



## **Cell 1 Regional Coastal Monitoring Programme Update Report 16: 'Partial Measures' Survey 2024**



**Durham County Council**

**May 2024**

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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)
	Featherbed Rocks to Blackhall Colliery
HAT	3.0
MHWS	2.5
MHWN	1.4
MLWN	-0.7
MLWS	-2.0

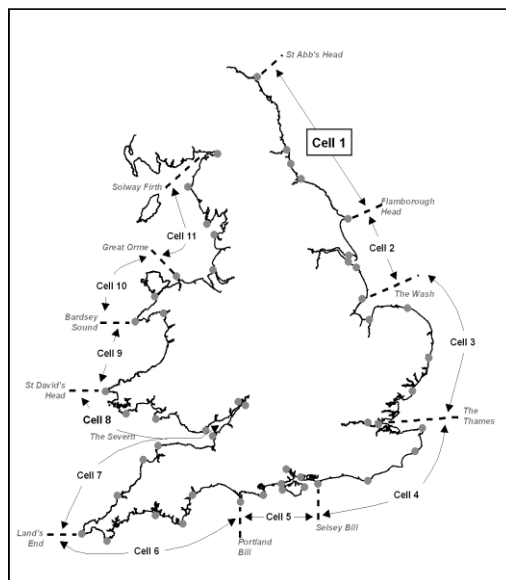
Source: UKHO Admiralty Tide Tables, 2020

## 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). Within this frontage the coastal landforms vary considerably, comprising low-lying tidal flats with fringing salt marshes, hard rock cliffs that are mantled with glacial sediment to varying thicknesses, softer rock cliffs and extensive landslide complexes.



**Figure 1 Sediment Cells in England and Wales**

The programme commenced in its present guise in September 2008<sup>1</sup> and is managed by North Yorkshire Council on behalf of the North East Coastal Observatory. It is funded by the Environment Agency, working in partnership with the following organisations:



<sup>1</sup> Prior to 2008, coastal monitoring was undertaken on a consistent basis across Northumberland and North Tyneside as part of the (then) Northumbrian Coastal Authorities Group's monitoring programme which commenced in 2002, whilst several authorities between the River Tyne and Flamborough Head undertook their own local monitoring programmes.

Royal HaskoningDHV has been appointed to provide Analytical Services in relation to the present phase of the Cell 1 Regional Coastal Monitoring Programme, between 2016 - 2027.

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.

Each year, an Analytical Report is produced for each individual authority, providing a detailed analysis and interpretation of the 'Full Measures' surveys. This is followed by a brief Update Report for each individual authority, providing ongoing findings from the 'Partial Measures' surveys.

At the end of each phase of the programme, a Cell 1 Overview Report is also produced. This provides a region-wide summary of the main findings relating to trends and interactions along the entire Cell 1 frontage. 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	Aug 21
14	2021/22	Nov 21	Jan 22	Apr 22	Jun 22	
15	2022/23	Nov 22	Jan 23	March 23	May 23	
16	2023/24	Sep 23	Nov 23	March 24	May 24(*)	

(\*) The present report is **Update Report 16** and provides an analysis of the 2024 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 15<sup>th</sup> March 2024. During the survey the weather was dry and sunny. The wind was force 5 from the south east. The state was slight.

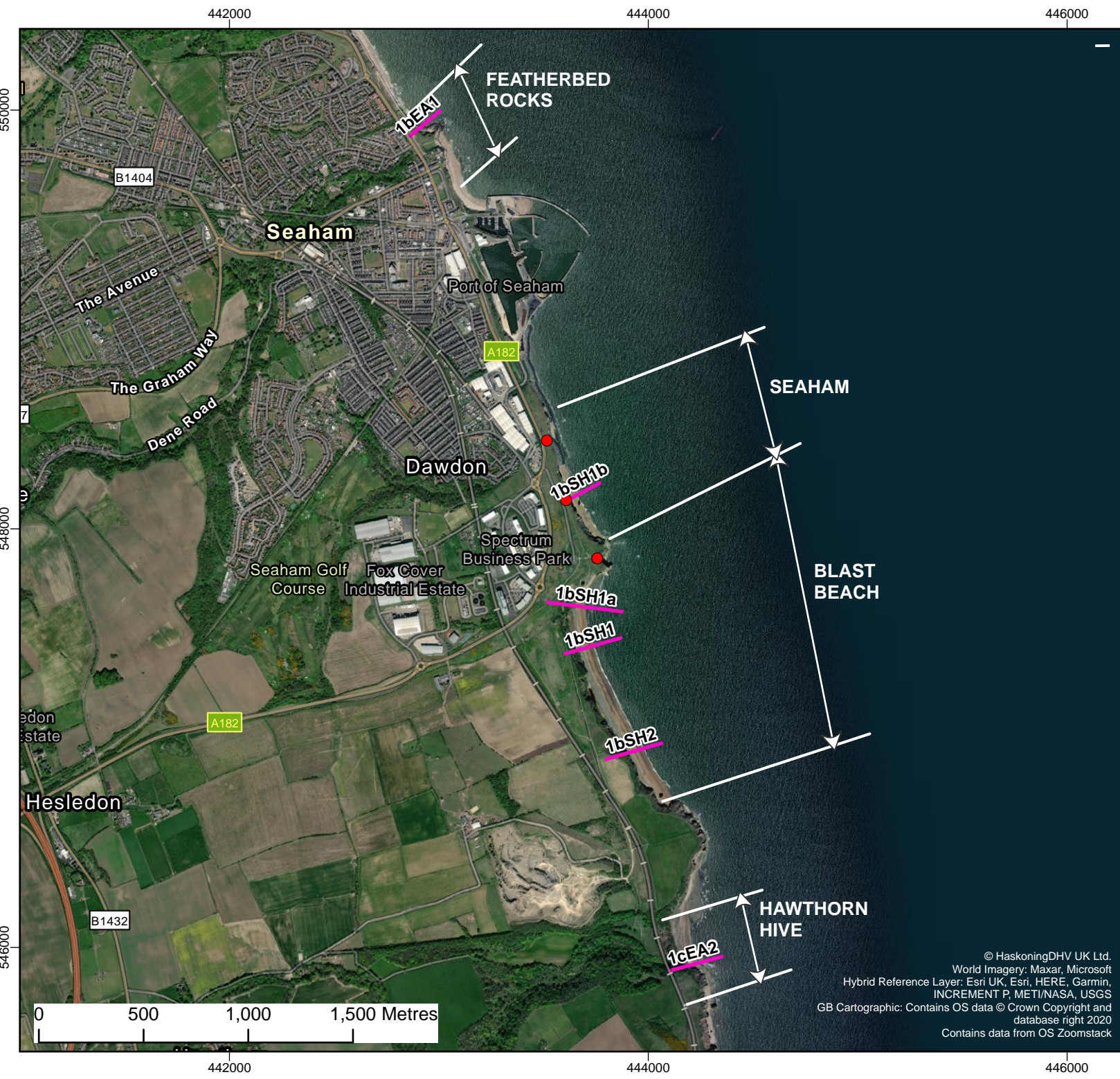
All data have been captured in a manner commensurate with the principles of the Environment Agency's *National Standard Contract and Specification for Surveying Services* and stored in a file format compatible with the software systems being used for the data analysis, namely SANDS and ArcGIS. This data collection approach and file format is comparable to that being used on other regional coastal monitoring programmes around England.

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
- key conclusions and highlighting of any areas of concern (Section 5).

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





**SURVEY LOCATIONS**

**Topographic Profile**

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

**Topographic Area**

- 6 monthly (Light Green)
- yearly (Orange)
- 5 yearly (Light Purple)

● Cliff Top Survey Points (refer to Figure 3 for details)

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

Title: **Figure 2 - Map 1**  
**FEATHERBED ROCKS TO HAWTHORN HIVE**  
**Durham County Council Frontage**

Report: **Survey Report**

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	n/a	TC	NJC	A4	1:25,000

Co-ordinate system: British National Grid

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 World Imagery: Maxar, Microsoft  
 Hybrid Reference Layer: Esri UK, Esri, HERE, Garmin,  
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**SURVEY LOCATIONS**

**Topographic Profile**

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

**Topographic Area**

- 6 monthly (Light Green)
- yearly (Orange)
- 5 yearly (Light Purple)

- Cliff Top Survey Points (Red dot)

(refer to Figure 3 for details)

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

Title:

**Figure 2 - Map 2**

**BLACKHALL COLLIERY**

**Durham County Council Frontage**

Report:

Survey Report

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	n/a	TC	NJC	A4	1:25,000

Co-ordinate system: British National Grid



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 Hybrid Reference Layer: Esri UK, Esri, HERE, Garmin,  
 INCREMENT P, METI/NASA, USGS  
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### SURVEY LOCATIONS

- Cliff Top Survey Points

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 Contains data from OS Zoomstack  
 Hybrid Reference Layer: Esri Community Maps Contributors, Esri UK, Esri, HERE, Garmin, INCREMENT P, METI/NASA, USGS

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

Title:

**Figure 3 - Map 1**

**SEAHAM**

**Durham County Council Frontage**

Report:

Survey Report

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	n/a	TC	NJC	A4	1:10,000

Co-ordinate system: British National Grid



## 2. Analysis of Survey Data

### 2.1 Featherbed Rocks

Survey Date	Description of Changes Since Last Survey	Interpretation
<p>15<sup>th</sup> March 2024</p>	<p><b>Beach Profiles:</b></p> <p>Featherbed Rocks is monitored by one beach profile line (<b>1bEA1</b>) during the Partial Measures survey (Appendix A). It was last surveyed in September 2023.</p> <p>At Profile <b>1bEA1</b>, chainage 0m to 56m covers the cliff top, cliff face and promenade. This section of the profile historically has remained unchanged due to the protection offered by the rock armour. It is assumed the changes across the cliff face are due to difficulties surveying the steep topography. Chainage 56m to chainage 80m is covered by a rock revetment, it appears that there has been some local movement of rock since the previous survey with an increase in level observed between chainage 61m and 67m. Seawards of the revetment, the volume of sediment present has decreased further with a drop in level of up to 0.4m observed between chainage 91m and 104m. As a result, the rocky foreshore remains exposed over a greater length.</p>	<p>As is the long term trend, little change has been observed at Profile <b>1bEA1</b>. Local changes across the revetment suggest either the movement of armour stones locally or the revetment has been topped up since the previous survey.</p> <p>The further loss of material from the rocky foreshore, a response to the particularly stormy winter 2023/24, has exposed sections of the rocky foreshore not previously exposed since monitoring began.</p> <p><b>Longer term trends:</b></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. Although the veneer beach has not been observed for a number of years. 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>

## 2.2 Seaham (Dawdon)

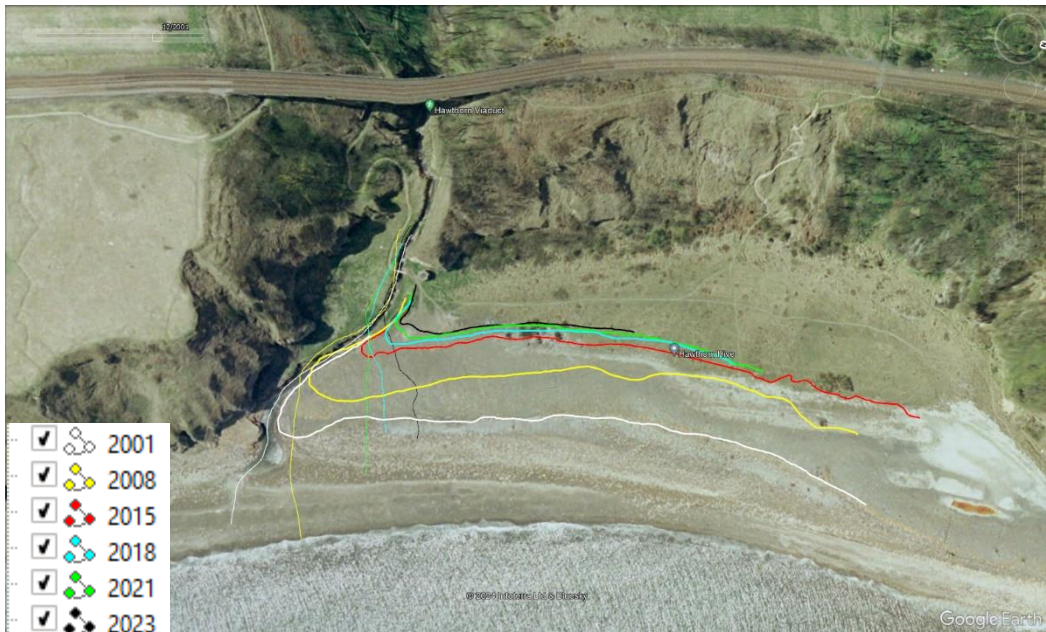
Survey Date	Description of Changes Since Last Survey	Interpretation
15 <sup>th</sup> March 2024	<p><b>Cliff-top Survey:</b></p> <p>Three ground control points have been established along the cliff top at Dawdon (Figure B1). The separation between any two points is nominally 300m. These cliff top surveys 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 March 2024 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 the change across the three control points over winter 2023/24 is limited to <math>\pm 0.03\text{m}</math>, indicating a period of stability (Point 1 = 0.03m, Point 2 = 0.00m, Point 3 = -0.02m).</p>	<p>The cliffs at Dawdon have undergone a period of stability with change over winter 2023/24 limited to <math>\pm 0.03\text{m}</math>.</p> <p><b>Longer term trends:</b></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>The period of recent stability has resulted in a reduction in the long term average recession rates. Since the baseline in 2008, Point 1 and 3 have comparable recession rate of 0.07m/year and 0.08m/year respectively whereas Point 2 having retreated only 0.32m in 14 years has a recession rate of 0.02m/year.</p>

## 2.3 Chemical Beach and Blast Beach

Survey Date	Description of Changes Since Last Survey	Interpretation
15 <sup>th</sup> March 2024	<p><b>Beach Profiles:</b></p> <p>Blast Beach and Chemical Beach are covered by four beach profile lines during the Partial Measures survey (Appendix A), last surveyed in</p> <p>Profile <b>1bSH1b</b> was added to the programme during the Full Measures survey in October 2015. The profile is located on Chemical Beach, adjacent to the sewage works south of Seaham. The profile consists of cliff to chainage 30m followed by a gravelly beach; the beach is bisected by a concrete obstruction at chainage 59m. The PM2024 survey indicates that the upper beach has largely remained stable with change limited to <math>\pm 0.1</math>m up to chainage 52m. Between chainage 52m and 59m, immediately landward of the concrete obstruction, the beach has locally scoured resulting in a reduction in level by 0.5m. Seawards of the concrete debris, the beach has locally accreted by up to 0.3m tapering to no change by chainage 67m where the rocky shore platform once again remains exposed. The profile generally remains within the range of the previous surveys with the exception of the scour adjacent to the concrete debris is locally at the lowest on record.</p> <p>Profile <b>1bSH1a</b> was added to the programme during the Full Measures survey in September 2009. It is located on Blast Beach, to the north of the previously-established <b>1bSH1</b>. Dense vegetation restricts access to the cliff top and cliff base meaning change across these sections is to be interpreted cautiously. Since the previous survey in September 2023, the face of the eroding colliery spoil has retreated significantly by a further a 4m. Fronting this, the steep shingle beach has largely remained stable with minor accretion (limited to 0.2m) observed on the upper beach. The foreshore remains exposed seawards of 168m. The range envelope from the previous surveys reinforces the retreating nature of the profile, with March 2024 survey at the most landward position.</p> <p>At profile <b>1bSH1</b>, between chainage 40m (toe of the cliff) and chainage 75m (face of the eroding colliery spoil), the upper beach platform has remained stable. The apparent erosion at the toe of the cliff can be assigned to variation in water levels of the trapped brackish puddle. Between chainage 75m and 128m, the beach has accreted significantly (up to 1.9m in level). This accretion has submerged the face of the eroding spoil. The foreshore remains exposed seawards of 128m. Overall, the profile is at high level compared to the range of the previous surveys.</p>	<p>The colliery spoil platform in the north of the bay (profile 1bSH1a) has retreated significantly since the previous survey. This 4m loss between September 2023 and March 2024, is second greatest loss between two surveys since the monitoring began in 2011 (4.4m was lost between November 2021 and April 2022). Due to the difficulties in surveying the cliff base (due to dense vegetation) it is difficult to ascertain the exact residual length of colliery spoil, however the profile suggests there is a minimum of 33m remaining in this location.</p> <p>On the contrary, notable accretion at profile 1bSH1 has fully submerged the colliery spoil platform which is offering protection against erosion in this location.</p> <p><b>Longer term trends:</b></p> <p>The cliffs behind Blast Beach are currently inactive because they are fronted by colliery spoil. The sea cliffs will eventually reactivate as ongoing erosion of the colliery spoil removes the protection it affords to the cliffs. In the past this has been deemed most likely to occur at the southern end of the bay where the spoil was more rapidly eroding. The (previously) accumulating sediment seaward of the colliery spoil in the northern part of the bay was thought to offer the cliffs more protection. However, since the winter of 2014 there has been a reversal in the trend with erosion in the north of the bay and accretion in the south.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>At profile <b>1bSH2</b>, between chainage 97m and 117m, accretion of up to 0.2m in level has occurred on the residual colliery spoil platform. Seawards of chainage 117m, the beach has been dominated by erosion, increasing in magnitude down the profile (peaking at chainage 183m with a magnitude of -0.8m). When compared to the range of the previous surveys, the upper beach is at the highest level on record as a result of the accretion whereas the rest of the profile is generally at a medium level.</p>	

## 2.4 Hawthorne Hive

Survey Date	Description of Changes Since Last Survey	Interpretation
<p><b>15<sup>th</sup> March 2024</b></p>	<p><b>Beach Profiles:</b></p> <p>Hawthorne Hive is covered by one beach profile line <b>1cEA2</b> during the Partial Measures survey (Appendix A). As of October 2012, the profile begins at chainage 92m due to dense vegetation restricting access to the cliff faces. Since the September 2023 survey the beach has generally been dominated by erosion, with the beach lowering by up to 0.8m in level between chainage 92m and 152m. This lowering has exposed a greater length of rocky foreshore which is now observed seawards of chainage 139m. Overall, the beach is at low level when compared to the range of the previous survey.</p>	<p>Since the previous survey in September 2023, beach levels at Hawthorne Hive have dropped. This pattern is observed across much of the North East coastline as a result of the intensity and direction of the storms through winter 2023/24.</p>
	 <p>Figure 4 - Hawthorne Burn alignment vs eroding colliery spoil platform.</p>	<p><b>Longer term trends:</b></p> <p>Figure 4 shows that over time, as the colliery spoil platform erodes, the Hawthorne Burn has been allowed to adopt a more natural, central alignment without being held in position by the spoil. This transition over time is also reflected in profile 1cEA2, where the channel has not been observed through profile since the partial measures survey in 2013, corresponding with the retreat of the spoil.</p> <p>Without the constraint of the colliery spoil, it is thought the channel will be more responsive to annual and seasonal variations in the flow of Hawthorn Burn and storm events which move sediment onshore to block the outflow of the burn which will result in a more varied alignment 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 almost 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**

- At Featherbed Rocks, local changes across the revetment suggest either the movement of armour stones locally or that the revetment has been topped up since the previous survey. The further loss of material from the rocky foreshore, a response to the particularly stormy winter 2023/24, has exposed sections of the rocky foreshore not previously exposed since monitoring began.
- At Seaham Cliffs, the control points have remained stable with none of the three control points experiencing significant change (>0.2m) since the previous survey.
- Along Blast Beach, the colliery spoil platform in the north of the bay (profile 1bSH1a) has retreated significantly since the previous survey. This 4m loss between September 2023 and March 2024, is the second greatest loss between two surveys since the monitoring began in 2011 (4.4m was lost between November 2021 and April 2022). Due to the difficulties in surveying the cliff base (due to dense vegetation) it is difficult to ascertain the exact residual length of colliery spoil, however the profile suggests there is a minimum of 33m remaining in this location. On the contrary, notable accretion at profile 1bSH1 has fully submerged the colliery spoil platform which will be offering protection against erosion in this location.
- At Hawthorne Hive, the beach profile has been dominated by erosion since the previous survey in September 2023. This is typical a response to the direction, severity and number of storms that occurred through winter 2023/24, a pattern that has been observed along much of the north east coastline.

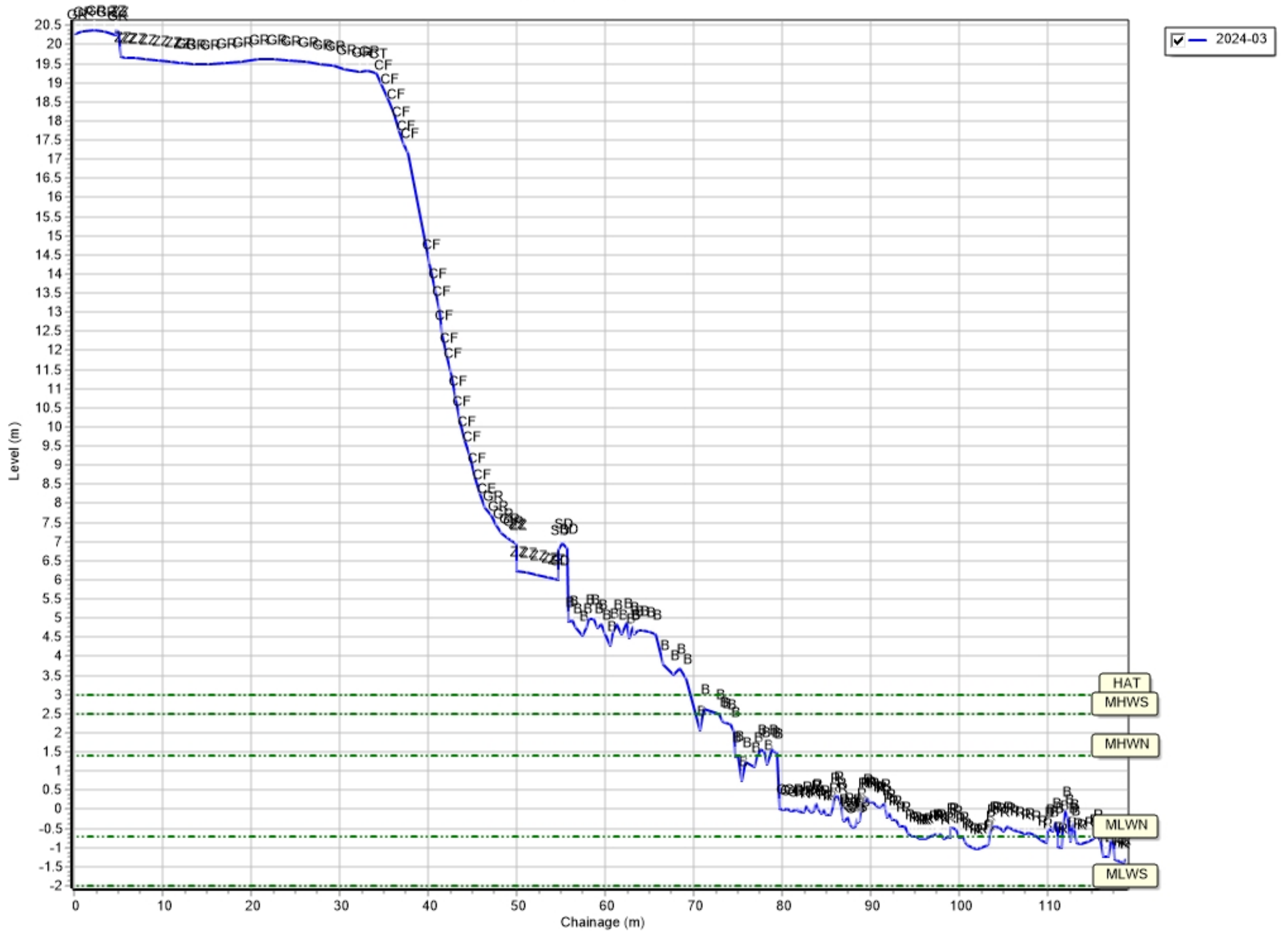
## **Appendices**

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

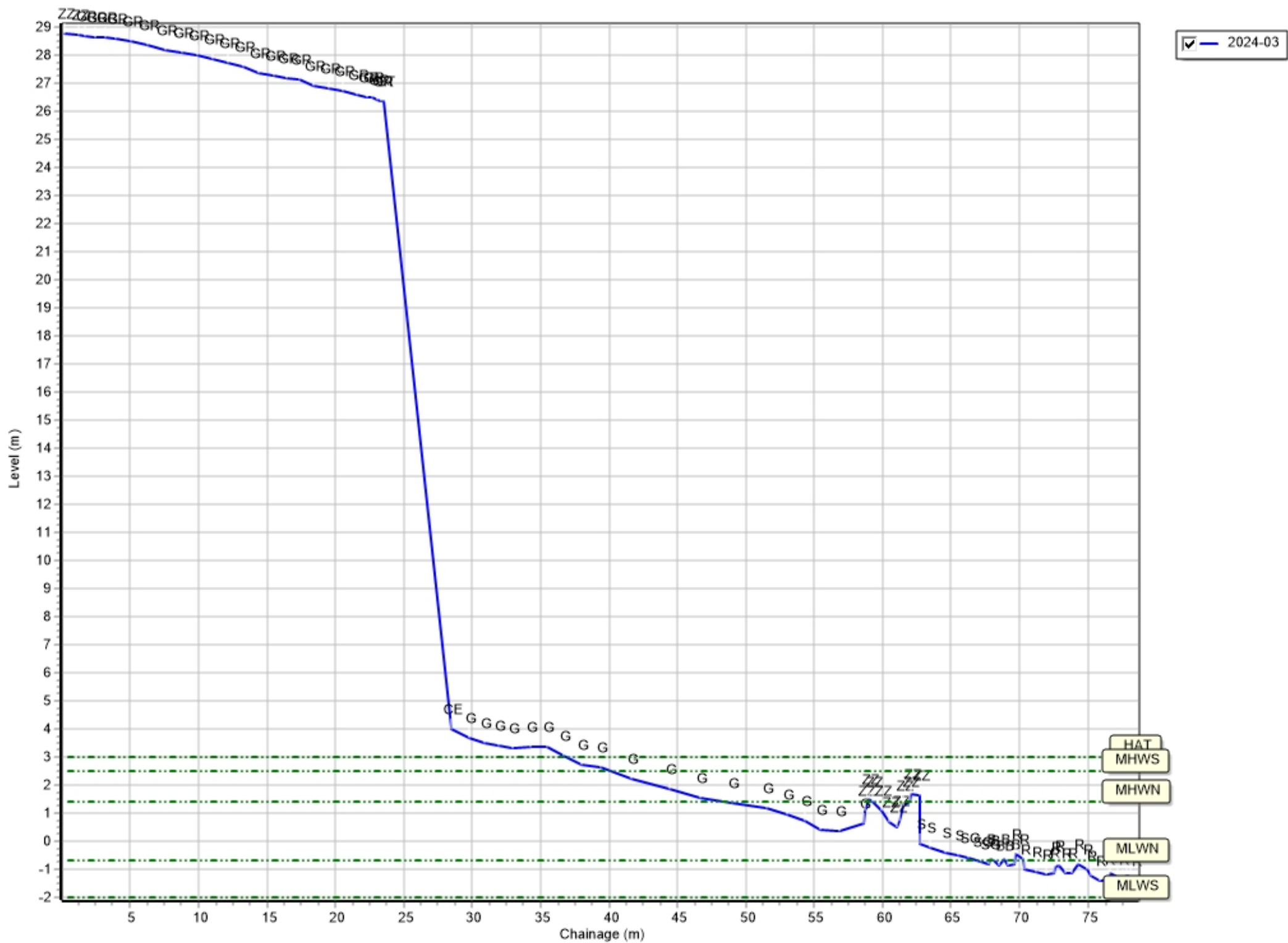
The following sediment feature codes are used on some profile plots:

<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

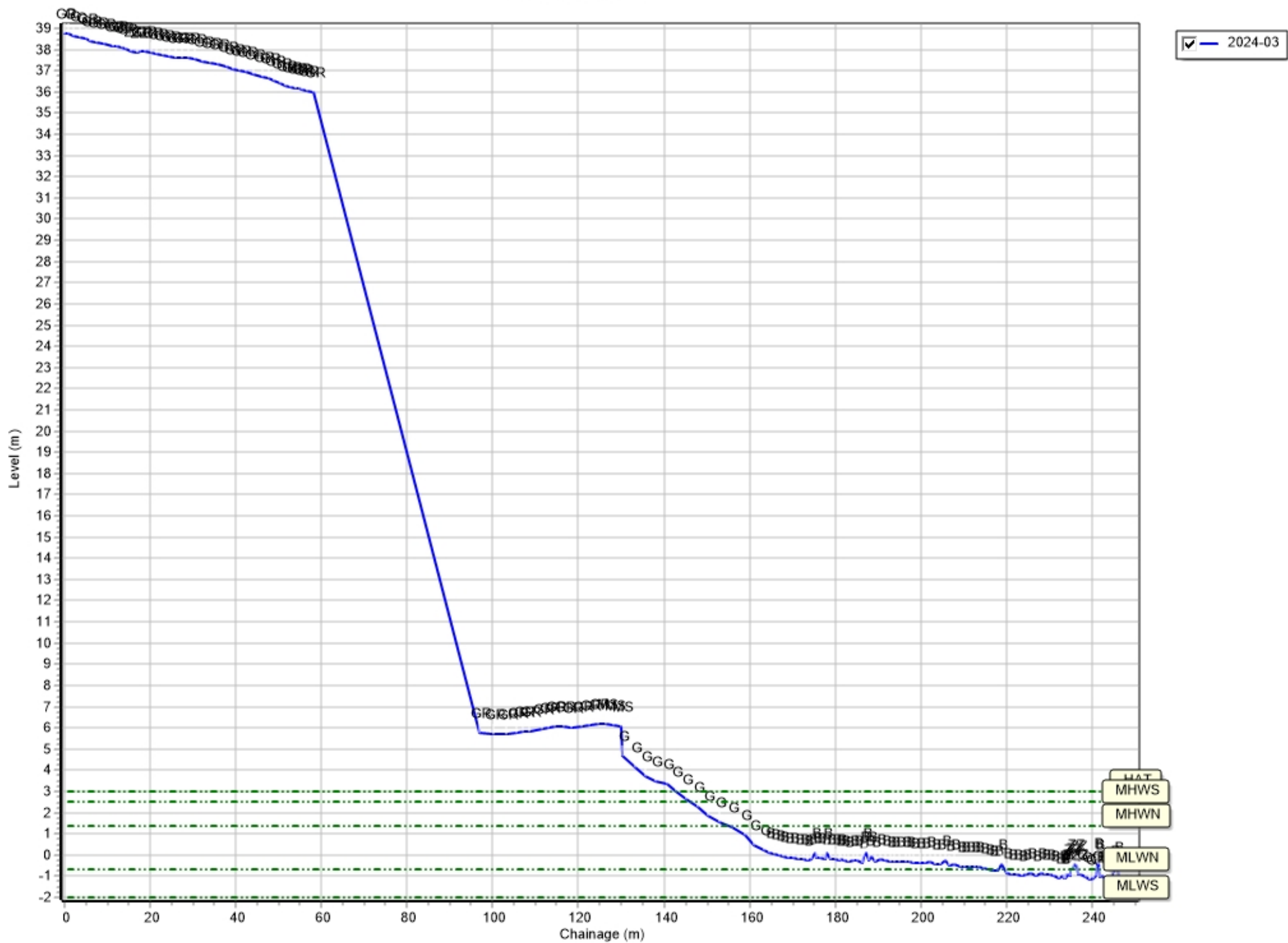
# Profiles: 1bEA1



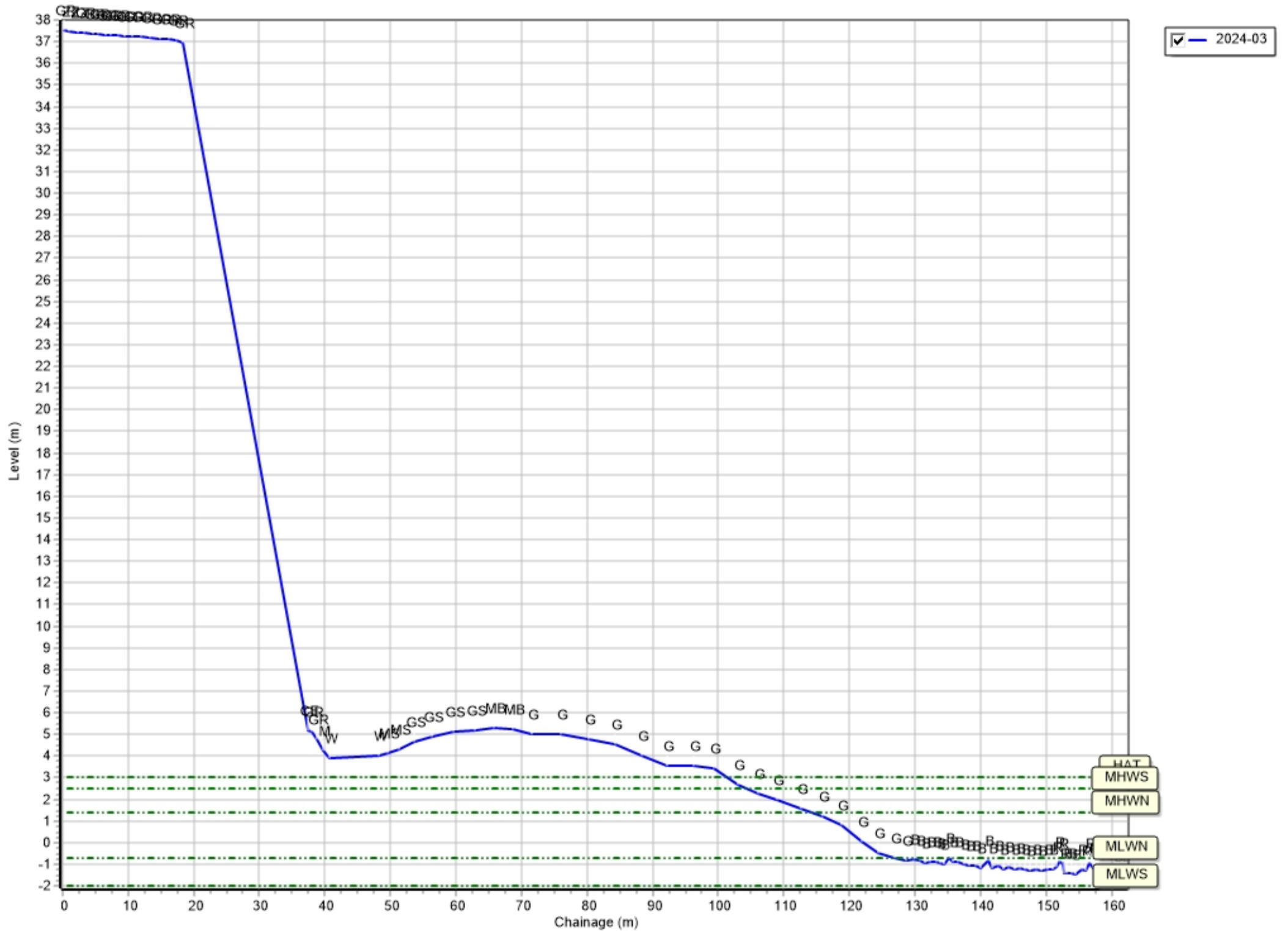
Profiles: 1bSH1B



# Profiles: 1bSH1A

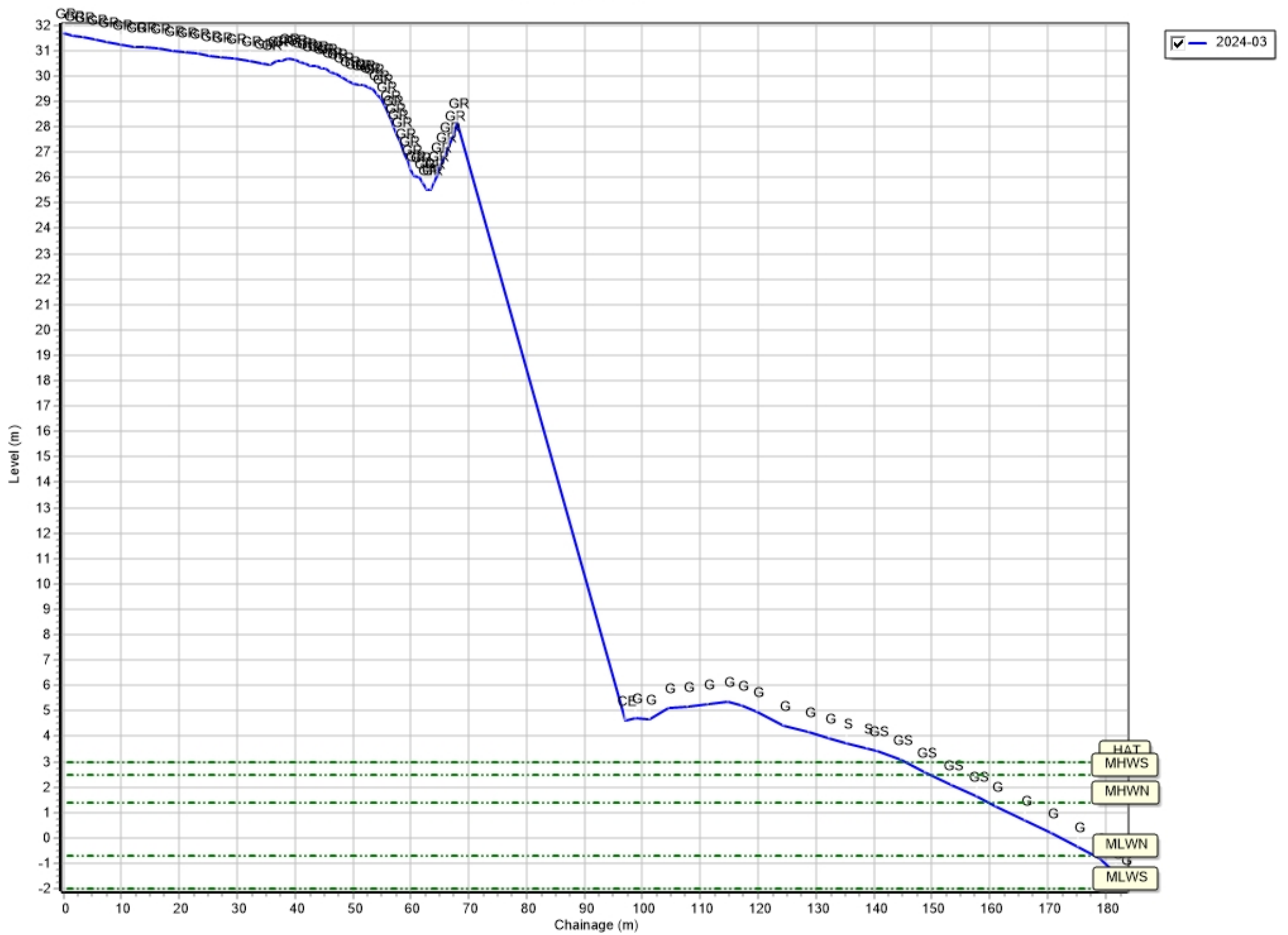


# Profiles: 1bSH1

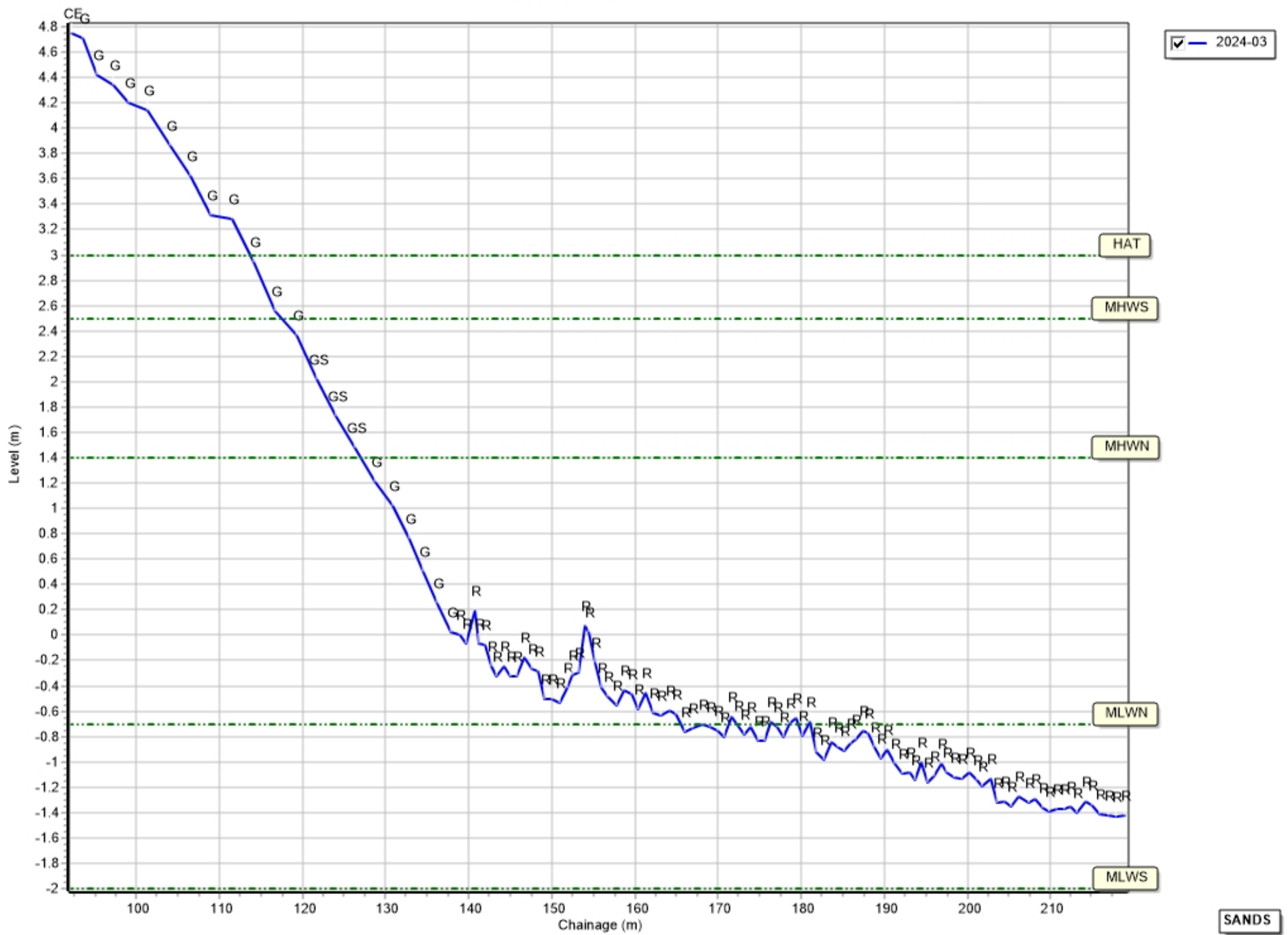




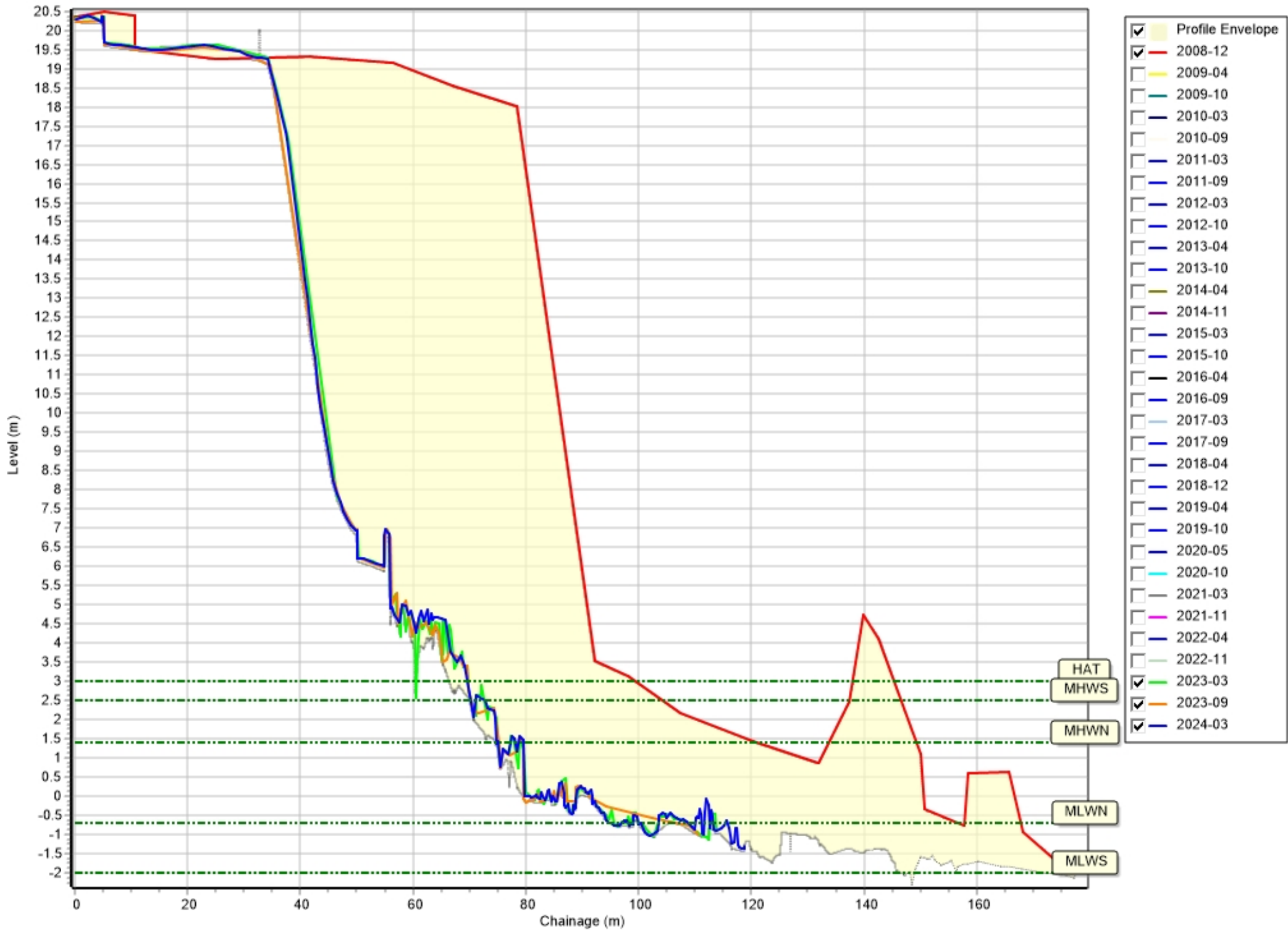
# Profiles: 1bSH2



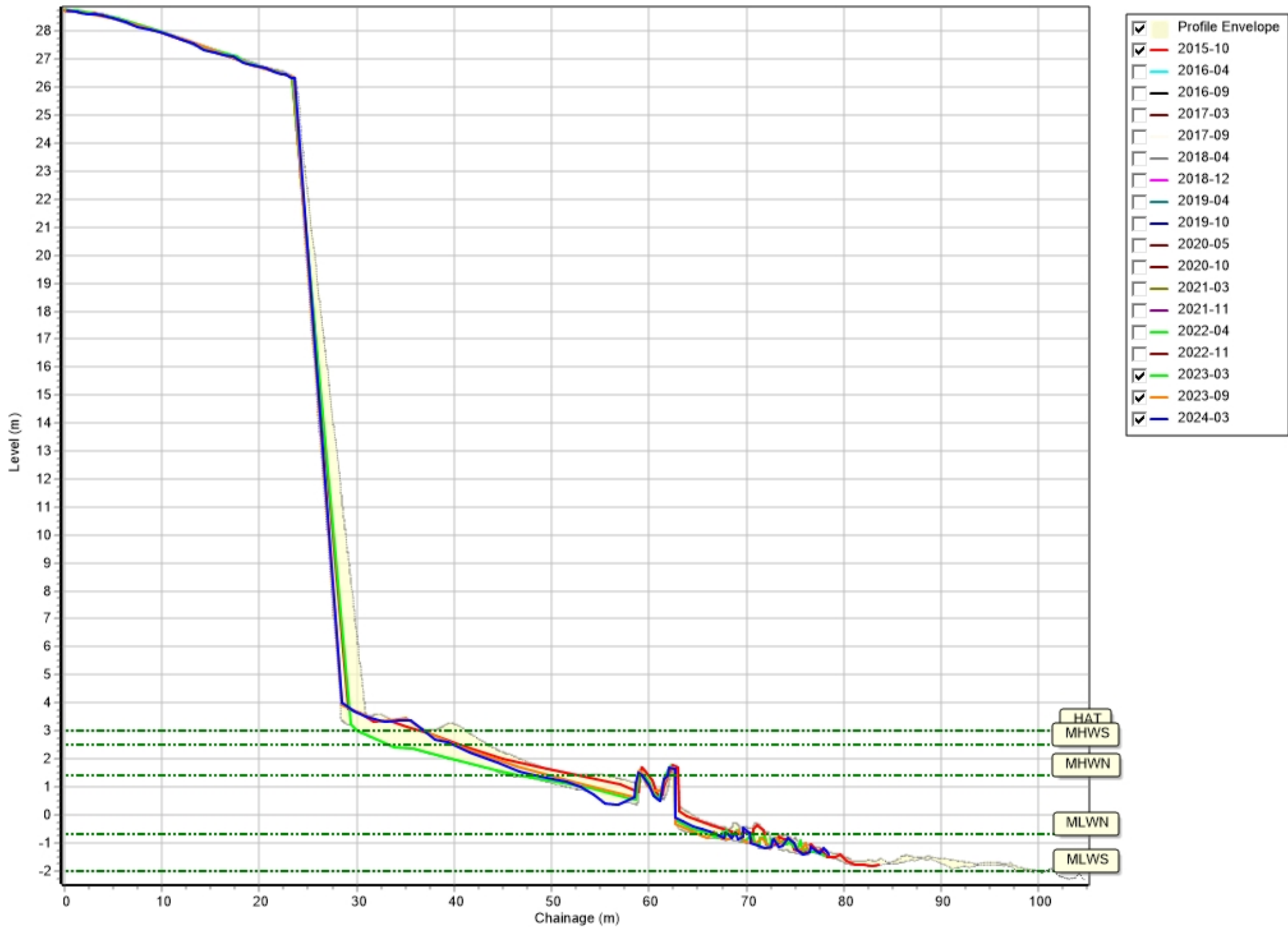
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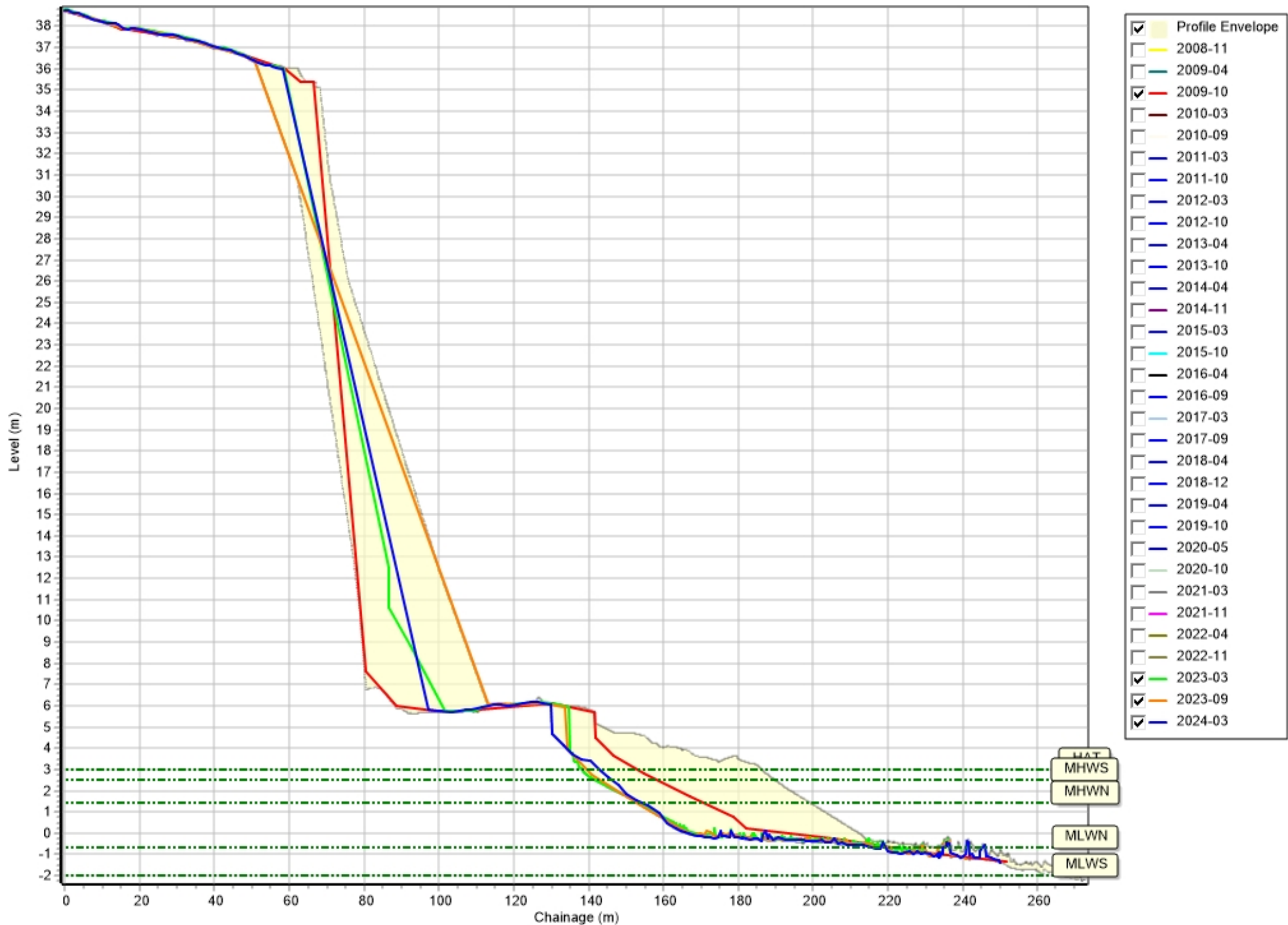
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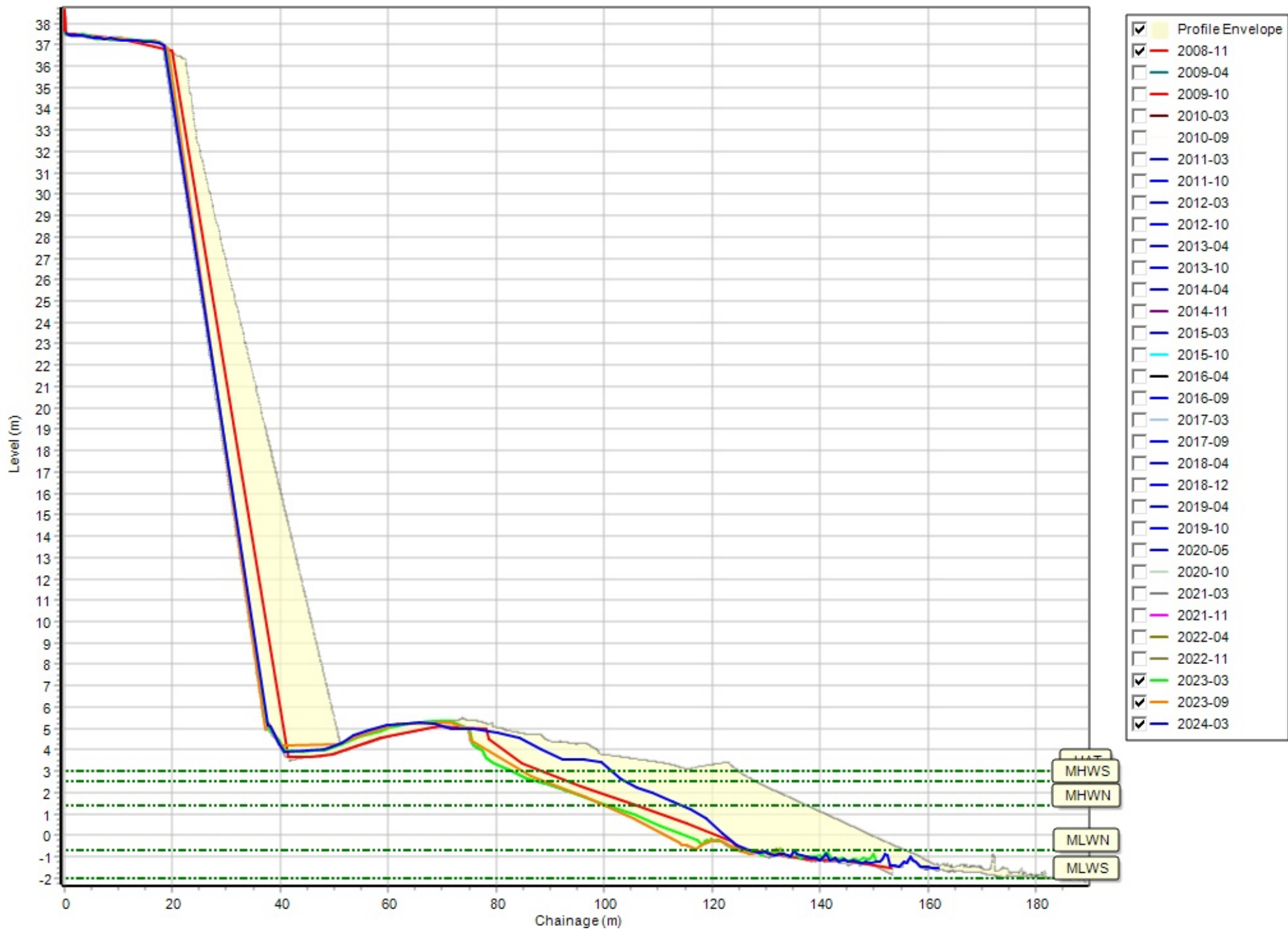
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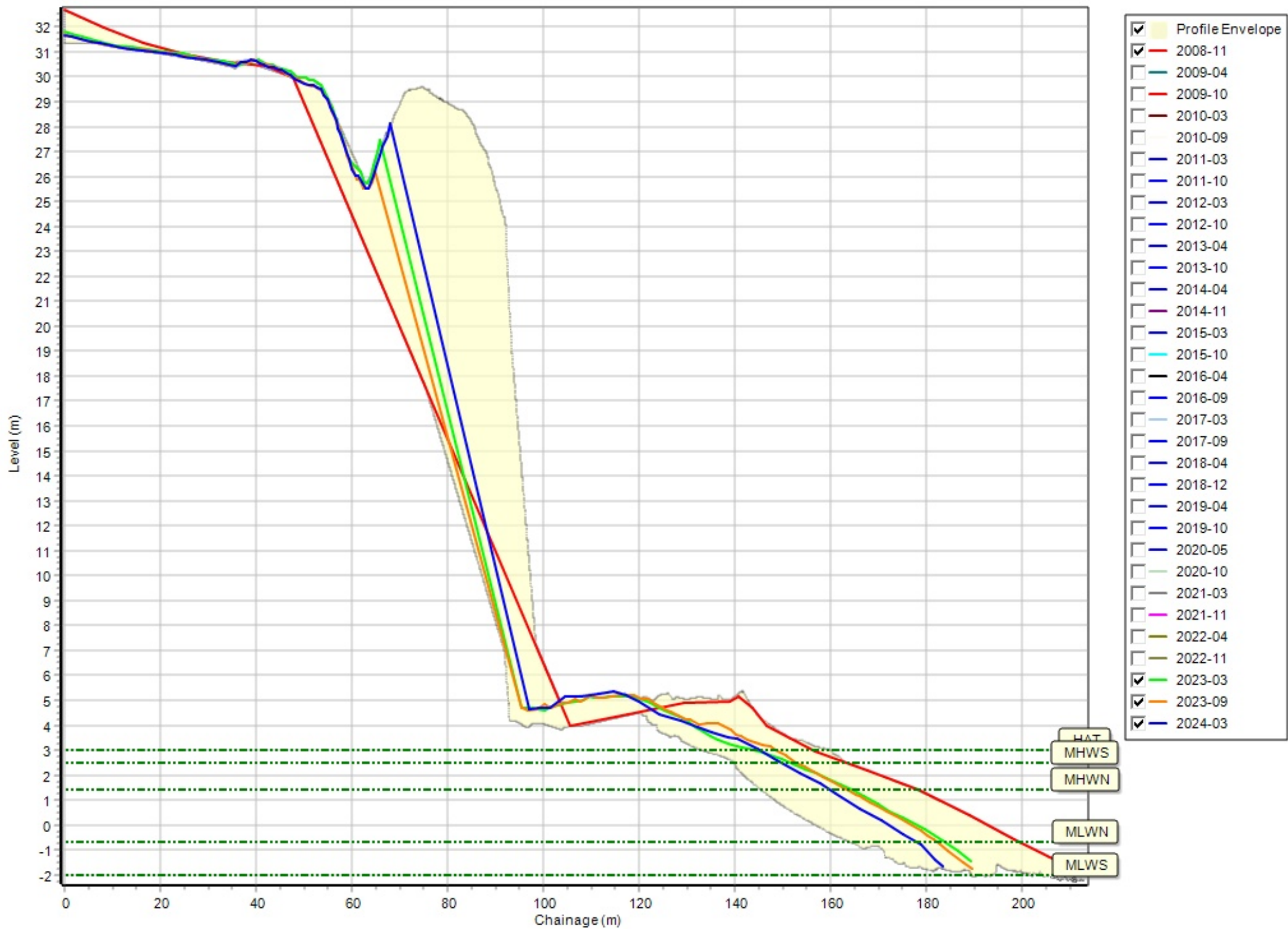
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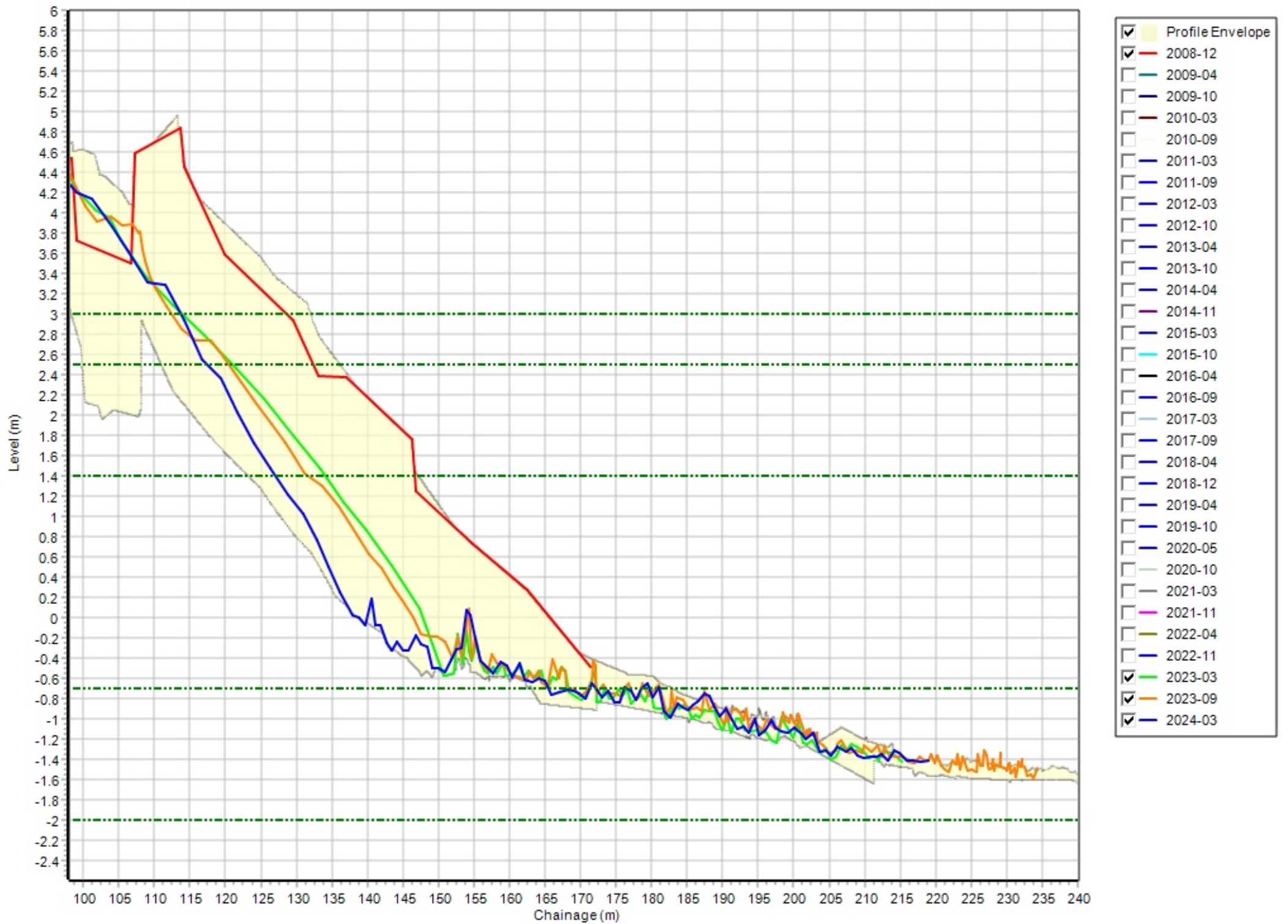
# Profiles: 1bSH1



# Profiles: 1bSH2



Profiles: 1cEA2





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

## 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	Sept 2023	Mar 2024	Nov 2008 - Mar 2024	Sept 2023 - Mar 2024	Nov 2008 - Mar 2024
1	443515.4	548421.7	70	16.1	15.05	15.02	1.08	0.03	0.07
2	443607.8	548136.3	90	13.3	12.98	12.98	0.32	0.00	0.02
3	443756.1	547858.5	95	14.8	13.43	13.45	1.35	-0.02	0.08