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

North Yorkshire Council

June 2024

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Authors	
Tom Ward	Royal HaskoningDHV
Dr Nick Cooper – Review & 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) Sandsend Beach to Whitby Sands	Water Level (m AOD) Scarborough North Bay to Cayton Bay	Water Level (m AOD) Filey Bay
HAT	3.2	3.25	3.35
MHWS	2.6	2.45	2.95
MHWN	1.4	1.35	2.05
MLWN	-0.8	-0.95	-0.45
MLWS	-2.0	-2.35	-1.85

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.

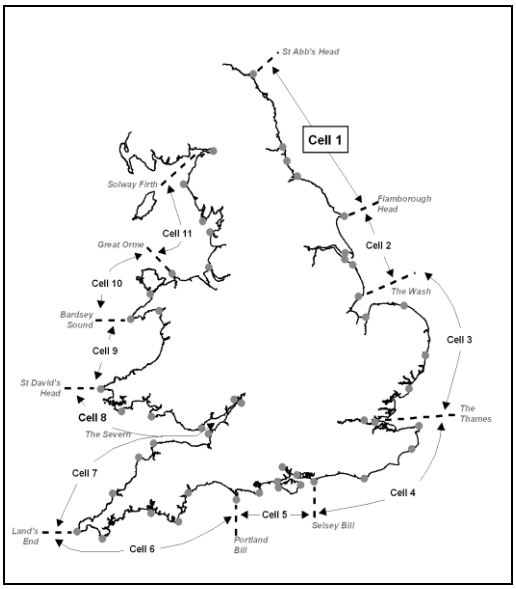

Figure 1 Sediment Cells in England and Wales

The programme commenced in its present guise in September 2008[1] 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:

Northumberland County Council
North Tyneside Council
South Tyneside Council
Sunderland City Council
Durham County Council
Redcar & Cleveland Borough Council
Hartlepool Borough Council
North Yorkshire Council
East Riding of Yorkshire Council
Environment Agency
Natural England
The National Trust

[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		Post Storm		Cell 1 Overview Report
		Survey	Analytical Report	Survey	Update Report	Survey	Report	
1	2008/09	Sep-Dec 08	May 09	Mar-May 09	Jun 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	Sep 12	Mar 13	Apr-May 13	May 13	-	-	-
6	2013/14	Sep 13	Feb 14	Mar-Apr 14	Jul 14	-	-	-
7	2014/15	Sep 14	Feb 15	Mar 15	Jul 15	-	-	-
8	2015/16	Sep 15	Feb 16	Mar–Apr 16	Jul 16	-	-	Jun 16
9	2016/17	Sep–Nov16	Feb 17	Feb-Apr 17	Jul 17	-	-	-
10	2017/18	Sep-Oct 16	Jan 17	Mar-May 18	Jun 18	-	-	-
11	2018/19	Sep-Oct 18	Mar 19	Mar-Apr 19	Jul 19	-	-	-
12	2019/20	Sep-Nov 19	Jan 20	Feb-Apr 20	Jun 20	-	-	-
13	2020/21	Nov-Dec 20	Mar 21	Mar-Apr 21	Jun 21	-	-	Aug 21
14	2021/22	Oct-Nov 21	Feb 22	Apr-May 22	Aug 22	-	-	-
15	2022/23	Sept-Oct 22	Jan 23	Mar 23	Jun 23	-	-	-
16	2023/24	Aug-Sep 23	Feb 23	Feb-Apr 24	Jun 24 (*)	Jan 24	Feb 24	-

(*) The present report is **Update Report 16** and provides an analysis of the 2024 Partial Measures survey for North Yorkshire Council's frontage.

1. Introduction

1.1 Study Area

North Yorkshire Council's frontage extends from Staithes Harbour in the north, to Speeton in Filey Bay in the south. For the purposes of this report, it has been sub-divided into eight areas, namely:

- Staithes[2]
- Runswick Bay
- Sandsend Beach, Upgang Beach and Whitby Sands
- Robin Hood's Bay
- Scarborough North Bay
- Scarborough South Bay
- Cayton Bay
- Filey Bay

1.2 Methodology

Along North Yorkshire Borough Council's frontage, the following surveying is undertaken:

- Full Measures survey annually each autumn/early winter comprising:
    - Beach profile surveys along 20 transect lines.
    - Topographic survey at Runswick Bay
    - Topographic survey along the Sandsend to Whitby frontage
    - Topographic survey at Robin Hood's Bay
    - Topographic survey at Scarborough North Bay
    - Topographic survey at Scarborough South Bay
    - Topographic survey at Cayton Bay
    - Topographic survey at Filey Bay
- Partial Measures survey annually each spring comprising:
    - Beach profile surveys along 20 transect lines.
    - Topographic survey at Runswick Bay
    - Topographic survey at Robin Hood's Bay
    - Topographic survey at Filey Bay (Town coverage)
- Cliff top survey bi-annually at:
    - Staithes
    - Robin Hoods Bay (new addition Spring 2010)
    - Scarborough South Bay (new addition Spring 2010)
    - Cayton Bay
    - Filey

The location of these surveys is shown in Figure 2. The Partial Measures survey was undertaken along this frontage between 27th Feb and 11th April 2024, more specifically:

- Staithes – 6th March 2024
- Runswick Bay – 27th February 2024
- Whitby – 8th April 2024;
- Robin Hood's Bay – 28th March 2024;
- Scarborough – 9th April 2024;
- Cayton Bay – 10th April 2024;
- Filey – 11th April 2024

During this time weather conditions varied considerably; refer to the survey reports for details of the weather conditions over this survey period. Data from the present survey are presented in a processed form in the Appendices.

[2] The Staithes frontage straddles the boundary of jurisdiction of both Redcar & Cleveland Borough Council and North Yorkshire Council.

SURVEY LOCATIONS

Topographic Profile

- Annual
- Bi-Annual

Topographic Area

- 6 monthly
- yearly
- 5 yearly

- 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

RUNSWICK BAY

Scarborough Borough 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

Royal HaskoningDHV
Enhancing Society Together

North East Coastal Observatory

SURVEY LOCATIONS

Topographic Profile

- Annual
- Bi-Annual

Topographic Area

- 6 monthly
- yearly
- 5 yearly

- 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 2

SANDSEND TO WHITBY

Scarborough Borough 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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SURVEY LOCATIONS

Topographic Profile

- Annual
- Bi-Annual

Topographic Area

- 6 monthly
- yearly
- 5 yearly

- 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 3

ROBIN HOOD'S BAY

Scarborough Borough Council Frontage

Report: Survey Report

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	n/a	TC	NJC	A4	1:12,500

Co-ordinate system: British National Grid

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SURVEY LOCATIONS

Topographic Profile

- Annual
- Bi-Annual

Topographic Area

- 6 monthly
- yearly
- 5 yearly

- 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 4

SCARBOROUGH NORTH BAY

Scarborough Borough Council Frontage

Report: Survey Report

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate system: British National Grid

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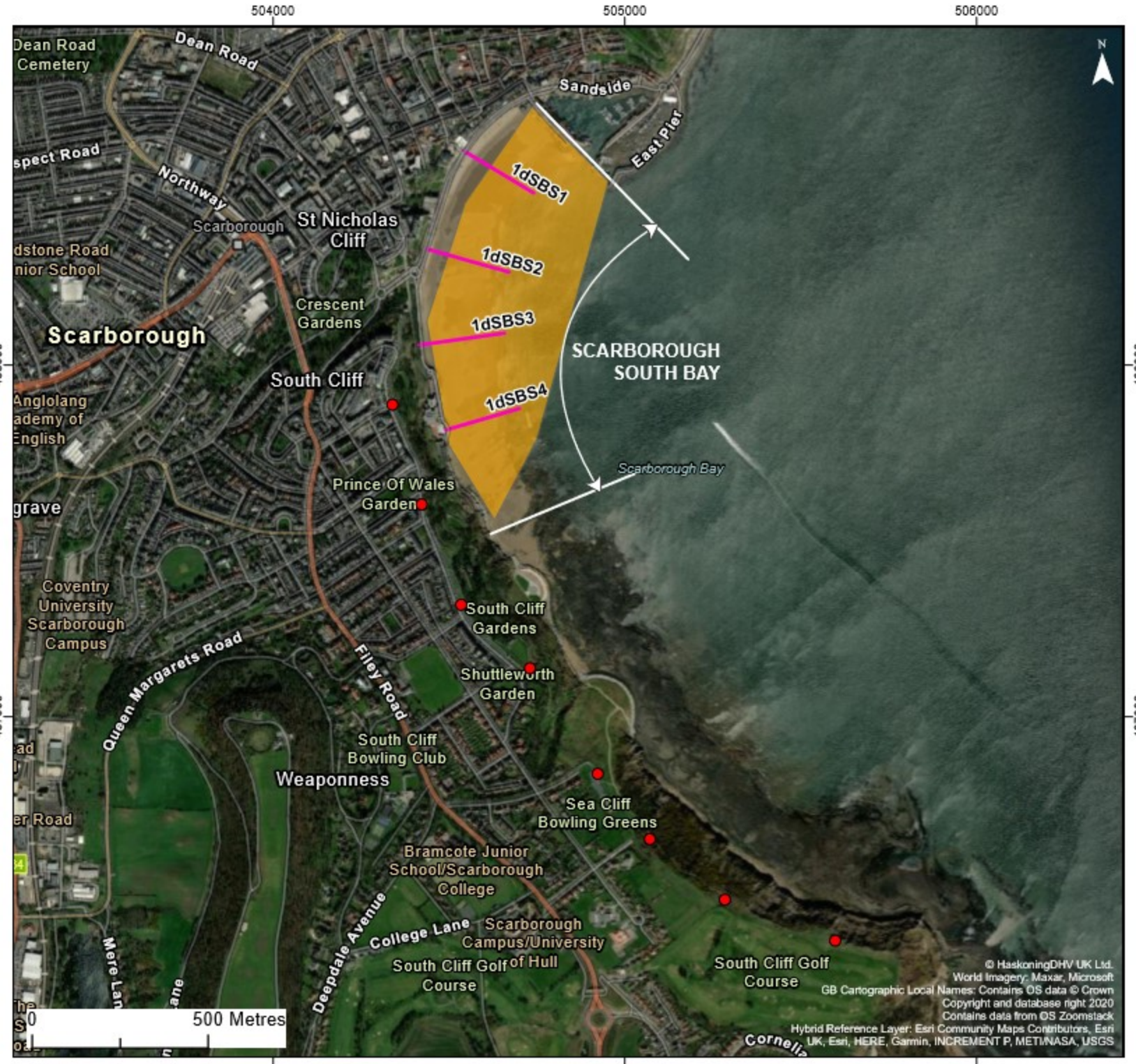

SURVEY LOCATIONS

Topographic Profile

- Annual
- Bi-Annual

Topographic Area

- 6 monthly
- yearly
- 5 yearly

- 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 5

SCARBOROUGH SOUTH BAY

Scarborough Borough Council Frontage

Report: Survey Report

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	n/a	TC	NJC	A4	1:15,000

Co-ordinate system: British National Grid

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SURVEY LOCATIONS

Topographic Profile

- Annual
- Bi-Annual

Topographic Area

- 6 monthly
- yearly
- 5 yearly

- 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 6

CAYTON BAY

Scarborough Borough Council Frontage

Report: Survey Report

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	n/a	TC	NJC	A4	1:15,000

Co-ordinate system: British National Grid

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SURVEY LOCATIONS

Topographic Profile

- Annual
- Bi-Annual

Topographic Area

- 6 monthly
- yearly
- 5 yearly

- 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 7

FILEY BAY

Scarborough Borough Council Frontage

Report: Survey Report

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate system: British National Grid

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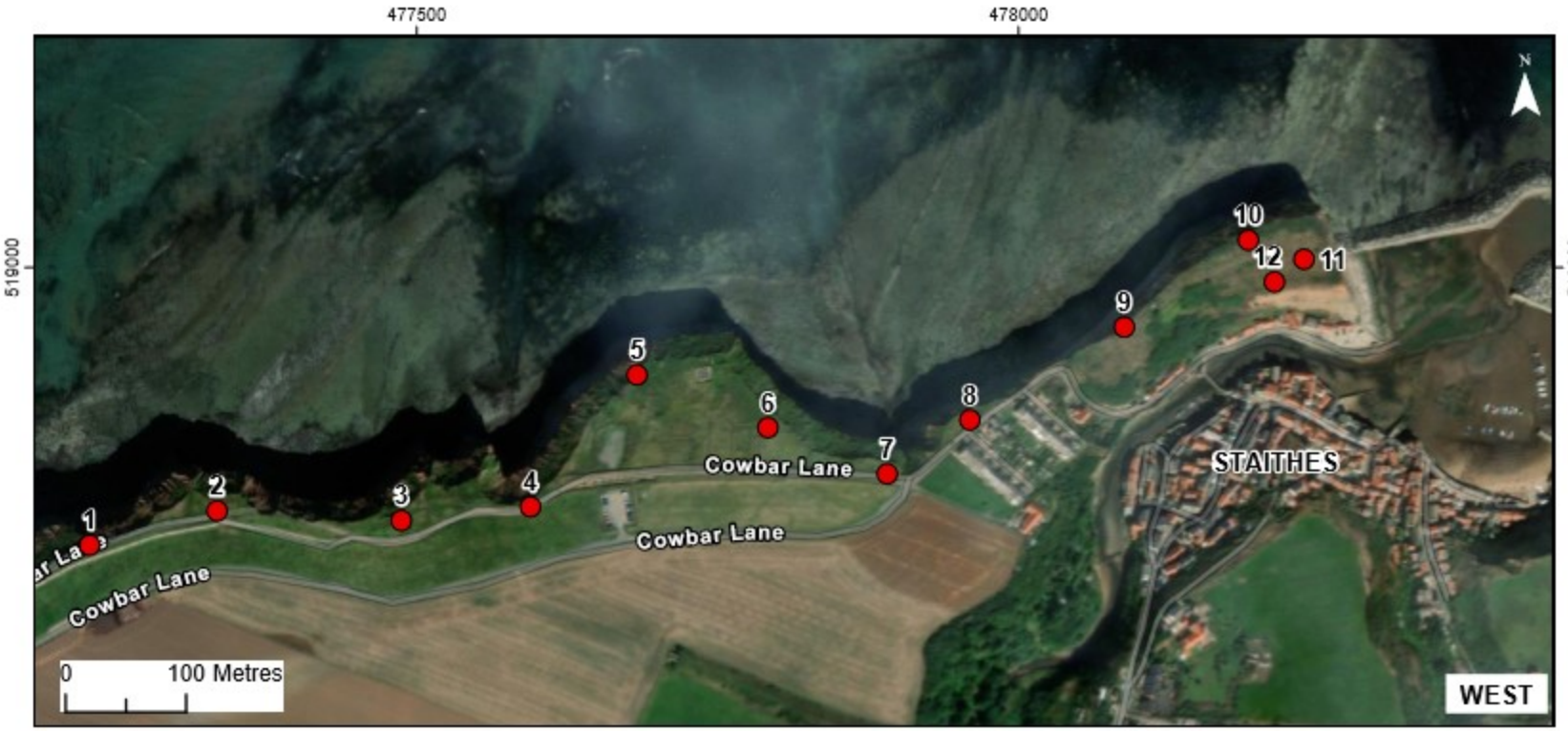

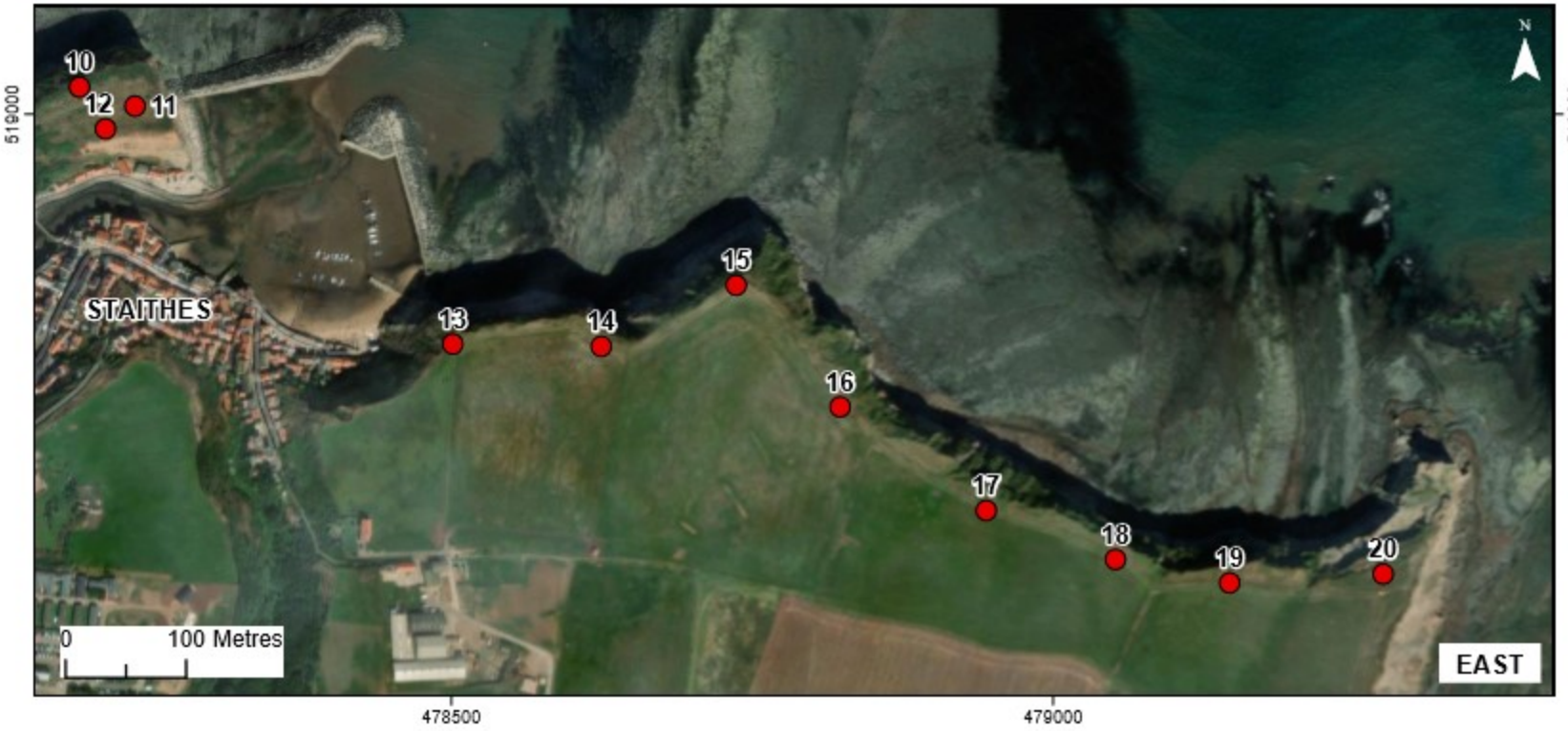

SURVEY LOCATIONS

- Cliff Top Survey Points

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

Title:

Figure 3 - Map 1

STAITHES

Scarborough Borough Council Frontage

Report: Survey Report

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	n/a	TC	NJC	A4	1:6,000

Co-ordinate system: British National Grid

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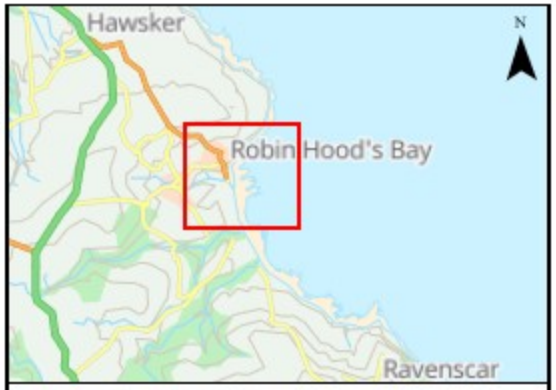

SURVEY LOCATIONS

- Cliff Top Survey Points

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

Title:

Figure 3 - Map 2

ROBIN HOOD'S BAY

Scarborough Borough 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

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SURVEY LOCATIONS

● Cliff Top Survey Points

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

Title:

Figure 3 - Map 3

SCARBOROUGH SOUTH BAY

Scarborough Borough Council Frontage

Report: Survey Report

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	n/a	TC	NJC	A4	1:15,000

Co-ordinate system: British National Grid

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SURVEY LOCATIONS

- Cliff Top Survey Points

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

Title:

Figure 3 - Map 4

CAYTON BAY

Scarborough Borough 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

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SURVEY LOCATIONS

- Cliff Top Survey Points

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

Title:

Figure 3 - Map 5

FILEY BAY (NORTH)

Scarborough Borough Council Frontage

Report: Survey Report

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	n/a	TC	NJC	A4	1:15,000

Co-ordinate system: British National Grid

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SURVEY LOCATIONS

- Cliff Top Survey Points

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

Title:

Figure 3 - Map 6

FILEY BAY (SOUTH)

Scarborough Borough Council Frontage

Report: Survey Report

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	n/a	TC	NJC	A4	1:20,000

Co-ordinate system: British National Grid

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2. Analysis of Survey Data

2.1 Staithes

Survey Date	Description of Changes Since Last Survey	Interpretation
6th March 2024	**Cliff-top Survey:** Twenty ground control points have been established at Staithes for the purposes of cliff top monitoring. The separation between any two points is a nominal 100m. The cliff top surveys at Staithes are undertaken bi-annually. Data collection involves a distance offset measurement from the ground control point to the cliff edge along a fixed bearing. Appendix C provides results from the March 2024 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 and the previous September 2023. The results show that zero of the 23 control points experienced erosion greater than the survey error (±0.2m) since the previous survey. This indicates a period of stability along this frontage. It has also resulted in a decrease in the long term recession rates. The two points with the greatest rates are now Point 1 (with 0.48m/yr.) and Point 13 (with 0.20m/yr.).	The cliff top along the Staithes frontage have remained stable since the previous survey. **Longer term trends:** Only Point 1 (0.48m/yr.) and Point 13 (0.20m/yr.) have experienced long term recession rates greater than the margin of error of the surveying technique. Point 4 also previously had a recession greater than the margin of error however, a period of stability means it is now only averaging 0.15m/yr.

2.2 Runswick Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
27th February 2024	**Topographic Survey:** Runswick Bay is covered by a 6-monthly topographic survey. A consistently applied GIS processing routine has been used to create a digital ground model (DGM) (Appendix B - Map 1) and to calculate the differences between the current topographic survey (Feb 2024) and the previous survey (August 2023) to highlight areas and amounts of erosion and deposition (Appendix B – Map 4). The difference plot shows two shoreline parallel bands of change have dominated the bay since the previous survey. A band of accretion, up to +1.25m in level, has occurred in the north of the bay running south on the lower beach. On the contrary a band of erosion up to -0.75m in level, is observed in the south of bay running north on the upper beach.	The bay appears to have experienced seasonal fluctuation with a drawdown of material from the upper beach to the lower beach typical of winter conditions. **Longer term trends:** The data collected since 2008 indicate a general pattern of winter drawdown and spring recovery with no measurable net longer-term change.

2.3 Sandsend Beach, Upgang Beach and Whitby Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
8th April 2024	**Beach Profiles:** The Sandsend, Upgang and Whitby frontage is covered by three beach profile lines for the Partial Measures survey (Appendix A). **Profile 1dWB1** is located around 400m south of Sandsend village. When compared to the September 2023 survey, shifting sands have resulted in alternating lengths of accretion and erosion. The beach has initially accreted at the toe of the stepped revetment (now chainage 38m) by 0.6m in level before tapering to no change at chainage 48m. Between chainages 48m and 80m, the beach has dropped in level by up to 0.4m. A shallow berm has formed at chainage 80m resulting in accretion of up to 0.2m. Erosion is again observed seawards of chainage 115m, where the lower beach has steepened. Such has been the change; the beach is at both a very high level (chainage 86m to 92m) and a very low level (138m to 144m) when compared to the range of the previous surveys. **Profile 1dWB2** is located in the centre of Upgang beach. As in previous surveys, the cliff top area was not measured due to dense vegetation. On the lower face of the cliff, between chainage 120m and 140m, it appears there has been a slippage of material down the profile. The toe of cliff, at chainage 141m, has not retreated. Between chainage 141m and 200m, the beach has accreted by up to 1.4m in level. Seawards of chainage 200m, the beach steepens significantly resulting in a drop in level at the end of the profile (chainage 230m) of 1.6m. The accretion on the upper beach means a section of profile, between chainage 162m and 174m, is at the highest level on record (compared to the range of the previous surveys). The lower beach is at a medium to low level. **Profile 1dWB3** is located on Whitby Sands. Up to chainage 88m, the profile is unchanged due to the presence of the coastal defence. At the toe of the defence the beach has eroded by 0.4m in level, this erosion continues across the upper beach tapering to no change by chainage 104m. Seawards of chainage 104m, the profile has remained largely stable with the majority of change limited to ±0.15m. At the end of the profile, the lower beach steepens resulting in a drop in level of 0.3m at chainage 251m. The profile remains within the range envelope of the previous surveys.	The pattern of change across the three profiles over the winter 2023/24 is again varied, likely due to the distances between each profile. Generally, the south of the bay has remained stable. Whereas, the centre and north of the bay appear to have been more affected by storms of winter 2023 / 24. Namely, the lowering of the lower beach and storm driven accretion of the upper beach up against the cliff / defences. **Longer term trends:** The beach profiles appear to be reasonably stable showing only seasonal fluctuations.

2.4 Robin Hood's Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
28th March 2024	**Topographic Survey:** Data from the most recent topographic survey (Partial Measures, May 2024) have been used to create a digital ground model (DGM) (Appendix B – Map 2) using a Geographical Information System (GIS). This DGM has been compared against the DGM from the August 2023 to create difference plot highlighting erosion and accretion over that period. As is the long term trend, the differences plot shows that the majority of the bay has experienced little change since the previous survey. This is largely due to the limited sediment located within the bay which instead is dominated by exposed rocky outcrops. The change that has occurred is limited to ±0.75m, and is patchy, reflecting the rocky topography of the bay. The most intense change has occurred at the toe of the ramp through the rock armour where up to 1.5m of beach material has been lost locally.	The distribution of change is very patchy typical of sediment movements over the rock promontories in the bay. The magnitude of change is low highlighting the lack of sediment with the bay. **Longer term trends:** The difference plots show a continuation of the trend of patchy distribution of erosion and accretion controlled by the nature of the rocky foreshore.
28th March 2024	**Cliff-top Survey:** Thirteen ground control points have been established at Robin Hood's Bay since 3rd March 2010 to monitor cliff top recession. The separation between any two points is a nominal 200m and monitoring is undertaken bi-annually. Appendix C provides results from the March 2024 survey showing change since the last survey in August 2023 and the baseline survey in March 2010 (Appendix C- Map 2). The accuracy of the survey technique means change of less than 0.2m is assumed to be error. Calculated advances of the cliff line are also assumed to be error associated with difficulty precisely identify the cliff top, particularly where vegetation is present. Between August 2023 and March 2024, zero of the 13 control points have experienced a change greater than the margin of error of the surveying technique (±0.2m), with all change limited to ±0.06m. Control Points 7, 8 and 9 were unsurveyable in the August 2023 survey due to ongoing construction works however these points were surveyed in March 2024 and will be analysed in the next Full Measure survey.	The cliff top along the Robin Hoods Bay frontage has remained stable since the previous survey. **Longer term trends:** The erosion rates calculated from the changes since March 2010 show stability at most of the monitoring locations. The period of inactivity has further reduced these long term rates. The longer-term rates show that Point 1 has a recession rate of 0.39m/yr., followed by point 11 (0.14m/yr.) with all other points having a rate of less than 0.1m/yr. This reflects localised and episodic cliff failure through rock fall.

2.5 Scarborough North Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
9th April 2024	**Beach Profiles:** Scarborough North Bay is covered by five beach profile lines for the Partial Measures survey (Appendix A) that are monitored biannually. An additional post storm survey was undertaken in January 2024 to assess the impact on the coastline of a particular stormy period between October 2023 and January 2024. It is this survey that April 2024 Partial Survey has been compared against below. **Profile 1dSBN1** is located around 200m south of the Sea Life Centre. The beach at the toe of the sea wall has accreted by 0.6m in level submerging a section of the stepped apron. This accretion continues across the upper beach, tapering to no change by chainage 63m. Seawards of chainage 81m, the beach then begins to erode, peaking in magnitude of 0.2m at the end of the profile (chainage 125m). The beach is a medium level when compared to the range of previous surveys. **Profile 1dSBN2** is located close to the former chair lift and is defended to chainage 8m. At the toe of the seawall the beach levels have accreted by 0.35m in level, tapering to no change by chainage 23m. Accretion has then again occurred between chainage 32m and 100m of up to 0.5m in level. Seawards of chainage 100m, the beach levels have dropped. The rocky foreshore remains exposed from chainage 118m. Generally, the beach remains at a medium level when compared to the range of the previous surveys. **Profile 1dSBN3** is located near Royal Albert Drive. At the toe of the seawall, at chainage 14m, to chainage 47m, the beach largely remained stable with minor accretion then followed by minor erosion with change limited to ±0.2m. Between chainages 47m and 124m, the beach has accreted by up to 0.5m in level. Seawards of 124m, the lower beach has steepened, resulting in a drop in level at the end of the profile (chainage 153m) of 0.7m. The profile is generally at a medium level when compared the range of the previous survey, with sections of the centre of the profile at a higher level corresponding with the accretion. **Profile 1dSBN4** is located at the northern end of Clarence Gardens. At the toe of the stepped apron (chainage 26m), beach levels have increased by 0.1m in level, tapering out to no change at chainage 33m, where the rocky outcrop remains exposed Between chainage 64m and 114m the beach has accreted by up to 0.25m in level. Seawards of 144m, the beach has eroded by up to 0.6m in level.	As was recorded in the January 2024 post storm survey, Scarborough North Bay experienced a net erosion over Winter 2023 / 2024 with material being draw down the profiles, particularly in the south. Since this post storm survey however, it appears there has some signs of recovery with accretion occurring, particularly on the upper and middle sections of the profiles. Although levels have not fully recovered to those observed pre-storms it is an encouraging start. **Longer term trends:** The observed changes in the profiles in North Bay are consistent with the seasonal fluctuations of sediment with a bay system.

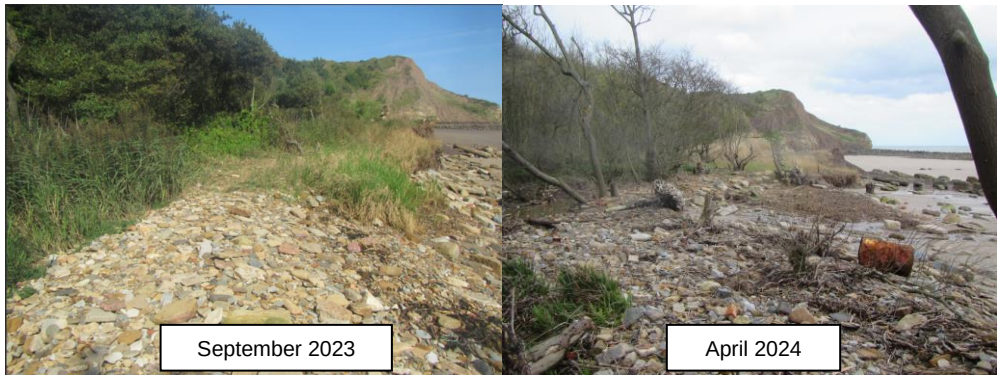
Survey Date	Description of Changes Since Last Survey	Interpretation
	Overall, the beach remains at a low level when compared to the range of the previous surveys. **Profile 1dSBN5** is located to the south of Clarence Gardens. The profile is defended by rock armour until chainage 28m over which length the profile has remained stable. From the toe of the revetment to chainage 146m, the beach has been dominated by accretion up 0.25m in level. Seawards of chainage 146m, the beach has dropped in level by 0.1m. The profile remains within the range envelope of the previous surveys.	

2.6 Scarborough South Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
9th April 2024	**Beach Profiles:** Scarborough South Bay is covered by four beach profile lines for the Partial Measures survey (Appendix A). An additional post storm survey was undertaken in January 2024 to assess the impact on the coastline of a particular stormy period between October 2023 and January 2024. It is this post storm survey that the March 2023 Partial Survey has been compared against below. **Profile 1dSBS1** is located around 250m south of the West Pier. Overall, the profile has remained stable in the three months since the previous survey. The beach level at the toe of the seawall (chainage 13m) has not changed. Across the upper beach, between chainage 14m and 58m, the beach has dropped by 0.1m in level. Between chainages 58m and 181m, the beach has accreted by a similar magnitude. The profile remains at a very high level when compared to the range of the previous surveys. **Profile 1dSBS2** is located on the shore fronting St Nicholas Cliff. At the toe of the seawall, beach levels have locally increased by 0.45m quickly tapering to no change by chainage 9m. Between chainage 9m and chainage 62m, the beach has dropped in level by up to 0.15m. Between chainages 62m and 120m the beach has accreted by a similar magnitude. Seawards of chainage 160m, the lower beach has steepened resulting in a drop in level of 0.3m at the end of the profile. The profile remains within the range envelope of the previous surveys. **Profile 1dSBS3** is located 250m north of the Scarborough Spa complex. At the toe of the seawall, beach levels have initially accreted by +0.1m until chainage 14m. Between chainage 14m and 58m the beach has then dropped in level by up to 0.25m. Seawards of chainage 58m, the beach has remained stable up to chainage 180m, before steepening at the end of the profile. This has resulted in a drop of 0.3m at chainage 198m. The profile generally remains at a medium level when compared to the range of the previous surveys. **Profile 1dSBS4** is located on the beach in front of the Scarborough Spa Complex. At the toe of the seawall beach levels are unchanged with the rocky foreshore still exposed between chainage 9m and 12m. Seawards of chainage 11m, the beach has been dominated by modest accretion. The magnitude of accretion varies between +0.1m and +0.35m. The beach, other than at the toe of the seawall, is at a medium level when compared to the range of the previous surveys.	Since the post storm surveys in January 2024, the profiles have experienced a period of stability, with the majority of change limited to ±0.35m. The southern profiles, which were most affected by the storms, appear to show some signs of recovery with accretion dominating much of the beach (particularly **1dSBS2**). **Longer term trends:** The observed changes in the profiles in South Bay are typically consistent with the seasonal fluctuations of sediment with a bay system.

Survey Date	Description of Changes Since Last Survey	Interpretation
9th April 2024	**Cliff-top Survey:** Thirteen cliff top monitoring control points have been established at Scarborough South Bay and from Cornelian Bay to Knipe Point. The separation between points is around 300m. The cliff top surveys at Scarborough South Bay are undertaken bi-annually. Appendix C provides results from the March 2010 baseline survey to April 2024, showing the distance from the ground control point to the edge of the cliff top along the defined bearing (Appendix C- Map 3). Error in the technique means change of less than 0.2m cannot be relied on. Calculated advances of the cliff line are also assumed to be error associated with difficulty precisely identify the cliff top, particularly where vegetation is present. Between August 2023 and March 2024, zero of the 13 monitoring points show erosion (of greater than 0.2m), highlighting a period of stability. Control point 13, recorded an advancement of 0.37m. However, by consulting the surveyors' photos it thought this is due to difficulties in accurately identifying the cliff top due to vegetation as opposed to true change.	Zero of the survey points has shown erosion outside of the survey tolerance over the course of winter 2023 / 2024. **Longer term trends:** This period of extended stability has reduced the long term recession rates along the frontage. Only Points 11 and 12 have rates greater than the margin of error with 0.27m/y and 0.21m/yr. respectively.

2.7 Cayton Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
10th April 2024	**Beach Profiles:** Cayton Bay is covered by four beach profile lines for the Partial Measures survey (Appendix A). The previous survey was undertaken in September 2023. **Profile 1dCY1A** is located on the beach below Knipe Point at the north of the bay and was added to the programme in November 2015. Since the previous survey the cobble berm at the rear of the beach has been decimated, with much of the material much pushed landward into the hinterland (see below). Seaward of the former berm the profile has been dominated by consistent accretion. The magnitude of the accretion is in the order of 0.4m in level. Compared to the range of the previous surveys, the upper beach, in the location of the former berm, is at the lowest level on record. Accretion across the rest of the profile means it is generally at medium level with one section at a very high level (between chainages 30m and 66m).  **Profile 1dCY1** is located on the beach in front of Tenants' Cliff in the north of the Bay. The survey report notes that "*the top of section 1 could not be measured due to dense vegetation"*. At the toe of the cliff (chainage 0m), further large rocks have deposited on the upper beach, likely as a result of rock falls from the cliffs themselves. This has led to an increase in level between chainage 0m and 2m of 0.6m. From the toe of the rock berm to chainage 78m, the beach has dropped in level by up to 0.5m. A short	With the exception of profile 1dCY1A (likely due to being in the lee of Knipe Point), the profiles along Cayton Bay have been dominated by erosion, particularly across the upper beach. However minor accretion across the lower beach indicates some drawdown of material. As would expected, the lowered beach levels across the upper beach appear to coincide with increased erosion activity in the cliff face, with both central profiles experiencing accretion at the toe of the cliff from the cliff itself. The decimation of the cobble berm in profile 1dCY1A and the dismantling of the WW2 pillbox in profile 1dCY3, both not observed before, highlight the severity of the storms over Winter 2023/2024. **Longer term trends:** Following notably low levels in March 2018 and 2019 beach levels on the upper beach appear to be recovering, with the exception of the most northerly profile. There is evidence that material lost from the cliff face accumulates at the toe of the cliffs and is redistributed across the upper beach. Additional cliff failures will feed additional material onto the beach and drive erosion of the cliff top.

Survey Date	Description of Changes Since Last Survey	Interpretation
	length of minor accretion (+0.2m) is then followed by no change seawards of chainage 100m. The profile remains at a low level when compared to the range of the previous surveys. **Profile 1dCY2** is close to the former pumping station in the middle of Cayton Bay. The survey report notes that "*the middle of section 2 could not be measured due to the ground makeup, soft mud flows and unstable grass"*. Since the previous survey, the toe of the cliff has advanced seawards 2m as a result of a mud slide. From the toe of this debris lobe to chainage 290m, the beach has dropped consistently in level by 0.2m. Seawards of chainage 290m, until the end of the profile at 340m, the beach has then accreted by a similar magnitude. Consequently, the lower beach is at a high level when compared to the range of the previous surveys with much of the upper beach at a low level. **Profile 1dCY3** is located around 600m southeast of the pumping station. The remains of a WW2 pill box had previously been located at the toe of the cliff. However, since the previous survey this structure has been completely dismantled through marine action. Seawards of the pillbox remains (chainage 127m), the beach has eroded by up to 0.35m, tapering out to no change by chainage 148m. Between chainage 148m and 275m, the beach has remained largely stable with the change limited to erosion of 0.1m in level. Seawards of 275m, the lower beach has steepened resulting in a drop in level at chainage 296m of 0.4m. The profile is generally at low level (when compared to the range of the previous surveys) particularly across the upper beach. The lower extents of the beach are at a high level.	
10th April 2024	**Cliff-top Survey:** Eight ground control points have been established within Cayton Bay for the purposes of cliff top monitoring. The separation between any two points is typically around 300m. The cliff top surveys at Cayton Bay are undertaken bi-annually. Appendix C provides results from the April 2024 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 and the previous September 2023 survey. The accuracy of the technique means results of less than 0.2m are not considered reliable. Dense vegetation means that point 2 has not been surveyed since the March 2018 survey. Of the remaining seven points, only one experienced change greater than survey tolerance of ±0.2m since the previous survey. This was control point 4 that advanced seaward 1.01m. It assumed from the surveying photos that this as result of difficulties identifying the cliff top as apposed to true advancement (i.e., a slip).	Zero of the seven monitoring points have shown erosion outside of the survey tolerance since September indicating a period of stability. **Longer term trends:** The recession rates show that only Point 4 (0.21m/yr) has a long term recession rate greater than the survey tolerances. This rate however has been artificial decreased due to the large advancement in this point in this survey. It is expected that the rate will increase again in the next survey providing the surveyors are able to more accurately pick up the cliff top.

2.8 Filey Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
11th April 2024	**Beach Profiles:** Filey Bay is covered by five beach profile lines for the Partial Measures survey (Appendix A). The previous programmed survey (Full Measures) was undertaken in September 2023. Profile **1dFB1** is located in front of Filey town in the north of the bay. The beach level at the toe of the seawall has dropped by 0.3m in level, exposing the top of the concrete toe. This erosion continues across the upper beach, peaking in magnitude at approx. chainage 32m with -0.85m, before tapering out to no change at chainage 115m. Seawards of chainage 115m, the lower beach has accreted, increasing in magnitude down the profile. At the end of the profile (chainage 216m) the beach has accreted by 0.45m. Consequently, when compared to the range of the previous surveys, the lower beach is at a high level whereas the upper beach is at a very low level. Between chainage 19m and 37m the beach is at the lowest level on record. Profile **1dFB2** is located north of Primrose Valley Holiday Village. The survey report notes that chainages 12m to 20m were inaccessible due to dense vegetation. Overall, the profile has been dominated by erosion. From the toe of the cliff (chainage 72m) to chainage 101m, this erosion is limited to 0.2m. The erosion increases between chainages 120m to 180m to 0.35m. Seawards of chainage 240m, the profile has remained stable. Compared to the range of the previous surveys, the upper beach is at a low level and the lower beach a high level. Profile **1dFB3** is located in front of Flat Cliffs hamlet. The survey report notes that chainages 2m to 14m and 24m to 32m were inaccessible due to dense vegetation, as such change across the face of the cliff cannot be interpretated accurately. At the toe of the cliff, beach levels have dropped by 0.3m in level. This erosion continues across the majority of the profile increasing to 0.5m in places. The erosion tapers out to no change at chainage 220m, before continuing again seaward of chainage 260m. The profile is generally at a medium level when compared to the range of the previous surveys, with the exception of the upper beach (between chainages 32m and 46m which is at the lowest level on record. Profile **1dFB4** is located near Hunmanby Gap. The survey report notes that "*the middle of section 4 is unable to be measured from chainage 3m to approx. 26m, due to the cliff face being unsafe*". This is corroborated by the fact the cliff top footpath has now been locally cordoned off. The profile has been	The profiles across Filey Bay generally show that since the previous survey in September 2023, erosion has dominated the beach, particularly across the upper and central sections. All of the profiles are at a very low level on the upper beach (compared to the range of the previous surveys) with several actually at the lowest on record. The profiles also generally show accretion on the lower beach indicating a draw down of material, a typical response to winter conditions. The low beach levels provide some cause for concern, particularly along the undefended sections, where an increase in rate of erosion would be expected until the beach levels recover. **Longer term trends:** Past trends dominated by migrating sand bars continue to the present day.

Survey Date	Description of Changes Since Last Survey	Interpretation
	dominated by erosion from the toe of the cliffs up to chainage 189m. The magnitude of this erosion varies, peaking at approximately chainage 155m with a drop of 1.4m in level. The erosion at the toe of the cliffs is more modest (-0.3m in level). Seawards of 190m a berm has formed resulting in accretion (of up to 0.4m) across the lower beach. Such has been the change, there are sections of the profile at very low level, particular between chainages 27m- 46m and 138m-172m, but also sections at a very high level (chainages 200m-238m). Profile **1dFB5** is located close to Reighton Gap. The survey report notes that "*the middle of section 5 was unable to be measured from chainage 65m to 199m, due to undergrowth and bushes*". At the toe of the cliff, the cobble berm has accreted by 0.3m in level tapering to no change by chainage 230m. Seawards of chainage 230m, the beach profile has been dominated by erosion all the way up to chainage 420m. The magnitude of erosion varies but peaks at chainage 335m with a drop in level of 0.85m. Seawards of chainage 430m the beach has accreted locally by up to 0.4m in level. The profile remains within the range envelope of the previous surveys despite the erosion.	
11th April 2024	**Topographic Survey:** Data from the Partial Measures 2024 topographic survey has been used to create a digital ground model (DGM) (Appendix B – Map 3) using a Geographical Information System (GIS). The topographic plot shows the gently sloping shore parallel bathymetry in front of Filey town. A difference plot has also been produced using the DGM (Appendix B – Map 6) comparing the last topographic survey (Full Measures, September 2023) to the present survey (March 2024). The plot shows there has been a clear pattern of change fronting Filey since the previous survey. From the toe of the defences, across the upper beach, the profile has been eroded decreasing in magnitude away from the defence. A shoreline parallel band of no change is then followed by a shoreline parallel band of accretion across the lower beach. The magnitude of change is limited to ±1.0m	As was seen with the beach profiles, since September 2023, there has been a drawdown of material from the upper beach to the lower beach. This is a typical beach response to winter conditions.

11th April 2024	**Cliff-top Survey:** Twenty-eight ground control points have been established within Filey Bay for the purposes of cliff top monitoring. This includes the installation of three additional locations in September 2010: points 12A (as a replacement for point 13 which can no longer be accessed due to vegetation growth), 24 & 25 (to the north of Filey Bay at Filey Brigg). A further replacement for monitoring point 13, 13A, has been added in 2014. The maximum separation between any two points is nominally 300 m. The cliff top surveys at Filey Bay are undertaken every six months. Data collection involves a distance offset measurement from the ground control point to the cliff edge along a fixed bearing. The accuracy of the technique means results of less than 0.2m are not reliable. Points 5, 12, 12A and 13 have been inaccessible due to heavy vegetation since at least April 2021. Control Point 8 was also inaccessible in this PM24 survey for the same reason. Since the September 2023 survey, four of the 28 markers showed erosion greater than the survey error of 0.2m. These were Points 3 (0.6m), 13A (1.16m), 17 (0.81m) and 18 (0.24m). The greatest change observed was actually Control Point 20 that seemingly advanced seaward 1.56m. However, by interrogating the surveyors' photos it appears that this an anomalous reading that has been affected by overgrown vegetation.	Of the four control points to have experienced change greater than margin of error of the surveying technique, three are located on the undefended cliffs in the vicinity of Hunmanby Gap (Points 13A, 17 and 18). This echoes the points with the largest long term recession rates along Filey Bay and reinforces this stretch of frontage as particularly active. **Longer term trends:** The greatest long-term recession rate is seen at Point 7 at Muston Sands, where 0.37m/yr has been recorded. However, the largest recession since the September 2023 survey corresponds with the point with the second greatest long term recession rate, Point 13A, that now has a rate of 0.31m/yr. The retreating cliff top here appears to be within the vicinity of a footpath which should be reviewed to ensure continued safe access in the future.

3. Problems Encountered and Uncertainty in Analysis

Individual Profiles

- At Whitby:
    - the cliff top area of profile 1dWB2 was not measured due to dense vegetation.
    - a new station 10 had to be established to replace station 5 that was located on a now collapsed ramp.
- At Scalby the cliff edge was very overgrown resulting in areas that were unable to be surveyed.
- At Cayton Bay:
    - the surveyor was unable to measure the top section of 1dCY1 due to dense vegetation;
    - the surveyor was unable to measure the middle of section profile due to the ground make-up, soft mud flows, and unstable grass;
    - the surveyor was unable to measure the middle of section profile 1dCY3.
- At Filey Bay:
    - the surveyor was unable to measure profile 1dFB2 between chainage 12m and 20m due to dense vegetation.
    - the surveyor was unable to measure profile 1dFB3 between chainage 2 to 14m and 24m and 32m due to dense vegetation.
    - the surveyor was unable to measure profile 1dFB4 between chainage 3 to 26m, due to the cliff face being unsafe.
    - the surveyor was unable to measure profile 1dFB5 between 65m and 199m due to dense undergrowth and bushes.

Cliff Top Surveys

- At Cayton Bay:
    - VMP2 was not surveyed due to dense vegetation prohibiting access.
- At Filey Bay:
    - VMPs 5, 8, 12,12A and 13 were inaccessible due to heavy vegetation.

4. Recommendations for ‘Fine-tuning’ the Monitoring Programme

No changes are recommended at the present time.

5. Conclusions and Areas of Concern

- At Staithes, the cliff top has remained stable since the previous survey with none of the 23 points experiencing change greater than the survey error (0.2m). This period of stability has reduced the long term recession rates such that only two points now have rates greater than 0.2m/yr (Point 1 = 0.48m/yr.) and Point 13 = 0.20m/yr.)
- At Runswick Bay, as in previous years, the bay appears to have experienced seasonal fluctuation with a drawdown of material from the upper beach to the lower beach, typical of winter conditions. The magnitude of change is modest and not a cause for concern.
- At Sandsend, Upgang and Whitby, the pattern of change across bay is again varied, likely due to the distances between each profile. Generally, the south of the bay has remained stable. Whereas, the centre and north of the bay appear to have been more affected by storms of winter 2023 / 24. Namely, the lowering of the lower beach and storm driven accretion of the upper beach up against the cliff / defences.
- At Robin Hoods Bay, the distribution of change is very patchy typical of sediment movements over the rock promontories. The magnitude of change is low highlighting the lack of sediment with the bay. The cliff top has remained unchanged since the previous survey.
- Scarborough North Bay experienced a net erosion over Winter 2023 / 2024 with material being draw down the profiles, particularly in the south (as was recorded in the January 2024 post storm survey). Since this post storm survey however, it appears there has some signs of recovery with accretion occurring, particularly on the upper and middle sections of the profiles. Although levels have not fully recovered to those observed pre-storms it is an encouraging start.

- At Cayton Bay, the winter storms have resulted in the erosion of material from the upper beach with the partial redistribution to the lower beach. This drop in beach levels coincides with the apparent increase in erosion activity in the cliff face, including a mud slide at profile 1dCY2 that has temporarily advanced the ‘toe’ of the cliff seawards 2m. The decimation of the cobble berm in profile 1dCY1A and the dismantling of the WW2 pillbox in profile 1dCY3, both not observed before, highlight the severity of the storms over Winter 2023/2024.
- At Filey Bay, erosion has dominated the beach, particularly across the upper and central sections. All of the profiles are at a very low level on the upper beach (compared to the range of the previous surveys) with several actually at the lowest on record. The profiles also generally show accretion on the lower beach indicating a drawdown of material, a typical response to winter conditions. The low beach levels provide some cause for concern, particularly along the undefended sections, where an increase in rate of erosion would be expected until the beach levels recover.

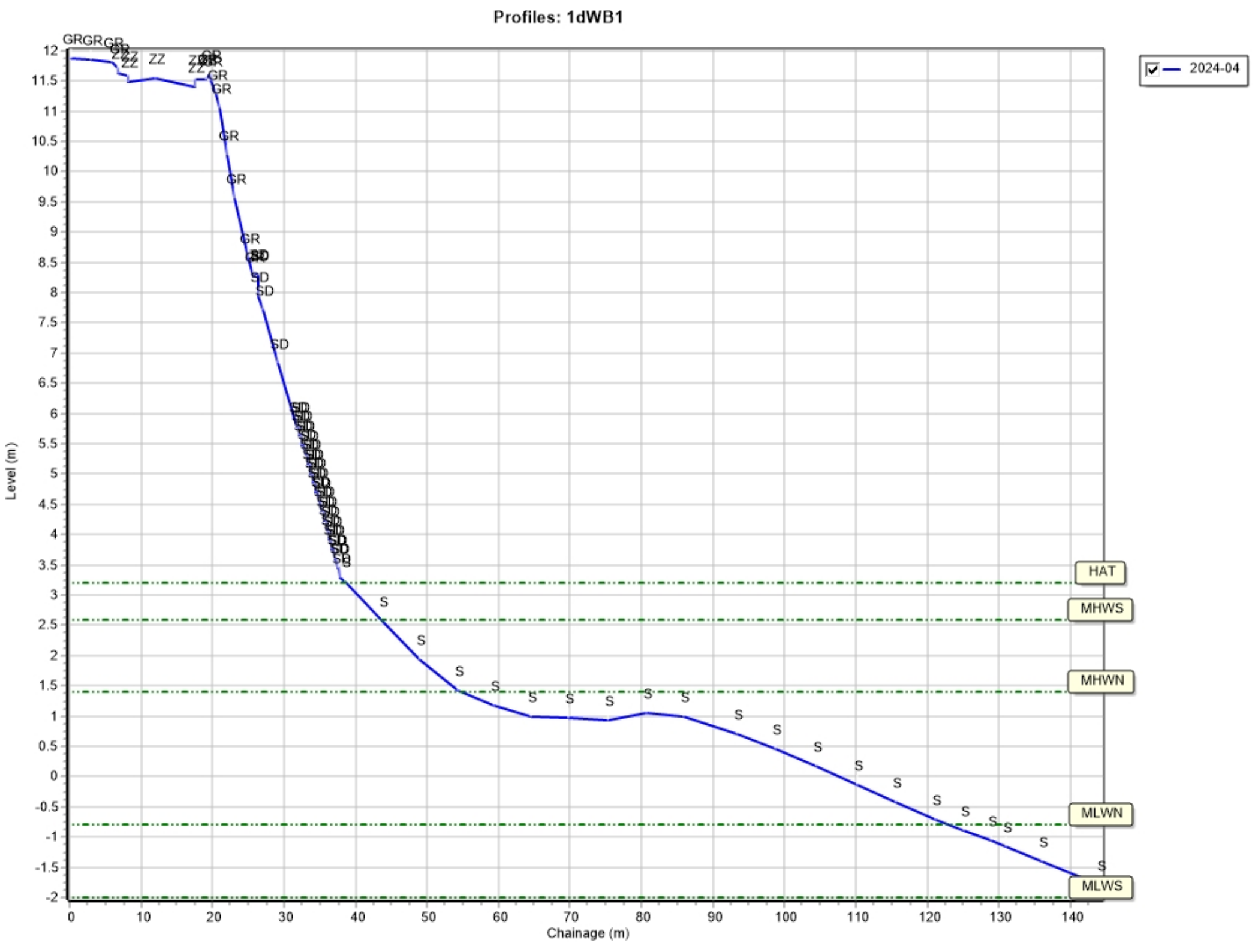
Appendices

Appendix A

Beach Profiles

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

Code	Description
S	Sand
M	Mud
G	Gravel
GS	Gravel & Sand
MS	Mud & Sand
B	Boulders
R	Rock
SD	Sea Defence
SM	Saltmarsh
W	Water Body
GM	Gravel & Mud
GR	Grass
D	Dune (non-vegetated)
DV	Dune (vegetated)
F	Forested
X	Mixture
FB	Obstruction
CT	Cliff Top
CE	Cliff Edge
CF	Cliff Face
SH	Shell
ZZ	Unknown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MHWS
MHWN
MLWN
MLWS
Level (m)
Chainage (m)
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11
10.5
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
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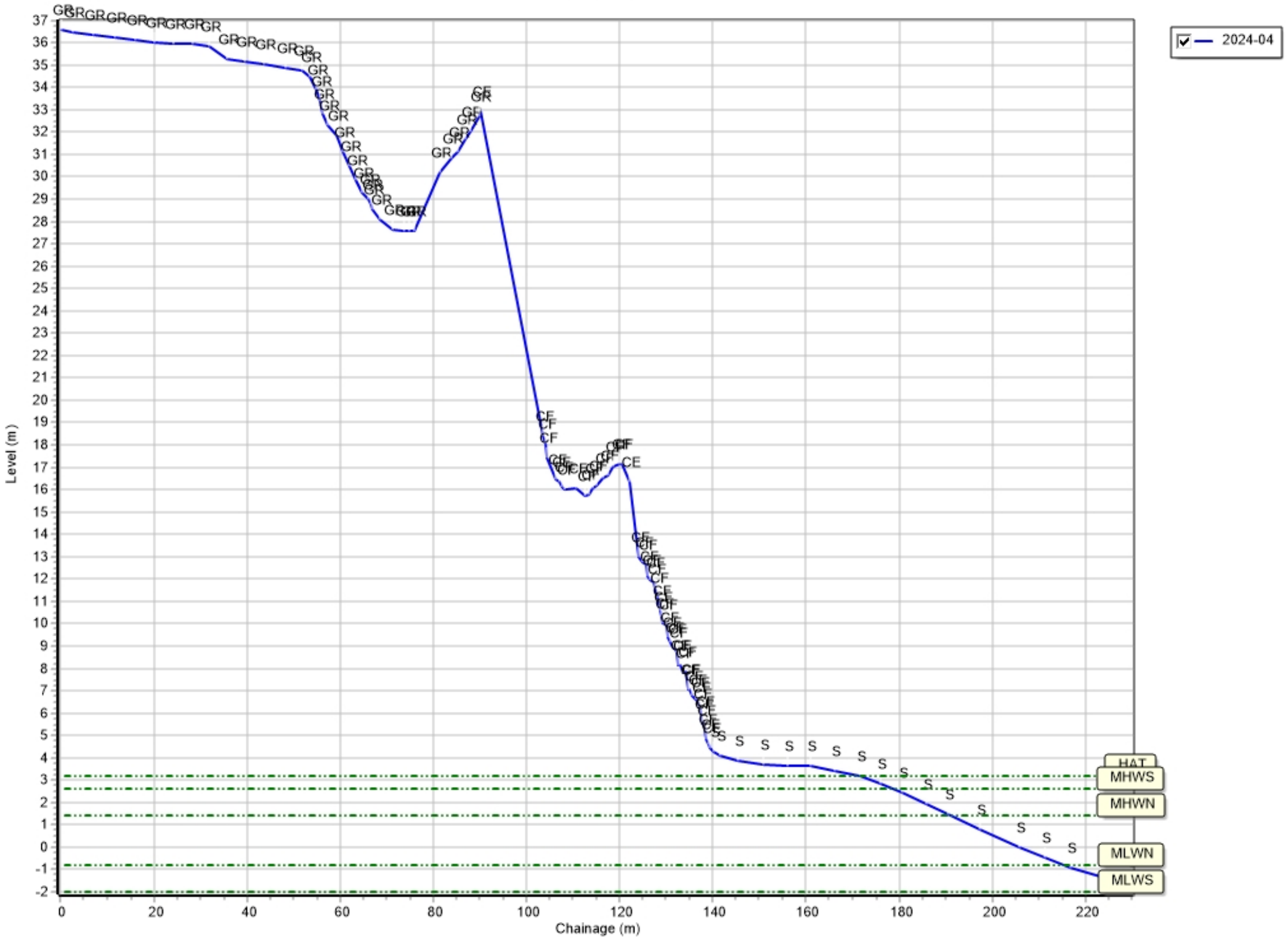
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Chainage (m)
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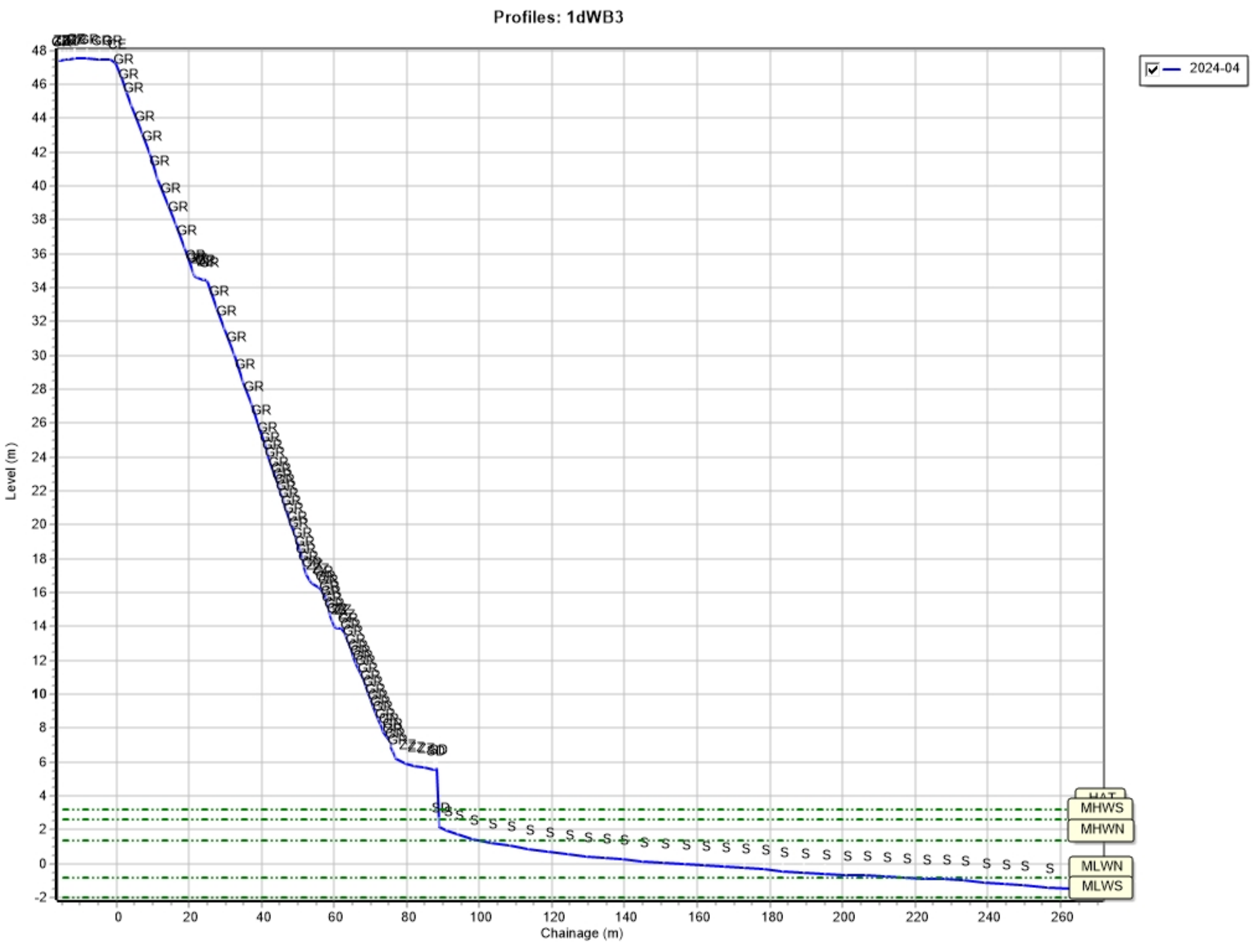
MHWN
MLWN
MLWS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Chainage (m)
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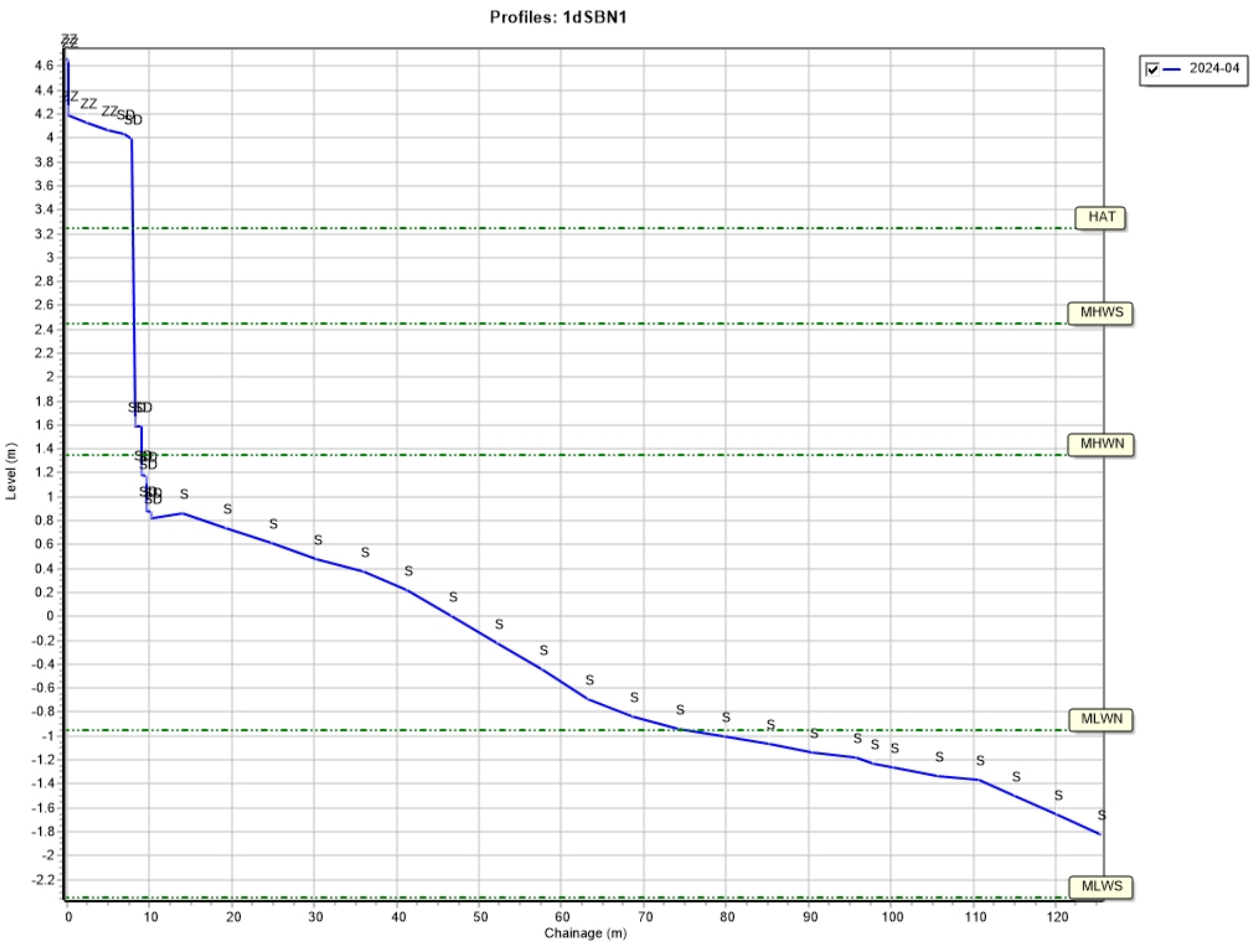
MHWN
MLWN
MLWS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MHWN
MLWN
MLWS
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Chainage (m)
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4
3.8
3.6
3.4
3.2
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
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0.6
0.4
0.2
0
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-1.2
-1.4
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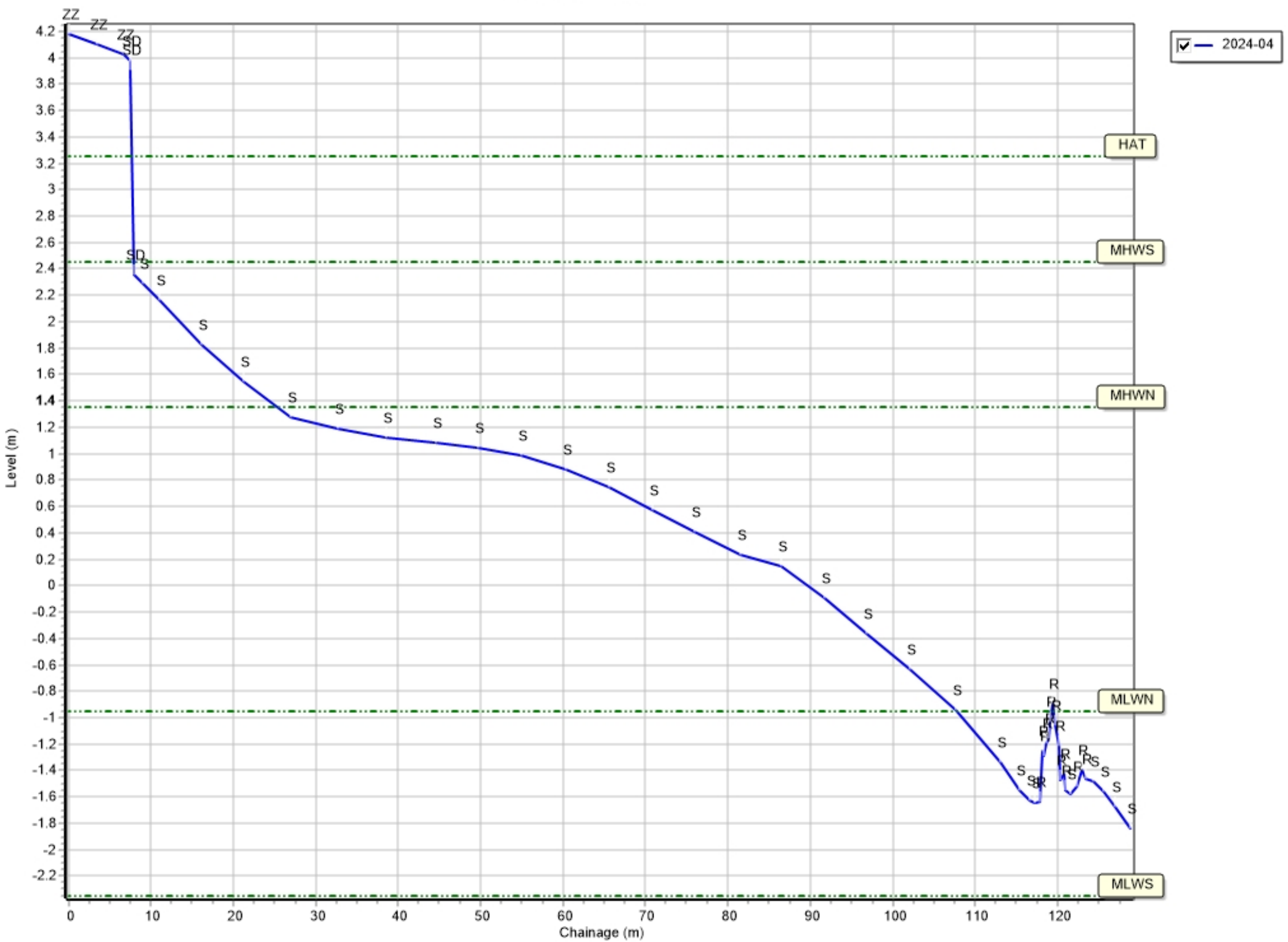
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2024-04
HAT
MHWS
MHWN
MLWN
MLWS
Level (m)
Chainage (m)
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3.8
3.6
3.4
3.2
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
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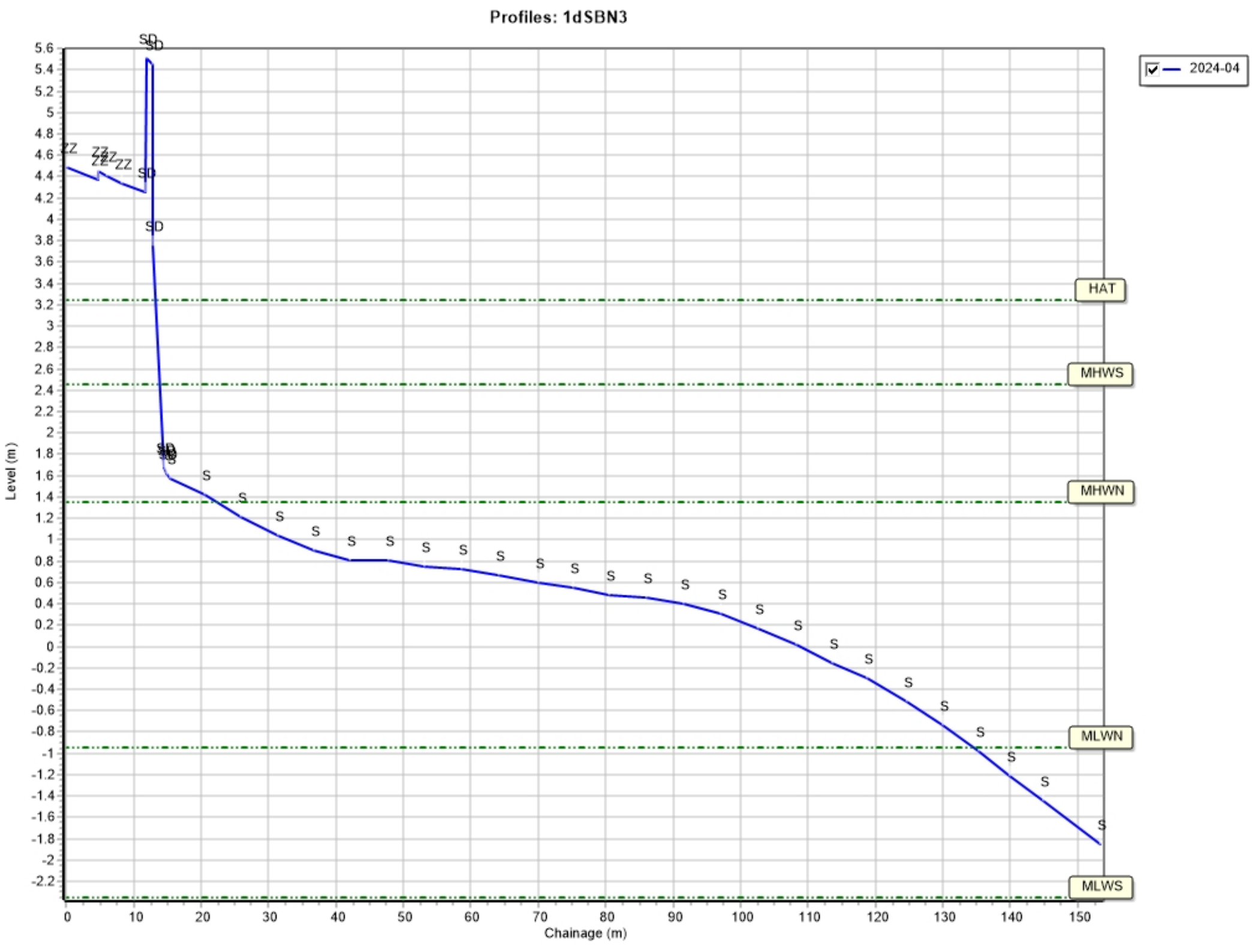
Profiles: 1dSBN3
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MHWS
MHWN
MLWN
MLWS
Level (m)
Chainage (m)
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4
3.8
3.6
3.4
3.2
3
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2.6
2.4
2.2
2
1.8
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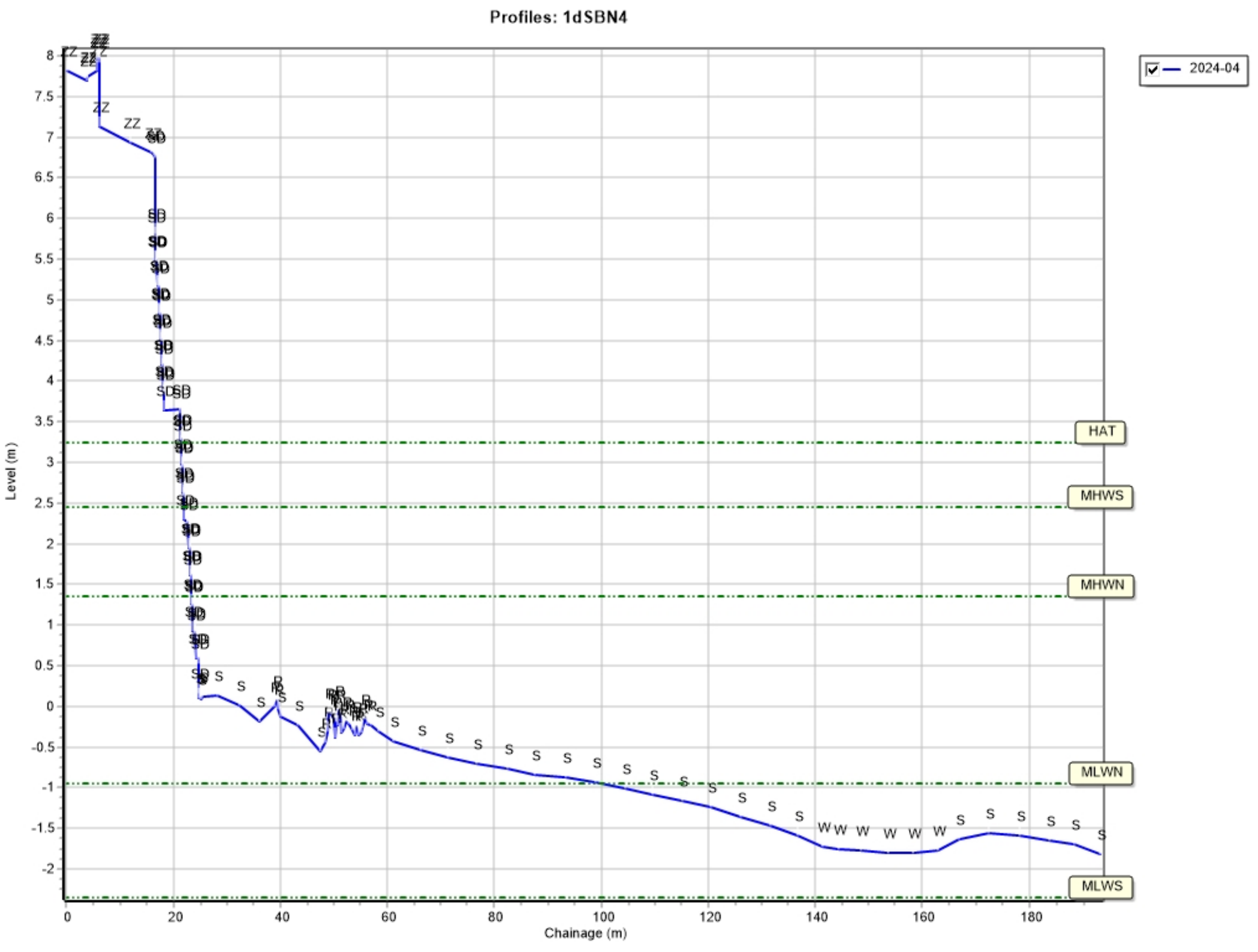
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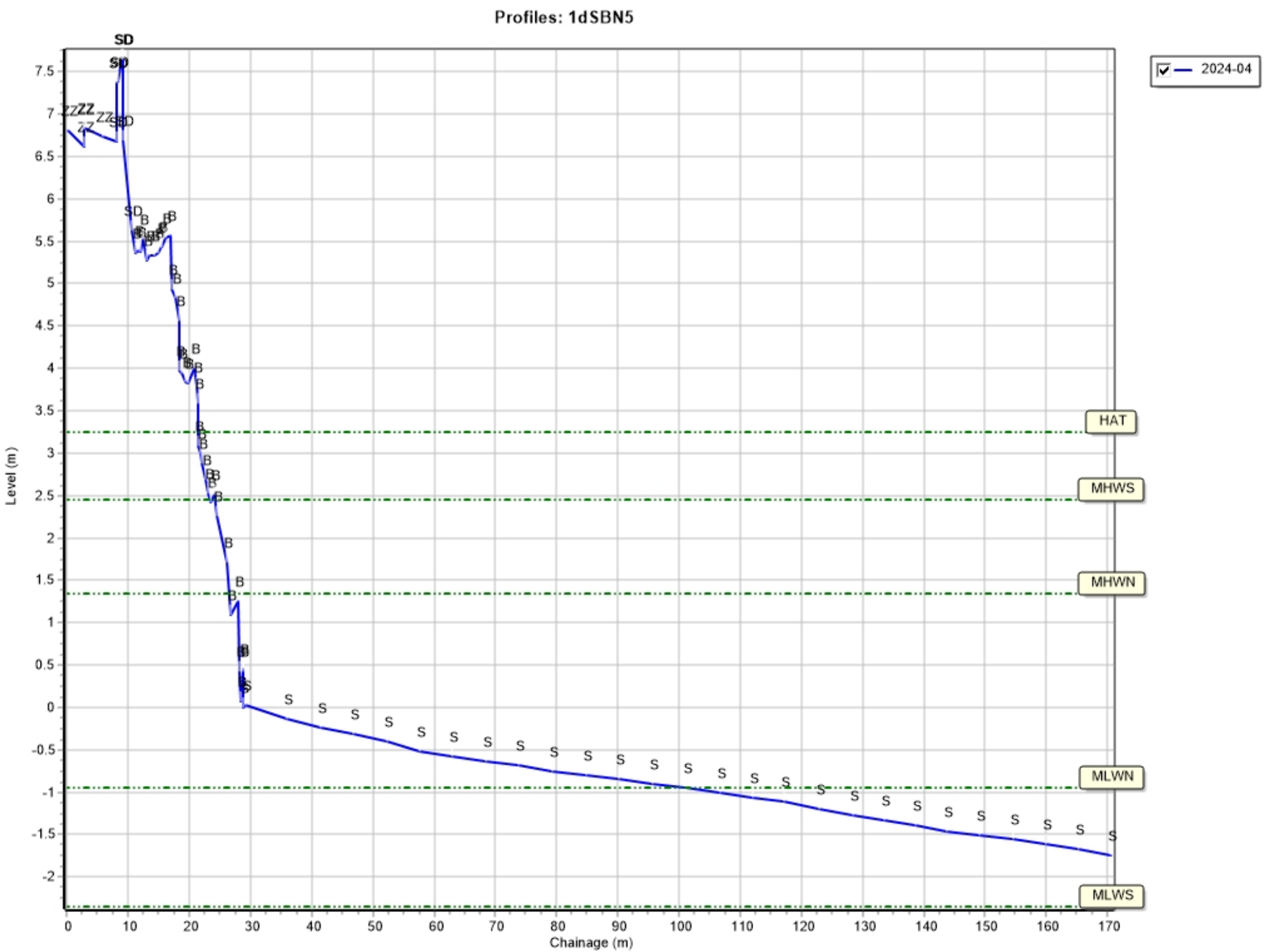
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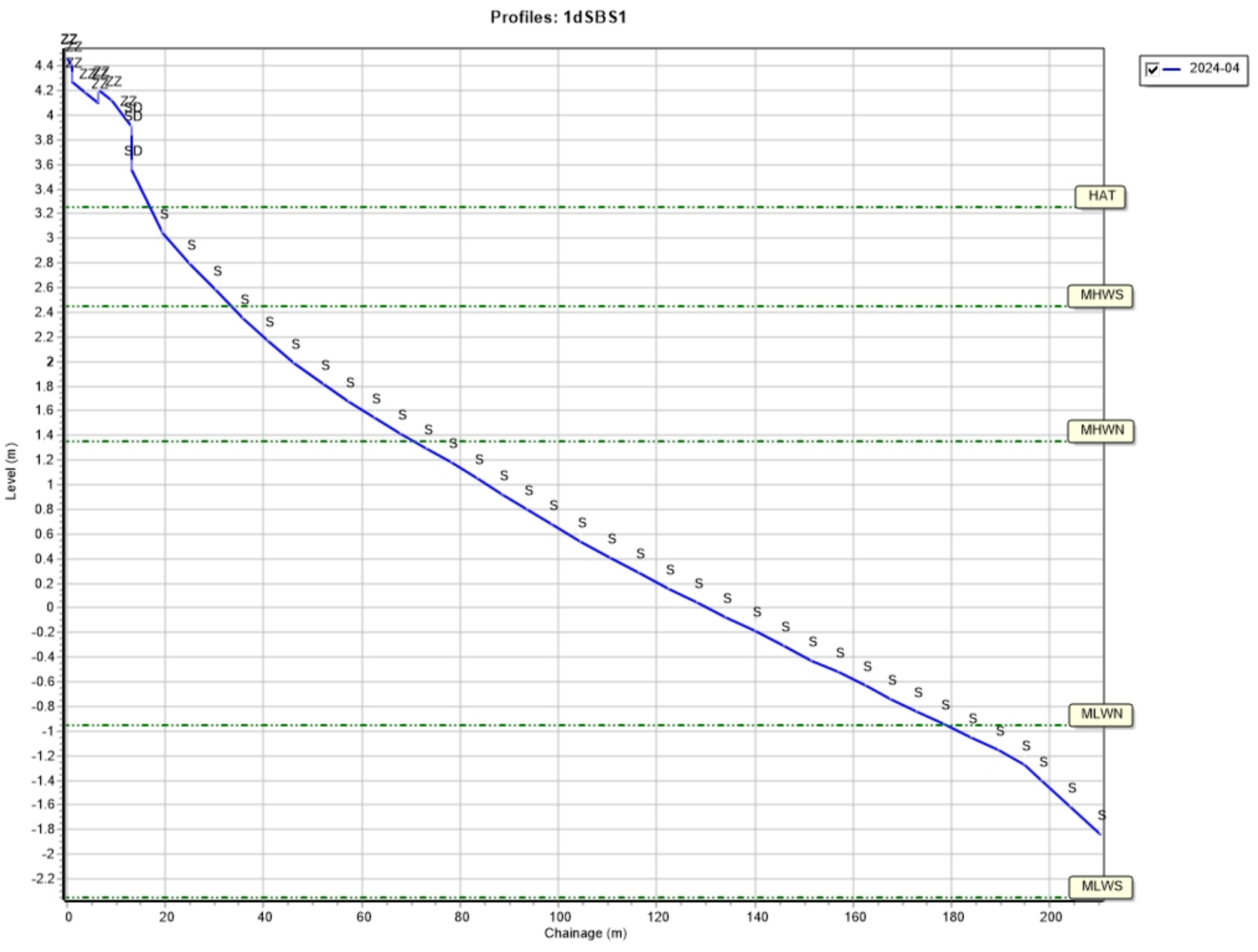
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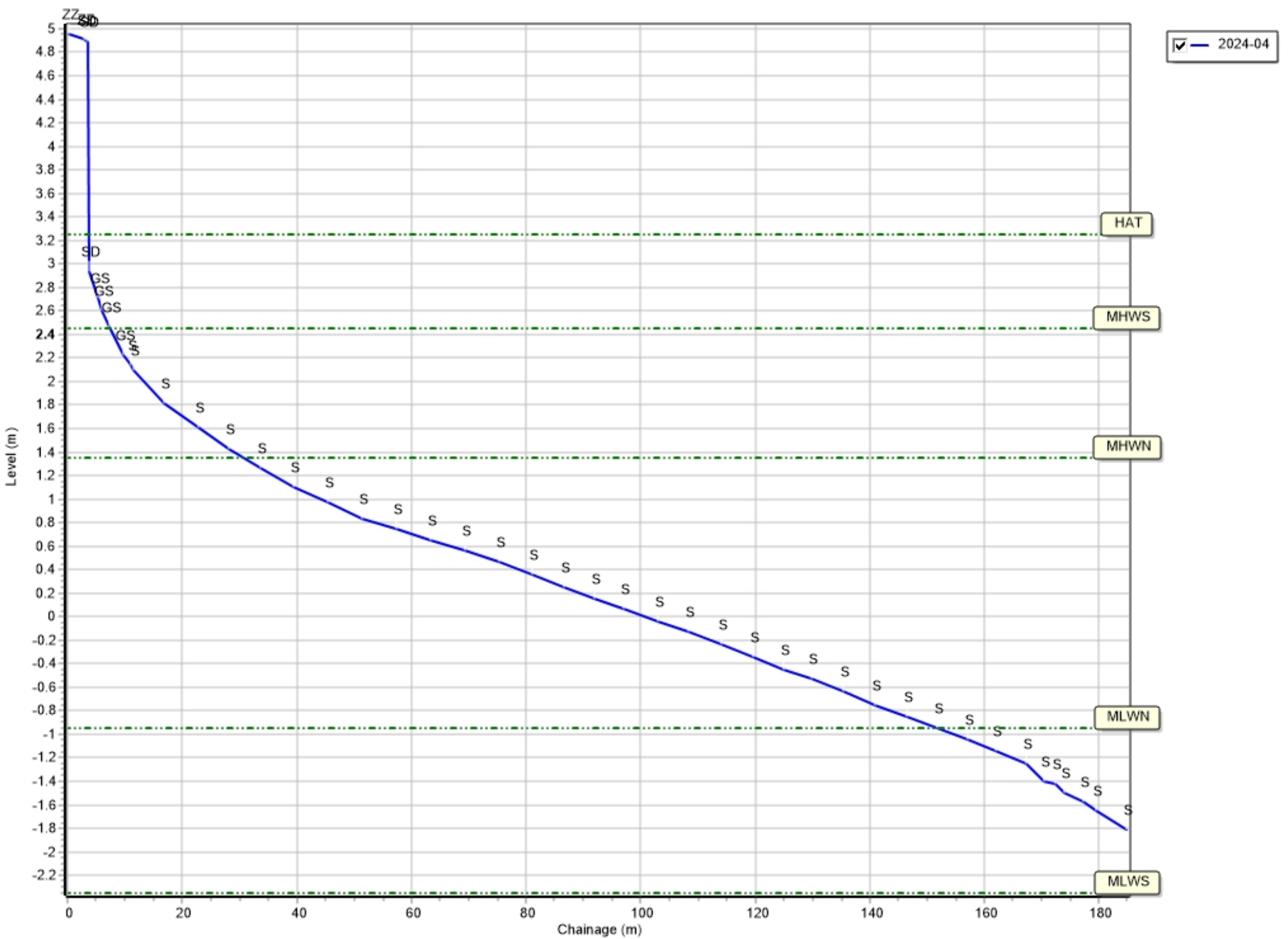
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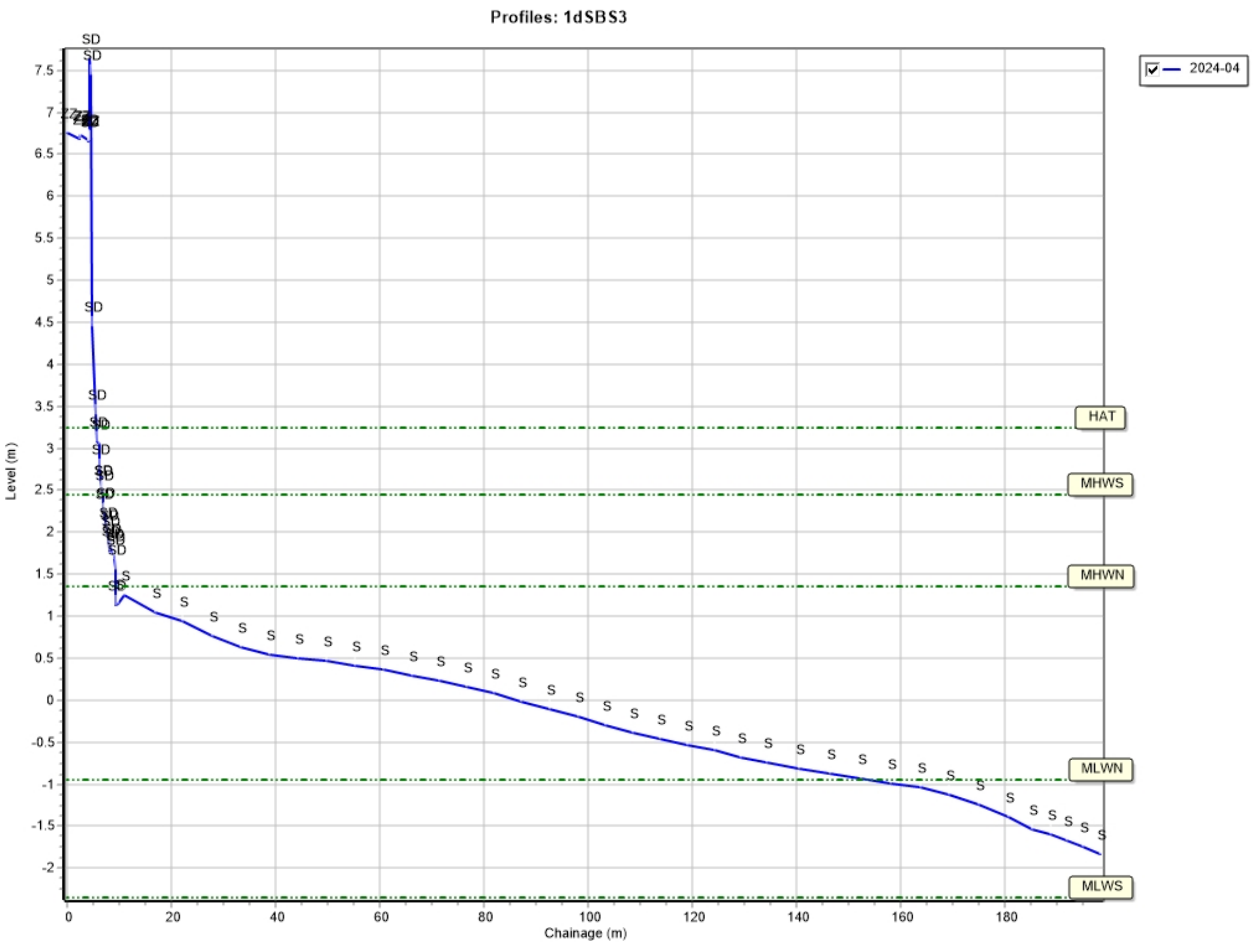
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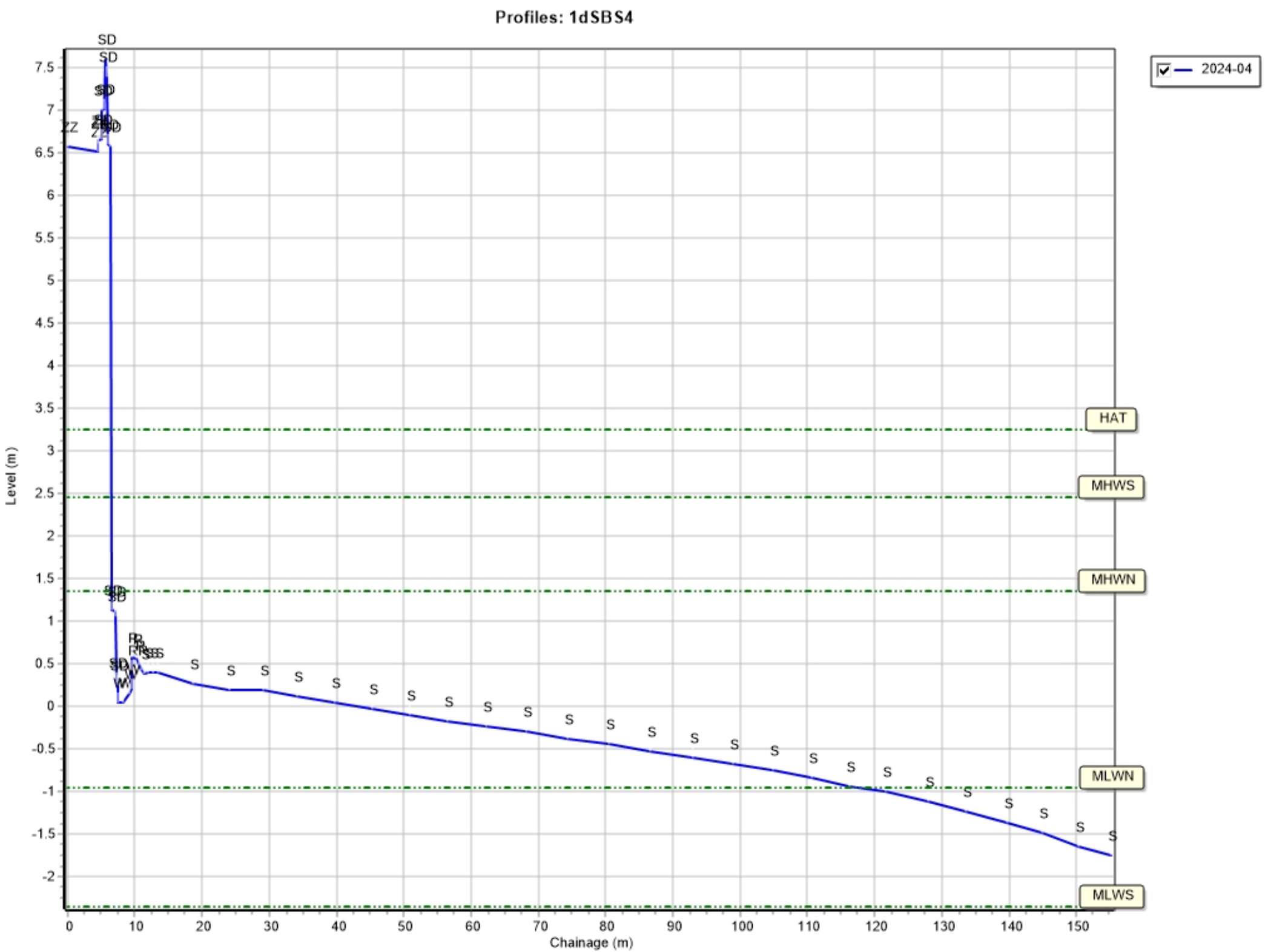
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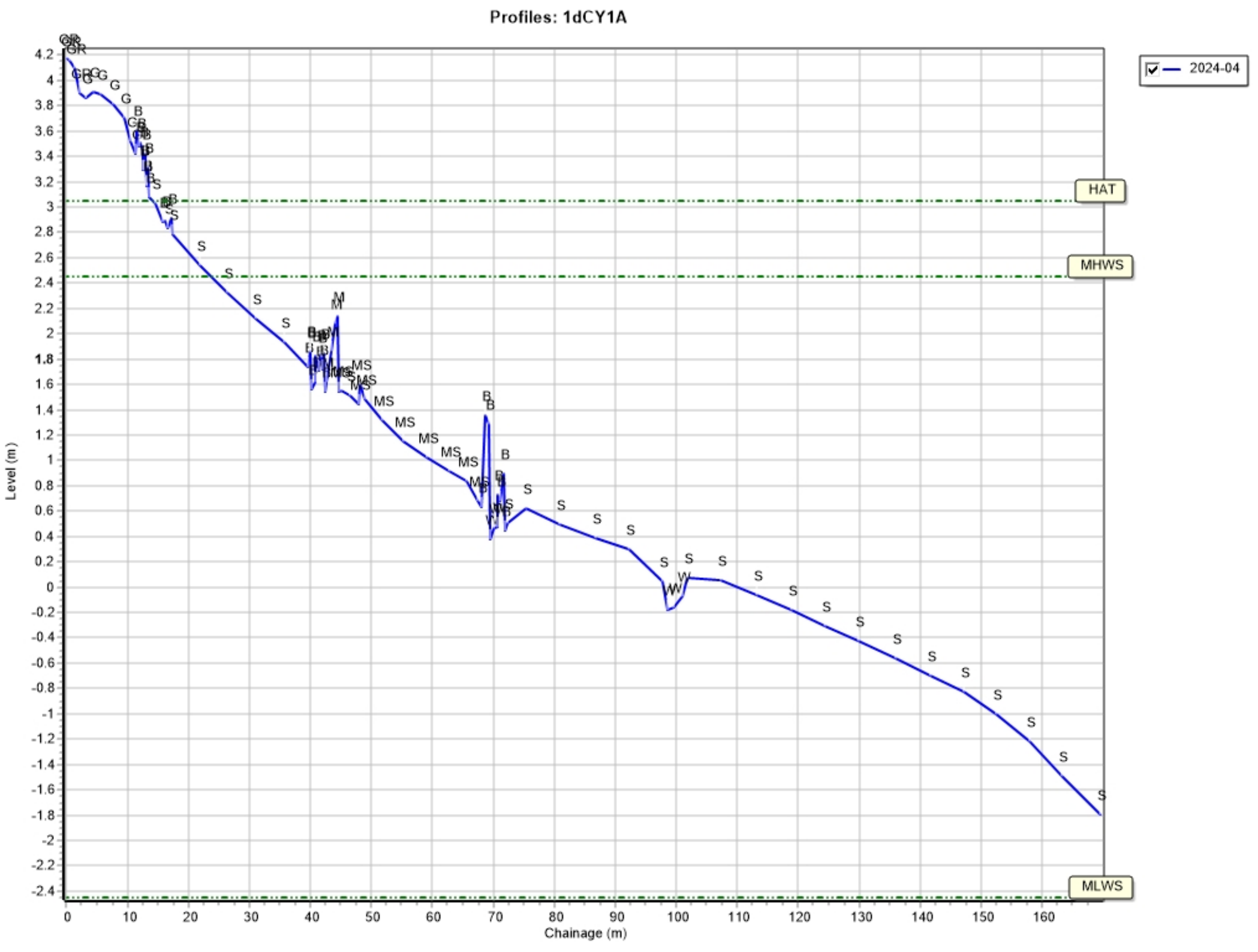
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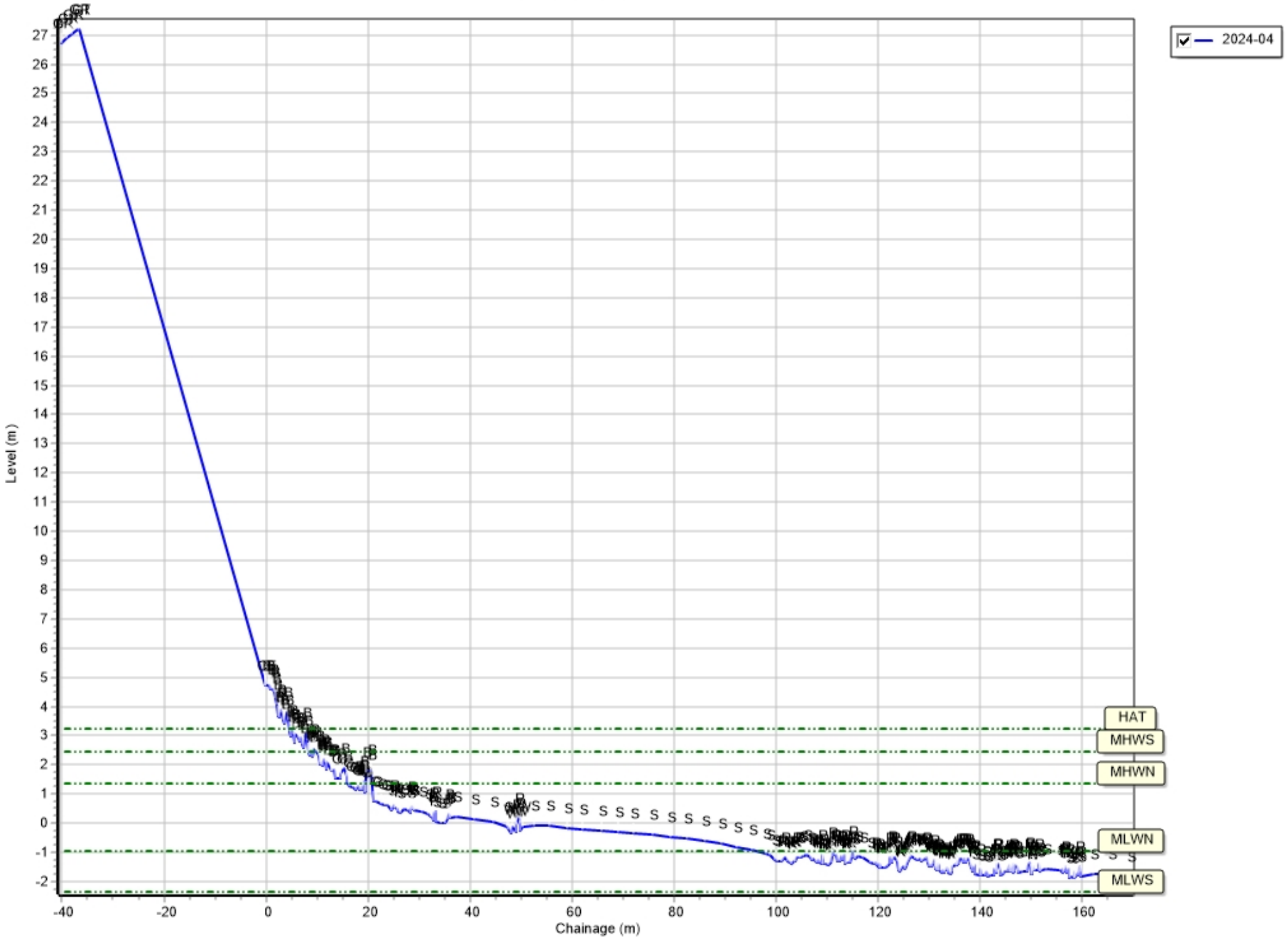
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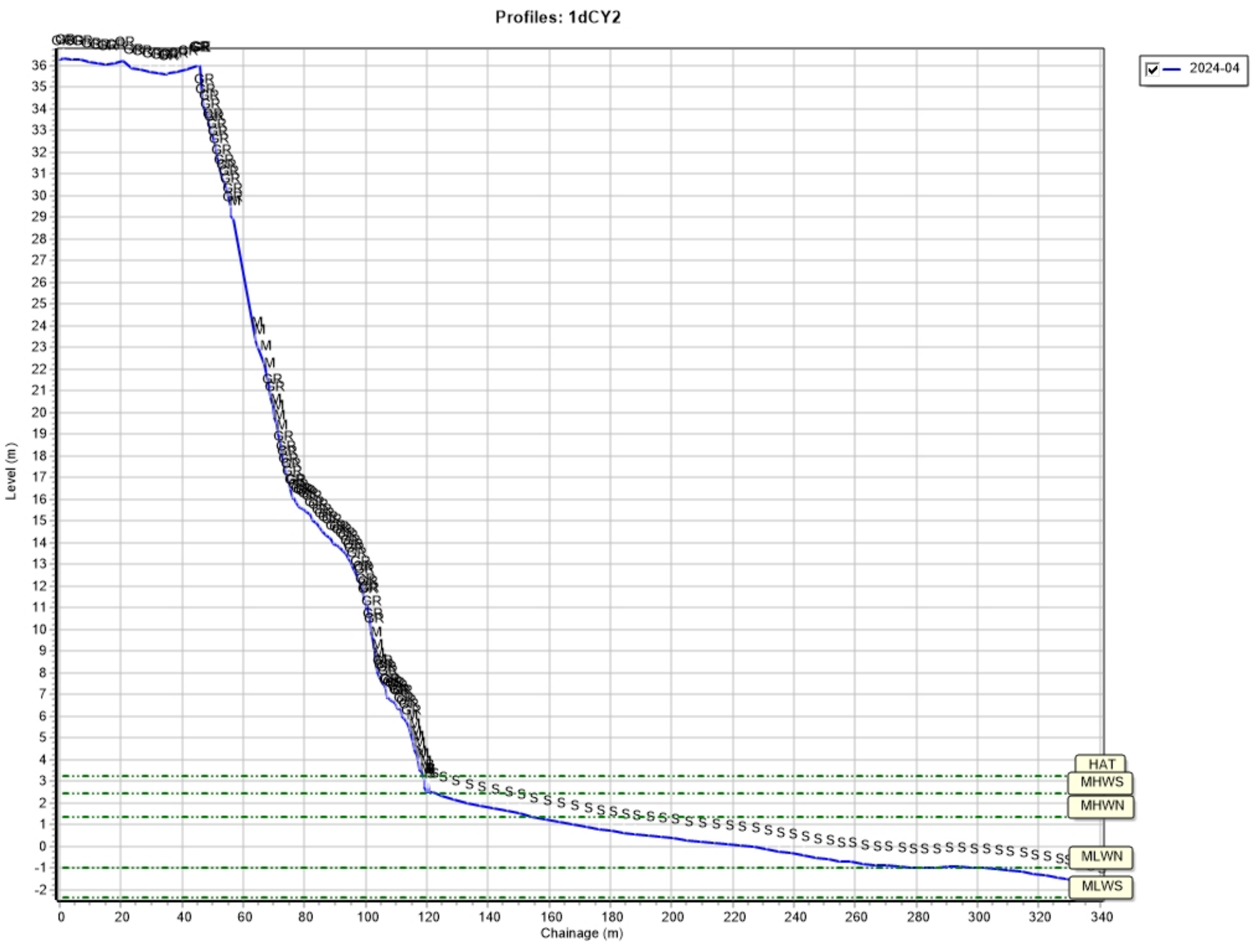
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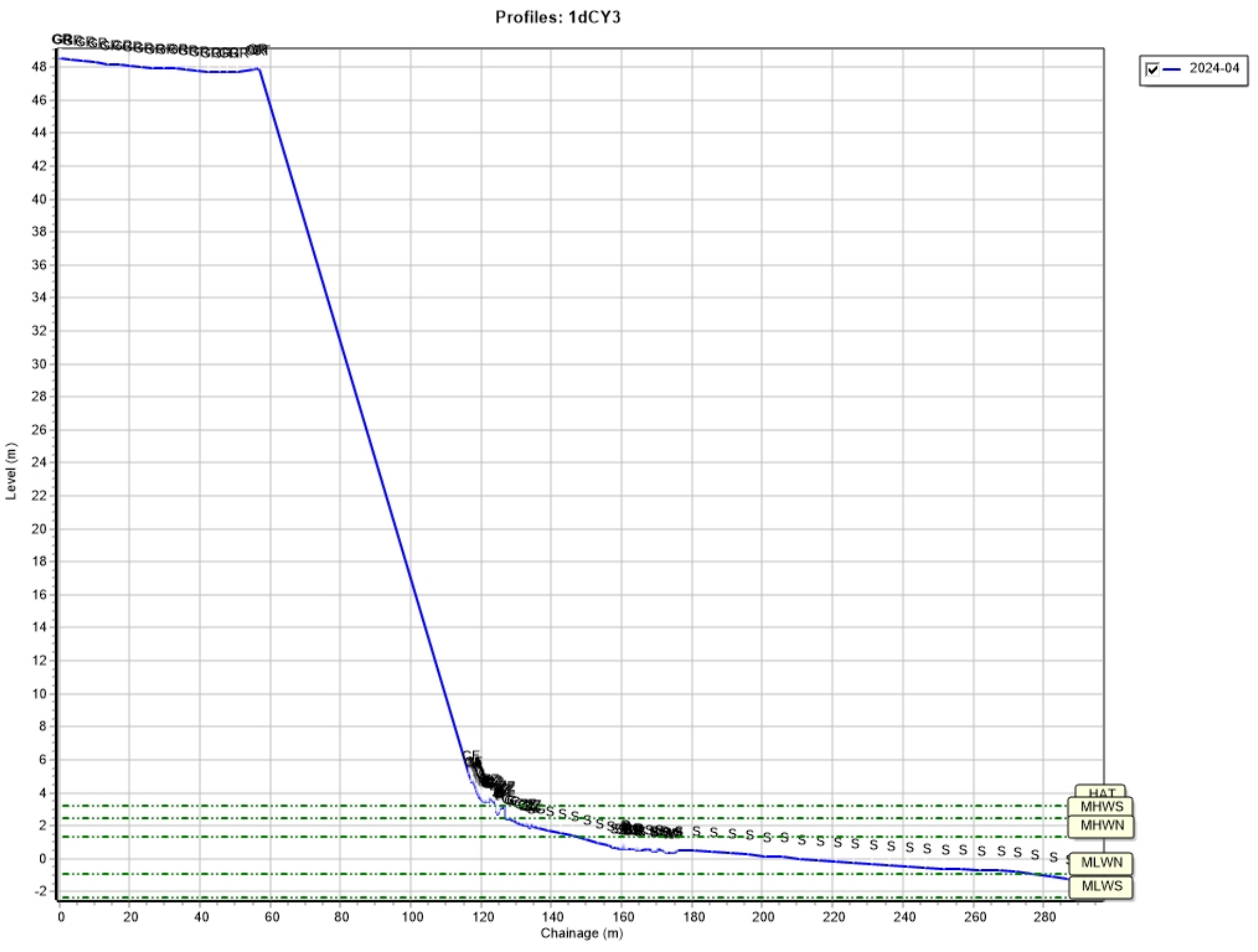
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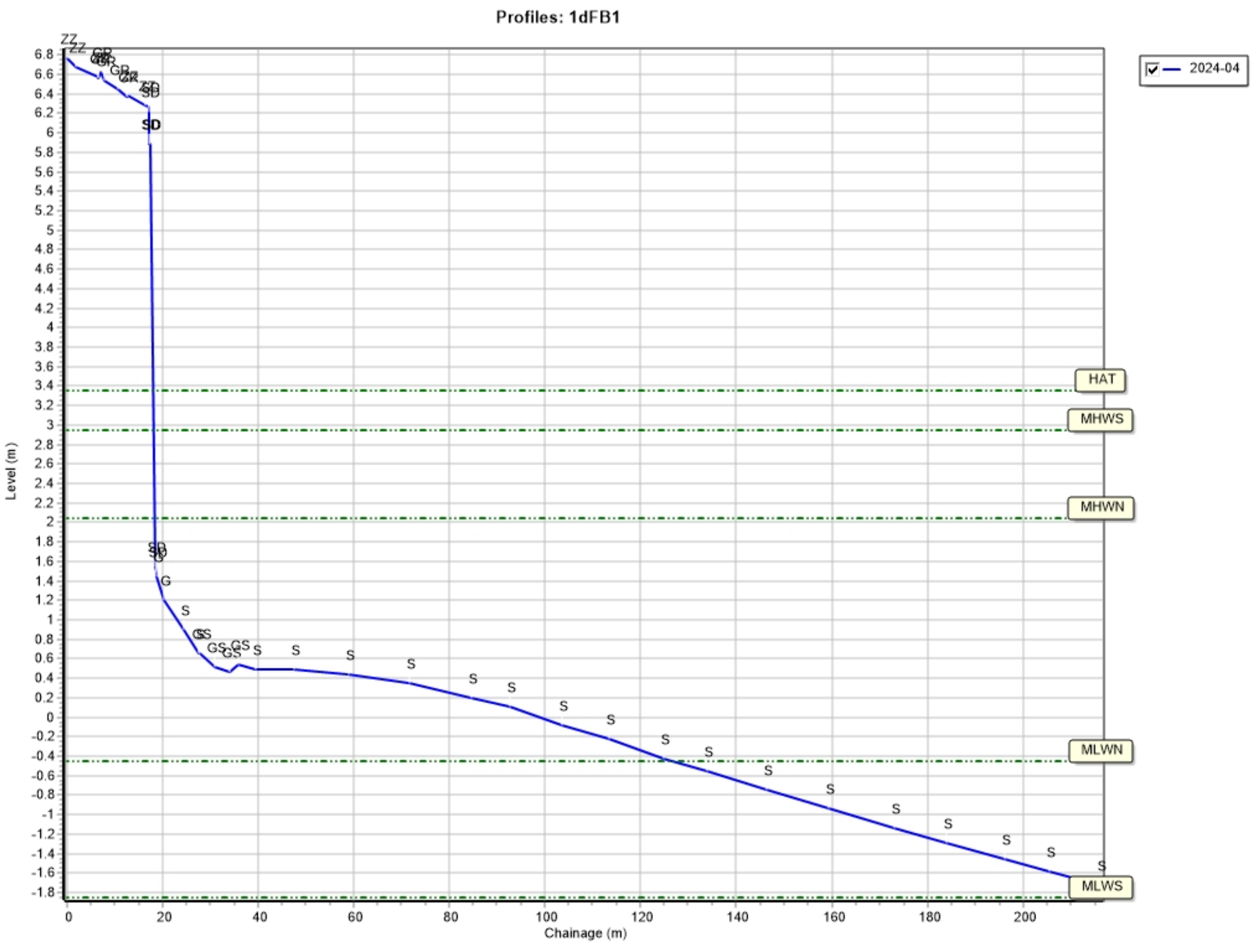
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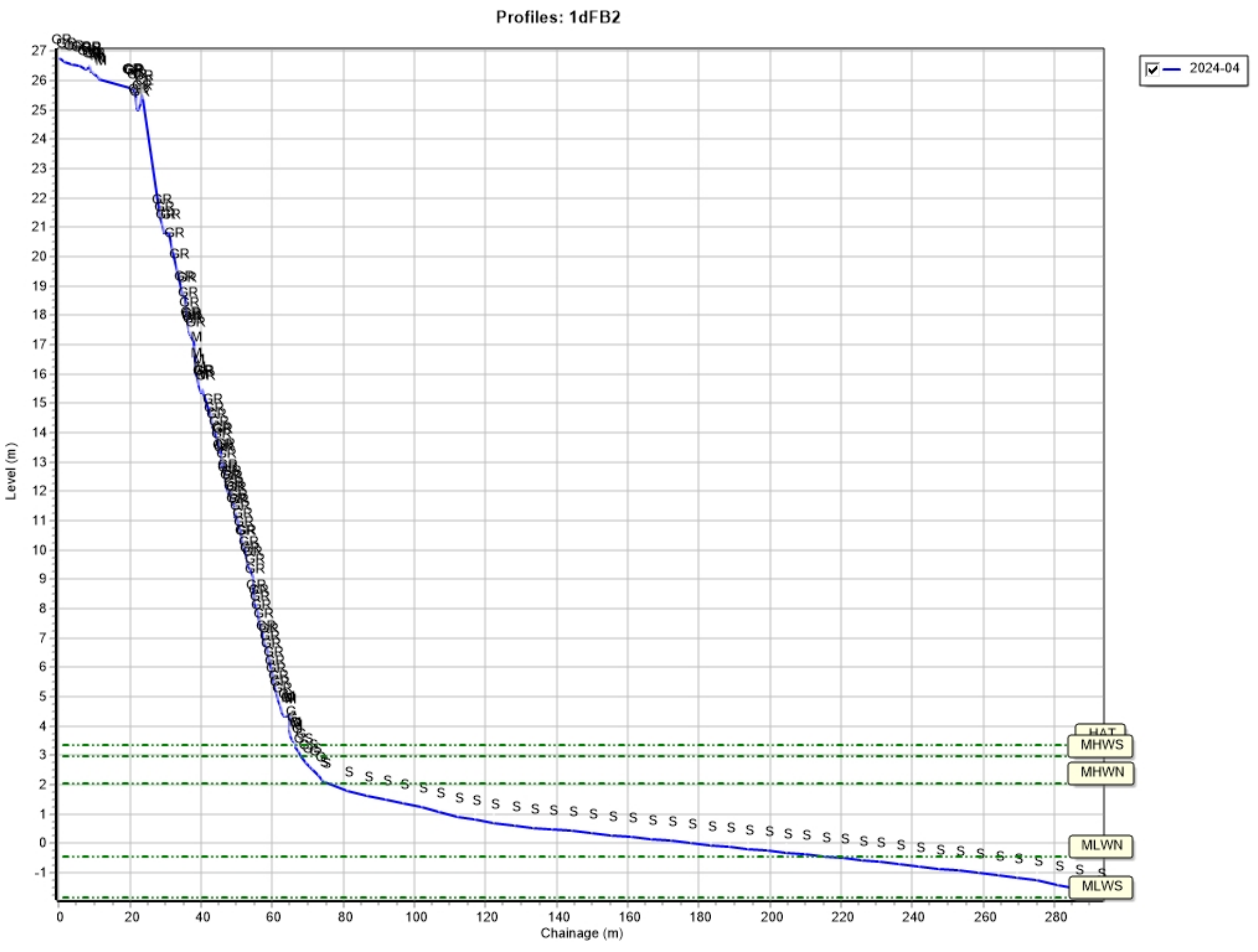
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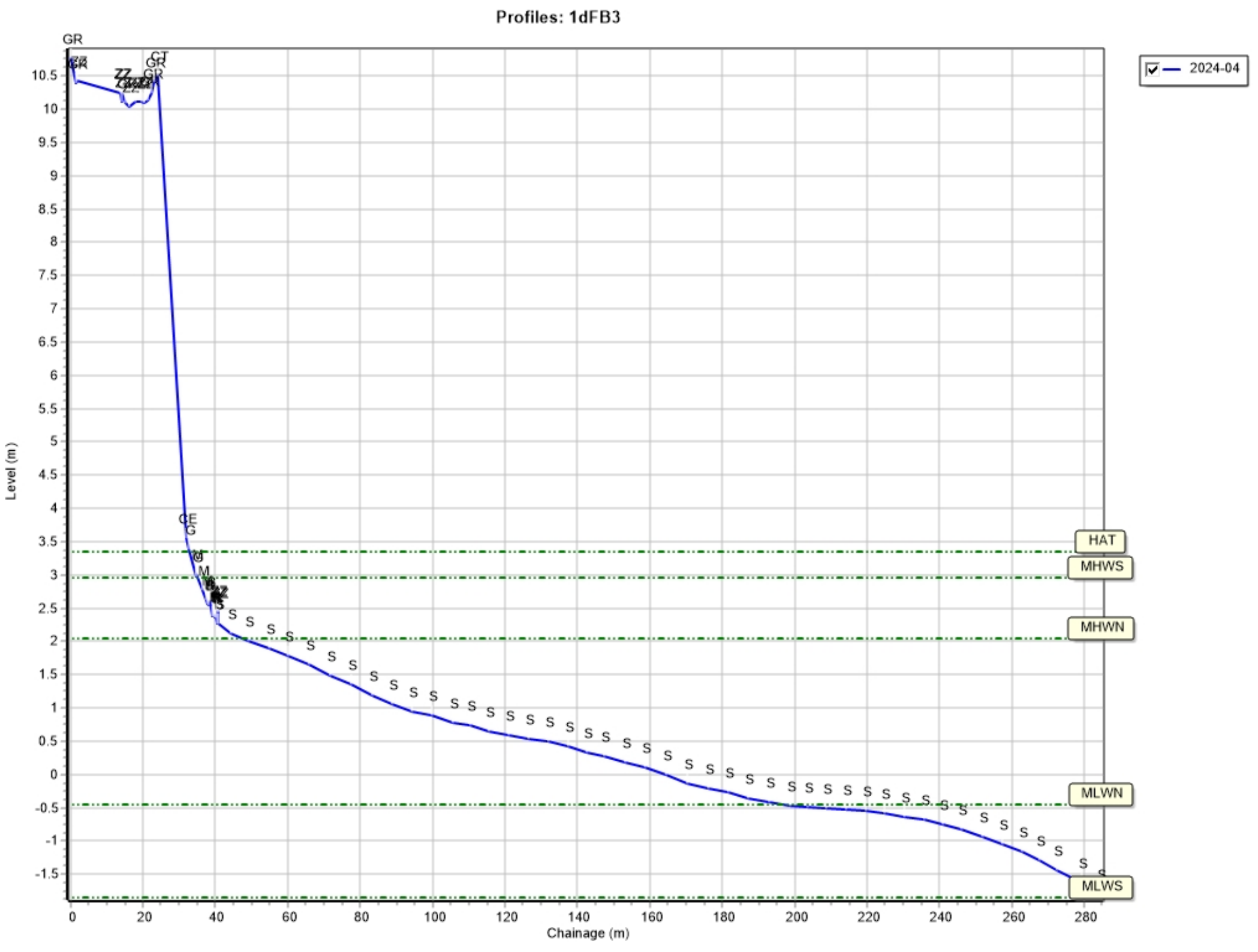
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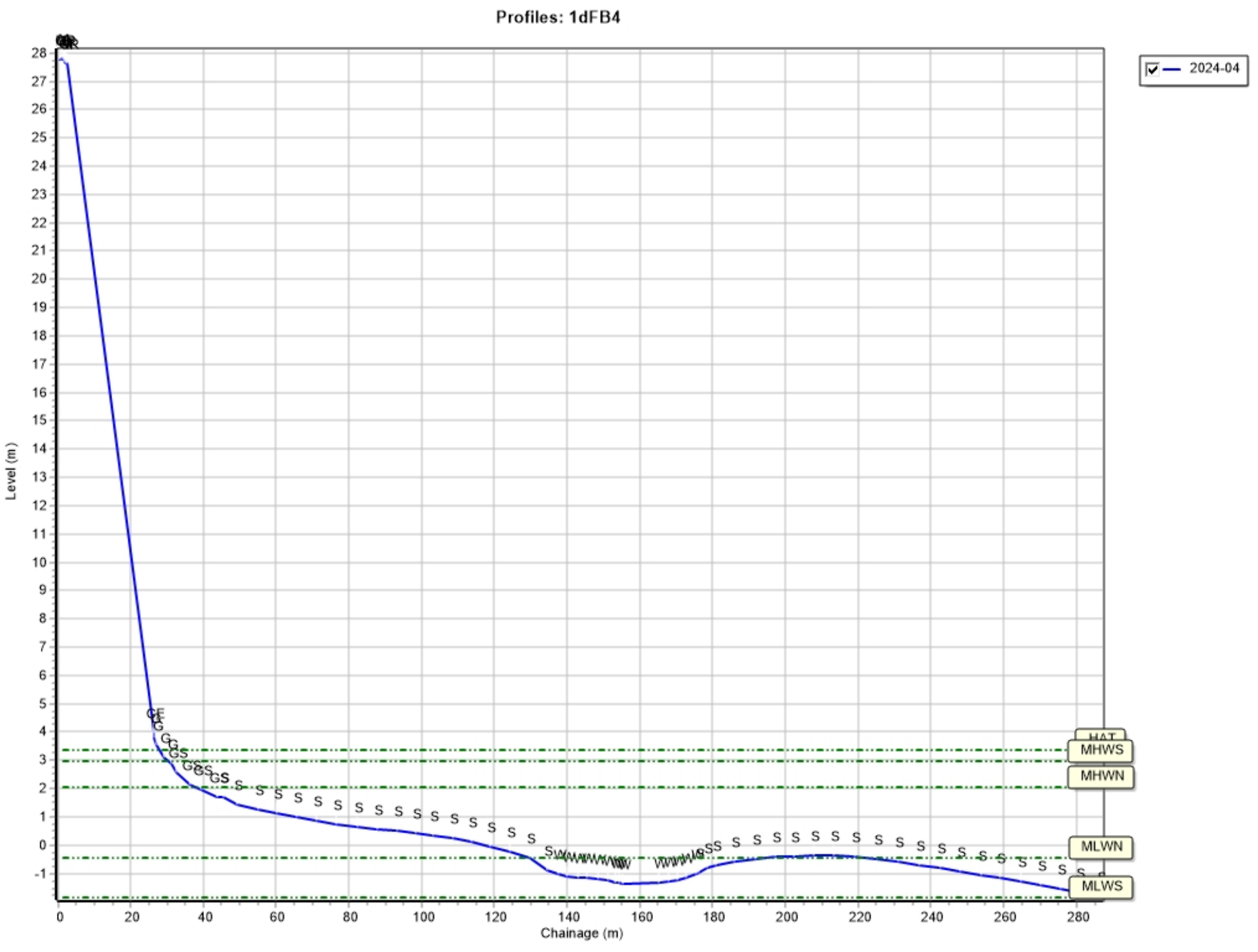
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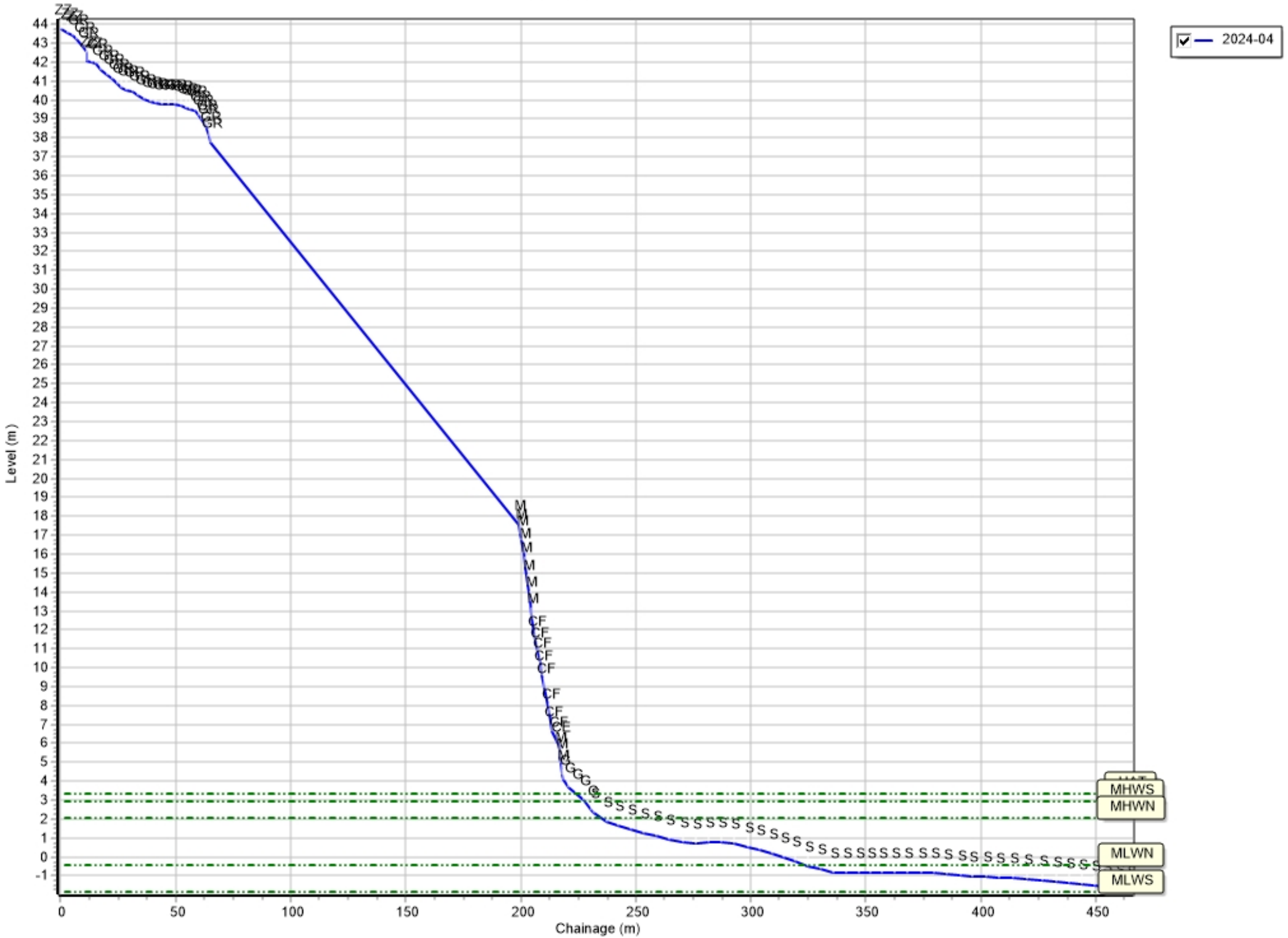
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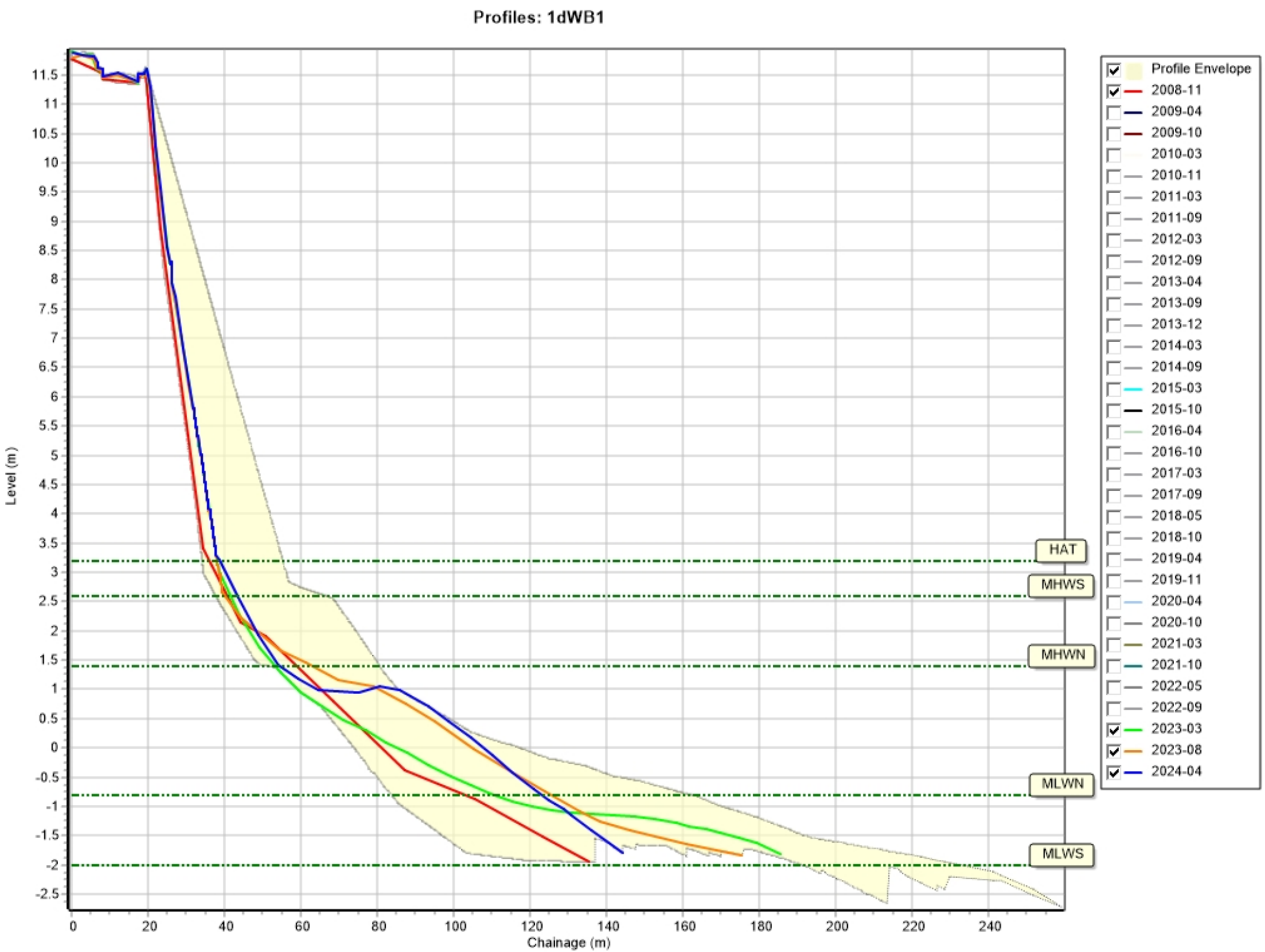
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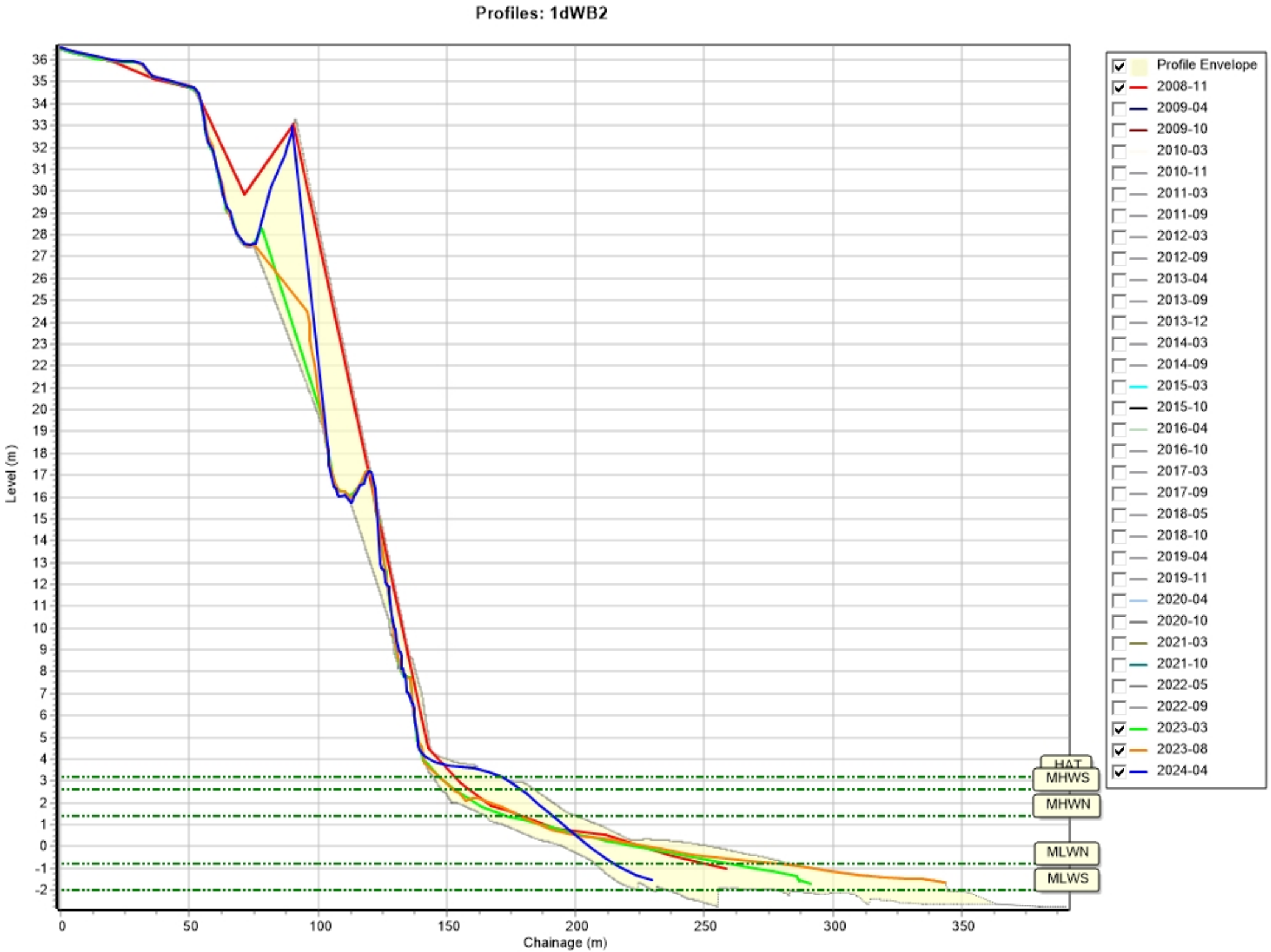
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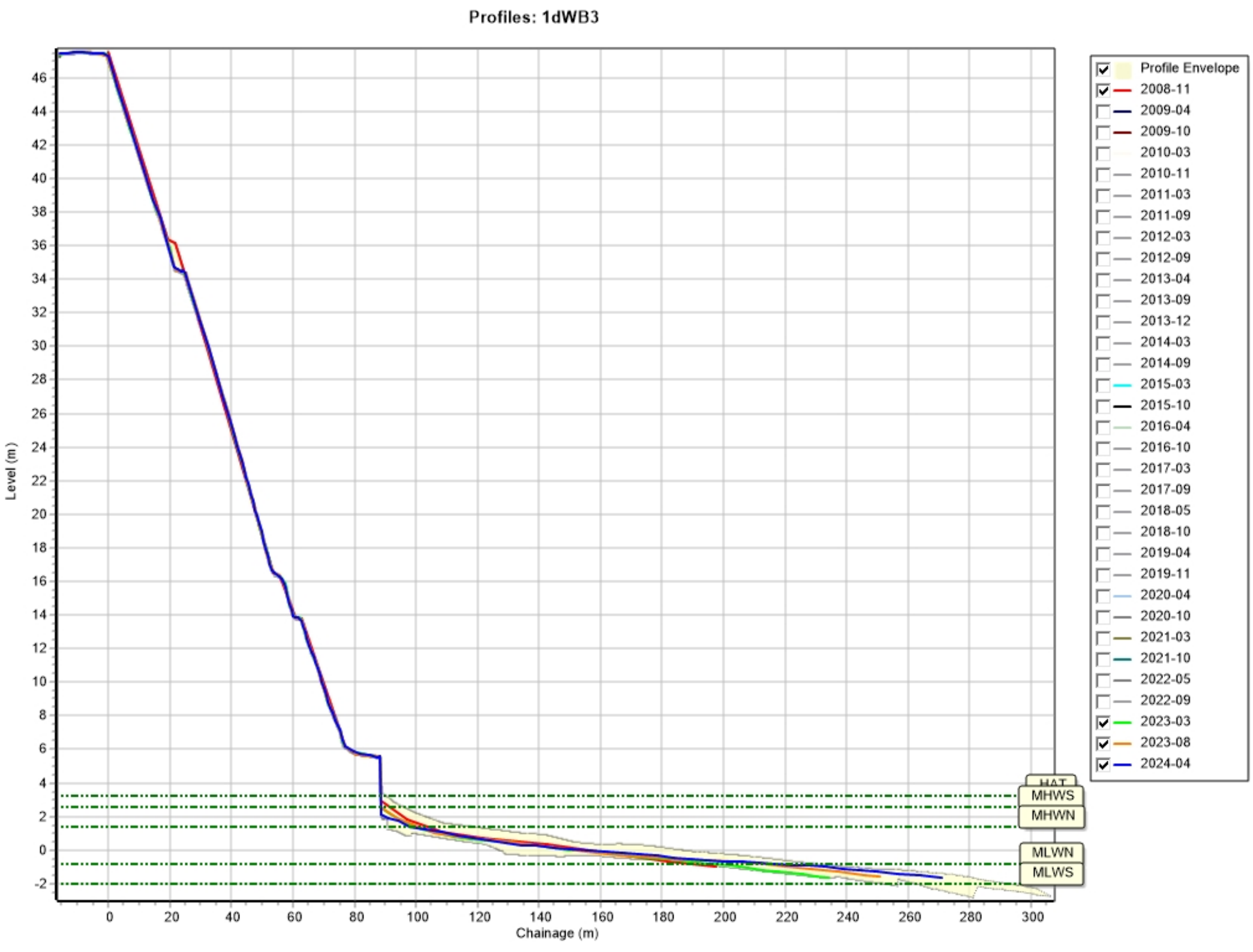
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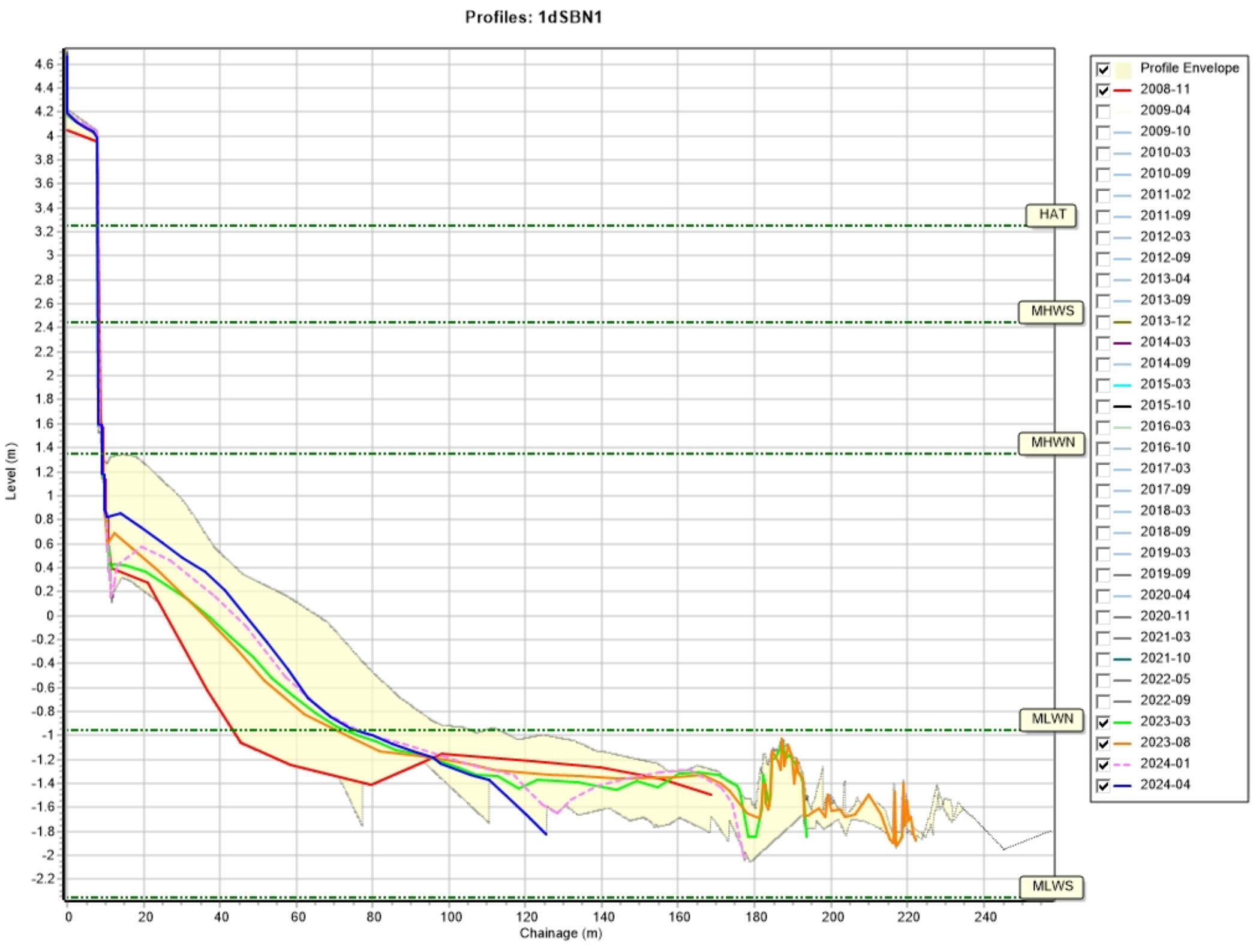
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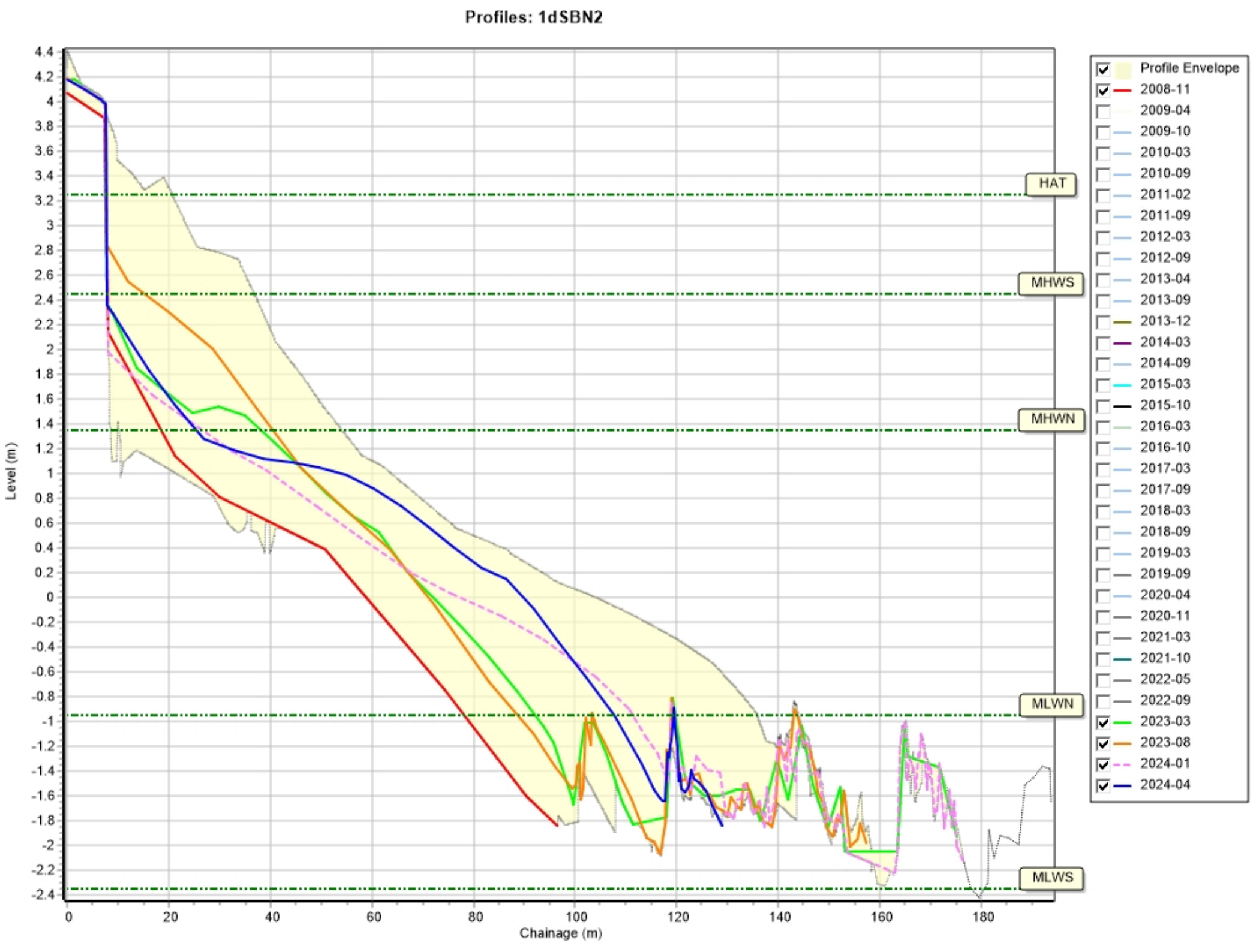
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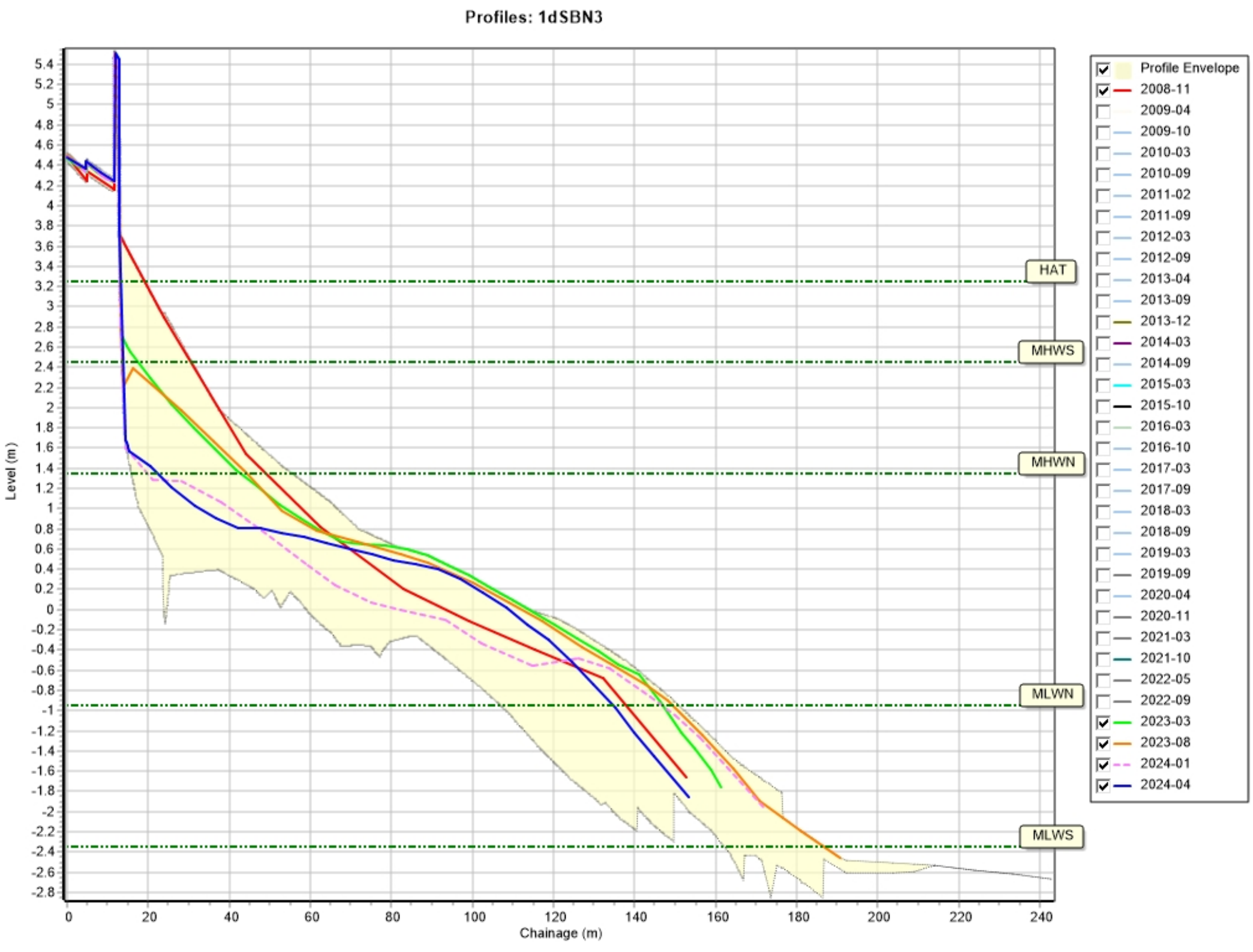
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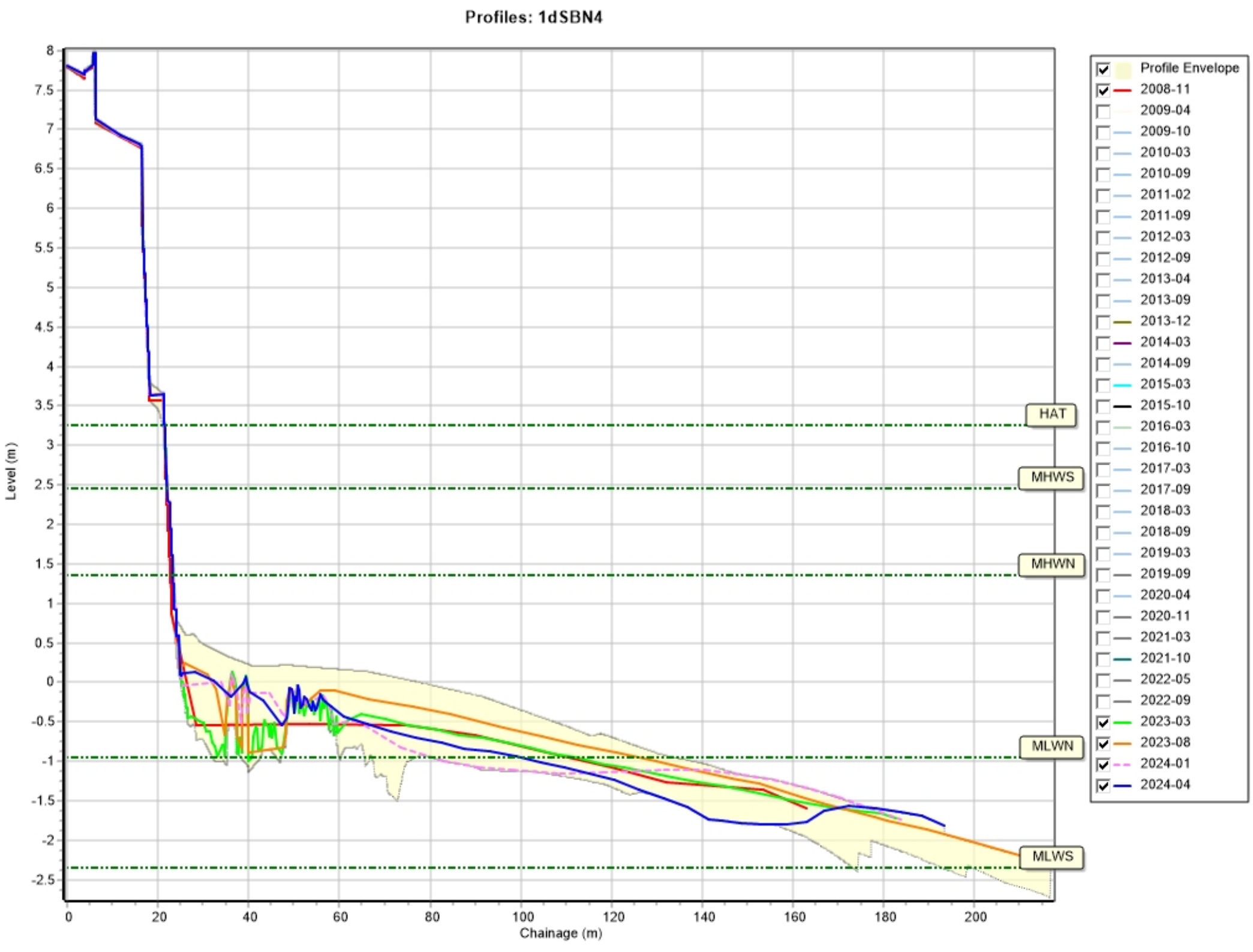
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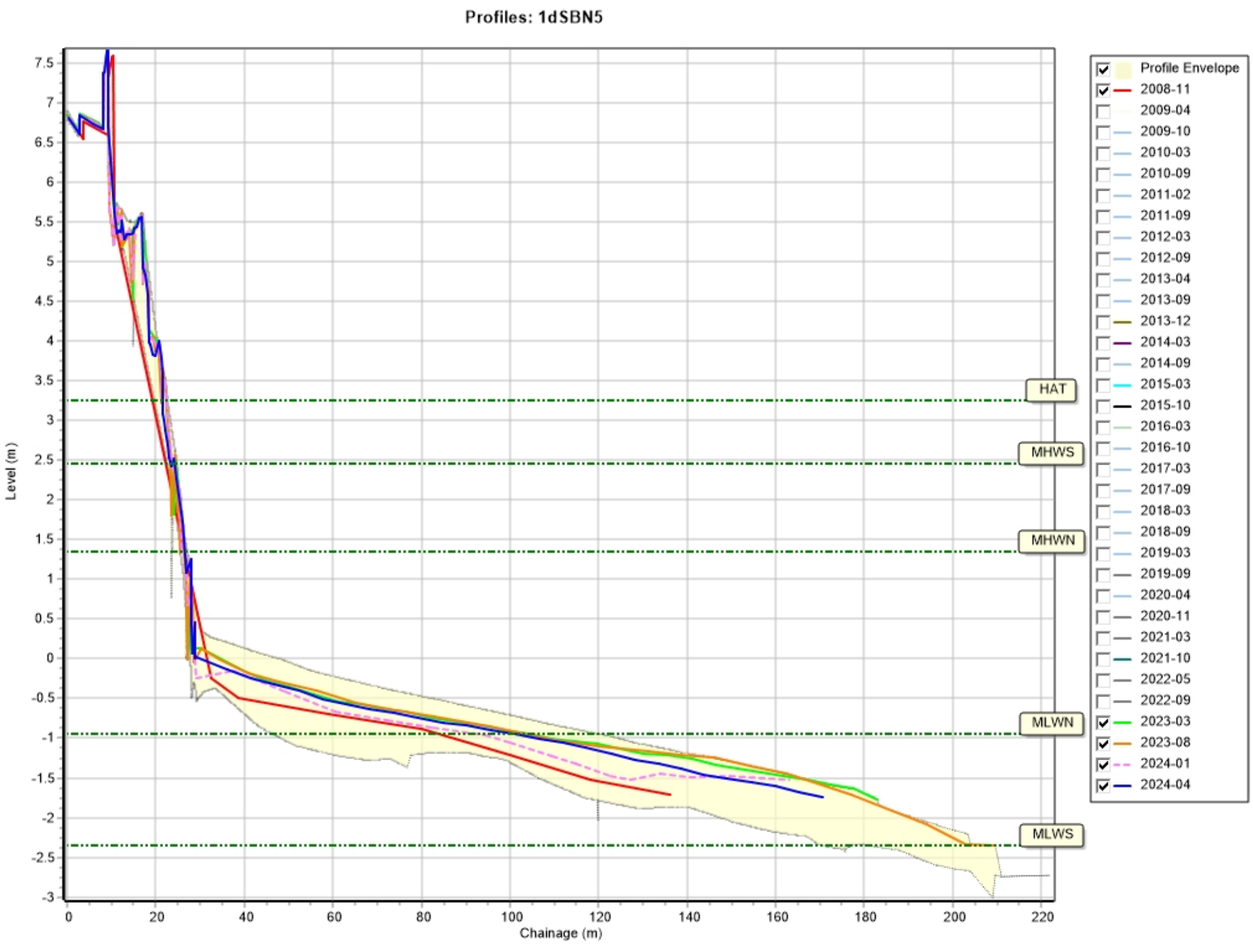
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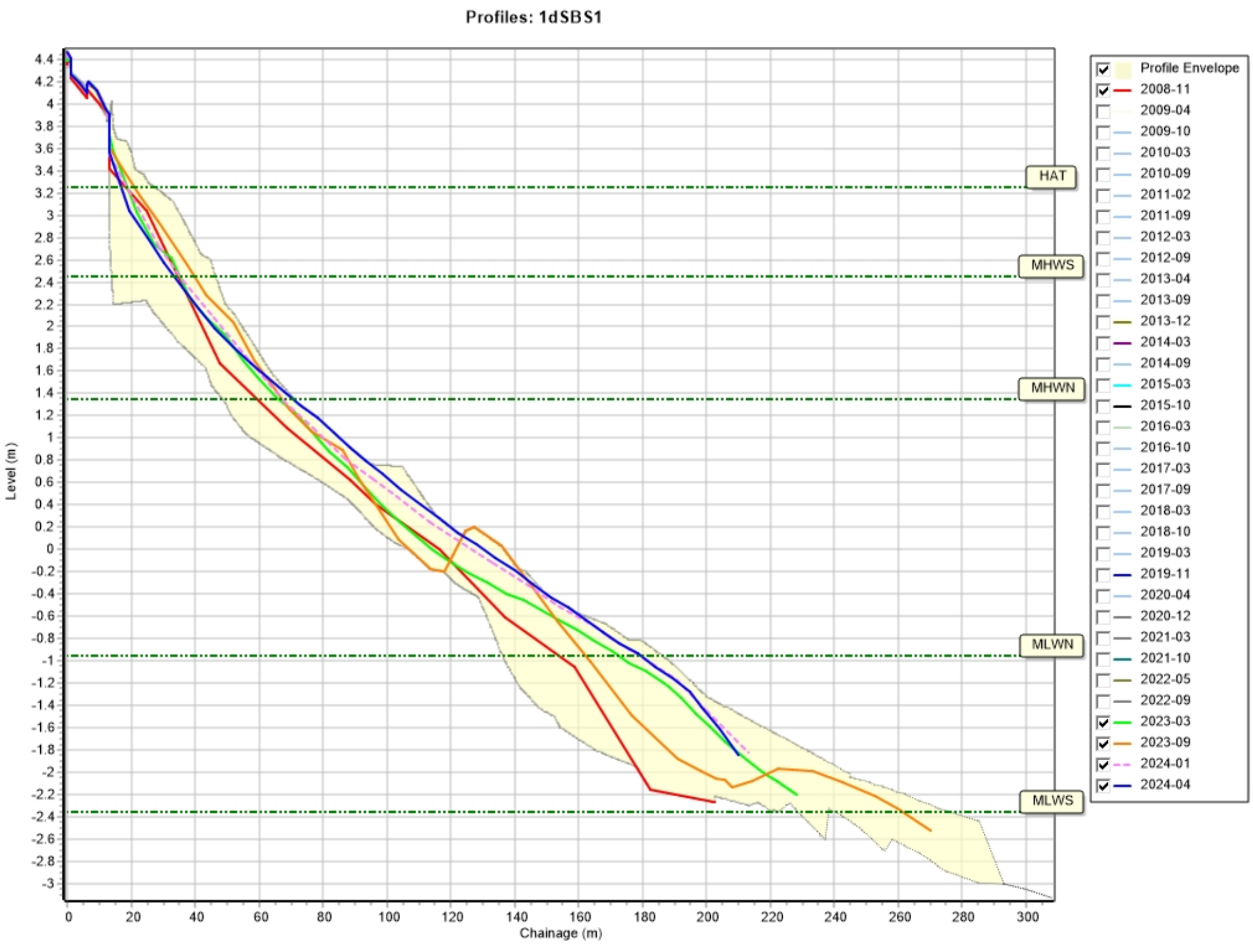
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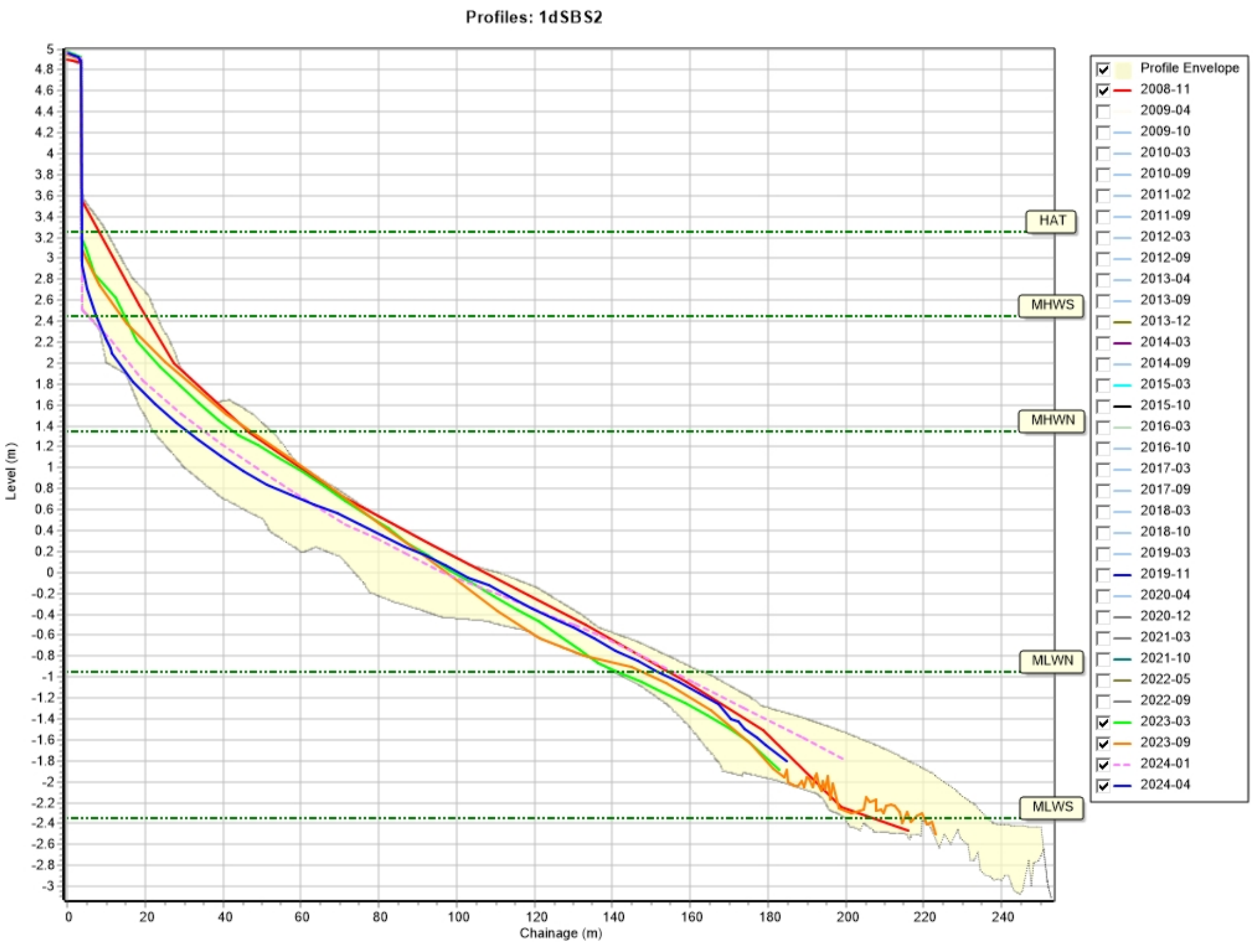
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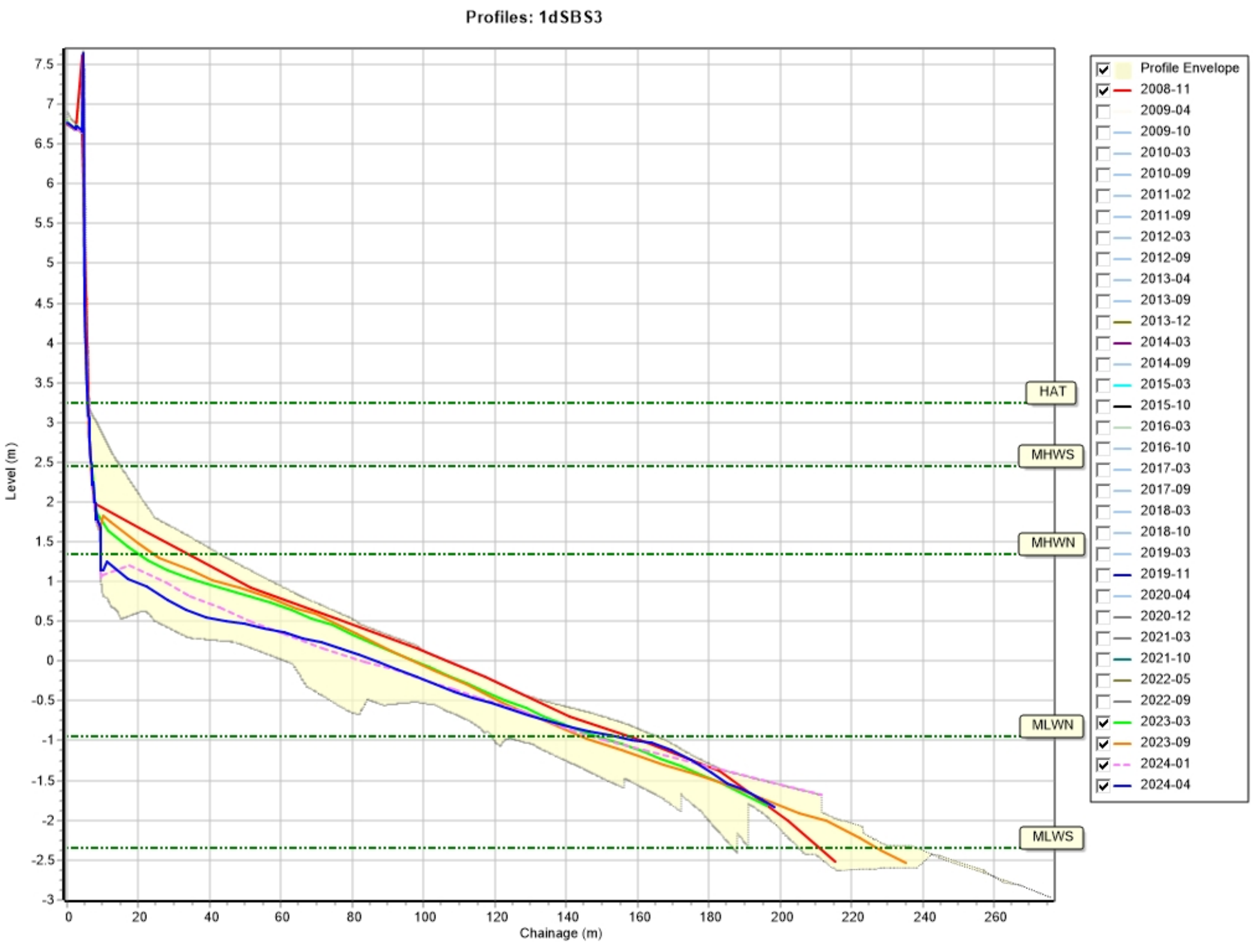
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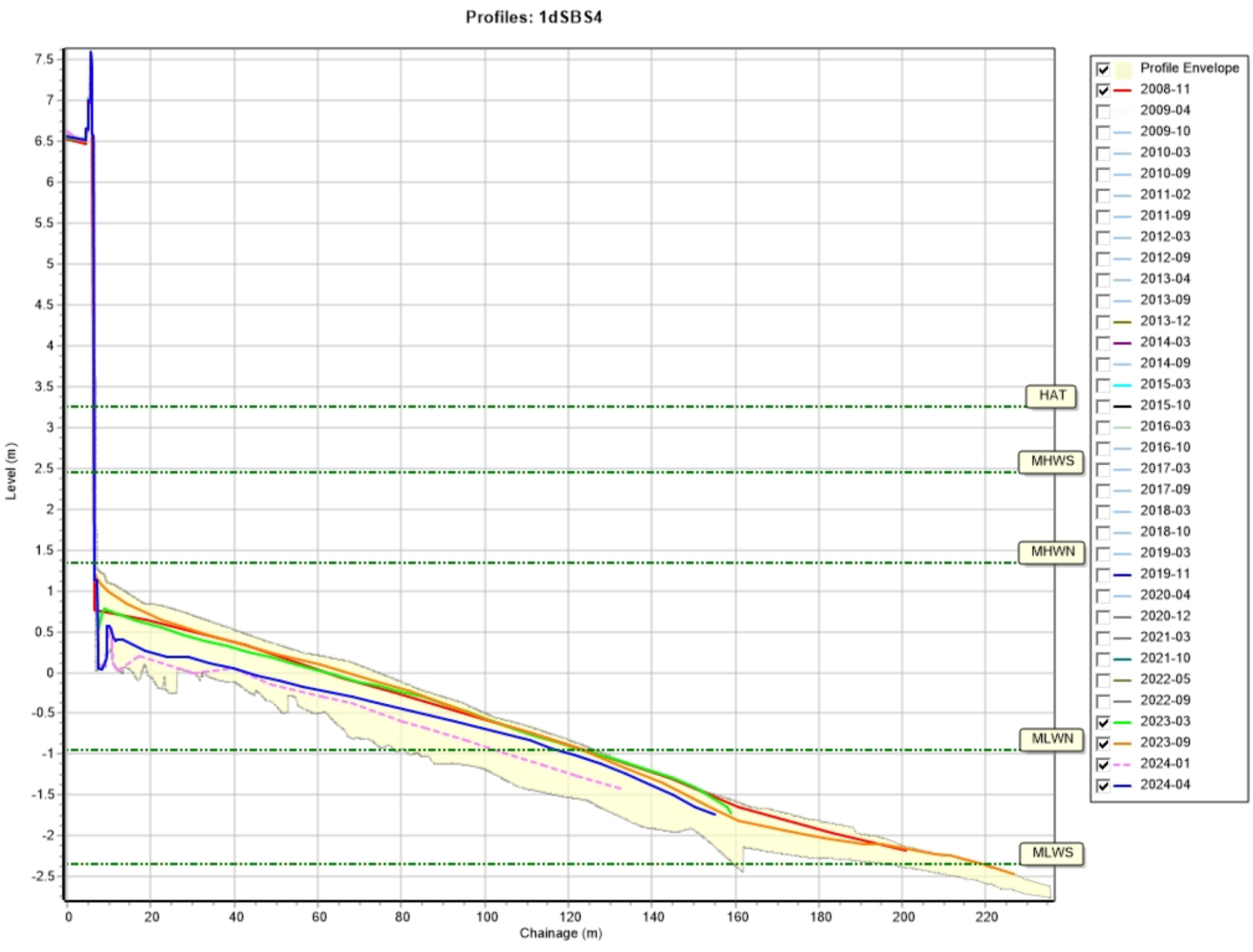
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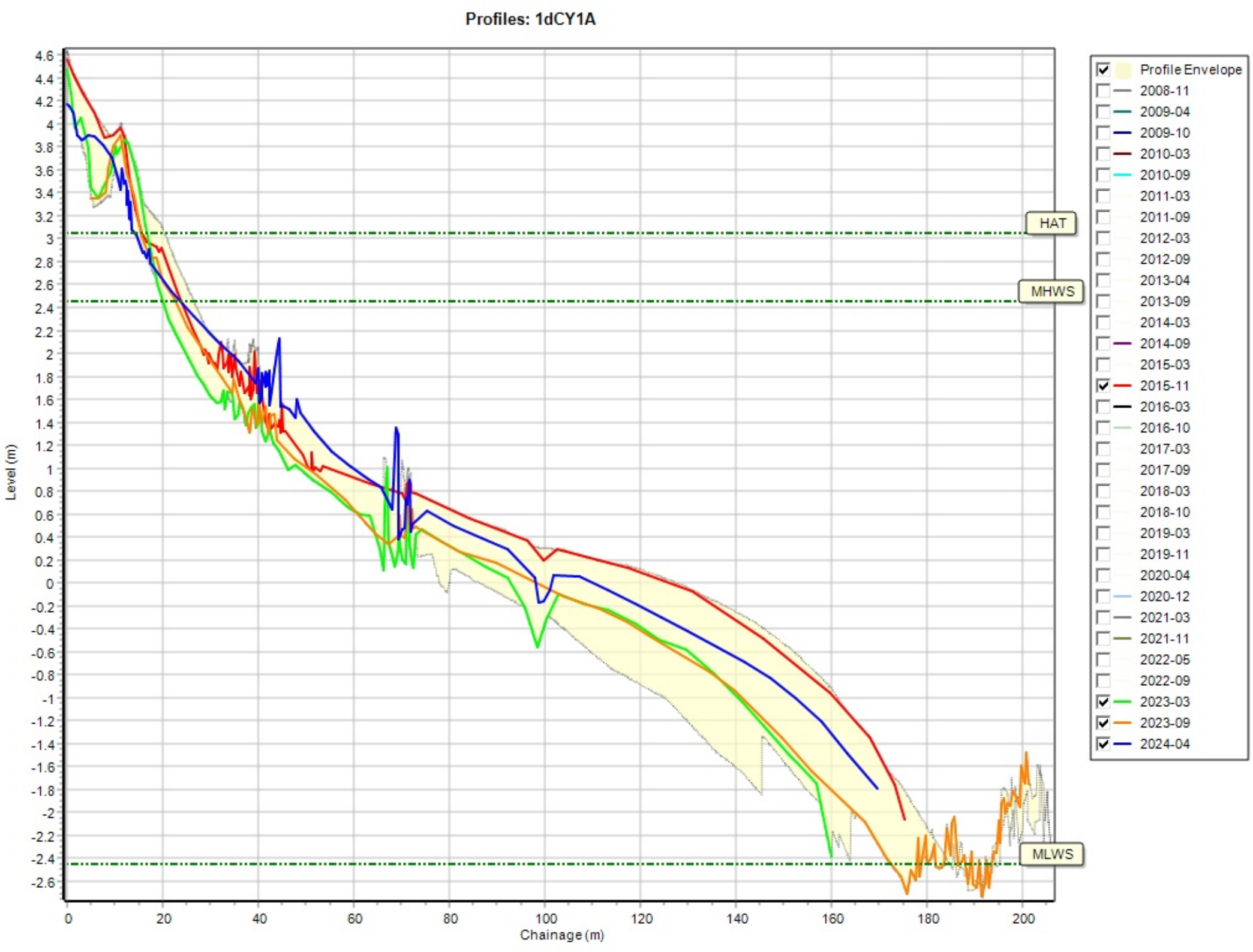
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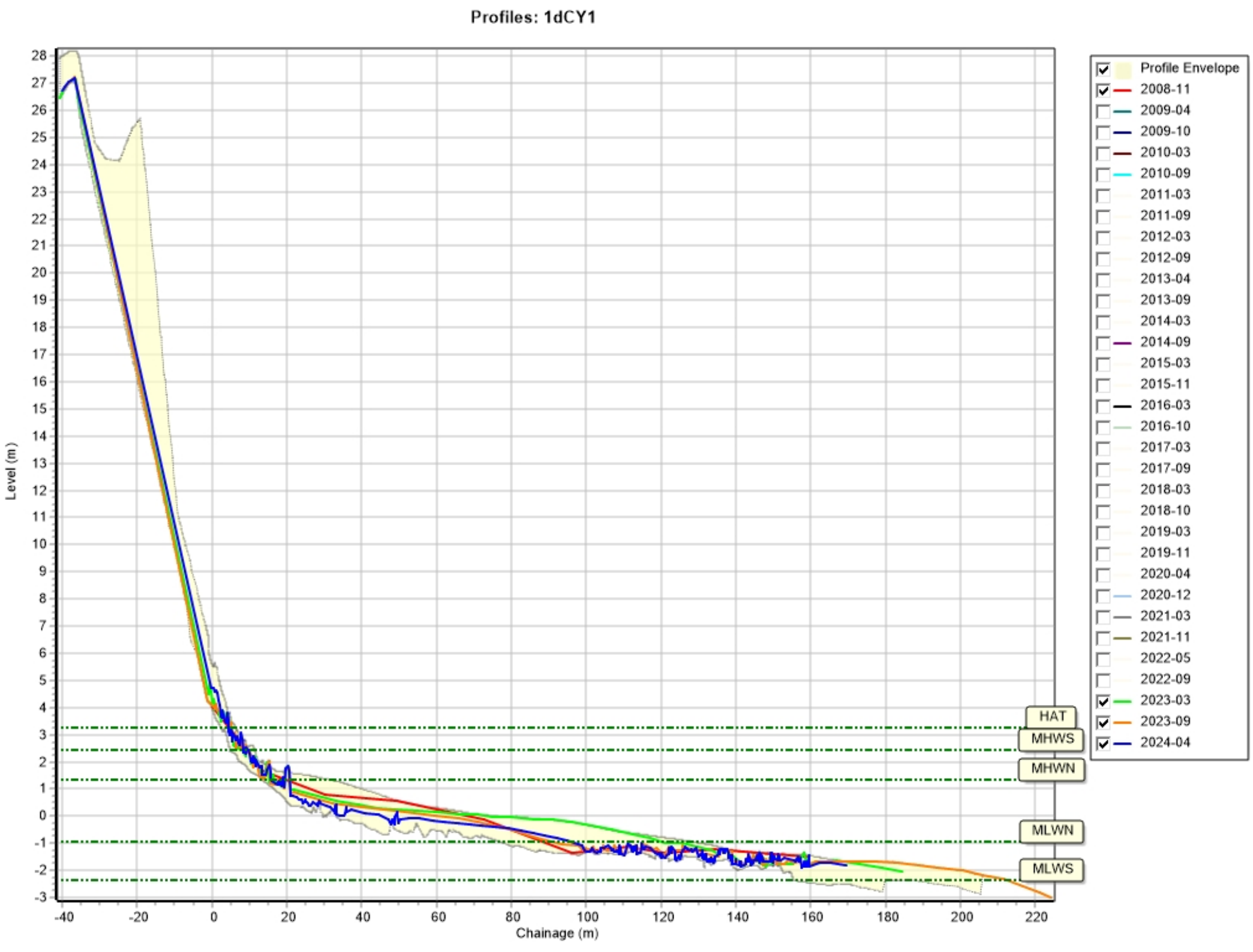
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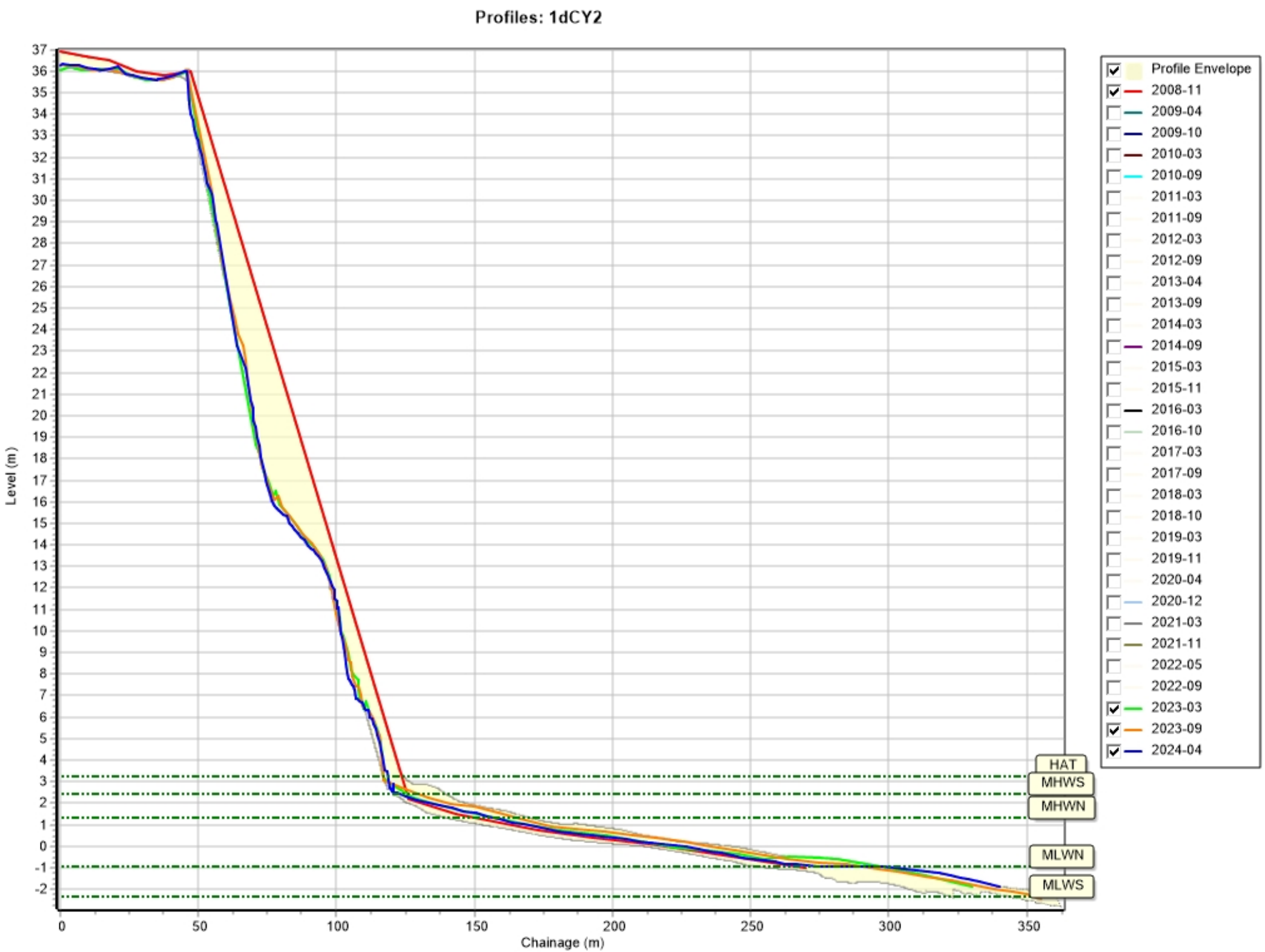
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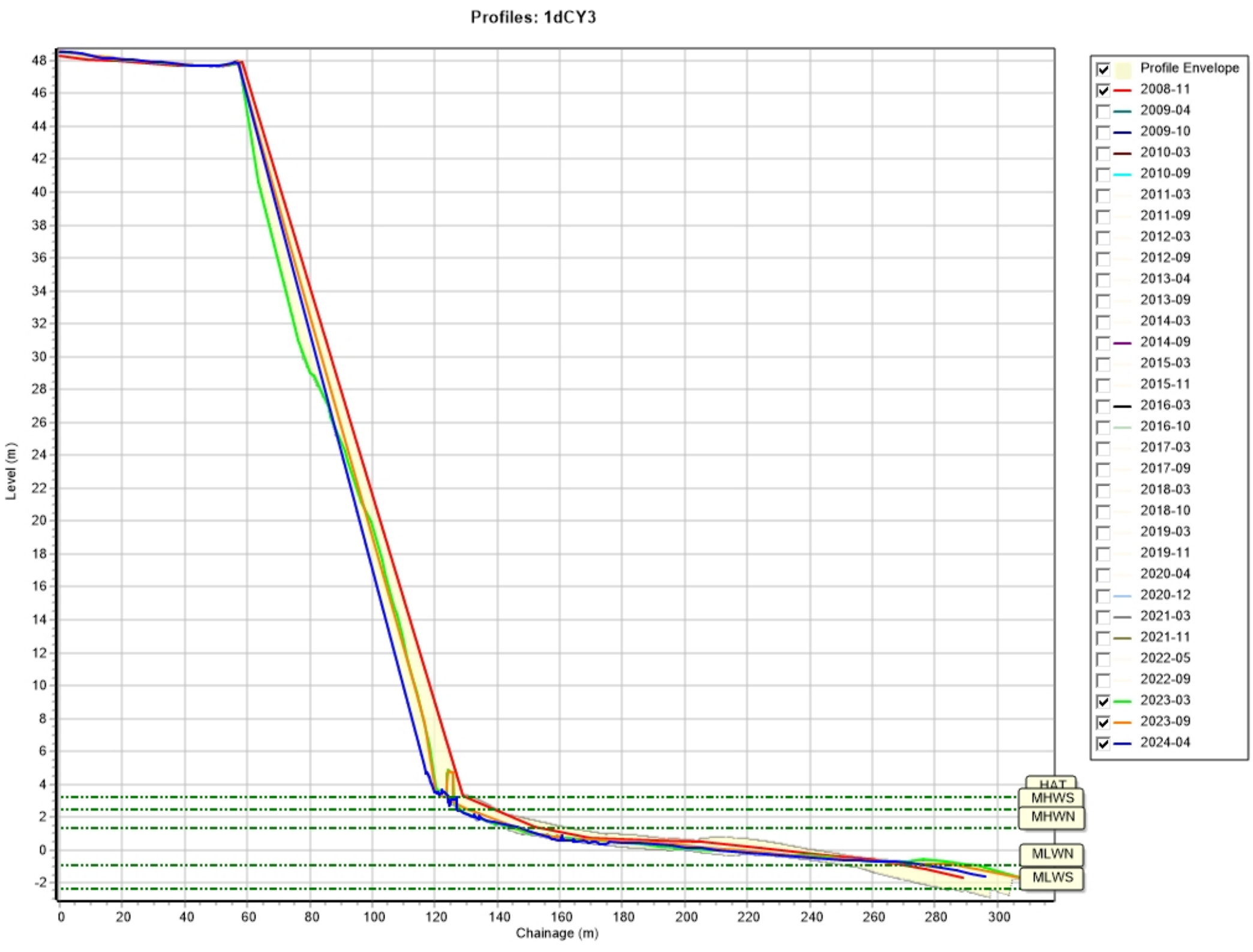
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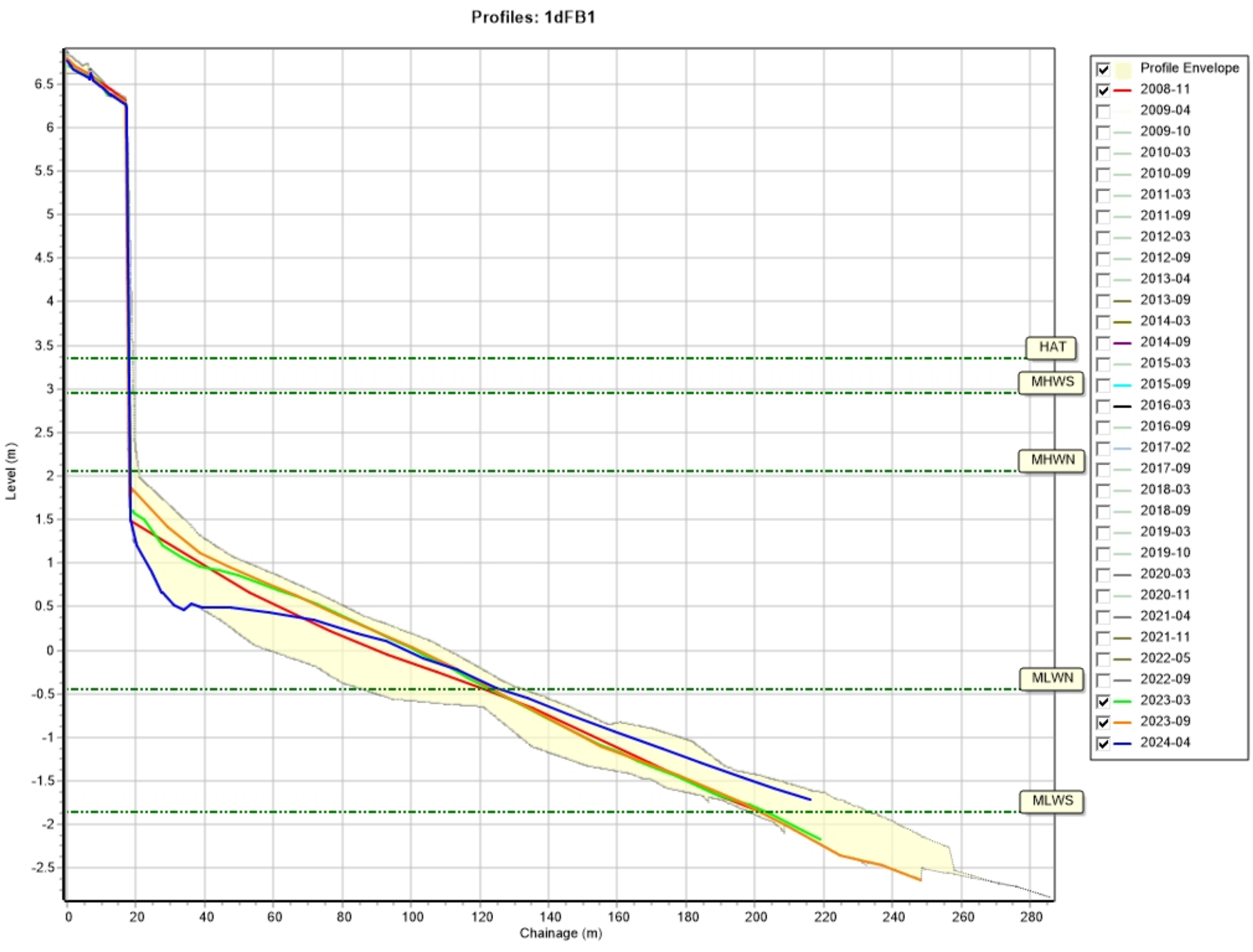
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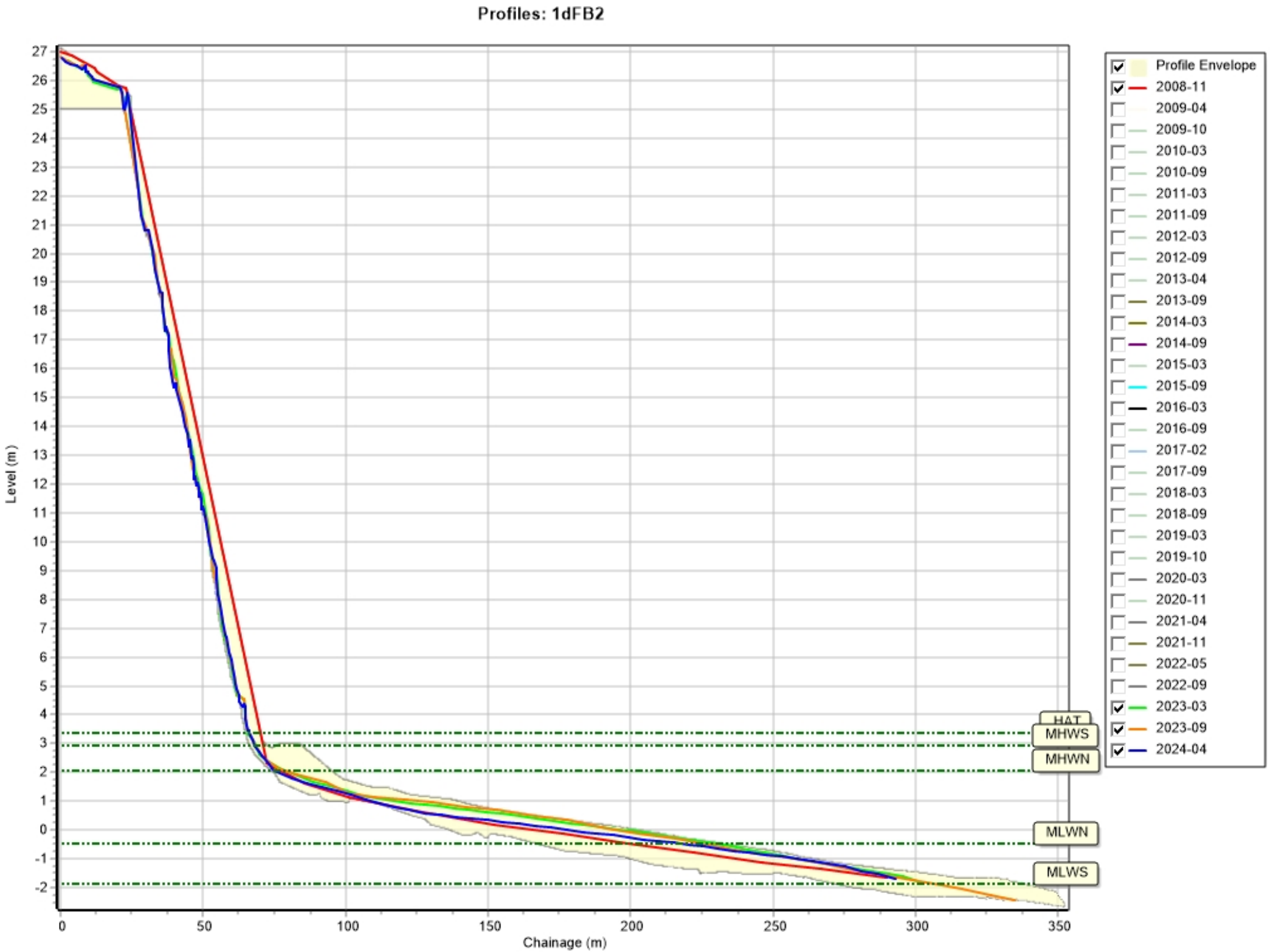
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12
11
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9
8
7
6
5
4
3
2
1
0
-1
-2
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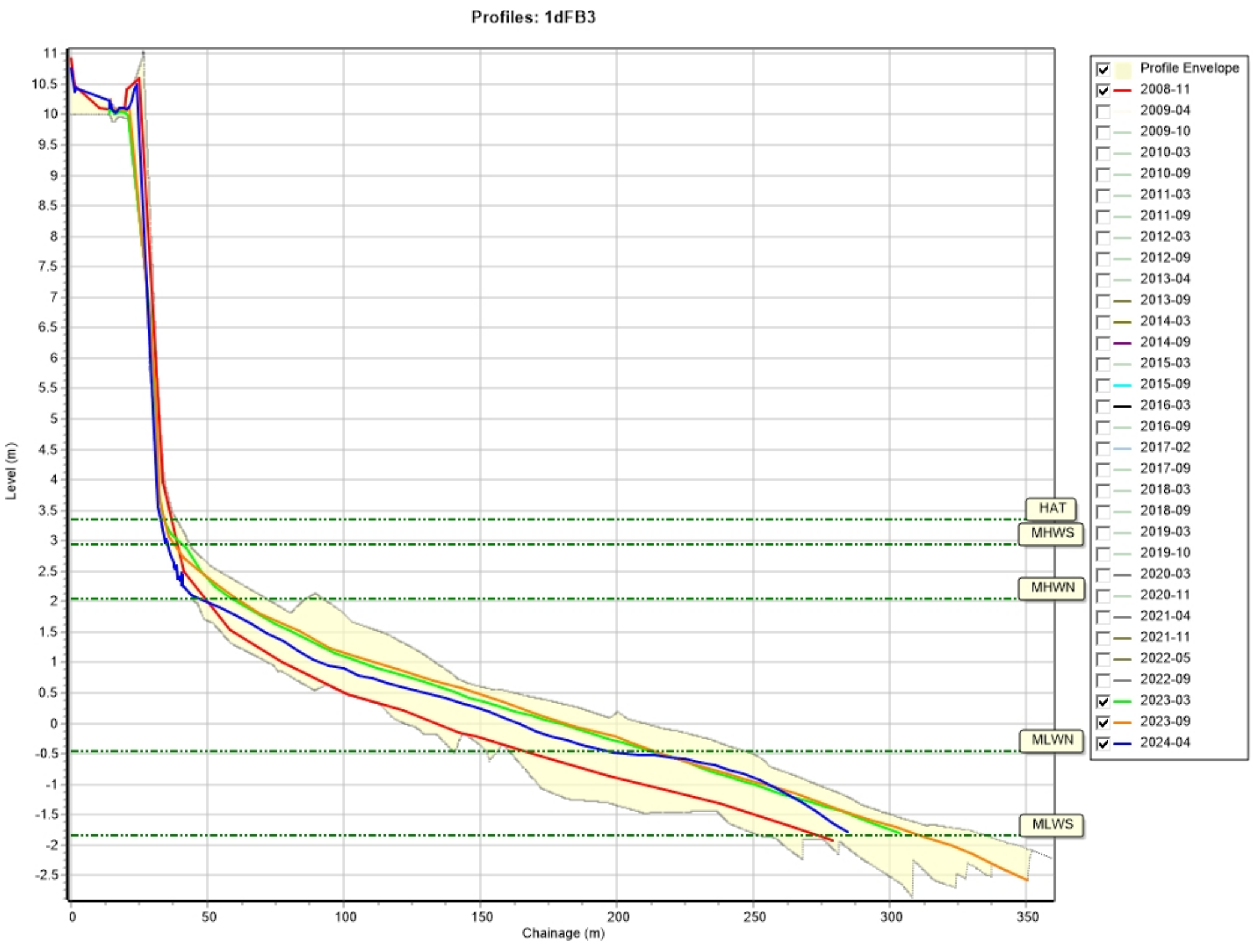
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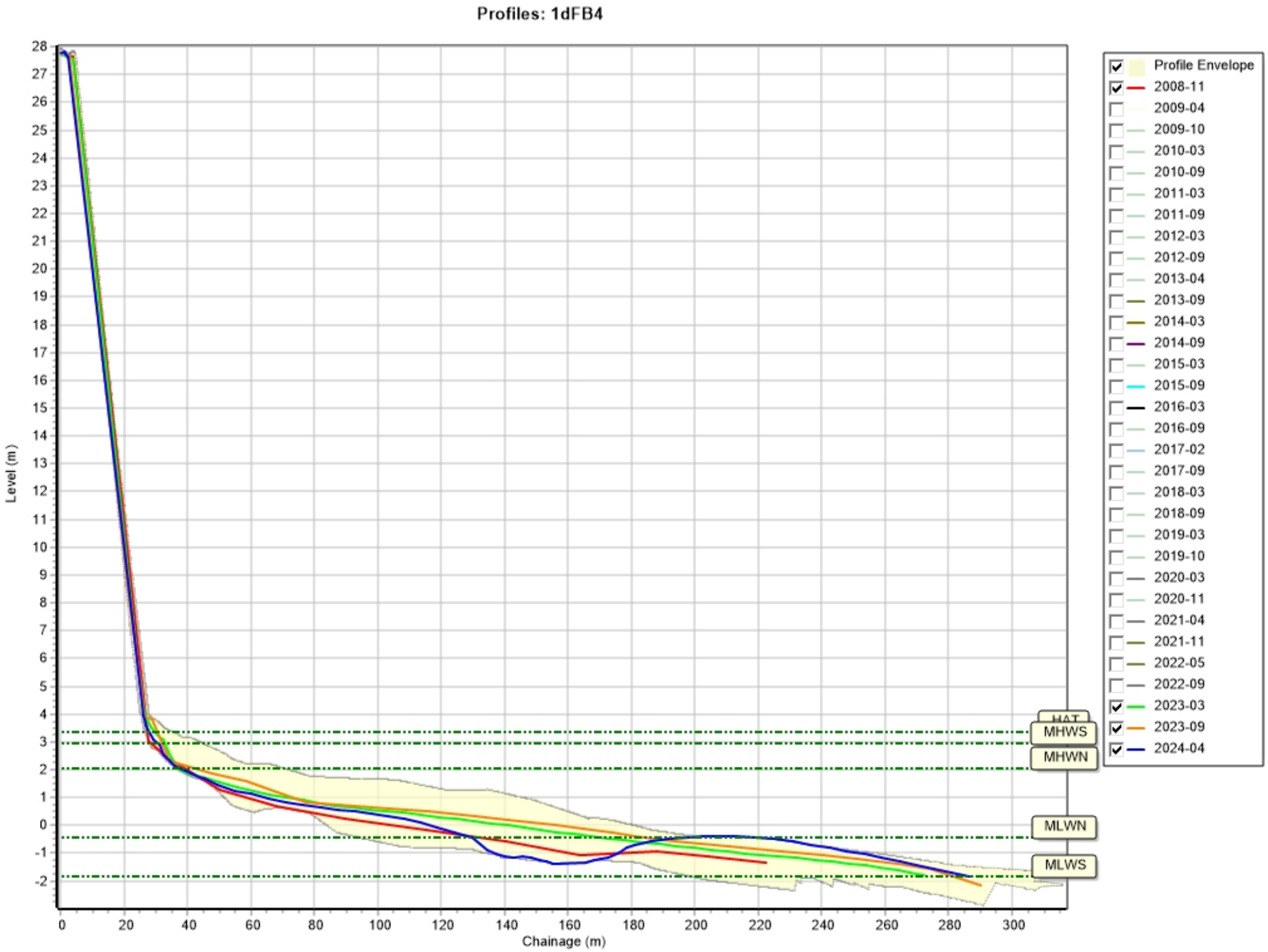
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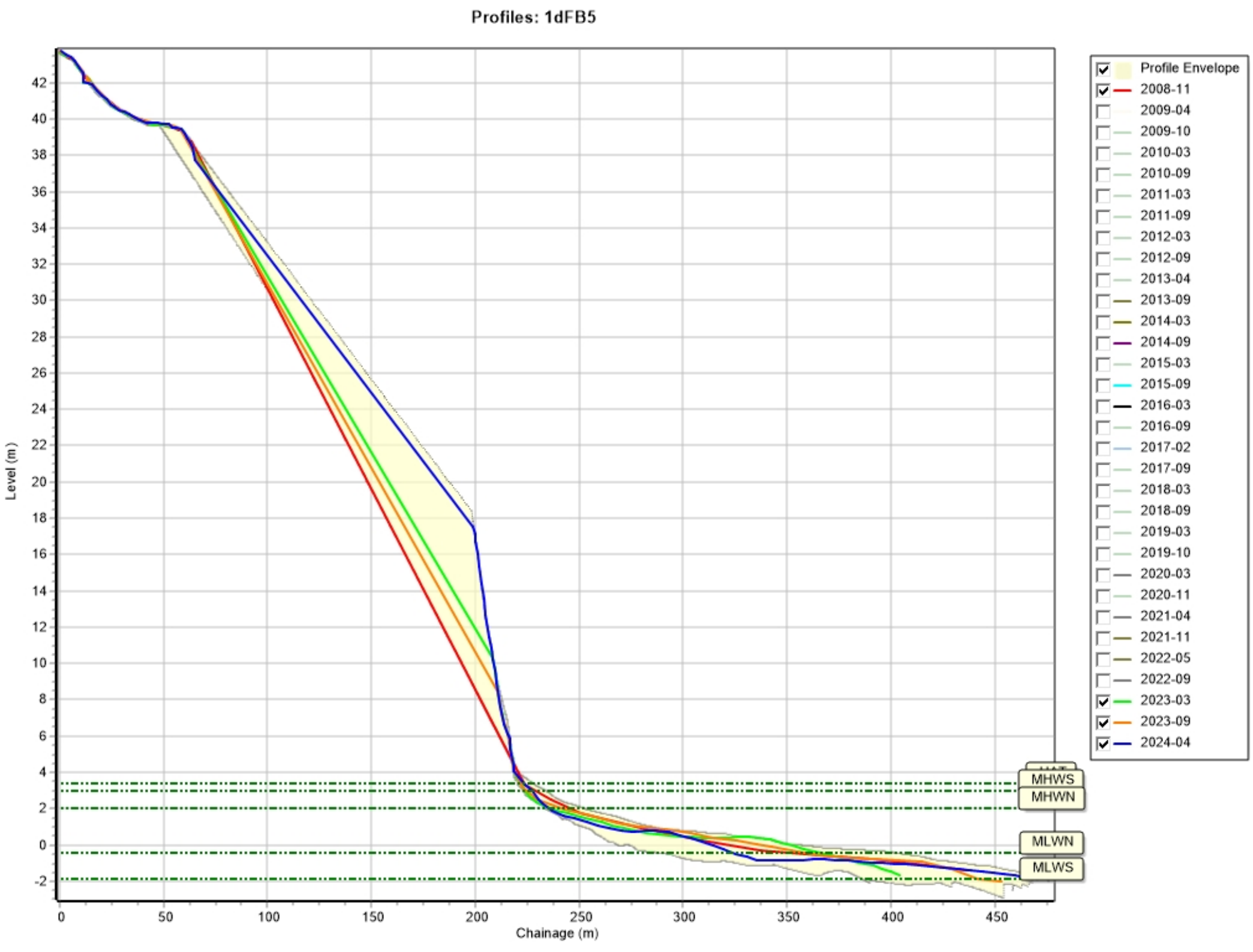
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22
20
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14
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10
8
6
4
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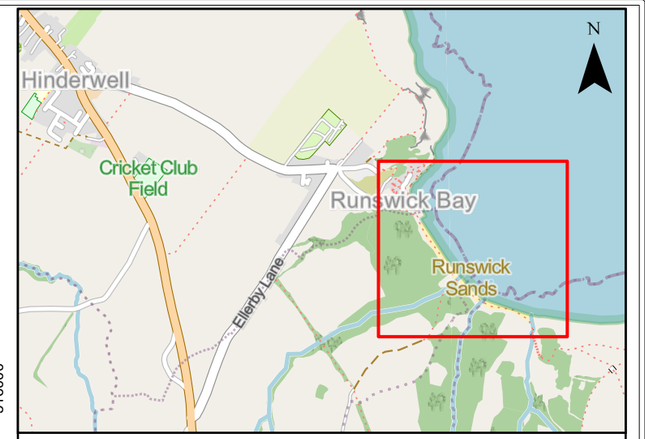
Appendix B

Topographic Survey



TOPOGRAPHIC SURVEY (February 2024)

Elevation (mOD)

- -2 - -2
- -1.9 - -1.5
- -1.4 - -1
- -0.9 - -0.5
- -0.4 - 0
- 0.1 - 0.5
- 0.6 - 1
- 1.1 - 1.5
- 1.6 - 2
- 2.1 - 2.5
- 2.6 - 3
- 3.1 - 3.5
- 3.6 - 4
- 4.1 - 4.5
- 4.6 - 5
- 5.1 - 5.5
- 5.6 - 6
- 6.1 - 6.5

Contours (mOD)*

- 1.0m interval
- 0.25m interval

* Contours only cover sandy beach areas.

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

Title:

Appendix B - Map 1

RUNSWICK BAY

North Yorkshire Council

Report:

Update Report
'Partial Measures' Survey 2024

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	08/05/2024	TC	NJC	A3	1:3,000

Co-ordinate system: British National Grid

Royal HaskoningDHV
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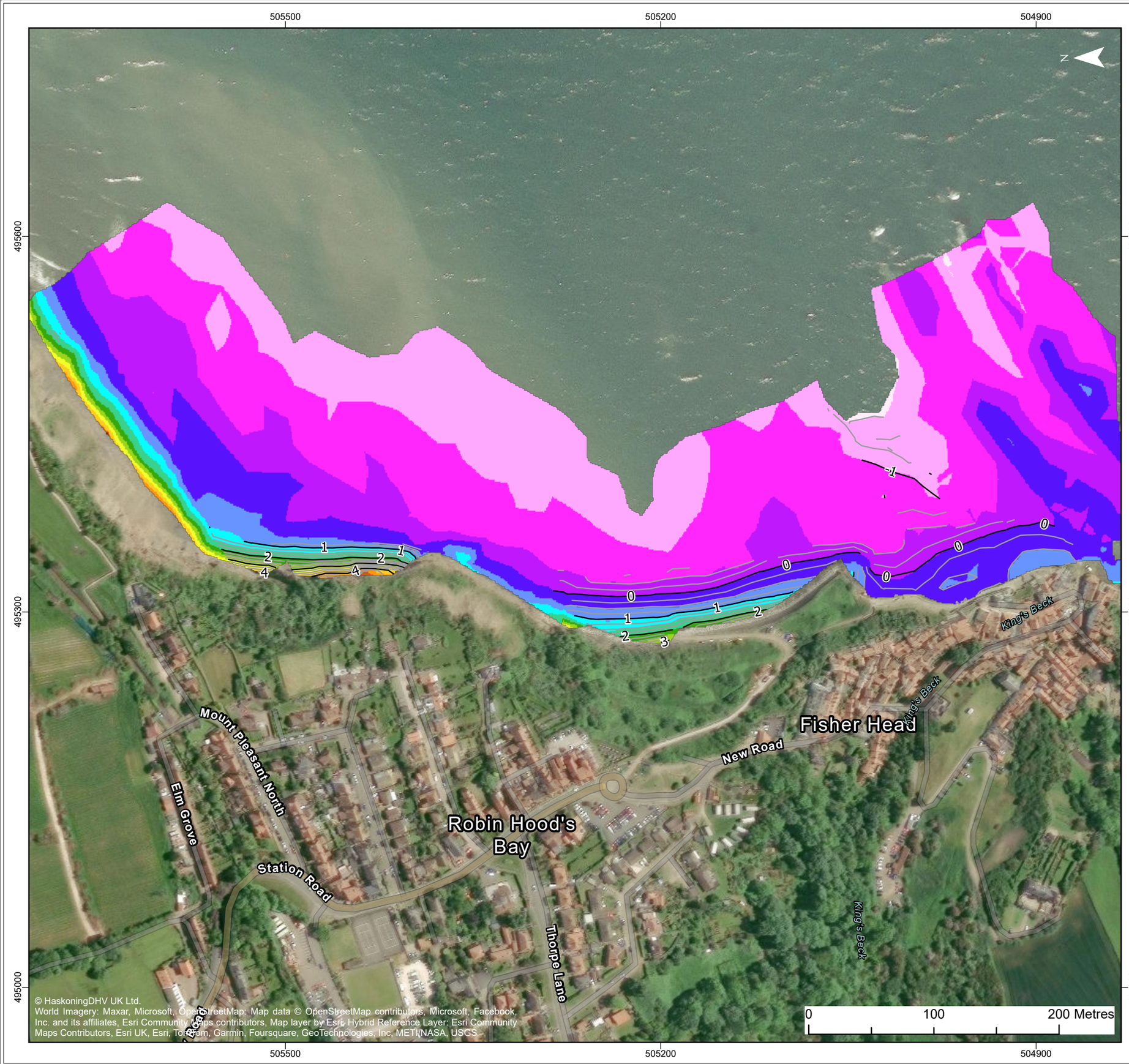
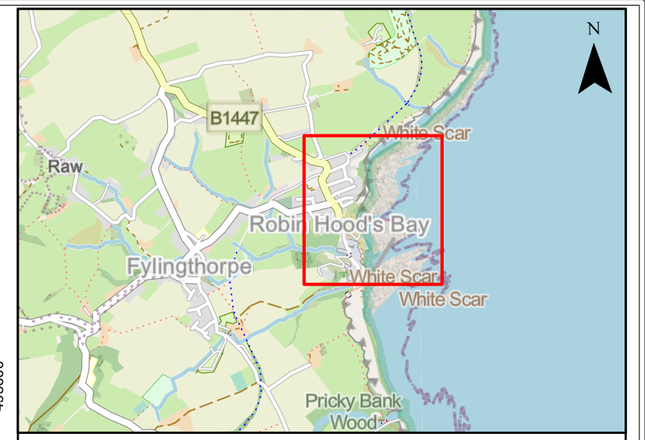
North East Coastal Observatory





TOPOGRAPHIC SURVEY (March 2024)

Elevation (mOD)

- -1.5 - -1.5
- -1.4 - -1
- -0.9 - -0.5
- -0.4 - 0
- 0.1 - 0.5
- 0.6 - 1
- 1.1 - 1.5
- 1.6 - 2
- 2.1 - 2.5
- 2.6 - 3
- 3.1 - 3.5
- 3.6 - 4
- 4.1 - 4.5
- 4.6 - 5
- 5.1 - 5.5

Contours (mOD)*

- 1.0m interval
- 0.25m interval

* Contours only cover sandy beach areas.

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

Title:

Appendix B - Map 2

ROBIN HOOD'S BAY

North Yorkshire Council

Report:

Update Report
'Partial Measures' Survey 2024

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate system: British National Grid

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TOPOGRAPHIC SURVEY (April 2024)

Elevation (mOD)

- -1.8 - -1.5
- -1.4 - -1
- -0.9 - -0.5
- -0.4 - 0
- 0.1 - 0.5
- 0.6 - 1
- 1.1 - 1.5
- 1.6 - 2
- 2.1 - 2.5
- 2.6 - 3
- 3.1 - 3.5
- 3.6 - 4
- 4.1 - 4.5

Contours (mOD)*

- 1.0m interval
- 0.25m interval

* Contours only cover sandy beach areas.

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

Title:

Appendix B - Map 3

FILEY

North Yorkshire Council

Report:

Update Report
'Partial Measures' Survey 2024

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate system: British National Grid

Royal HaskoningDHV
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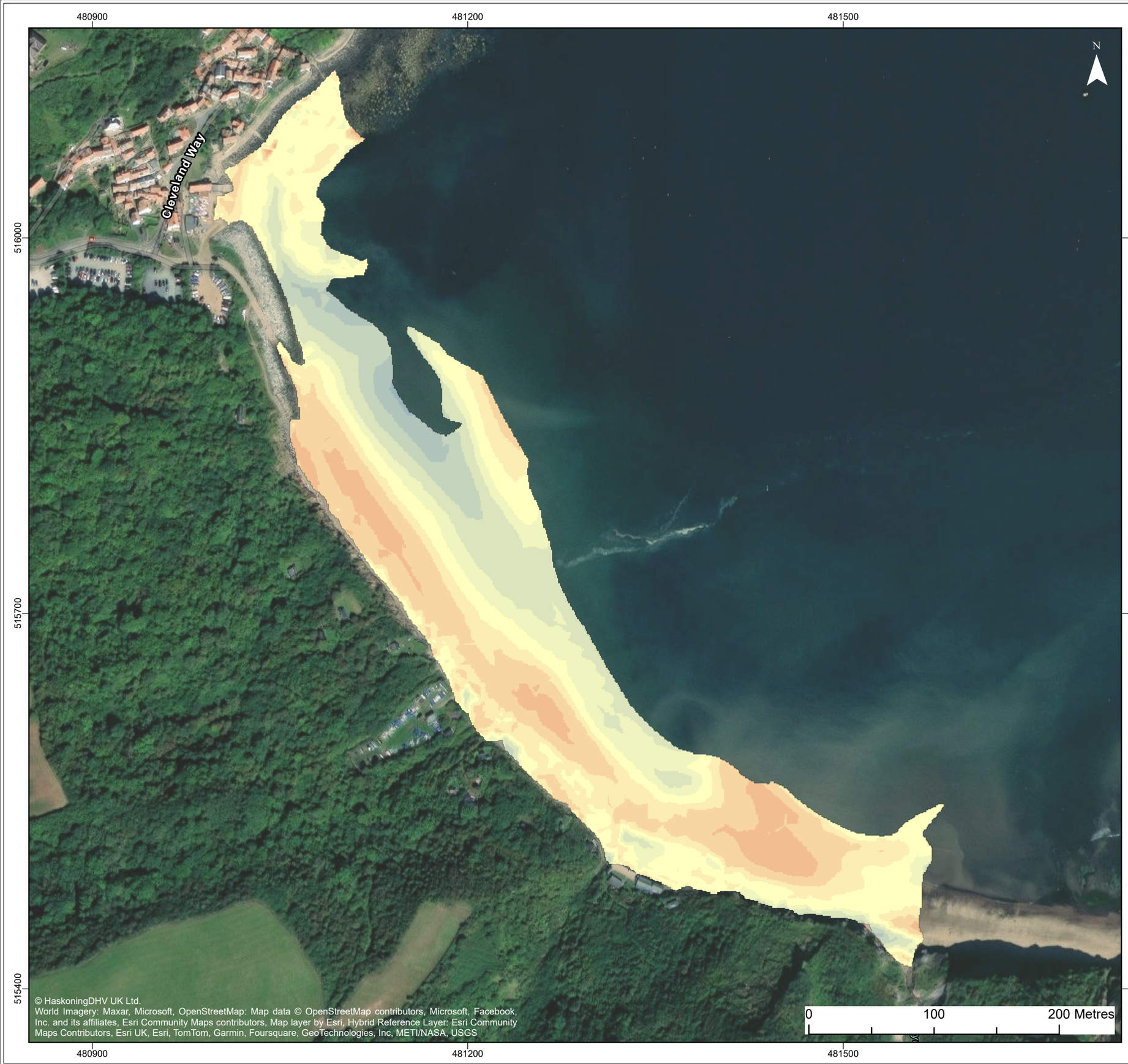
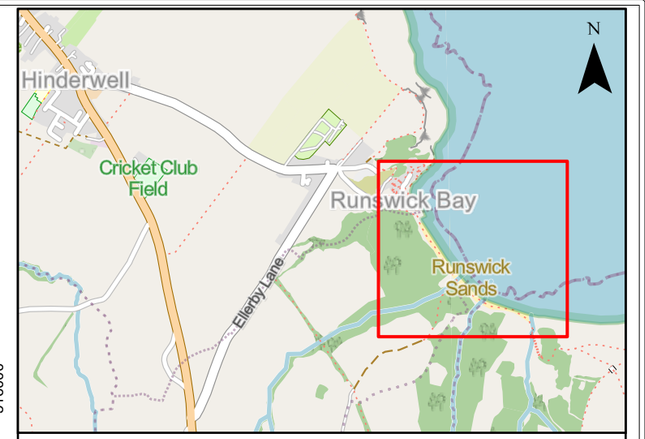
North East Coastal Observatory





Difference between topographic surveys
(Aug 2023 to Feb 2024)
Change in Elevation (mOD)

Gain	>2.0
	1.75 - 2
	1.5 - 1.75
	1.25 - 1.5
	1 - 1.25
	0.75 - 1
	0.5 - 0.75
	0.25 - 0.5
	0.1 - 0.25
Change +/- 0.1m	0 - 0.1
	-0.1 - 0
Loss	-0.25 - -0.1
	-0.5 - -0.25
	-0.75 - -0.5
	-1 - -0.75
	-1.25 - -1
	-1.5 - -1.25
	-1.75 - -1.5
	-2 - -1.75
	<-2

Client:
North East Coastal Group

Project:
Cell 1 Regional Coastal Monitoring Programme

Title:
Appendix B - Map 4

RUNSWICK BAY

North Yorkshire Council

Report:
Update Report
'Partial Measures' Survey 2024

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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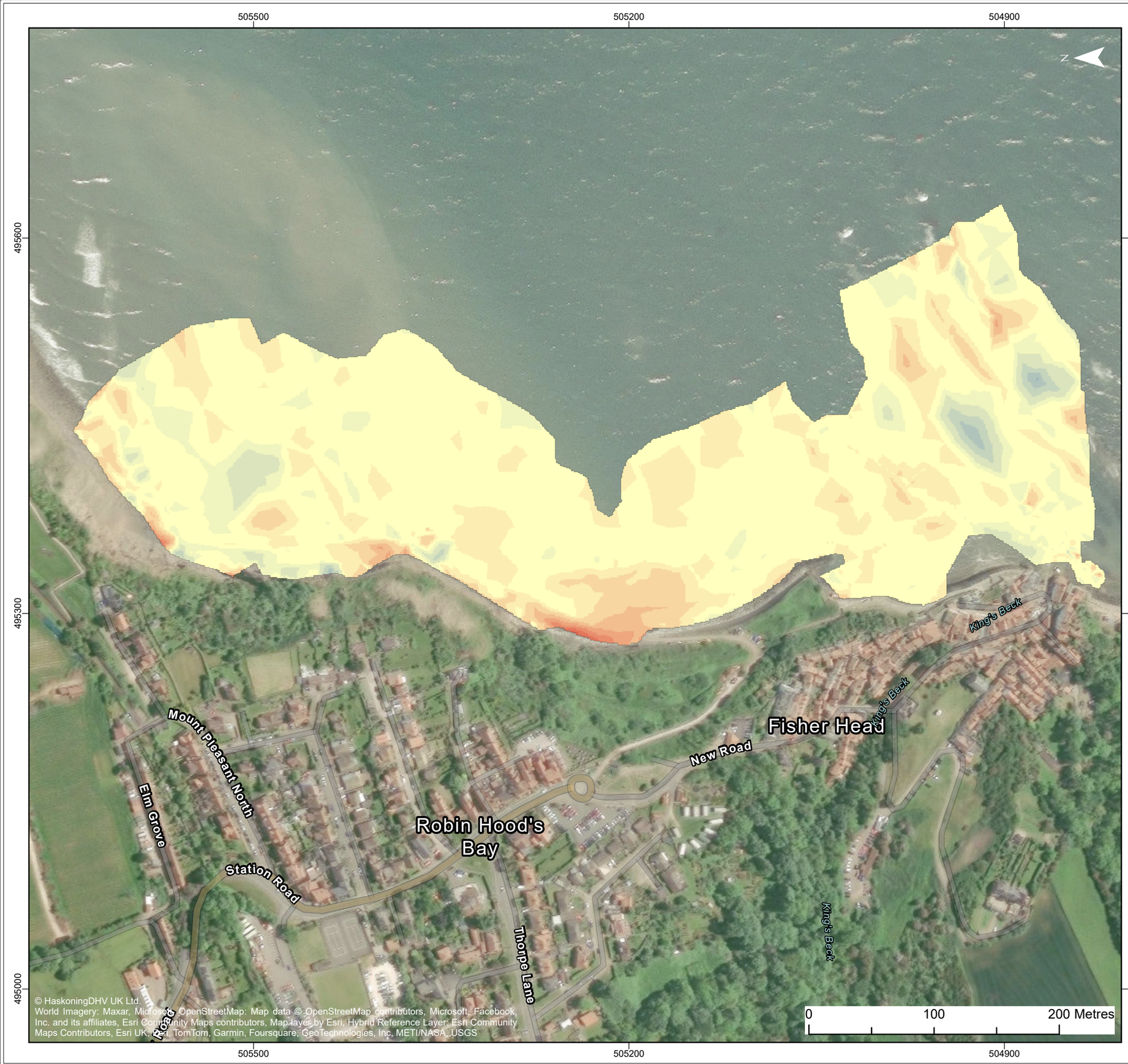
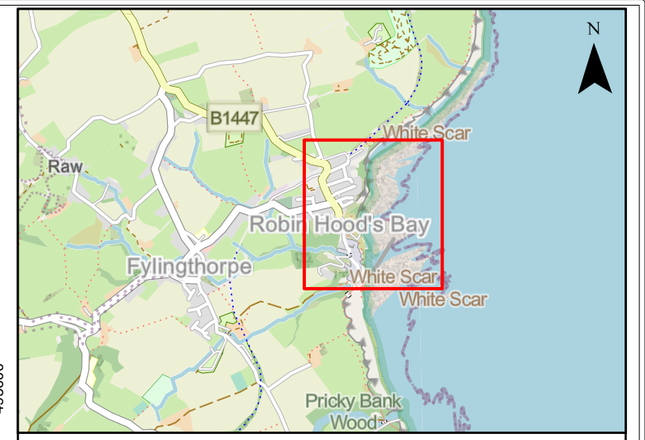
Co-ordinate system: British National Grid

Royal HaskoningDHV
Enhancing Society Together

North East Coastal Observatory





Difference between topographic surveys
(Aug 2023 to March 2024)
Change in Elevation (mOD)

Gain	>2.0
	1.75 - 2
	1.5 - 1.75
	1.25 - 1.5
	1 - 1.25
	0.75 - 1
	0.5 - 0.75
	0.25 - 0.5
	0.1 - 0.25
Change +/- 0.1m	0 - 0.1
	-0.1 - 0
	-0.25 - -0.1
	-0.5 - -0.25
	-0.75 - -0.5
	-1 - -0.75
	-1.25 - -1
Loss	-1.5 - -1.25
	-1.75 - -1.5
	-2 - -1.75
	<-2

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

Title:

Appendix B - Map 5

ROBIN HOOD'S BAY

North Yorkshire Council

Report:
Update Report
'Partial Measures' Survey 2024

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate system: British National Grid

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North East Coastal Observatory

Difference between topographic surveys
(Sept 2023 to Apr 2024)
Change in Elevation (mOD)

Gain	>2.0
	1.75 - 2
	1.5 - 1.75
	1.25 - 1.5
	1 - 1.25
	0.75 - 1
	0.5 - 0.75
	0.25 - 0.5
	0.1 - 0.25
Change +/- 0.1m	0 - 0.1
	-0.1 - 0
Loss	-0.25 - -0.1
	-0.5 - -0.25
	-0.75 - -0.5
	-1 - -0.75
	-1.25 - -1
	-1.5 - -1.25
	-1.75 - -1.5
	-2 - -1.75
	<-2

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme

Title:

Appendix B - Map 6

FILEY

North Yorkshire Council

Report: Update Report 'Partial Measures' Survey 2024

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	08/05/2024	TC	NJC	A3	1:5,000

Co-ordinate system: British National Grid

Royal HaskoningDHV
Enhancing Society Together

North East Coastal Observatory

Appendix C

Cliff Top Survey

Cliff Top Survey

Staithes

Twenty ground control points have been established at Staithes (Figure C1). The maximum separation between any two points is nominally.
100m.

The cliff top surveys at Staithes 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 C1 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 C1 – Cliff Top Surveys at Staithes

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
STAITHES				Nov 2008	Sep 2023	Mar 2024	Nov 2008 - Mar 2024	Sep 2023 - Mar 2024	Nov 2008 - Mar 2024
1	477228	518769	320	1.90	-5.70	-5.80	7.70	0.10	0.48
2	477334	518798	0	10.90	10.66	10.66	0.24	0.00	0.02
3	477487	518789	350	7.10	8.03	8.01	-0.91	0.02	0.00
4	477594	518801	340	5.90	3.62	3.47	2.43	0.15	0.15
5	477683	518911	350	8.40	8.52	8.53	-0.13	-0.01	0.00
6	477792	518867	30	8.60	8.63	8.54	0.06	0.09	0.00
7	477891	518828	60	7.70	7.23	7.20	0.50	0.03	0.03
8	477959	518873	350	8.70	8.39	8.42	0.28	-0.03	0.02
9	478088	518950	350	7.60	8.05	8.03	-0.43	0.02	0.00
10	478191	519023	340	8.40	8.66	8.62	-0.22	0.04	0.00
11	478237	519007	60	6.90	6.56	6.56	0.34	0.00	0.02
12	478213	518988	150	6.10	6.17	6.16	-0.06	0.01	0.00
13	478501	518809	15	11.40	8.24	8.22	3.18	0.02	0.20

14	478624	518807	20	7.50	7.30	7.28	0.22	0.02	0.01
15	478737	518858	60	6.10	6.12	6.13	-0.03	-0.01	0.00
16	478823	518757	60	8.00	8.41	8.41	-0.41	0.00	0.00
17	478944	518671	30	9.30	8.55	8.56	0.74	-0.01	0.05
18	479052	518630	20	9.20	9.05	9.03	0.17	0.02	0.01
19	479147	518610	0	14.20	13.67	13.66	0.54	0.01	0.03
20	479274	518618	20	11.40	10.95	10.96	0.44	-0.01	0.03

Cliff Top Survey

Robin Hoods Bay

Thirteen ground control points have been established at Robin Hoods Bay (Figure C2). The maximum separation between any two points varies along the coast, reflecting the degree of risk from the erosion. The cliff top surveys at Robin Hoods Bay 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 C2 provides baseline information about these ground control points and results from the 2010 (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 C2 – Cliff Top Surveys at Robin Hoods Bay

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
ROBIN HOODS BAY				Mar 2010	August 2023	March 2024	Mar 2010 - Mar 2024	Aug 2023 - March 2024	Mar 2010 - Mar 2024
1	495799.5	506002.2	130	11.60	6.17	6.11	5.49	0.06	0.39
2	495549.2	505807.3	135	9.30	8.97	8.96	0.34	0.01	0.02
3	495456.3	505740	130	5.00	5.04	5.02	-0.02	0.02	0.00
4	495389.9	505683.7	140	6.30	6.07	6.07	0.23	0.00	0.02
5	495259.4	505342.5	130	11.30	14.23	14.17	-2.87	0.06	0.00
6	495231.2	505315.7	95	5.90	5.71	5.68	0.22	0.03	0.02
7	495184.8	505210.7	85	6.40	UTS	7.47	-1.07	UTS	0.00
8	495206.5	505153	75	5.00	UTS	4.90	0.10	UTS	0.01
9	495287.8	505060.5	80	4.30	UTS	4.60	-0.30	UTS	0.00
10	495187.8	504708.8	70	3.10	1.92	1.96	1.14	-0.04	0.08
11	495226.2	504615.7	120	3.80	1.85	1.79	2.01	0.06	0.14
12	495297.5	504380.2	80	11.00	10.71	10.74	0.26	-0.03	0.02
13	495350.4	504193	55	3.70	3.67	3.69	0.01	-0.02	0.00

Cliff Top Survey

Scarborough South Bay

Thirteen ground control points have been established at Scarborough South Bay (Figure C3). The maximum separation between any two points varies along the coast, reflecting the degree of risk from the erosion. The cliff top surveys at Scarborough South Bay 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 C3 provides baseline information about these ground control points and results from the 2010 (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 C3 – Cliff Top Surveys at Scarborough South Bay

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
SCARBOROUGH SOUTH BAY				Mar 2010	Sep 2023	April 2024	Mar 2010 - April 2024	Sep 2023 - April 2024	Mar 2010 - April 2024
1	504339.5	487887.3	70	7.00	6.96	6.91	0.09	0.05	0.01
2	504422.3	487603.7	80	4.80	4.81	4.80	0.00	0.01	0.00
3	504534.8	487318.3	40	15.10	14.96	14.96	0.14	0.00	0.01
4	504730.2	487137.9	55	9.60	9.56	9.56	0.04	0.00	0.00
5	504922.9	486837.8	60	8.80	8.48	8.47	0.33	0.01	0.02
6	50571.1	486652.1	75	3.80	3.64	3.65	0.15	-0.01	0.01
7	505284.3	486480	35	7.00	6.61	6.61	0.39	0.00	0.03
8	505597.9	486363.4	30	8.60	8.19	8.18	0.42	0.01	0.03
9	505758.6	486005.1	45	9.10	8.44	8.42	0.68	0.02	0.05
10	505896	485889.6	15	14.80	14.61	14.66	0.14	-0.05	0.01
11	505990	485657.1	80	4.70	0.97	0.98	3.72	-0.01	0.27
12	506024.9	485421.8	55	6.10	3.03	3.13	2.97	-0.10	0.21
13	506036	485315.3	90	7.00	6.49	6.86	0.14	-0.37	0.01

Cliff Top Survey

Cayton Bay

Eight ground control points have been established at Cayton Bay (Figure C4). The maximum separation between any two points varies along the coast, reflecting the degree of risk from the erosion.

The cliff top surveys at Cayton Bay 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 C4 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 C4 – Cliff Top Surveys at Cayton Bay

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
CAYTON BAY				Nov 2008	Sep 2023	April 2024	Nov 2008 - April 2024	May 2023 - April 2024	Nov 2008 - April 2024
1	506325.5	484849.7	50	4.00	3.41	3.40	0.60	0.01	0.04
2	506459.4	484715.9	65	5.00	UTS	UTS	UTS	UTS	UTS
3	506597.4	484538.6	65	5.00	5.43	5.44	-0.44	-0.01	0.00
4	506778.1	484345.5	21	9.00	4.60	5.61	3.39	-1.01	0.21
5	507018.6	484221.6	342	7.70	7.92	7.87	-0.17	0.05	0.00
6	507242.3	484121.7	2	7.40	5.77	5.77	1.63	0.00	0.10
7	507518.2	484008.2	25	7.50	7.35	7.31	0.19	0.04	0.01
8	507818.7	484006	1	5.50	5.47	5.45	0.05	0.02	0.00

Cliff Top Survey

Filey Bay

Twenty-eight ground control points have been established in Filey Bay (Figure C5 and C6). The maximum separation between any two points varies along the coast, reflecting the degree of risk from the erosion.

The cliff top surveys at Filey Bay 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 C5 provides baseline information about these ground control points and results from the 2008 (baseline) (and 2011 baseline for profiles 12A and 24-27) 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 C5 – Cliff Top Surveys in Filey Bay

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
FILEY				Nov 2008	Sep 2023	April 2024	Nov 2008 - April 2024	Sept 2023 - April 2024	Nov 2008 - April 2024
1	512444.9	481630.9	130	8.70	8.28	8.29	0.41	-0.01	0.03
2	512306.7	481490.3	144	7.60	7.71	7.67	-0.07	0.04	0.00
3	512153.6	481234.6	122	8.30	8.12	7.52	0.78	0.60	0.05
4	512029.2	480959.9	115	7.40	7.14	7.12	0.28	0.02	0.02
5	511895.4	479888	89	7.10	UTS	UTS	UTS	UTS	UTS
6	511908.5	479597.1	48	6.70	5.37	5.38	1.32	-0.01	0.08
7	511991.4	479310.4	69	6.70	0.74	0.72	5.98	0.02	0.37
8	512083.4	478981.5	66	10.20	10.29	UTS	UTS	UTS	UTS
9	512121.3	478786.3	76	8.30	8.14	8.14	0.16	0.00	0.01
10	512226.2	478547.9	74	7.50	5.68	5.69	1.81	-0.01	0.11
11	512471.4	478153.5	53	6.60	6.62	6.65	-0.05	-0.03	0.00
12*	512558.9	477901.9	66	7.70	UTS	UTS	UTS	UTS	UTS
12A*	512655.8	477822.4	67	13.90	UTS	UTS	UTS	UTS	UTS
13**	512697.6	477719	34	4.20	UTS	UTS	UTS	UTS	UTS

13A*	512805.5	477572.1	32	13.42	9.62	8.46	4.96	1.16	0.31
14	512939.4	477400.9	66	8.00	6.12	6.21	1.79	-0.09	0.11
15	513157	477192.7	51	5.20	4.51	4.52	0.68	-0.01	0.04
16	513299.5	477024.6	30	7.70	5.69	5.68	2.02	0.01	0.13
17	513507.7	476821.1	34	10.70	9.94	9.13	1.57	0.81	0.10
18	513721	476602.3	31	7.20	5.85	5.61	1.59	0.24	0.10
19	513916.6	476354.1	51	6.60	6.20	6.19	0.41	0.01	0.03
20	514174.8	476179.4	32	7.00	4.51	6.07	0.93	-1.56	0.06
21	514471.5	475965.7	66	7.60	7.15	7.16	0.44	-0.01	0.03
22	514656.2	475728.8	101	8.10	6.74	6.74	1.36	0.00	0.09
23	514889.5	475537.6	60	9.10	7.17	7.15	1.95	0.02	0.12
24*	512603.7	481665.9	14	19.90	19.71	19.72	0.18	-0.01	0.01
25*	512607.1	481648.9	184	17.20	16.88	16.87	0.33	0.01	0.02
26*	512301.9	481825.5	18	11.00	10.68	10.67	0.33	0.01	0.02
27*	512475.8	481712.1	20	11.60	11.20	11.22	0.38	-0.02	0.02

NOTE: *baseline for 12A and 24-27 is March 2011
**Surveyor's report has previously stated that '*VMPs 5, 12 and 13 were inaccessible due to heavy vegetation.*'