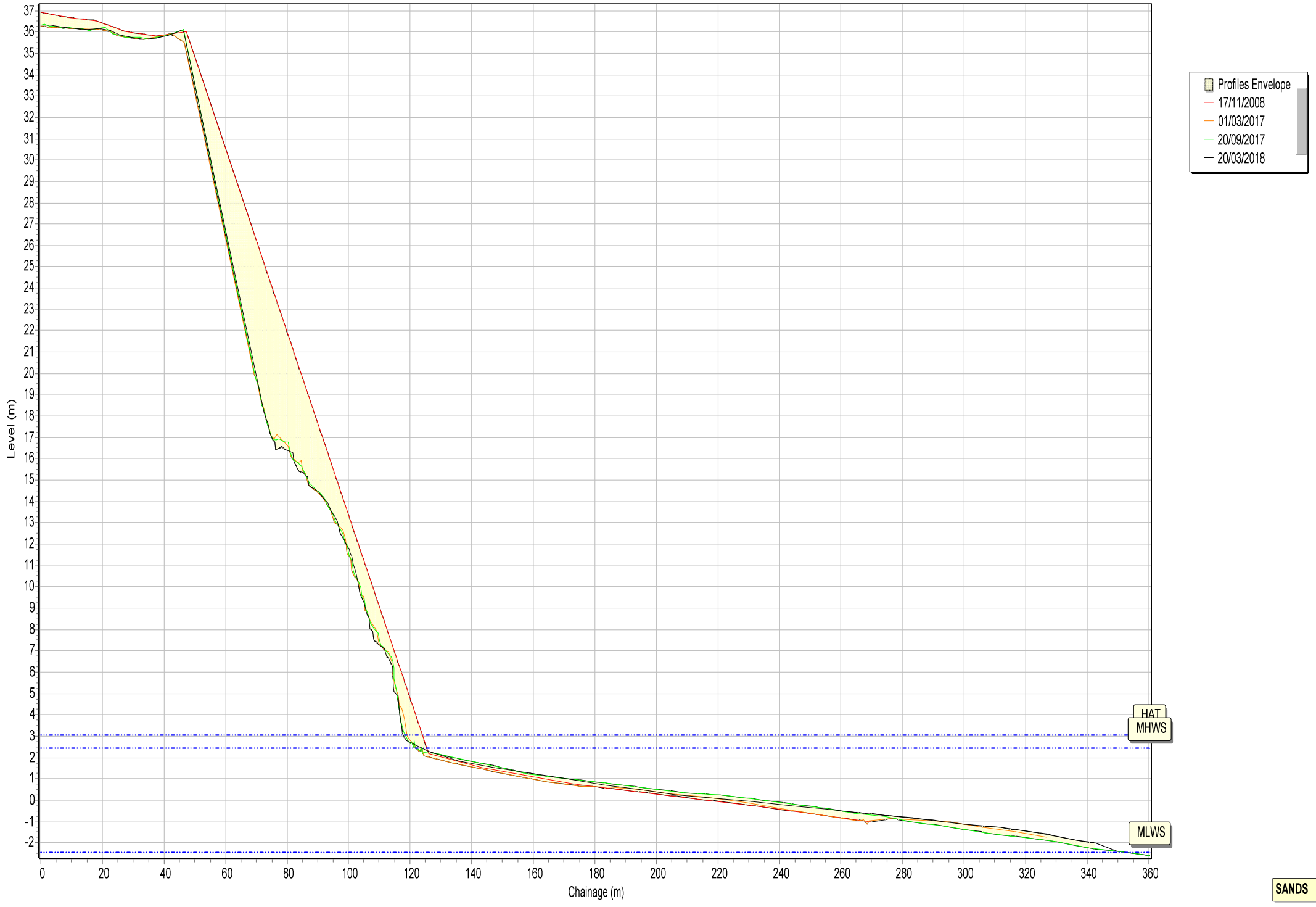


Beach Profiles: 1dCY1A



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- 12/11/2015
- 01/03/2017
- 20/09/2017
- 20/03/2018

Beach Profiles: 1dCY2



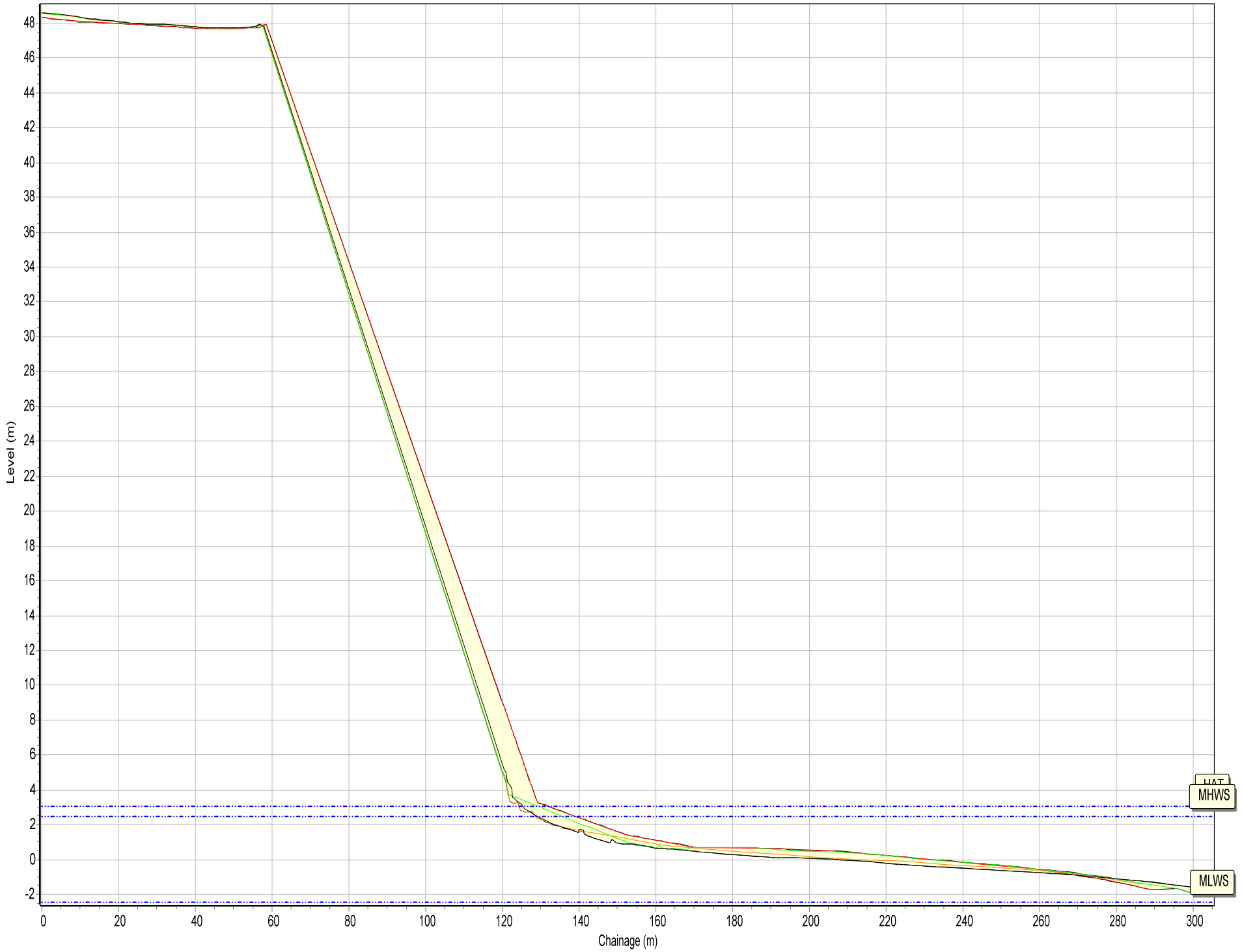
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HAT
MHWS

MLWS

SANDS

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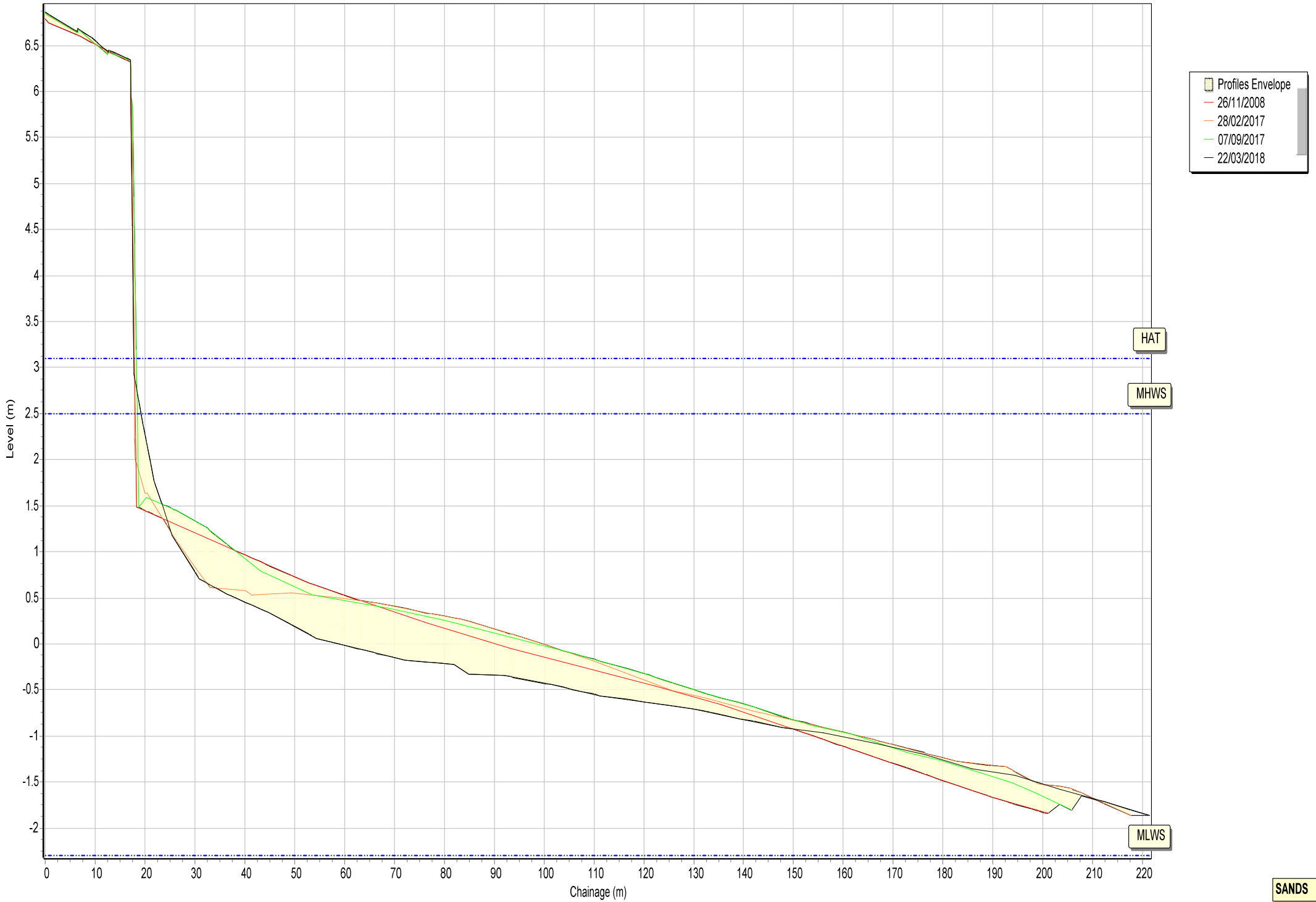
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LAT
MHWS

MLWS

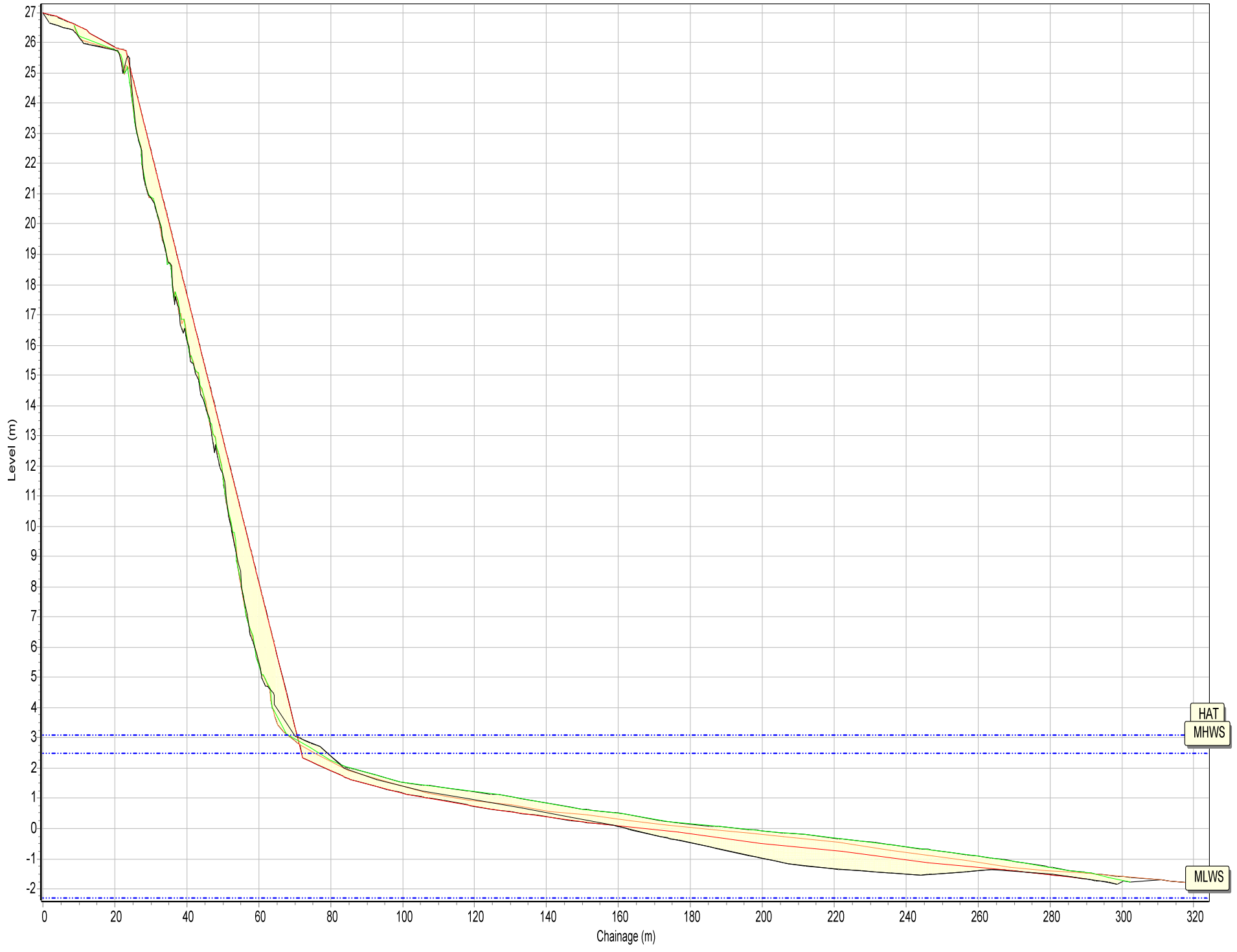
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SANDS

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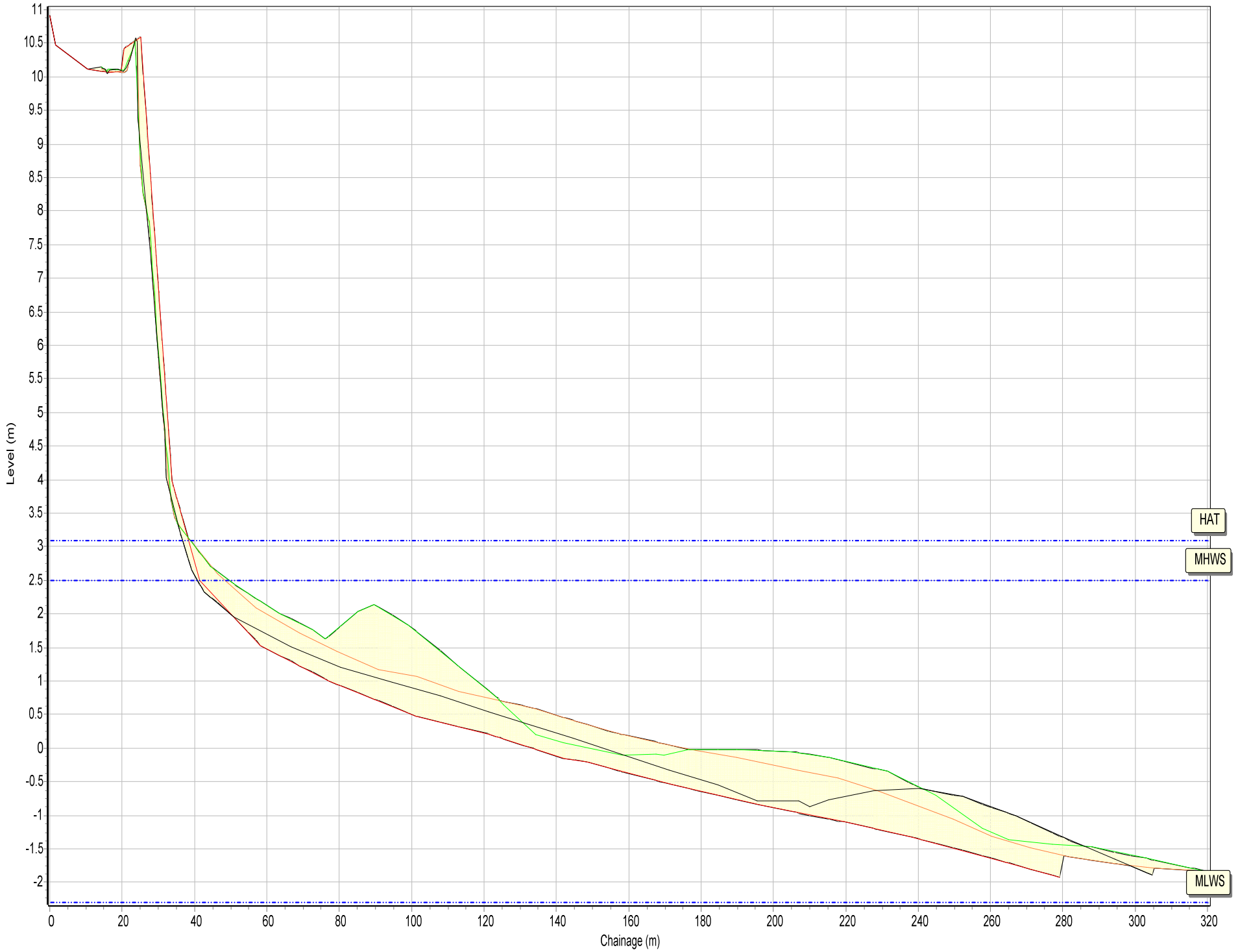
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22/03/2018

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MLWS

SANDS

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Profiles Envelope
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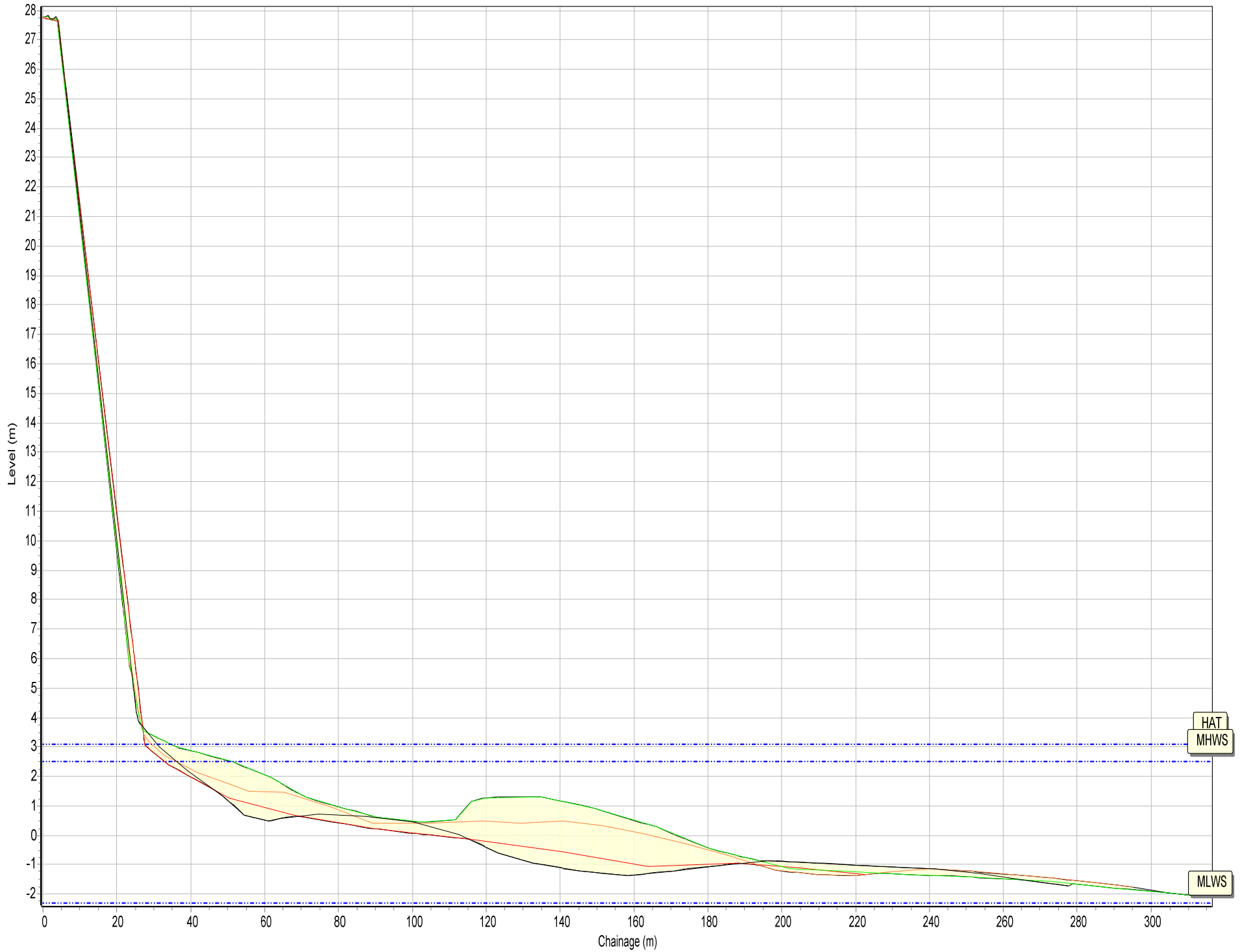
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MLWS

SANDS

Beach Profiles: 1dFB4



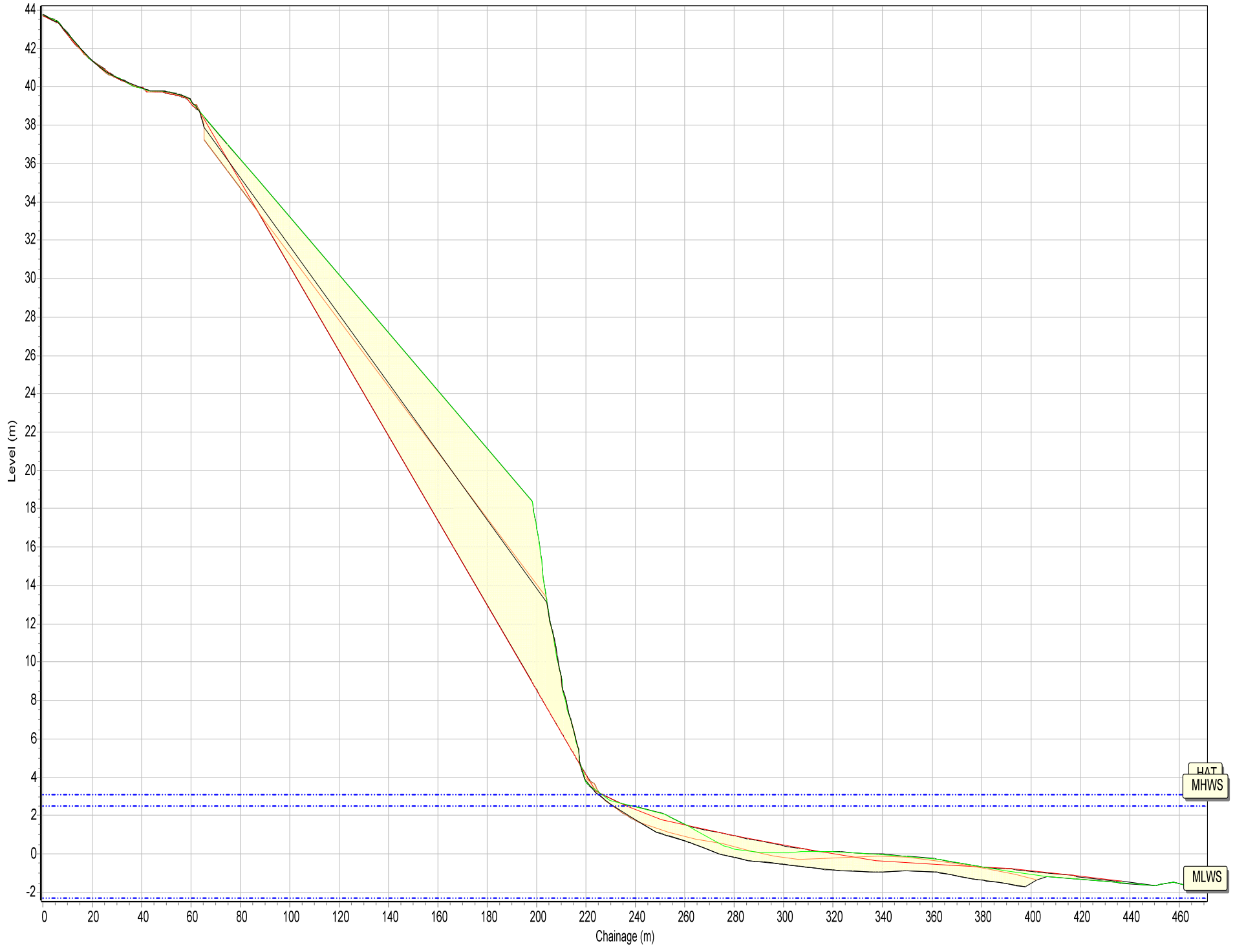
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HAT
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MLWS

SANDS

Beach Profiles: 1dFB5



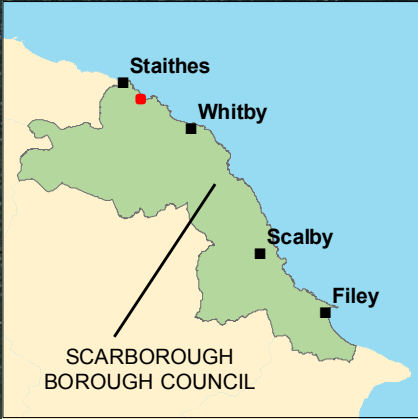
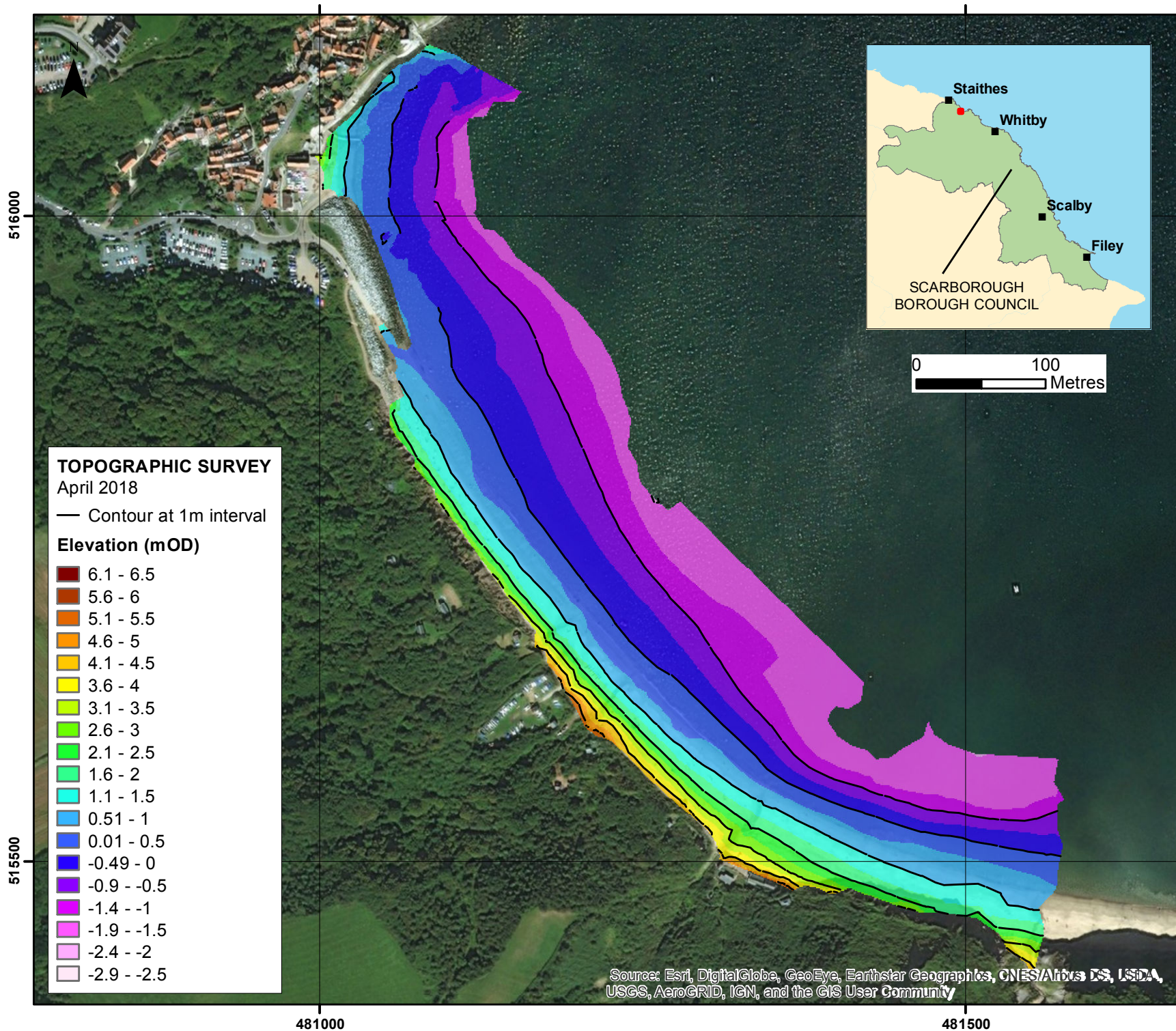
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28/02/2017
07/09/2017
22/03/2018

HAT
MHWS

MLWS

SANDS

Appendix B
Topographic Survey



Key

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

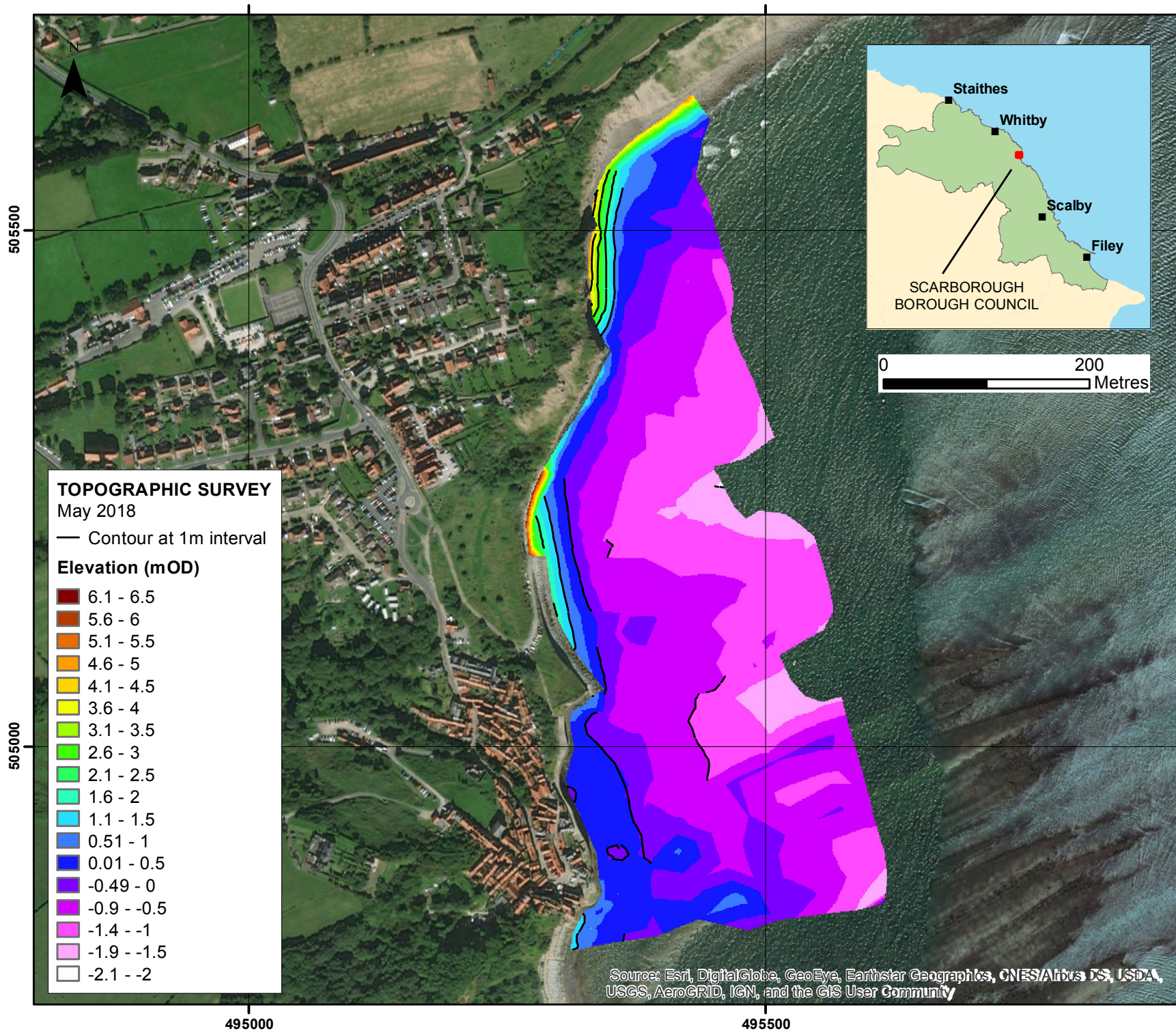
Appendix B - Map 1
RUNSWICK BAY
Scarborough Borough Council Frontage
Update Report
'Partial Measures' Survey 2018

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

Royal HaskoningDHV
Enhancing Society Together



Key

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

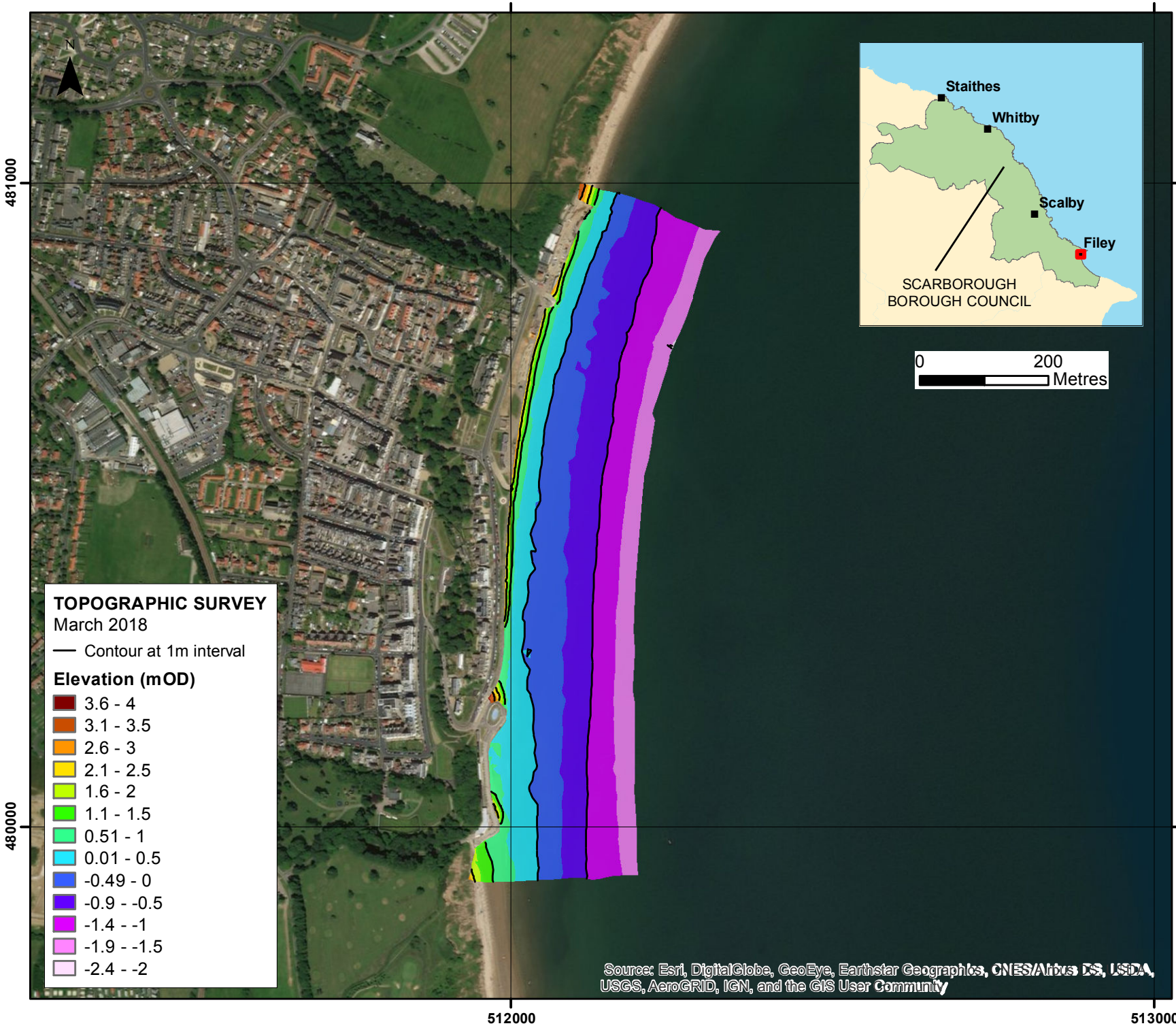
Appendix B - Map 2
ROBIN HOOD'S BAY
Scarborough Borough Council Frontage
Update Report
'Partial Measures' Survey 2018

Drawing Scale at A4 1:5,000

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

Tel: +44 (0)191 211 1300
Fax: +44 (0)191 211 1313
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Key



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

Appendix B - Map 3

FILEY BAY

Scarborough Borough Council Frontage

Update Report
'Partial Measures' Survey 2018

Drawing Scale at A4 1:8,000

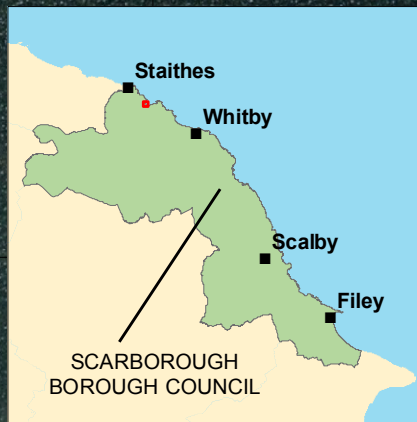
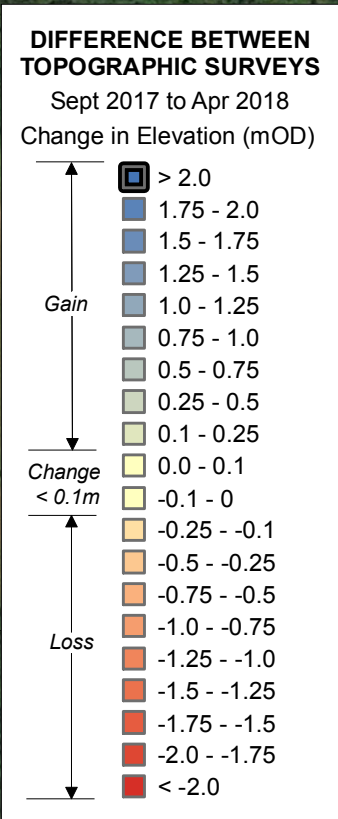
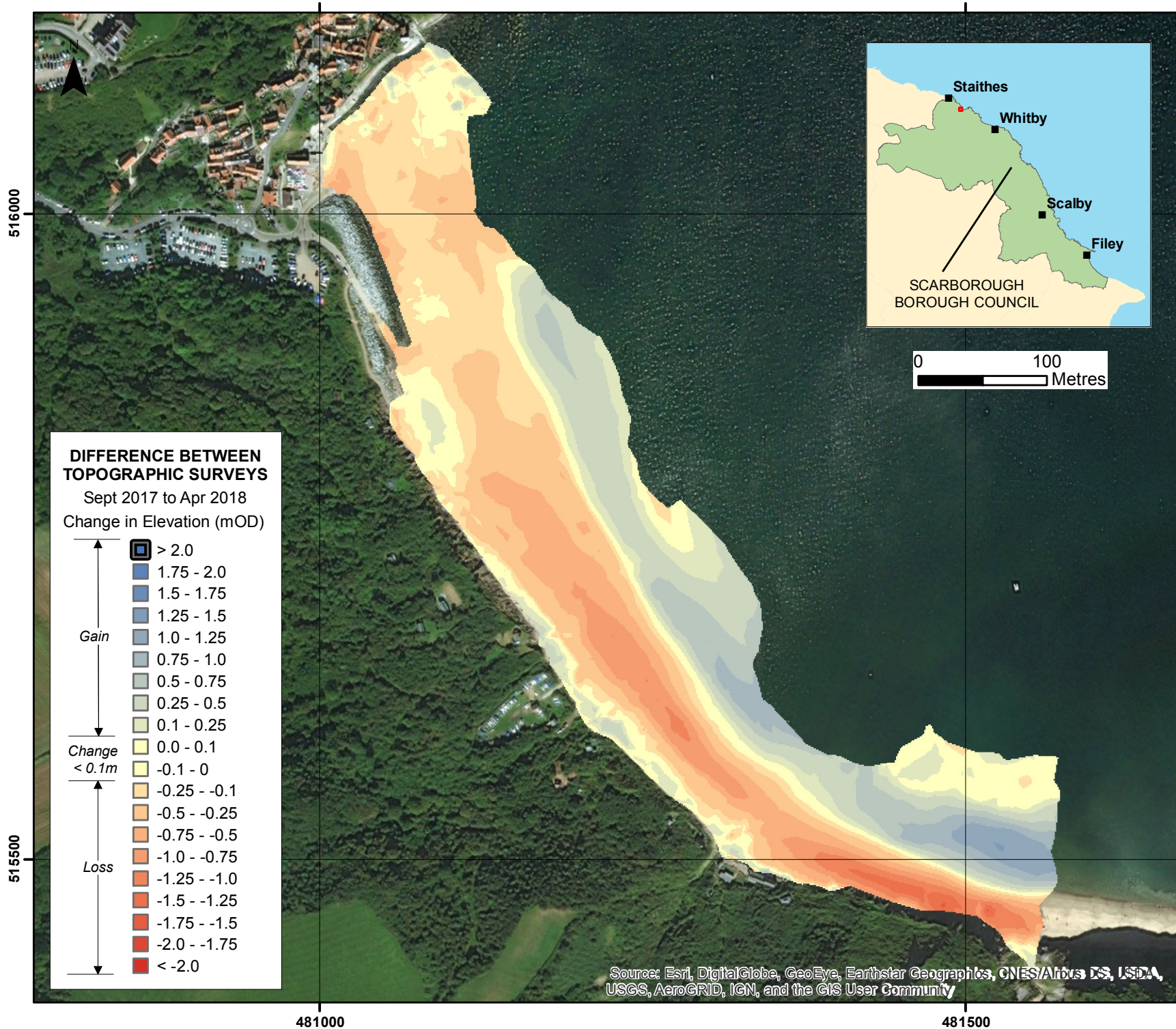
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Royal HaskoningDHV
Marlborough House
Marlborough Crescent
Newcastle upon Tyne
NE1 4EE

Tel: +44 (0)191 211 1300
Fax: +44 (0)191 211 1313
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512000

513000



Key

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

Appendix B - Map 4
RUNSWICK BAY

Scarborough Borough Council Frontage

Update Report
 'Partial Measures' Survey 2018

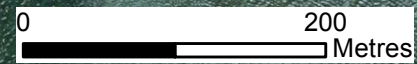
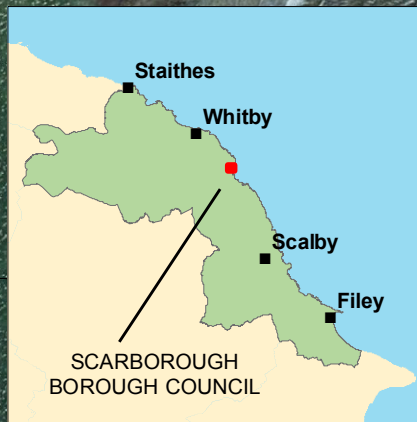
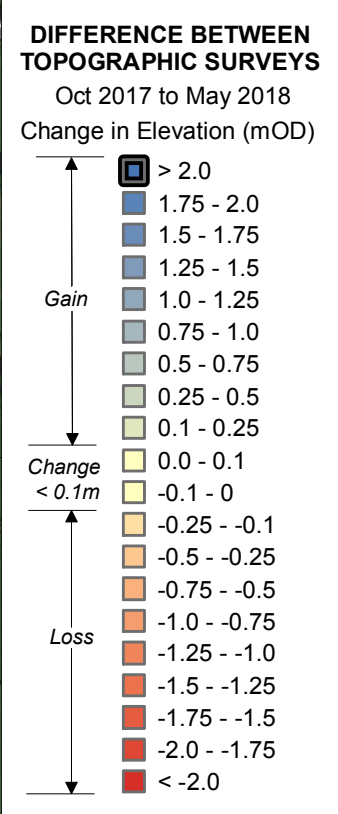
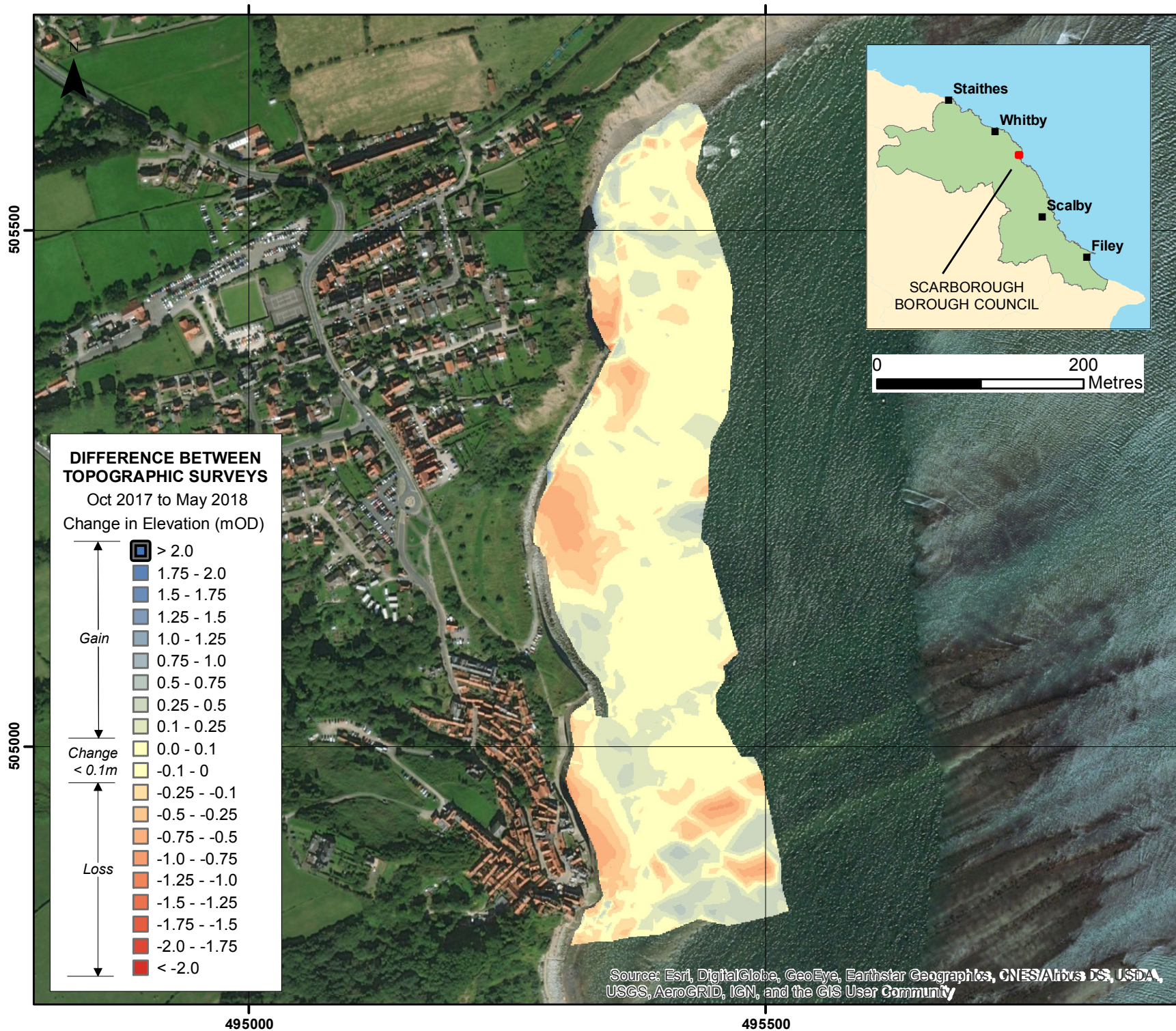
Drawing Scale at A4 1:4,000

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

Tel: +44 (0)191 211 1300
 Fax: +44 (0)191 211 1313
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Source: Esri, DigitalGlobe, 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

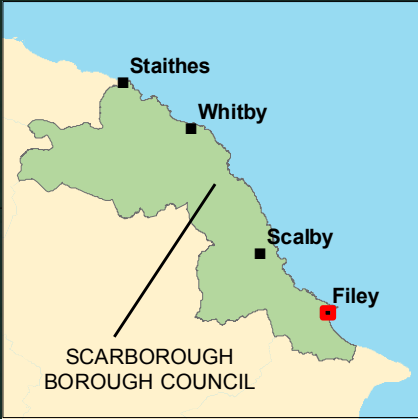
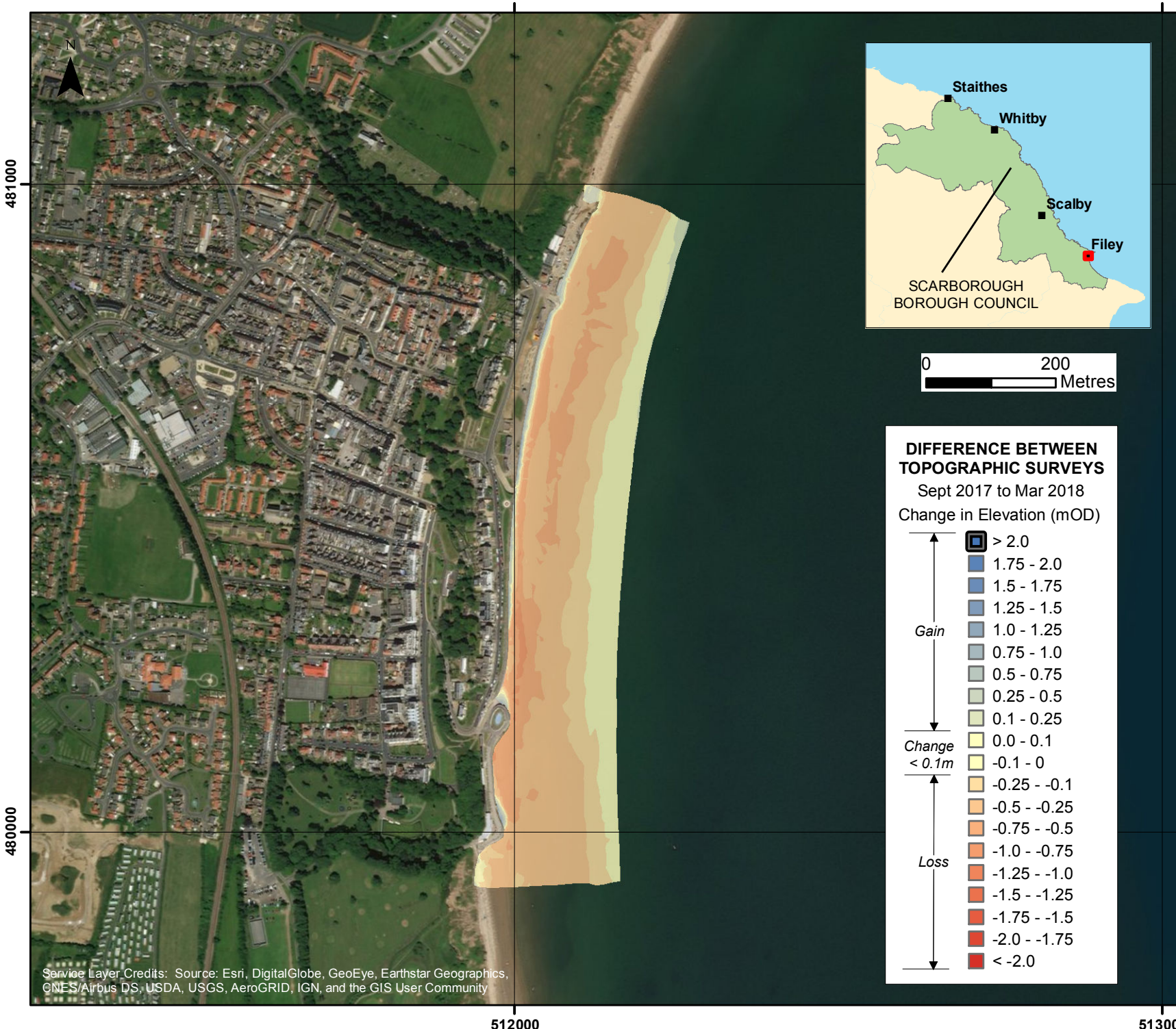
Appendix B - Map 5
ROBIN HOOD'S BAY
Scarborough Borough Council Frontage
 Update Report
 'Partial Measures' Survey 2018

Drawing Scale at A4 1:5,000

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 Royal HaskoningDHV
 Marlborough House
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 Newcastle upon Tyne
 NE1 4EE

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 Fax: +44 (0)191 211 1313
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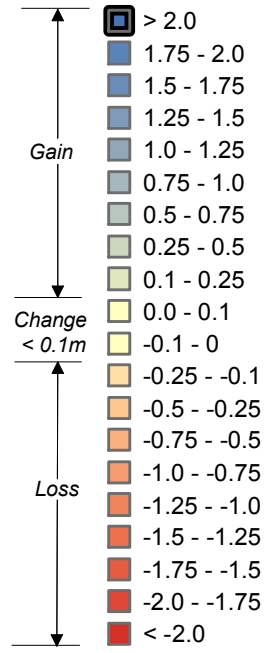
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



DIFFERENCE BETWEEN TOPOGRAPHIC SURVEYS

Sept 2017 to Mar 2018

Change in Elevation (mOD)



Service Layer Credits: Source: Esri, DigitalGlobe, 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
FILEY BAY
Scarborough Borough Council Frontage
 Update Report
 'Partial Measures' Survey 2018

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
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Appendix C
Cliff Top Survey

Cliff Top Survey

Staithes

Twenty ground control points have been established at 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	Sep 2017	Mar 2018	Nov 2008 - Mar 2018	Sep 2017 - Mar 2018	Nov 2008 - Mar 2018
1	477228	518769	320	1.9	-0.15	0.04	1.86	-0.19	0.19
2	477334	518798	0	10.9	10.74	10.78	0.12	-0.04	0.01
3	477487	518789	350	7.1	8	8.02	-0.92	-0.02	0.00
4	477594	518801	340	5.9	4.26	4.24	1.66	0.02	0.17
5	477683	518911	350	8.4	8.73	8.68	-0.28	0.05	0.00
6	477792	518867	30	8.6	8.41	8.39	0.21	0.02	0.02
7	477891	518828	60	7.7	7.34	7.31	0.39	0.03	0.04
8	477959	518873	350	8.7	9.64	9.64	-0.94	0.00	0.00
9	478088	518950	350	7.6	No Access	No Access	No Access	0	-0.06
10	478191	519023	340	8.4	No Access	No Access	No Access	0	-0.04
11	478237	519007	60	6.9	No Access	No Access	No Access	0	0.02
12	478213	518988	150	6.1	No Access	No Access	No Access	0	-0.14

13	478501	518809	15	11.4	9.03	9.02	2.38	0.01	0.24
14	478624	518807	20	7.5	7.46	7.5	0.00	-0.04	0.00
15	478737	518858	60	6.1	6.16	6.17	-0.07	-0.01	0.00
16	478823	518757	60	8	8.67	8.67	-0.67	0.00	0.00
17	478944	518671	30	9.3	9.21	9.09	0.21	0.12	0.02
18	479052	518630	20	9.2	9.25	9.18	0.02	0.07	0.00
19	479147	518610	0	14.2	14.37	14.29	-0.09	0.08	0.00
20	479274	518618	20	11.4	11.33	11.36	0.04	-0.03	0.00

Cliff Top Survey

Robin Hoods Bay

Thirteen ground control points have been established at Robin Hoods Bay (Figure C2). The maximum separation between any two points varies along the coast, reflecting the degree of risk from the erosion. The cliff top surveys at Robin Hoods Bay 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 C2 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 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
ROBIN HOODS BAY				Mar 2010	Oct 2017	May 2018	Mar 2010 - May 2018	Oct 2017 - May 2018	Mar 2010 - May 2018
1	495799.5	506002.2	130	11.6	7.27	7.25	4.35	0.02	0.62
2	495549.2	505807.3	135	9.3	9.03	9.03	0.27	0.00	0.04
3	495456.3	505740	130	5	4.93	4.93	0.07	0.00	0.01
4	495389.9	505683.7	140	6.3	6.04	6.06	0.24	-0.02	0.03
5	495259.4	505342.5	130	11.3	12.04	12.02	-0.72	0.02	0.00
6	495231.2	505315.7	95	5.9	5.75	5.74	0.16	0.01	0.02
7	495184.8	505210.7	85	6.4	6.76	6.75	-0.35	0.01	0.00
8	495206.5	505153	75	5	5.16	5.15	-0.15	0.01	0.00
9	495287.8	505060.5	80	4.3	4.59	4.58	-0.28	0.01	0.00
10	495187.8	504708.8	70	3.1	2.48	2.31	0.79	0.17	0.11
11	495226.2	504615.7	120	3.8	3.64	3.65	0.15	-0.01	0.02
12	495297.5	504380.2	80	11	11.08	11.03	-0.03	0.05	0.00
13	495350.4	504193	55	3.7	3.75	3.77	-0.07	-0.02	0.00

Cliff Top Survey

Scarborough South Bay

Thirteen ground control points have been established at Scarborough South Bay (Figure C3). The maximum separation between any two points varies along the coast, reflecting the degree of risk from the erosion. The cliff top surveys at Scarborough South Bay 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 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 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
SCARBOROUGH SOUTH BAY				Mar 2010	Sep 2017	Mar 2018	Mar 2010- Mar 2018	Sep 2017 - Mar 2018	Mar 2010- Mar 2018
1	504339.5	487887.3	70	7	6.93	6.94	0.06	-0.01	0.01
2	504422.3	487603.7	80	4.8	4.8	4.82	-0.02	-0.02	0.00
3	504534.8	487318.3	40	15.1	15.03	15.05	0.05	-0.02	0.01
4	504730.2	487137.9	55	9.6	9.6	9.63	-0.03	-0.03	0.00
5	504922.9	486837.8	60	8.8	8.7	8.66	0.14	0.04	0.02
6	50571.1	486652.1	75	3.8	3.68	3.7	0.10	-0.02	0.01
7	505284.3	486480	35	7	6.7	6.72	0.28	-0.02	0.04
8	505597.9	486363.4	30	8.6	8.45	8.5	0.10	-0.05	0.01
9	505758.6	486005.1	45	9.1	8.58	8.59	0.51	-0.01	0.07
10	505896	485889.6	15	14.8	14.84	14.78	0.02	0.06	0.00
11	505990	485657.1	80	4.7	1.33	1.45	3.25	-0.12	0.46
12	506024.9	485421.8	55	6.1	3.27	3.15	2.95	0.12	0.42
13	506036	485315.3	90	7	7.08	7.08	-0.08	0.00	0.00

Cliff Top Survey

Cayton Bay

Eight ground control points have been established at Cayton Bay (Figure C4). The maximum separation between any two points varies along the coast, reflecting the degree of risk from the erosion.

The cliff top surveys at Cayton Bay 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 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
CAYTON BAY				Nov 2008	Sep 2017	Mar 2018	Nov 2008 - Sep 2017	Mar 2017 - Sep 2017	Nov 2008 - Sep 2017
1	506325.5	484849.7	50	4	3.6	3.6	0.40	0.00	0.04
2	506459.4	484715.9	65	5	-0.02	-0.12	5.12	0.10	0.57
3	506597.4	484538.6	65	5	6.25	6.28	-1.28	-0.03	0.00
4	506778.1	484345.5	21	9	5.96	5.94	3.06	0.02	0.34
5	507018.6	484221.6	342	7.7	7.88	8	-0.30	-0.12	0.00
6	507242.3	484121.7	2	7.4	6.17	6.01	1.39	0.16	0.15
7	507518.2	484008.2	25	7.5	7.64	7.77	-0.27	-0.13	0.00
8	507818.7	484006	1	5.5	5.46	5.4	0.10	0.06	0.01

Cliff Top Survey

Filey Bay

Twenty-eight ground control points have been established in Filey Bay (Figure C5 and C6). The maximum separation between any two points varies along the coast, reflecting the degree of risk from the erosion.

The cliff top surveys at Filey Bay 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 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 in 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	Sep 2017	Mar 2018	Nov 2008 - Mar 2018	Sep 2017 - Mar 2018	Nov 2008 - Mar 2018
1	512444.9	481630.9	130	8.7	8.41	8.45	0.25	-0.04	0.03
2	512306.7	481490.3	144	7.6	7.92	7.9	-0.30	0.02	0.00
3	512153.6	481234.6	122	8.3	8.2	8.18	0.12	0.02	0.01
4	512029.2	480959.9	115	7.4	7.27	7.3	0.10	-0.03	0.01
5	511895.4	479888	89	7.1	0.65	0.65	6.45	0.00	0.72
6	511908.5	479597.1	48	6.7	5.6	5.6	1.10	0.00	0.12
7	511991.4	479310.4	69	6.7	4.26	4.27	2.43	-0.01	0.27
8	512083.4	478981.5	66	10.2	10.16	10.15	0.05	0.01	0.01
9	512121.3	478786.3	76	8.3	8.35	8.35	-0.05	0.00	0.00
10	512226.2	478547.9	74	7.5	7.13	7.2	0.30	-0.07	0.03
11	512471.4	478153.5	53	6.6	7.81	7.8	-1.20	0.01	0.00
12*	512558.9	477901.9	66	7.7	No Data	No Data	No Data	No Data	No Data

12A*	512655.8	477822.4	67	13.9	12.97	13.12	0.78	-0.15	0.09
13**	512697.6	477719	34	4.2	No Data	No Data	No Data	No Data	No Data
13A*	512805.5	477572.1	32	13.42	13.38	13.29	0.13	0.09	0.01
14	512939.4	477400.9	66	8	6.45	6.49	1.51	-0.04	0.17
15	513157	477192.7	51	5.2	4.61	4.6	0.60	0.01	0.07
16	513299.5	477024.6	30	7.7	7.05	6.55	1.15	0.50	0.13
17	513507.7	476821.1	34	10.7	10.51	10.49	0.21	0.02	0.02
18	513721	476602.3	31	7.2	6.25	6.22	0.98	0.03	0.11
19	513916.6	476354.1	51	6.6	6.15	6.17	0.43	-0.02	0.05
20	514174.8	476179.4	32	7	6.86	6.89	0.11	-0.03	0.01
21	514471.5	475965.7	66	7.6	7.42	7.43	0.17	-0.01	0.02
22	514656.2	475728.8	101	8.1	8.07	8.14	-0.04	-0.07	0.00
23	514889.5	475537.6	60	9.1	8.06	8.09	1.01	-0.03	0.11
24*	512603.7	481665.9	14	19.9	19.82	19.85	0.05	-0.03	0.01
25*	512607.1	481648.9	184	17.2	17.06	17.06	0.14	0.00	0.02
26*	512301.9	481825.5	18	11	10.86	10.9	0.10	-0.04	0.01
27*	512475.8	481712.1	20	11.6	11.51	11.51	0.09	0.00	0.01

NOTE: *base line for 12A and 24-27 is March 2011

**Surveyor's report has previously stated that 'VMP 13 was unable to be measured due to vegetation growth and land shape change'