

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

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

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## Abbreviations and Acronyms

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

## Water Levels Used in Interpretation of Changes

Water Level Parameter	Water Level (m AOD)
	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.

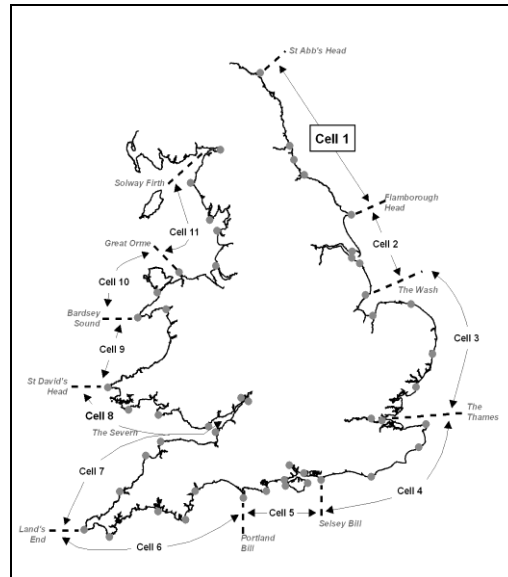


## Glossary of Terms

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
- walk-over 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 (*)	

(\*) The present report is **Update Report 9** and provides an analysis of the 2017 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:

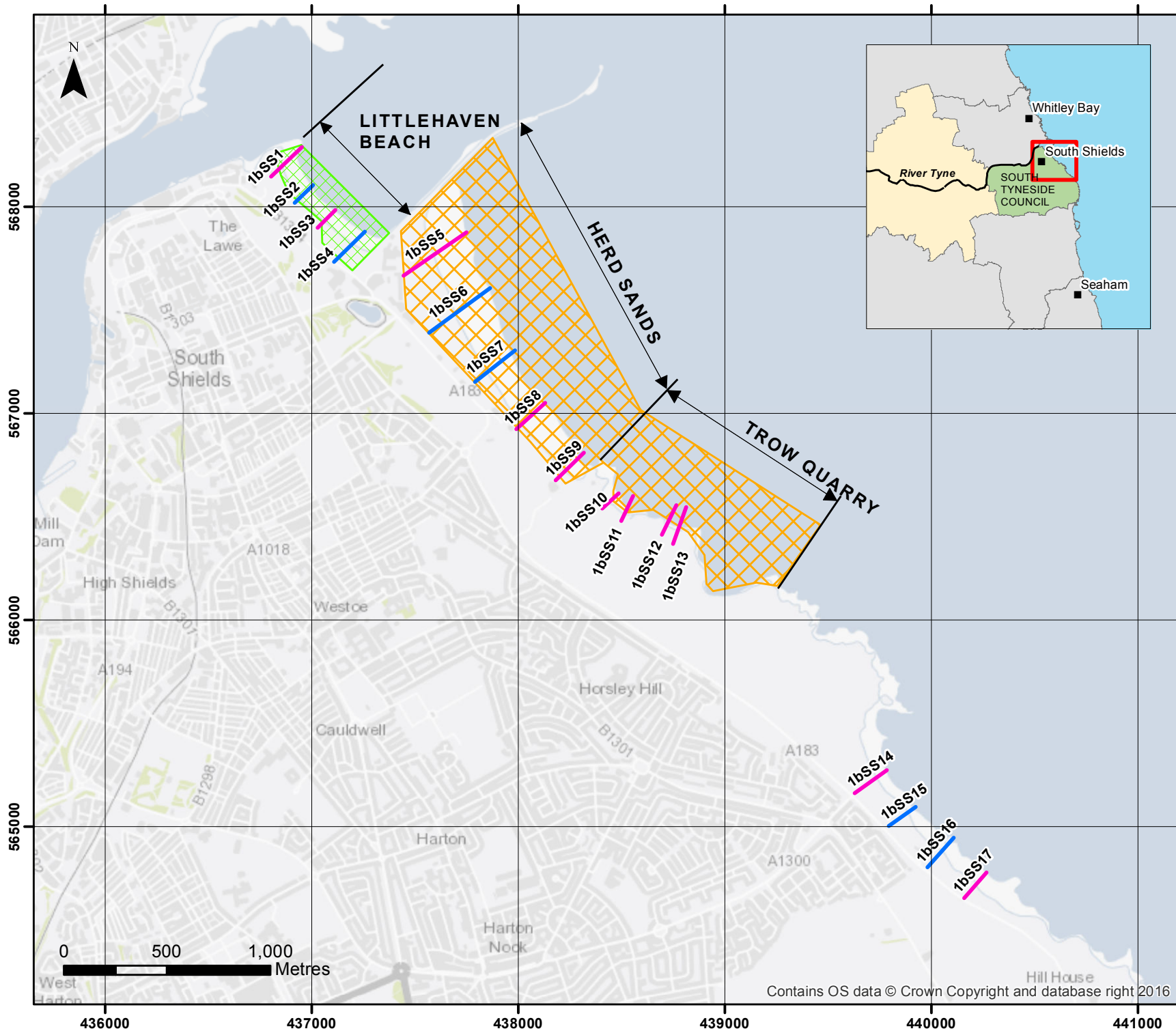
- Full Measures survey annually each autumn comprising:
  - Beach profile surveys along 58 transect lines (commenced 2009)
  - Topographic survey at Whitburn Bay (commenced 2009)
  - Topographic survey at Hendon to Ryhope (including Halliwell Banks) (commenced 2009)
- Partial Measures survey annually 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 26<sup>th</sup> and 27<sup>th</sup> April 2017 (Hendon to Ryhope, including Halliwell Bank) and 24<sup>th</sup> April 2017 (Whitburn Bay). 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**

**South Tyneside Council Frontage**

Analytical Report  
Topo Surveys

Drawing Scale at A4 1:25,000

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

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



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## 2. Analysis of Survey Data

### 2.1 Whitburn Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
24 <sup>th</sup> April 2017	<p><b>Beach Profiles:</b></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 autumn 2016.</p> <p><b>1bSNN1</b> is just to the south of Sunderland City Council's northern boundary. Since the last survey the backshore above HAT has changed little. From chainage 45m seawards the beach shows a drop in levels of up to 0.6m, but more typically 0.2m. Overall the profile is at a medium level compared to the range recorded from previous surveys.</p> <p><b>1bSNN7</b> is at Seaburn, north of Parson's Rock. Beach levels in front of the seawall have fallen by up to 0.4m. The rest of the profile shows small amounts of alternating accretion and erosion of &lt;0.2m, with accretion at the toe of the beach. Overall this profile is at a medium-high level compared to the range recorded from previous surveys.</p> <p><b>1bSNN10</b> is located mid-way between Parson's Rock and Roker Pier. There has been alternating accretion and erosion along the profile, with erosion of 0.2m from the base of the seawall to chainage 25m, and up to 0.4m between chainage 64m and 120m. Erosion of up to 0.6m has occurred between chainage 25m and 65m, and seawards of chainage 120m. The overall effect has been to steepen the upper beach, whilst flattening the middle beach. The profile is at a relatively medium level for the upper and lower beach compared to the range recorded from previous surveys but at its lowest recorded level for the middle beach between chainage 30m and 60m.</p>	<p>Along the length of Whitburn Bay beaches have been dynamic, experiencing reductions in beach level.</p> <p><b>Longer term trends:</b> Profiles in Whitburn Bay are within the bounds of previous surveys, with all being at medium to low levels.</p>

## 2.2 Hendon to Ryhope (incl. Halliwell Banks)

Survey Date	Description of Changes Since Last Survey	Interpretation
April 2017	<p><b>Beach Profiles:</b></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 autumn 2016.</p> <p>Profile <b>1bSNS4</b> includes a seawall and rock revetment, after which it extends across boulders to low water. This profile was removed from the survey in the previous Full Measures survey.</p> <p>Profile <b>1bSNS8</b> extends across the seawall, rock revetment, and sandy beach. Beach levels between the toe of the rock revetment and 60m chainage have increased by up to 0.3m, with a berm forming at chainage 47m. Seaward of 60m chainage, the elevation of the beach has reduced by up to 0.4m. The combined effect has been to steepen the beach. Overall the beach is at a medium level compared to the range recorded from previous surveys.</p> <p>Profile <b>1bSNS11</b> starts at the coastal slope backing the sea wall and extends over the rock armour and beach. Beach levels have increased from the sea defences to chainage 90m by up to 0.8m, but more typically 0.4m. Seawards of chainage 90m the beach levels have dropped by 0.2m exposing rock. Overall the profile is at a relatively high level compared to the range recorded from previous surveys, with the section between chainage 76m and 87m being the highest on record.</p> <p>Profile <b>1bSNS20</b> is located at Shirley Banks. There has been very little change on this profile, <math>\pm 0.1</math>m, with rock exposed along much of the profile length. Overall the profile is at a high-medium level compared to the range recorded from previous surveys.</p> <p>Profile <b>1bSNS25</b> 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 a small accumulation of material at the toe of the cliff, up to 0.4m. Between chainage 70m and 90m there has been erosion of up to 0.4m exposing the rock c.5m further up the beach than the previous survey. There has also been erosion of up to 0.8m between chainage 105m and 130m, further exposing rock compared to the previous survey. Seawards of chainage 135m there has been accretion at the toe of the beach of 0.2m. The upper beach is at a relatively medium level compared to the range recorded from previous surveys, where the rock has been exposed since the previous survey the beach level is relatively low, whilst the toe of the beach</p>	<p>At South Hendon (1bSNS8 and 1bSNS11), sand levels have increased in the upper beach but fallen in the lower beach.</p> <p>At Profile 1bSNS20 only minor changes have occurred since the previous survey.</p> <p>At profile 1bSNS25, has experienced a general fall in beach level since the previous survey, with the exception of the toe of the beach, but this fall is relatively limited.</p> <p>At the landfill site (profiles 1bSSN26 to 1bSSN33) the cliff there has seen some apparent erosion of the cliff toe and a more limited amount at the cliff top. There appears to have been quite a consistent reduction in the elevation of the upper beach, with little change/small slight accretion at the toe of the beach.</p> <p><b>Longer term trends:</b> 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 and a more limited amount of cliff top change. Overall the beach levels are medium compared to past surveys.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>which has accreted is at a relatively high level.</p> <p>Profiles <b>1bSNS26</b> to <b>1bSNS33</b> 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 <b>1bSNS26</b>, there has been apparent recession of the cliff face by c.0.5m. There is an accumulation of gravel at the base of the cliff up to 1.0m deep and c.5m wide. Between chainage 100m and 185m there has been erosion of up to 0.6m, exposing rock between chainage 130m and 165m. Seawards of chainage 185m there has been slight increase in levels at the toe of the beach of &lt;0.2m. Overall the profile is at a medium level in the upper and lower beach compared to the range recorded from previous surveys, the middle beach where the rock is exposed is at a low level.</p> <p>At <b>1bSNS27</b> the beach has behaved in a similar way to <b>1bSNS26</b> showing a reduction in level across the beach of up to 0.7m, but more typically 0.2-0.4m. Rock has been exposed between chainage 125m and 135m. There is little change at the toe of the beach, with the possibility of some slight accretion. Overall the profile is at a medium-low level compared to the range recorded from previous surveys.</p> <p>At <b>1bSNS28</b>, the beach has behaved in a similar way as at 1bSNS26 and 1bSNS27, with erosion of up to 0.6m. Overall the profile is at a medium level compared to the range recorded from previous surveys.</p> <p>At profiles <b>1bSNS29</b>, the toe of the cliff appears to have retreated by c.1m, with an accumulation of gravel at the toe up to 0.2m deep and c.10m wide. Between chainage 100m and 190m there has been erosion of up to 0.7m. There is little change at the toe of the beach, with the possibility of some slight accretion. Overall the profile is at a medium-low level compared to the range recorded from previous surveys.</p> <p>At <b>1bSNS30</b>, there has been erosion of up to 0.6m of the upper beach between chainage 100m and 140m. Seawards of chainage 140m there has been very little change, <math>\pm 0.2</math>m. Overall the profile is at a relatively medium level compared to the range recorded from previous surveys.</p> <p>Profile <b>1bSNS31</b> has behaved in a similar manner as 1bSNS30, with erosion of up to 0.5m between chainage 95m and 140m, and very little change, <math>\pm 0.2</math>m, seawards of chainage 140m. Overall the profile is at a relatively medium level compared to the range recorded from previous surveys.</p> <p>At <b>1bSNS32</b> the cliff toe has retreated by c.2.5m with the debris from a recent fall present at the toe of the cliff. Between chainage 102m and 133m there has been erosion of up to 0.4m. Between chainage</p>	



Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>133m and 150m there has been accretion of up to 0.4m, infilling a hollow in the profile from the previous survey. Seawards of chainage 150m there has been very little change, <math>\pm 0.2\text{m}</math>. Overall the profile is at a relatively medium level compared to the range recorded from previous surveys.</p> <p>At <b>1bSNS33</b>, the beach has behaved in a similar way as profile 1bSNS32, with erosion of up to 0.4m between the toe of the cliff and chainage 95m, accretion of up to 0.6m infilling a hollow in the previous survey between chainage 95m and 120m, and very little change, <math>\pm 0.2\text{m}</math>, seawards of chainage 120m. Overall the profile is at a relatively medium level compared to the range recorded from previous surveys.</p>	
<p><b>27<sup>th</sup> April 2017</b></p>	<p><b>Cliff-top Survey:</b></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. 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 <math>\pm 0.2\text{m}</math> 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 (October 2016) cliff top surveys.</p> <p>Results show that since the last survey, only one location has shown erosion greater than the anticipated survey error; Point 11 by 1.85m. There are however several locations which have recorded negative erosion (Points 8, 9, 10, 13, 17, 18, 19, 23, 25, and 26, with recorded erosion of -0.2m to -0.3m, and point 22 with erosion of -0.9m), this is likely to be caused by the difficulty in determining the edge of the cliff top through vegetation, and where the break in slope is less obvious.</p> <p>Since surveys began in March 2009 (or September 2009 for 28A, 28B, and 28C) erosion greater than</p>	<p>Since the last survey, the cliffs at Point 11 have eroded by 1.85m, with very little change elsewhere.</p> <p><b>Longer term trends:</b> 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 and 32 where between 6.2m and 11.4m have been lost.</p>

<b>Survey Date</b>	<b>Description of Changes Since Last Survey</b>	<b>Interpretation</b>
	the survey error has occurred at around 75% of the ground control points, where total losses are 11.4m (at location 27) at their greatest, and more typically less than 5m. The long-term erosion rates are up to 1.4m/yr (location 27), with up to 0.5m/yr being more typical.	

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

#### **Individual Profiles**

- The cliff top at profile 1bSNS11 was inaccessible due to slippy and unsafe conditions;
- 

#### **Cliff Top Surveys**

- A large section of cliff to the north of Point 8 was ready to collapse at the time of survey.

### **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.
- At Hendon to Ryhope (incl. Halliwell Banks), the greatest amount of erosion recorded to have taken place between March 2009 and April 2017 was 11.4m at point 27 which is on the northern border of the landfill site. Since the last survey, the greatest erosion has been at Point 11 (midway between Hendon and Salterfen Rocks)), where the cliff edge has receded 1.85m.
- Elsewhere at Hendon to Ryhope (incl. Halliwell Banks), the recorded profiles and cliff top surveys present no causes for concern.

## **Appendices**

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

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

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

# Beach Profile

Location: 1bSNN1

Date: 24/04/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

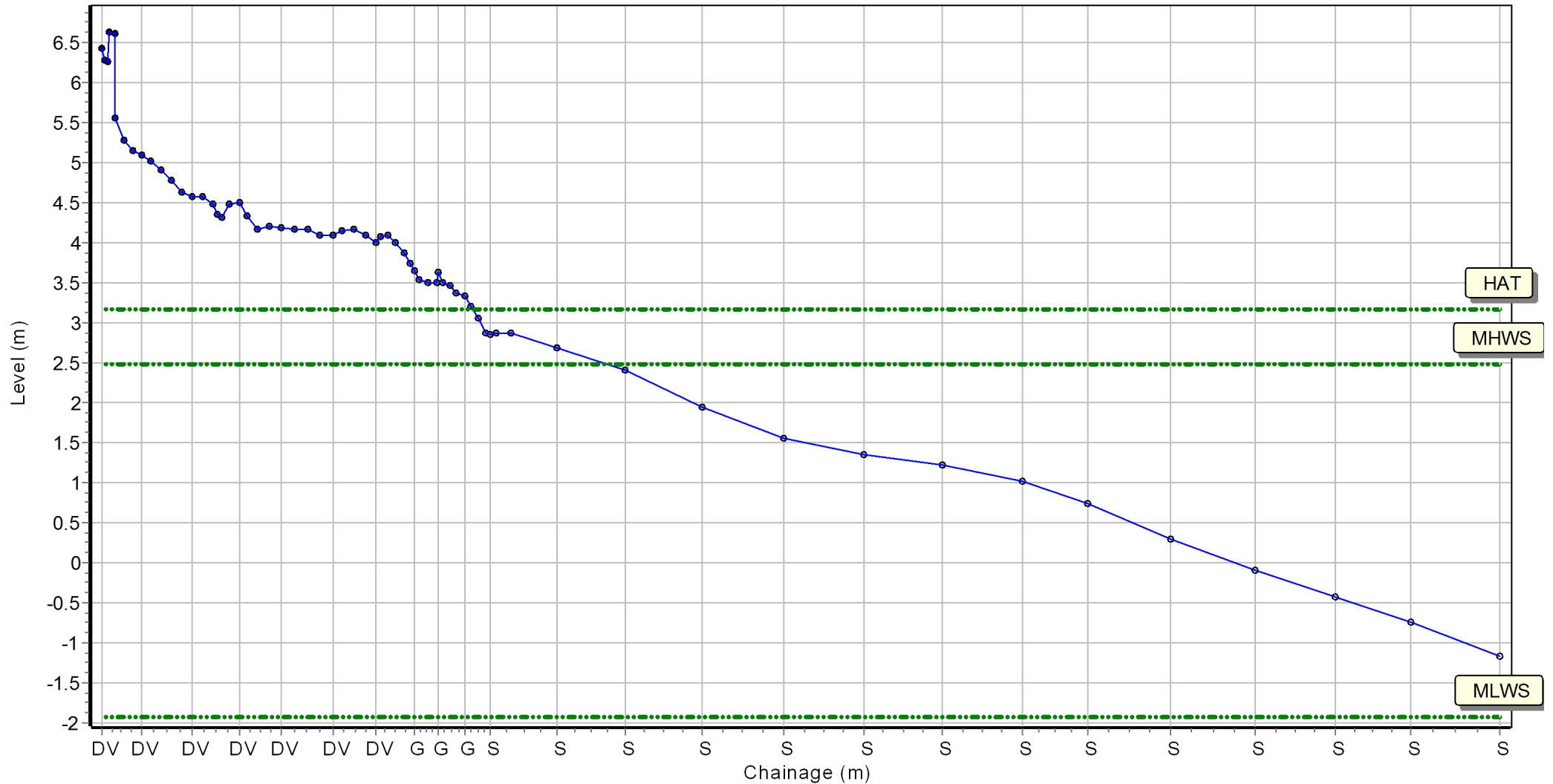
Sea State:

Visibility:

Rain:

Summary: 2017 Partial Measures Topo Survey

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



# Beach Profile

Location: 1bSNN7

Date: 24/04/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

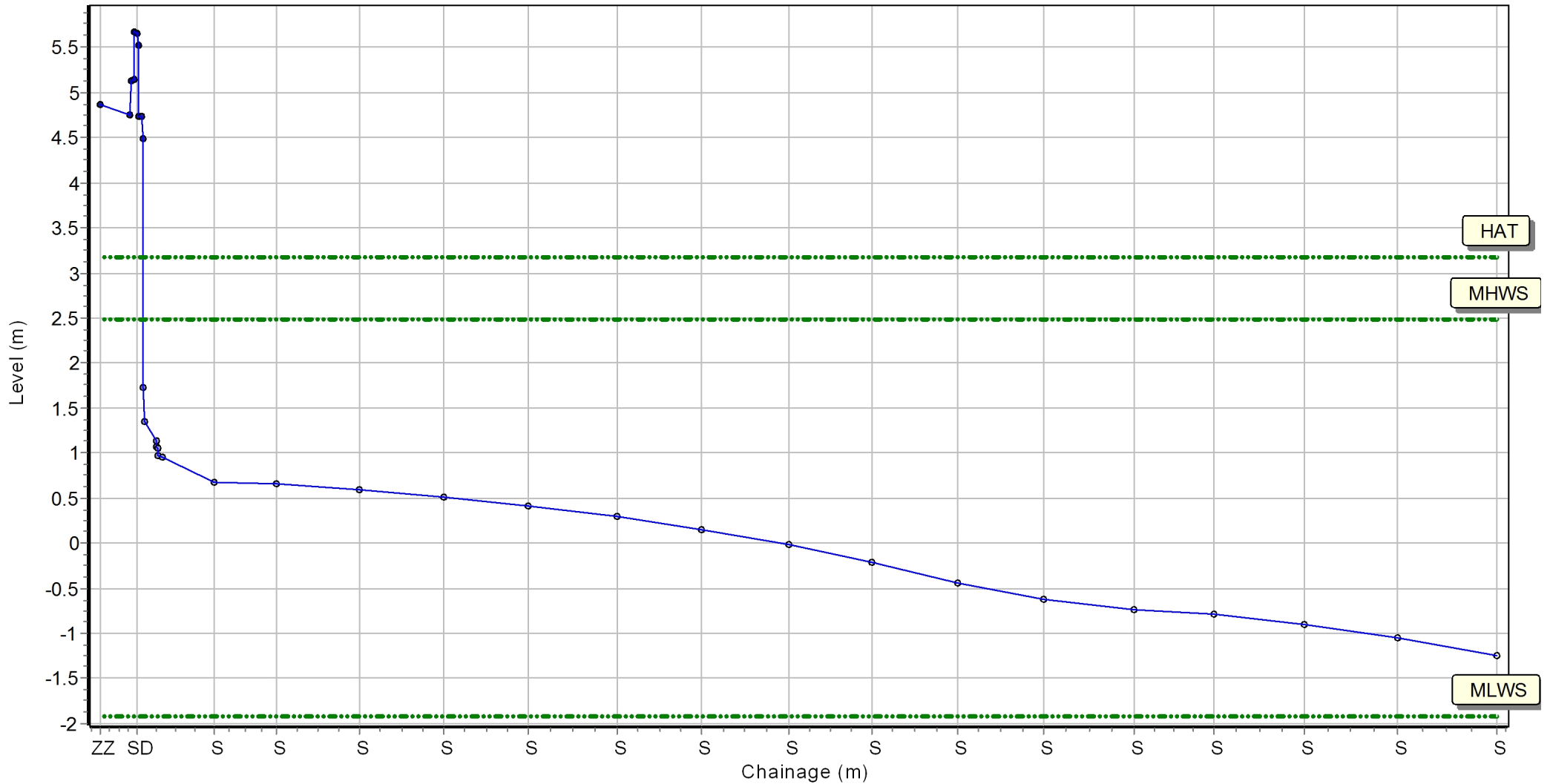
Sea State:

Visibility:

Rain:

Summary: 2017 Partial Measures Topo Survey

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





# Beach Profile

Location: 1bSNN10

Date: 24/04/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

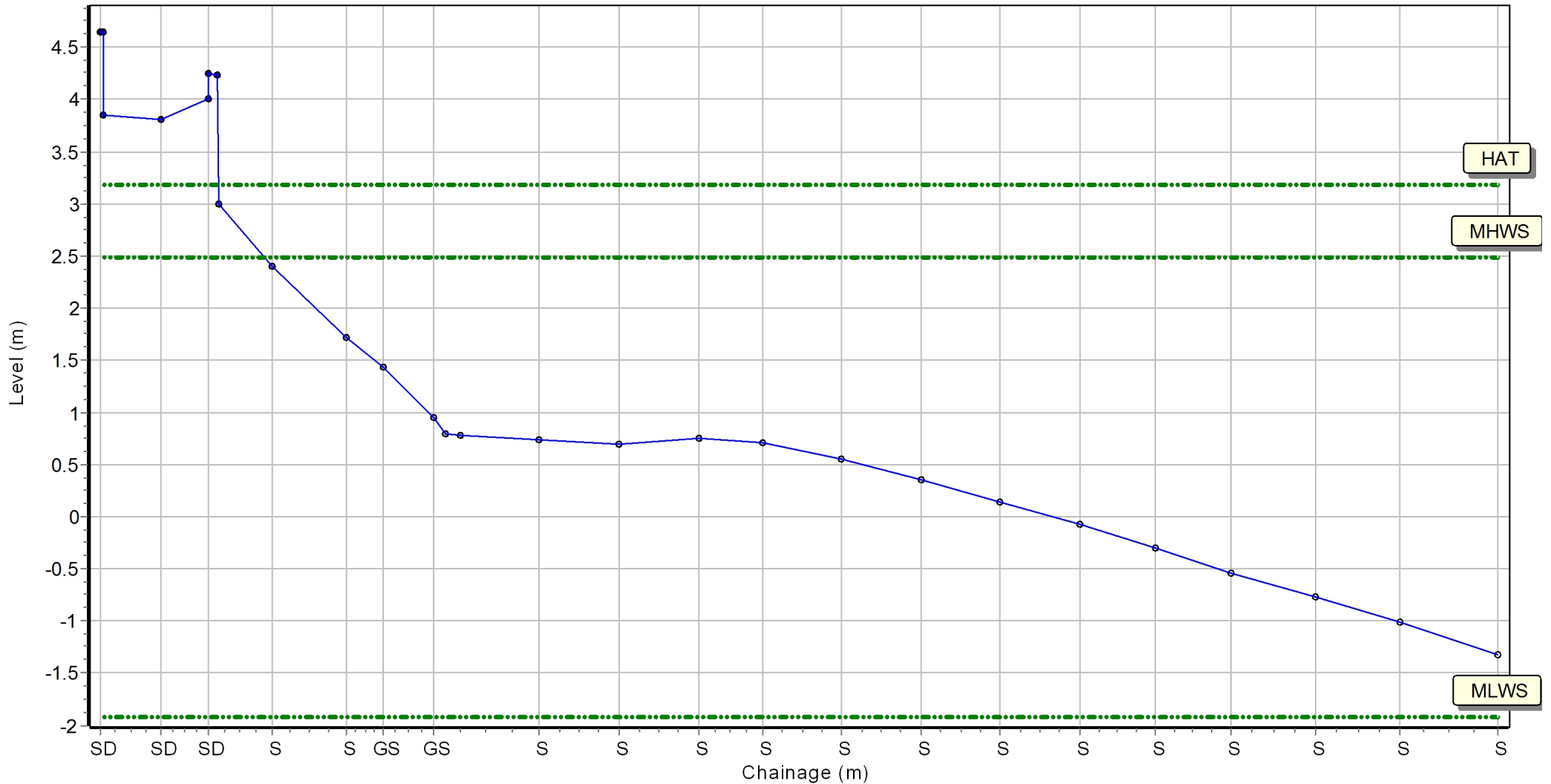
Sea State:

Visibility:

Rain:

Summary: 2017 Partial Measures Topo Survey

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



# Beach Profile

Location: 1bSNS8

Date: 27/04/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

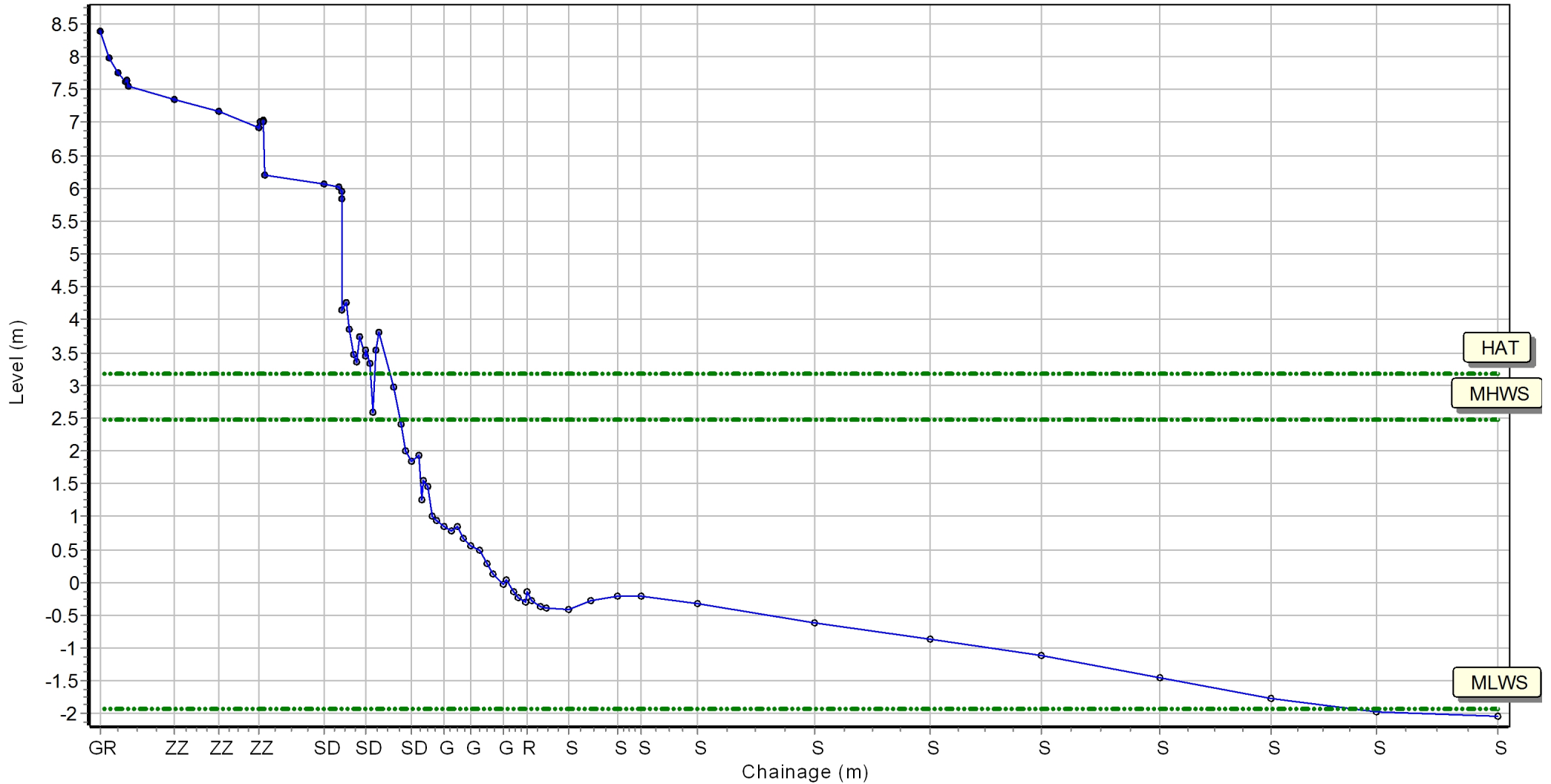
Sea State:

Visibility:

Rain:

Summary: 2017 Partial Measures Topo Survey

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



# Beach Profile

Location: 1bSNS11

Date: 27/04/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

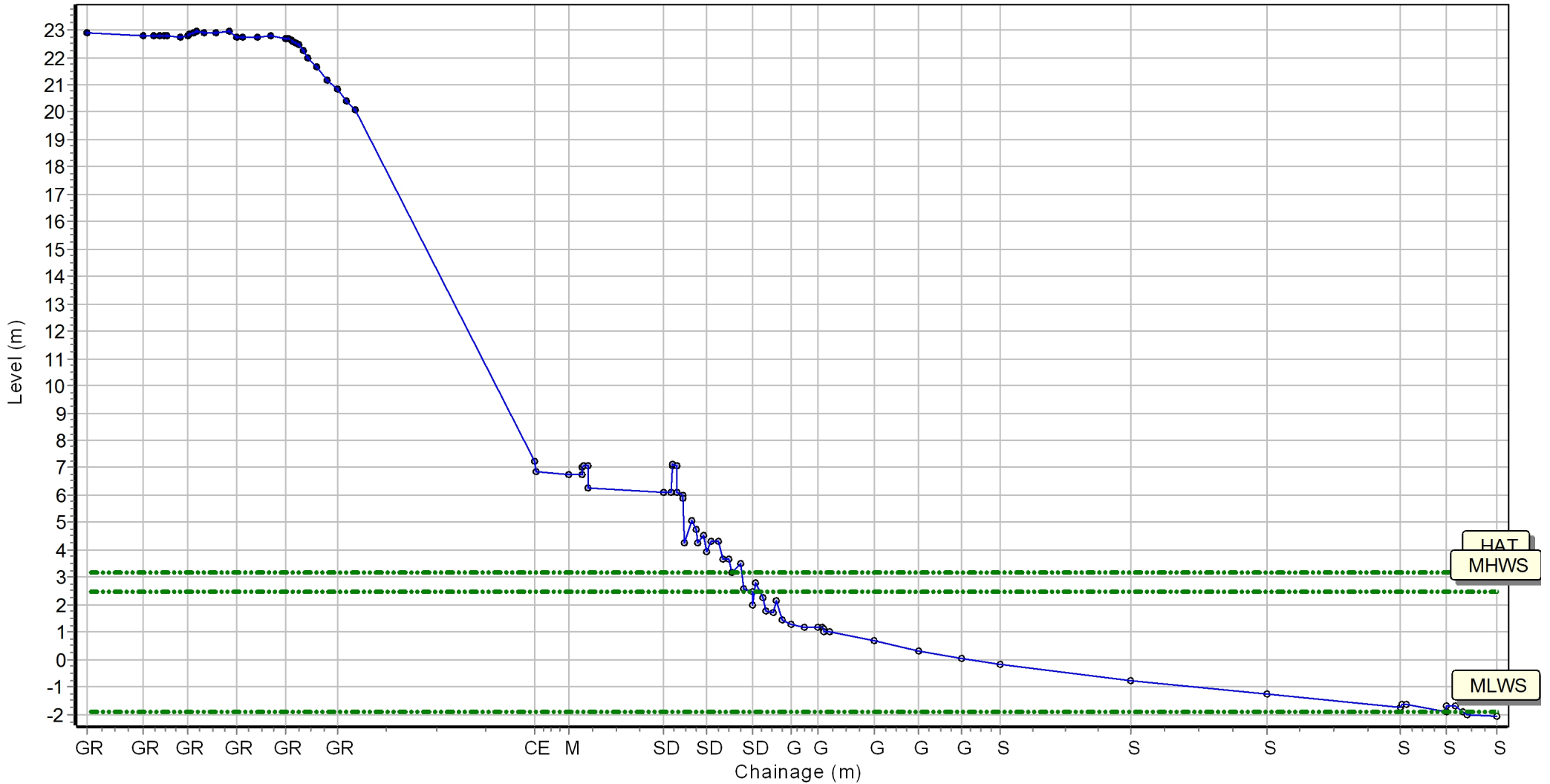
Sea State:

Visibility:

Rain:

Summary: 2017 Partial Measures Topo Survey

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



# Beach Profile

Location: 1bSNS20

Date: 27/04/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

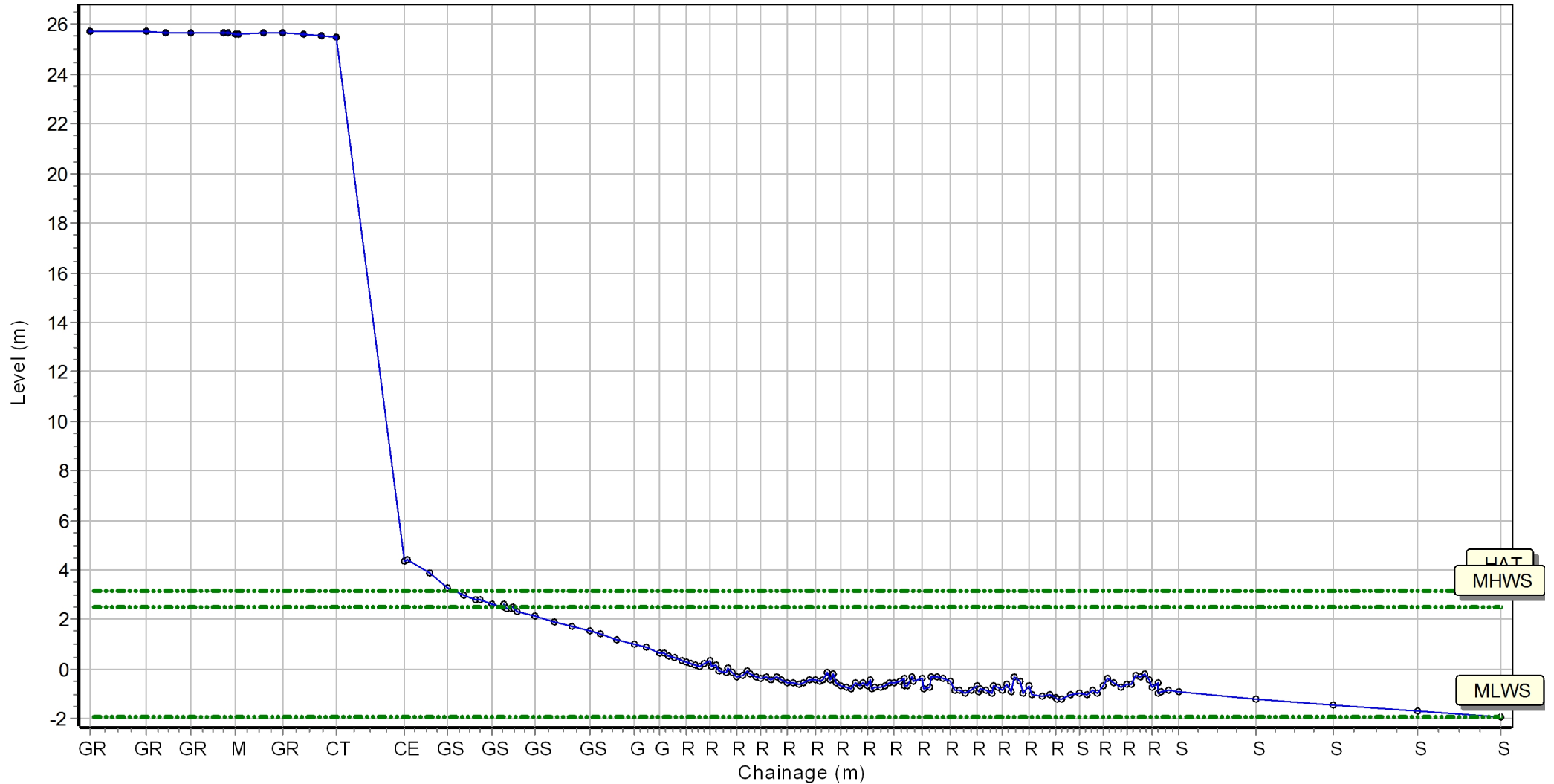
Sea State:

Visibility:

Rain:

Summary: 2017 Partial Measures Topo Survey

Easting: 441378.054 Northing: 553599.123 Profile Bearing: 81 ° from North



# Beach Profile

Location: 1bSNS26

Date: 27/04/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

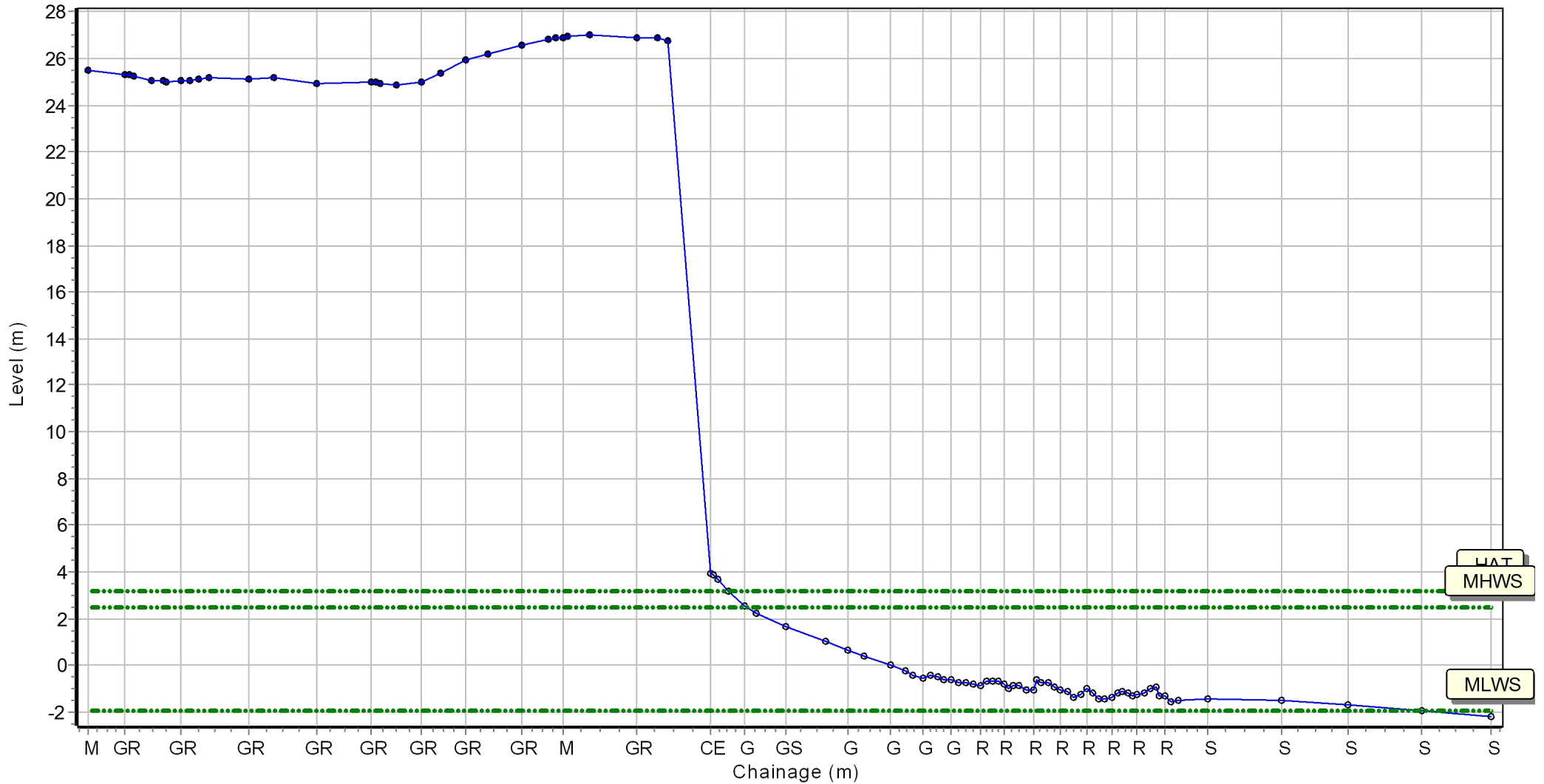
Sea State:

Visibility:

Rain:

Summary: 2017 Partial Measures Topo Survey

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



# Beach Profile

Location: 1bSNS27

Date: 27/04/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

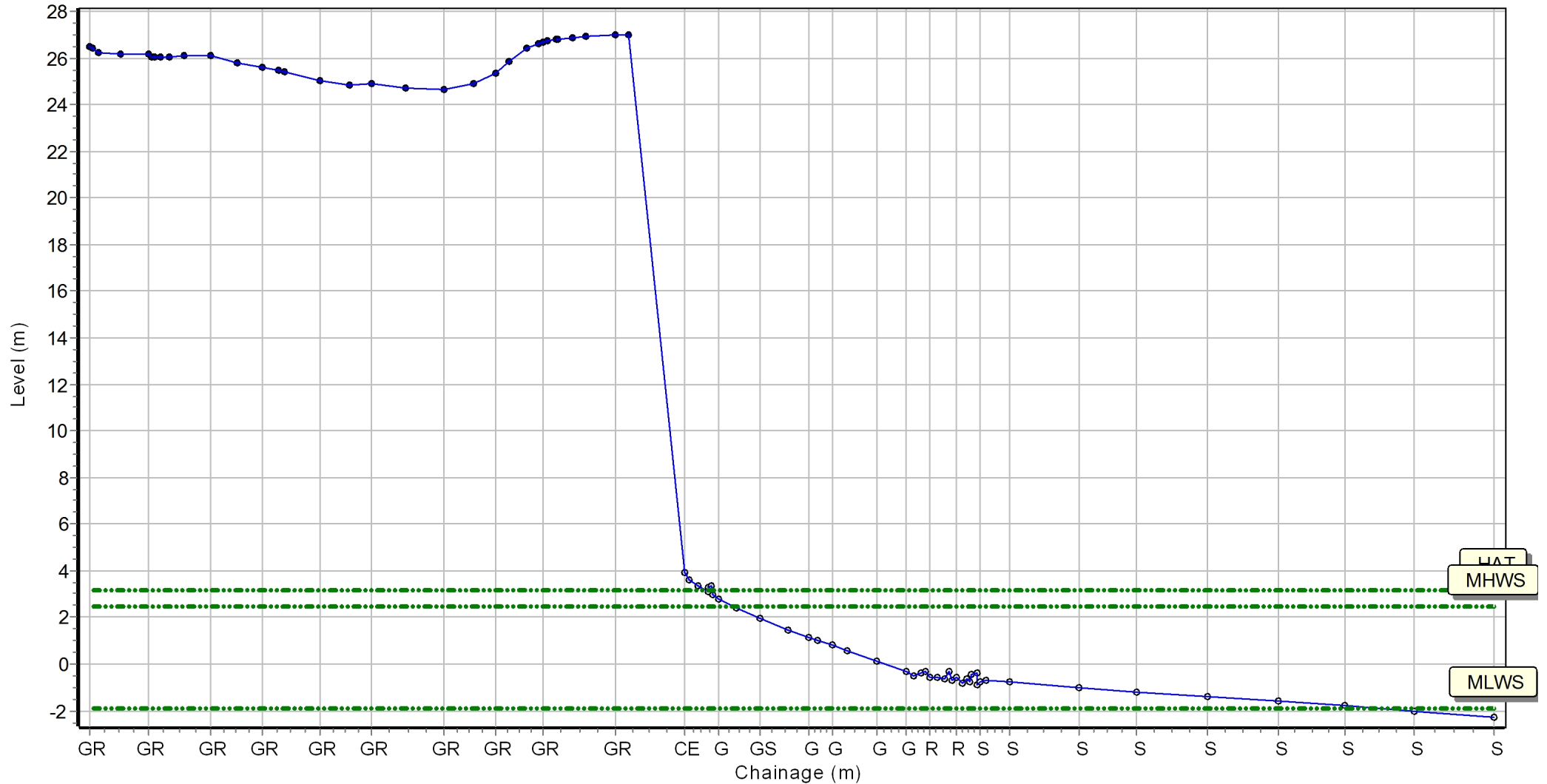
Sea State:

Visibility:

Rain:

Summary: 2017 Partial Measures Topo Survey

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



# Beach Profile

Location: 1bSNS28

Date: 27/04/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

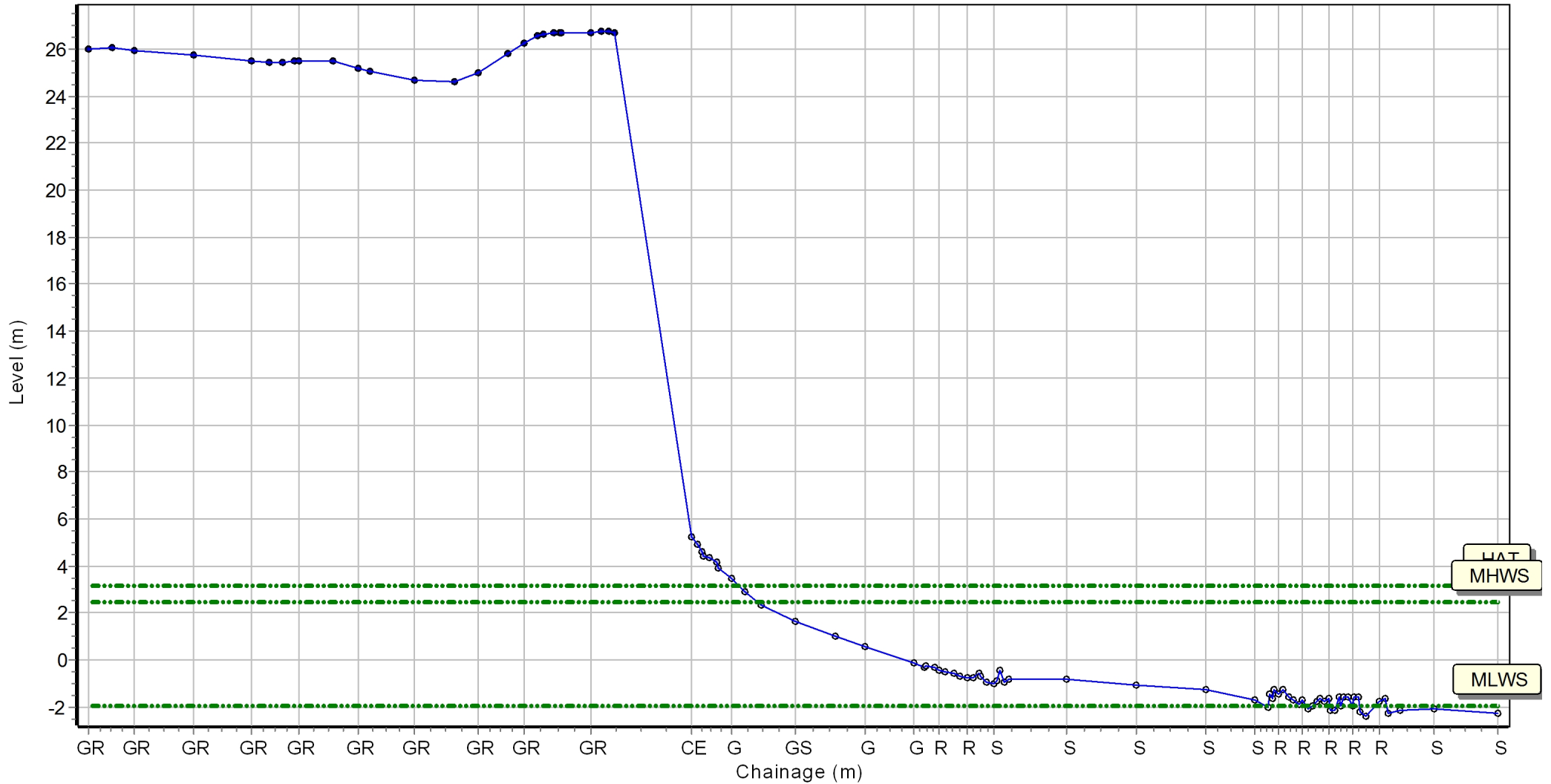
Sea State:

Visibility:

Rain:

Summary: 2017 Partial Measures Topo Survey

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



# Beach Profile

Location: 1bSNS29

Date: 27/04/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

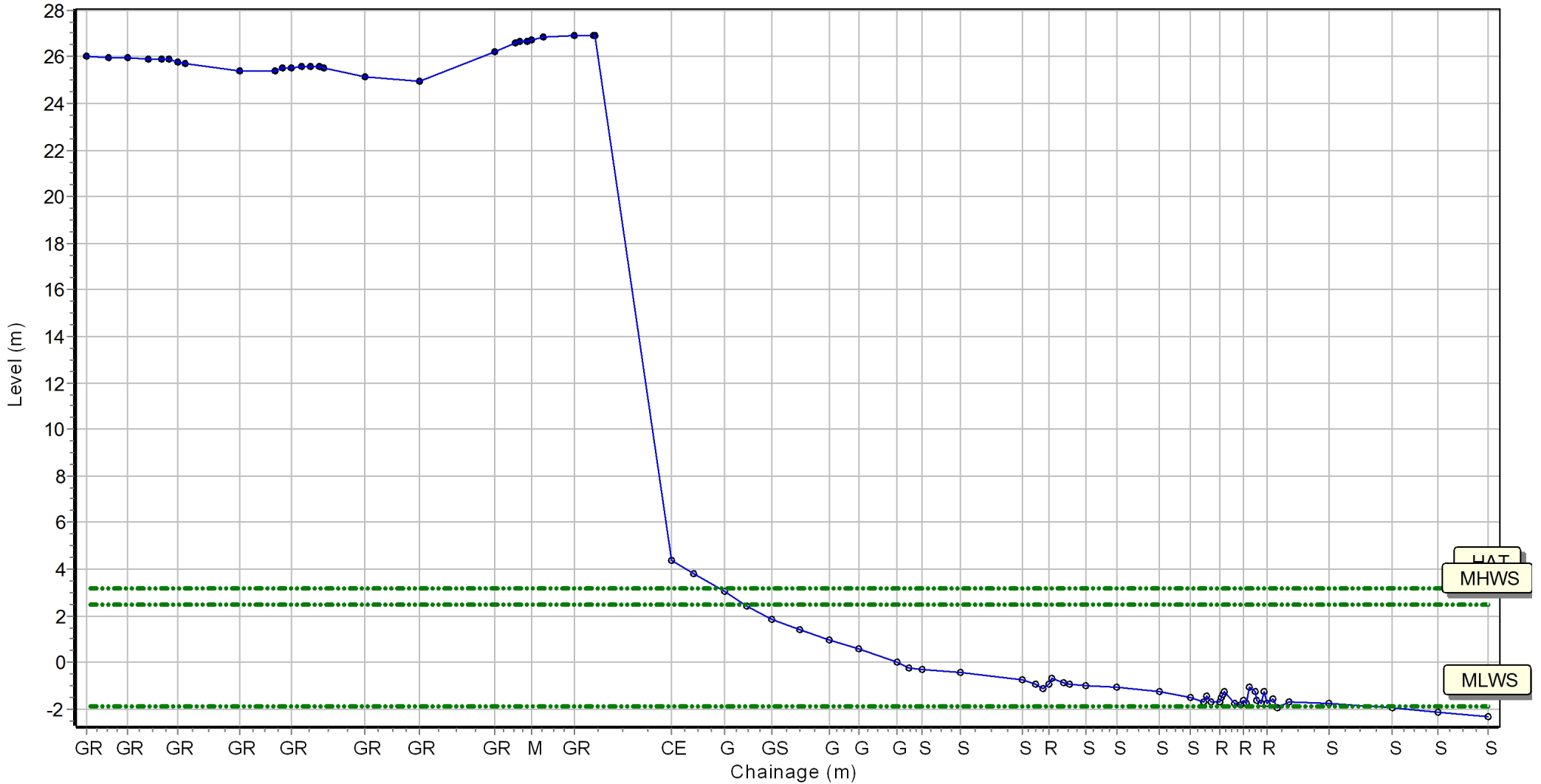
Sea State:

Visibility:

Rain:

Summary: 2017 Partial Measures Topo Survey

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





# Beach Profile

Location: 1bSNS30

Date: 27/04/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

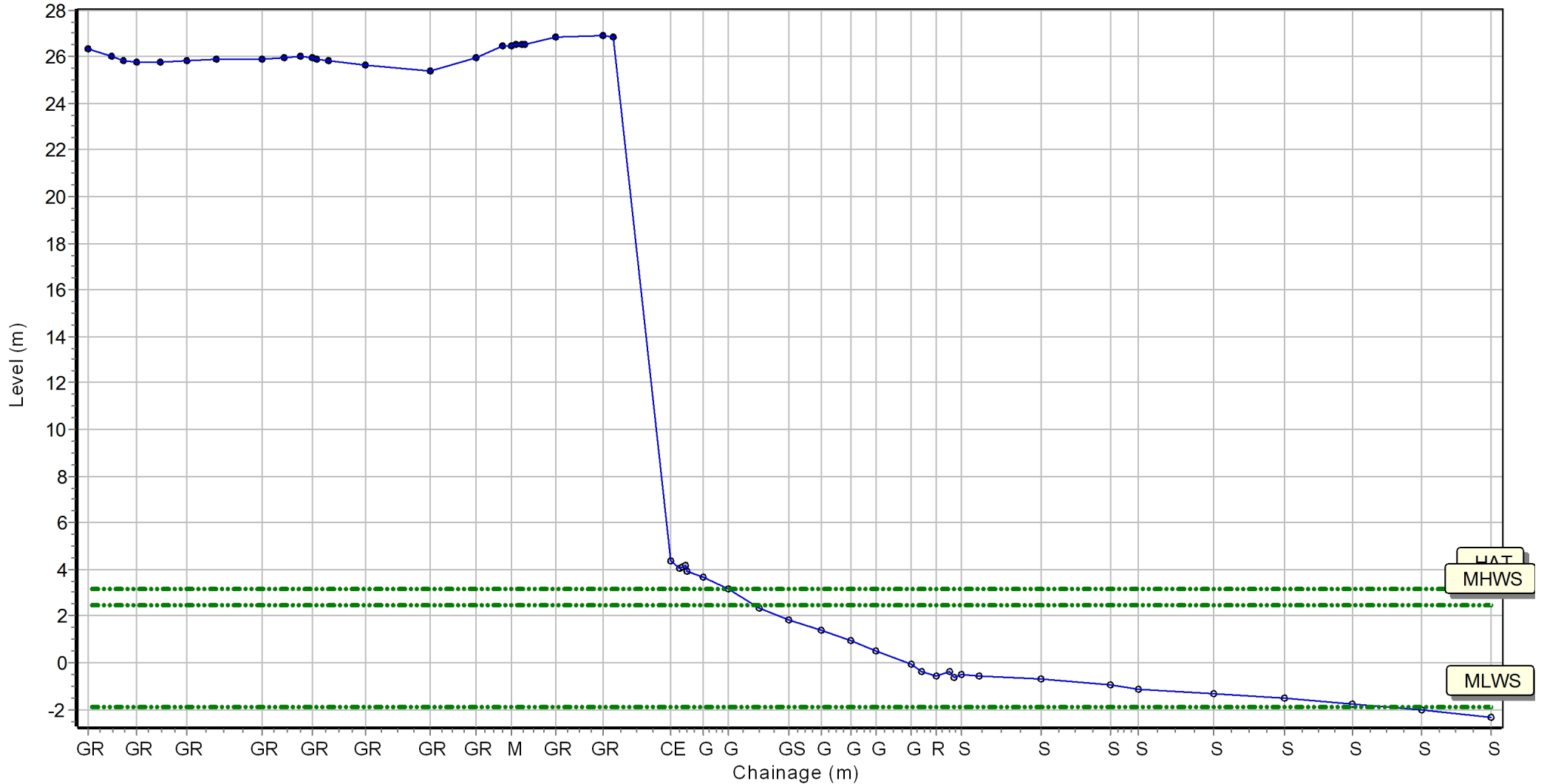
Sea State:

Visibility:

Rain:

Summary: 2017 Partial Measures Topo Survey

Easting: 441756.353 Northing: 552511.624 Profile Bearing: 60 ° from North



# Beach Profile

Location: 1bSNS31

Date: 27/04/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

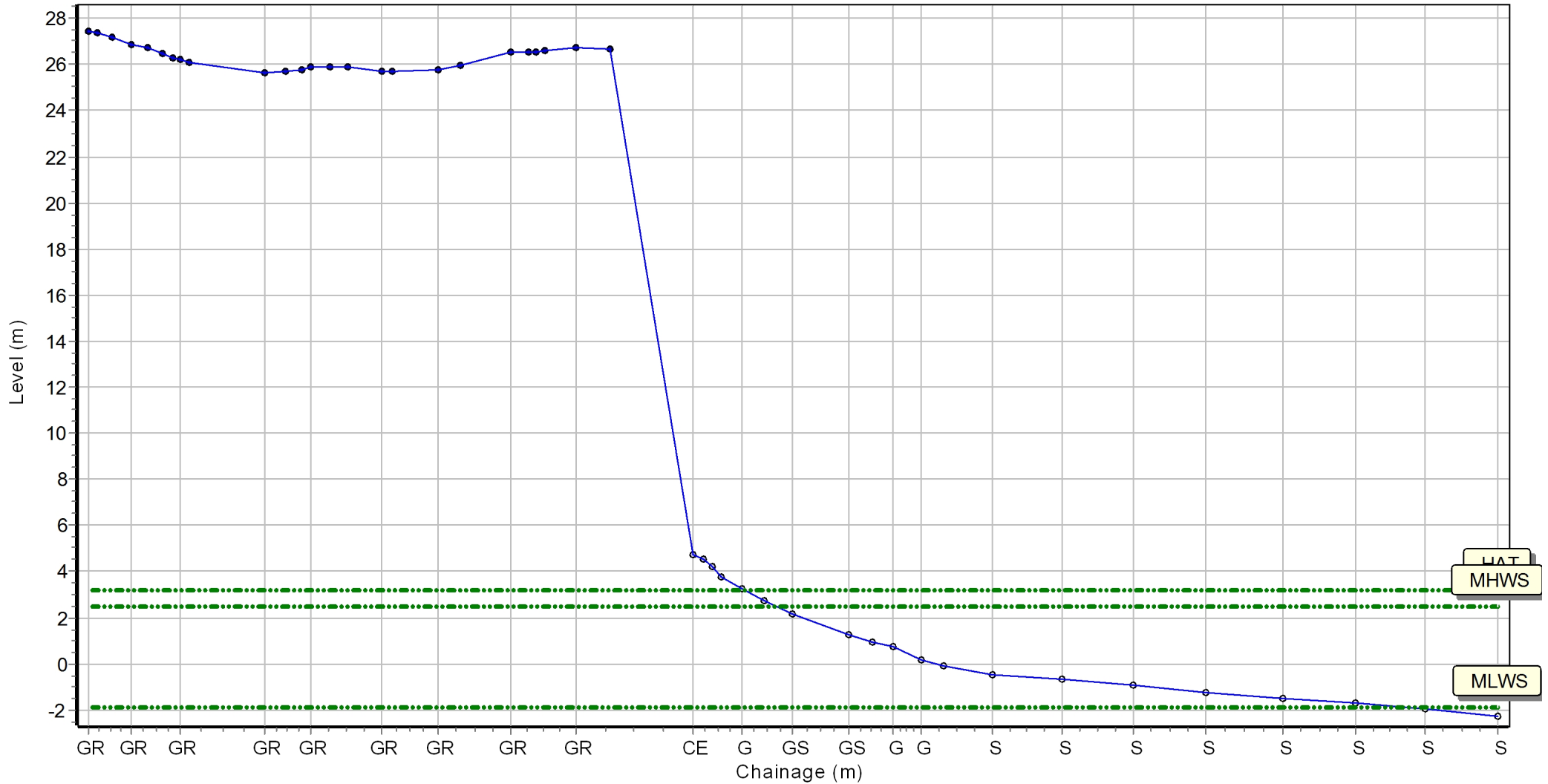
Sea State:

Visibility:

Rain:

Summary: 2017 Partial Measures Topo Survey

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



# Beach Profile

Location: 1bSNS32

Date: 27/04/2017

Inspector: AG

Low Tide:

Low Tide Time:

Wind

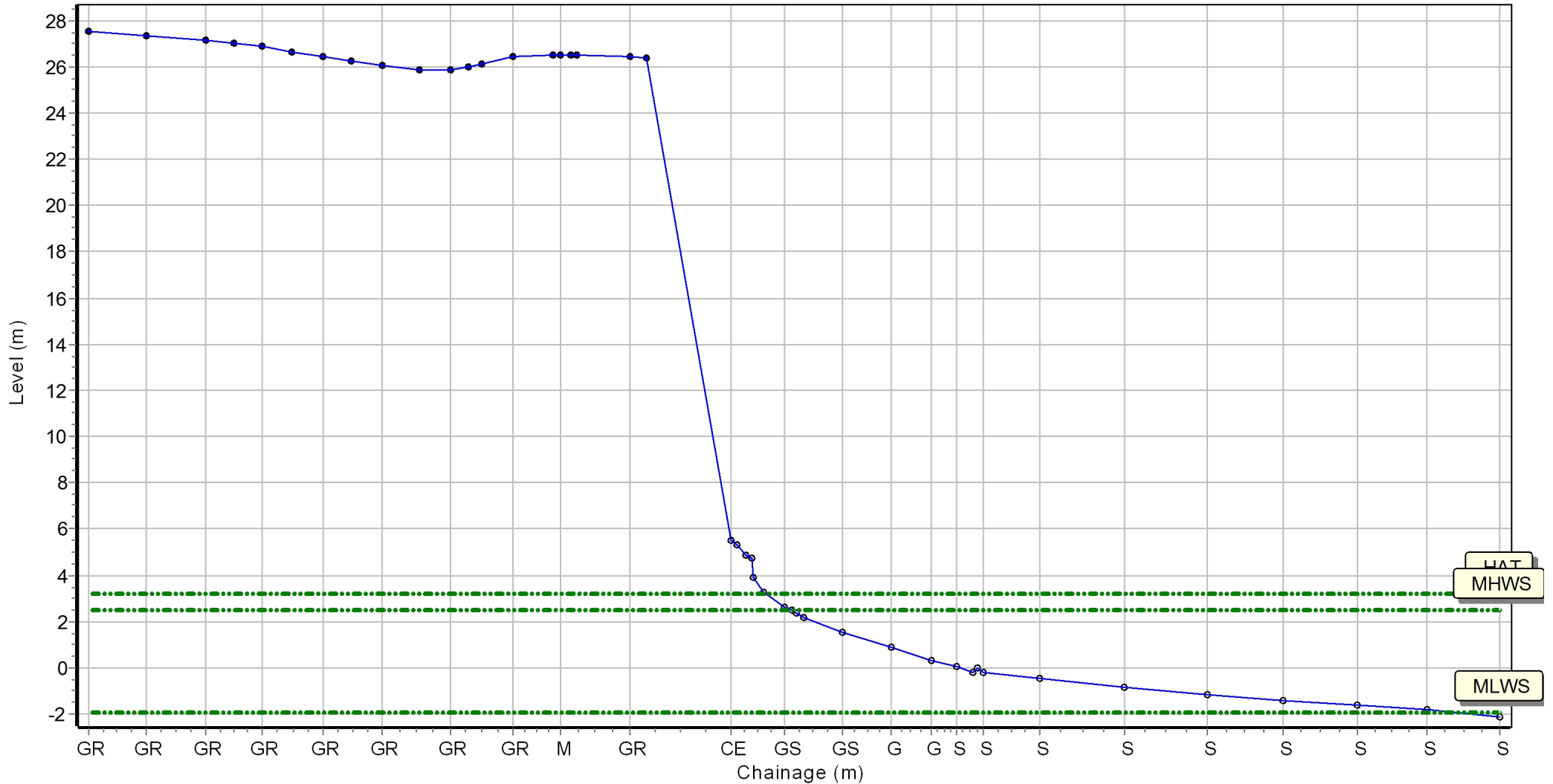
Sea State:

Visibility:

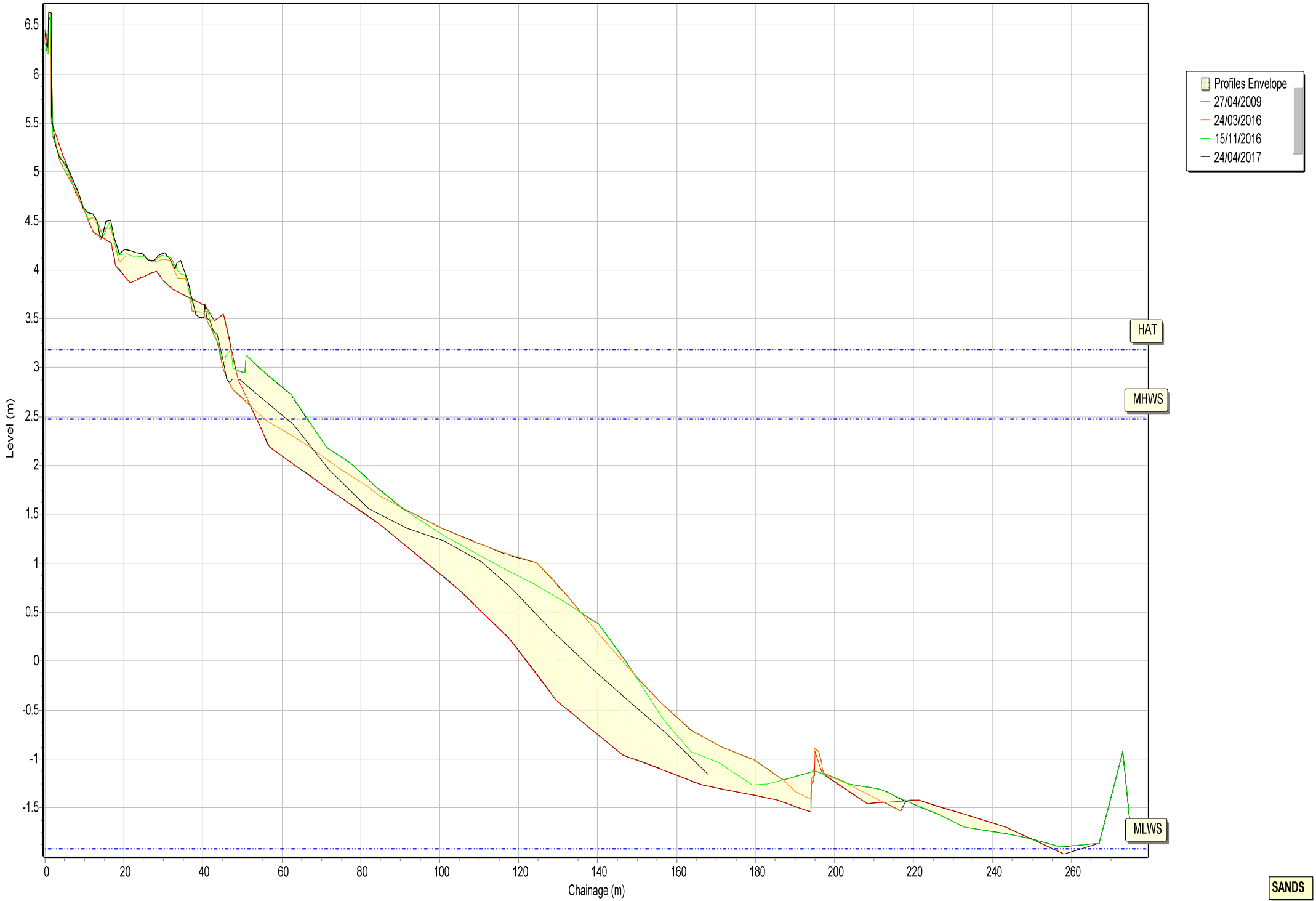
Rain:

Summary: 2017 Partial Measures Topo Survey

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

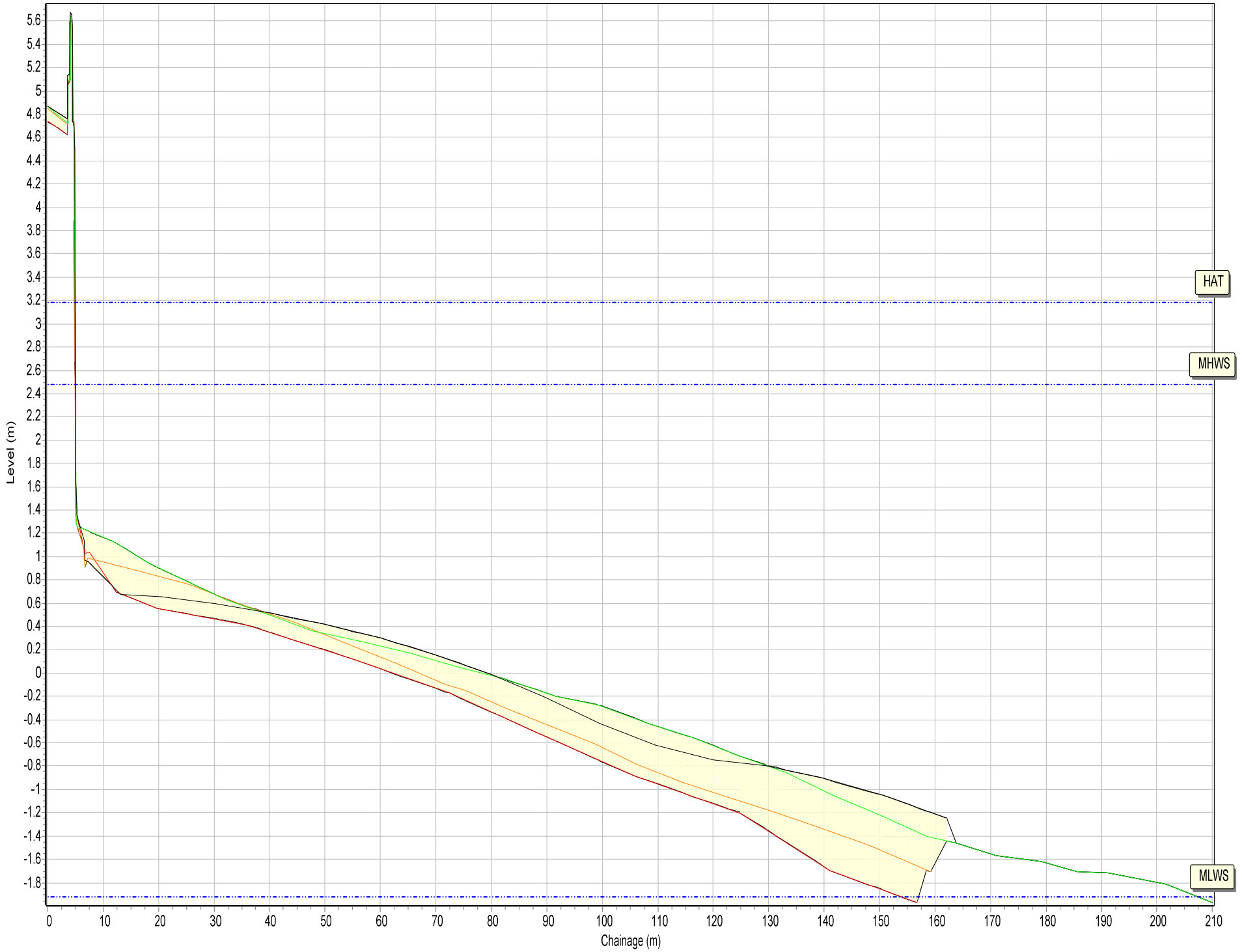


Beach Profiles: 1bSNN1



SANDS

Beach Profiles: 1bSNN7



Profiles Envelope  
27/04/2009  
24/03/2016  
15/11/2016  
24/04/2017

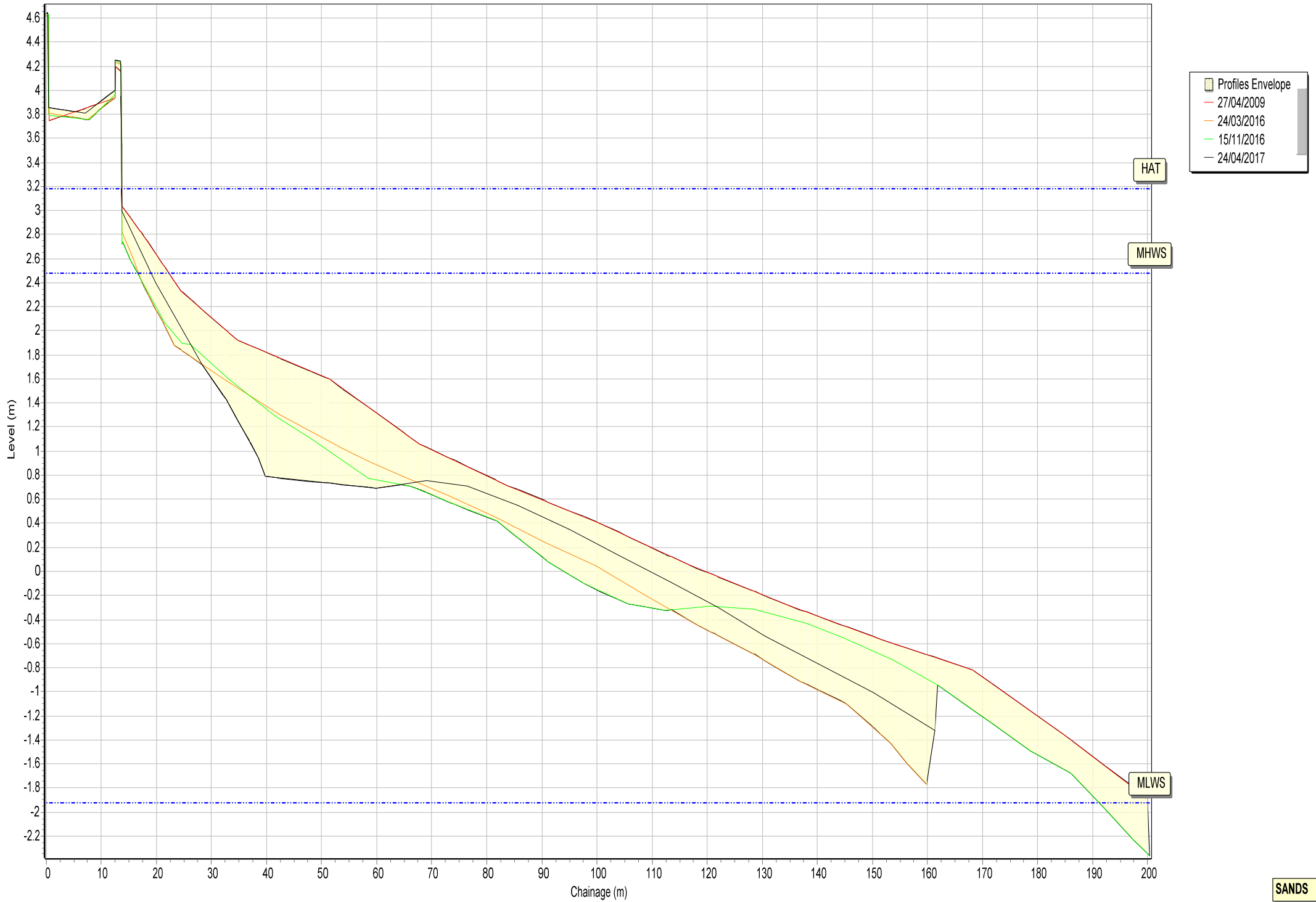
HAT

MHWS

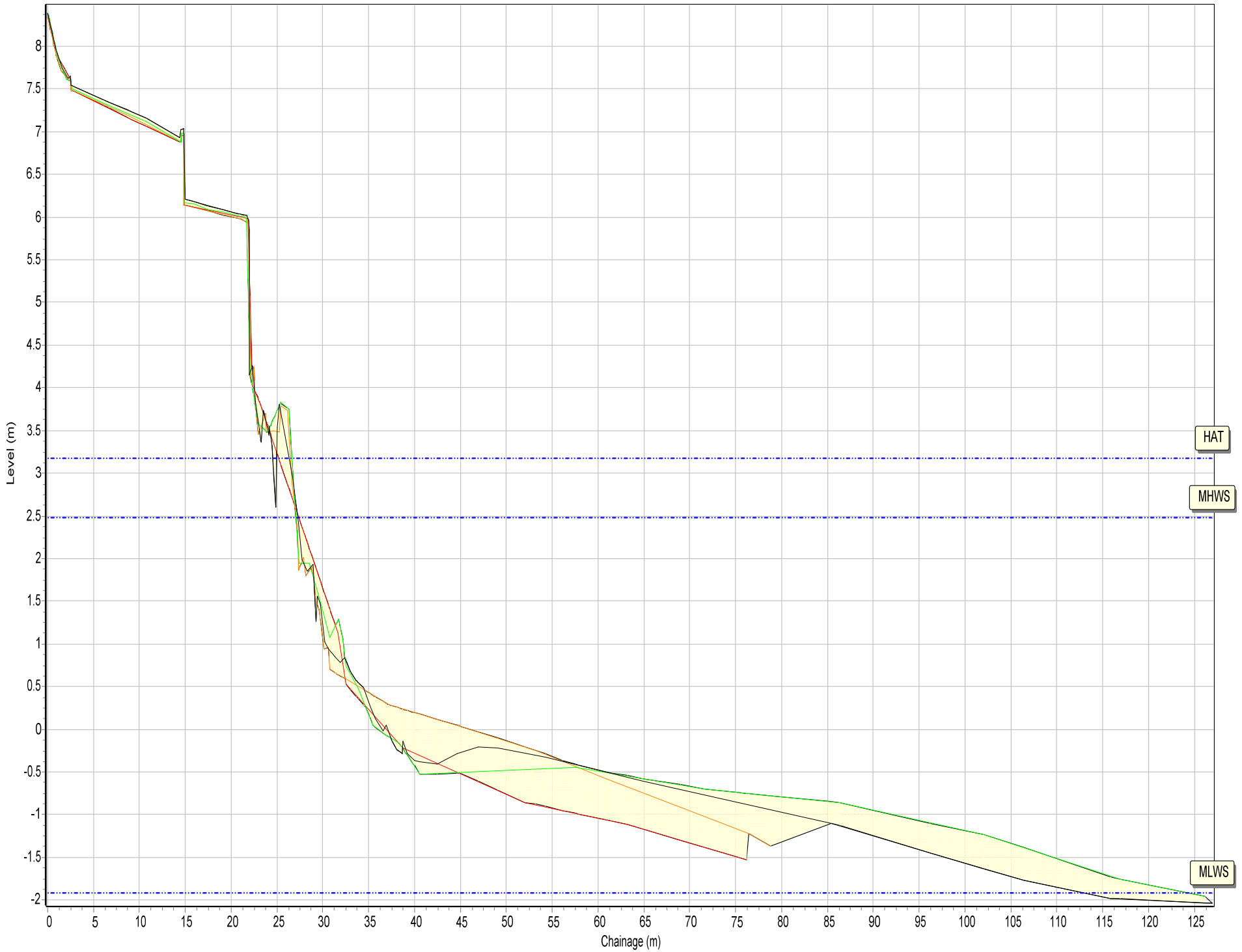
MLWS

SANDS

Beach Profiles: 1bSNN10



Beach Profiles: 1bSNS8



Profiles Envelope  
25/03/2009  
23/03/2016  
16/10/2016  
27/04/2017

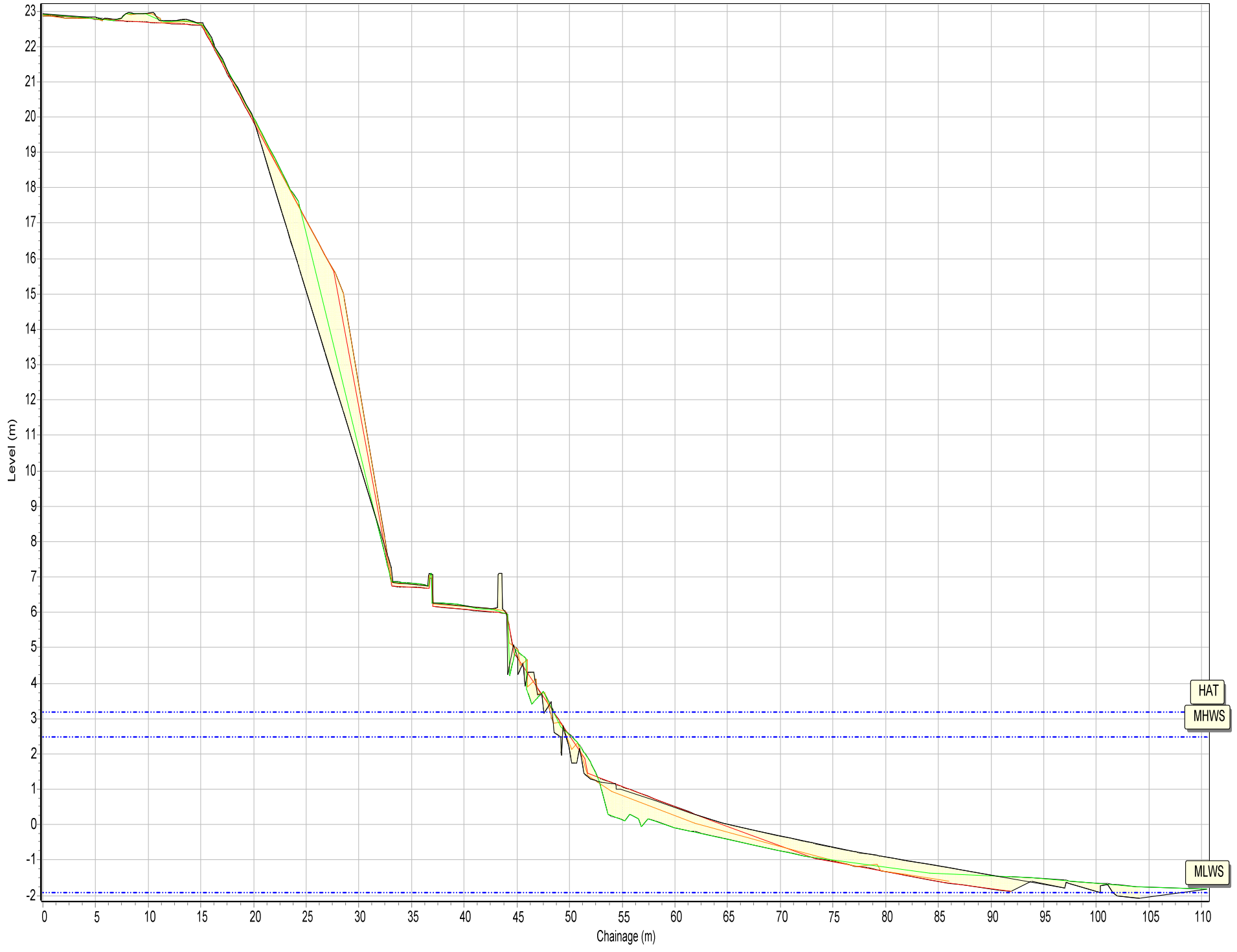
HAT

MHWS

MLWS

SANDS

Beach Profiles: 1bSNS11

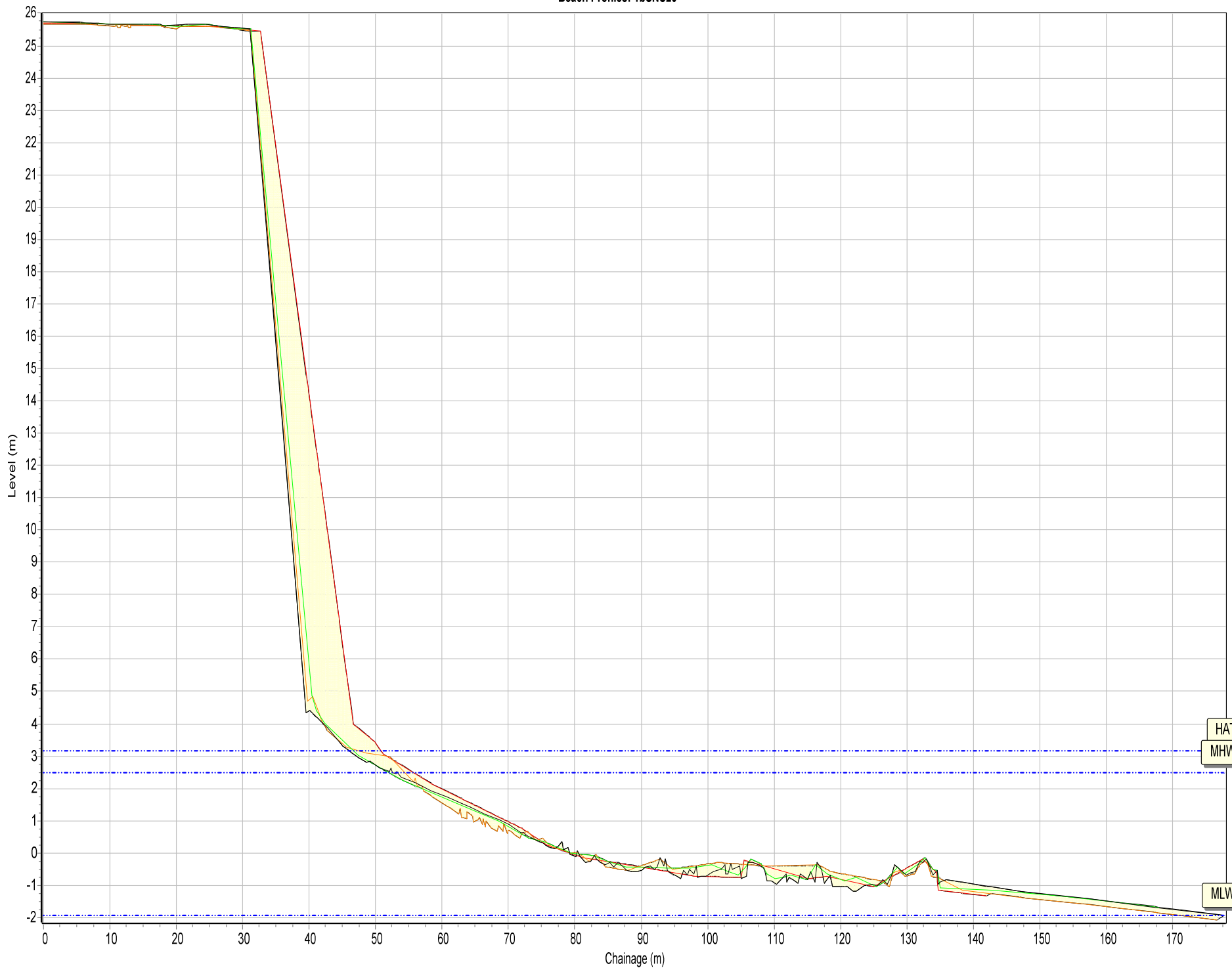


Profiles Envelope  
25/03/2009  
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16/10/2016  
27/04/2017

HAT  
MHWS  
MLWS



Beach Profiles: 1bSNS20



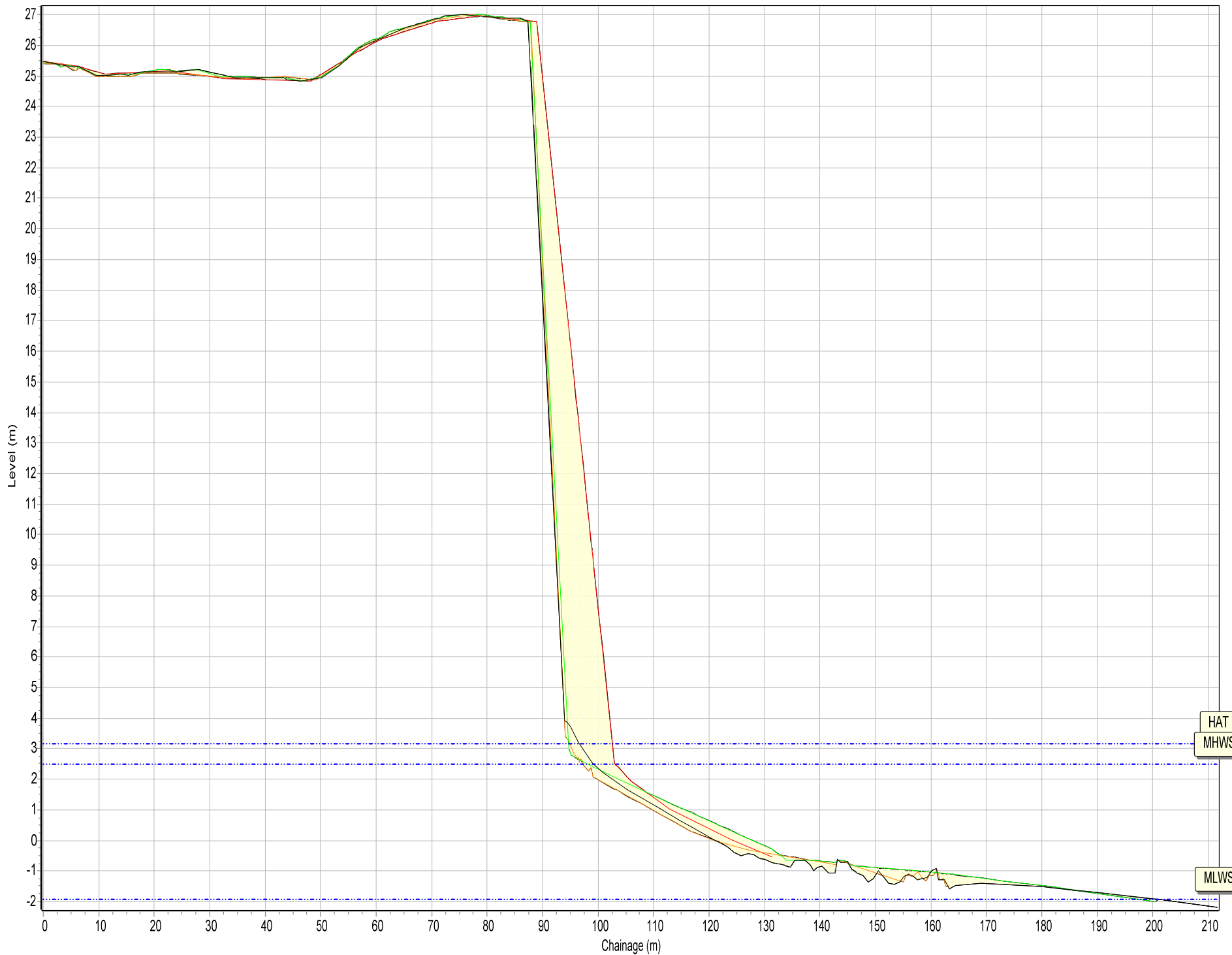
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23/03/2016  
16/10/2016  
27/04/2017

HAT  
MHWS

MLWS

SANDS

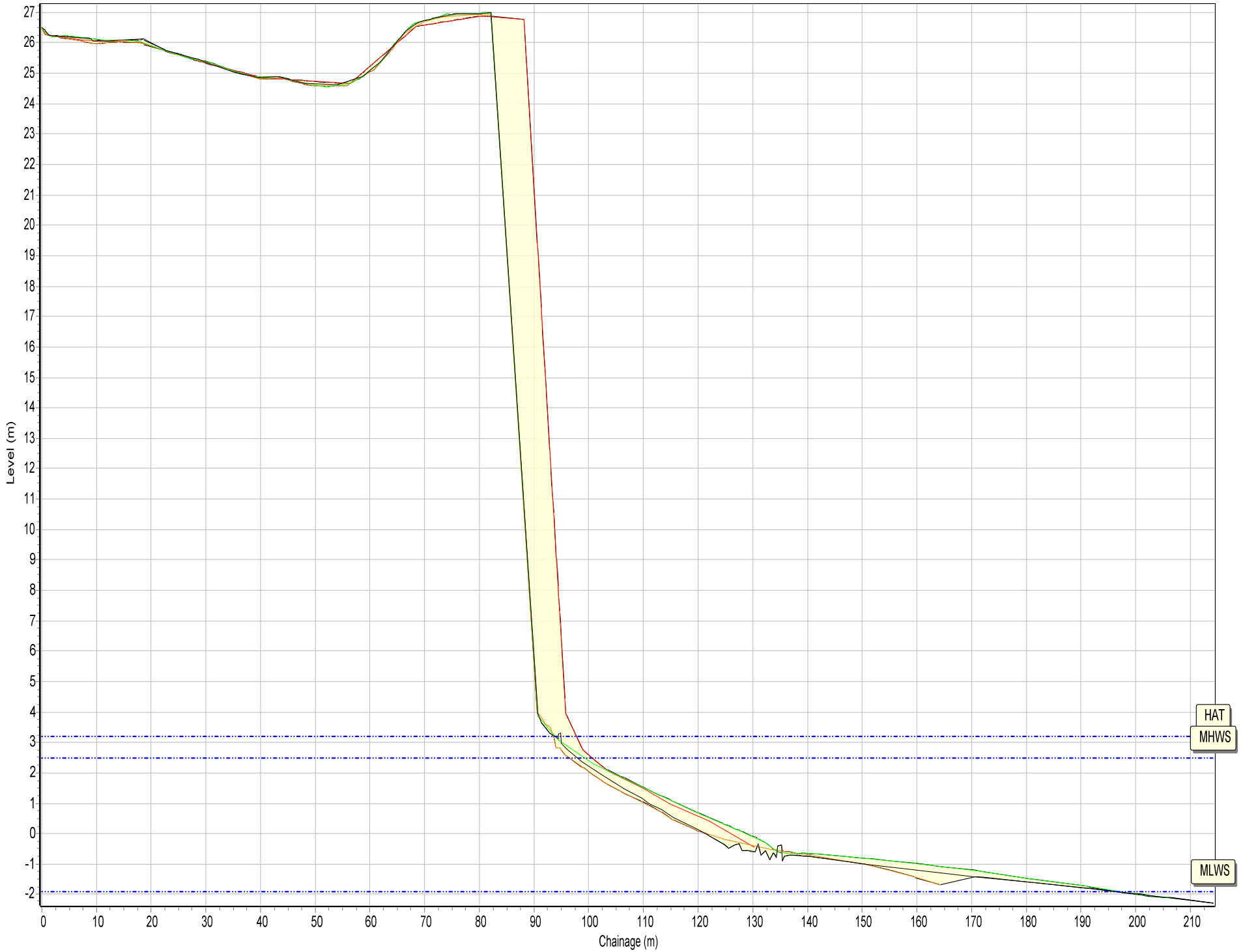
Beach Profiles: 1bSNS26



Profiles Envelope  
25/03/2009  
23/03/2016  
16/10/2016  
27/04/2017

HAT  
MHWS  
MLWS

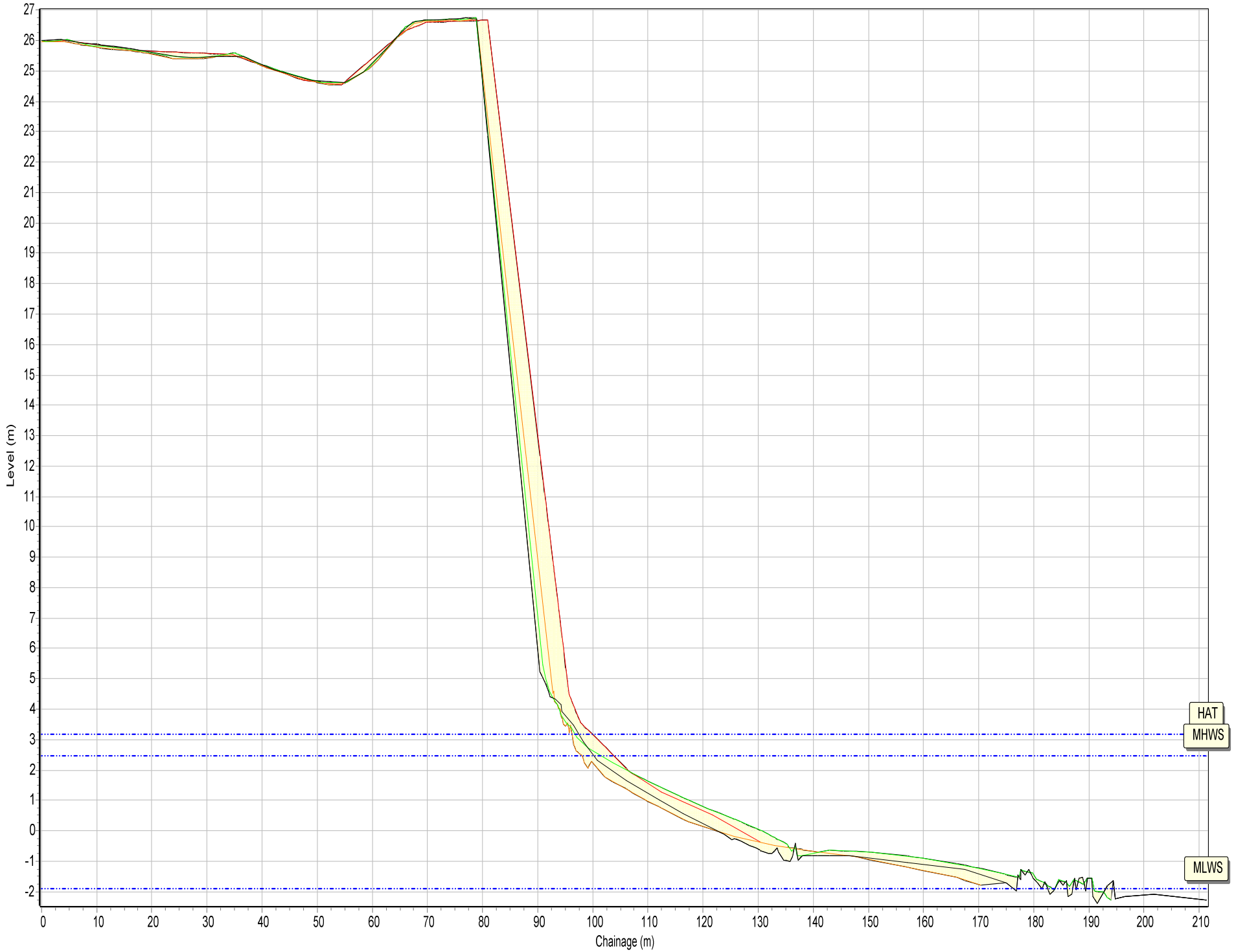
Beach Profiles: 1bSNS27



Profiles Envelope  
25/03/2009  
23/03/2016  
16/10/2016  
27/04/2017

HAT  
MHWS  
MLWS

Beach Profiles: 1bSNS28



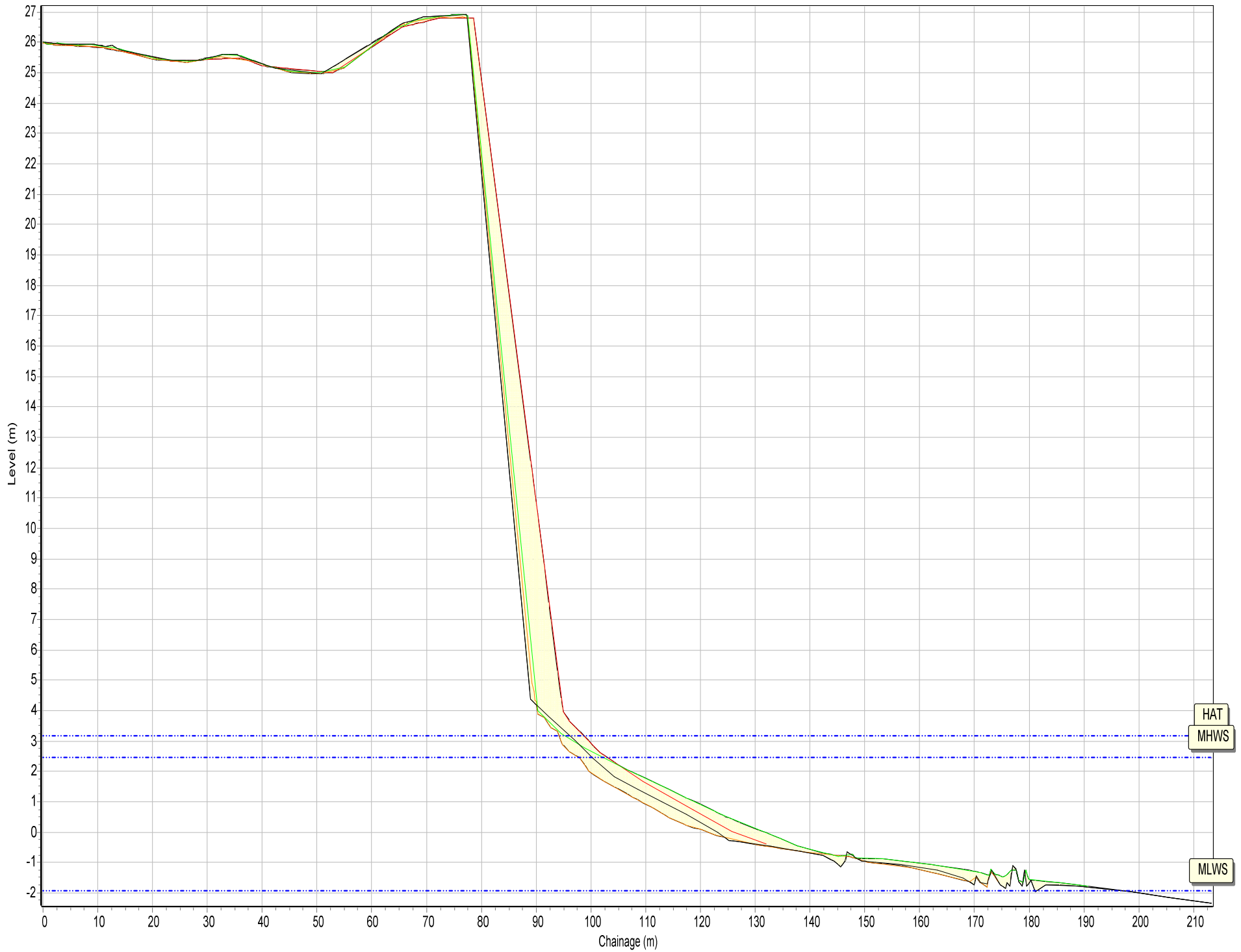
Profiles Envelope  
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23/03/2016  
16/10/2016  
27/04/2017

HAT  
MHWS

MLWS

SANDS

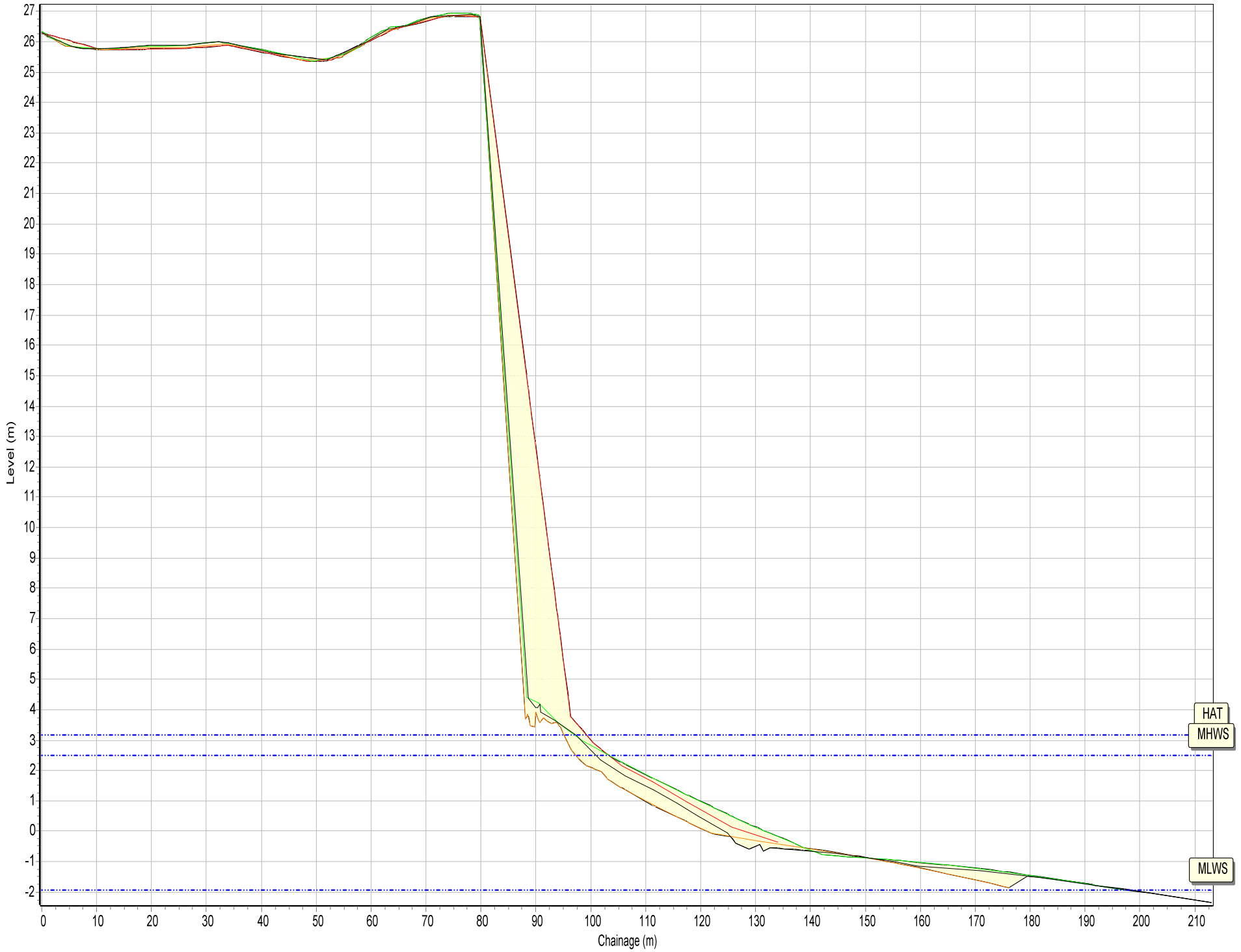
Beach Profiles: 1bSNS29



Profiles Envelope  
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27/04/2017

HAT  
MHWS  
MLWS

Beach Profiles: 1bSNS30

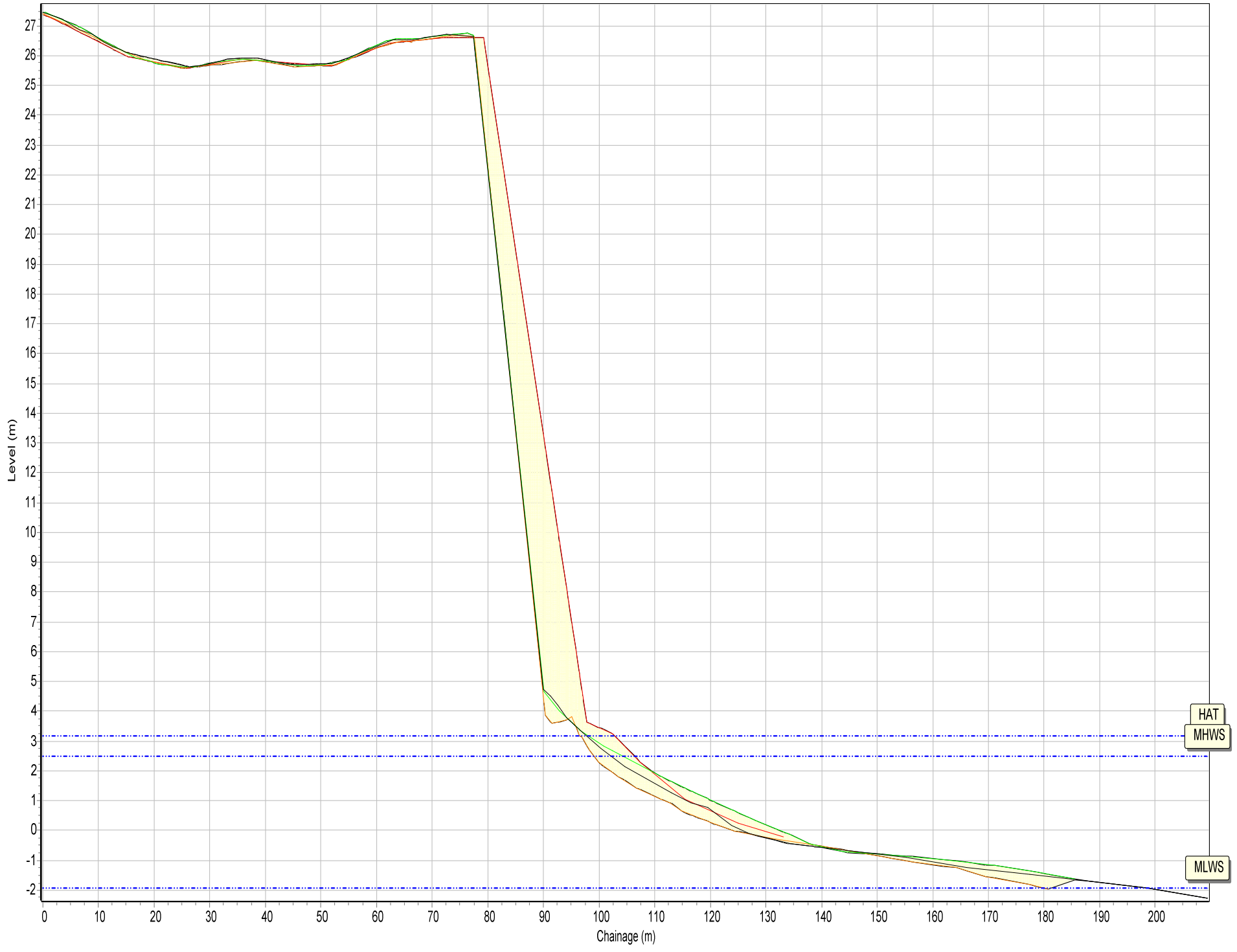


Profiles Envelope  
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23/03/2016  
16/10/2016  
27/04/2017

HAT  
MHWS

MLWS

Beach Profiles: 1bSNS31

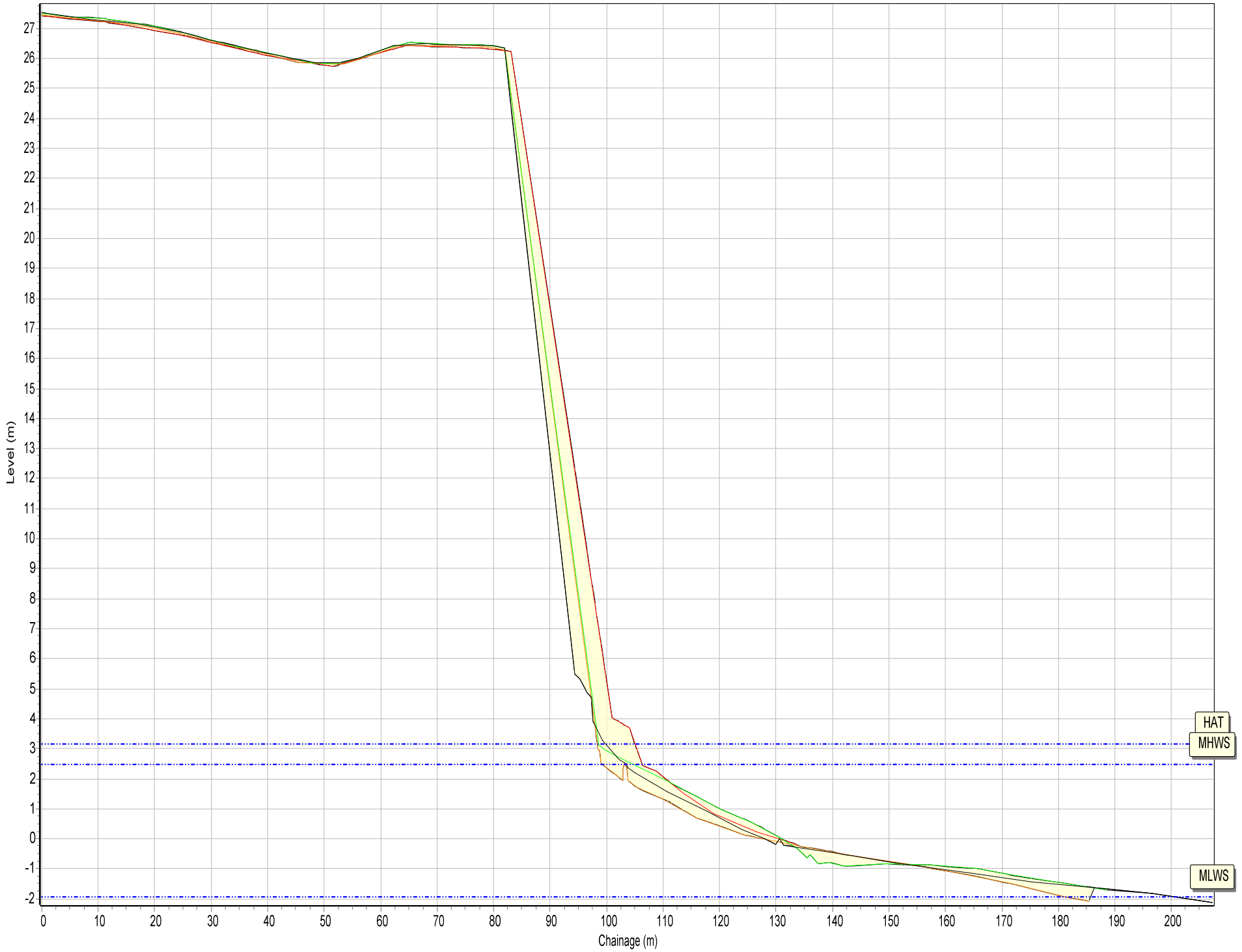


Profiles Envelope  
25/03/2009  
23/03/2016  
16/10/2016  
27/04/2017

HAT  
MHWS  
MLWS

SANDS

Beach Profiles: 1bSNS32



Profiles Envelope  
25/03/2009  
23/03/2016  
16/10/2016  
27/04/2017

HAT  
MHWS

MLWS

SANDS



**Appendix B**  
**Cliff Top Survey**

## 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	Oct 2016	Apr 2017	Mar 2009 - Apr 2017	Oct 2016 - Apr 2017	Mar 2009 - Apr 2017
1	441025.7	555571.1	75	8.16	8.28	8.22	-0.06	0.06	-0.01
2	441064.4	555355.1	85	7.09	5.23	5.29	1.80	-0.06	0.23
3	441098	555124	82	10.01	10.34	10.32	-0.31	0.02	-0.04
4	441174	554938.7	65	10.3	10.42	10.44	-0.14	-0.02	-0.02
5	441199.1	554861.1	65	7.71	10.87	10.87	-3.16	0.00	-0.40
6	441224.5	554774.2	71	10.83	10.86	10.95	-0.12	-0.09	-0.01
7	441248.4	554690.3	74	10.18	10.44	10.47	-0.29	-0.03	-0.04
8	441259.3	554596.6	101	10.08	9.57	9.9	0.18	-0.33	0.02
9	441275.8	554513.4	66	10.52	6.15	6.47	4.05	-0.32	0.51
10	441309.4	554421.3	58	8.77	1.08	1.37	7.40	-0.29	0.93
11	441354	554346.5	68	8.2	5.9	4.05	4.15	1.85	0.52
12	441400.2	554248.2	56	6.17	5.86	5.88	0.29	-0.02	0.04
13	441452.3	554174.7	63	11.61	8.36	8.65	2.96	-0.29	0.37

14	441472.3	554080.5	127	7.33	6.03	6.04	1.29	-0.01	0.16
15	441413	554005.1	122	7.84	7.72	7.9	-0.06	-0.18	-0.01
16	441384.8	553913.3	90	9.89	7.67	7.85	2.04	-0.18	0.26
17	441404.1	553815.5	93	6.32	5.76	5.98	0.34	-0.22	0.04
18	441404.1	553723.6	119	8.1	2.86	3.19	4.91	-0.33	0.61
19	441398.5	553632.8	78	8.23	4.24	4.5	3.73	-0.26	0.47
20	441438.3	553452.9	71	10.09	5.53	5.65	4.44	-0.12	0.56
21	441506.1	553256.1	62	8.57	1.38	1.5	7.07	-0.12	0.88
22	441550.1	553158.7	103	6.57	2.45	3.35	3.22	-0.90	0.40
23	441585.2	553076.5	64	8.11	7.72	7.93	0.18	-0.21	0.02
24	441624.4	552870.7	69	7.53	3.72	3.85	3.68	-0.13	0.46
25	441689.1	552758	70	14.58	6.64	6.89	7.69	-0.25	0.96
26	441715	552713.3	54	12.87	10.4	10.7	2.17	-0.30	0.27
27	441749.2	552674.4	62	14.56	2.97	3.12	11.44	-0.15	1.43
28	441776.6	552629.9	57	8.62	4.01	4.17	4.45	-0.16	0.56
28A	441798.6	552586.3	56	13.63	7.8	7.98	5.65	-0.18	0.71
28B	441817.4	552542.4	64	12.3	11.13	11.28	1.02	-0.15	0.13
28C	441852.2	552502.6	52	13.11	12.51	12.63	0.48	-0.12	0.06
29	441880.1	552471.6	83	15.46	14.98	15.1	0.36	-0.12	0.05
30	441921.4	552269	97	8.55	6.46	6.47	2.08	-0.01	0.26
31	441853.1	552094	75	11.2	5.83	5.89	5.31	-0.06	0.66
32	441883.3	551988.5	96	9.82	3.49	3.62	6.20	-0.13	0.78

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