

Cell 1 Regional Coastal Monitoring Programme Update Report 9: 'Partial Measures' Survey 2017



Redcar and Cleveland Council

July 2017

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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
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
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).

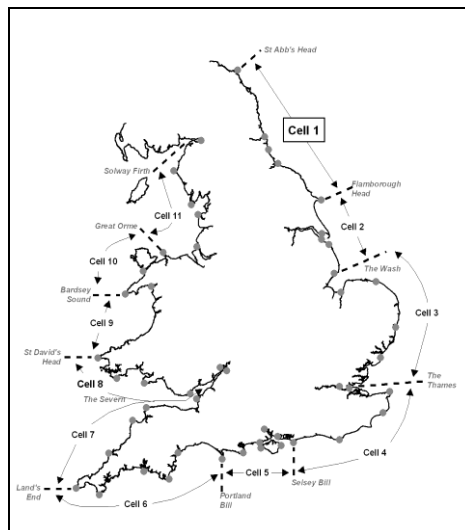


Figure 1 Sediment Cells in England and Wales

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		
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-Oct 11	Oct 12	Mar-May 12	Feb 13	
5	2012/13	Sep 2012	Mar 13	Feb- Mar 13	May 13	
6	2013/14	Oct-Nov 13	Feb 14	Mar-Apr 14	Jul 14	
7	2014/15	Sep-Oct 14	Feb 15	Mar-Apr	Jul 15	
8	2015/16	Sep-Oct 15	Feb 16	Mar 16	Jul 16	Jun 16
9	2016/17	Sep-Nov 16	Feb 17	Mar 17	Jul 17 (*)	

(*) The present report is **Update Report 9** and provides an analysis of the 2017 Partial Measures survey for Redcar and Cleveland Council's frontage.

1. Introduction

1.1 Study Area

South Gare Breakwater at the mouth of the River Tees estuary to Cowbar Nab at Staithes. For the purposes of this report, it has been sub-divided into six areas, namely:

- Coatham Sands
- Redcar Sands
- Marske Sands
- Saltburn Sands
- Cattersty Sands (Skinningrove)
- Staithes ¹

1.2 Methodology

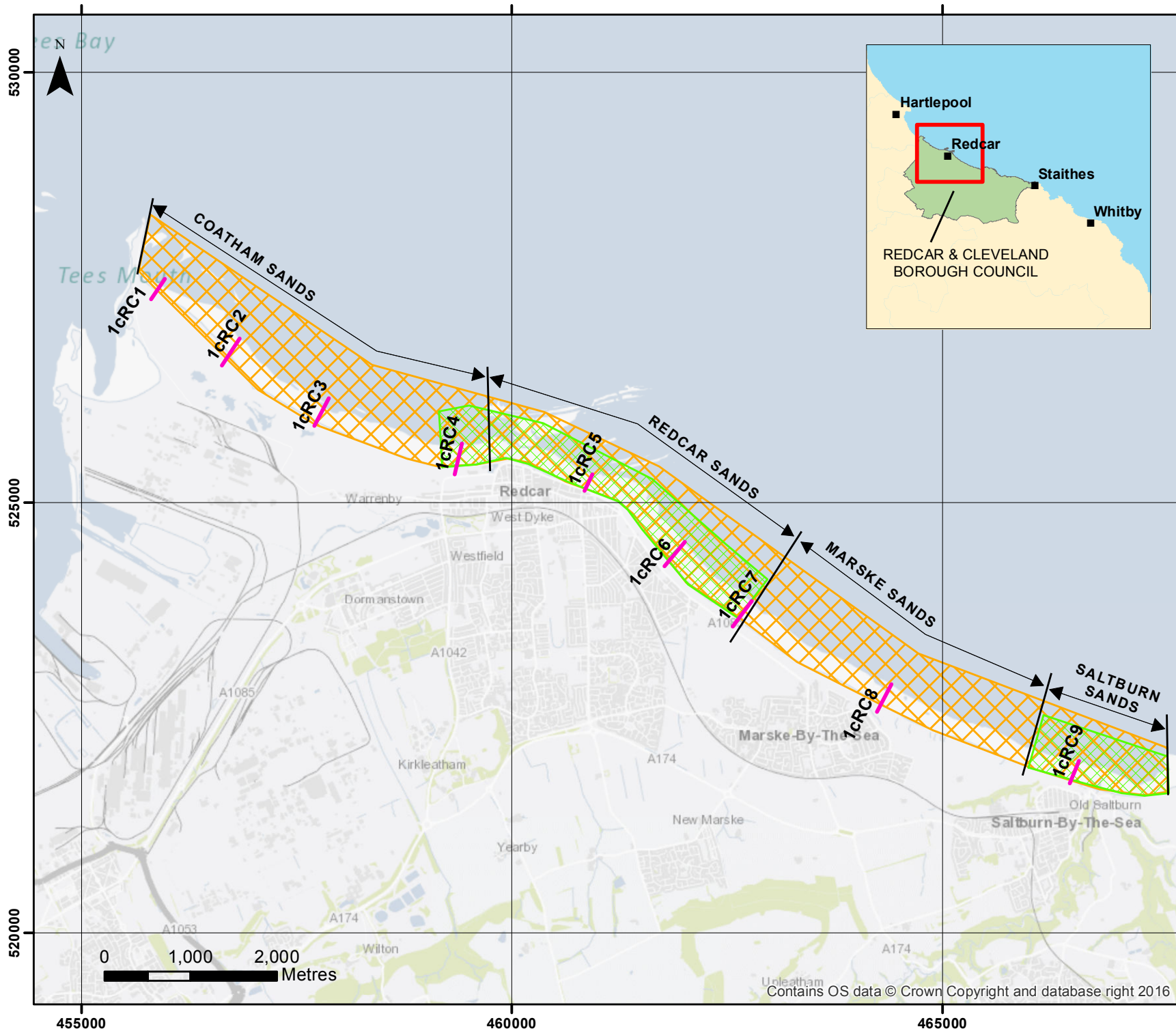
Along Redcar & Cleveland Borough Council's frontage, the following surveying is undertaken:

- Full Measures survey annually each autumn/early winter comprising:
 - Beach profile surveys along nine transect lines
 - Topographic survey along Coatham Sands
 - Topographic survey along Redcar Sands
 - Topographic survey along Marske Sands
 - Topographic survey along Saltburn Sands
 - Topographic survey at Skinningrove along Cattersty Sands
- Partial Measures survey annually each spring comprising:
 - Beach profile surveys along nine transect lines
 - Topographic survey along Redcar Sands
 - Topographic survey along Saltburn Sands
 - Topographic survey at Skinningrove along Cattersty Sands
- Cliff top survey (biannually) at:
 - Staithes

The location of these surveys is shown in Figure 2. The Partial Measures survey was undertaken along this frontage between 30th March at Skinningrove, 27th and 29th March at Redcar (Coatham Sands, Redcar Sands, Markse Sands and Saltburn Sands) and 6th March 2016 at Staithes. During the surveys the weather was mostly overcast with varying sea states. Specific weather conditions are detailed in the survey reports.

Processed data from the present survey are presented in the Appendices.

¹ The Staithes frontage straddles the boundary of jurisdiction of 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

Redcar & Cleveland Borough Council Frontage

Analytical Report
Topo Surveys

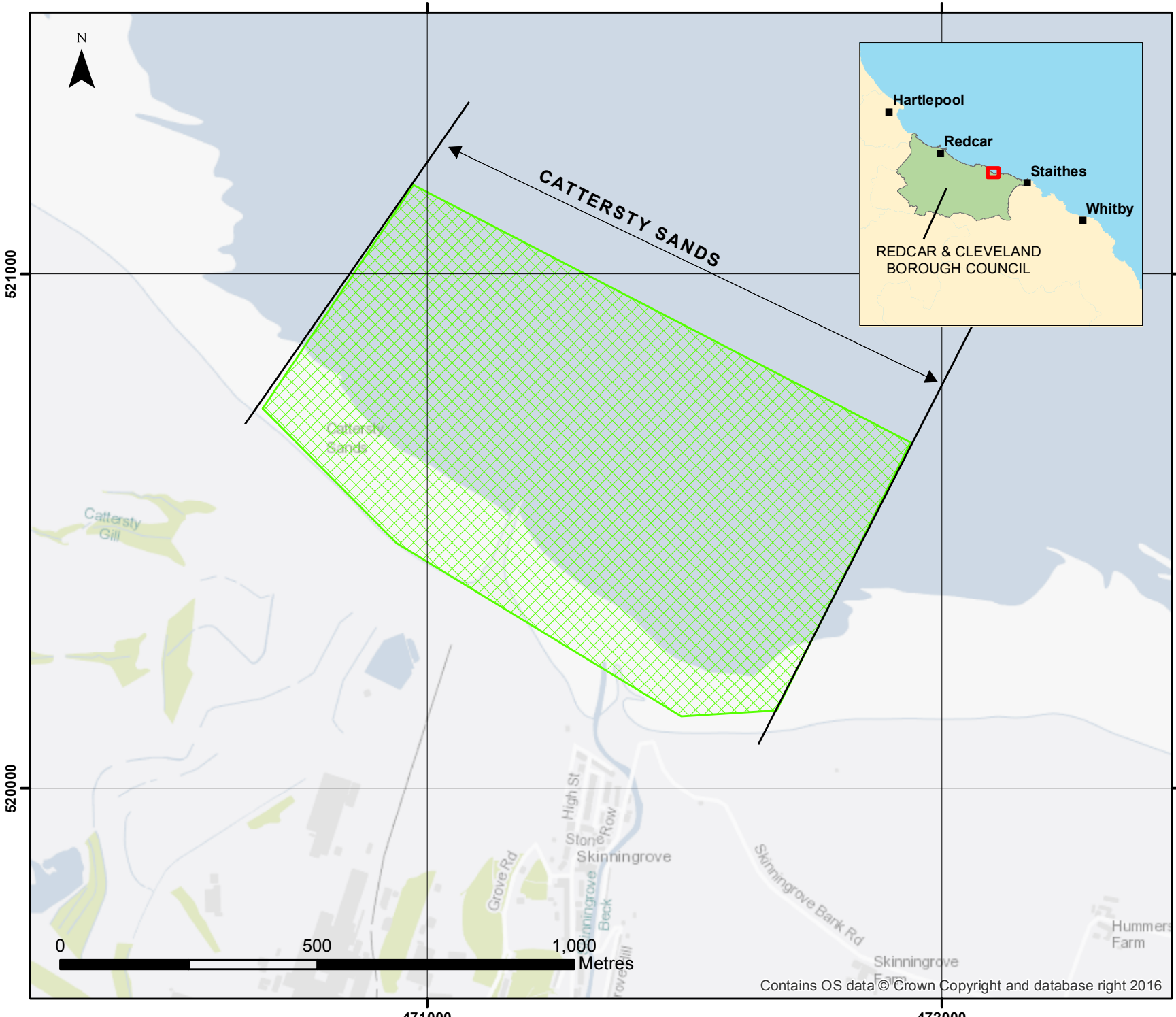
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Key

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

Redcar & Cleveland Borough Council Frontage

Analytical Report
Topo Surveys

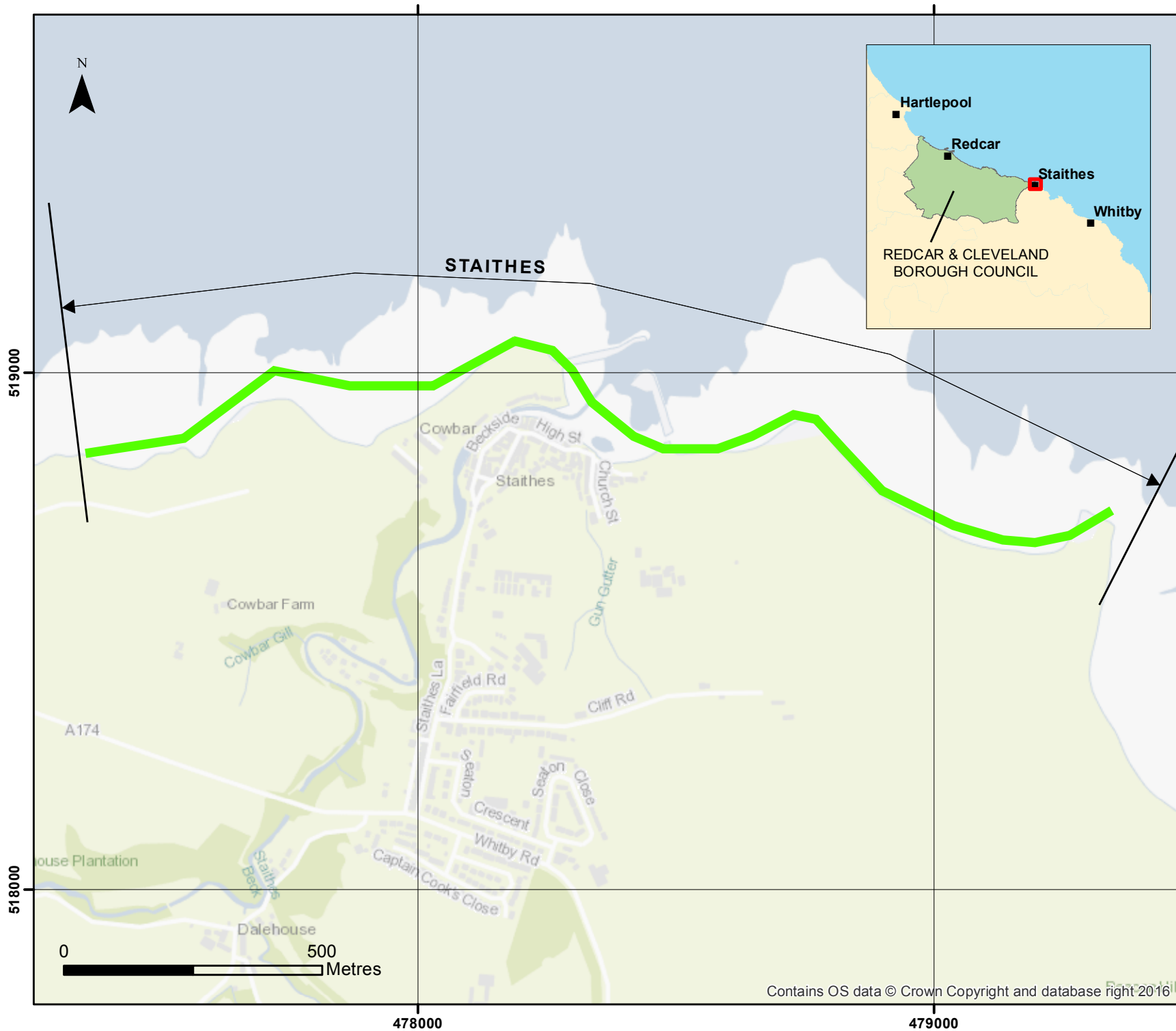
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Key

SURVEY LOCATIONS

Frequency

- @ 50
- @ 100
- @ 300

(Indicative Survey Extents shown)

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

Figure 2 - Map 3

Redcar & Cleveland Borough Council Frontage

Analytical Report
Topo Surveys

Drawing Scale at A4 1:10,000

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2. Analysis of Survey Data

2.1 Coatham Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
29 th March 2017	<p>Beach Profiles:</p> <p>Coatham Sands is covered by four beach profiles during the Partial Measures survey (1cRC1 to 1cRC4; Appendix A) that were last surveyed in October 2016.</p> <p>Profile 1cRC1 is located 300m southeast of the South Gare Breakwater, in the lee of the German Charlies slag banks. The upper profile to 80m chainage is dominated by dunes that have remained stable since 2009. The highest dune, closest to the beach, is unchanged since October 2013. The foredune between 80m and 120m chainage has increased in height by 0.3m, and is at its highest recorded level. Between 120m and 180m chainage the upper beach has eroded by up to 1.2m since October 2016, removing the berm previously surveyed. From 180m to the end of the profile at 320m chainage the lower beach level is high, having accreted by up to 1.2m, but more typically <0.4m, forming a more convex shape to the profile. Overall the upper and lower beach is at the highest recorded level.</p> <p>At profile 1cRC2 the dunes have remained stable with a small amount of accretion of <0.2m on the foredunes. Between chainage 100m and 190m there has been very little change, ± 0.1m. From chainage 190m to 360m there has been erosion of up to 0.3m. Seawards of chainage 360m a berm has formed at the toe of the beach, up to 0.6m above the previously surveyed beach level. Overall the beach is at a medium-high level compared to the range recorded from previous surveys, with the dunes and lower beach showing highest recorded levels.</p> <p>Profile 1cRC3 showed little change to 60m chainage, with the main dune and foredune crests both remaining stable since April 2014. The beach between 60m and 215m has dropped since October 2016 by up to 0.7m but more typically 0.3m, removing the berm previously recorded at chainage 165m. Between chainage 165m and 260m the beach has accreted by 0.3m infilling a low spot. Between 260m and the end of the survey at 350m chainage erosion of up to 0.5m has occurred removing the lower beach berm. The overall effect is a smoother and less steep profile. The dunes are at a high level compared to the range recorded from previous surveys, however the upper beach is at a relatively low</p>	<p>Overall the beaches are healthy. The dune areas remained stable over the winter of 2016/17, which conforms to a wider trend towards stability.</p> <p>At RC1 there was a very high upper and lower beach with a depression in the centre of the beach. The berm on the lower beach has been progressively accreting since monitoring started in 2008. March 2017 was among the highest recorded profiles for the upper and lower beach. A similar pattern was observed at RC2 where there was also a high upper and lower beach.</p> <p>At RC3 the beach has remained stable overall although the berms on the bottom of the beach have lowered over the winter.</p> <p>At RC4 the beach was stable apart the lower beach accreting. This shows that accretion of the lower beach occurred in all of the profiles.</p> <p>Longer term trends:</p> <p>All of the Redcar profiles show progressive accretion of the beach. The dunes are stable or accreting on their seaward extent.</p> <p>The pattern of accretion in the east of the bay with erosion or limited accretion in the central bay is consistent with previous observations of an eastwards net transfer of material at Coatham sands.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>level, and the lower beach at a more medium level.</p> <p>Profile 1cRC4 is located at the beginning of the defended section at Coatham and Redcar. No change has occurred landward of the base of the seawall. The beach levels at the toe fo the seawall have increased by up to 0.4m. Between chainage 55m and 235m here has been erosion of up to 0.4m, removing the upper berm previously recorded at chainage 75m. Seawards of chainage 235m there has been accretion of up to 0.2m. Overall the profile is at a medium-low level compared to the range recorded from previous surveys, with the middle section particularly low (chainage130m to 230m).</p>	

2.2 Redcar Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
29 th March 2017	<p>Beach Profiles:</p> <p>Redcar Sands is covered by three beach profiles (RC5 to RC7; Appendix A), with RC7 being approximately on the boundary with the Marske Sands area. They were last surveyed in October 2016.</p> <p>At profile 1cRC5 the sea defences constructed in 2012 remain unchanged as far as 20m chainage. From the sea defences to chainage 95m there has been erosion of up to 0.5m creating a depression and exposing sections of rock at chainages 50m and 75m. Between chainage 95m and 130m there has been accretion of up to 0.3m forming a berm. Between 130m and 185m chainage the rocks in the lower beach remain exposed. From 185m chainage to the end of the survey at 230m chainage the beach has accreted by 0.3m. Overall the beach is at a relatively medium level compared to the range recorded from previous surveys, except between chainage 40m and 75m where it is relatively low, and chainage 120 where it is relatively high.</p> <p>The profile at 1cRC6 has not changed landward of 55m chainage since the last survey due to the presence of the sea defence. The profile has changed very little seawards of chainage 55m, with small amounts of alternating erosion and accretion of ± 0.2m. A small berm has formed at the toe of the beach at chainage 300m. Overall the profile is at a medium-high level compared to the range recorded from previous surveys.</p> <p>Profile 1cRC7 is undefended. The profile has changes little to 80m chainage. The dune face at 60m chainage remained stable since October 2014. From 80m chainage the beach level has dropped since October 2016, by up to 1.1m but more typically < 0.3m. The upper and lower beach are at a relatively low level compared to the range recorded from previous surveys, but at a medium-high level in the mid-beach.</p>	<p>All of the profiles show erosion but remain within the bounds of the previous profiles.</p> <p>Longer term trends:</p> <p>Profiles RC5 and RC7 show movement of beach berms, across the profile with some evidence for gradual accretion.</p>
March 2017	<p>Topographic Survey:</p> <p>Redcar Sands is covered by a 6-monthly topographic survey. Data have been used to create a DGM (Appendix B – Map 1a) using a GIS. The DGM shows that the beach topography broadly parallel to the shore, although there is a slight embayment with a slightly steeper beach between the two headlands at Coatham Rocks and Redcar Rocks.</p>	<p>The topographic difference plots show that erosion has dominated since the previous survey which confirms the pattern shown by beach profiles.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>The GIS has also been used to calculate the differences between the current topographic survey (Spring 2017) and the most recent (Autumn 2016) topographic survey, as shown in Appendix B – Map2a, to identify areas of erosion and accretion.</p> <p>The difference plot is dominated by erosion, with some smaller areas of accretion on the lower beach, and at the western end of the survey at the top of the beach. The area of greatest change is in the centre of the plot between West Scar and Redcar Rocks, with erosion of up to 1.5m.</p>	

2.3 Marske Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
<p>29th March 2017</p>	<p>Beach Profiles:</p> <p>Marske Sands is covered by two beach profiles during the Partial Measures survey (RC7 to RC8; Appendix A). RC7 is on the boundary with the Redcar Sands area.</p> <p>Profile 1cRC7 is located along The Stray and has been discussed in Section 2.2.</p> <p>Profile 1cRC8 is unchanged as far as 55m chainage. Since April 2014 the dune face has remained stable, which contrasts with the winter of 2013/14 when 10m of recession was recorded. From 55m to 300m chainage the beach level has dropped by up to 0.5m since October 2016. From chainage 300m to the end of the profile at 330m the beach level has increased by 0.2m, forming a berm. The profile is relatively low in the upper beach compared to the range recorded from previous surveys (chainage 55m to 100m), but at a more medium-high level along the rest of the profile.</p>	<p>The cliffed face of the dune remained stable at both RC7 and RC8 following the recession over the winter of 2013/14.</p> <p>RC8 shows erosion, however a berm has formed on the lower beach.</p> <p>Longer term trends:</p> <p>The April 2014 profiles were amongst the lowest seen at 1cRC8, due to the December 2013 storm surge. The beach has recovered and levels are now comparatively medium-high.</p>

2.4 Saltburn Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
29 th March 2017	<p>Beach Profiles:</p> <p>Saltburn Sands is covered by one beach profile (RC9; Appendix A).</p> <p>Overall Profile 1cRC 9 has experienced no change over the section covered by the sea defence as far as 30m chainage. Seawards of chainage 30m there has been erosion of up to 0.5m. The section of beach between chainage 50m and 170m is the lowest recorded compared to the previous surveys, seawards of 170m the beach is at a relatively medium level.</p>	<p>The drop in beach level at RC9 over the winter of 2016/17 was relatively high. Overall, the beach level is low and has been eroding at a low rate since 2008.</p> <p>Longer term trends: The profile plots show net erosion, although there are periods of recovery. The profile for March 2017 is the lowest recorded in the upper beach but in the middle of the range of lower beach profiles.</p>
March 2017	<p>Topographic Survey:</p> <p>Saltburn Sands is covered by a 6-monthly topographic survey. Data have been used to create a DGM (Appendix B – Map 2a). The beach topography consists of shore parallel contours, with a small change at the mouth of the channel. This DGM has been compared against the previous (Autumn 2016) survey in Appendix B – Map 2b.</p> <p>The difference plot comparing the DGMs shows that since Autumn 2016 the recorded changes on the beach have been dominated by erosion, with some small areas of accretion at the very top of the beach, and at the western end of the survey area on the lower beach. The magnitude of erosion is fairly uniform across the survey area.</p>	<p>The difference plot indicates that erosion has dominated over the winter of 2016/17, which confirms the pattern shown in the profile.</p>

2.5 Cattersty Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
5 th April 2016	<p>Topographic Survey:</p> <p>Cattersty Sands is covered by a 6-monthly topographic survey. Data have been used to create a DGM (Appendix B – Map 3a). For the most part the beach contours are shore-parallel, and steeper east of the breakwater than west of it. Two deviations from the shore parallel pattern occur where the channel outflow crosses the beach and in the furthest east part of the survey where the contours indicate an embayment.</p> <p>The Spring 2016 DGM has been compared against the previous (Autumn 2016) survey in Appendix B – Map 3b. The comparison between DGMs shows a patchy distribution of erosion and accretion. On the north-western side of the breakwater there was erosion at the top and toe of the beach with a wide band of little change/accretion across the middle of the beach. On the south east side of the breakwater there has been accretion in the mouth of the channel and immediately in the lee of the breakwater. Elsewhere the beach is dominated by erosion, with the greatest magnitude recorded to the east of the rock groyne.</p>	<p>The data shows erosion on the upper and lower beach and small amounts of accretion in the mid beach. The distribution of change is likely to be linked to the movement of material seaward during the winter.</p> <p>Longer term trends: The long term difference plot which cover Autumn 2008 to Autumn 2016 shows that on the north west side of the breakwater there was erosion in the upper beach and accretion in the lower beach. That pattern has continued through the winter of 2016/17. On the south east side of the breakwater the long term pattern of accretion in the mid beach continued although the channel mouth showed accretion which was not a continuation of the long term trend for the beach.</p> <p>The winter erosion dominates the overall behaviour of the beach but the calmer weather in the summer months should lead to some accretion. If the erosion of the upper beach continues it is likely to drive cliff failures which would add material to the upper beach for redistribution.</p>

2.6 Staithes

<p>6th March 2017</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 2017 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 2016 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 1, where a significant landslip resulting in the cliff top retreating by 1.75m occurred over winter of 2016/17. Points 18 and 19 have recorded a negative movement of 0.5m and 0.6m respectively; 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 2016 and March 2017 are generally small. There has been one failure which has significantly affected the cliff top at the survey transects.</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 have a recession rate of 0.2, 0.2, and 0.3m/yr respectively.</p>
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3. Problems Encountered and Uncertainty in Analysis

Topographic Survey

No significant problems were reported with the topographic surveys.

Cliff Top Surveys

The cliff top surveys at Staithes are assumed to have a limit of accuracy of ± 0.1 m due to the methodology. Erosion can reliably be measured at only one location but as monitoring progresses, underlying patterns in erosion will become more evident. The following points were highlighted in the survey reports:

- There was a significant landslip at survey point 1 at Staithes of approximately 1.7m.
- Survey points 9 to 12 at Staithes have been cordoned off by the National Trust due to a landslip on the headland and could not be surveyed, as was the case for the September 2016 survey.

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

No further recommendations are made at this stage for the fine-tuning of the monitoring programme.

5. Conclusions and Areas of Concern

- At Redcar all of the profiles RC1-RC4 show progressive accretion of the beach. The dunes are stable or accreting on their seaward extent.
- At Redcar Sands, all of the profiles show erosion but remain within the bounds of the previous surveys. Profiles RC5 and RC7 show the movement of beach berms, up and down the profile with evidence for gradual accretion. The topographic change plots show that erosion has dominated since the previous survey, which broadly agrees with the pattern seen in the beach profiles.
- At Marske Sands, the cliffed face of the dune remained stable at both RC7 and 8 following the recession caused by the winter storms of 2013/14. RC8 shows erosion but with a berm forming on the lower beach.
- At Saltburn Sands, the profile plots show net erosion, although there are years of recovery. The profile for March 2016 is one of the lowest recorded in the upper beach but in the middle of the range of lower beach profiles.
- At Cattersty Sands, the plot for the bay shows erosion on the upper and lower beach and small amounts of accretion in the mid beach. The distribution of change is likely to be linked to the movement of material seaward during the winter.
- At Staithes, the recorded changes to the cliff top between September 2016 and March 2017 are generally small. There has been one failure which has significantly affected the cliff top at the survey transects. There are erosion rates which are calculated from the data collected since 2008. Points 1, 4, and 13 have a recession rate of 0.2, 0.2, and 0.3m/yr respectively.

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: 1cRC1

Date: 29/03/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

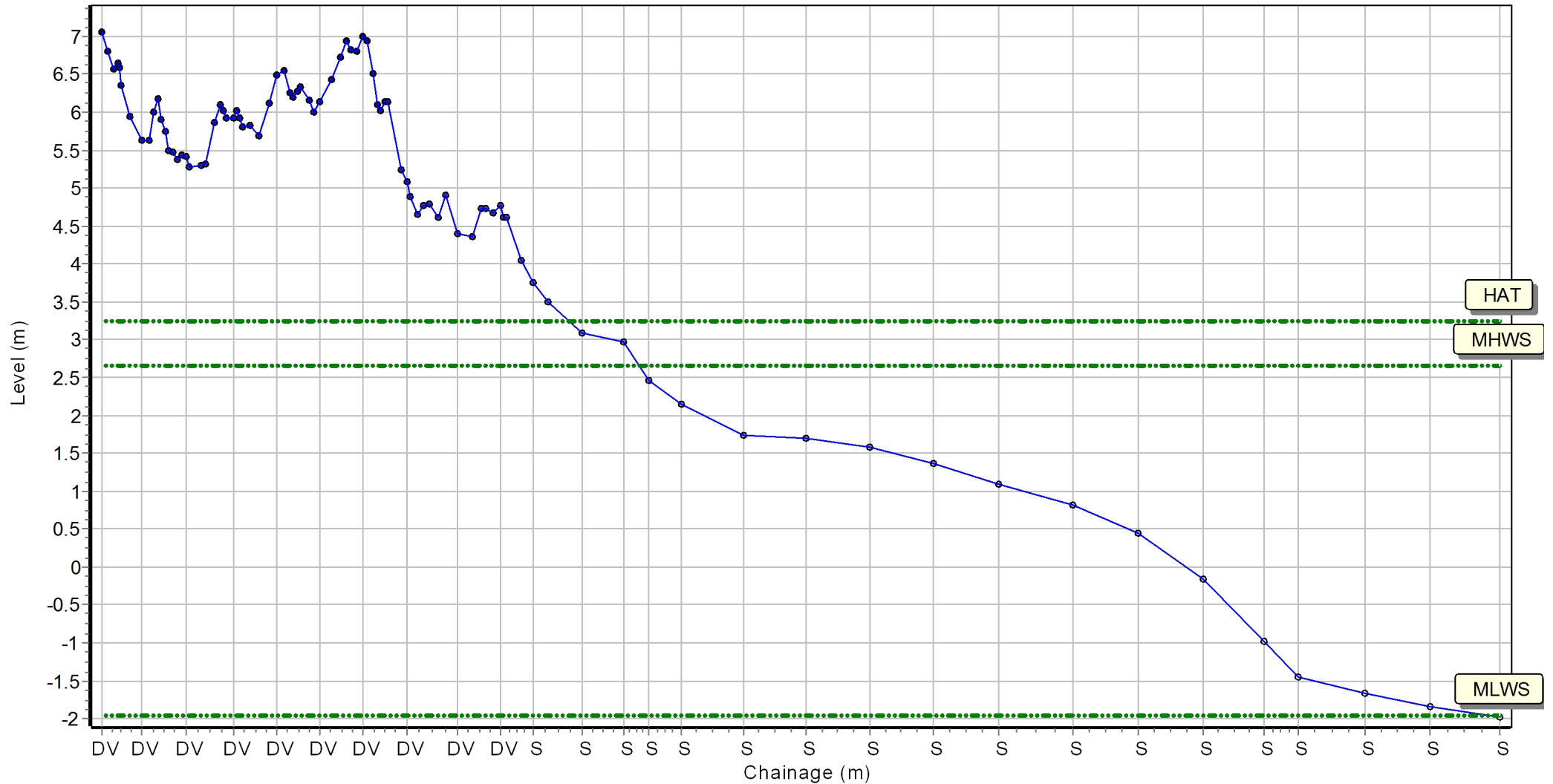
Sea State:

Visibility:

Rain:

Summary: 2017 Partial Measures Topo Survey

Easting: 455811.436 Northing: 527373.402 Profile Bearing: 34 ° from North



Beach Profile

Location: 1cRC2

Date: 29/03/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

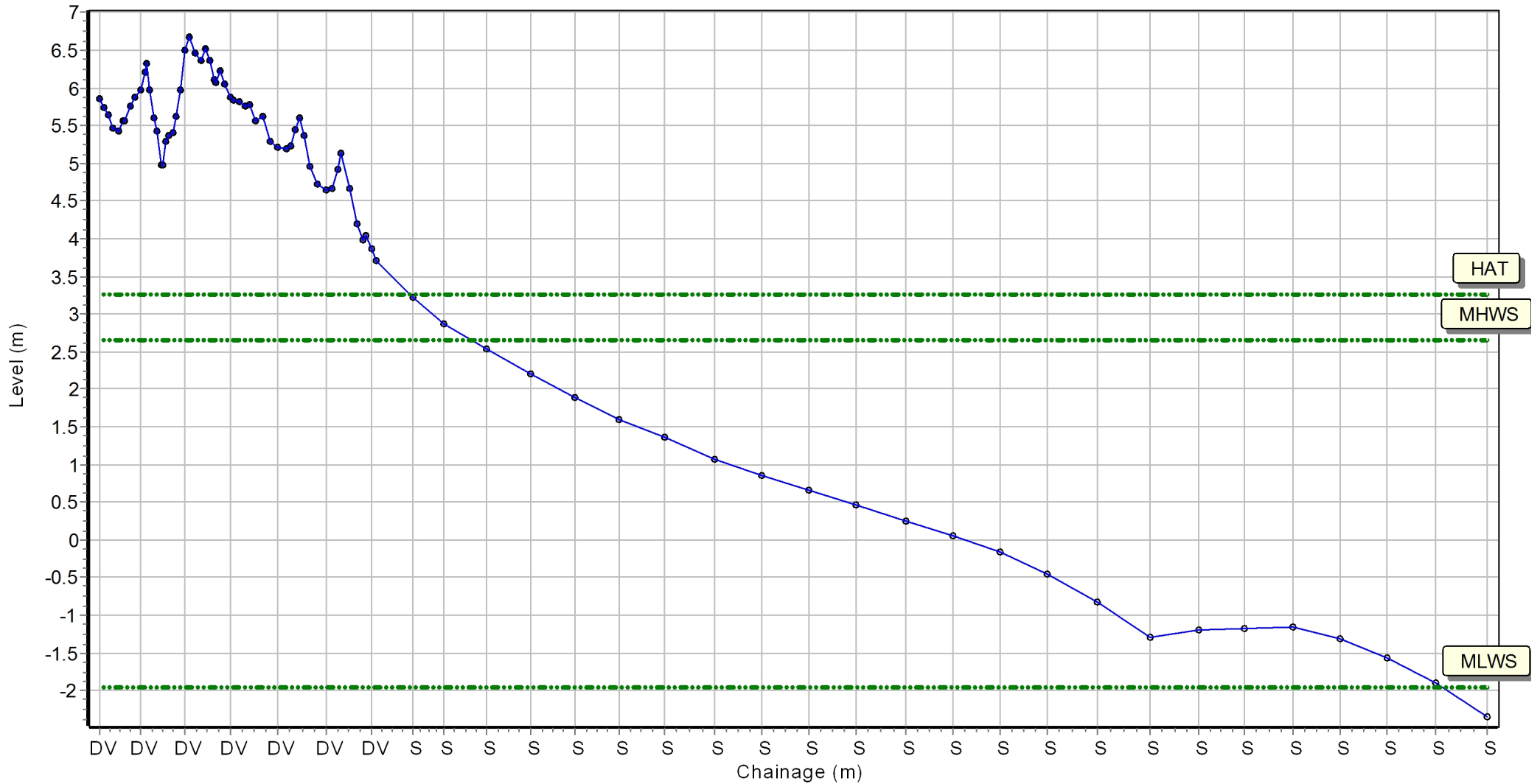
Sea State:

Visibility:

Rain:

Summary: 2017 Partial Measures Topo Survey

Easting: 456633.253 Northing: 526599.577 Profile Bearing: 34 ° from North



Beach Profile

Location: 1cRC3

Date: 29/03/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

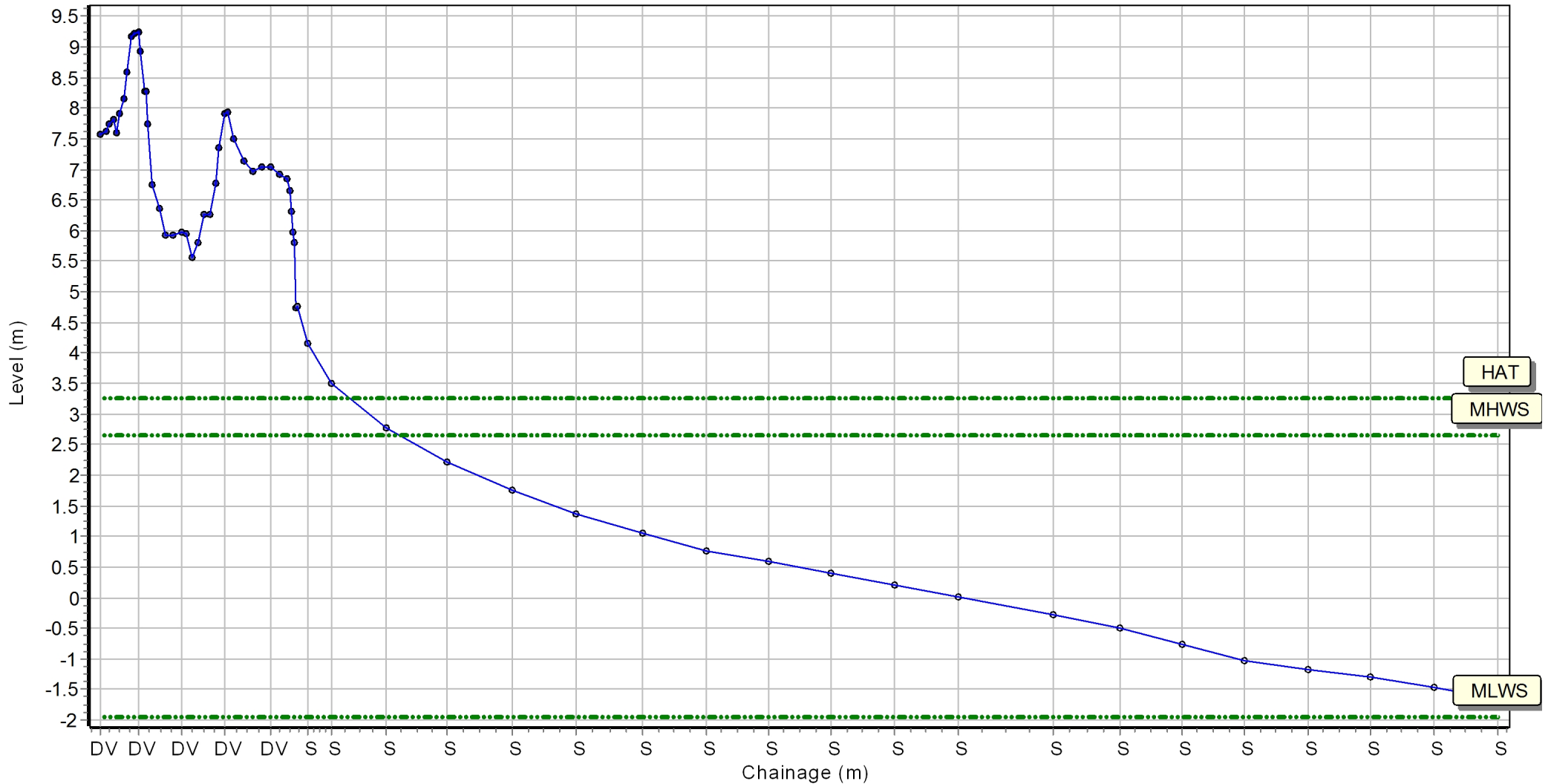
Sea State:

Visibility:

Rain:

Summary: 2017 Partial Measures Topo Survey

Easting: 457706.365 Northing: 525898.597 Profile Bearing: 28 ° from North



Beach Profile

Location: 1cRC4

Date: 29/03/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

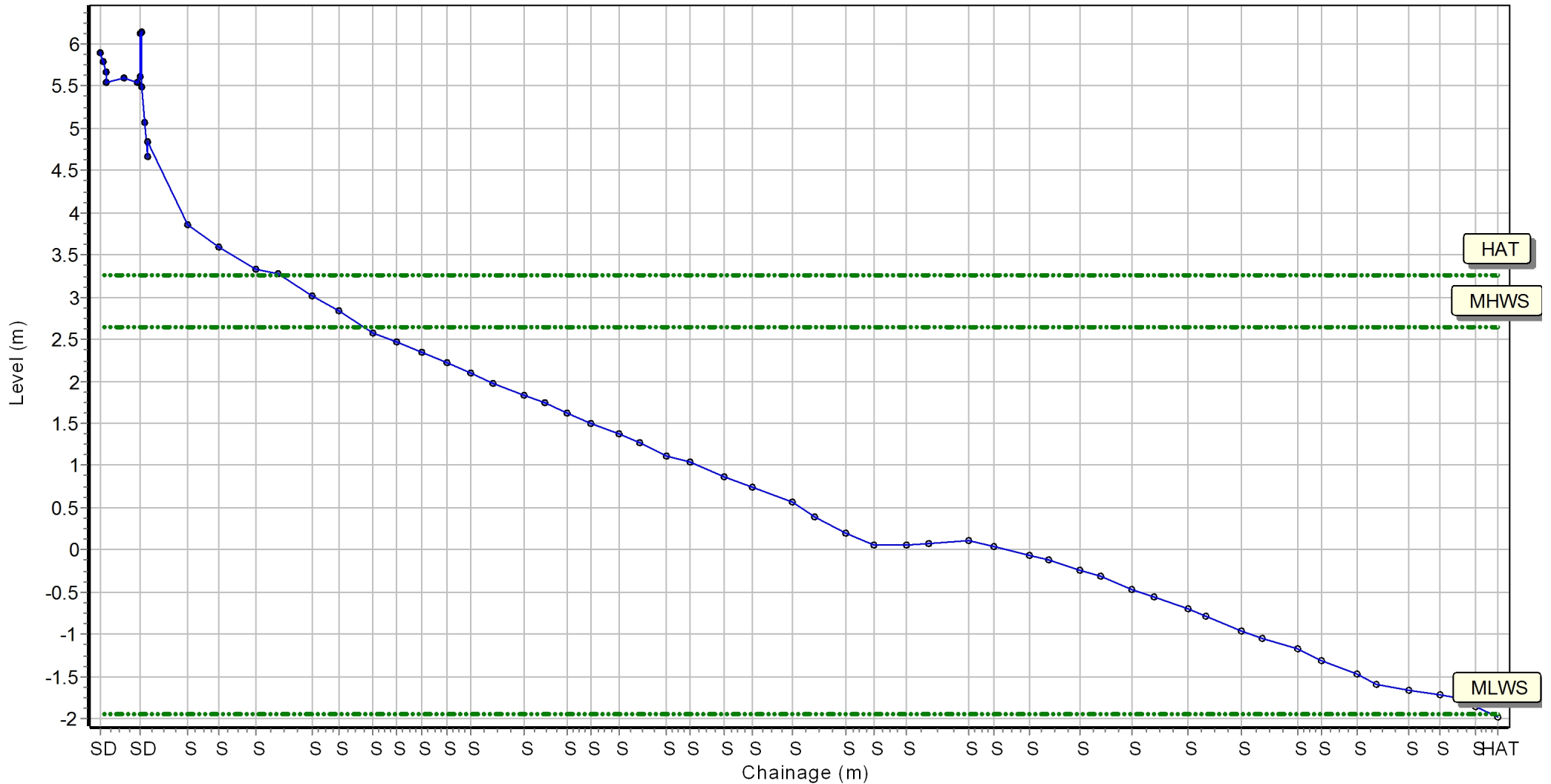
Sea State:

Visibility:

Rain:

Summary: 2017 Partial Measures Topo Survey

Easting: 459337.597 Northing: 525336.99 Profile Bearing: 13 ° from North



Beach Profile

Location: 1cRC5

Date: 29/03/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

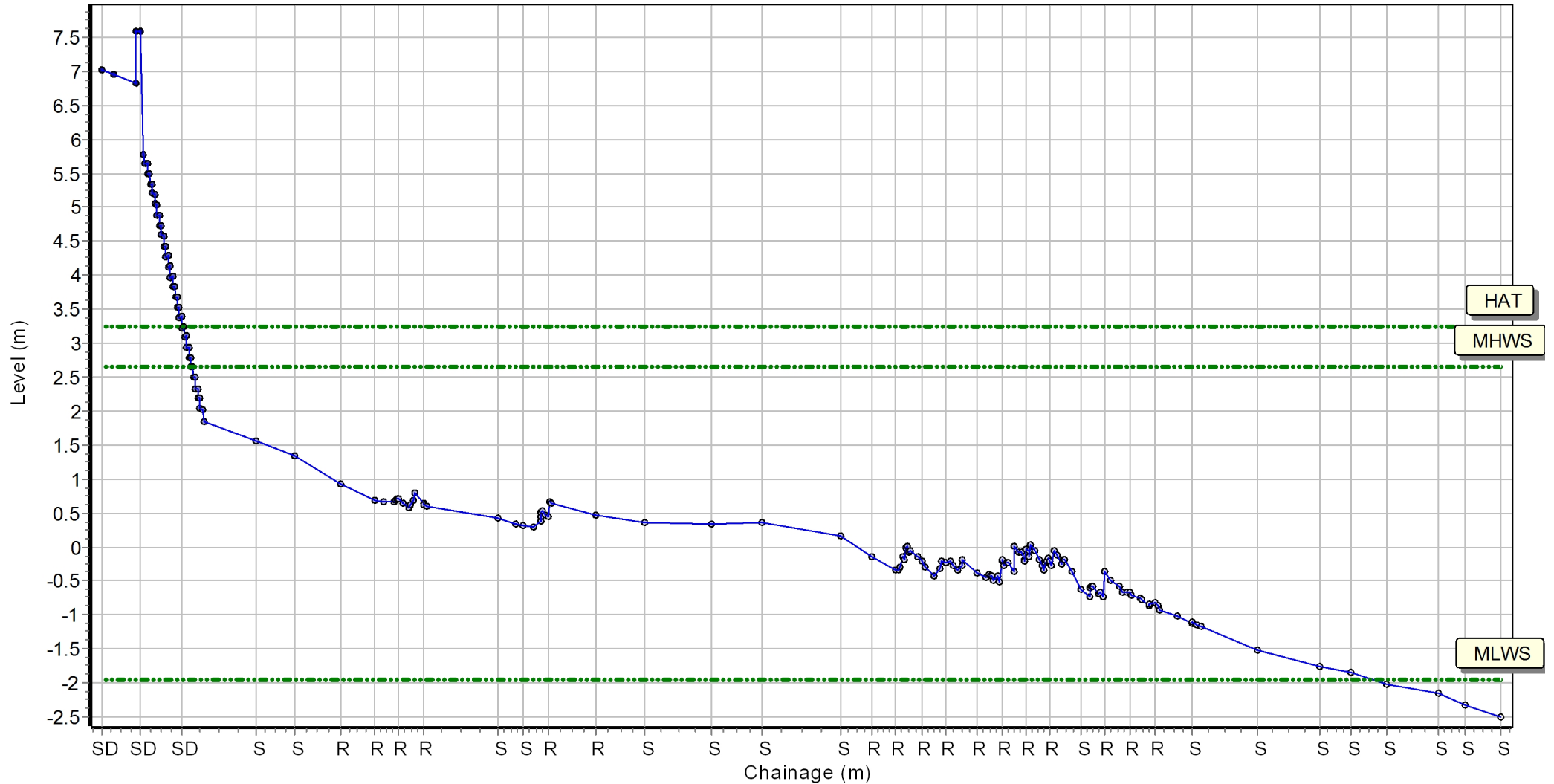
Sea State:

Visibility:

Rain:

Summary: 2017 Partial Measures Topo Survey

Easting: 460845.21 Northing: 525146.997 Profile Bearing: 26 ° from North



Beach Profile

Location: 1cRC6

Date: 29/03/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

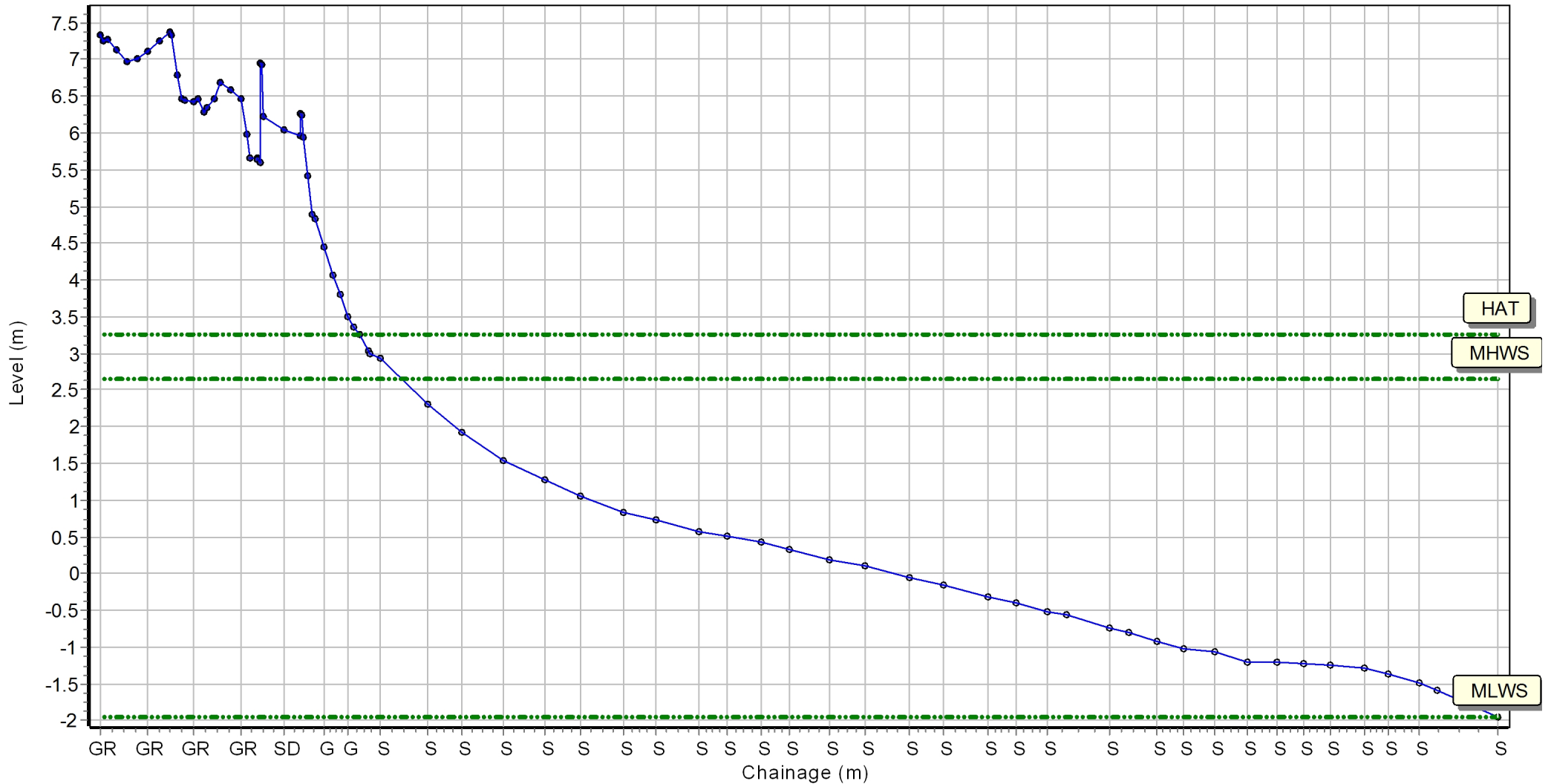
Sea State:

Visibility:

Rain:

Summary: 2017 Partial Measures Topo Survey

Easting: 461776.835 Northing: 524269.592 Profile Bearing: 39 ° from North



Beach Profile

Location: 1cRC7

Date: 29/03/2017 Inspector: AG

Low Tide:

Low Tide Time:

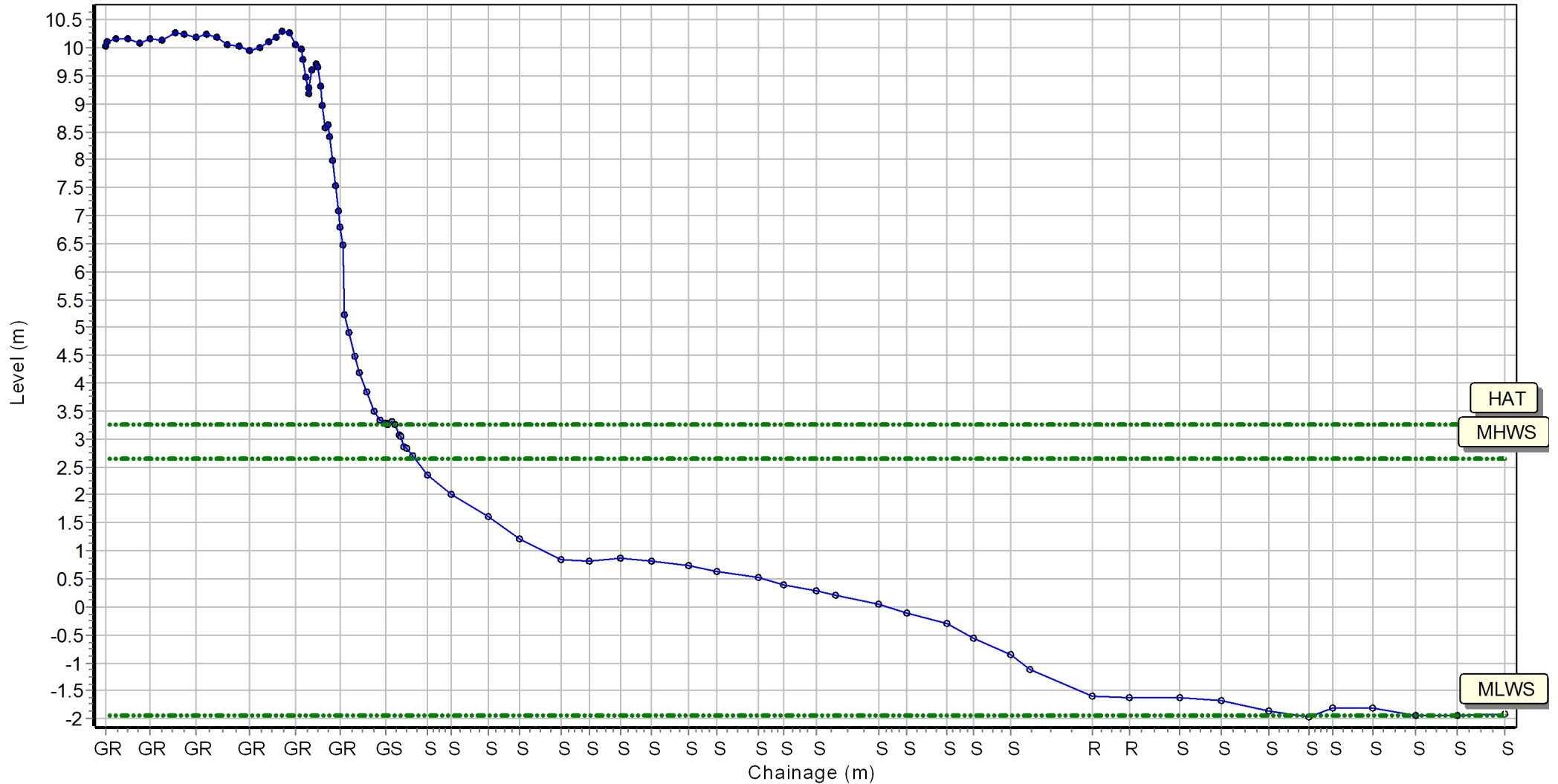
Wind Sea State:

Visibility:

Rain:

Summary: 2017 Partial Measures Topo Survey

Easting: 462568.453 Northing: 523568.436 Profile Bearing: 37 ° from North



Beach Profile

Location: 1cRC8

Date: 29/03/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

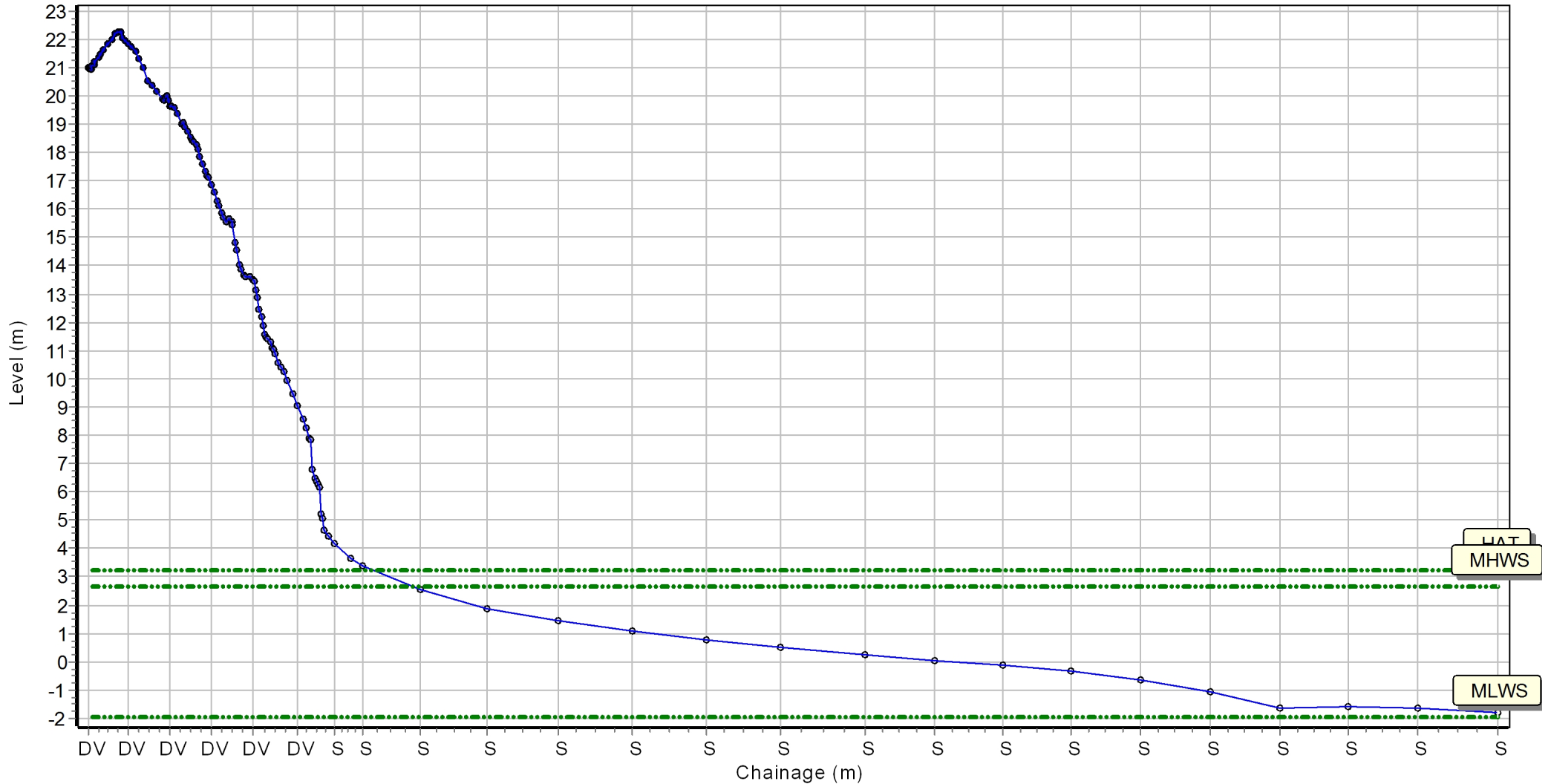
Sea State:

Visibility:

Rain:

Summary: 2017 Partial Measures Topo Survey

Easting: 464245.579 Northing: 522578.097 Profile Bearing: 28 ° from North



Beach Profiles: 1cRC1



Profiles Envelope
17/11/2008
07/04/2016
07/10/2016
29/03/2017

HAT

MHS

MLWS

SANDS

Beach Profiles: 1cRC2



Profiles Envelope
17/11/2008
07/04/2016
07/10/2016
29/03/2017

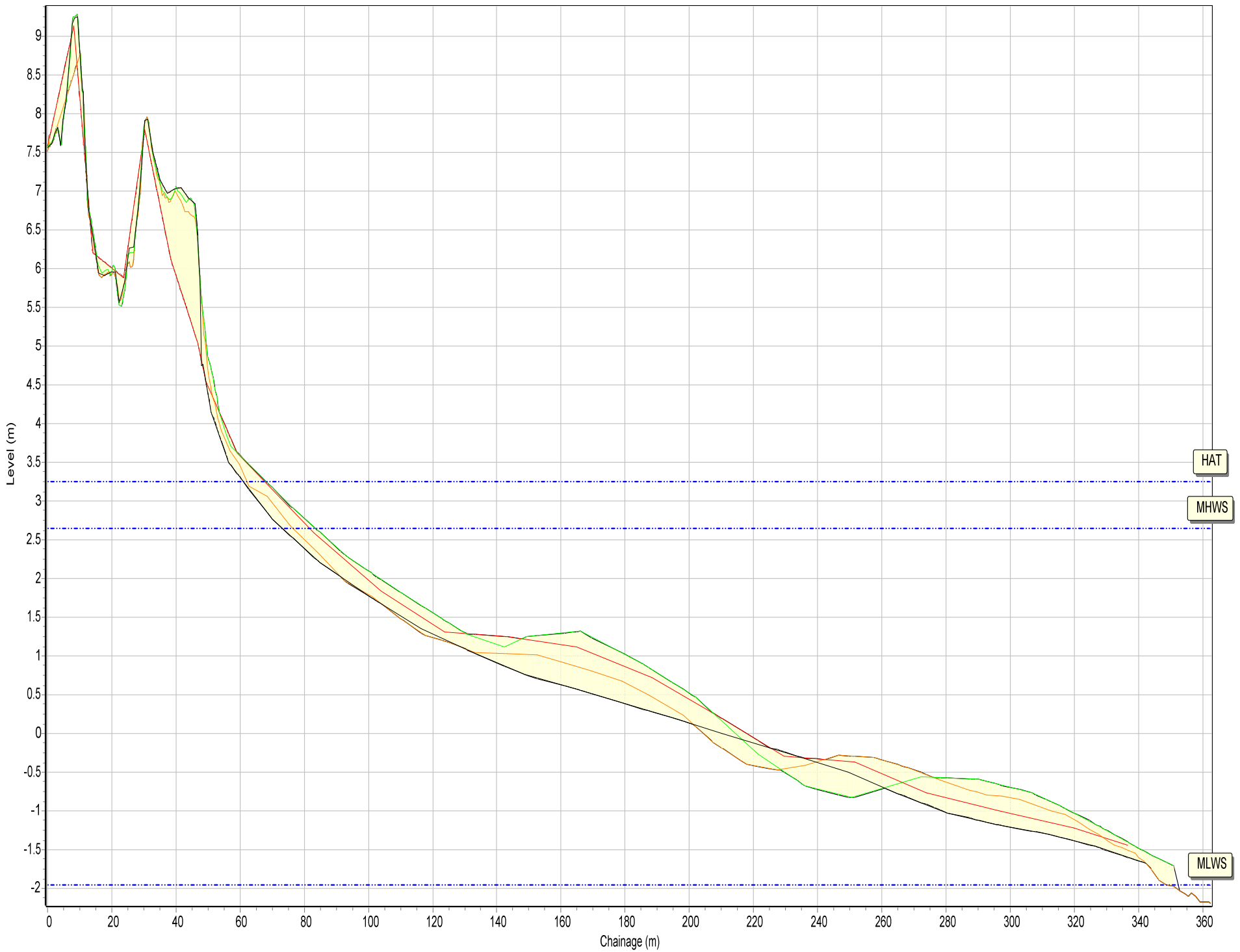
HAT

MHWS

MLWS

SANDS

Beach Profiles: 1cRC3



Profiles Envelope
17/11/2008
07/04/2016
07/10/2016
29/03/2017

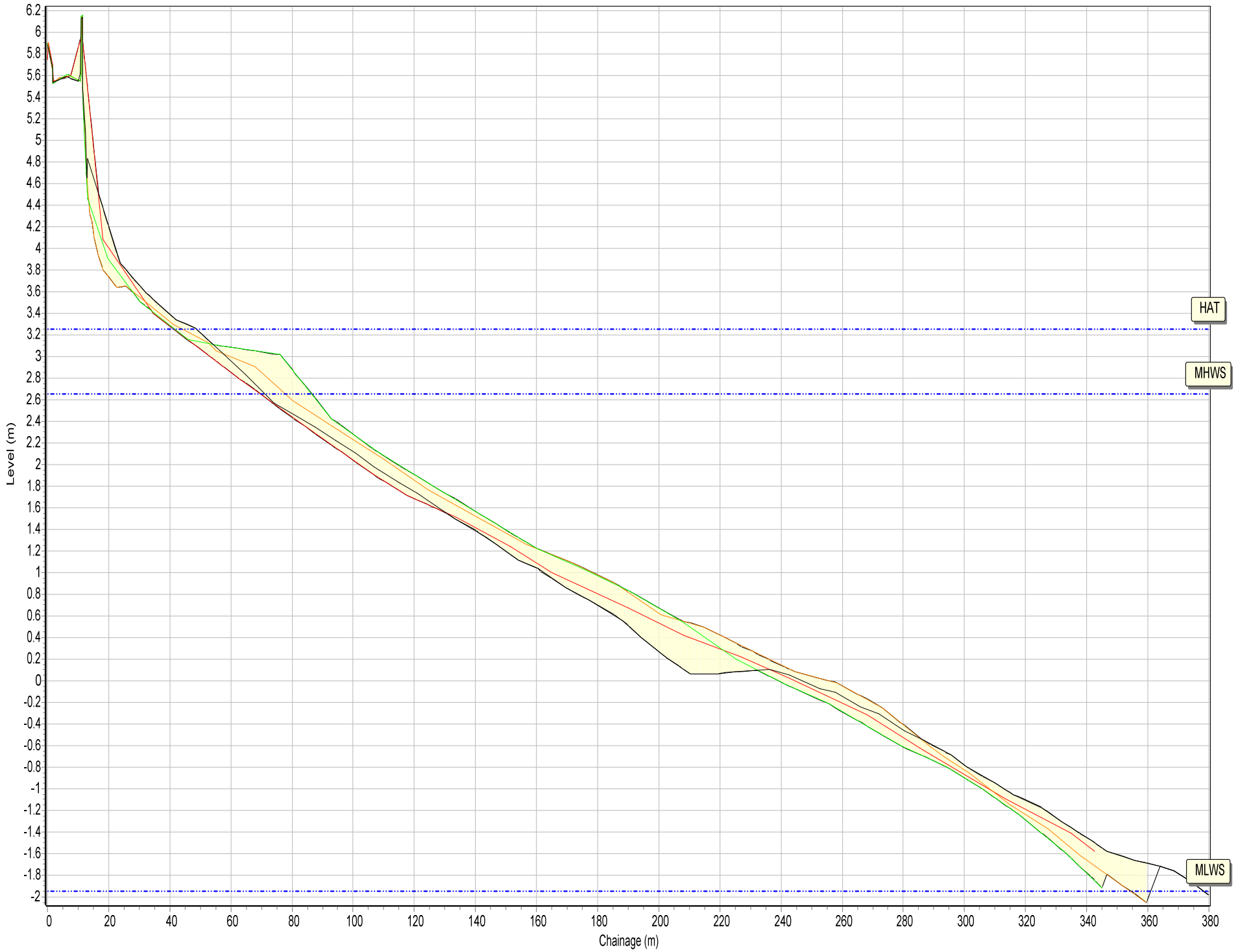
HAT

MHWS

MLWS

SANDS

Beach Profiles: 1cRC4



Profiles Envelope
17/11/2008
06/04/2016
07/10/2016
29/03/2017

HAT

MHWS

MLWS

SANDS

Beach Profiles: 1cRC5



Profiles Envelope
17/11/2008
06/04/2016
07/10/2016
29/03/2017

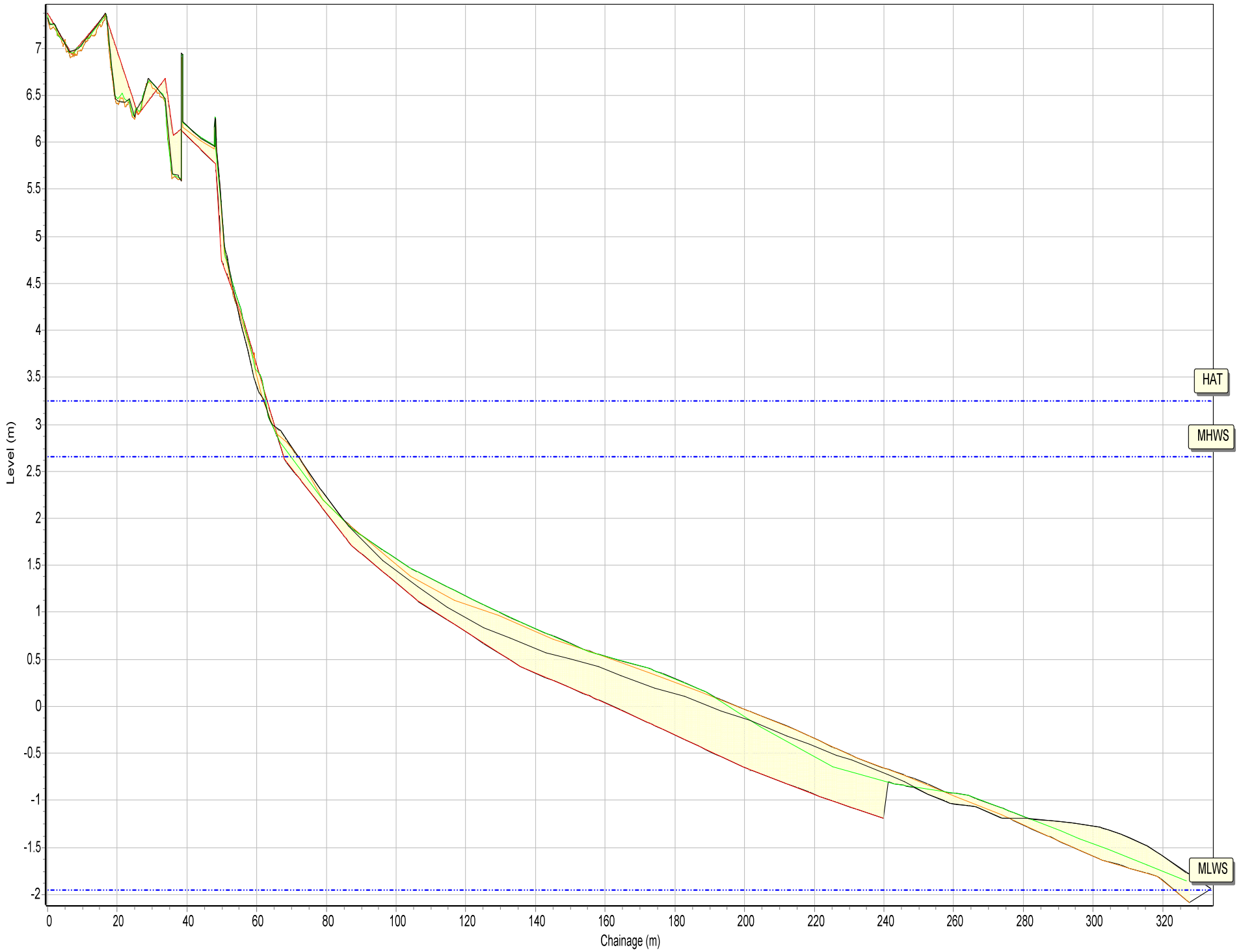
HAT

MHWS

MLWS

SANDS

Beach Profiles: 1cRC6



Profiles Envelope
17/11/2008
06/04/2016
07/10/2016
29/03/2017

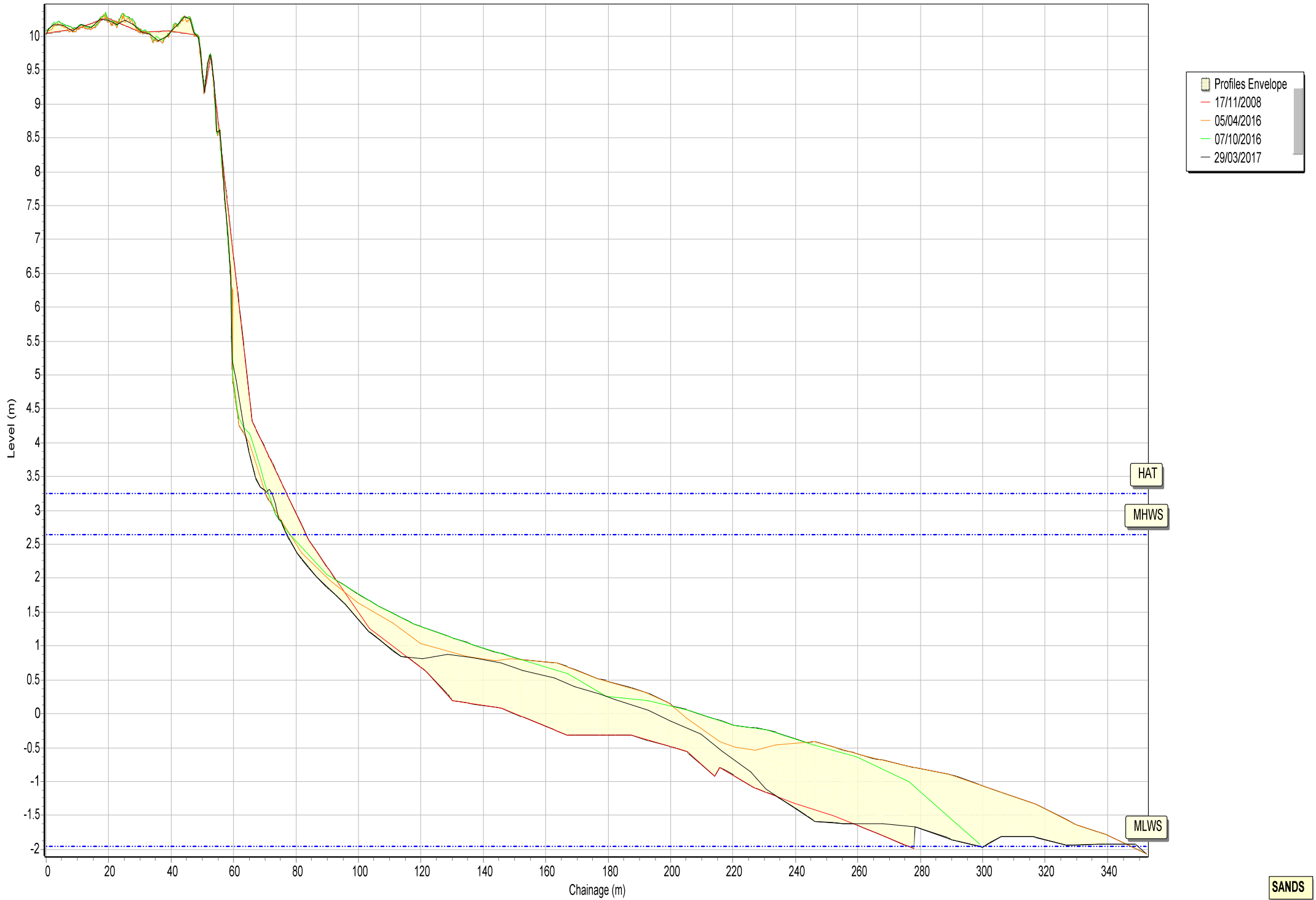
HAT

MHWS

MLWS

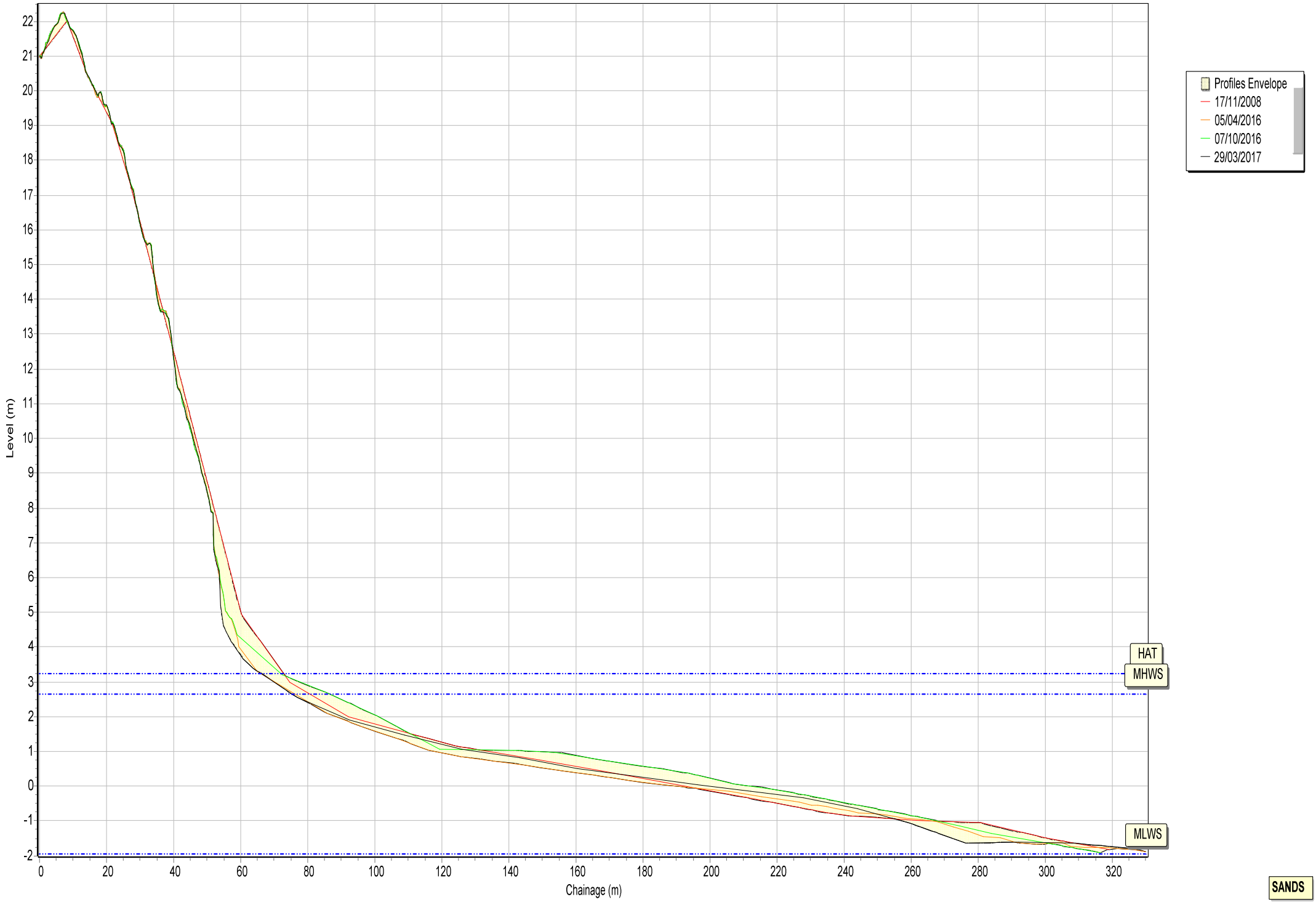
SANDS

Beach Profiles: 1cRC7



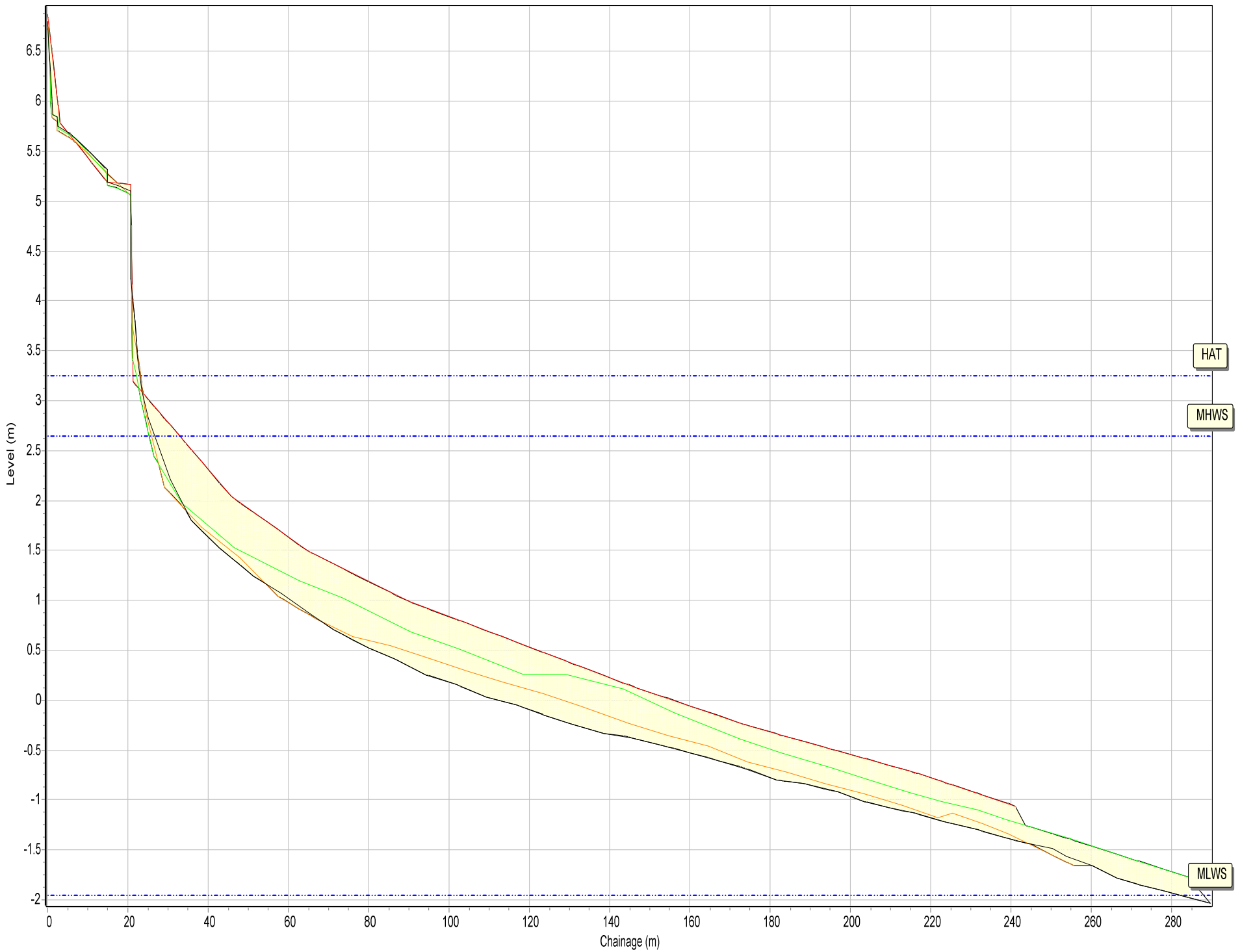
SANDS

Beach Profiles: 1cRC8



SANDS

Beach Profiles: 1cRC9



Profiles Envelope
17/11/2008
05/04/2016
07/10/2016
29/03/2017

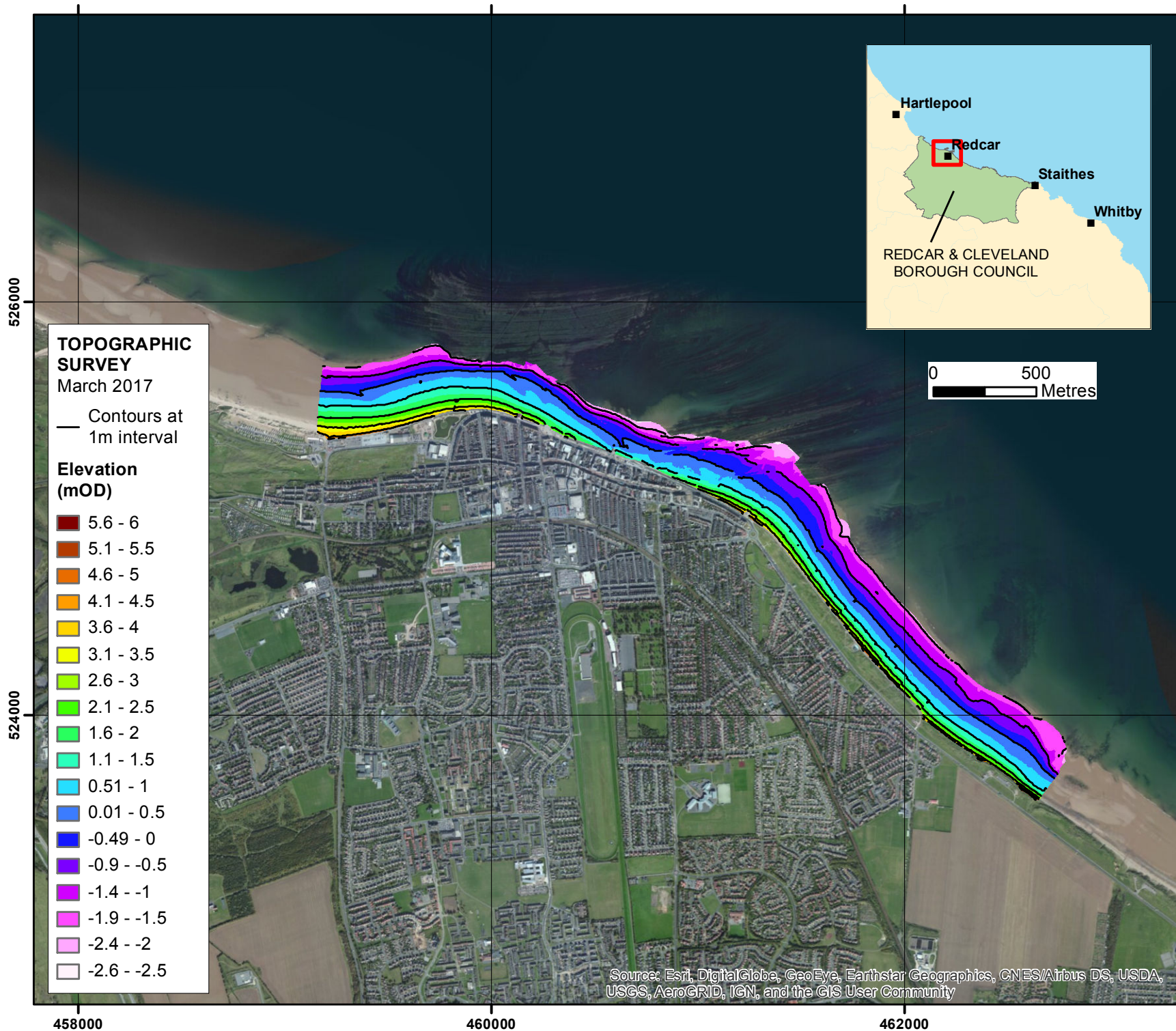
HAT

MHWS

MLWS

SANDS

Appendix B
Topographic Survey



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

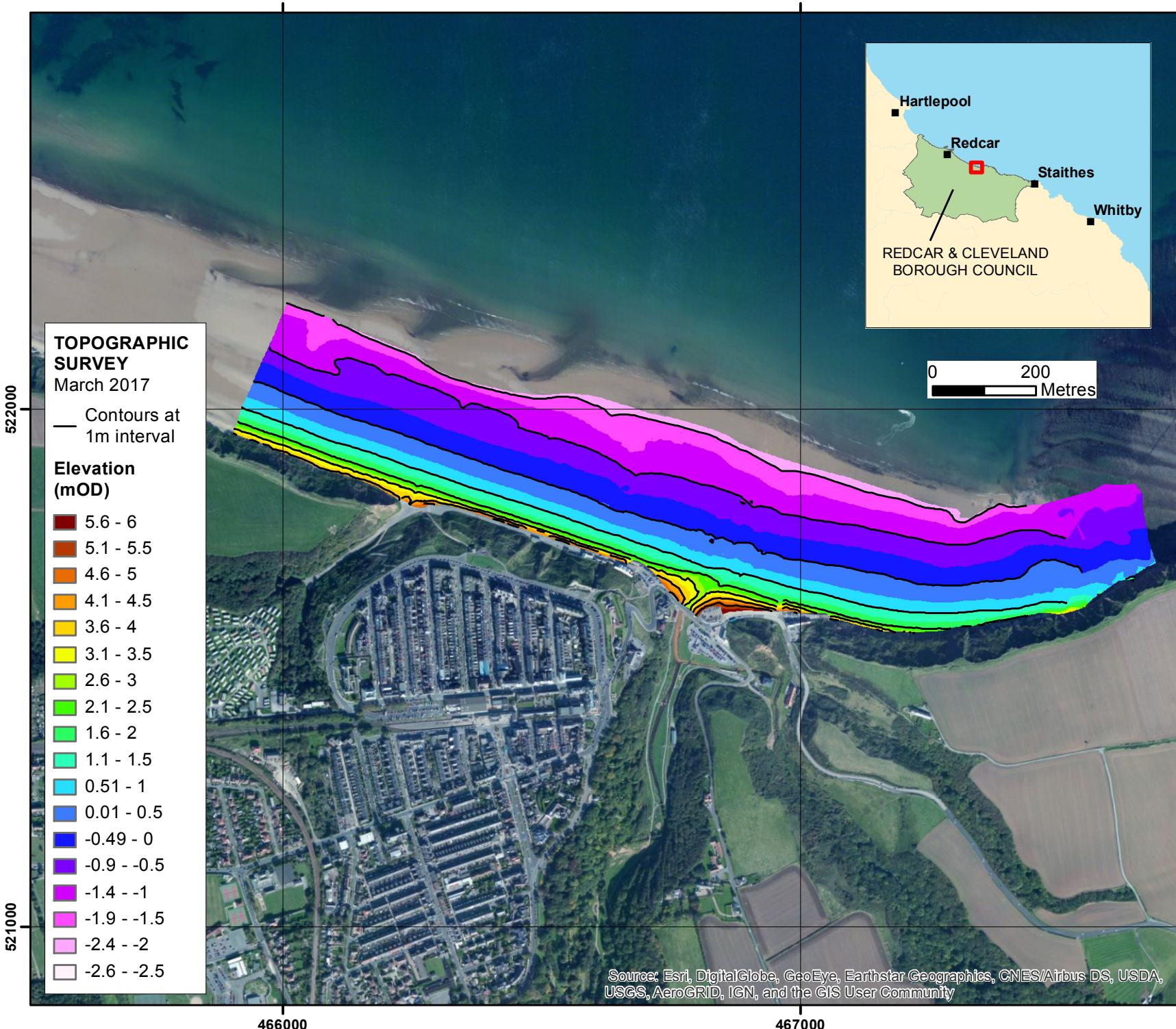
Appendix B - Map 1
REDCAR SANDS
Redcar and Cleveland Borough Council Frontage
Update Report
'Partial Measures' Survey 2017

Drawing Scale at A4 1:25,000

WATER
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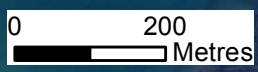


TOPOGRAPHIC SURVEY
 March 2017

— Contours at 1m interval

Elevation (mOD)

5.6 - 6
5.1 - 5.5
4.6 - 5
4.1 - 4.5
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
-2.6 - -2.5



Key

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

Appendix B - Map 2
SALTBURN SANDS
Redcar and Cleveland Borough Council Frontage

Update Report
 'Partial Measures' Survey 2017

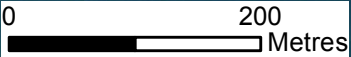
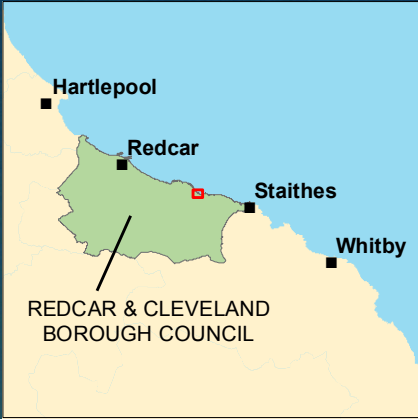
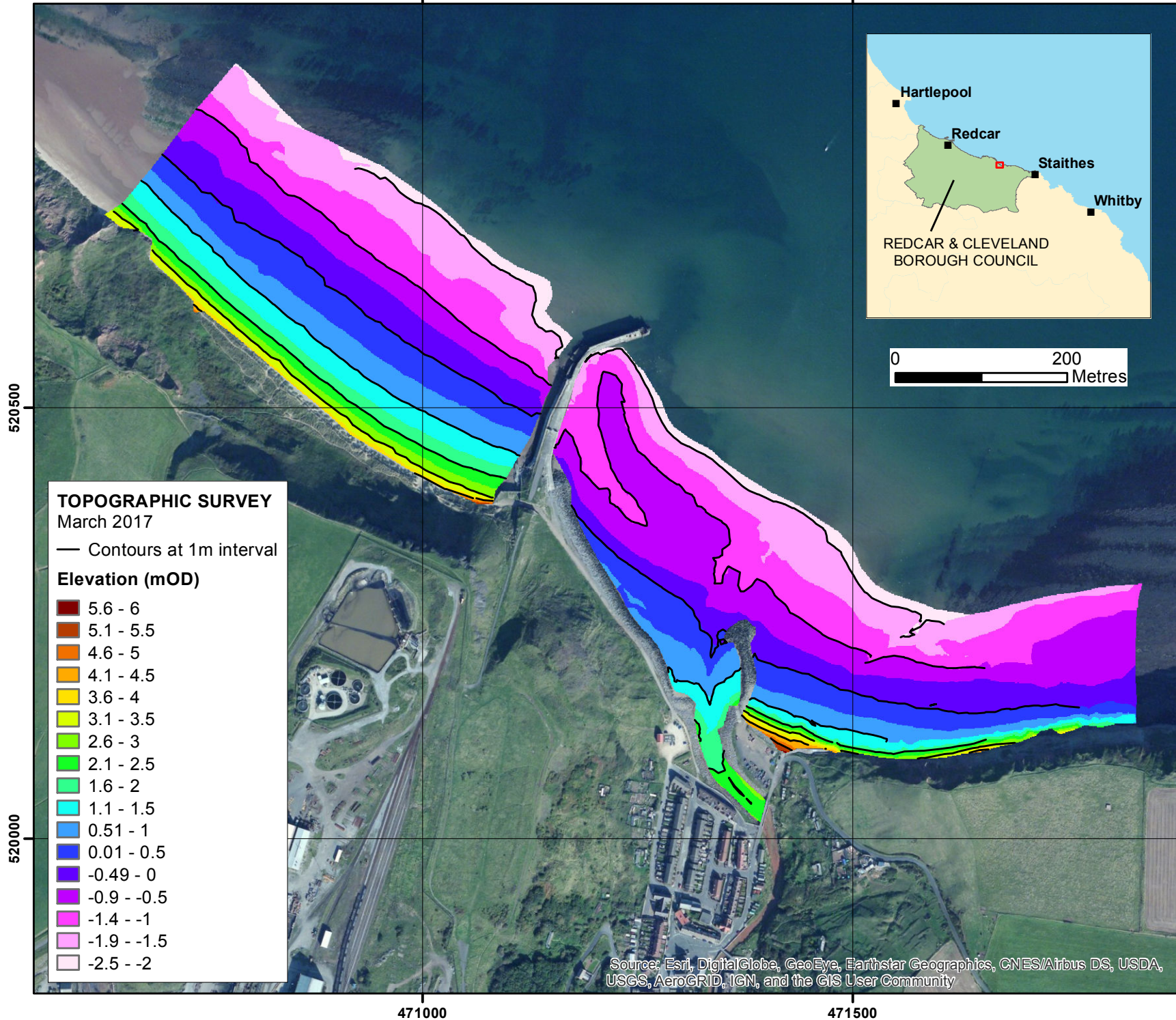
Drawing Scale at A4 1:10,000

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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

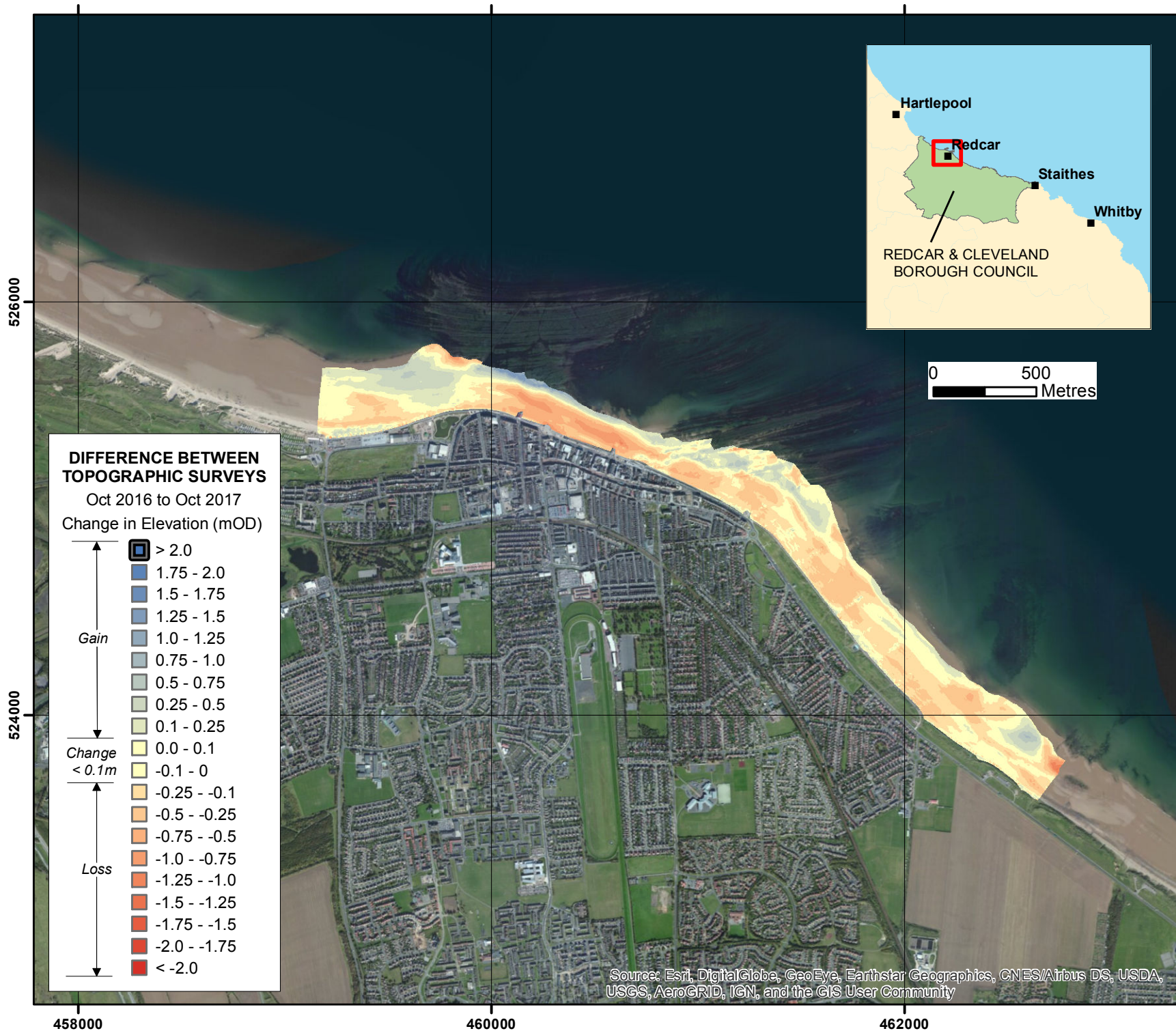
Appendix B - Map 3
CATTERSTY SANDS
Redcar and Cleveland Borough Council Frontage
Update Report
'Partial Measures' Survey 2017

Drawing Scale at A4 1:6,000

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Newcastle upon Tyne
NE1 4EE

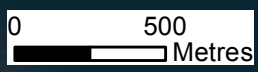
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DIFFERENCE BETWEEN TOPOGRAPHIC SURVEYS
 Oct 2016 to Oct 2017
 Change in Elevation (mOD)

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 4
REDCAR SANDS

Redcar and Cleveland Borough Council Frontage

Update Report
 'Partial Measures' Survey 2017

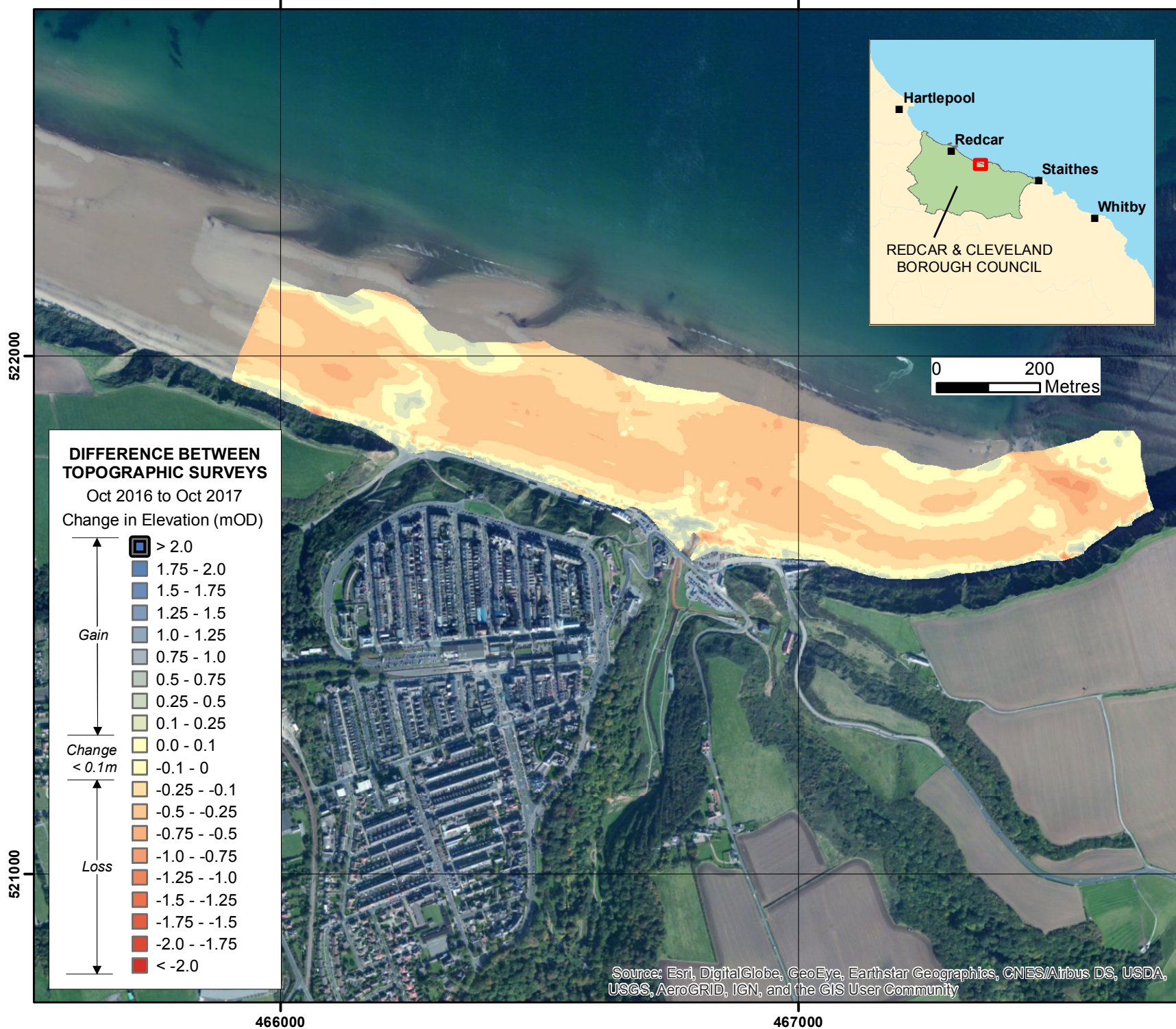
Drawing Scale at A4 1:25,000

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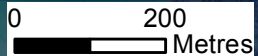
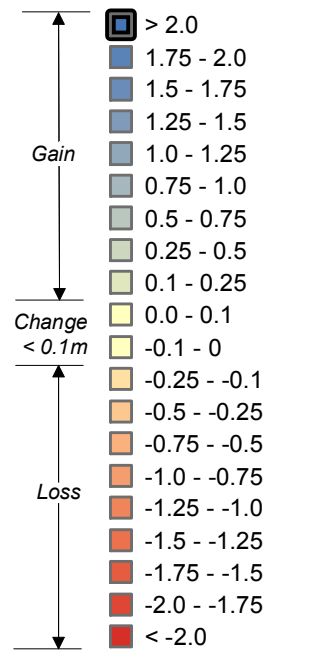


Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



DIFFERENCE BETWEEN TOPOGRAPHIC SURVEYS

Oct 2016 to Oct 2017
Change in Elevation (mOD)



Key

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

Appendix B - Map 5
SALTBURN SANDS
Redcar and Cleveland Borough Council Frontage

Update Report
'Partial Measures' Survey 2017

Drawing Scale at A4 1:10,000

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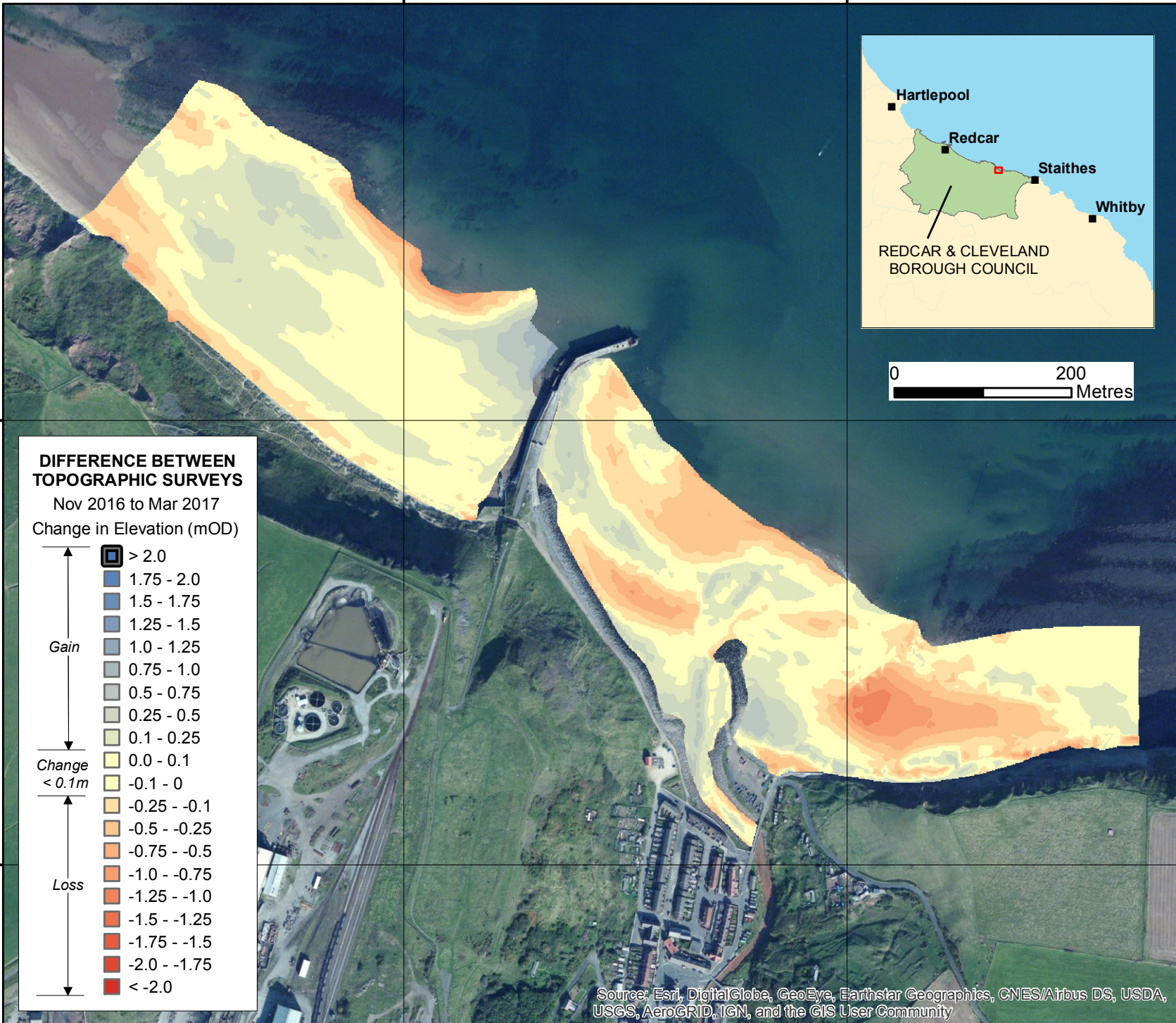
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

520 500

520 000

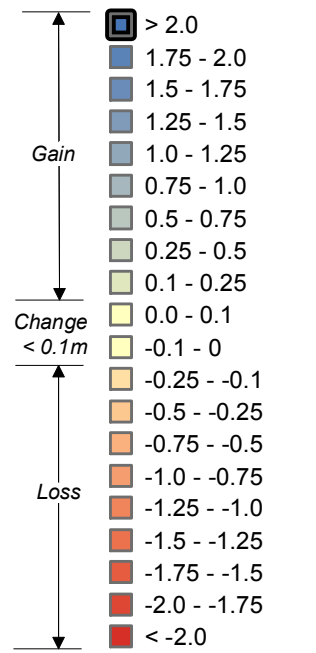
471 000

471 500



DIFFERENCE BETWEEN TOPOGRAPHIC SURVEYS

Nov 2016 to Mar 2017
Change in Elevation (mOD)



Key

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

Appendix B - Map 6
CATTERSTY SANDS
Redcar and Cleveland Borough Council Frontage
Update Report
'Partial Measures' Survey 2017

Drawing Scale at A4 1:6,000

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Source: Esri, DigitalGlobe, 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 at Staithes (Figure C1). The maximum separation between any two points varies along the coast, reflecting the degree of risk from the erosion.

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 November 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
			(°)	Nov 2008	Sep 2016	Mar 2017	Nov 2008 - Mar 2017	Sep 2016 - Mar 2017	Nov 2008 - Mar 2017
1	477228	518769	320	1.9	1.62	-0.13	2.03	1.75	0.23
2	477334	518798	0	10.9	10.73	10.74	0.16	-0.01	0.02
3	477487	518789	350	7.1	8.14	8.35	-1.25	-0.21	0.00
4	477594	518801	340	5.9	4.48	4.35	1.55	0.13	0.17
5	477683	518911	350	8.4	8.75	8.73	-0.33	0.02	0.00
6	477792	518867	30	8.6	8.39	8.35	0.25	0.04	0.03
7	477891	518828	60	7.7	7.31	7.31	0.39	0.00	0.04
8	477959	518873	350	8.7	9.6	9.61	-0.91	-0.01	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	9.07	9.07	2.33	0.00	0.26
14	478624	518807	20	7.5	7.44	7.51	-0.01	-0.07	0.00
15	478737	518858	60	6.1	6.33	6.23	-0.13	0.10	0.00
16	478823	518757	60	8	8.58	8.65	-0.65	-0.07	0.00
17	478944	518671	30	9.3	9.24	9.29	0.01	-0.05	0.00
18	479052	518630	20	9.2	8.87	9.36	-0.16	-0.49	0.00
19	479147	518610	0	14.2	13.79	14.41	-0.21	-0.62	0.00
20	479274	518618	20	11.4	11.33	11.4	0.00	-0.07	0.00