



Cell 1 Regional Coastal Monitoring Programme Analytical Report 16: 'Full Measures' Survey 2023



Durham County Council

November 2023

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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.

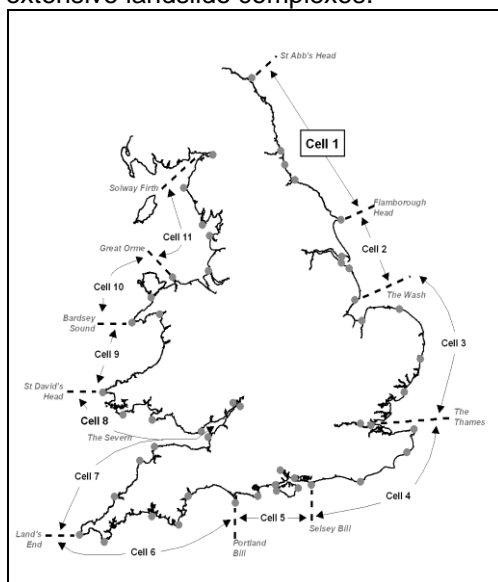


Figure 1 Sediment Cells in England and Wales

The programme commenced in its present guise in September 2008¹ 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:



¹ 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 11	Sep 11
4	2011/12	Sep 11	Aug 12	Mar-May 12	Feb 13	
5	2012/13	Sept 12	Feb 13	Mar-Apr 13	May 2013	
6	2013/14	Oct 13	Feb 14	Mar-Apr 14	Jul 14	
7	2014/15	Nov 14	Feb 15	Mar15	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	April 18	Jun 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	Jun 21	Aug 21
14	2021/22	Nov 21	Jan 22	Apr 22	Jun 22	
15	2022/23	Nov 22	Jan 23	Mar 23	May 23	
16	2023/24	Sep 23	Nov 23			

(*) The present report is **Analytical Report 16** and provides an analysis of the 2023 Full Measures survey for County Durham Council's frontage.

In addition, separate reports are produced for other elements of the programme as and when specific components are undertaken, such as wave data collection, bathymetric and sea bed sediment data collection, aerial photography, and walk-over visual inspections.

For purposes of analysis, the Cell 1 frontage has been split into the sections listed in Table 2.

Table 2 Sub-divisions of the Cell 1 Coastline

Authority	Zone
Northumberland County Council	Spittal A
	Spittal B
	Goswick Sands
	Holy Island
	Bamburgh
	Beadnell Village
	Beadnell Bay
	Embleton Bay
	Boulmer
	Alnmouth Bay
	High Hauxley and Druridge Bay
	Lynemouth Bay
	Newbiggin Bay
	Cambois Bay
Blyth South Beach	
North Tyneside Council	Whitley Sands
	Cullercoats Bay
	Tynemouth Long Sands
	King Edward's Bay
South Tyneside Council	Littehaven Beach
	Herd Sands
	Trow Quarry (incl. Frenchman's Bay)
	Marsden Bay
Sunderland Council	Whitburn Bay
	Harbour and Docks
	Hendon to Ryhope (incl. Halliwell Banks)
Durham County Council	Featherbed Rocks
	Seaham
	Blast Beach
	Hawthorn Hive
	Blackhall Colliery
Hartlepool Borough Council	North Sands
	Headland
	Middleton
	Hartlepool Bay
Redcar & Cleveland Borough Council	Coatham Sands
	Redcar Sands
	Marske Sands
	Saltburn Sands
	Cattersty Sands (Skinningrove)
Scarborough Borough Council	Staithes
	Runswick Bay
	Sandsend Beach, Uppang Beach and Whitby Sands
	Robin Hood's Bay
	Scarborough North Bay
	Scarborough South Bay
	Cayton Bay
	Filey Bay

1. Introduction

1.1 Study Area

Durham County Council's frontage extends from Ryhope Dene to Crimdon Beck. For the purposes of this report and for consistency with previous reporting, 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 (since 2008) each autumn/early winter comprising:
 - Beach profile surveys along nine transect lines
- Partial Measures survey annually (since 2009) 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 2023 Full Measures survey was undertaken along the Seaham and Easington frontage on the 20th September 2023 and along the Blackhall frontage on the 4th September 2023. During the Seaham & Easington survey the weather was wet and overcast. The wind was force six from the southwest and the sea state was calm. During the Blackhall survey, the weather was dry and sunny. The wind force was two from the north west. The sea state was calm.

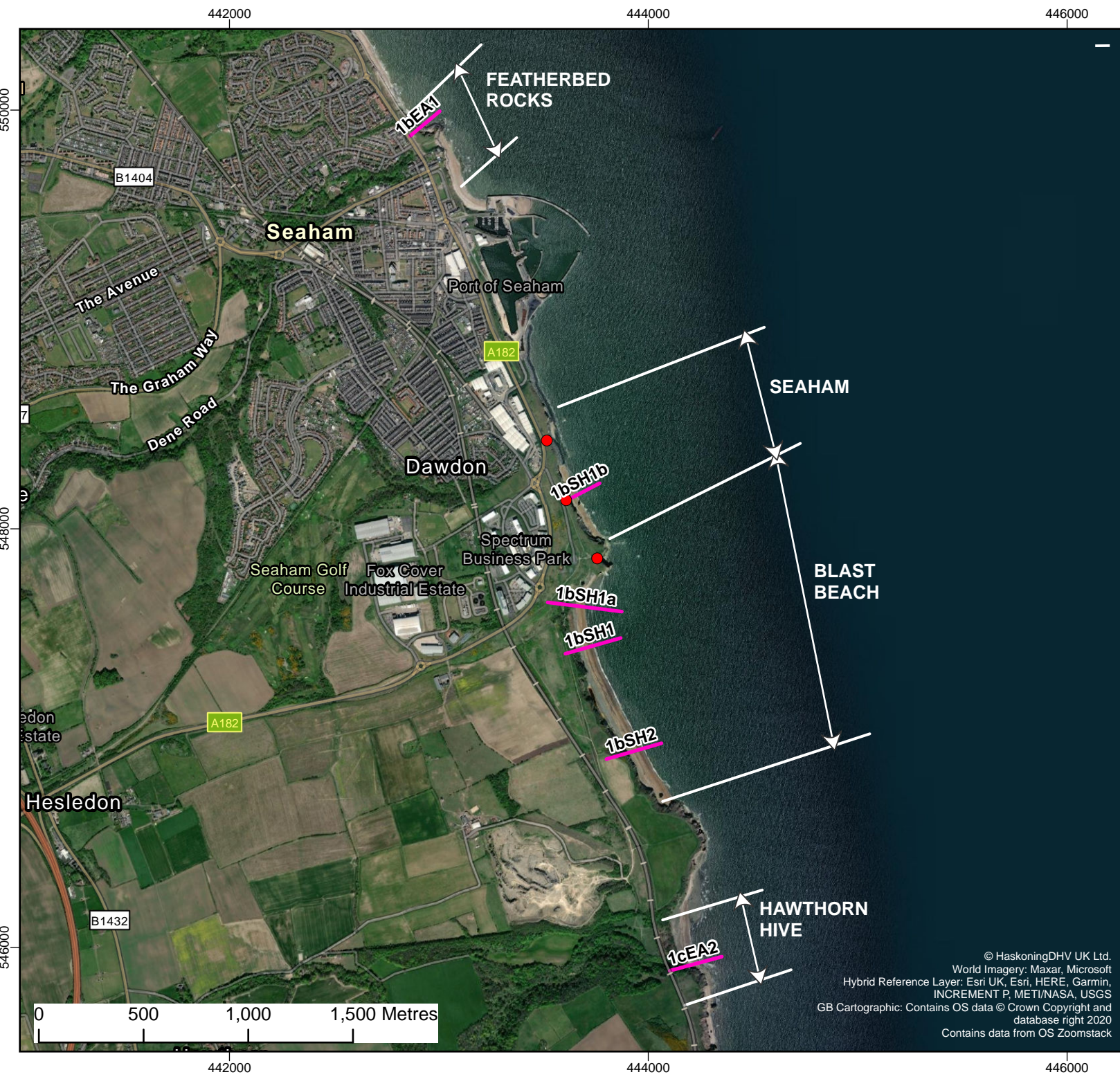
All data have been captured in a manner commensurate with the principles of the Environment Agency's *National Standard Contract and Specification for Surveying Services* and stored in a file format compatible with the software systems being used for the data analysis, namely SANDS and ArcGIS. This data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

Upon receipt of the data from the survey team, they are quality assured and then uploaded onto the programme's website for storage and availability to others and also input to SANDS and GIS for subsequent analysis.

The Analytical Report is then produced following a standard structure for each authority. This involves:

- 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.



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
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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

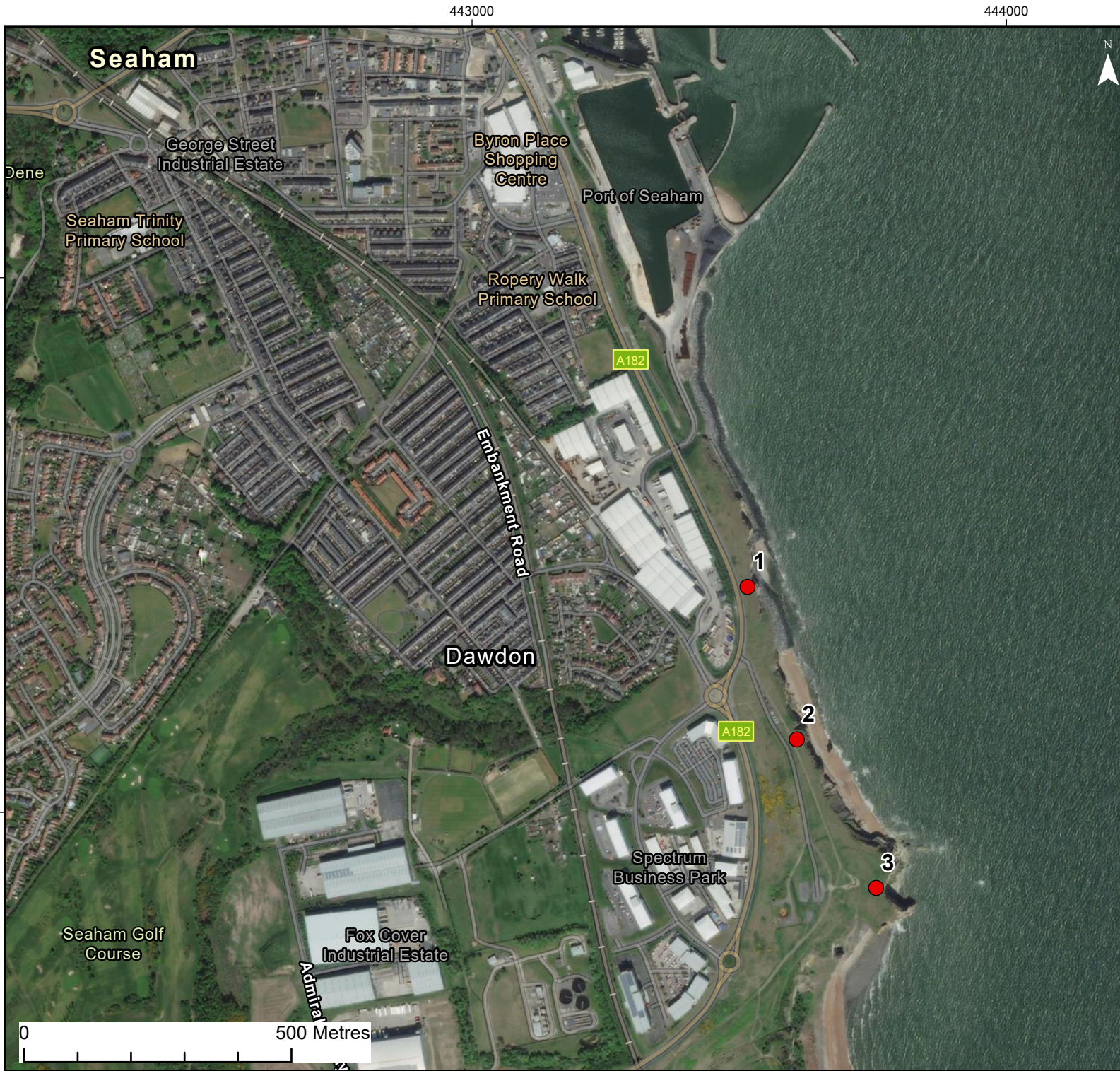
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	n/a	TC	NJC	A4	1:25,000

Co-ordinate system: British National Grid

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

- Cliff Top Survey Points

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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
3 rd September 2023	<p>Beach Profiles:</p> <p>Beach profile line 1bEA1, located at Featherbed Rocks (Appendix A), has been monitored since April 2009. The profile extends across the cliff top and cliff face then extends across the promenade (chainage 55m), rock armour sea defence (chainage 55m to 80m) and beach. Seaward of the rock armour at chainage 80m, there has again been very little change over the summer of 2023. The beach profile reflects the rocky nature of the foreshore with any minor change reflecting the movement of pockets of sediment between the rock outcrops. Previous surveys have shown accumulations of material at the base of the revetment, but this has not been present since the 2012 Full Measures survey.</p>	<p>Longer term trends: The cliff top and cliff face in this location appear stable and are unlikely to activate whilst the coastal defences remain present.</p> <p>The rocky nature of this foreshore means it is unlikely to undergo significant changes in morphology unless sediment is deposited upon it. A veneer beach was reportedly present between 2010 and 2012 but has not been recorded since.</p>

2.2 Seaham (Dawdon)

Survey Date	Description of Changes Since Last Survey	Interpretation
<p>20th September 2023</p>	<p>Cliff-top Survey:</p> <p>Three ground control points have been established along the cliff top at Dawdon (Figure B1). The separation between any two points is nominally 300m. These cliff top surveys are intended to inform on erosion rates of the undefended sea cliffs extending south of the rock armour revetment to the south of Seaham Harbour.</p> <p>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. Appendix B provides information about the ground control points and results from between the 2008 (baseline) cliff top survey and the current (November 2021) survey.</p> <p>Between March 2023 and September 2023 , none of the three control points have experienced any significant movement landward (>0.1m), recording -0.11m, -0.01m and -0.03m respectively.</p> <p>Appendix B provides results from the September 2023 survey, showing the distance from the ground control point to the edge of the cliff top along the defined bearing and changes in position since the November 2008 baseline survey.</p>	<p>All three control points have recorded a retreat less than 0.1m indicating a period of stability. The fact that all three points show an apparent advancement, may highlight the difficulties associated with identifying the cliff top (possibly due to vegetation) but also generally highlights the margin of error with the survey technique.</p> <p>Longer term trends: Long-term recession rates calculated from the data collected since November 2008 show retreat at 0.07m/yr. for Point 1, 0.02m/yr. for point 2 and 0.09m/yr. at Point 3.</p>

2.3 Blast Beach

Survey Date	Description of Changes Since Last Survey	Interpretation
10 th September 2023	<p>Beach Profiles:</p> <p>Blast Beach and Chemical Beach are covered by four beach profile lines (Appendix A). All the profiles exhibit similar forms, with a rock cliff, wide colliery spoil beach with a distinct low cliff at its eroding seaward edge, and a mixed gravel and sand foreshore extending to MLW. The survey report notes that; <i>'Dense vegetation restricts access to the cliff tops of sections SH1, SH2 & SH1A and the cliff base of SH1A.'</i></p> <p>Profile 1bSH1b 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, fronted by a gravel beach. The beach is bisected by a large concrete block between chainage 59m and 63m. Over the summer 2023, the upper section of the beach has accreted by up to 1m at chainage 35m, reducing to accretion of 0.1m at the landward side of the concrete block. Seaward of the concrete blocks, the beach has initially eroded by up to 0.15m over a 3m length, at which point the rocky foreshore is exposed. When compared to the range of the previous surveys, the beach is at a high level at the toe of cliff gradually reducing to a low on the lower beach.</p> <p>Profile 1bSH1a was added to the programme during the Full Measures survey in September 2009. It is located to the north of the previously established 1bSH1. The cliff top, face and landward extents of the colliery spoil platform have all remained unchanged since the previous survey. The eroding face of the spoil also remained unchanged, located at chainage 135m. Seaward of the spoil face, the upper beach has dropped in level significantly with the apparent draw down of material offshore. The drop in beach level peaks at chainage 147m, dropping by 1.7m. From chainage 166m onwards, the rocky foreshore remains exposed.</p> <p>At 1bSH1, the profile has remained unchanged across the cliff top and cliff face up to chainage 40m. At the toe of the cliff, on the colliery spoil platform, an incised channel holds water. The beach profile shows that the channel has accreted by 0.3m over summer 2023, however it is unclear whether this true change or in fact a reflection of varying water levels altering where the surveyors could take readings. The face of the retreating colliery spoil platform has shifted landward 0.4m since the previous survey, a relatively small retreat compared to previous years. Between the spoil and the exposed rocky</p>	<p>The colliery spoil platform on all profiles across Blast Beach appears to have remained stable over the summer 2023 indicating a period of calmer weather.</p> <p>This said, the significant draw down of material in front of the colliery spoil at profile 1bSH1a is thought to likely leave the spoil vulnerable for the subsequent winter months.</p> <p>Longer term trends: The cliffs behind Blast Beach are currently inactive because they are fronted by colliery spoil. The sea cliffs will eventually reactivate as on-going erosion of the colliery spoil removes the protection it affords to the cliffs. This is most likely to occur at the southern end of the bay where the spoil is most rapidly eroding. The accumulating sediment seaward of the colliery spoil in the northern part of the bay will offer the cliffs more protection. However, the trend reversed in the the winter of 2014 with erosion in the north of the bay and accretion in the south. Since 2022, the colliery spoil has undergone a period of stability.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>platform (at chainage 117m) the beach has steepened. This has resulted in an increase in level of 0.4m between 75m and 96m and decrease in level of similar magnitude between 96m and 117m.</p> <p>At 1bSH2, the most southerly profile along Blast Beach, dense vegetation at the cliff top (noted in the survey report) has resulted in anomalous readings on the profile between chainage 64m and the toe of the cliff at chainage 95m. Unlike elsewhere on Blast Beach, there is little to no cliffing between the edge of the spoil and the beach sediment. The profile has generally remained stable since the previous survey other than one area of accretion between chainage 130m and 155m of up to 0.5m in level. The profile remains at a medium to high level compared to the range recorded from previous surveys.</p>	

2.4 Hawthorne Hive

Survey Date	Description of Changes Since Last Survey	Interpretation
20 th September 2023	<p>Beach Profiles:</p> <p>Hawthorne Hive is monitored by beach profile 1cEA2 (Appendix A). The survey report notes “<i>unable to measure start of Section EA2 as the vegetation has choked out the section line and route over cliff faces</i>” and therefore all surveys following October 2012 start at 95m chainage. The steeper upper beach, from chainage 95m to 148m, has remained largely stable. Low levels of accretion (+0.4m) has formed a shallow berm at chainage 108m, with erosion less than 0.2m observed until chainage 148m. Seaward of chainage 148m, the rocky foreshore remains exposed. The upper beach remains at medium level when compared to the range of previous surveys, with the exposed foreshore naturally at the lowest level.</p>	<p>Longer term trends: The upper beach levels were recorded to be notably low in 2014, 2018 and May 2021. On all occasion the beach levels appeared to demonstrate some recovery but not enough to alter the long-term pattern that suggests the beach is undergoing progressive erosion.</p> <p>Limited cliff erosion occurs in this section and therefore sediment supply is limited to erosion of colliery spoil.</p> <p>Storm events and varying flows in Hawthorne Burn are likely to continue to episodically block the channel and change its course across the beach.</p>

2.5 Blackhall Colliery

Survey Date	Description of Changes Since Last Survey	Interpretation
4 th September 2023	<p>Beach Profiles:</p> <p>Blackhall Colliery is covered by three beach profile lines (Appendix A) that are monitored annually. As at Blast Beach, profiles are dominated by colliery spoil and exhibit similar forms with a rock cliff, wide spoil beach with a distinct cliff at the eroding face of the colliery spoil, and a gravel and sand foreshore that extends to MLW. The survey report notes that the surveyor was <i>'unable to survey part of section BH1 and BH2 due to dense vegetation'</i>.</p> <p>1cBH1 is located near Horden Point. The Full Measures 2023 survey shows that the profile has remained stable up to the face of the retreating colliery spoil at chainage 137m. Apparent accretion of material at the face of the spoil has resulted in the cliffed face becoming more gradual in topography. The cobble beach/foreshore has maintained a very similar profile to the November 2022 profile with change again limited to the movement of large rocks. The profile remains at the bottom of the range envelope due to the retreating colliery spoil platform over time.</p> <p>At Profile 1cBH2, the backing till cliff appears to have been recently active, with slumping evident in the survey photos. From the toe of the cliff to the face of the retreating colliery spoil, the platform has remained unchanged. Compared to previous years the rate of retreat of the colliery spoil itself is significantly less, retreating landward less than 0.5m since the previous survey, The lower beach, seaward of chainage 190m, has accreted by up to 0.5m in level. Overall, the profile remains at the bottom of the range envelope due to the retreating colliery spoil platform over time, with the exception of the lower beach due to the recent accretion.</p> <p>Profile 1cBH3 shows that since 2008 there has been episodic migration, infilling and scouring of the outflow of Castle Eden Burn, which crosses the profile. The channel has been migrating landward over the years and now is located at the toe of the cliff. Since the previous inspection the channel bed has accreted marginally by 0.2m level but has not changed in width.. The berm crest, seaward of the channel, remains unchanged. On the beach itself the profile appears to show the movement of material up the profile, with accretion of up to 0.8m occurring between 164m and 196m and erosion of a similar magnitude between 196m and 246m. Compared to the range of previous surveys the profile remains largely at its most landward position.</p>	<p>The frontage appears to have experienced a period of stability with the colliery platforms at profile 1cBH1 and 1cBH2 both retreating less than 0.5m since the previous surveys. As a result, there is approximately 30m and 25m of spoil remaining fronting the cliffs at 1cBH1 and 1cBH2 respectively.</p> <p>Longer term trends: The surveys show that the spoil beach along much of the Blackhall Colliery shore is progressively eroding but continues to protect the cliffs in the short term. The colliery spoil face at profile 1cBH1 and profile 1cBH2 has eroded back ~8m and 24m respectively since the first survey in 2011. In recent years profile 1cBH2 has experienced an inflated rate of erosion. This was not observed in the latest survey but should still be monitored closely.</p>

3. Problems Encountered and Uncertainty in Analysis

The cliff top position surveys at Dawdon are assumed to have a limit of accuracy of $\pm 0.1\text{m}$ due to the techniques used. The accuracy of short-term recession data are therefore limited, but longer-term recession rates will become more reliable as further data is obtained (see section 1.3).

At Blast Beach 1bSH1, 1bSH1A and 1bSH2 there was no access to the cliff top and at the cliff bottom of 1bSH1A due to dense vegetation.

At Hawthorne Hive the surveyor was unable to measure the start of Section 1cEA2 as the vegetation has choked out the section line and route over cliff faces.

At Blackhall the surveyor was unable to access part of sections 1cBH1 and 1cBH2 due to dense vegetation.

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

No changes are recommended at the present time.

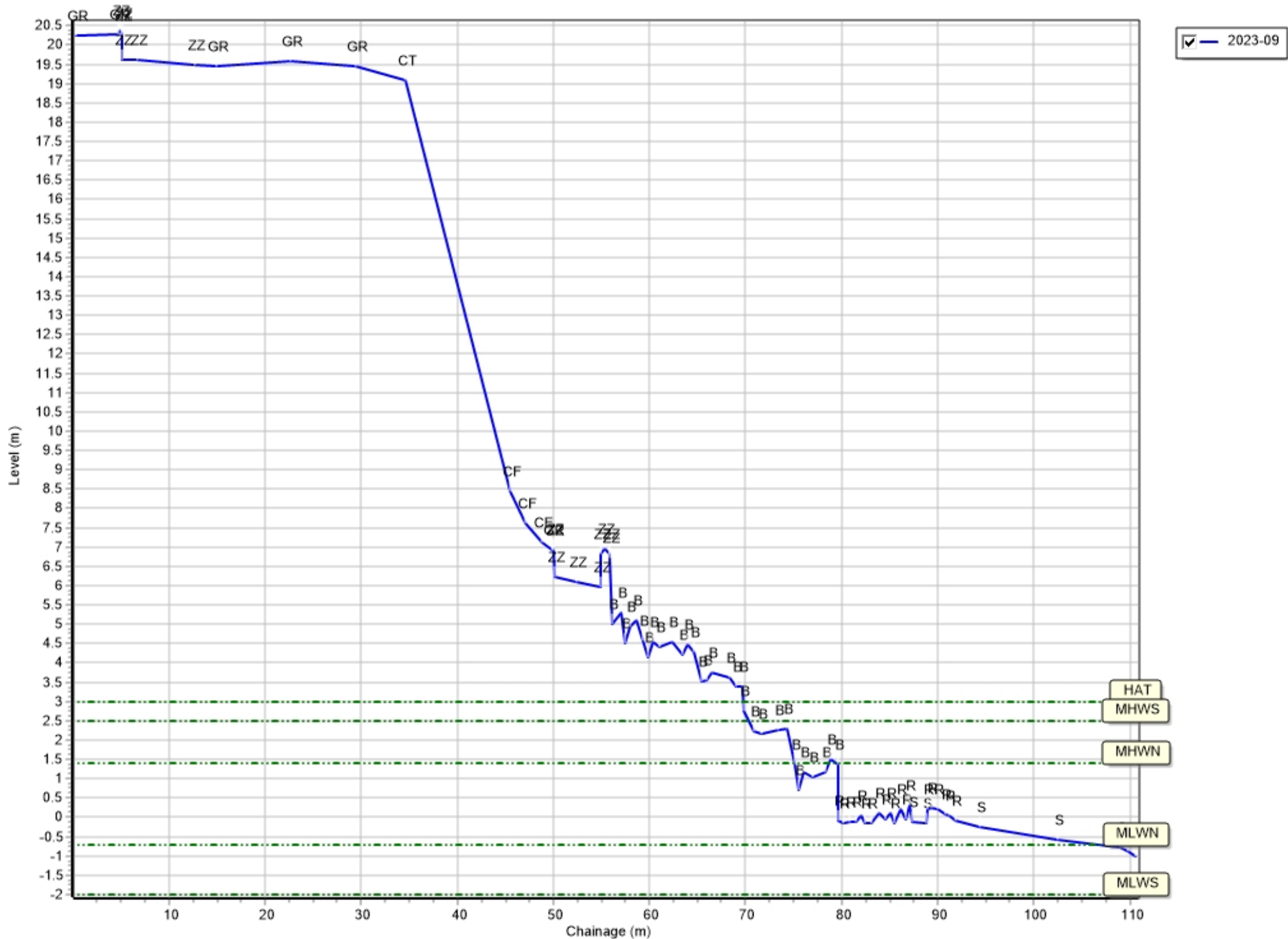
5. Conclusions and Areas of Concern

- There has been little change at Featherbed Rocks. The rocky shore platform remains exposed with the veneer beach that was present in earlier surveys still absent since autumn 2012.
- At Seaham cliffs, all three of the control points showed an apparent advancement since the previous survey, albeit at a low magnitude. This highlights the difficulty in identifying the cliff edge potentially due to vegetation growth.
- The colliery spoil platform on all profiles across Blast Beach appears to have remained stable (relative to previous years) over the summer 2023 indicating a period of calmer weather. This said, the significant draw down of material in front of the colliery spoil at profile 1bSH1a is thought to likely leave the spoil vulnerable for the subsequent winter months.
- At Hawthorne Hive, there has been little change since the previous survey with the upper beach remaining stable. The rocky foreshore remains exposed on the lower beach.
- The frontage appears to have experienced a period of stability with the colliery platforms at profile **1cBH1** and **1cBH2** both retreating less than 0.5m since the previous surveys. As a result, there is approximately 30m and 25m of spoil remaining fronting the cliffs at **1cBH1** and **1cBH2** respectively.

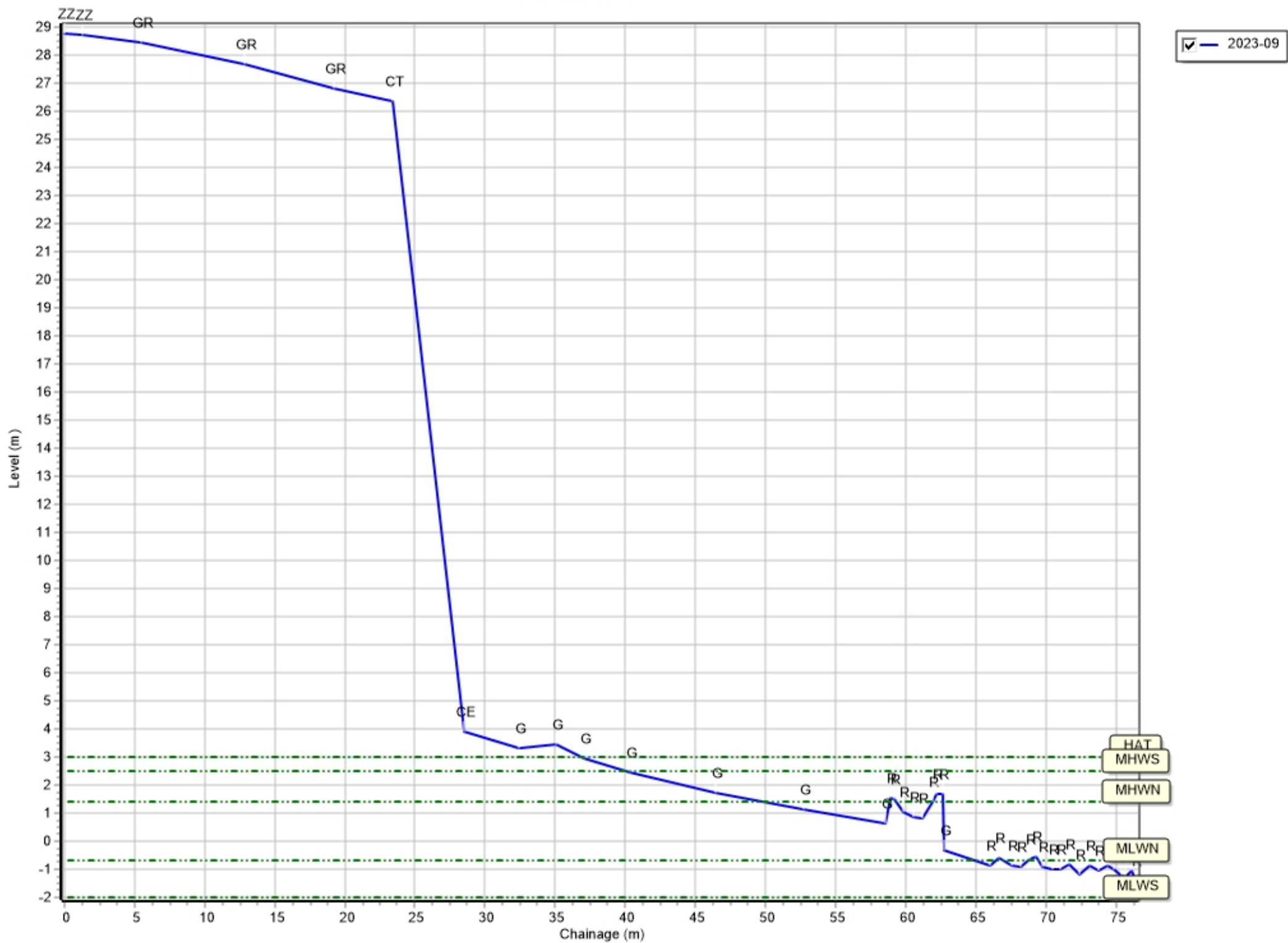
Appendices

Appendix A
Beach Profiles

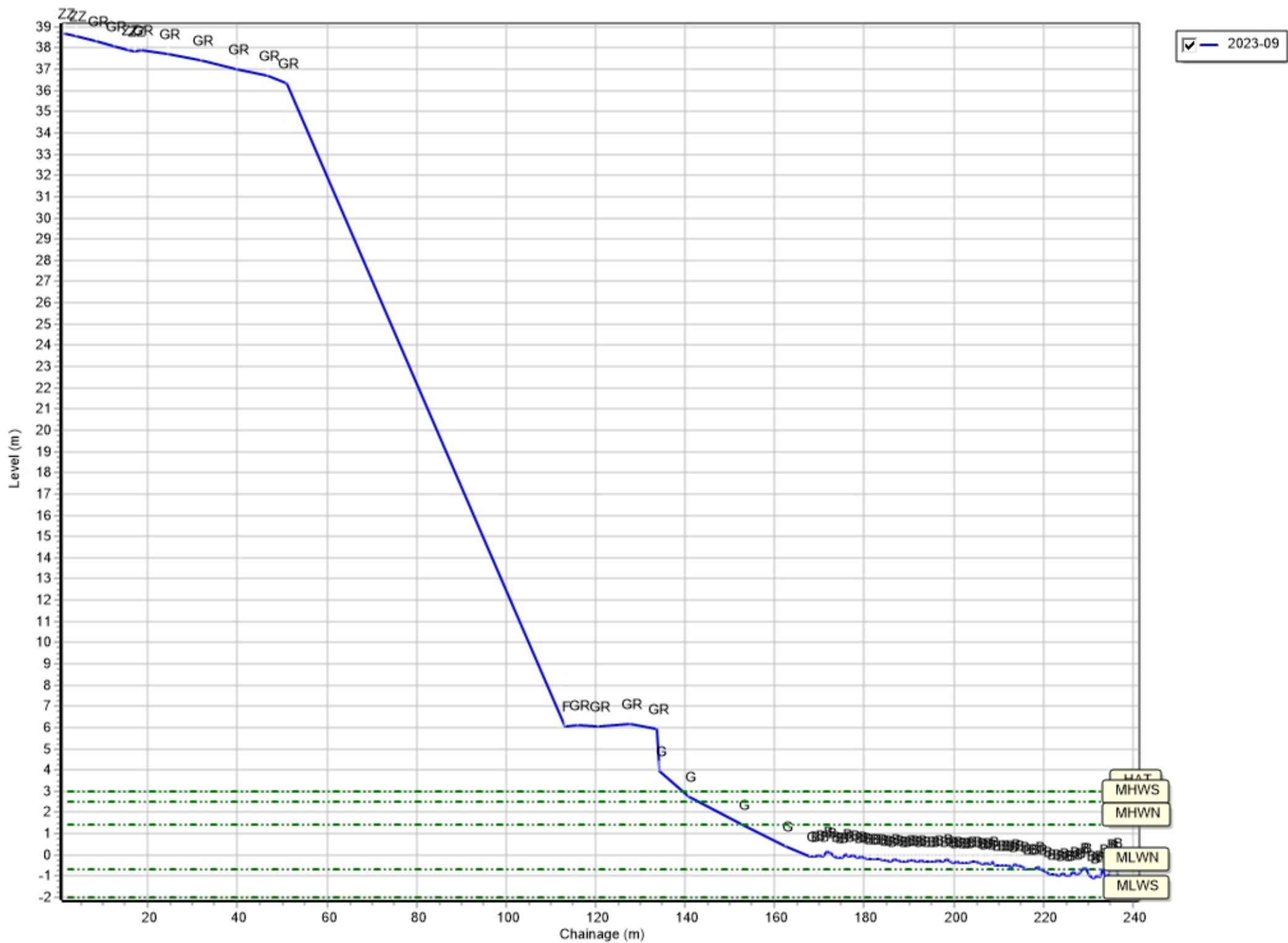
Profiles: 1bEA1



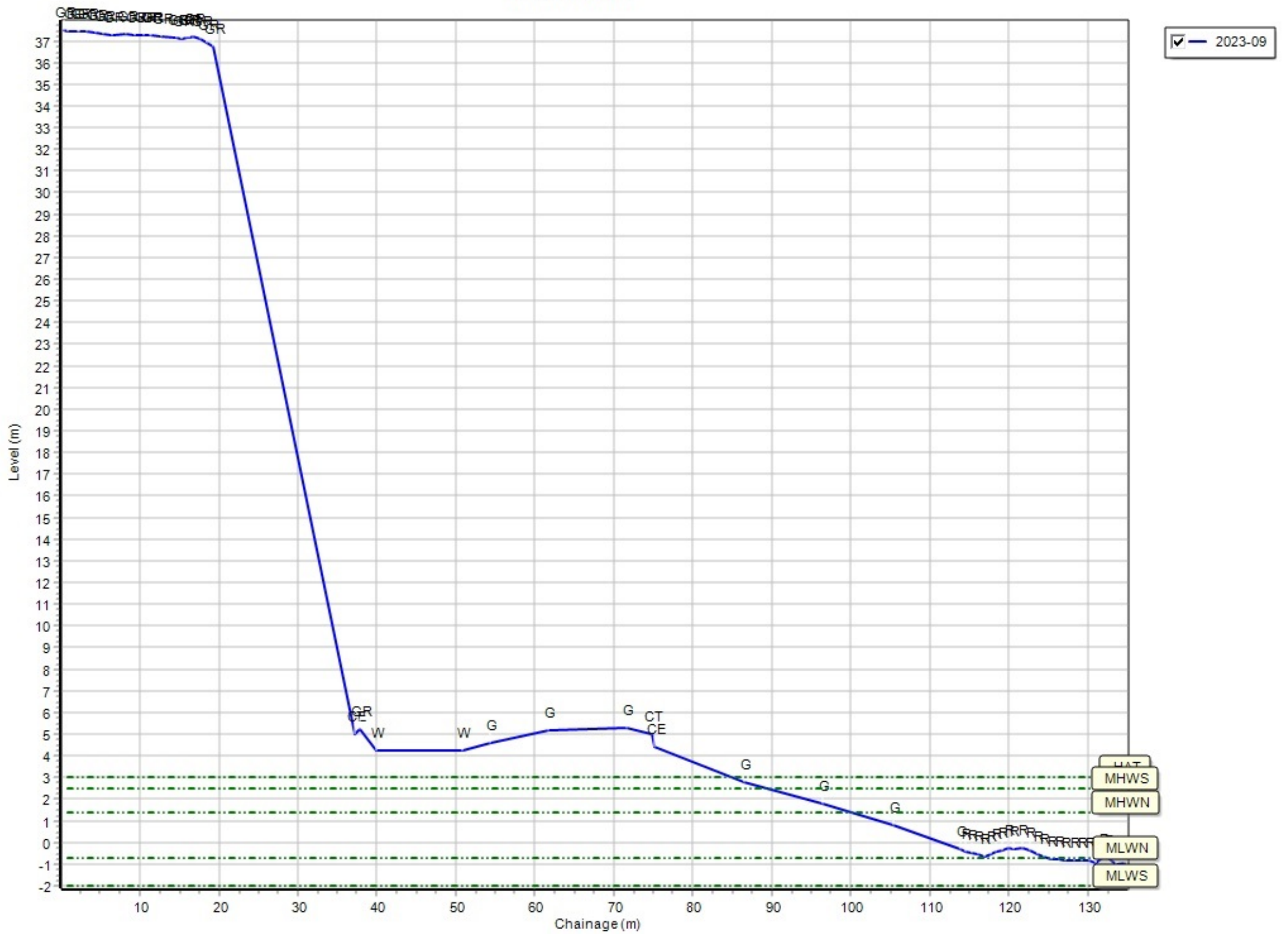
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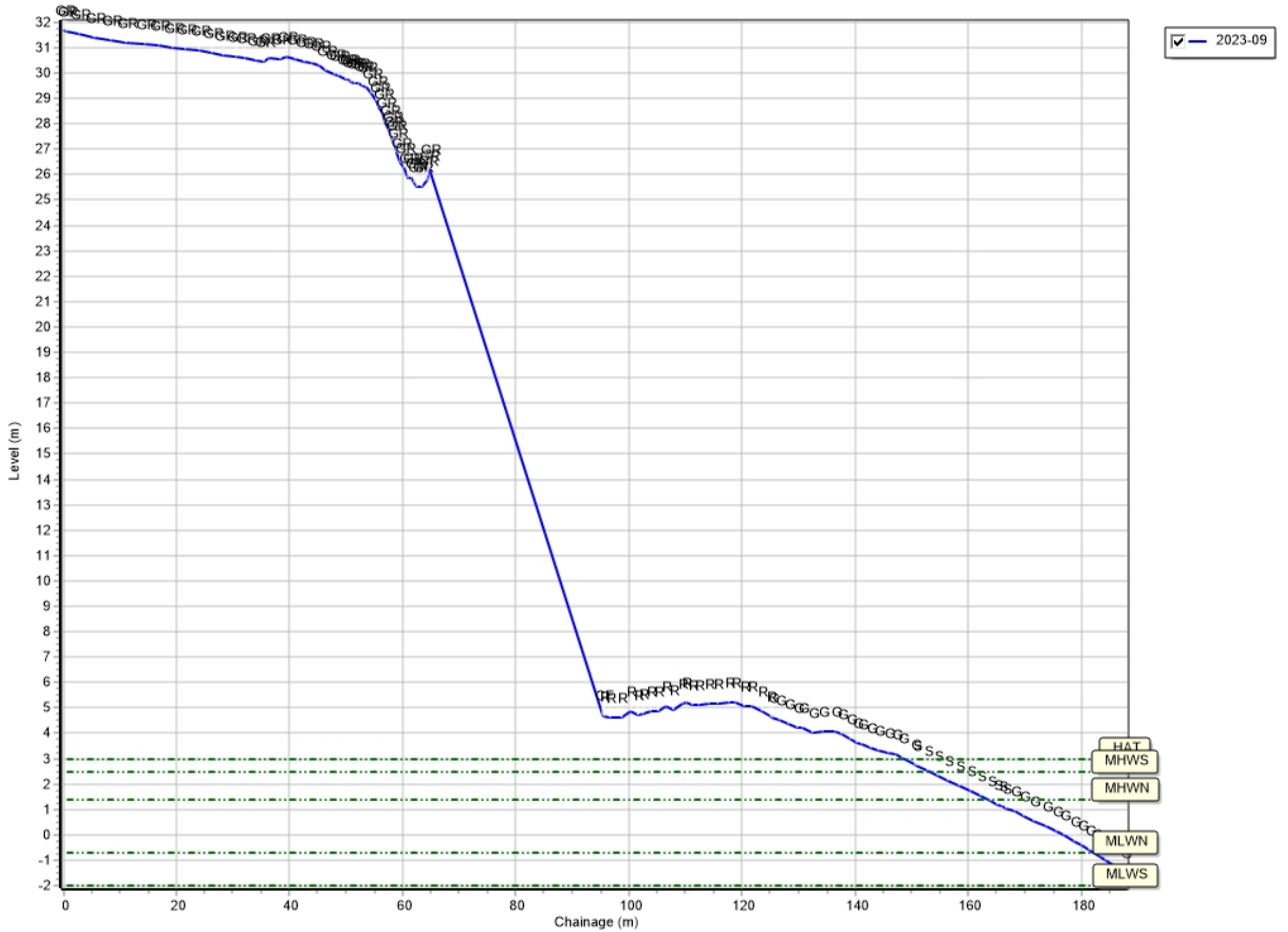
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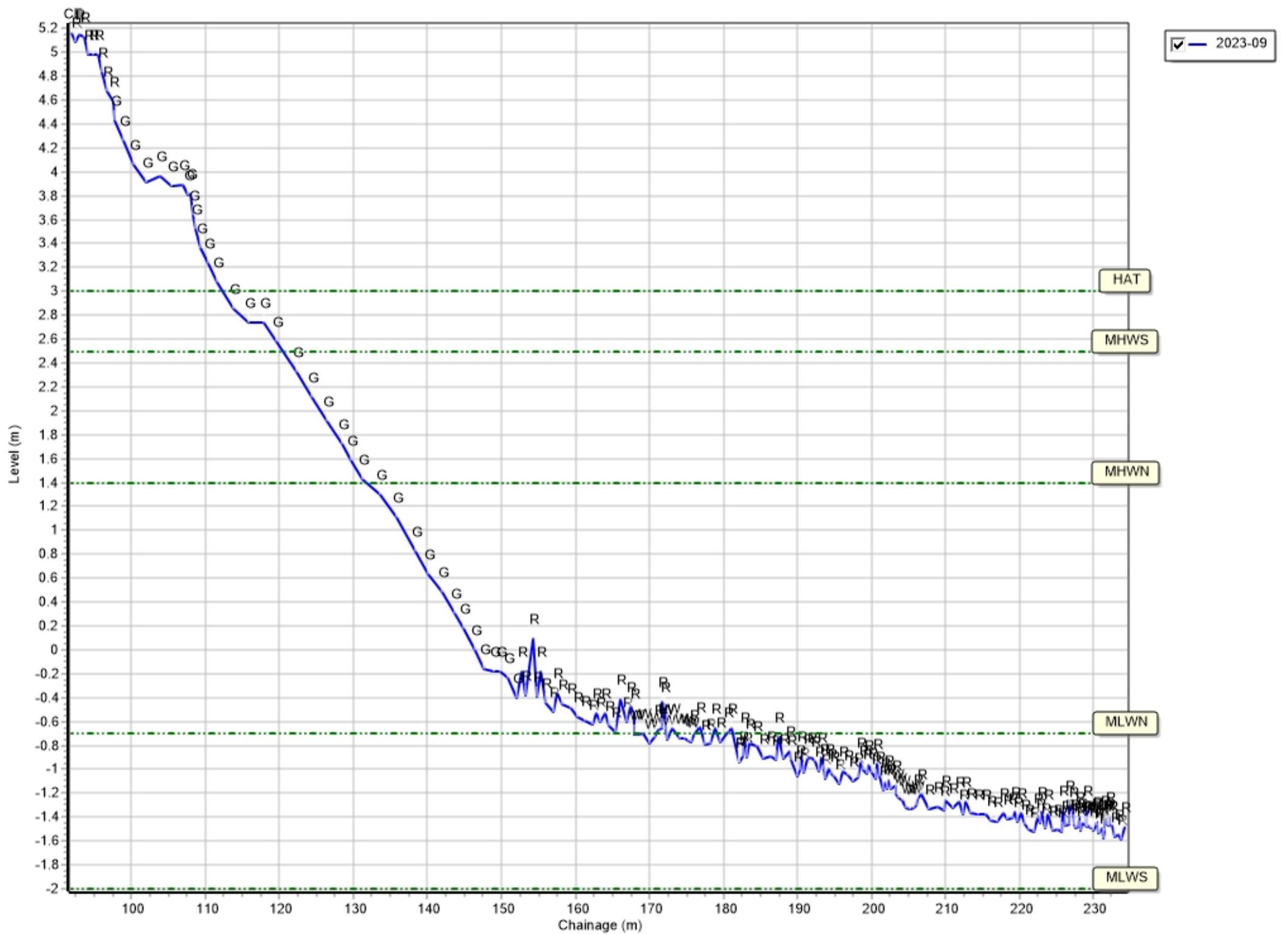
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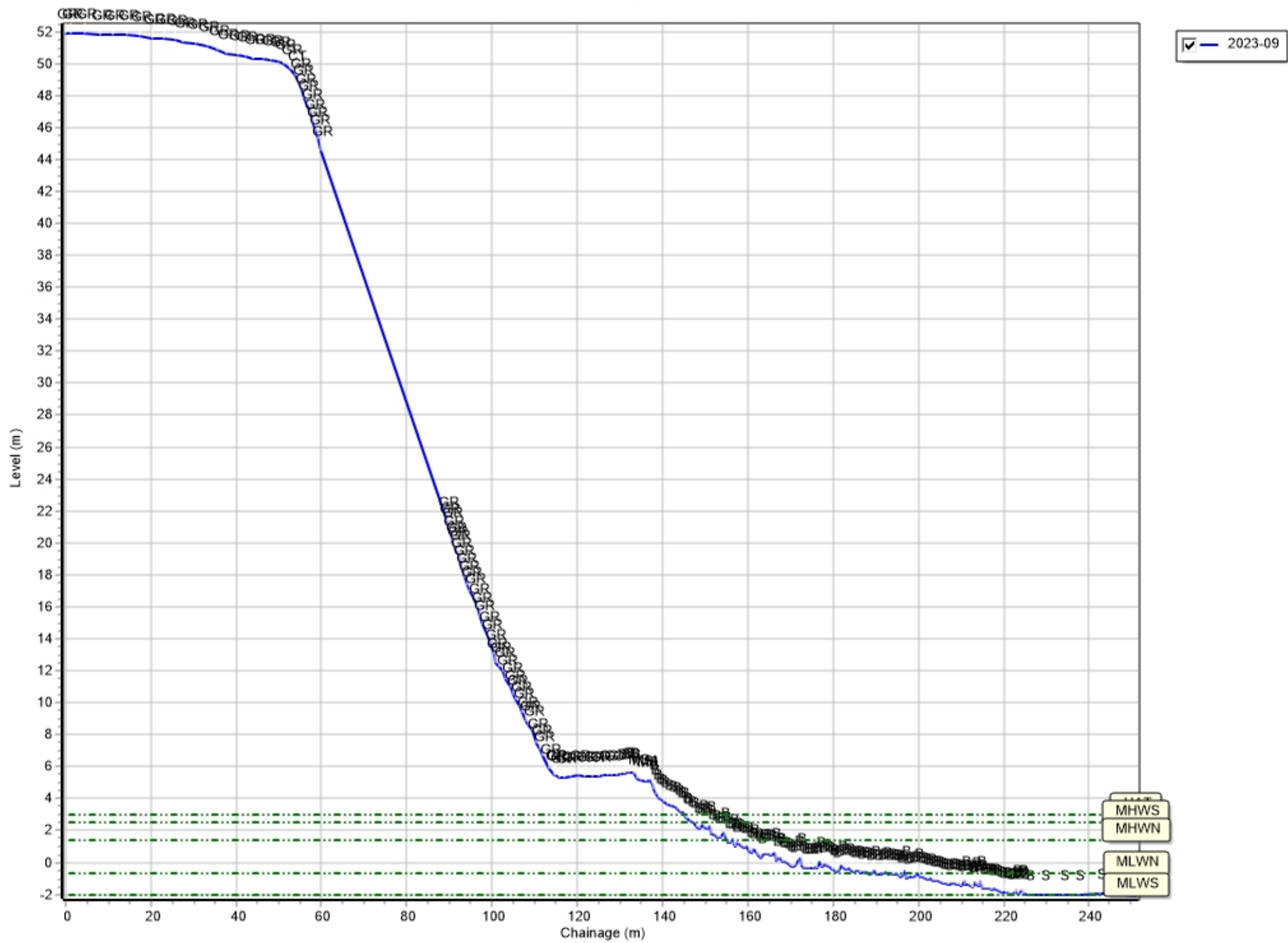
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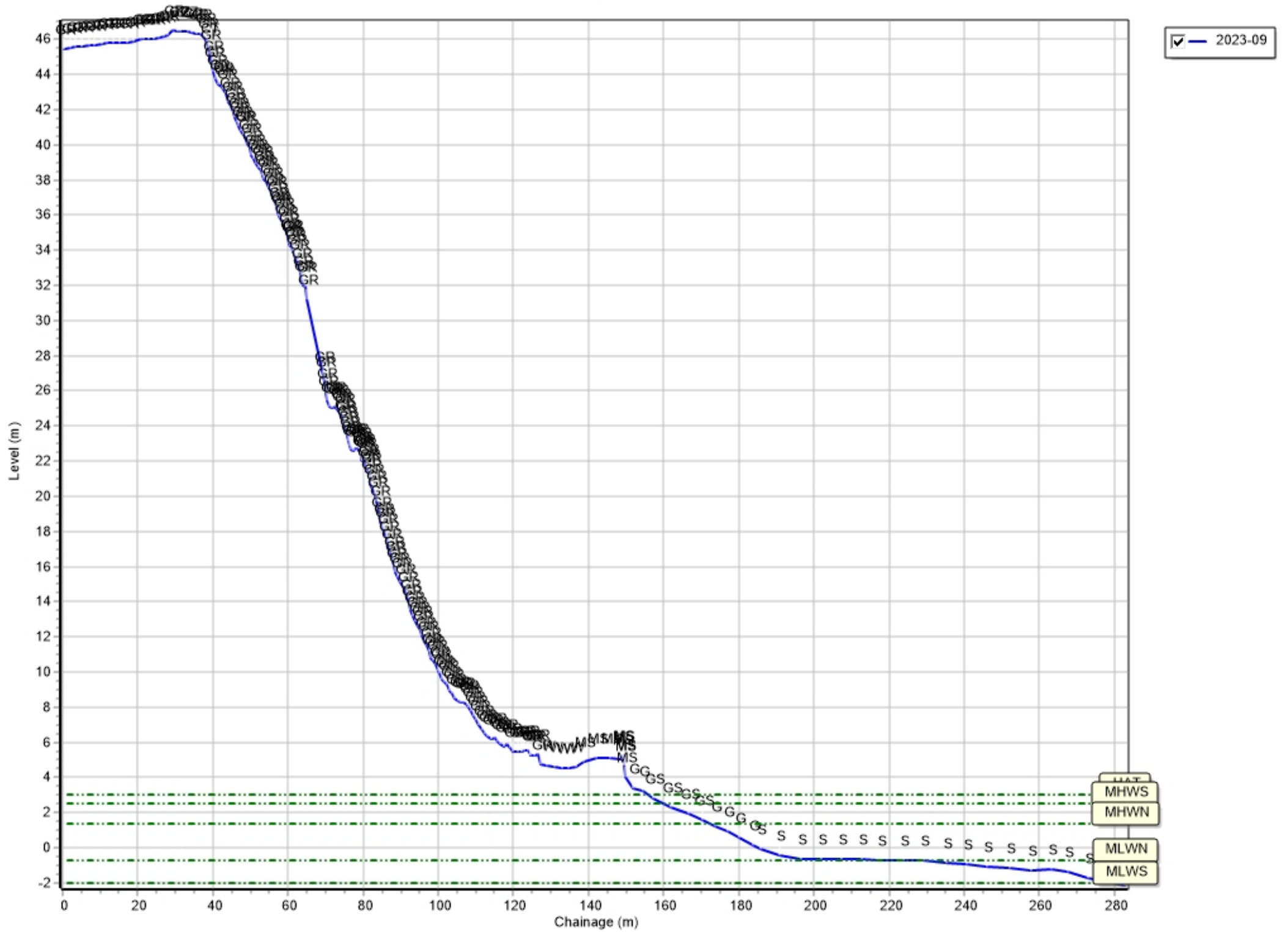
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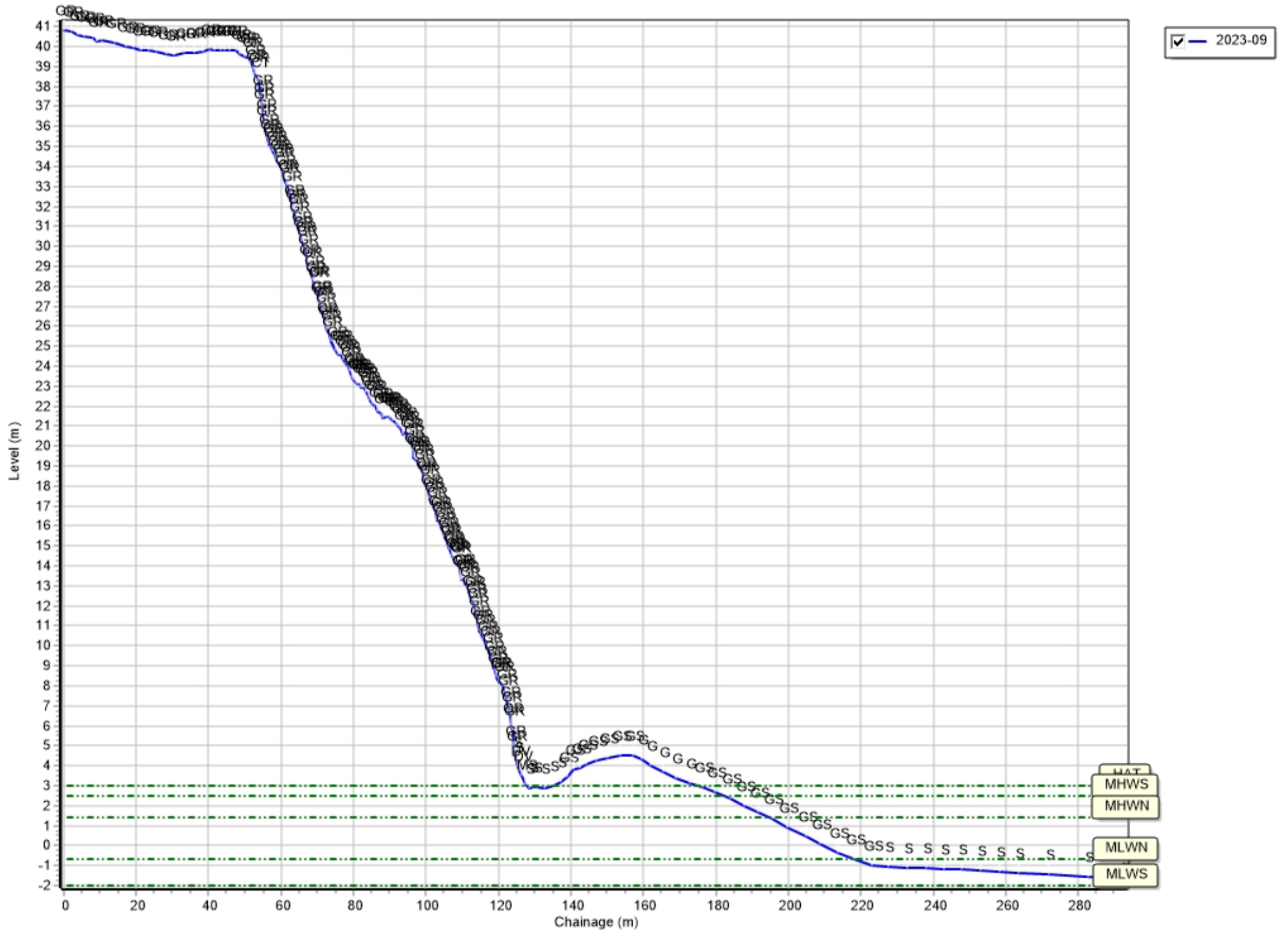
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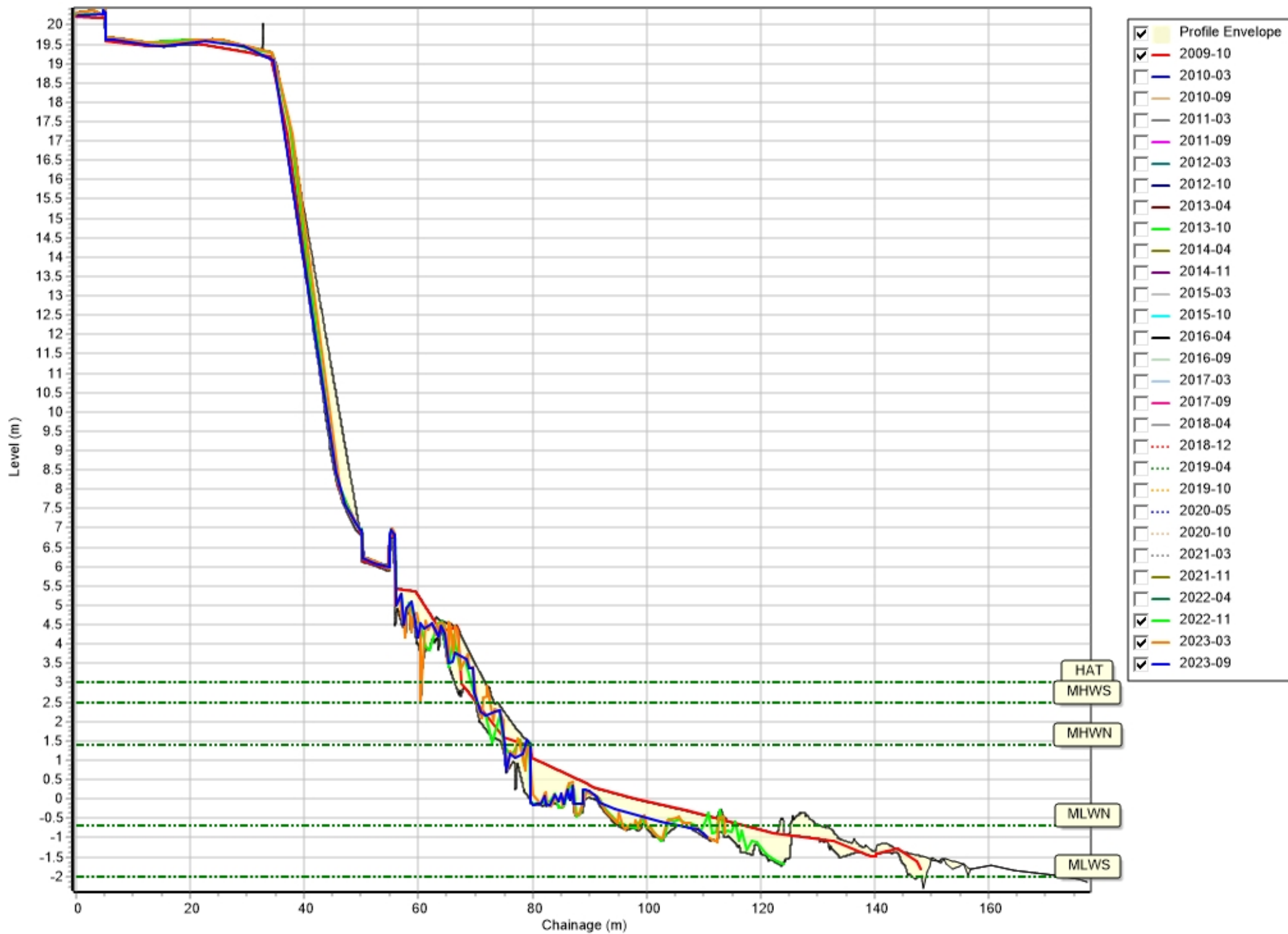
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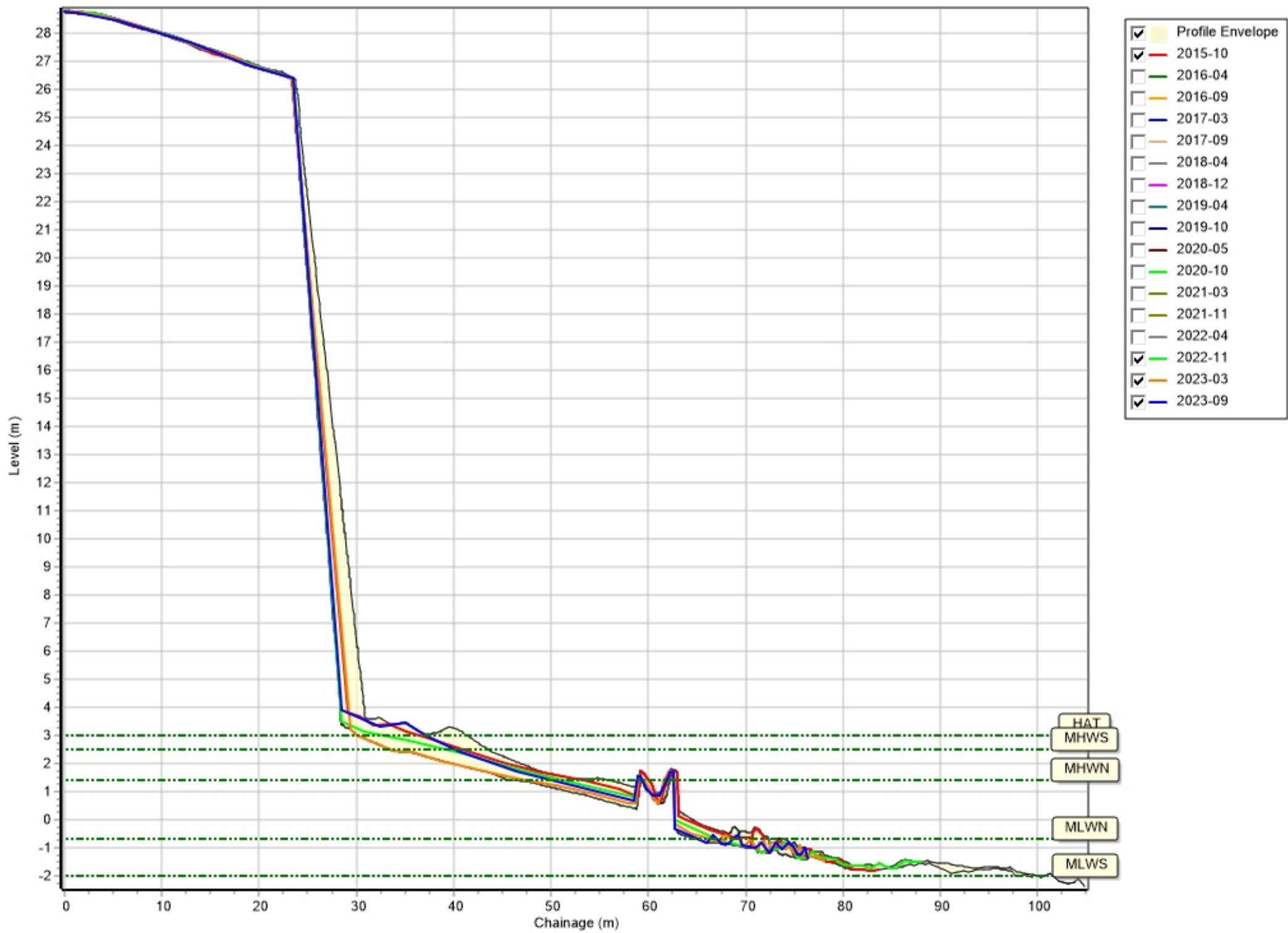
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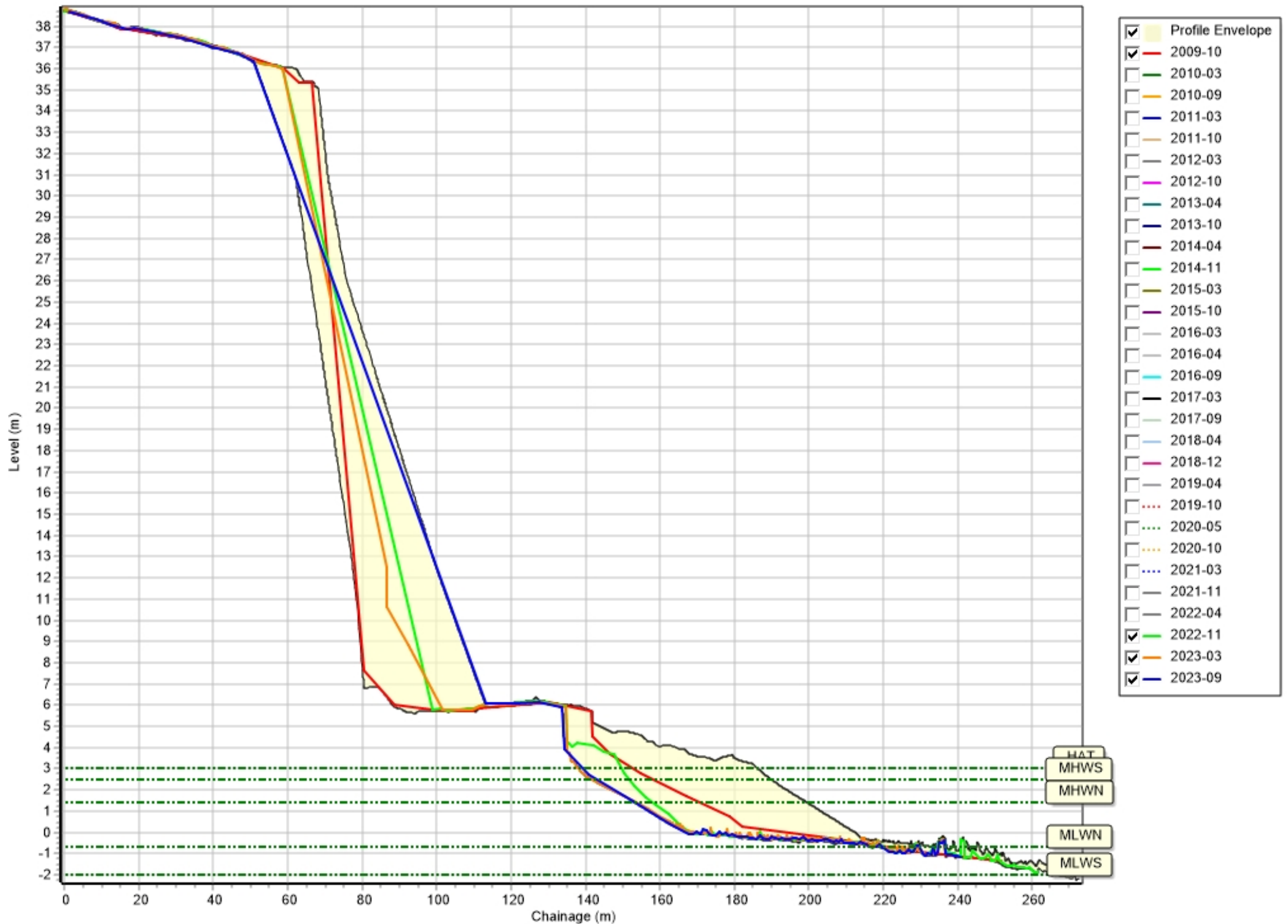
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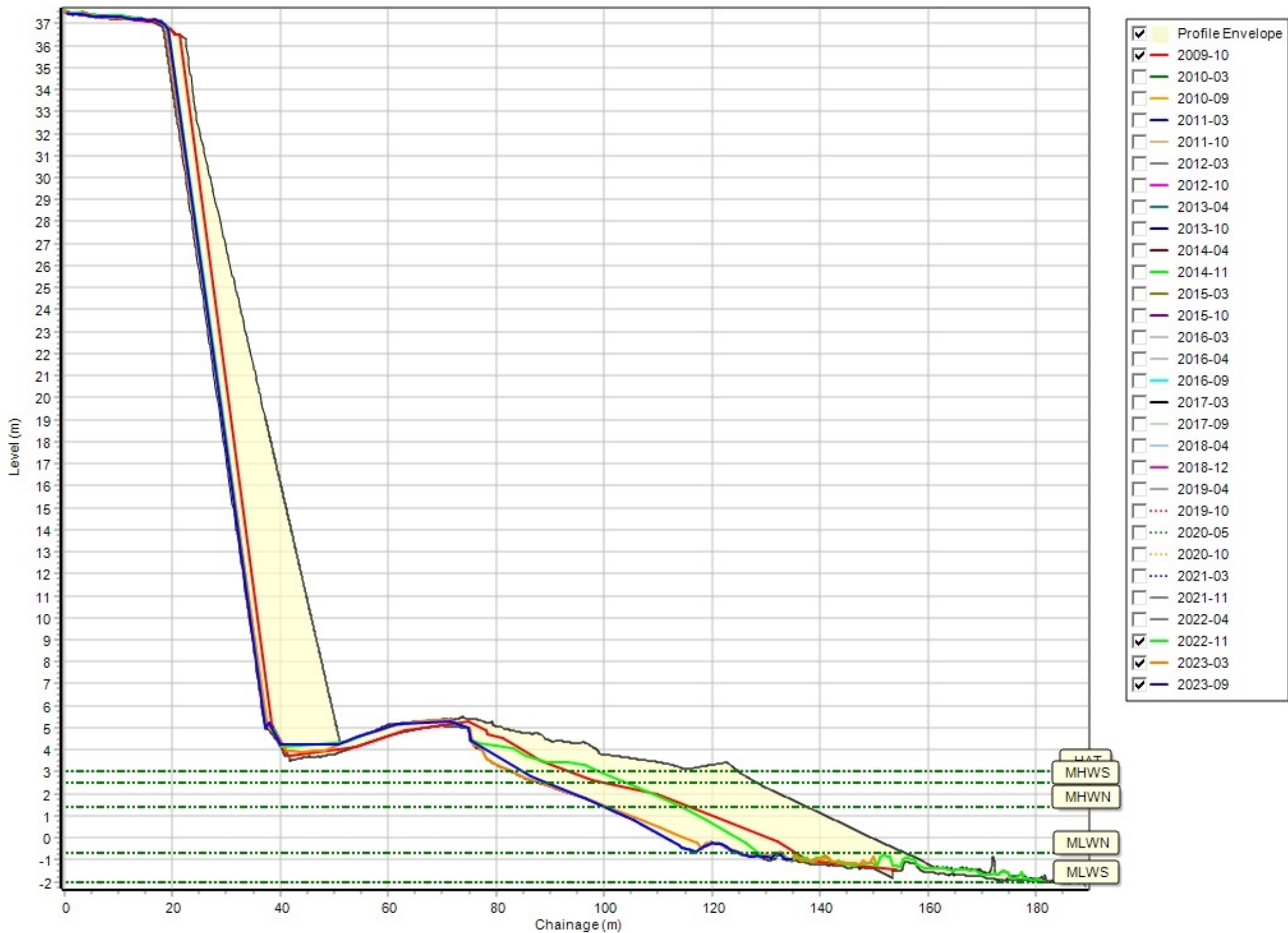
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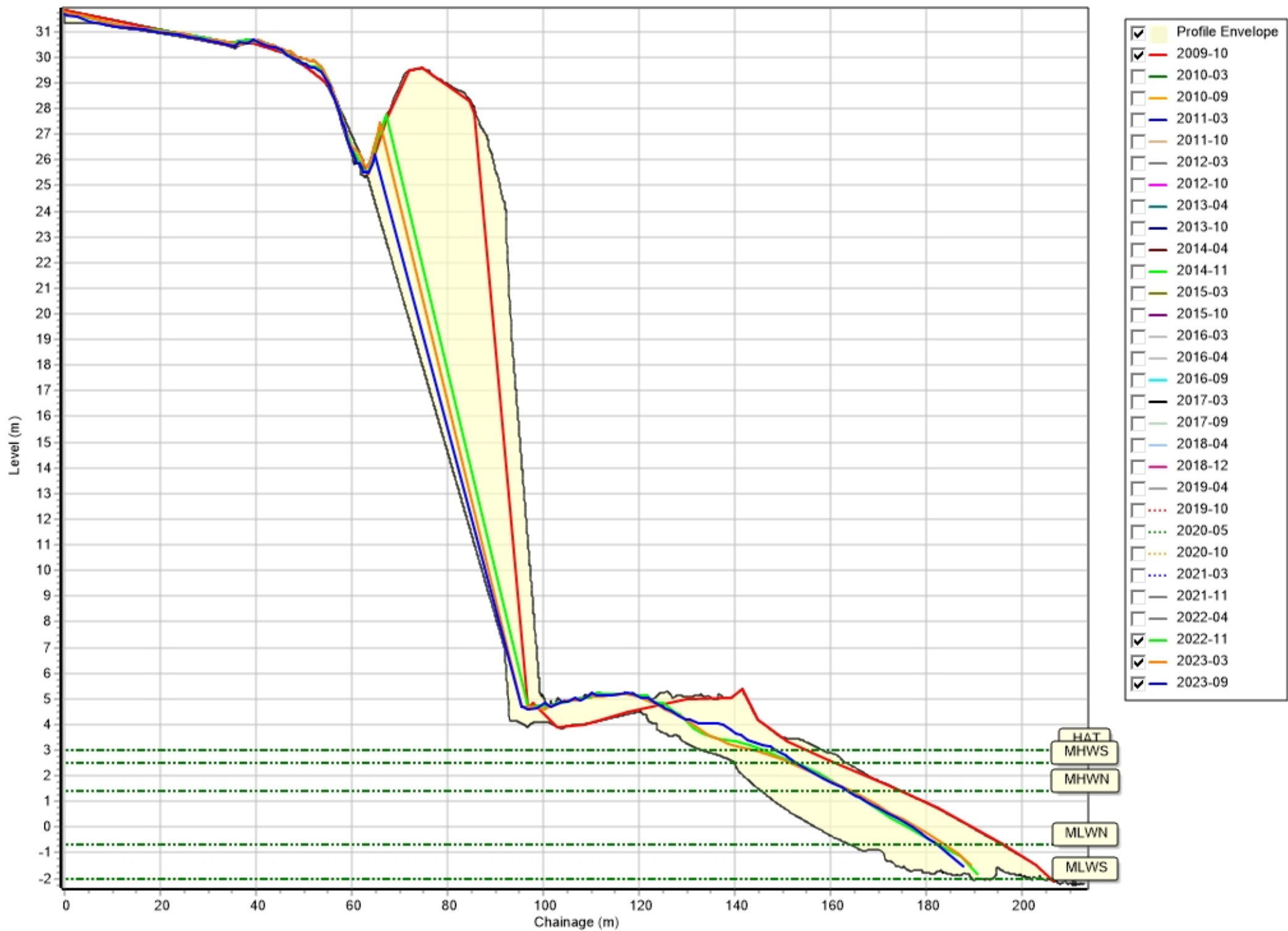
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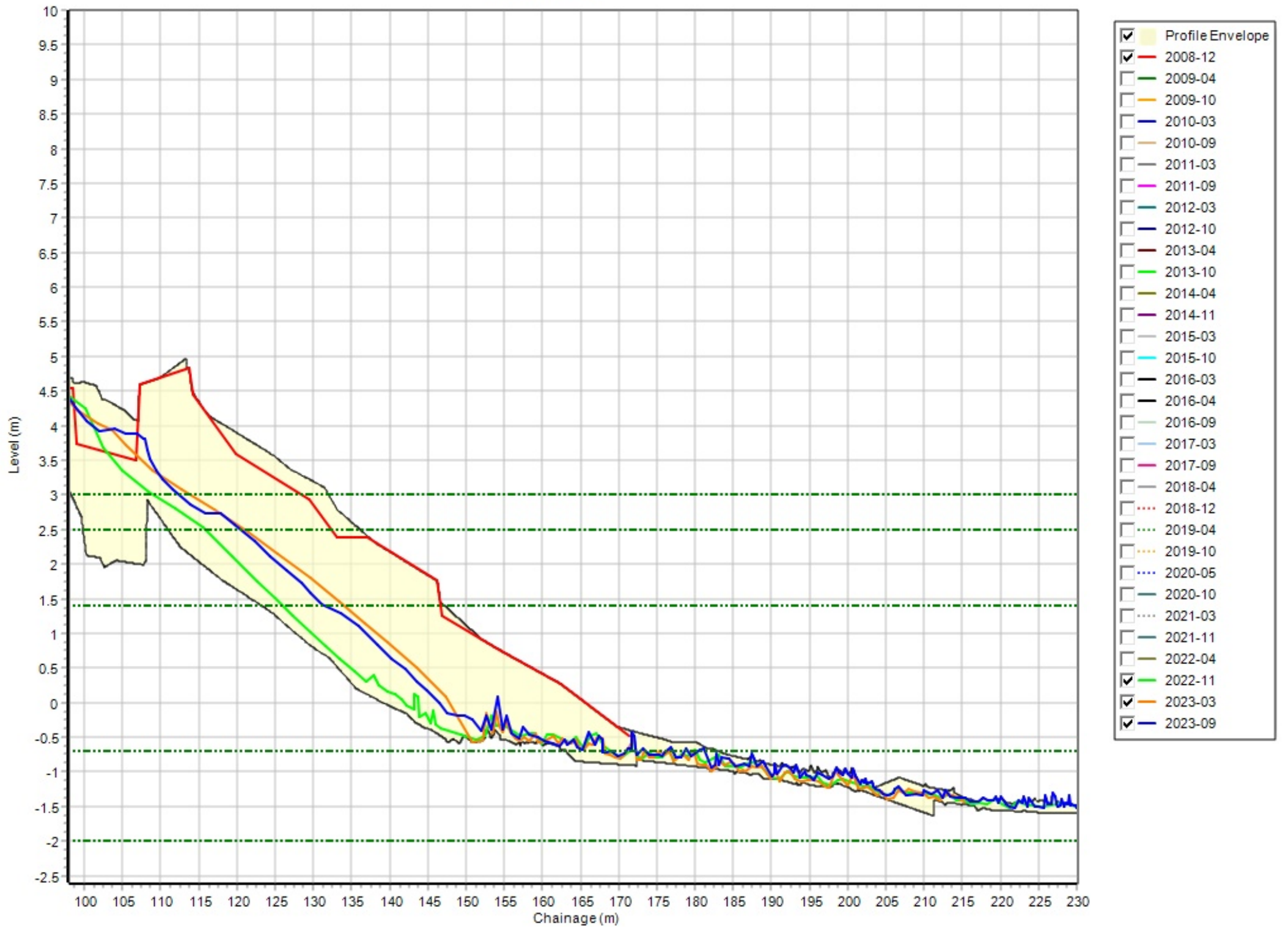
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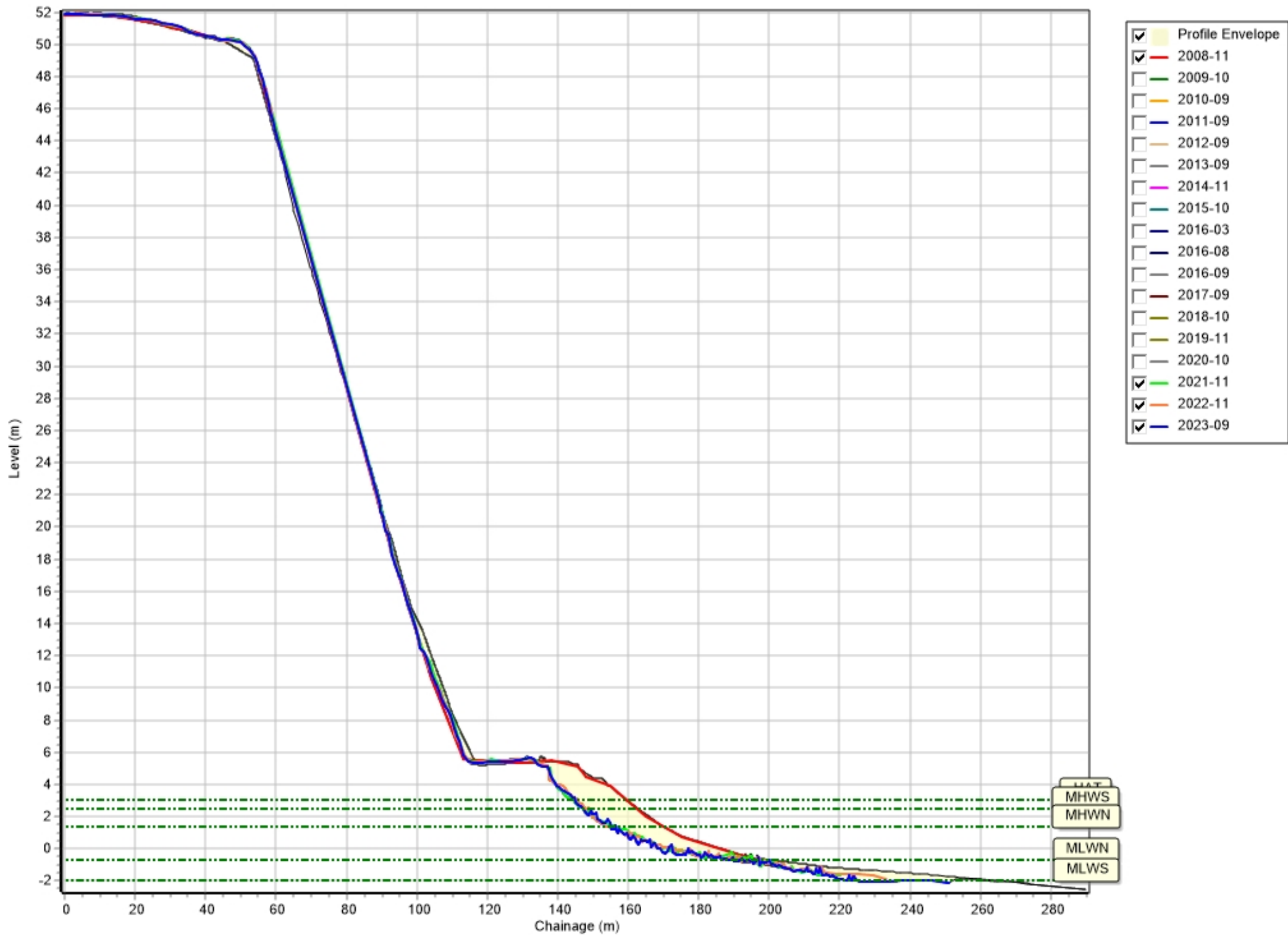
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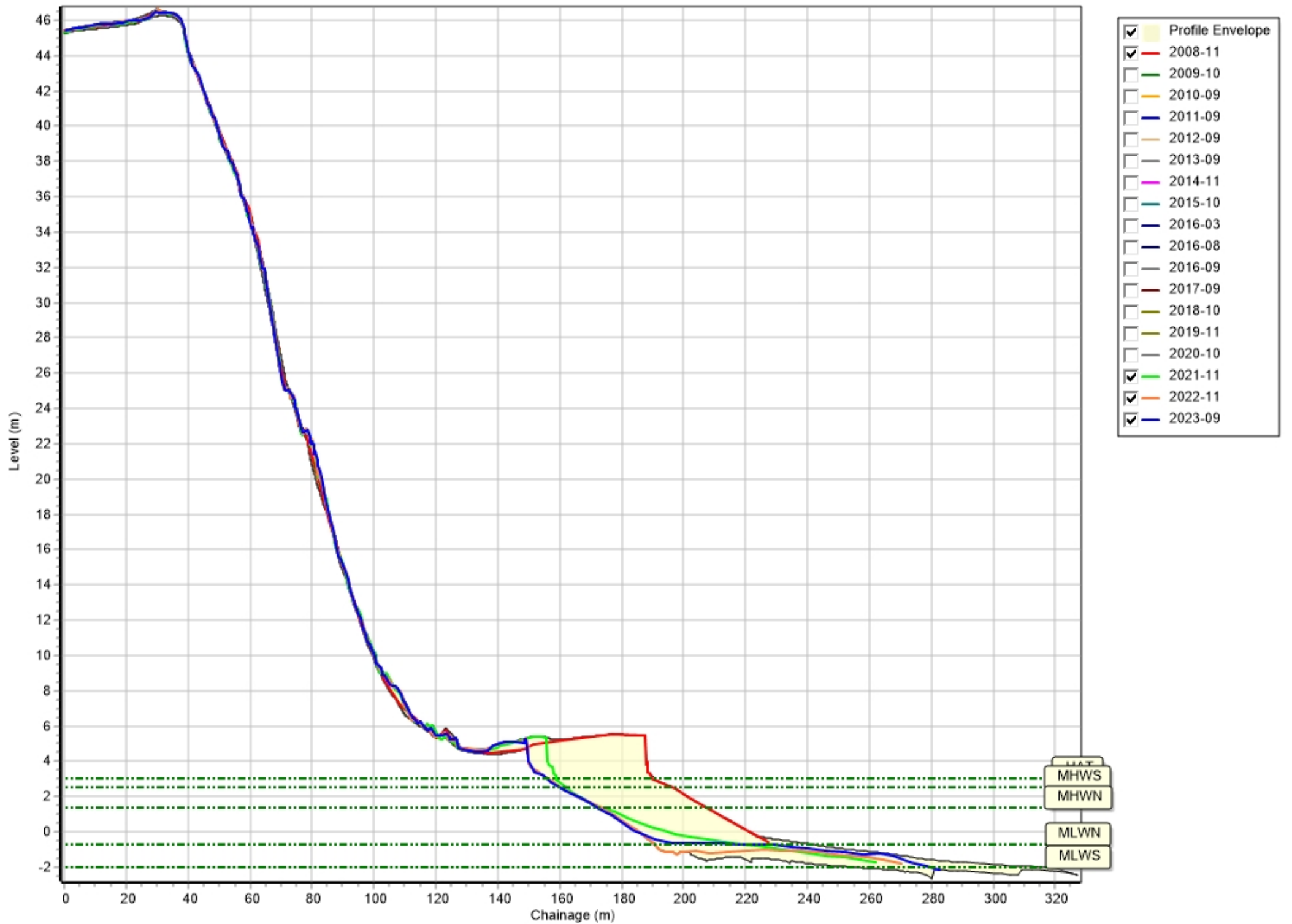
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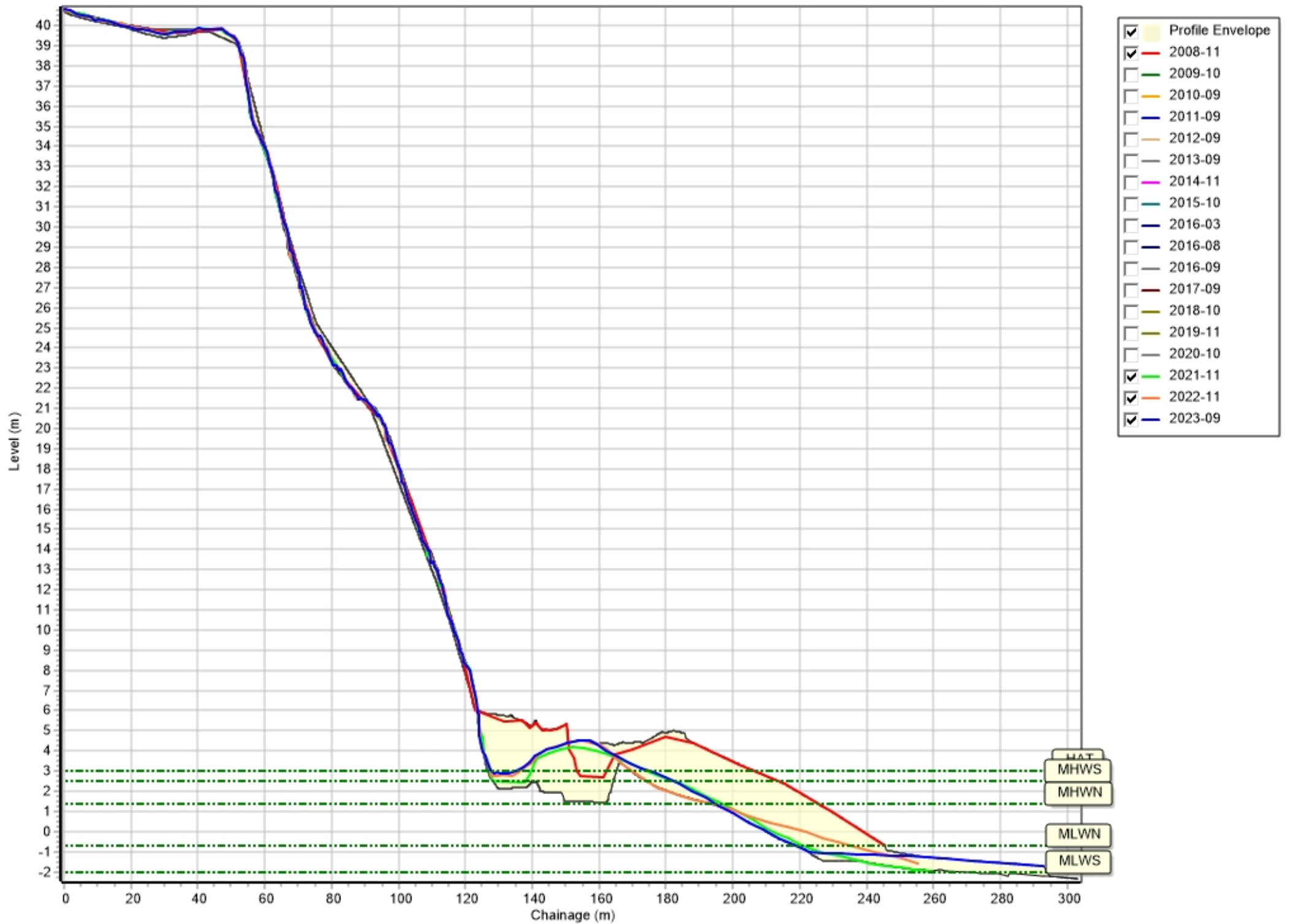
Profiles: 1cBH1



Profiles: 1cBH2



Profiles: 1cBH3



Appendix B
Cliff Top Survey

Cliff Top Survey

Seaham

Three ground control points have been established on the Seaham frontage (Figure B1). The maximum separation between any two points is nominally 300m.

The cliff top surveys at Seaham are undertaken biannually. 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 Seaham

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	Mar 2023	Sept 2023	Nov 2008 – Sept	Mar 2023 – Sept 2023	Nov 2008 – Sept 2023
1	443515.4	548421.7	70	16.1	14.94	15.05	1.05	-0.11	0.07
2	443607.8	548136.3	90	13.3	12.97	12.98	0.32	-0.01	0.02
3	443756.1	547858.5	95	14.8	13.40	13.43	1.37	-0.03	0.09

