



**Cell 1 Regional Coastal Monitoring Programme
Update Report 11: 'Partial Measures' Survey 2019**

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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)
	Souter Point to Chourdon Point
HAT	3.18
MHWS	2.48
MLWS	-1.92

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).

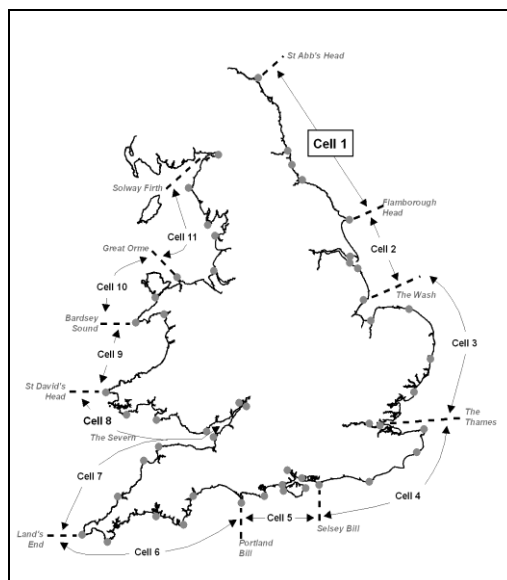


Figure 1 Sediment Cells in England and Wales

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 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	Oct-Nov 11	Oct 12	Mar-May 12	Oct 12	
5	2012/13	Sep-Oct 12	Mar 13	Mar 13	Jun 13	
6	2013/14	Sep-Oct 13	Feb 14	Mar 14	Jul 14	
7	2014/15	Sep-Nov 14	Feb 15	Mar-Apr 15	Jul 15	
8	2015/16	Sep-Nov 15	Feb 16	Mar 16	Jul 16	Jun 16
9	2016/17	Sep-Nov 16	Feb 17	Apr 17	Jul 17	
10	2017/18	Oct-Nov 17	Mar 18	Mar 18	May 18	Nov 18
11	2018/19	Oct-Nov 18	Feb 19	Feb-Mar 19	May 19(*)	

(*) The present report is **Update Report 11** and provides an analysis of the 2019 Partial Measures survey for Sunderland City Council's frontage.

1. Introduction

1.1 Study Area

Sunderland City Council's frontage extends from The Bents to Ryhope. For the purposes of this report and for consistency with previous reporting, it has been sub-divided into three areas, namely:

- Whitburn Bay
- Sunderland Harbour and Docks
- Hendon to Ryhope (including Halliwell Banks)

1.2 Methodology

Along Sunderland City Council's frontage, the following surveying is undertaken:

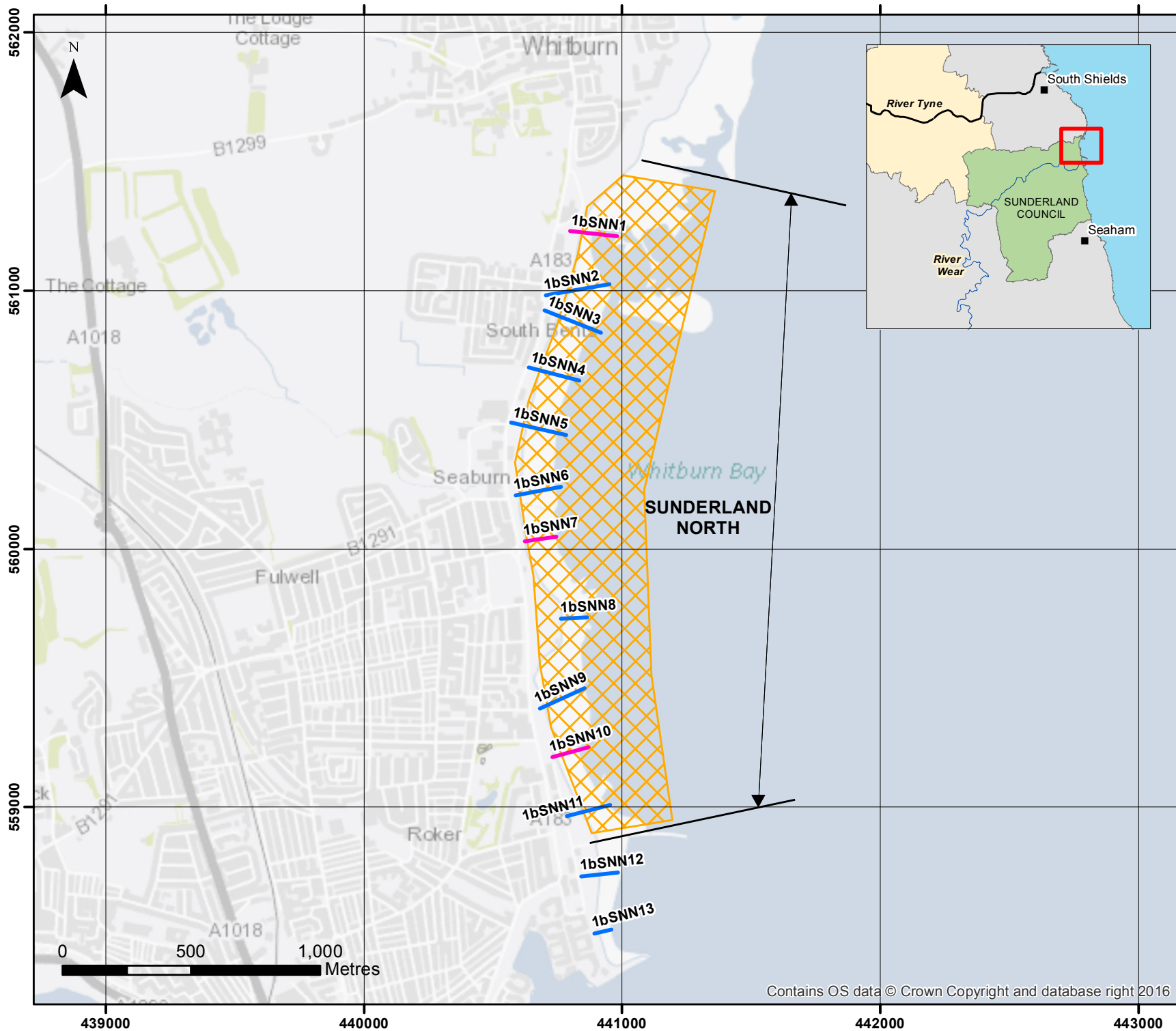
- Full Measures survey annually each autumn comprising:
 - Beach profile surveys along 58 transect lines (commenced 2009)
 - Topographic survey at Whitburn Bay (commenced 2009)
 - Topographic survey at Hendon to Ryhope (including Halliwell Banks) (commenced 2009)
- Partial Measures survey annually each spring comprising:
 - Beach profile surveys along 16 transect lines (commenced 2009)
- Cliff top survey bi-annually at:
 - Hendon to Ryhope (including Halliwell Banks) (commenced 2009)

The location of these surveys is shown in Figure 2. The Partial Measures survey was undertaken along this frontage on 18th February 2019 (Whitburn Bay), and between 5th and 6th March 2019 (Hendon to Ryhope, including Halliwell Bank). During this time weather conditions varied, see surveyors reports for details.

The Update Report presents the following:

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

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



Key

SURVEY LOCATIONS

Topographic Profiles

- Annual
- Bi-Annual

Topographic Surveys

- 6 monthly
- yearly
- 5 yearly

(Indicative Survey Extents shown)

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

Figure 2 - Map 1

Sunderland Council Frontage

Analytical Report
Topo Surveys

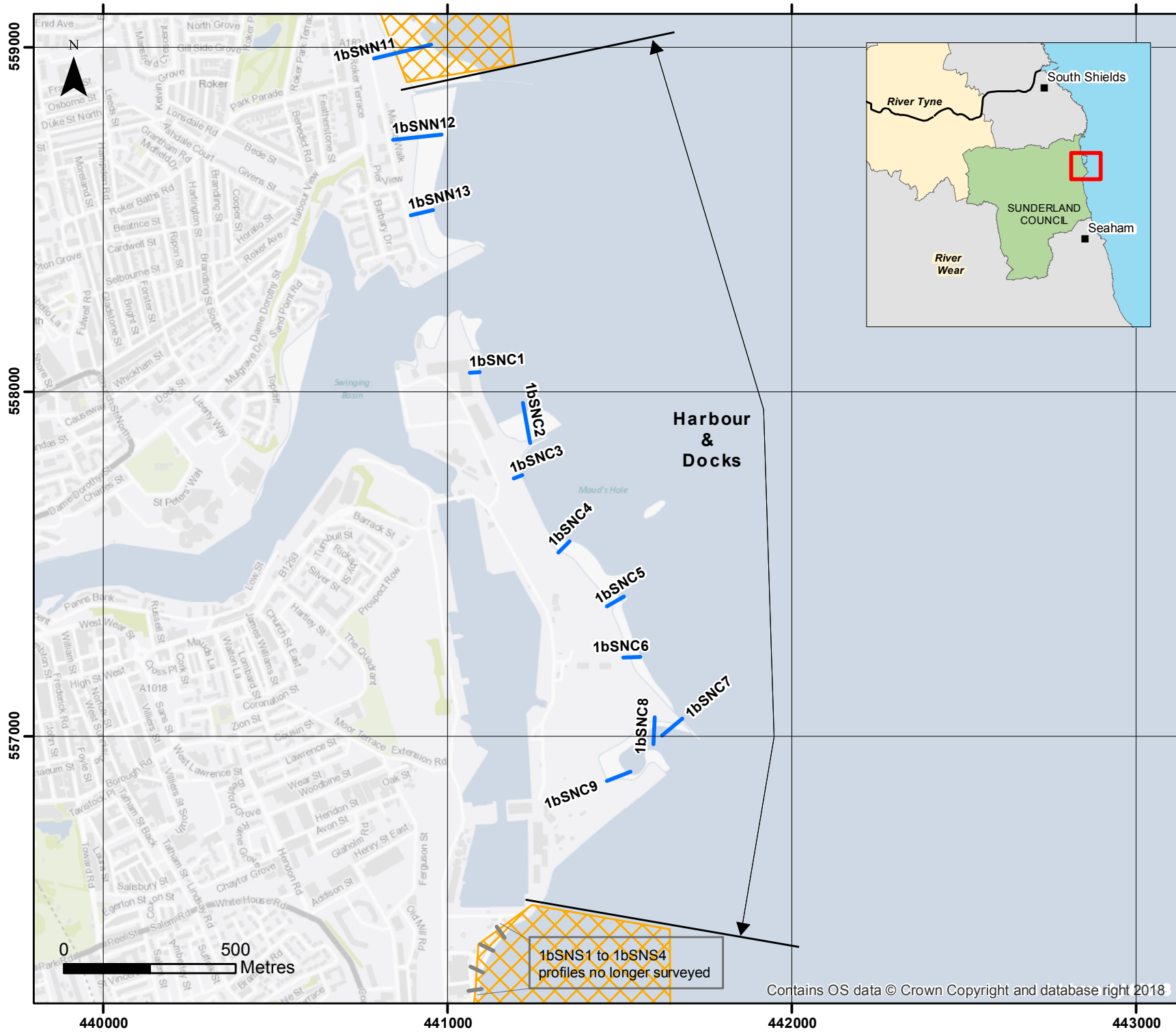
Drawing Scale at A4 1:20,000

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Key

SURVEY LOCATIONS

Topographic Profiles

- Annual
- Bi-Annual
- Discontinued

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
 Sunderland Council
 Frontage**

Analytical Report
 Topo Surveys

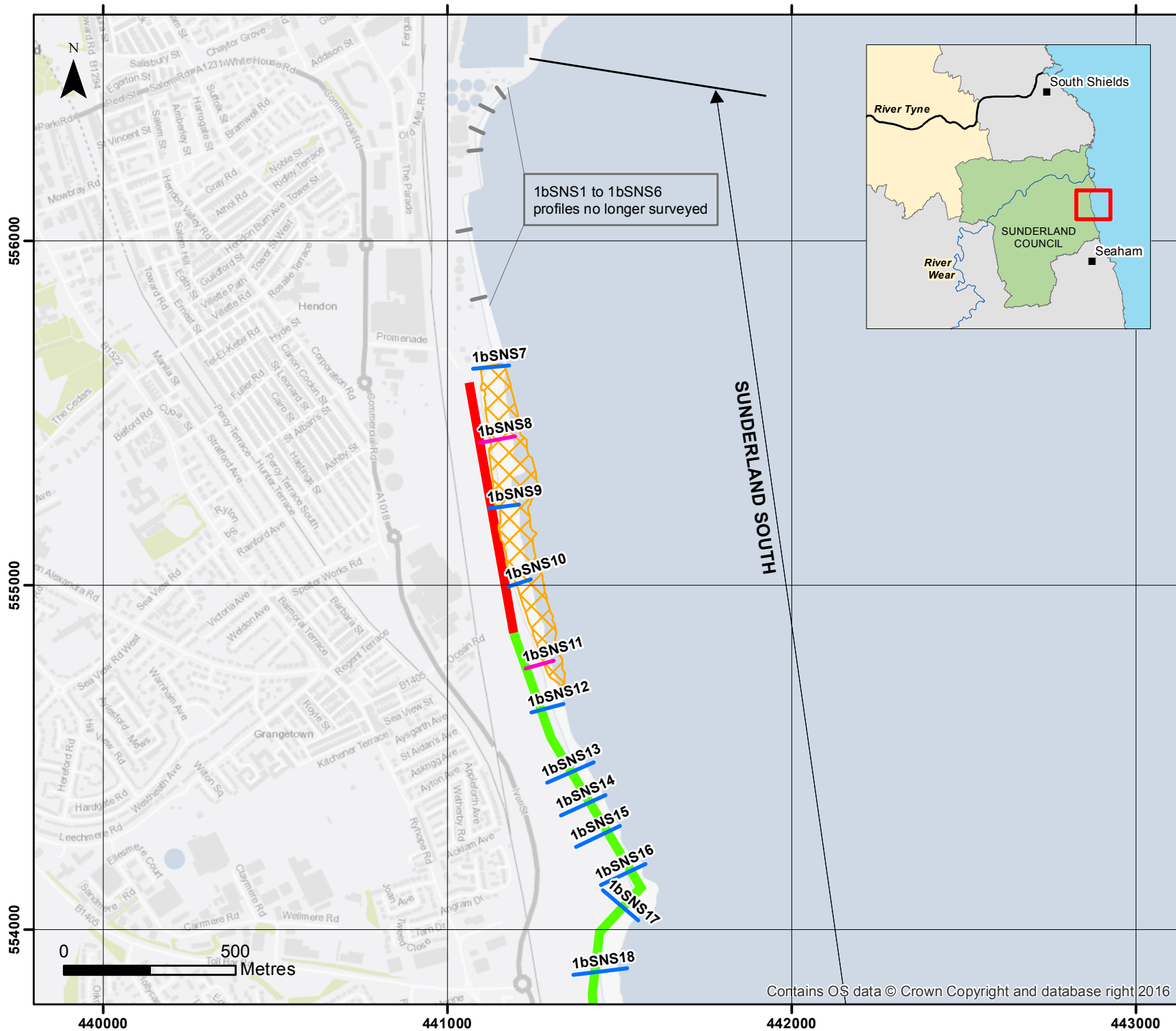
Drawing Scale at A4 1:15,000

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Key

SURVEY LOCATIONS

Topographic Profiles

- Annual
- Bi-Annual
- Discontinued

Topographic Surveys

- 6 monthly
- yearly
- 5 yearly

Cliff Top Monitoring Pegs

- @ 100
- @ 300

(Indicative Survey Extents shown)

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

Figure 2 - Map 3
Sunderland Council Frontage

Analytical Report
 Topo Surveys

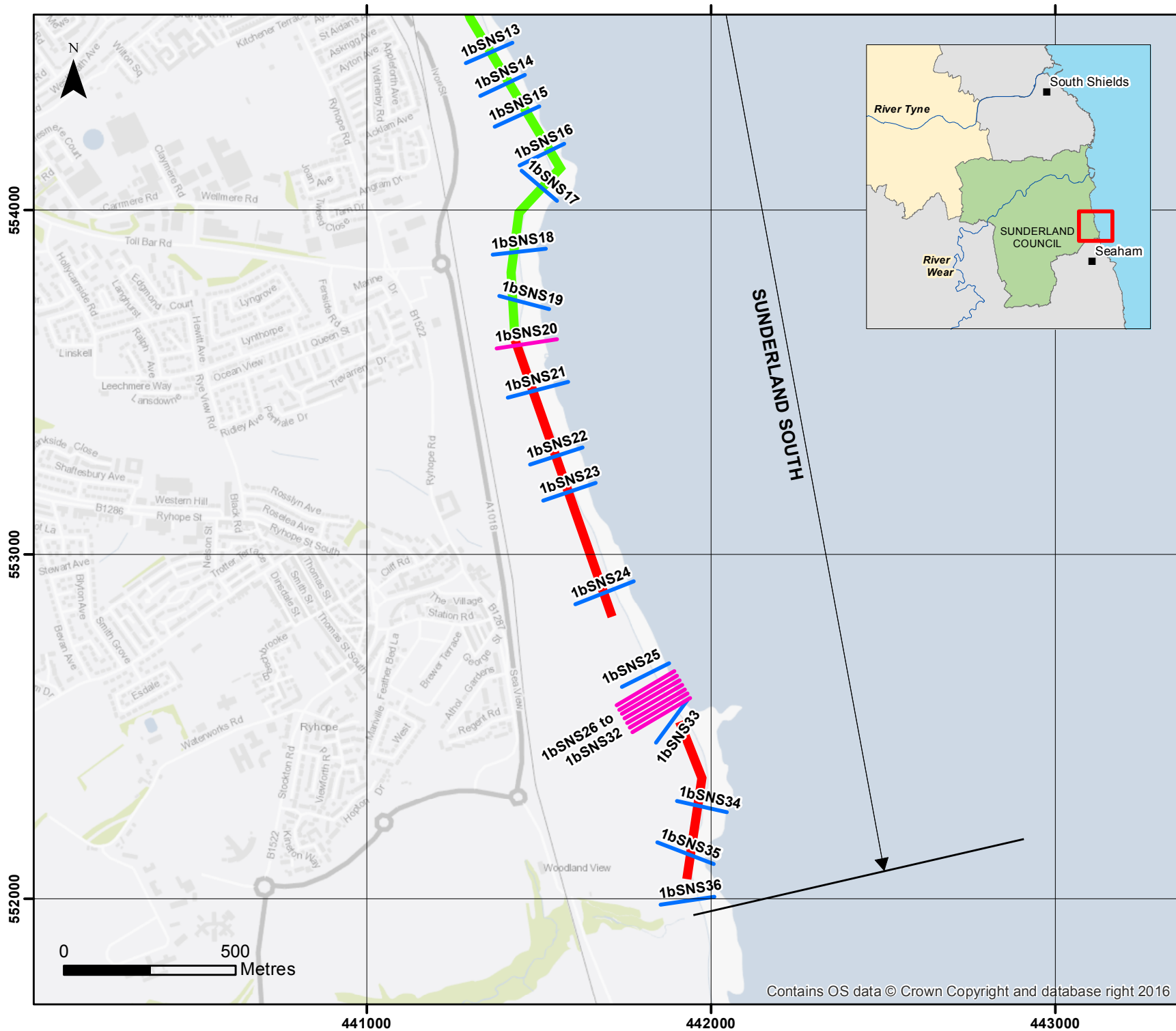
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Key

SURVEY LOCATIONS

Topographic Profiles

- Annual
- Bi-Annual

Cliff Top Monitoring Pegs

- @ 100
- @ 300

(Indicative Survey Extents shown)

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

Figure 2 - Map 4

Sunderland Council Frontage

Analytical Report
Topo Surveys

Drawing Scale at A4 1:15,000

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2. Analysis of Survey Data

2.1 Whitburn Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
<p>18th February 2019</p>	<p>Beach Profiles:</p> <p>Whitburn Bay is covered by three beach profile lines for the Partial Measures survey (Appendix A). The last survey was Full Measures, undertaken in November 2018.</p> <p>1bSNN1 is just to the south of Sunderland City Council's northern boundary. Since the last survey the backshore above HAT has changed little, with small sections of accretion of up to 0.1m. From chainage 45m to 104m the beach shows an increase in levels of up to 0.3m. Seawards of chainage 115m there has been erosion of up to 0.45m. The upper beach is at a relatively high level on the upper beach compared to the range recorded from previous surveys, particularly between chainages 19m and 41m which is at its highest level recorded. The lower beach is at a more medium level, however the beach toe is recorded at its most landward position since records began,</p> <p>1bSNN7 is at Seaburn, north of Parson's Rock. Beach levels in front of the seawall have risen by up to 0.3m. The profile from chainage 29m to 85m shows little change, with a small of accretion of up to 0.05m. Seaward of chainage 85m there is an accretion of the lower beach by up to 0.4m and a seaward extension of the beach toe by 36m. Overall this profile is at a medium-low level on the upper and middle beach compared to the range recorded from previous surveys, whilst the lower beach is at a high level.</p> <p>1bSNN10 is located mid-way between Parson's Rock and Roker Pier. There has been accretion on the upper beach from the seawall to chainage 29m of up to 0.3m. Between chainages 29m and 118m there has been erosion of up to 0.4m, switching to accretion at the toe of the beach of up to 0.3m. The upper beach to chainage 50m is at a medium level, however the rest of the beach is at a low level compared to the range recorded from previous surveys, particularly between chainages 52m to 72m which is at its lowest level on record.</p>	<p>Along the length of Whitburn Bay beaches have been dynamic, generally showing the greatest accretion on the central profile (1bSNN7) and upper beach of the northern profile (1bSNN1), with erosion dominating the southern (1bSNN10) profile.</p> <p>Longer term trends: Profiles in Whitburn Bay are generally within the bounds of previous surveys, however small sections are now at their highest (19-41m chainage at profile 1bSNN1) and lowest levels (52-72m chainage at profile 1bSNN10) recorded.</p>

2.2 Hendon to Ryhope (incl. Halliwell Banks)

Survey Date	Description of Changes Since Last Survey	Interpretation
5 th -6 th March 2019	<p>Beach Profiles:</p> <p>Hendon to Ryhope is covered by twelve beach profile lines for the Partial Measures survey (Appendix A). The last survey was Full Measures, undertaken in November 2018.</p> <p>Profile 1bSNS8 extends across the seawall, rock revetment, and sandy beach. Beach levels between the toe of the rock revetment and 74m chainage have changed very little, with accretion/erosion limited to 0.15m. Seaward of 74m chainage, the elevation of the beach has reduced by 0.3m. The toe of the beach has moved landwards by around 12m. The combined effect has been to steepen the beach profile. The beach profile is at a medium low level compared to the range recorded from previous surveys. Profile 1bSNS11 starts at the coastal slope backing the sea wall and extends over the rock armour and beach. Beach levels have increased across the profile by up to 1.2m, covering up the rock armour toe which was previously exposed. Overall the profile is at a high level compared to the range recorded from previous surveys, with the section between the toe of the seawall and chainage 92m at its highest level recorded</p> <p>Profile 1bSNS20 is located at Shirley Banks. The profile shows the cliff toe receding landward by around 3m, with upper beach levels decreasing by up to 0.2m from the cliff toe at chainage 42m to chainage 69m. The survey photos show there has been slumping at the toe of the cliff. There has been very little change over the rest of the profile, ± 0.1m, with rock exposed along much of the profile length. Overall the profile is at a medium low level compared to the range recorded from previous surveys.</p> <p>Profile 1bSNS25 is located at Halliwell Banks. The top of the cliffs, cliff face and cliff toe have not changed since the last survey. There has been accretion of up to 0.2m from the toe of the cliff to the rock exposure at chainage 86m. The upper beach is at a relatively medium level compared to the range recorded from previous surveys.</p> <p>Profiles 1bSNS26 to 1bSNS33 are located on Halliwell Banks to assess erosion of a former land fill site. Cliff tops are between 26m and 27mOD.</p> <p>At profiles 1bSNS26, there has been apparent recession of the cliff toe by c.1.0m. Between the cliff toe and chainage 126m there has been very little change in the beach profile, with erosion / accretion of up to 0.1m. Overall the profile is at a relatively low level compared to the range recorded from previous</p>	<p>At South Hendon (1bSNS8 and 1bSNS11), there has been erosion of the lower beach in the northernmost profile (1bSNS8), with an increase in beach level across profile 1bSNS11 to the south. At profile 1bSNS20 only minor changes have occurred since the previous survey.</p> <p>Profile 1bSNS25 has experienced an increase in beach since the previous survey.</p> <p>At the landfill site (profiles 1bSSN26 to 1bSSN33) the cliff there has seen some apparent erosion of the cliff toe. Generally, the profiles are dominated by erosion of between 0.1-0.4m, with some low levels of accretion of up to 0.1m.</p> <p>Longer term trends: In general, the profile change along the Hendon to Ryhope frontage is within the bounds of previous surveys.</p> <p>At the landfill site, profiles 1bSSN25 to 1bSSN33 continue to show recession of the cliff toe, with some profiles showing accumulation of sediment slumped from the cliff face. Overall the beach levels are low-medium compared to past surveys.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>surveys.</p> <p>At 1bSNS27 there has been no change in the position of the top of the cliff, cliff face or cliff toe since the last survey. From chainage 90m to 112m there has been erosion of up to 0.3m. Between chainage 112m to 125m there has been accretion of up to 0.1m. Seawards of chainage 125m the lower beach has dropped by 0.5m. Overall the profile is at a low-medium level compared to the range recorded from previous surveys, particularly between chainages 94m to 104m which is at its lowest level and the beach toe is at its most landward position since records began.</p> <p>At 1bSSN28, the toe of the cliff appears to have retreated by c.0.5m. There has been very little change across the beach profile, with erosion limited to 0.2m on the upper beach and accretion limited to 0.1m on the lower beach. Sediment has been removed (0.2m) infilling exposed rocks seaward of chainage 120m. Overall the profile is at a low-medium level compared to the range recorded from previous surveys.</p> <p>At profiles 1bSNS29, the toe of the cliff appears to have retreated by c.1.0m. Between the cliff toe and chainage 92m there has been accretion of up to 0.4m. Between chainage 92m and 119m there has been erosion of up to 0.4m. Overall the profile is at a low level compared to the range recorded from previous surveys, particularly between chainages 92m and 110m which is at its lowest level recorded.</p> <p>At 1bSNS30, there has been an accumulation of 0.6m of material at the toe of the cliff. Between chainage 98m and 127m there has been erosion of up to 0.2m, exposing rocks at chainage 123m. Overall the profile is at a low-medium level compared to the range recorded from previous surveys.</p> <p>Profile 1bSNS31 shows an apparent erosion of the cliff face and toe by c.3.5m. The rest of the beach profile shows erosion of up to 0.3m, exposing rocks at chainage 130m. Overall the profile is at a low-medium level compared to the range recorded from previous surveys.</p> <p>At 1BSNS32 the cliff shows apparent recession of 0.5m at the toe. There has been a drop in levels across the whole beach profile, ranging from 0.4m on the upper beach to less than 0.1m on the middle and lower beach. The rocks are still exposed seaward of chainage 124m. Overall the profile is at a low-medium level compared to the range recorded from previous surveys.</p> <p>At 1bSNS33, the cliff shows apparent recession of the cliff toe of 1.5m. There is limited accretion of up to 0.1m across the rest of the beach profile. Overall the profile is at a low-medium level compared to the</p>	

Survey Date	Description of Changes Since Last Survey	Interpretation
	range recorded from previous surveys.	
6 th March 2019	<p>Cliff-top Survey:</p> <p>32 ground control points (numbered 1-32) were established along the cliff top between Hendon and Ryhope in March 2009, with a further three (28A, 28B and 28C) added in September 2009 (Figure 3). Note: the numbering of ground control points is not intended to correlate with that of the beach profile lines.</p> <p>Measurements are taken from each ground control point along a fixed bearing to the edge of the cliff top. These cliff top surveys are undertaken bi-annually and are intended to inform on erosion rates of the sea cliffs extending from the defended industrial areas at Hendon southwards along the undefended cliffs to Ryhope Dene.</p> <p>The results from the cliff top monitoring are anticipated to have an accuracy of $\pm 0.2\text{m}$ due to the technique used. These cliff top surveys are undertaken bi-annually and are intended to inform on erosion rates of the sea cliffs extending from the defended industrial areas at Hendon southwards along the undefended cliffs to Ryhope Dene. Appendix B – Table B1 provides results from the March 2009 cliff top survey, showing the position from the ground control point to the edge of the cliff top along a defined bearing. Also shown is the change in measurement since the original (March 2009) and previous (November 2018) cliff top surveys.</p> <p>Results show that since the last survey, six locations have shown erosion greater than the anticipated survey error; Point 5 by 0.23m, Point 11 by 0.27m, Point 27 by 0.59m, Point 28B by 0.27m, Point 31 by 0.89m and Point 32 by 0.32m.</p> <p>Since surveys began in March 2009 (or September 2009 for 28A, 28B, and 28C) erosion greater than the survey error has occurred at around 80% of the ground control points, where total losses are 11.53m (at location 27) at their greatest, and more typically less than 5m. The long-term erosion rates are up to 1.15m/yr (location 27), with up to 0.5m/yr being more typical.</p>	<p>Since the last survey, the cliffs at Points 5, 11, 27, 28B, 31 and 32 have eroded, with very little change elsewhere. Point 31 shows the greatest amount of erosion of 0.89m.</p> <p>Longer term trends: Since 2009, the majority of the points south of the sea defences have eroded. The greatest erosion has occurred at points 10, 21, 25, 27, 31 and 32 where between 7.03m and 11.53m have been lost.</p>

3. Problems Encountered and Uncertainty in Analysis

Individual Profiles

- No problems were encountered.

Cliff Top Surveys

- No problems were encountered

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

No changes are recommended at the present time.

5. Conclusions and Areas of Concern

- At Whitburn Bay, the recorded profiles present no causes for concern, with beach levels being low-medium compared to the range recorded from previous surveys.
- At Hendon to Ryhope (incl. Halliwell Banks), the greatest amount of erosion recorded to have taken place between March 2009 and March 2019 was 11.53m at point 27 which is on the northern border of the landfill site. Since the last survey in November 2018, the greatest erosion has been at Point 31 (adjacent to Pincushion Rocks at the southern extent of the cliff top survey) where the cliff edge has receded by 0.89m.
- Elsewhere at Hendon to Ryhope (incl. Halliwell Banks), the recorded profiles and cliff top surveys present no causes for concern, with beach levels being low-medium compared to the range recorded from previous surveys.

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: 1bSNN1

Date: 18/02/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

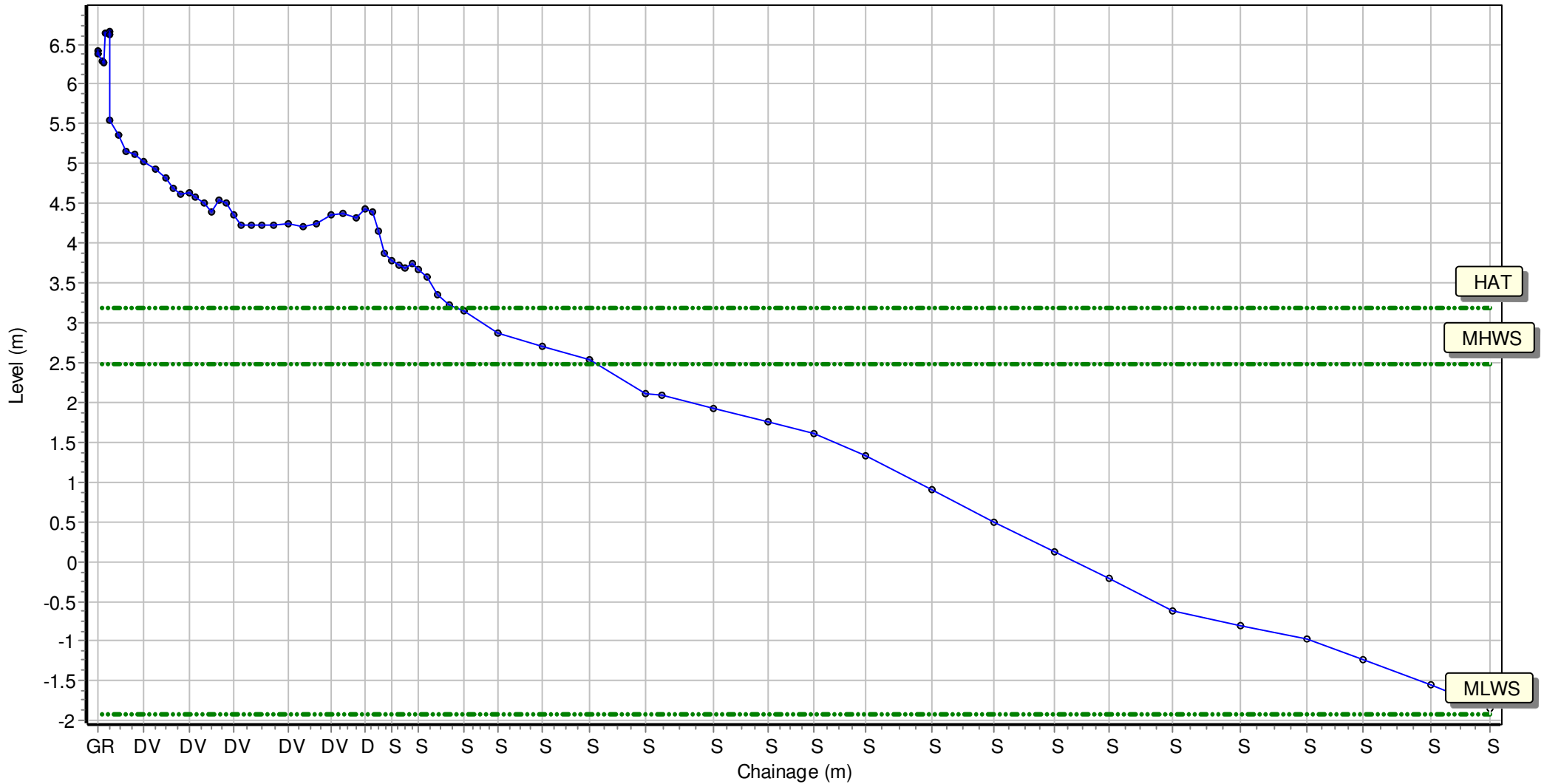
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 440797.428 Northing: 561231.249 Profile Bearing: 97 ° from North



Beach Profile

Location: 1bSNN7

Date: 18/02/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

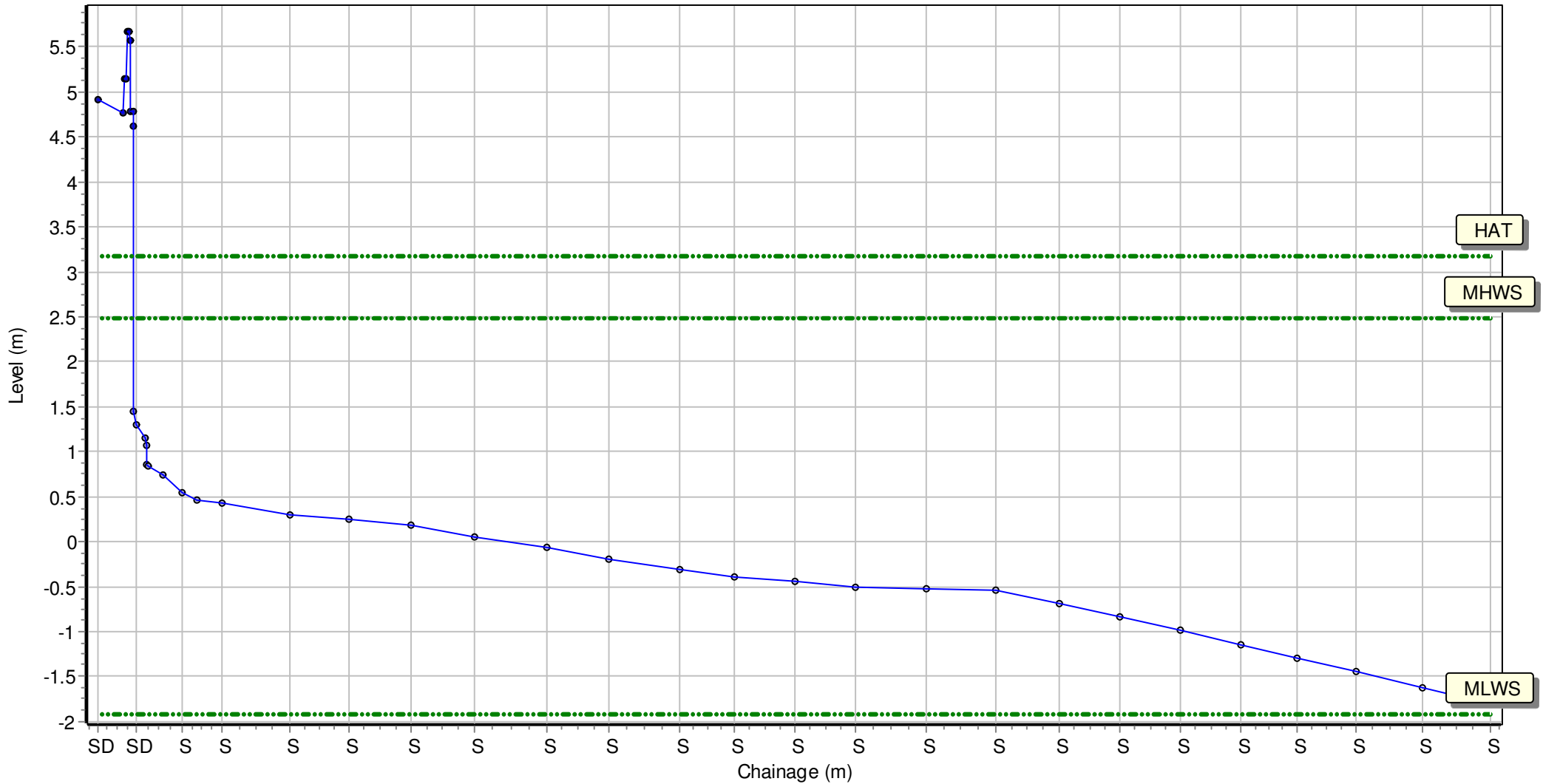
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 440623.795 Northing: 560029.932 Profile Bearing: 81 ° from North



Beach Profile

Location: 1bSNN10

Date: 18/02/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

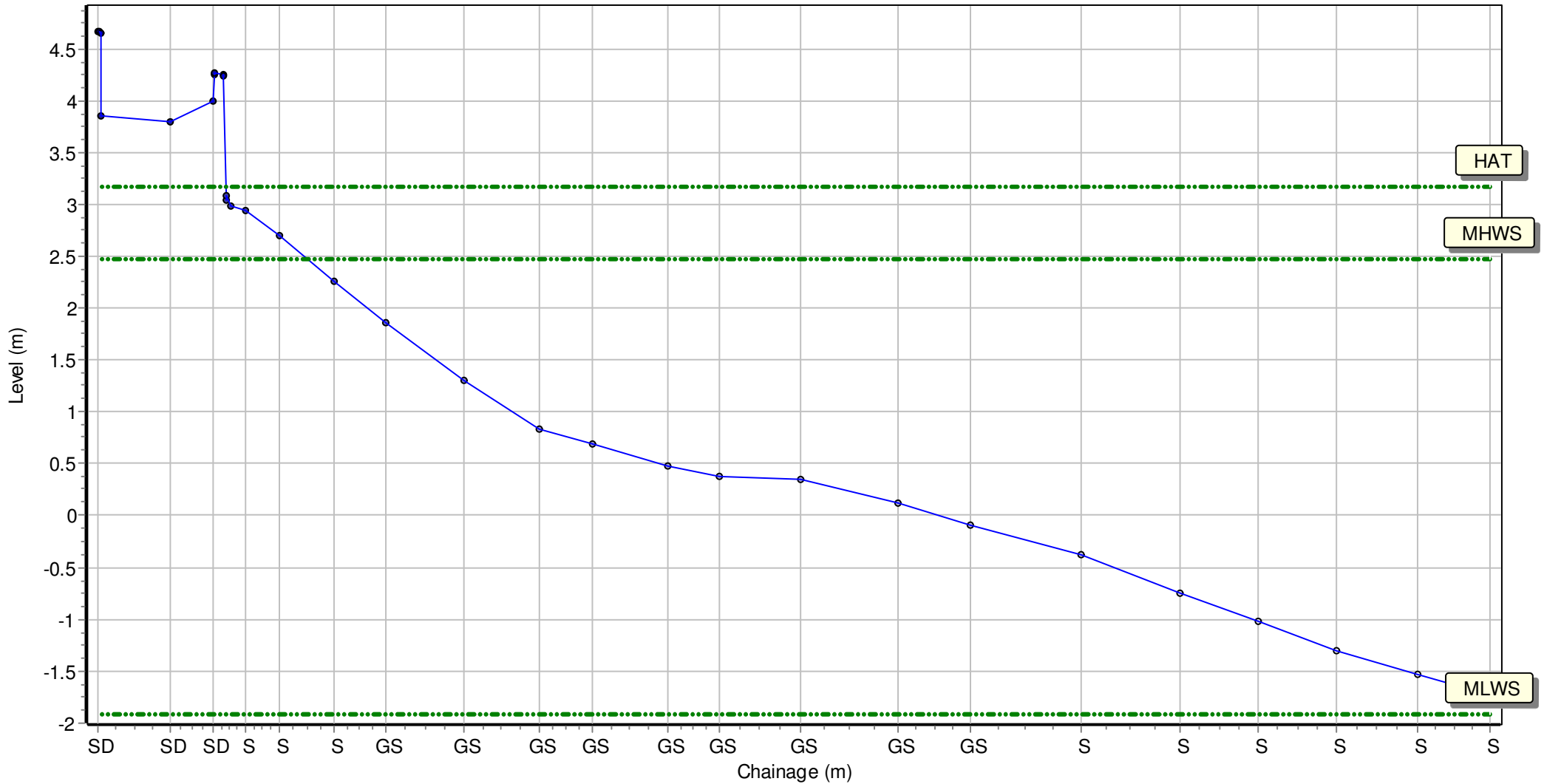
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 440728.714 Northing: 559193.372 Profile Bearing: 74 ° from North



Beach Profile

Location: 1bSNS8

Date: 06/03/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

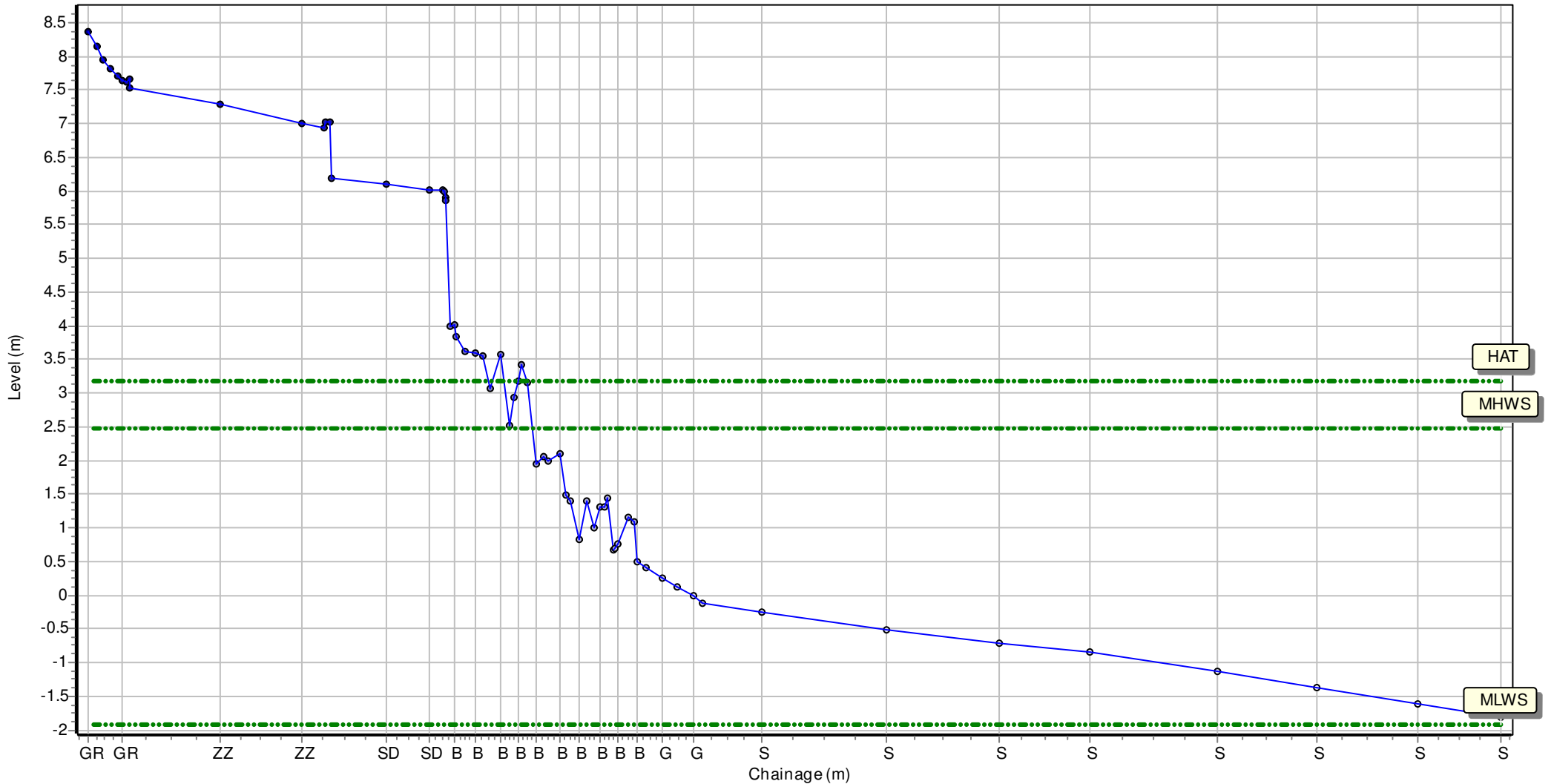
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 441092.263 Northing: 555414.414 Profile Bearing: 80 ° from North



Beach Profile

Location: 1bSNS11

Date: 06/03/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

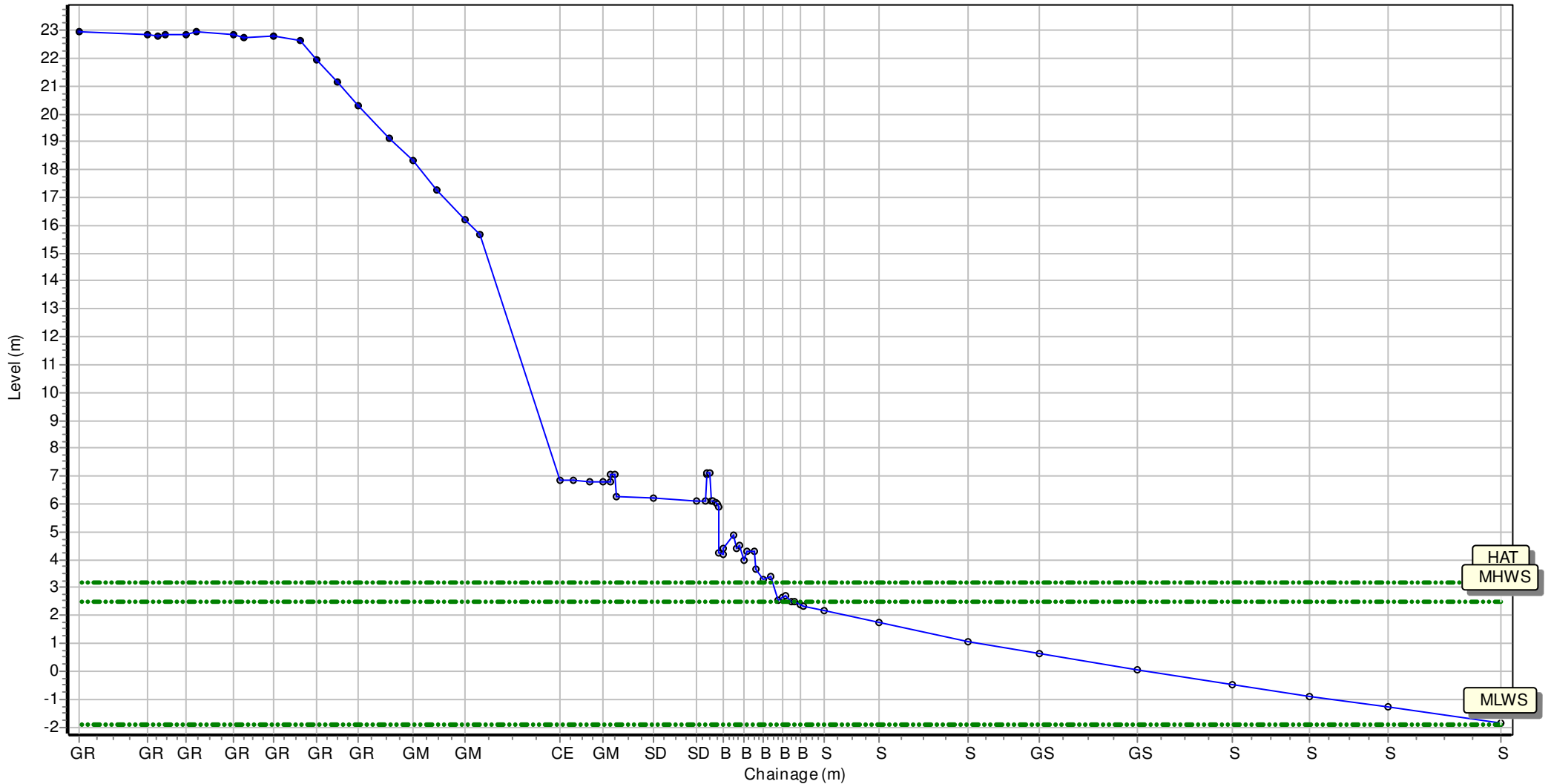
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 441225.182 Northing: 554759.021 Profile Bearing: 75 ° from North



Beach Profile

Location: 1bSNS26

Date: 06/03/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

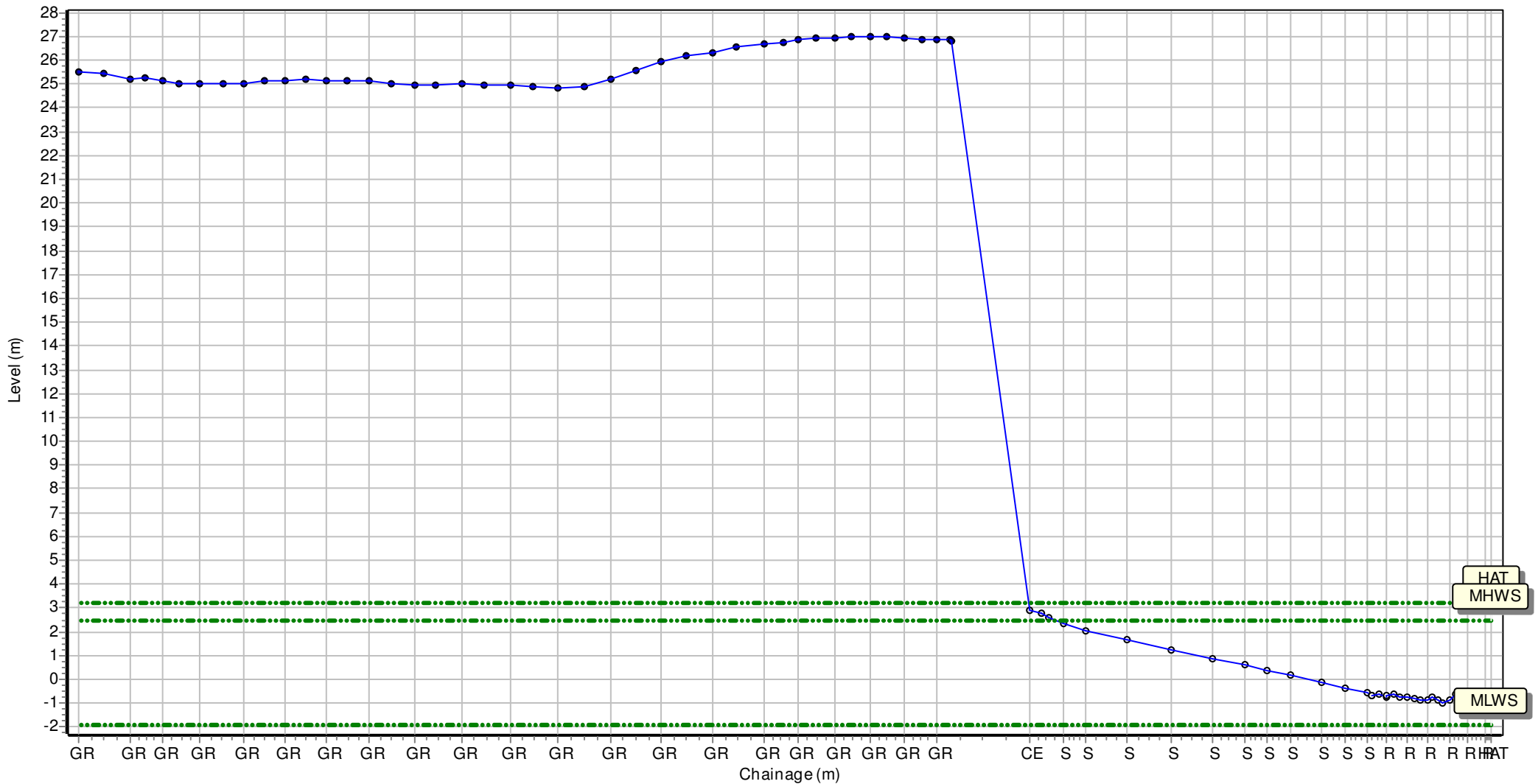
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 441726.053 Northing: 552563.41 Profile Bearing: 60 ° from North



Beach Profile

Location: 1bSNS27

Date: 06/03/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

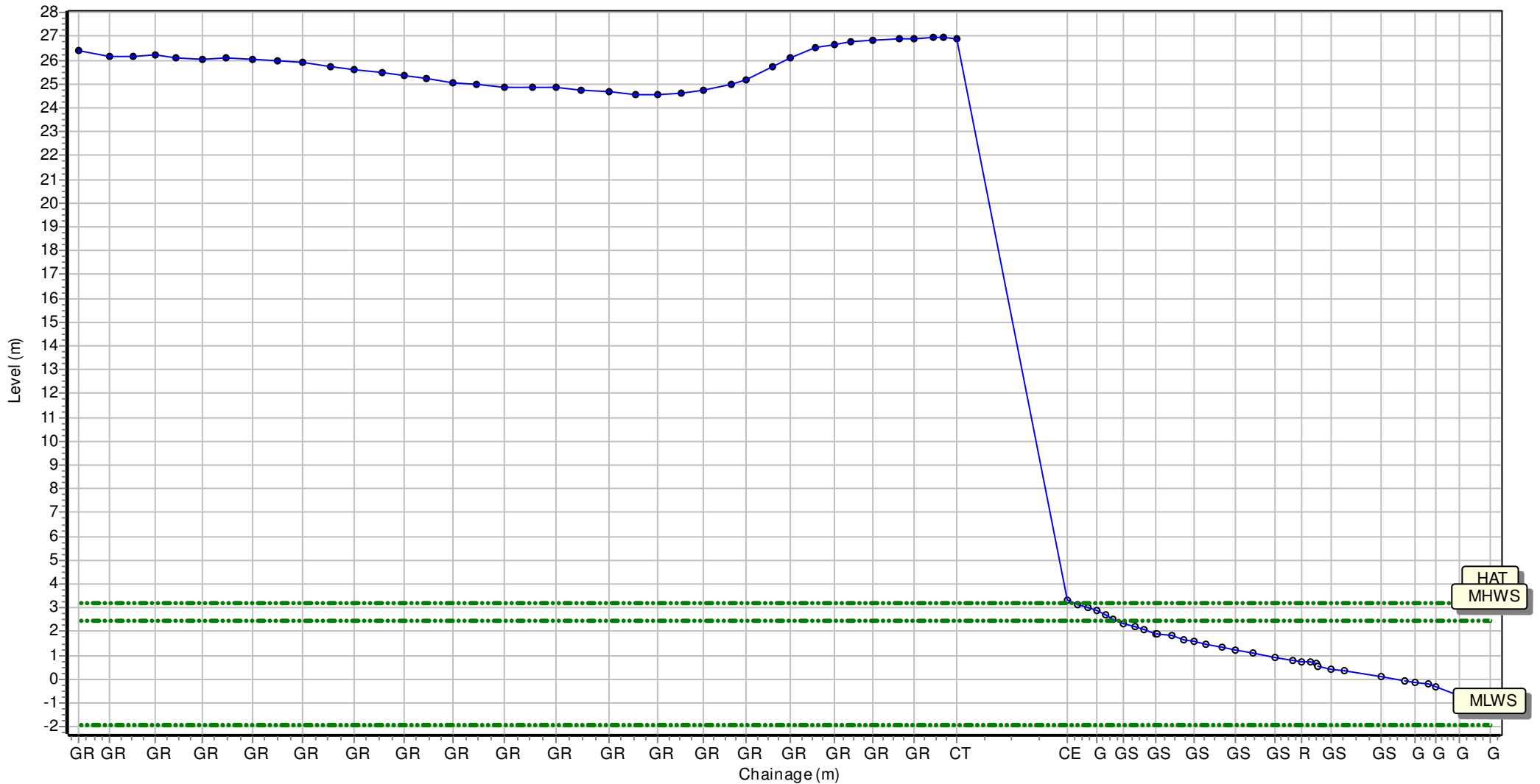
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 441733.63 Northing: 552550.463 Profile Bearing: 60 ° from North



Beach Profile

Location: 1bSNS28

Date: 06/03/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

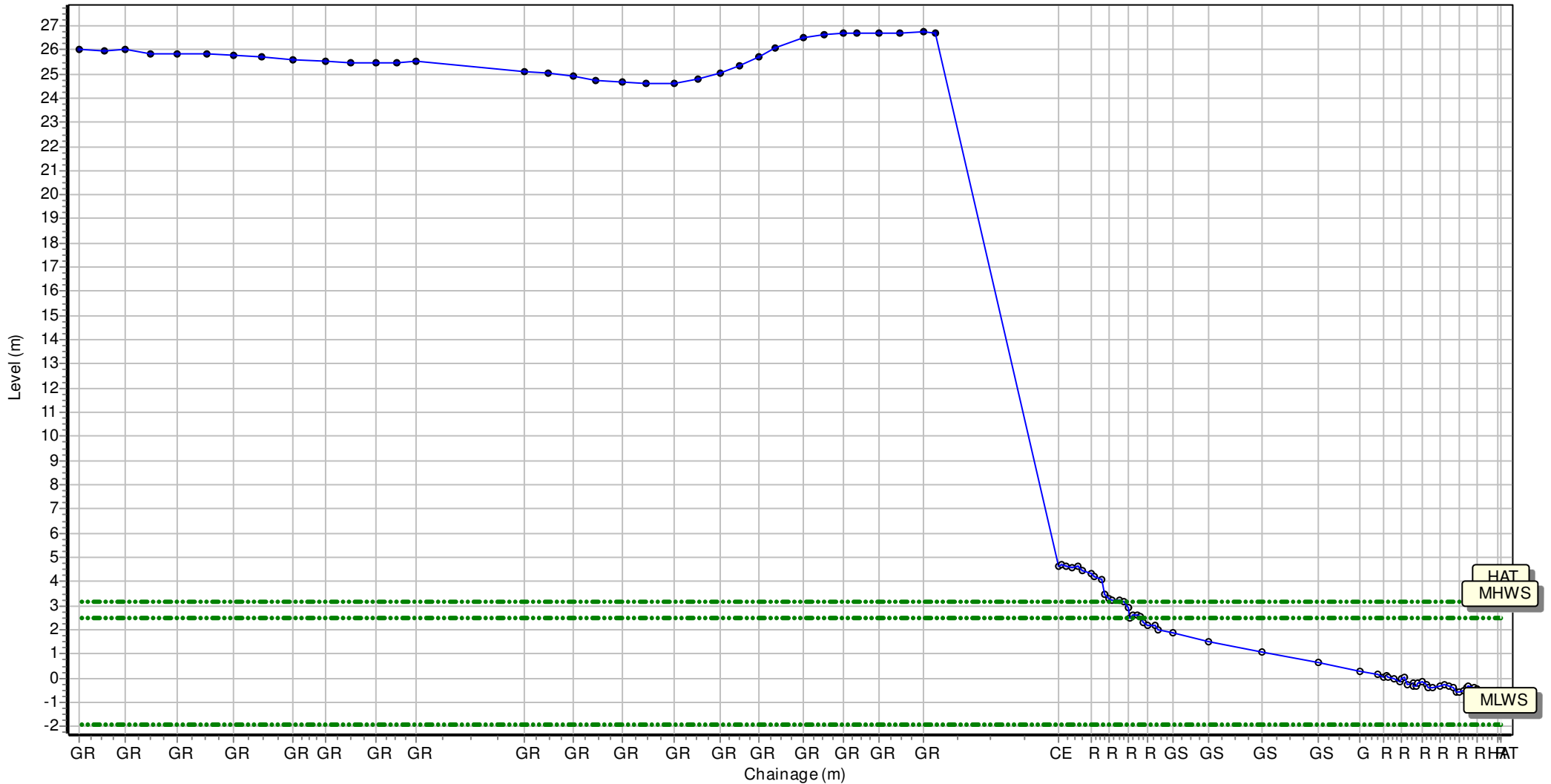
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 441741.207 Northing: 552537.517 Profile Bearing: 60 ° from North



Beach Profile

Location: 1bSNS29

Date: 06/03/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

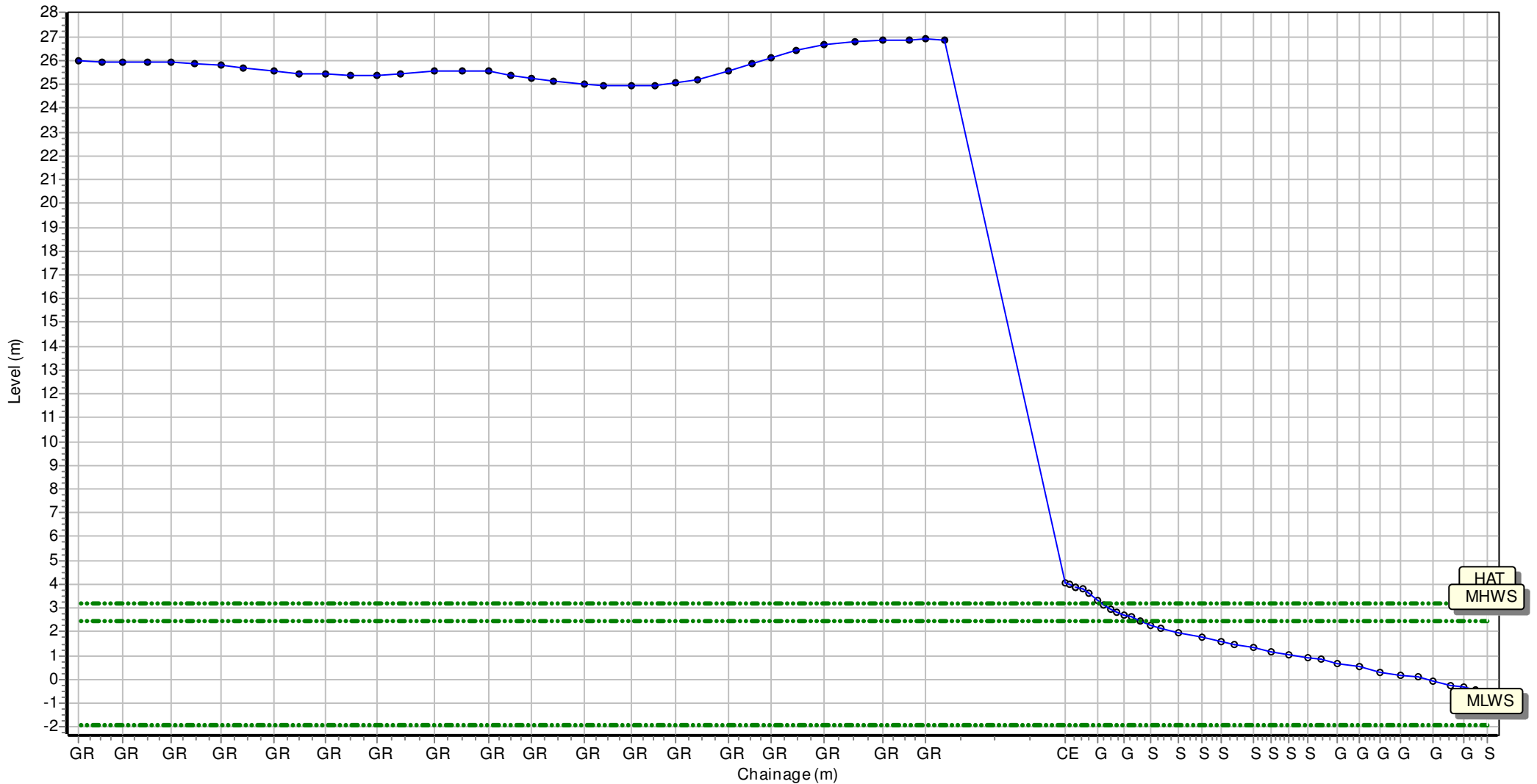
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 441748.776 Northing: 552524.571 Profile Bearing: 60 ° from North



Beach Profile

Location: 1bSNS31

Date: 06/03/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

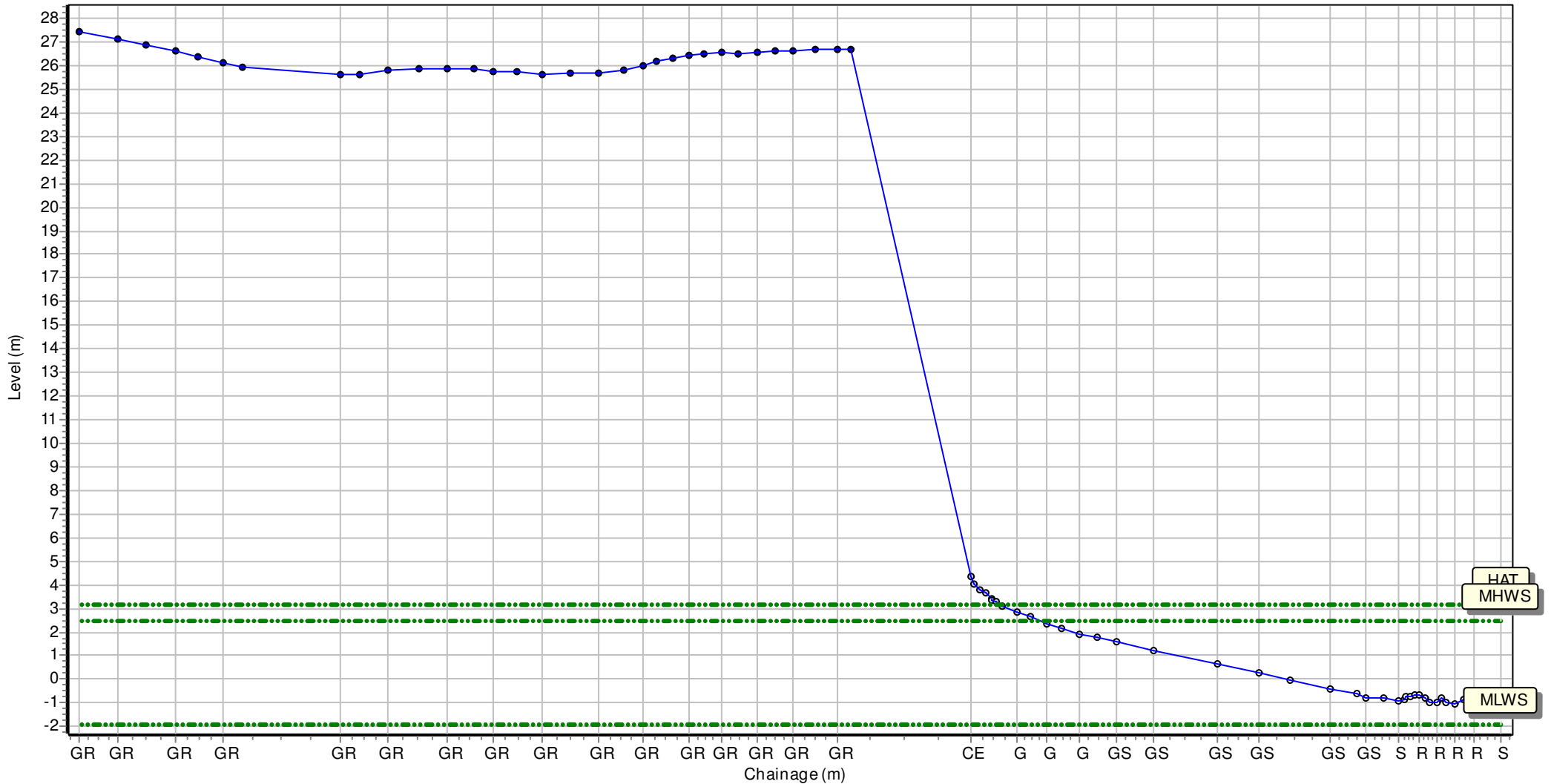
Sea State:

Visibility:

Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 441763.931 Northing: 552498.678 Profile Bearing: 60 ° from North



Beach Profile

Location: 1bSNS32

Date: 06/03/2019

Inspector: AG

Low Tide:

Low Tide Time:

Wind

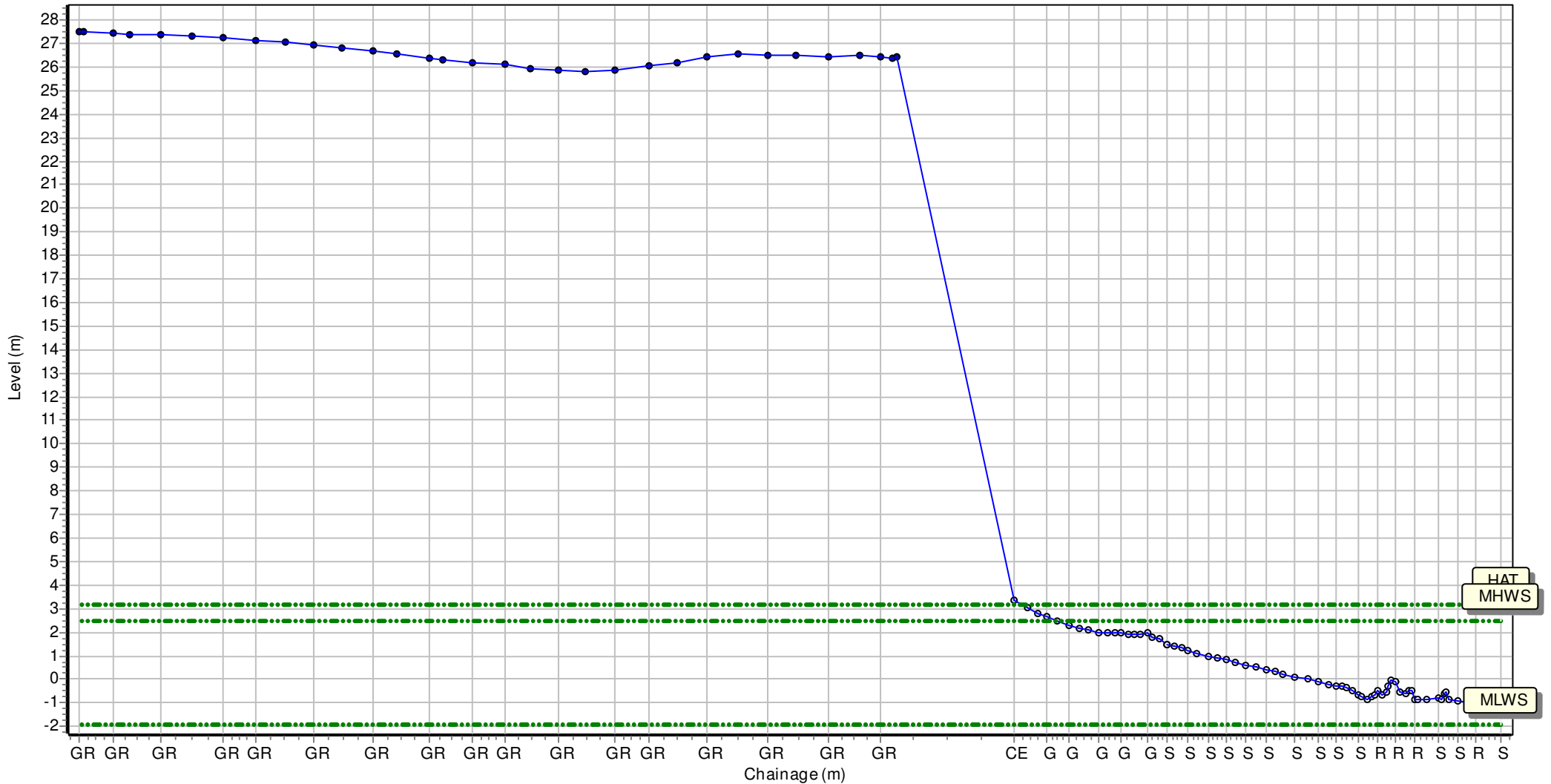
Sea State:

Visibility:

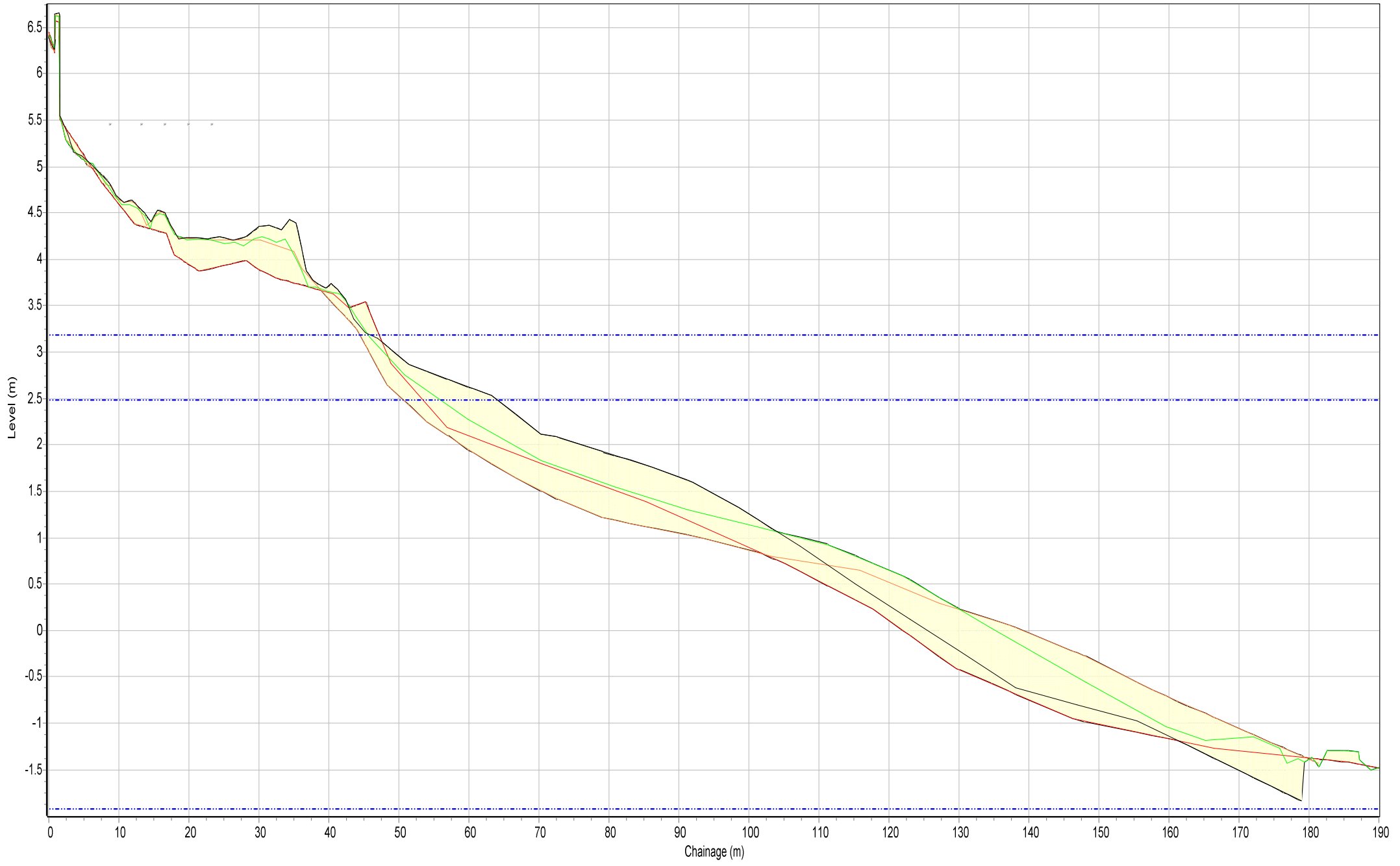
Rain:

Summary: 2019 Partial Measures Topo Survey

Easting: 441771.5 Northing: 552485.732 Profile Bearing: 60 ° from North

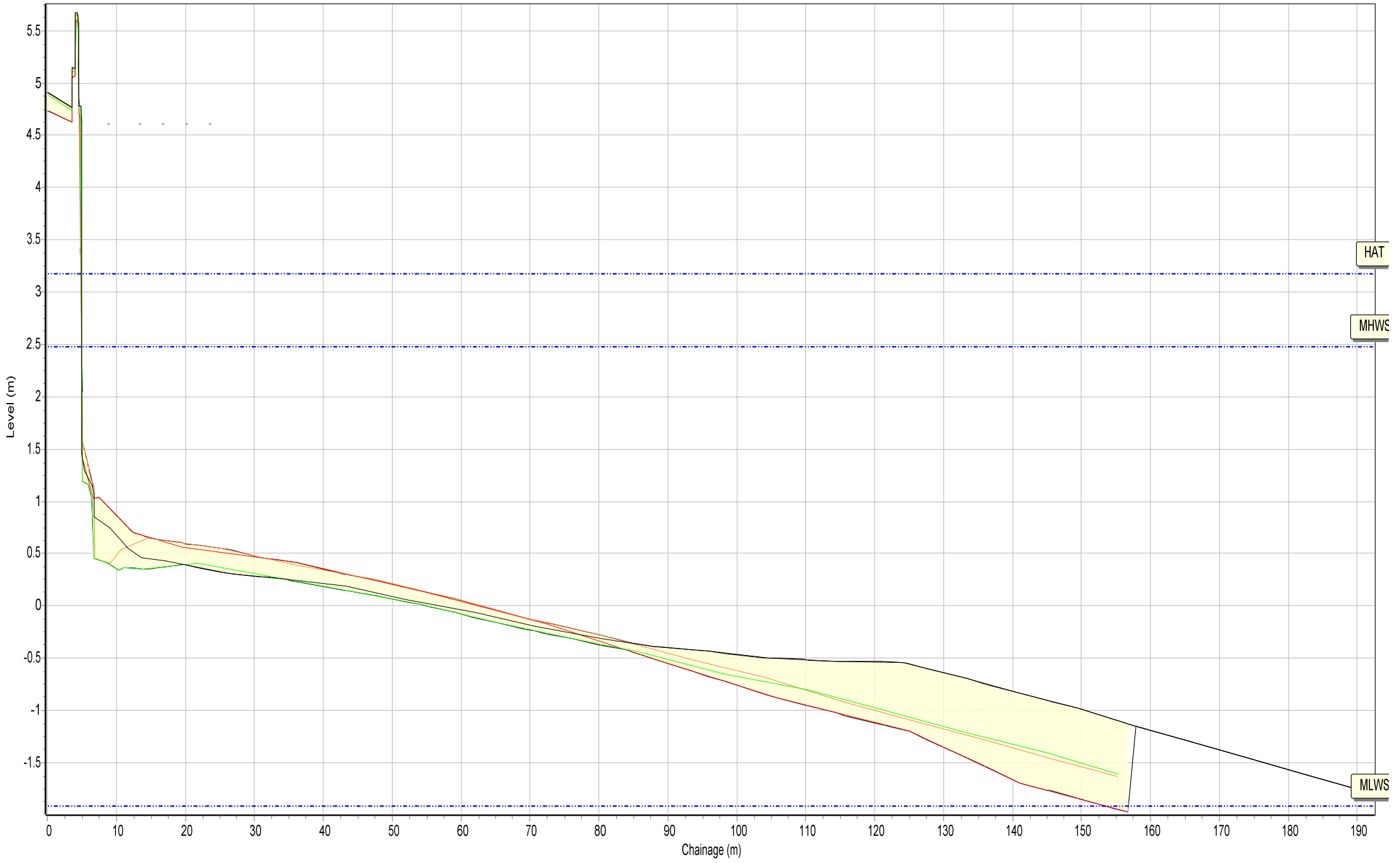


Beach Profiles: 1bSNN1



Profiles Envelope 27/04/2009 07/03/2018 22/11/2018 18/02/2019

Beach Profiles: 1bSNN7



Profiles Envelope 27/04/2009 07/03/2018 22/11/2018 18/02/2019

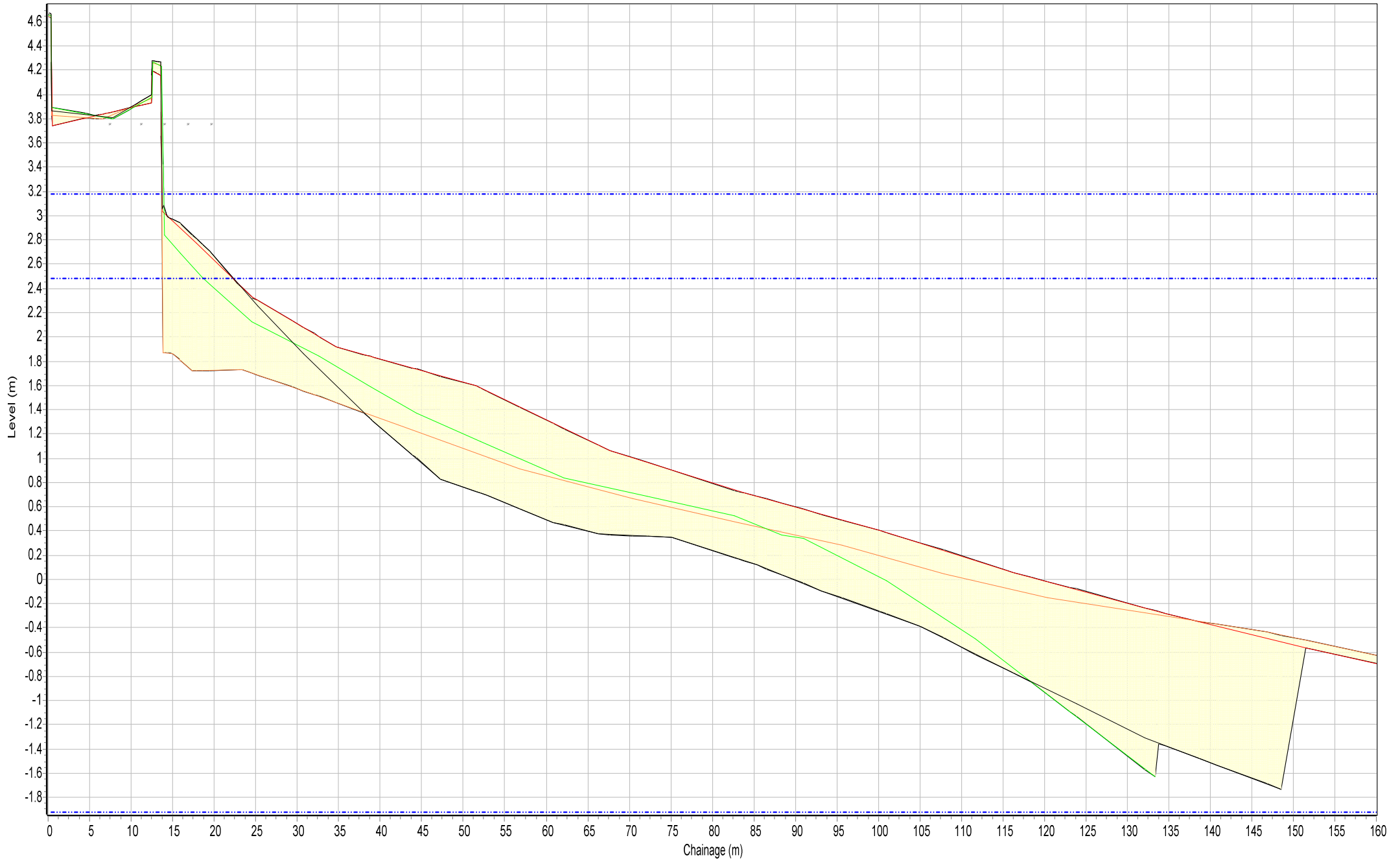
HAT

MHWS

MLWS

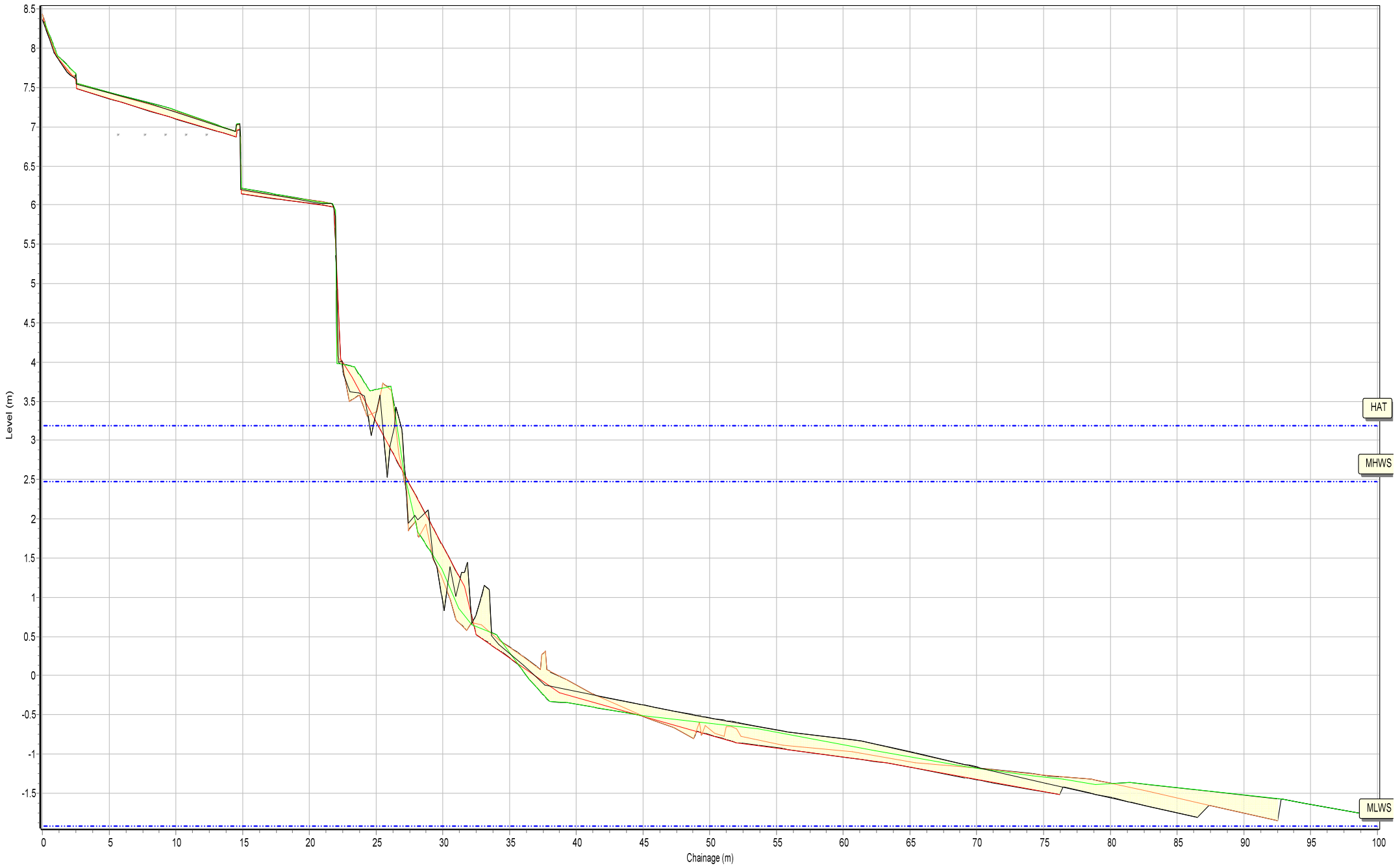
SANDS

Beach Profiles: 1bSNN10



Profiles Envelope 27/04/2009 07/03/2018 22/11/2018 18/02/2019

Beach Profiles: 1bSNS8



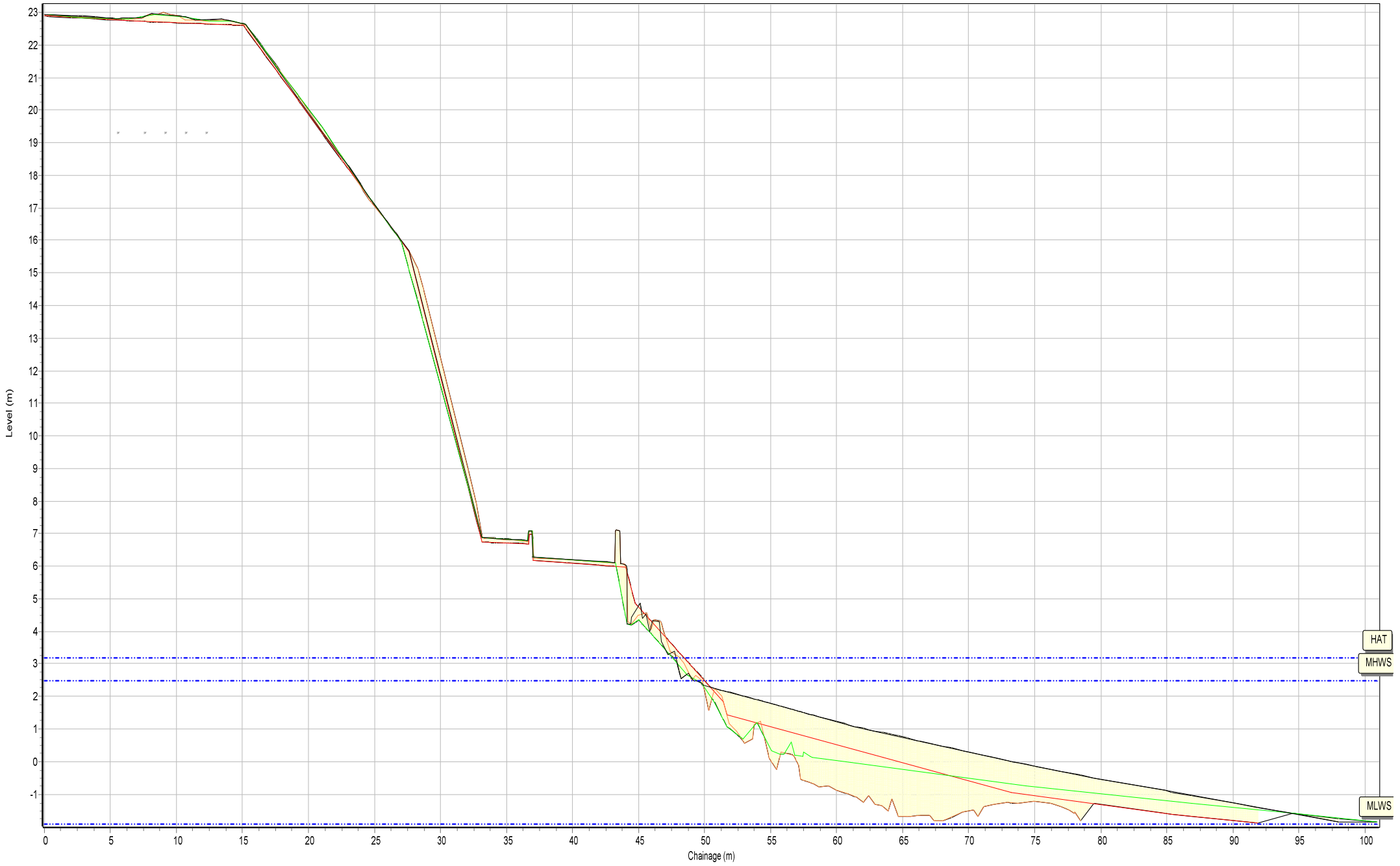
HAT

MHWS

MLWS

SANDS

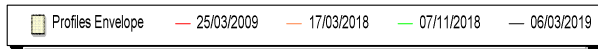
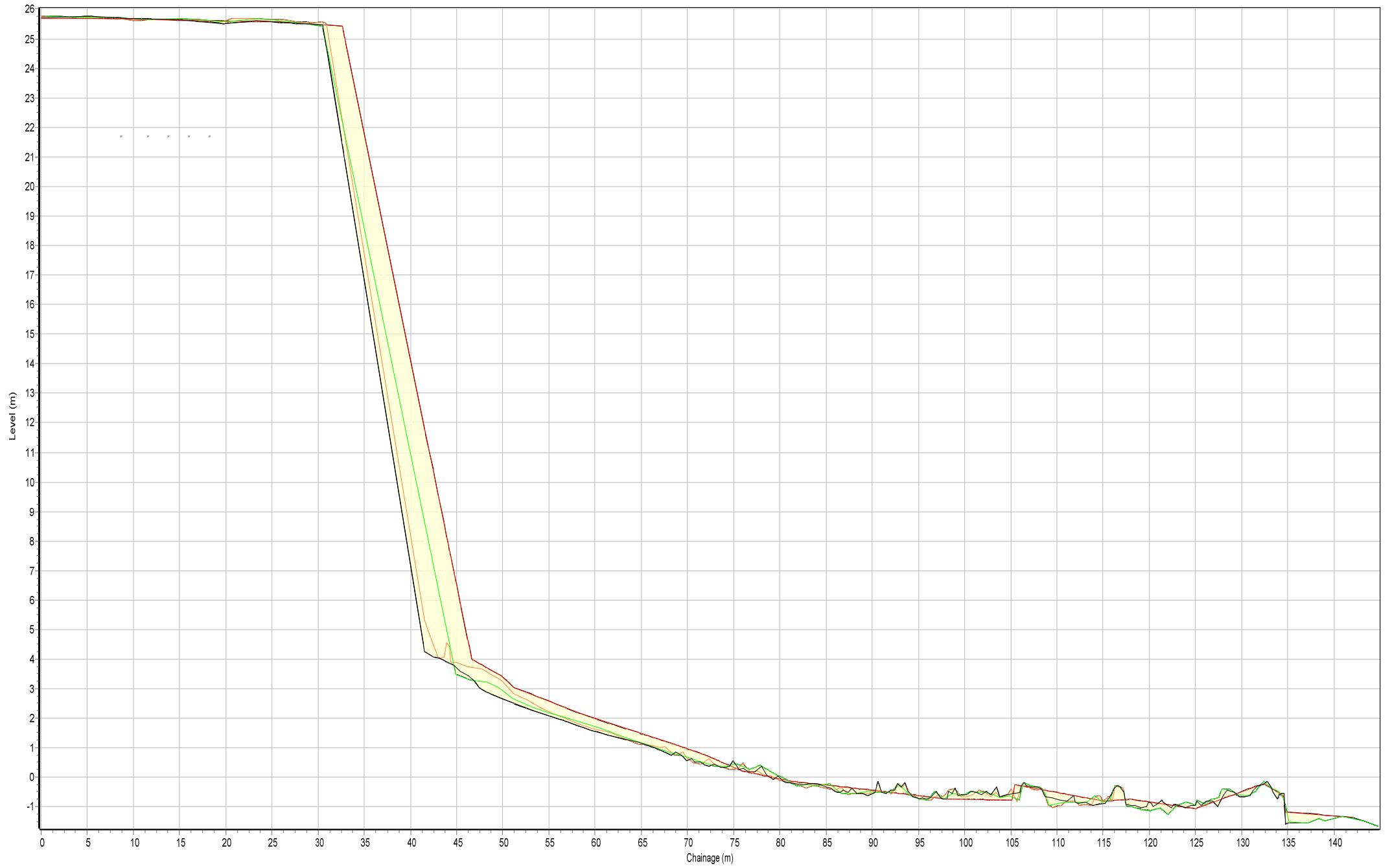
Beach Profiles: 1bSNS11



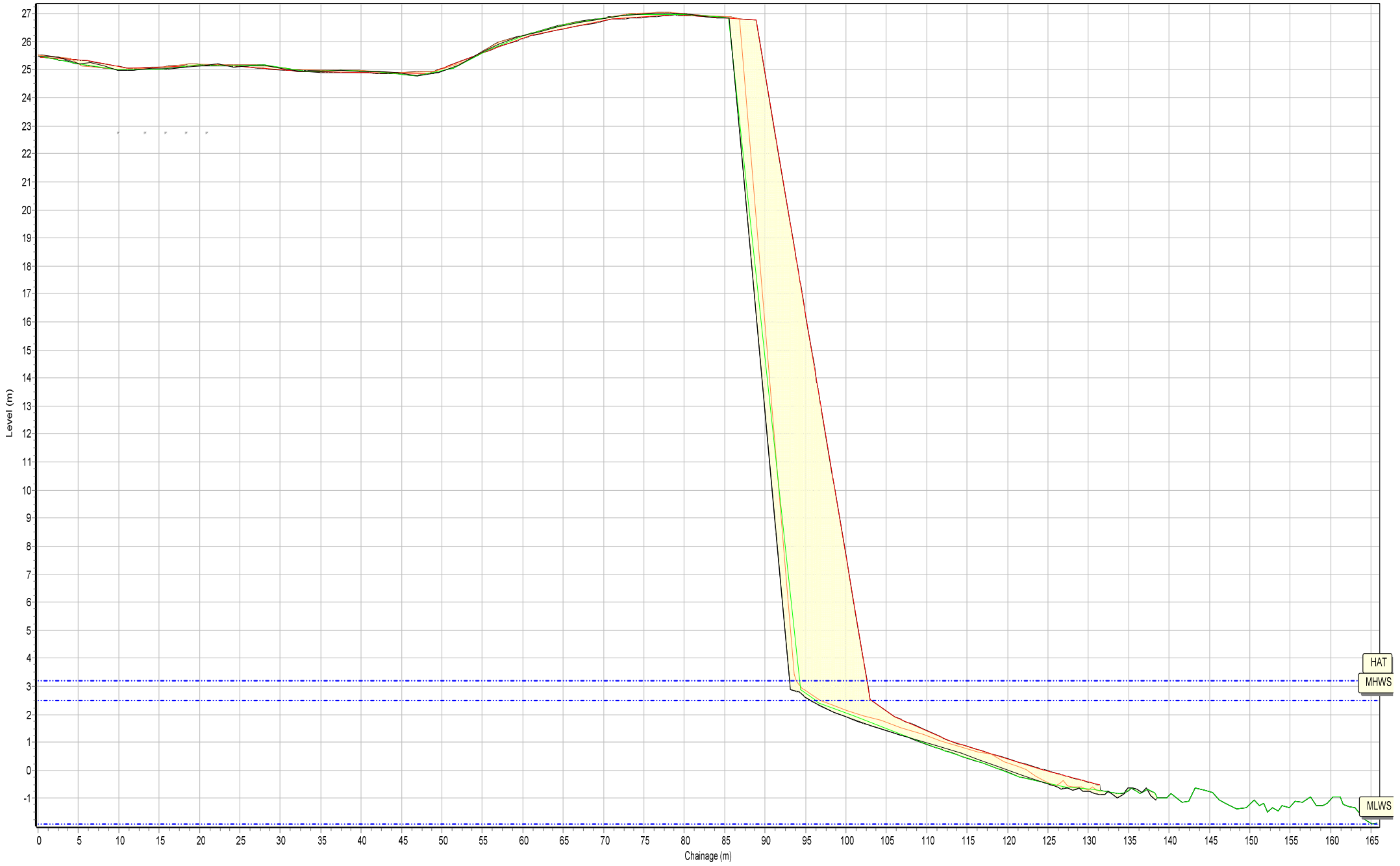
Profiles Envelope 25/03/2009 17/03/2018 07/11/2018 06/03/2019

HAT
MHWS
MLWS

Beach Profiles: 1bSNS20



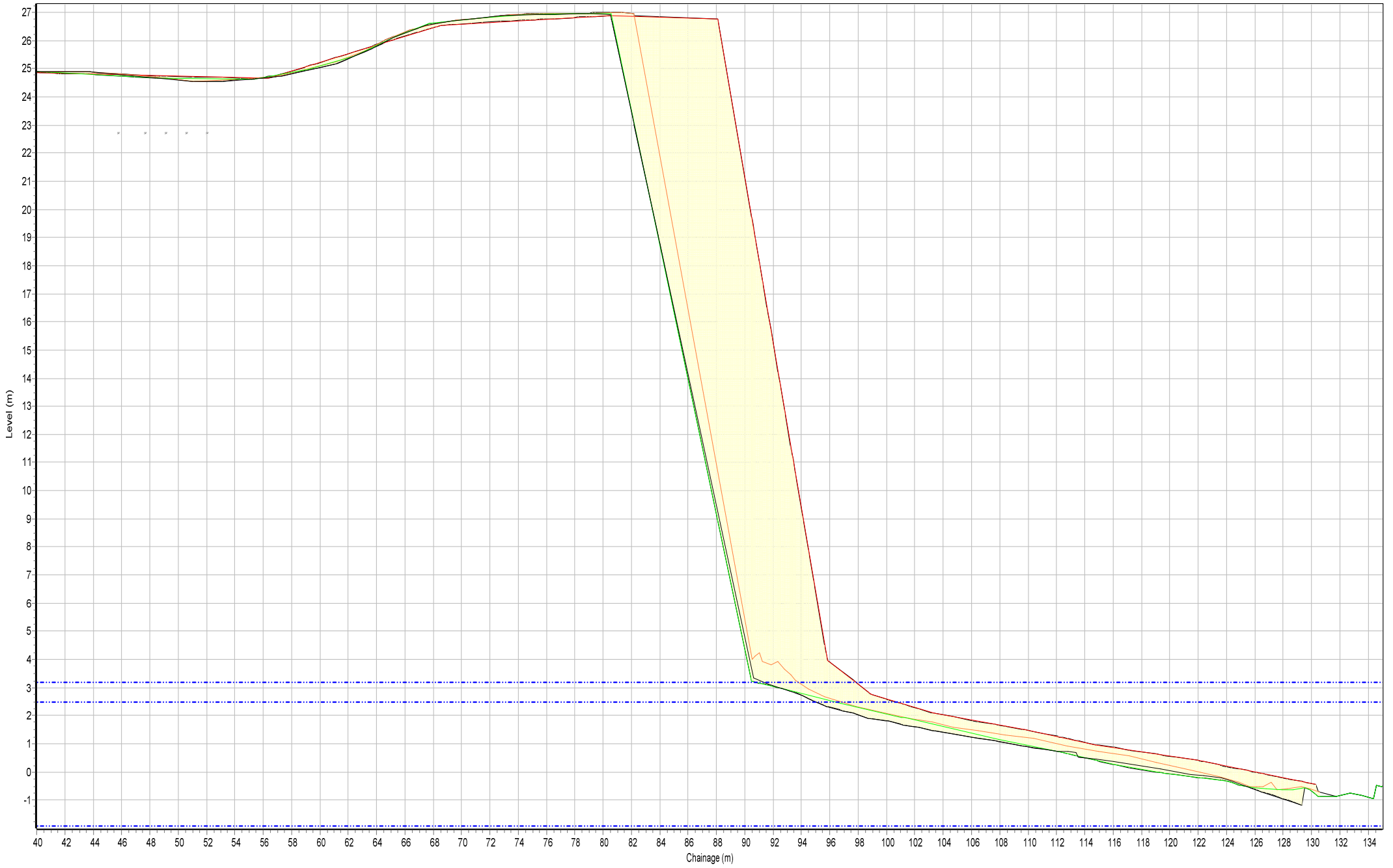
Beach Profiles: 1bSNS26



HAT
MHWs

MLWS

Beach Profiles: 1bSNS27



Beach Profiles: 1bSNS28



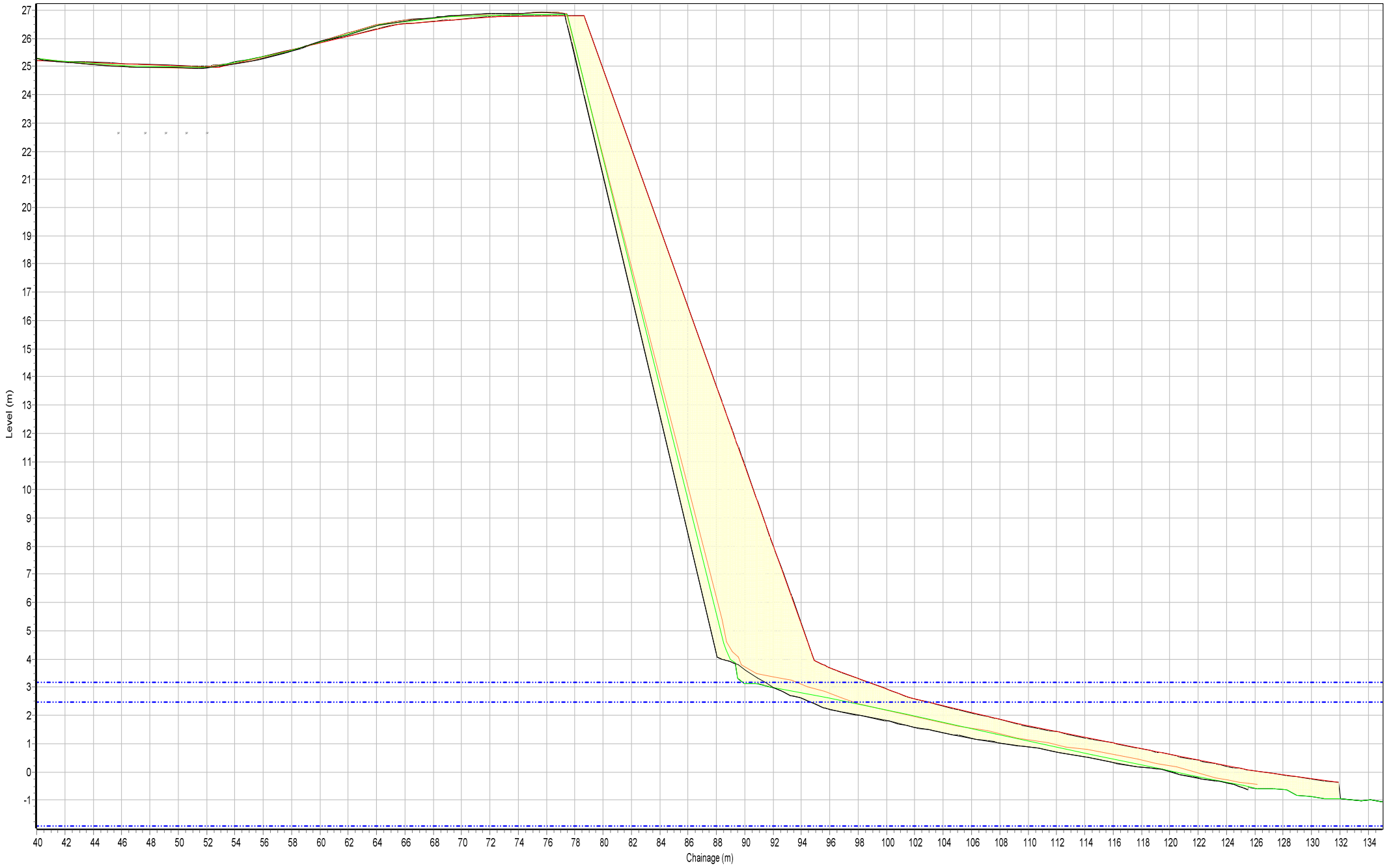
Profiles Envelope 25/03/2009 17/03/2018 07/11/2018 06/03/2019

HAT
MHWS

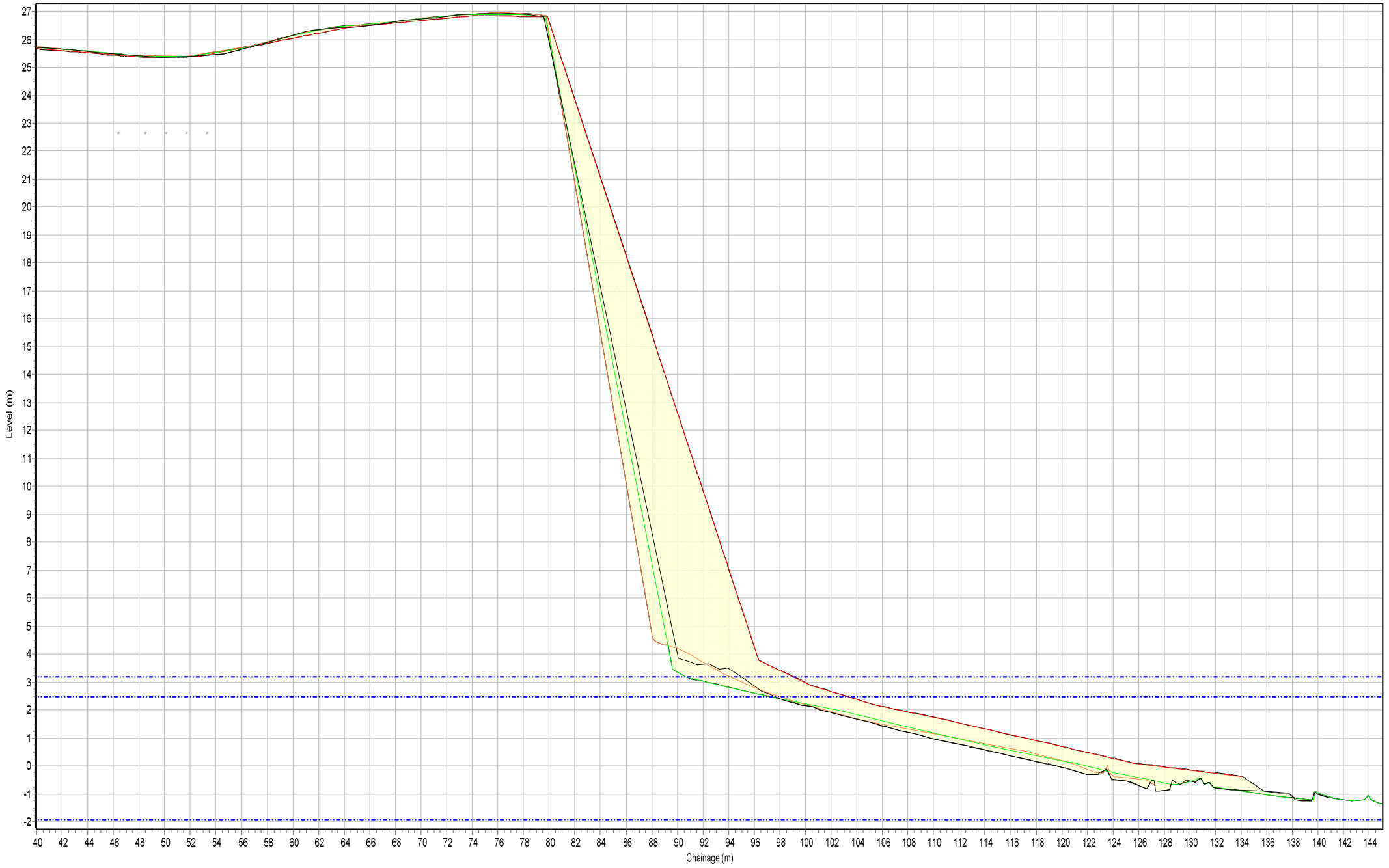
MLWS

SANDS

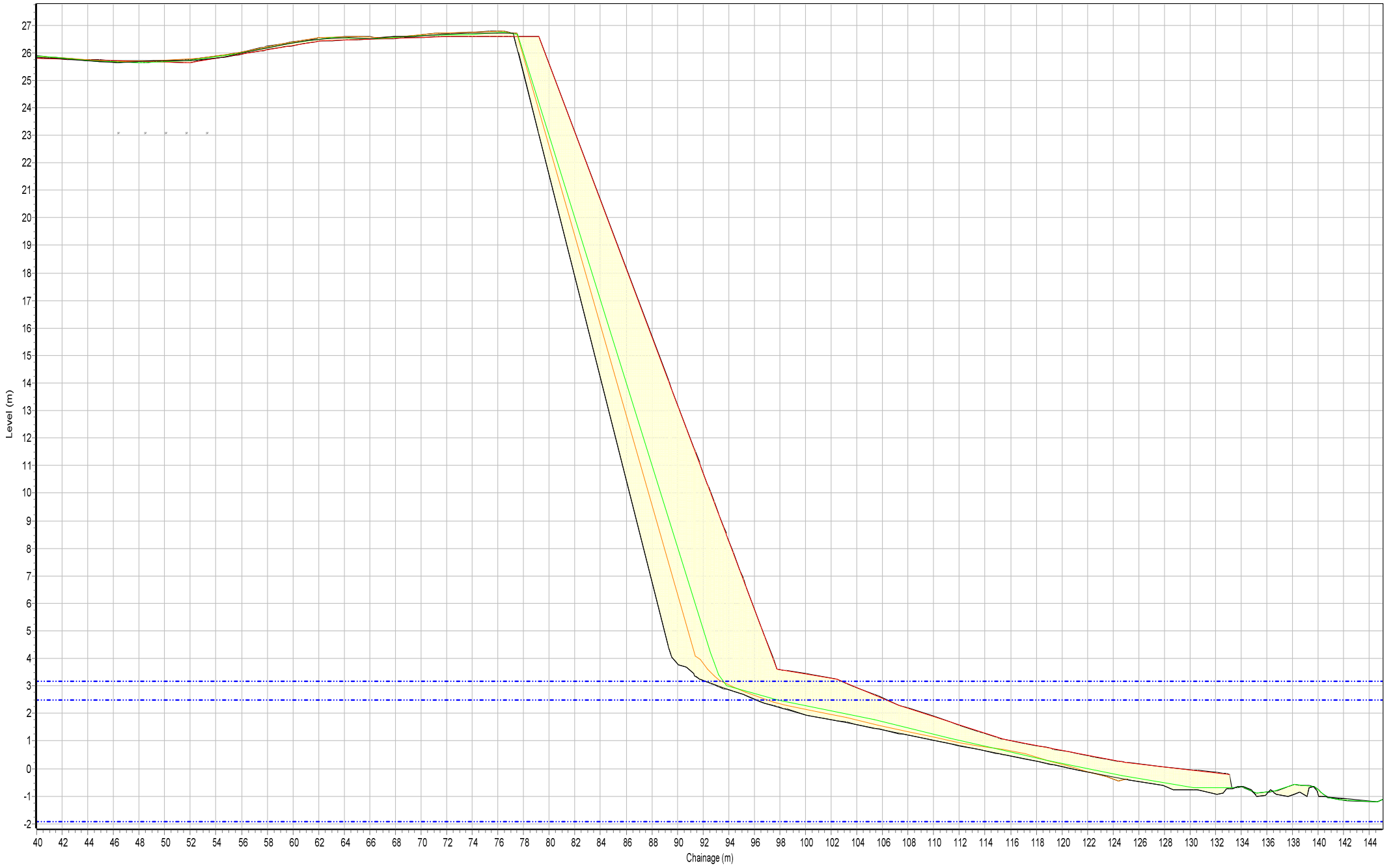
Beach Profiles: 1bSNS29



Beach Profiles: 1bSNS30



Beach Profiles: 1bSNS31



Beach Profiles: 1bSNS32



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
HENDON TO RYHOPE SOUTH
Sunderland City Council
Council Frontage
 Cliff Top Survey Locations

Drawing Scale at A4 1:10,000

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



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

Cliff Top Survey

Hendon and Ryhope

Thirty-two ground control points have been established between Hendon and Ryhope. The maximum separation between any two points varies along the coast, reflecting the degree of risk from the erosion.

The cliff top surveys between Hendon and Ryhope 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 2009 (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 between Hendon and Ryhope

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
			(°)	March 2009	Nov 2018	Mar 2019	Mar 2009 - Mar 2019	Nov 2018- Mar 2019	Mar 2009 - Mar 2019
1	441025.7	555571.1	75	8.16	8.31	8.28	0.12	-0.03	0.01
2	441064.4	555355.1	85	7.09	5.25	5.37	-1.72	0.12	-0.17
3	441098	555124	82	10.01	10.35	10.31	0.3	-0.04	0.03
4	441174	554938.7	65	10.3	10.46	10.55	0.25	0.09	0.03
5	441199.1	554861.1	65	7.71	11.02	10.79	3.08	-0.23	0.31
6	441224.5	554774.2	71	10.83	10.9	10.87	0.04	-0.03	0.00
7	441248.4	554690.3	74	10.18	10.35	10.57	0.39	0.22	0.04
8	441259.3	554596.6	101	10.08	9.62	9.69	-0.39	0.07	-0.04
9	441275.8	554513.4	66	10.52	6.04	5.94	-4.58	-0.1	-0.46
10	441309.4	554421.3	58	8.77	1.31	1.19	-7.58	-0.12	-0.76
11	441354	554346.5	68	8.2	3.91	3.64	-4.56	-0.27	-0.46
12	441400.2	554248.2	56	6.17	5.78	5.83	-0.34	0.05	-0.03
13	441452.3	554174.7	63	11.61	6.41	6.4	-5.21	-0.01	-0.52

14	441472.3	554080.5	127	7.33	6.2	6.04	-1.29	-0.16	-0.13
15	441413	554005.1	122	7.84	7.85	7.86	0.02	0.01	0.00
16	441384.8	553913.3	90	9.89	7.57	7.46	-2.43	-0.11	-0.24
17	441404.1	553815.5	93	6.32	5.84	5.8	-0.52	-0.04	-0.05
18	441404.1	553723.6	119	8.1	3.19	3.23	-4.87	0.04	-0.49
19	441398.5	553632.8	78	8.23	4.19	4.16	-4.07	-0.03	-0.41
20	441438.3	553452.9	71	10.09	5.52	5.53	-4.56	0.01	-0.46
21	441506.1	553256.1	62	8.57	1.59	1.54	-7.03	-0.05	-0.70
22	441550.1	553158.7	103	6.57	3.37	3.27	-3.3	-0.1	-0.33
23	441585.2	553076.5	64	8.11	4.64	4.67	-3.44	0.03	-0.34
24	441624.4	552870.7	69	7.53	3.21	3.11	-4.42	-0.1	-0.44
25	441689.1	552758	70	14.58	6.66	6.58	-8	-0.08	-0.80
26	441715	552713.3	54	12.87	10.46	10.35	-2.52	-0.11	-0.25
27	441749.2	552674.4	62	14.56	3.62	3.03	-11.53	-0.59	-1.15
28	441776.6	552629.9	57	8.62	4.16	4.11	-4.51	-0.05	-0.45
28A	441798.6	552586.3	56	13.63	6.08	6.14	-7.49	0.06	-0.75
28B	441817.4	552542.4	64	12.3	11.18	10.91	-1.39	-0.27	-0.14
28C	441852.2	552502.6	52	13.11	12.38	12.43	-0.68	0.05	-0.07
29	441880.1	552471.6	83	15.46	15.1	15.08	-0.38	-0.02	-0.04
30	441921.4	552269	97	8.55	6.41	6.38	-2.17	-0.03	-0.22
31	441853.1	552094	75	11.2	4.09	3.2	-8	-0.89	-0.80
32	441883.3	551988.5	96	9.82	3.72	3.4	-6.42	-0.32	-0.64

*Note that 28a-c baseline is September 2009.