

**Cell 1 Regional Coastal Monitoring Programme
Update Report 13: 'Partial Measures' Survey 2021**

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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)			
	River Tyne to Frenchman's Bay	Frenchman's Bay to Souter Point	Souter Point to Chourdon Point	Chourdon Point to Hartlepool Headland
1 in 200 year	3.41	3.44	3.66	3.91
HAT	2.85	2.88	3.18	3.30
MHWS	2.15	2.18	2.48	2.70
MLWS	-2.15	-2.12	-1.92	-1.90

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).

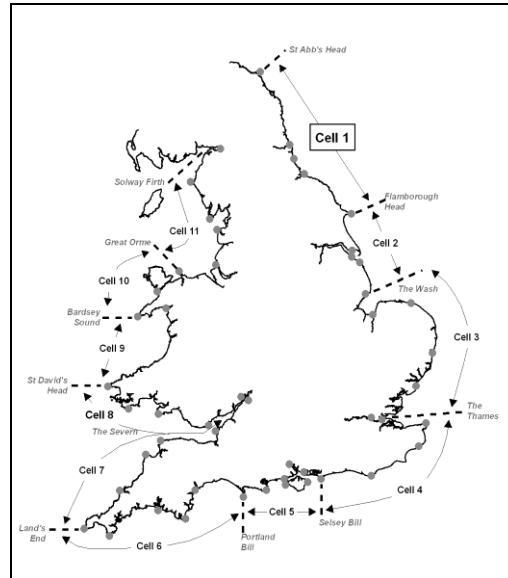


Figure 1 Sediment Cells in England and Wales

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
- LiDAR Surveys
- walk-over cliff and coastal defence asset surveys

The beach profile surveys, topographic surveys and cliff top recession surveys are undertaken as a 'Full Measures' survey in autumn/early winter every year. Some of these surveys are then repeated the following spring as part of a 'Partial Measures' survey. 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 1	Sep 11
4	2011/12	Sep 11	Aug 12	Mar-May 12	Feb 13	-
5	2012/13	Sep 12	Feb 13	Mar-Apr 13	May 13	-
6	2013/14	Oct 13	Feb 14	Mar-Apr 14	Jul 14	-
7	2014/15	Nov 14	Feb 15	Mar 15	Jun 15	-
8	2015/16	Nov 15	Feb 16	Apr 16	Jul 16	Jun 16
9	2016/17	Aug-Sep 16	Jan 17	Mar 17	Jul 17	
10	2017/18	Sep 17	Feb 18	Apr 18	Jun 18	Nov 18
11	2018/19	Oct - Dec 18	Jan 19	Apr 19	May 19	
12	2019/20	Oct-Nov 19	Jan 20	May 20	Jul 20	
13	2020/21	Oct 20	Jan 21	Mar 21	May 21(*)	Expected Summer 21

(*) The present report is **Update Report 13** and provides an analysis of the 2021 Partial Measures survey for Durham County Council's frontage.

1. Introduction

1.1 Study Area

Durham Council's frontage extends from Ryhope Dene to Crimdon Beck. For the purposes of this report, it has been sub-divided into five areas, namely:

- Featherbed Rocks
- Seaham (Dawdon)
- Blast Beach
- Hawthorn Hive
- Blackhall Colliery

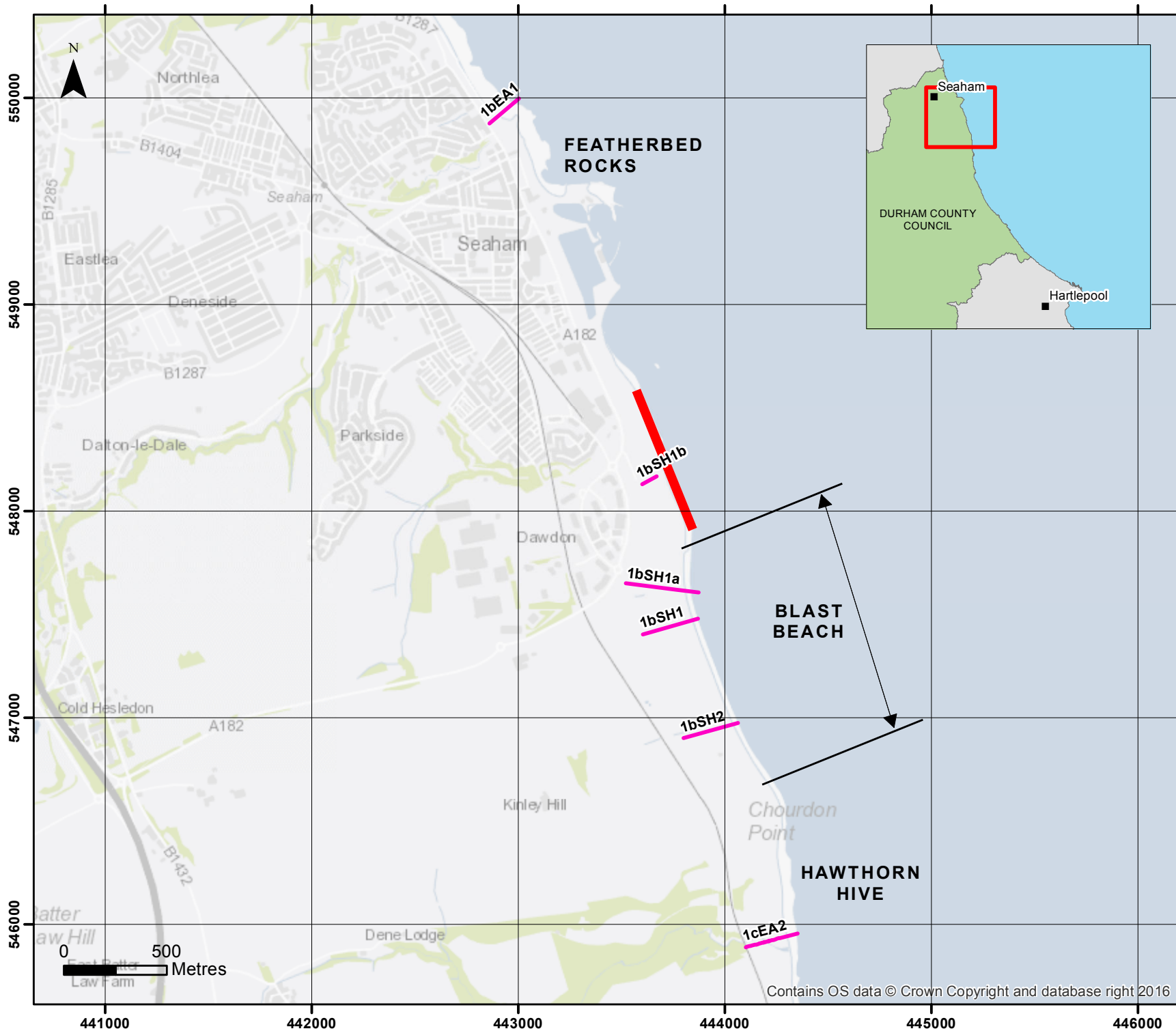
1.2 Methodology

Along Durham County Council's frontage, the following surveying is undertaken:

- Full Measures survey annually each autumn/early winter comprising:
 - Beach profile surveys along nine transect lines
- Partial Measures survey annually each spring comprising:
 - Beach profile surveys along six transect lines
- Cliff top survey bi-annually at:
 - Seaham (Dawdon)

The location of these surveys is shown in Figure 2. The Partial Measures survey was undertaken along this frontage on 5th March 2021. During the survey the weather was dry and overcast, with a force 3 wind from the north-east and a slight sea state.

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



Key

SURVEY LOCATIONS

Topographic Profiles

- Annual
- Bi-Annual

Topographic Surveys

- 6 monthly
- yearly
- 5 yearly

Cliff Top Monitoring Pegs

- @ 300

(Indicative Survey Extents shown)

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

Figure 2 - Map 1
Durham County Council
Frontage

Analytical Report
 Topo Surveys

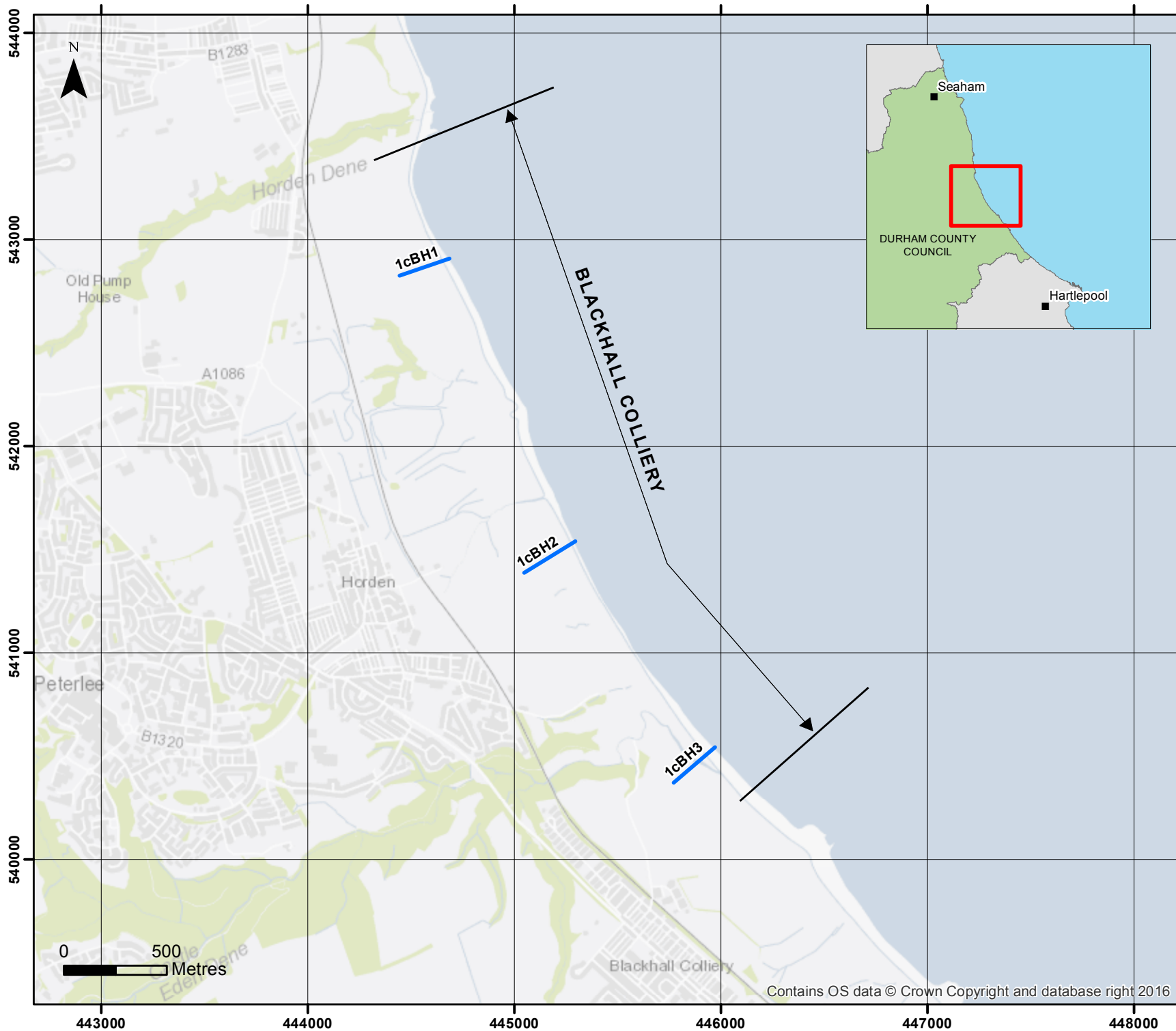
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Key

SURVEY LOCATIONS

Topographic Profiles

— Annual

— Bi-Annual

(Indicative Survey Extents shown)

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

Figure 2 - Map 2

Durham County Council

Frontage

Analytical Report

Topo Surveys

Drawing Scale at A4 1:25,000

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2. Analysis of Survey Data

2.1 Featherbed Rocks

Survey Date	Description of Changes Since Last Survey	Interpretation
5 th March 2021	<p>Beach Profiles:</p> <p>Featherbed Rocks is monitored by one beach profile line (EA1) during the Partial Measures survey (Appendix A). The previous survey was October 2020.</p> <p>Profile 1bEA1 has changed very little to 55m chainage, which covers the cliff and promenade. The uneven profile at the base of the sea wall between 55m and 80m is due to the rock armour. Beyond 90m there has been little change over the winter of 2020/21. The beach profiles reflect the rocky nature of the foreshore and that there is no beach over the shore platform.</p>	<p>The rocky nature of the foreshore means it is unlikely to undergo significant changes in morphology unless sediment is deposited. Previous monitoring indicates that a veneer beach tends to accumulate over the summer and is stripped off by winter storms, giving rise to small and localised changes in profile. The upper part of the profile, which covers the cliff promenade and rock armour remains unchanged, as does the lower part of the profile which covers the rocky foreshore.</p> <p>Longer term trends:</p> <p>The level of the beach in March 2021 was comparable to May 2020. The shore platform is exposed and as a result any apparent changes are likely to be due to differences in the survey point locations and the way that survey points are joined to show an interpolated surface.</p>

2.2 Seaham (Dawdon)

Survey Date	Description of Changes Since Last Survey	Interpretation
5 th March 2021	<p>Cliff-top Survey:</p> <p>Three ground control points have been established along the cliff top at Dawdon (Figure B1). The separation between any two points is nominally 300m. These cliff top surveys are intended to inform on erosion rates of the undefended sea cliffs extending south of the rock armour revetment to the south of Seaham Harbour. The cliff top surveys at Dawdon are undertaken bi-annually.</p> <p>Measurements are taken from a fixed ground control point along a fixed bearing to the edge of the cliff top. Appendix B provides results from the May 2020 survey showing the position from the ground control point to the edge of the cliff top along the defined bearing and changes since the November 2008 baseline survey.</p> <p>The cliff monitoring data shows that there has been very little change over the winter of 2020/21, with no control points experiencing recession greater than the survey error of $\pm 0.2\text{m}$. The cliff face at Points 1 and 2, located at Dawdon, have experienced an advancement of 0.09m and 0.02m over the winter of 2020/21. It is likely that this is caused by slumping of the upper cliff, however this cannot be confirmed without a detailed visual inspection.</p>	<p>There has been little change over the winter of 2020/21. Overall, since November 2008 Point 1 has shown erosion of 1.02m, Point 2 has shown erosion of 0.02m, and Point 3 has shown erosion of 1.28m.</p> <p>Longer term trends:</p> <p>There is more confidence in the long-term pattern of change, where the cumulative measured erosion is greater than the error inherent in the technique.</p> <p>Points 1 and 3 have shown an average recession rate of 0.08m/yr and 0.10m/yr since monitoring began in 2008, whilst Point 2 has shown an average recession rate of 0.002m/yr.</p>

2.3 Blast Beach

Survey Date	Description of Changes Since Last Survey	Interpretation
5 th March 2021	<p>Beach Profiles:</p> <p>Blast Beach is covered by four beach profile lines during the Partial Measures survey (Appendix A). Two of these commenced in November 2008, with 1bSH1a being added in October 2009, and 1bSH1b added in October 2015.</p> <p>Profile 1bSH1B is adjacent to the sewage works south of Seaham. The 2021 survey recorded a lowering of the upper and middle beach from the cliff toe to the rock patch at chainage 59m by up to 0.5m. The lower beach seaward of the rock patch has risen by up to 0.2m to the end of the survey. Overall, the upper and middle beach profile is at a low level compared to the range recorded from previous surveys, particularly between chainages 40-54m which is at its lowest level recorded. The lower beach is at a medium level.</p> <p>The Survey Report notes that at profile 1bSH1A dense vegetation restricts access to the cliff top and cliff base. There has been very little change to the spoil face at chainage 140m. Between chainage 140m and 176m there has been accretion of up to 1.5m, forming a small berm at chainage 155m. Seaward of chainage 155m there has been very little change in the beach profile. Overall, the profile is at a medium level compared to the range recorded from previous surveys.</p> <p>At 1bSH1 dense vegetation also restricts access to the cliff tops. There has been accretion of up to 0.2m from the base of the cliff to chainage 50m. The shallow berm on the upper beach has lowered on the seaward side by up to 0.2m to chainage 90m. The lower beach seaward of chainage 90m has risen by up to 1.0, covering the rocky foreshore at the end of the survey. The beach is at a medium level compared to the range recorded from previous surveys.</p> <p>At 1bSH2 dense vegetation also restricts access to the cliff tops. There has been very little change between the cliff toe and chainage 125m across the upper beach. From chainage 125m to the end of the survey, the middle and lower beach has lowered by up to 1.0m. Overall, the beach is at a medium to low level compared to the range recorded from previous surveys.</p>	<p>Through the winter there has been varying erosion and accretion across the beach profiles. Whilst profiles 1bSH1B and 1bSH2 have lowered since the previous survey, profiles 1bSH1A and 1bSH1 have accreted. The rocky foreshore is exposed to the north and has been covered by sediment to the south.</p> <p>All the profiles show the beach levels are generally in the range of previous profiles, however the section between chainages 40-54m at profile SH1B is now at its lowest level recorded.</p> <p>Longer term trends:</p> <p>The beach at 1bSH2 shows an overall pattern of erosion from October 2008 to its lowest level at April 2014, showing recovery to the most recent survey in March 2021. However, SH1 and SH1a show much more fluctuation in beach level between 08/09 and March 2021.</p>

2.4 Hawthorne Hive

Survey Date	Description of Changes Since Last Survey	Interpretation
5 th March 2021	<p>Beach Profiles:</p> <p>Hawthorne Hive is covered by one beach profile line 1cEA2 during the Partial Measures survey (Appendix A). The survey report notes “<i>unable to measure start of Section EA2 as the vegetation has choked out the section line and route over cliff faces</i>” and therefore all surveys following October 2012 start at 95m chainage.</p> <p>Until the partial measures survey in April 2013, a channel was present between 95m and 105m chainage, but it has infilled.</p> <p>The profile has generally eroded since the previous survey in October 2020. From the start of the survey to chainage 146m there has been a lowering of the upper and middle beach profile by up to 1.0m. From 146m chainage to the end of the survey at 237m chainage, boulders from the previous survey appear to have moved in some places. Overall, the beach is at a low level compared to the range recorded from previous surveys, particularly between chainages 109-125m and 132-142m which are at their lowest levels recorded.</p>	<p>The beach has lowered to a similar level as the record levels seen in April 2014 and December 2018.</p> <p>Longer term trends:</p> <p>The profiles show the beach is undergoing progressive erosion.</p> <p>The infilling and incision of the channel seems to be an episodic process and is likely to reflect a combination of annual and seasonal variations in the flow of Hawthorn Burn and storm events which move sediment onshore to block the outflow of the burn.</p>

3. Problems Encountered and Uncertainty in Analysis

Individual Profiles

- The surveyor noted difficulties accessing the cliff tops of sections SH1, SH2 and SH1A and the cliff base of SH1A due to dense vegetation.
- At Hawthorne Hive the surveyor was unable to measure the start of Section EA2 due to vegetation cover.

Cliff Top Surveys

- Whilst there is low confidence in the short-term erosion rates due to the error in the method, longer-term data are more reliable and suggest erosion rates of up to 0.1m/yr.

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

- No changes are recommended at the present time.

5. Conclusions and Areas of Concern

- The level of the beach at Featherbed Rocks in May 2020 was comparable to May 2019. The shore platform is exposed on the lower beach.
- At Seaham Cliffs, the survey data indicates that the average recession rate since monitoring began in 2008 is 0.08m/yr at Point 1 and 0.1m/yr at Point 3. Point 2 shows little change over the monitoring period.
- At Blast Beach, colliery spoil still prevents the sea from actively eroding the cliffs. There has been varying changes in the beach profile over the winter of 2020/21, typically consisting of erosion at 1bSH1B and 1bSH2, and accretion at profiles 1bSH1A and 1bSH1.
- At Hawthorn Hive, the beach level has lowered to a similar level as the record low levels seen in April 2014 and December 2018. It is likely that the long-term trend of progressive erosion will continue on this profile.

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: 1bEA1

Date: 05/03/2021

Inspector: AG

Low Tide:

Low Tide Time:

Wind

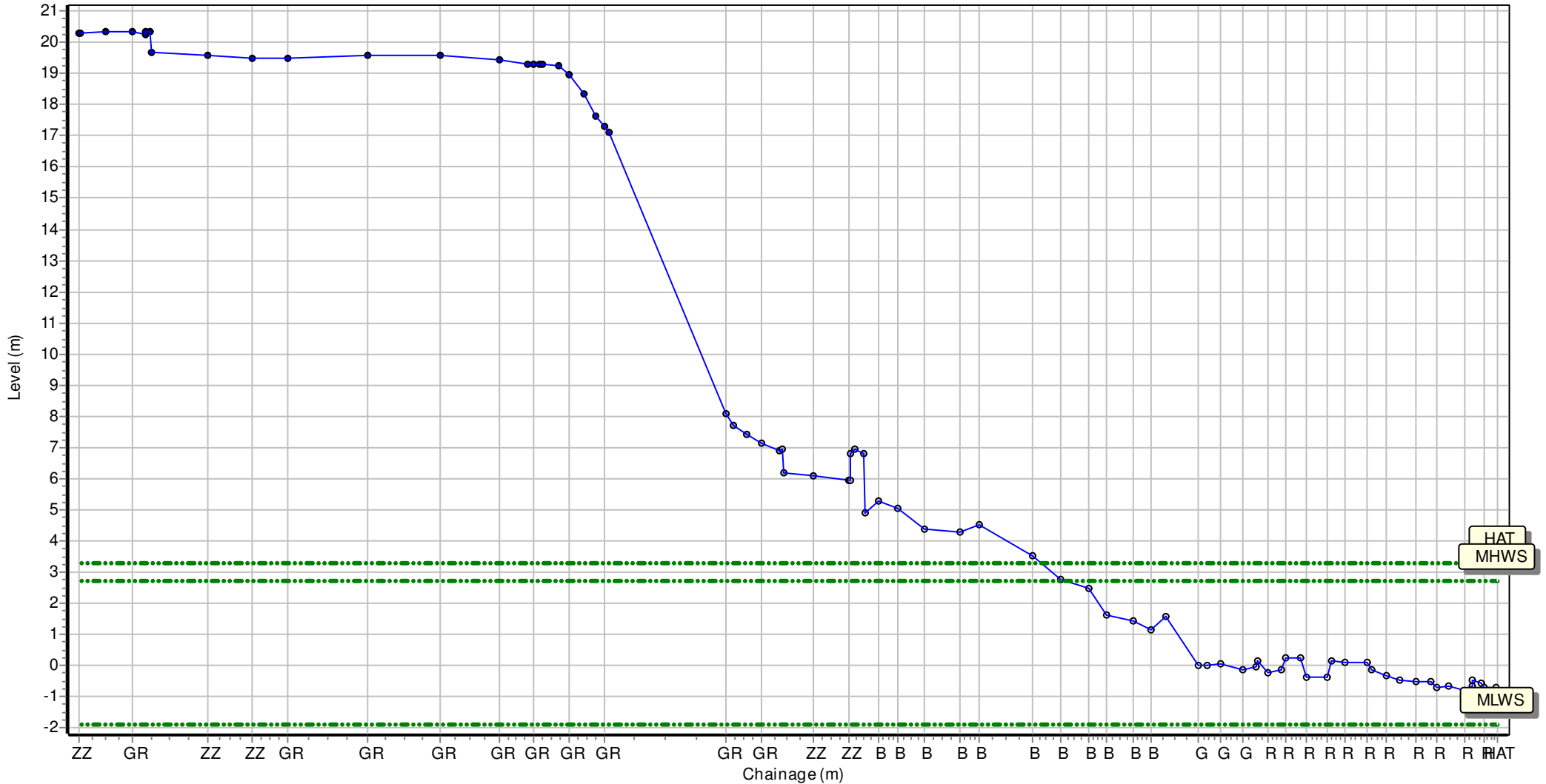
Sea State:

Visibility:

Rain:

Summary: 2021 Partial Measures Topo Survey

Easting: 442861.92 Northing: 549874.593 Profile Bearing: 50 ° from North



Beach Profile

Location: 1bSH1B

Date: 05/03/2021

Inspector: AG

Low Tide:

Low Tide Time:

Wind

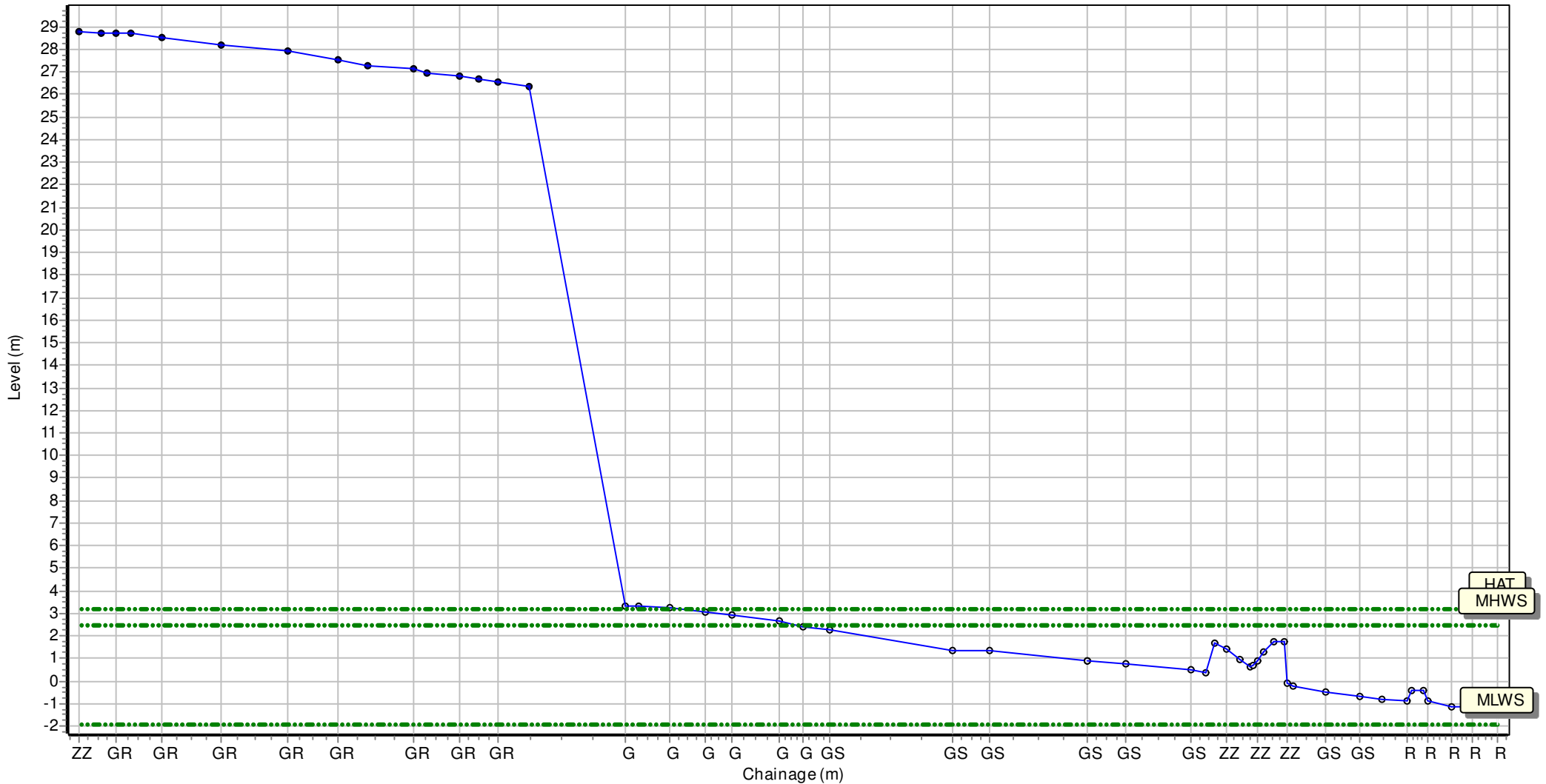
Sea State:

Visibility:

Rain:

Summary: 2021 Partial Measures Topo Survey

Easting: 443599.944 Northing: 548130.378 Profile Bearing: 63 ° from North



Beach Profile

Location: 1bSH1A

Date: 05/03/2021 Inspector: AG

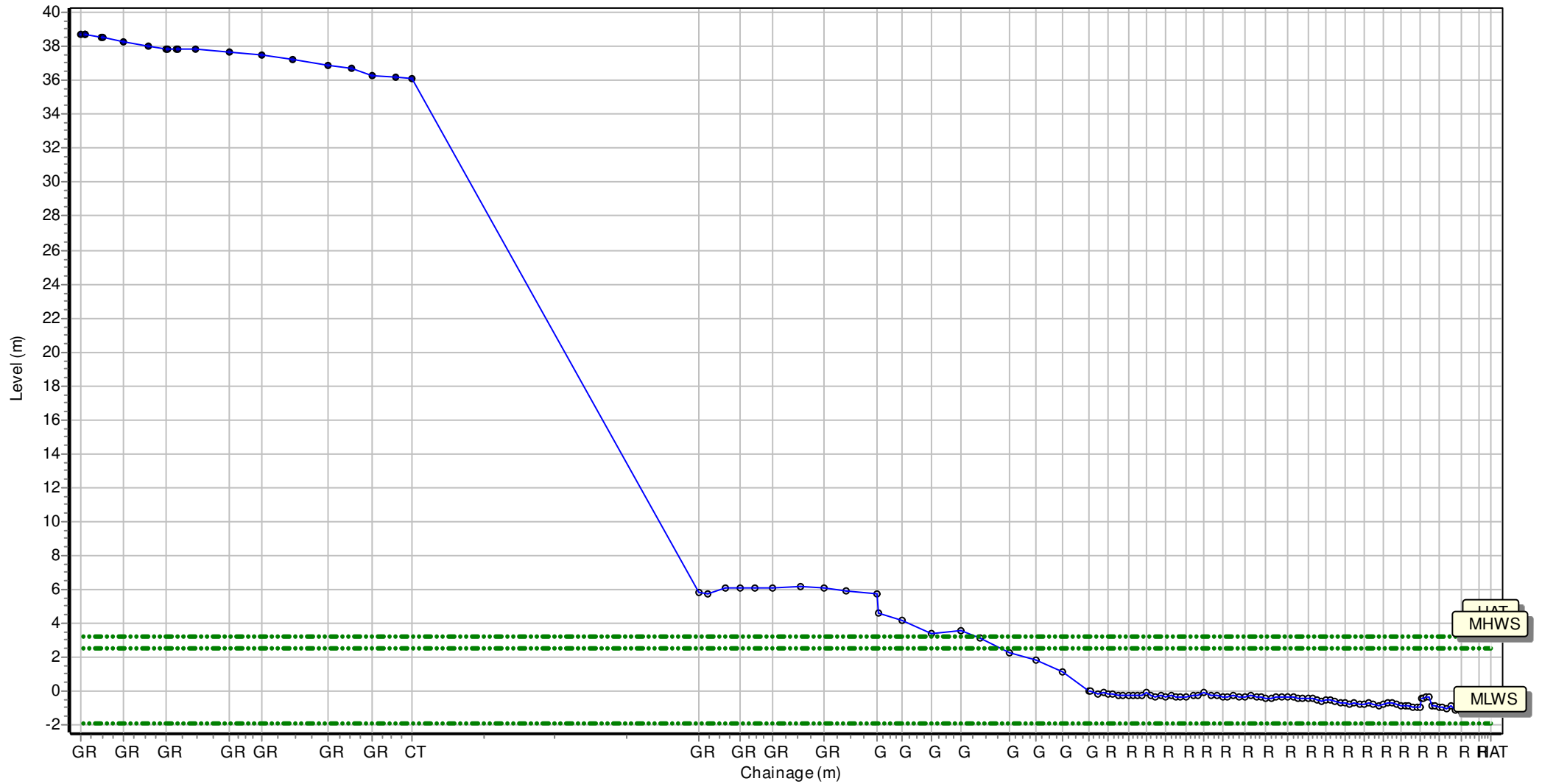
Wind Sea State:

Low Tide: Low Tide Time:

Visibility: Rain:

Summary: 2021 Partial Measures Topo Survey

Easting: 443519.427 Northing: 547648.502 Profile Bearing: 97 ° from North



Beach Profile

Location: 1bSH1

Date: 05/03/2021 Inspector: AG

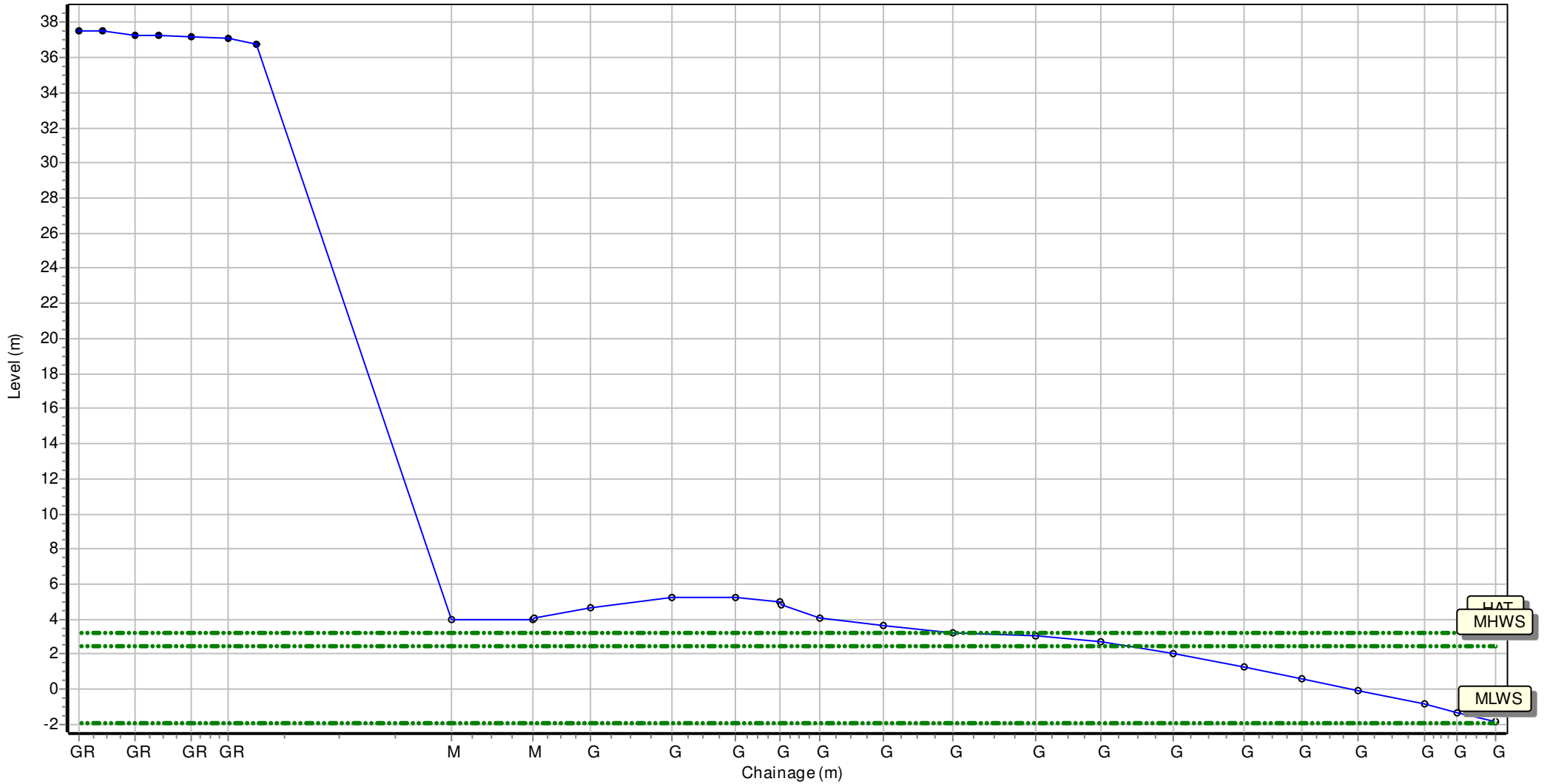
Low Tide: Low Tide Time:

Wind Sea State:

Visibility: Rain:

Summary: 2021 Partial Measures Topo Survey

Easting: 443613.742 Northing: 547404.589 Profile Bearing: 74 ° from North



Beach Profile

Location: 1bSH2

Date: 05/03/2021

Inspector: AG

Low Tide:

Low Tide Time:

Wind

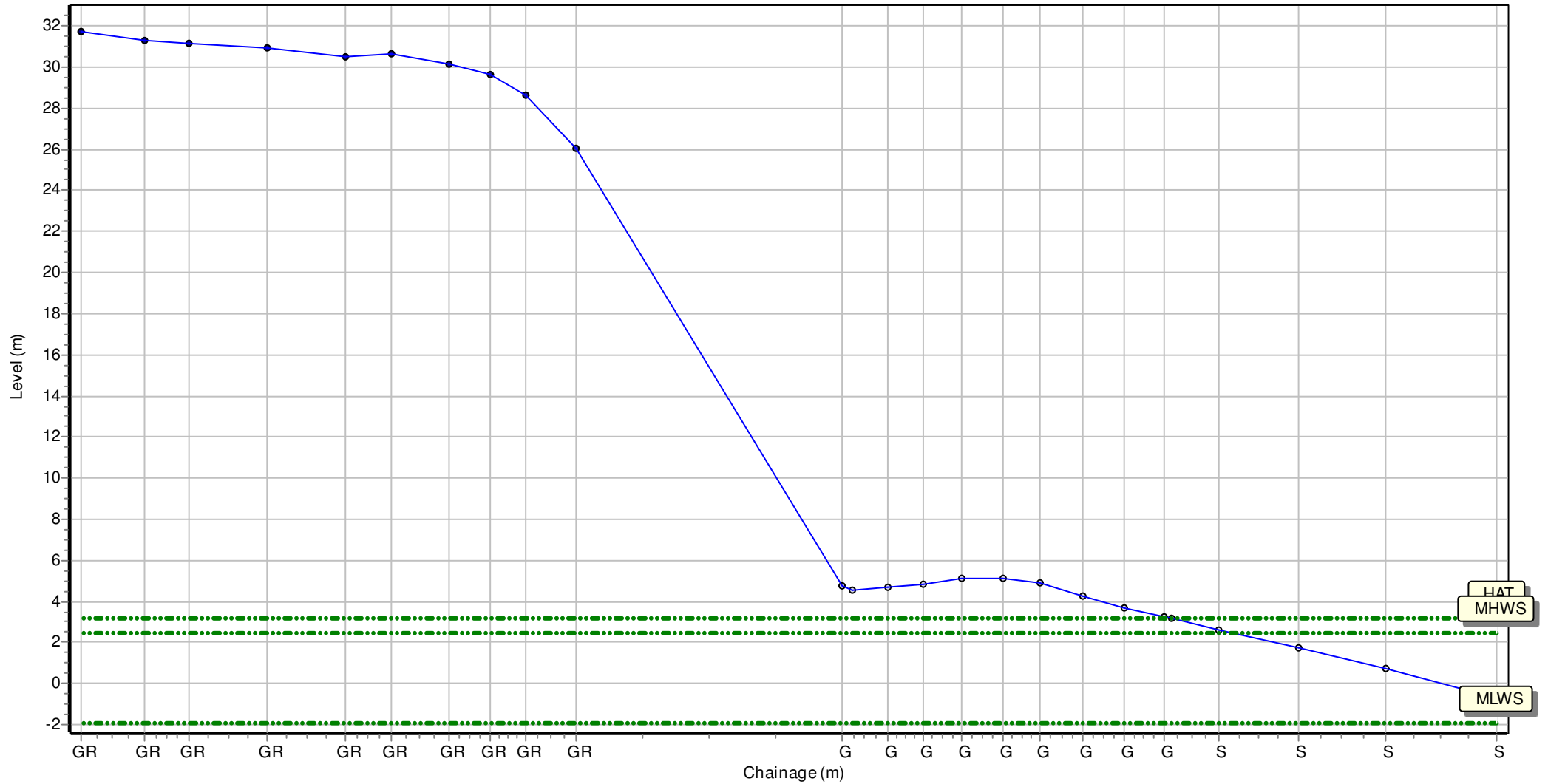
Sea State:

Visibility:

Rain:

Summary: 2021 Partial Measures Topo Survey

Easting: 443806.533 Northing: 546899.552 Profile Bearing: 74 ° from North



Beach Profile

Location: 1cEA2

Date: 05/03/2021

Inspector: AG

Low Tide:

Low Tide Time:

Wind

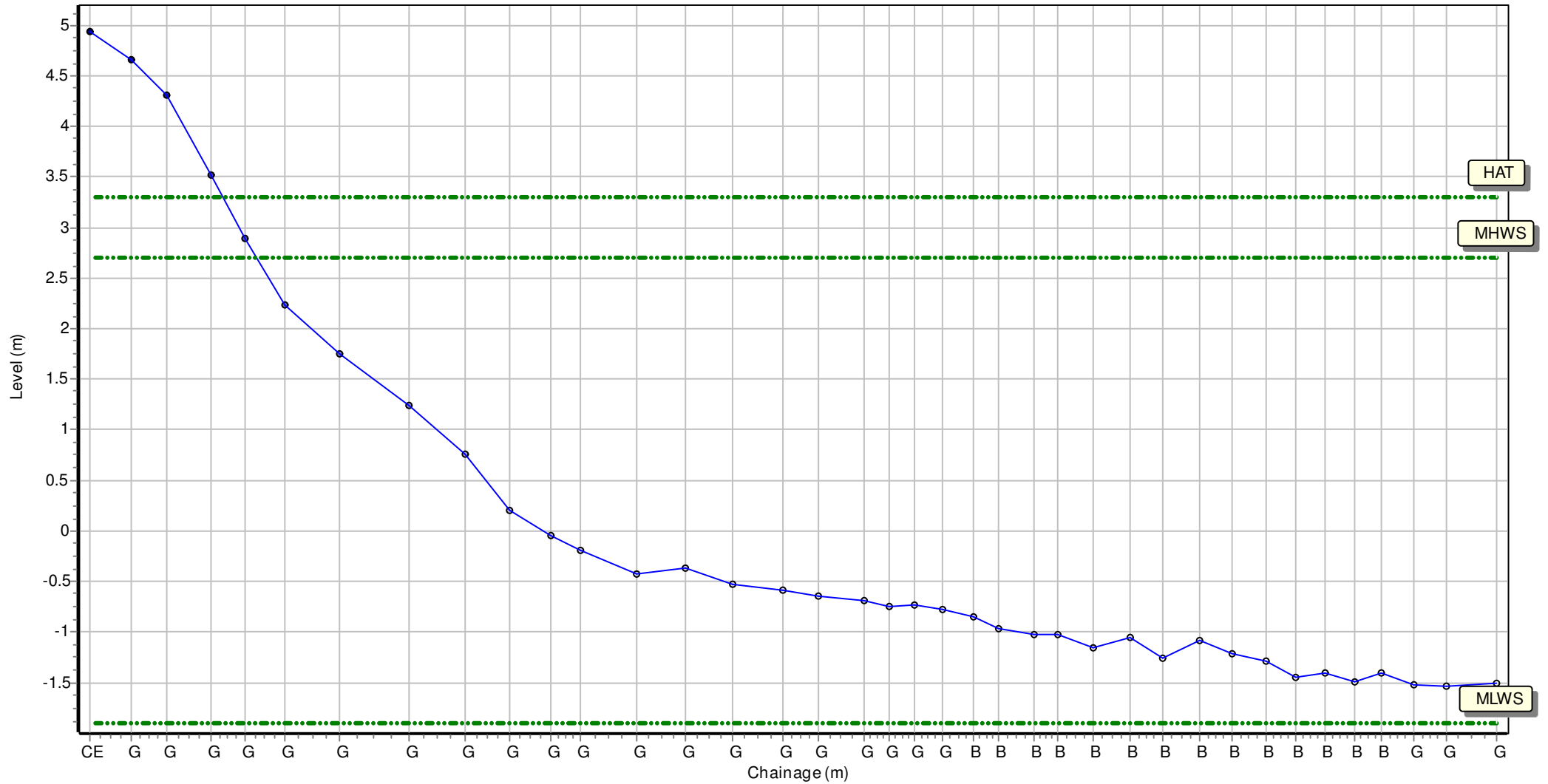
Sea State:

Visibility:

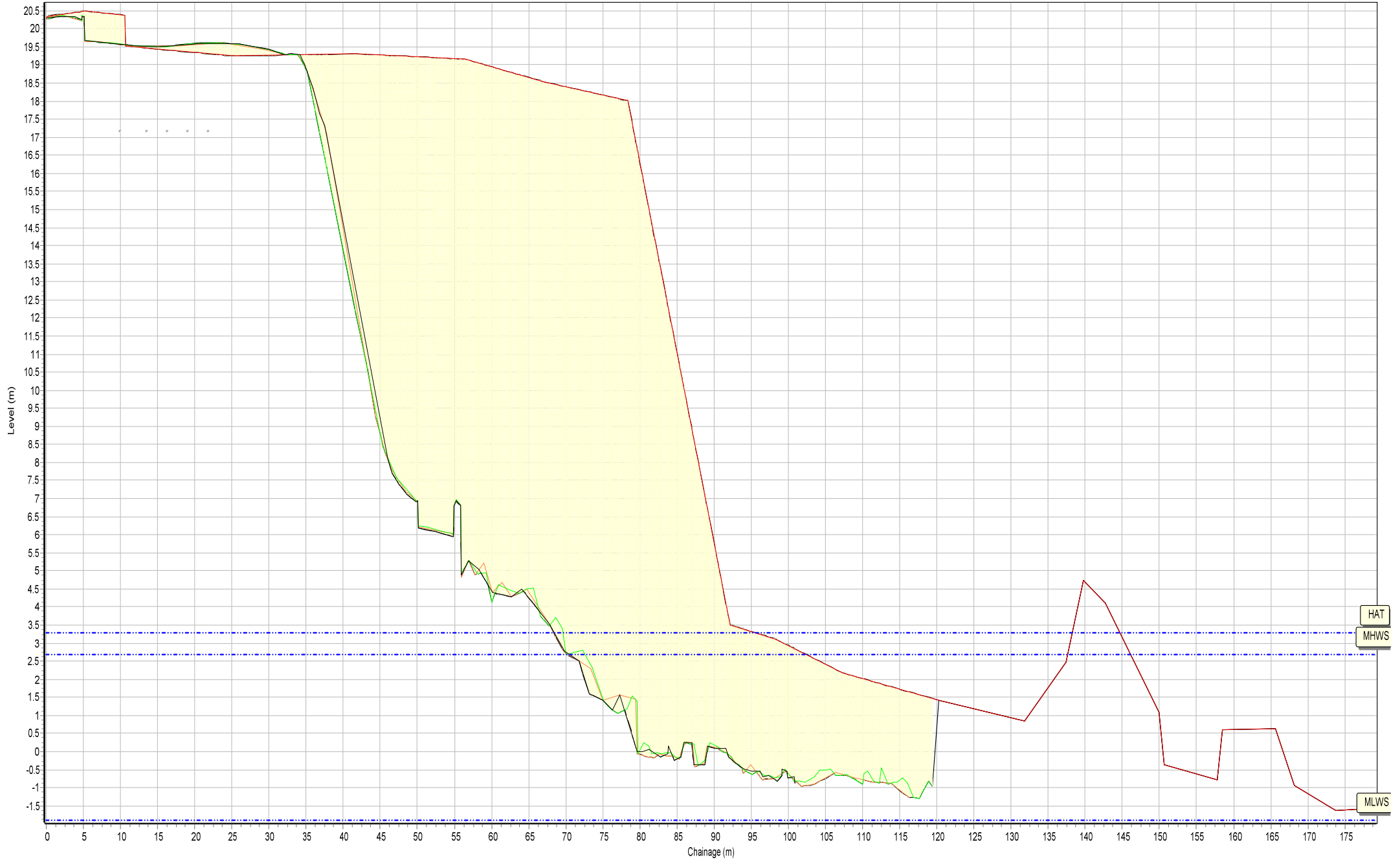
Rain:

Summary: 2021 Partial Measures Topo Survey

Easting: 444101.532 Northing: 545888.48 Profile Bearing: 75 ° from North



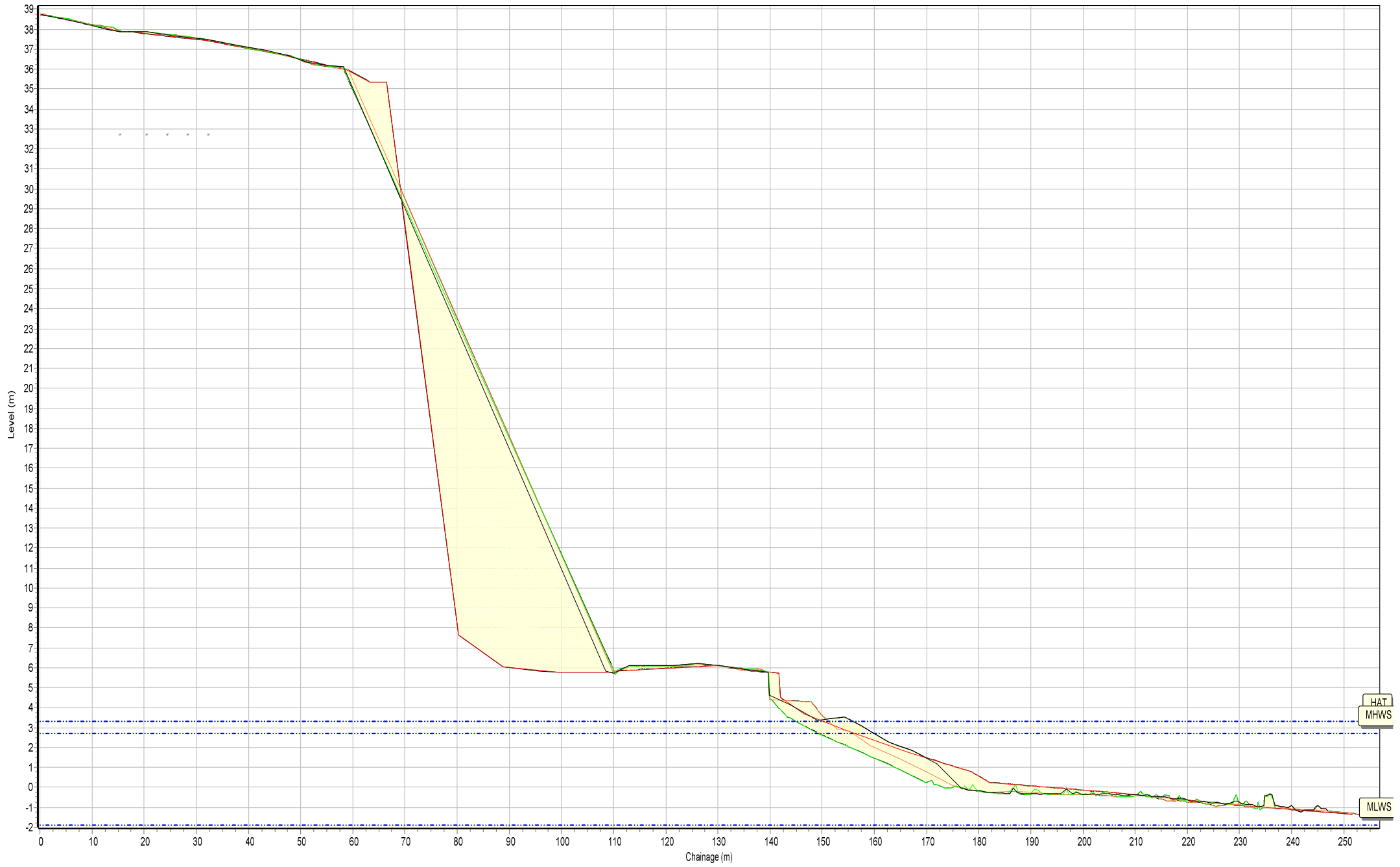
Beach Profiles: 1bEA1



Beach Profiles: 1bSH1B



Beach Profiles: 1bSH1A

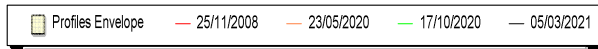
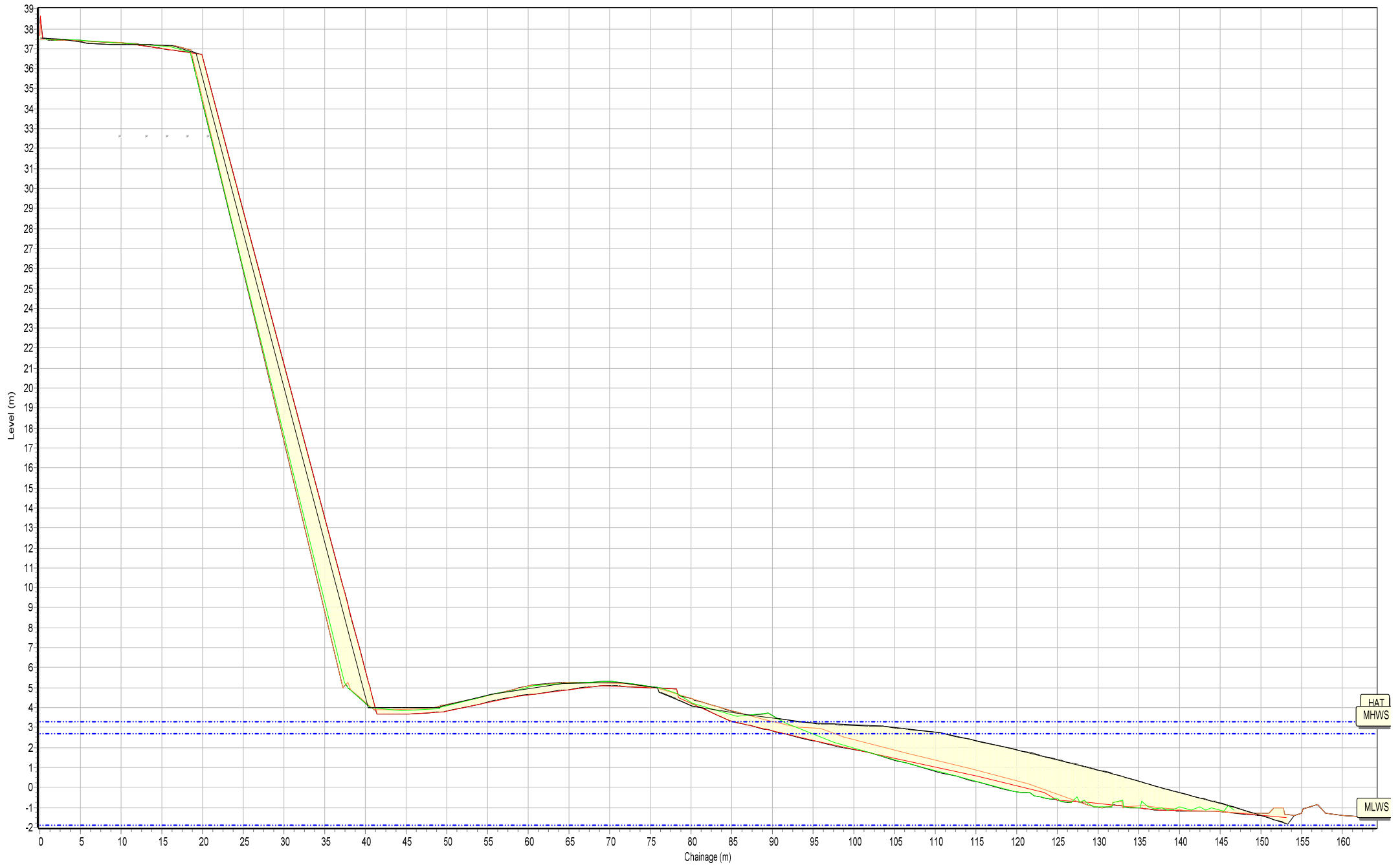


HAT
MHWS

MLWS

SANDS

Beach Profiles: 1bSH1

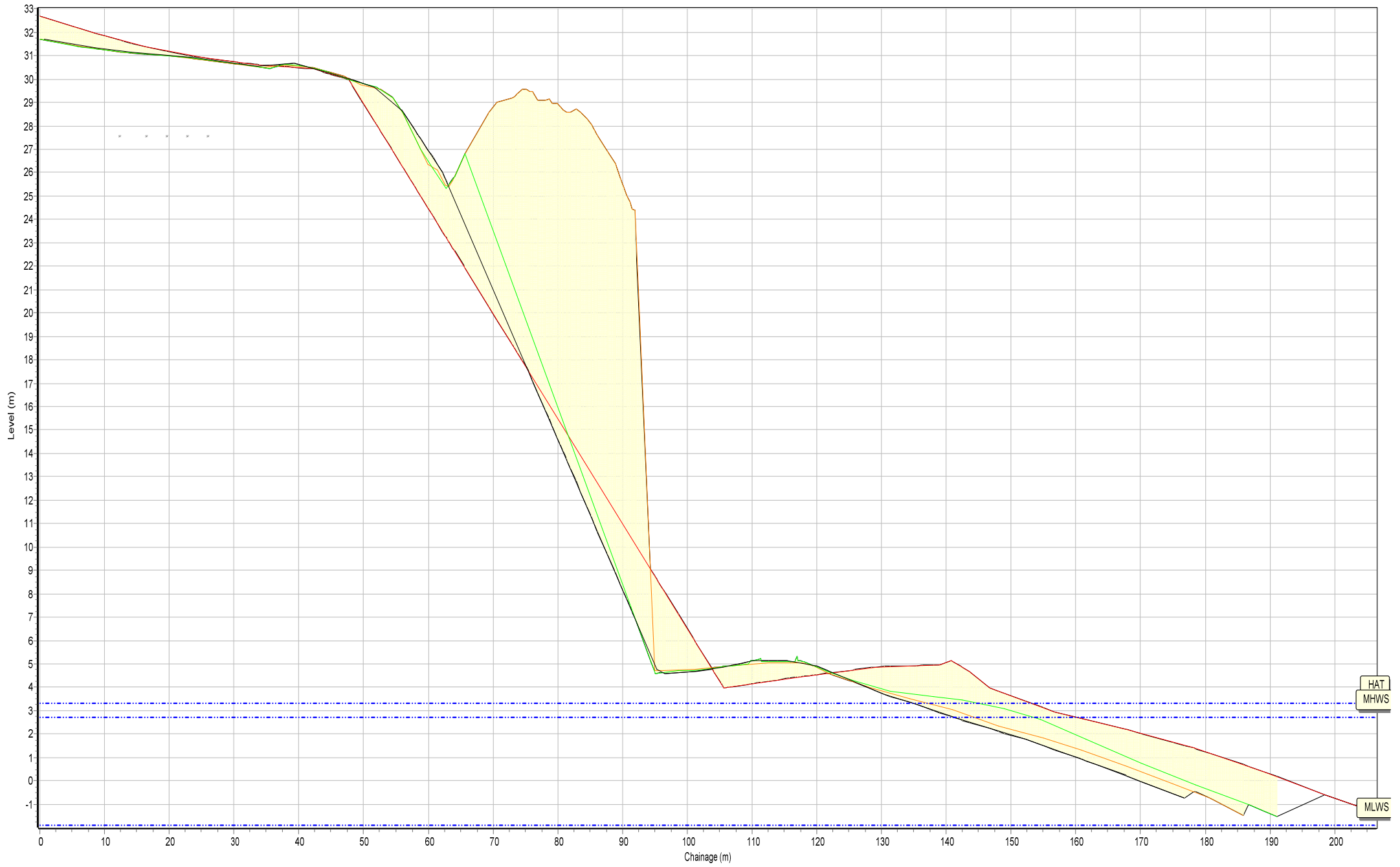


HAT
MHWS

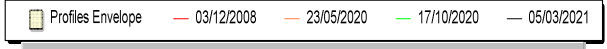
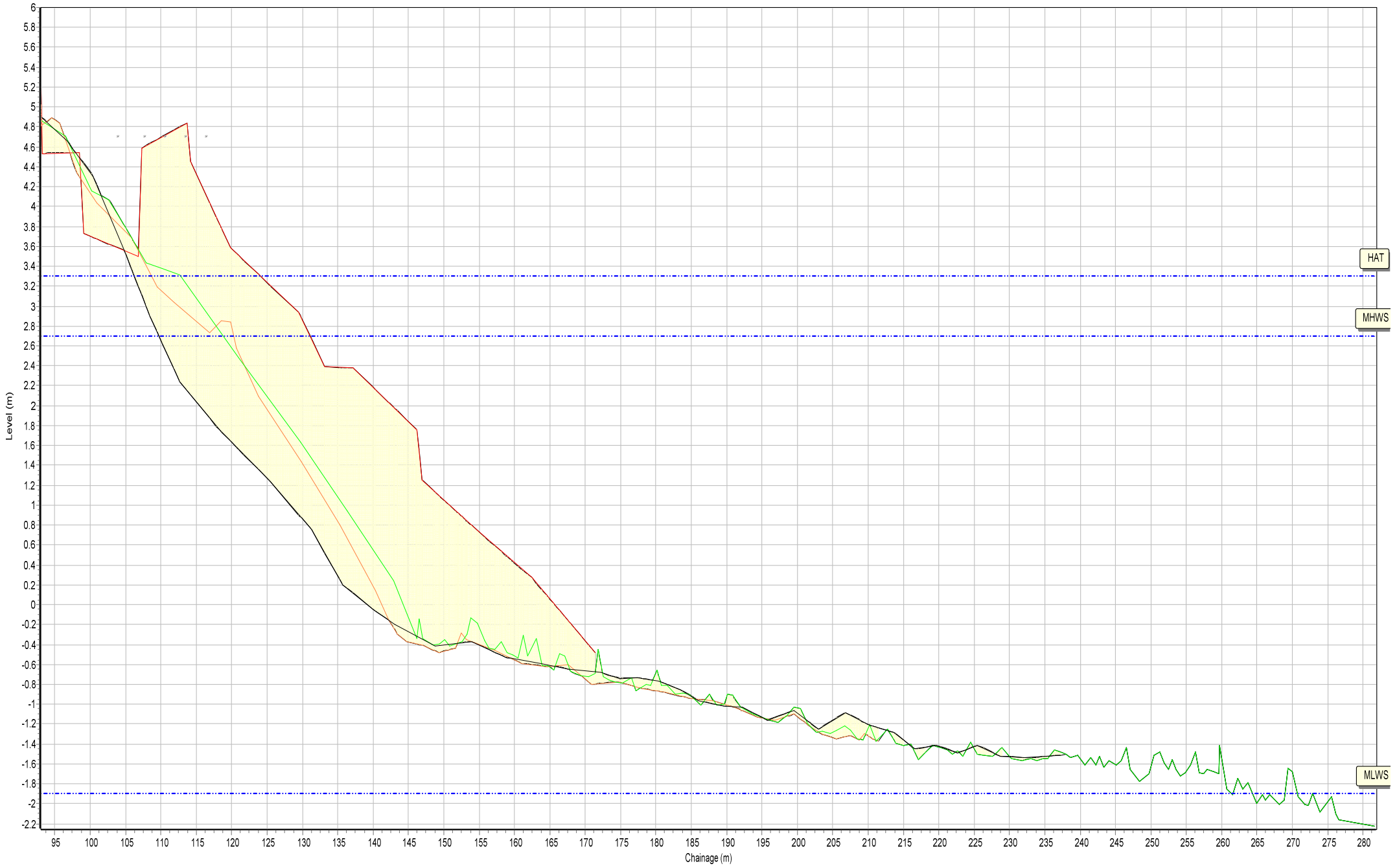
MLWS

SANDS

Beach Profiles: 1bSH2



Beach Profiles: 1cEA2



HAT

MHWS

MLWS

SANDS

Appendix B
Cliff Top Survey



Key
 ● Cliff Top Survey Locations

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

Figure 3 - Map 1

SEAHAM

Durham County Council Frontage

Cliff Top Survey Locations

Drawing Scale at A4 1:8,000

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

Cliff Top Survey

Seaham (Dawdon)

Three ground control points have been established at Dawdon (Figure B1). The maximum separation between any two points varies along the coast, reflecting the degree of risk from erosion.

The cliff top surveys at Dawdon 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 B1 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 B1 – Cliff Top Surveys at Dawdon

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	Oct 2020	Mar 2021	Nov 2008 – Mar 2021	Oct 2020-Mar 2021	Nov 2008 – Mar 2021
1	443515.4	548421.7	70	16.1	14.99	15.08	-1.02	0.09	-0.078
2	443607.8	548136.3	90	13.3	13.26	13.28	-0.02	0.02	-0.002
3	443756.1	547858.5	95	14.8	13.58	13.52	-1.28	-0.06	-0.098