



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



**Northumberland County
Council**

February 2024

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Abbreviations and Acronyms

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

Water Levels Used in Interpretation of Changes

Water Level Parameter	Water Level (m AOD)	Water Level (m AOD)	Water Level (m AOD)
	Berwick upon Tweed to Goswick Sands	Holy Island	Goswick Sands to Embleton Bay
HAT	2.8	3.1	3.1
MHWS	2.2	2.4	2.4
MHWN	1.3	1.3	1.3
MLWN	-1.3	-1.0	-0.9
MLWS	-1.8	-1.7	-1.6

Water Level Parameter	Water Level (m AOD)	Water Level (m AOD)
	Boulmer to Druridge Bay	Lynemouth Bay to Blyth South Beach
HAT	3.05	3.0
MHWS	2.35	2.4
MHWN	1.25	1.3
MLWN	-0.85	-0.9
MLWS	-1.75	-1.8

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.

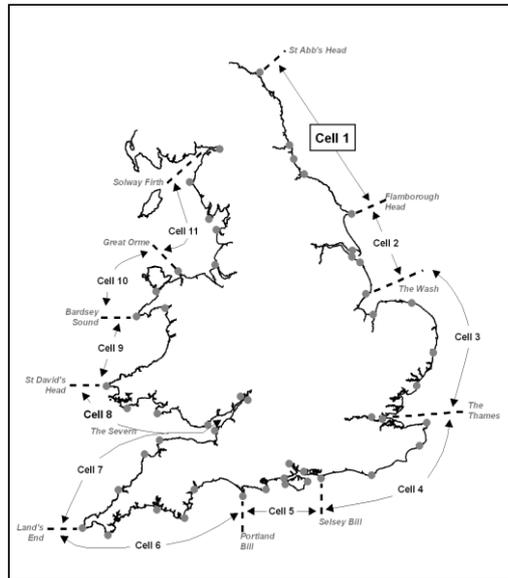


Figure 1 Sediment Cells in England and Wales

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 seabed 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.

Annually, 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	Oct-Nov 11	Oct 12	Mar-May 12	Feb13	
5	2012/13	Sep-Nov 12	Mar 13	Mar-Apr 13	Jun 13	
6	2013/14	Sep-Oct 13	Feb 14	Mar-Apr 14	Jul 14	
7	2014/15	Sep-Nov 14	Feb 15	Mar-Apr 15	Jul 15	
8	2015/16	Sep-Dec 15	Feb 16	Mar-May 16	Jul 16	Jun 16
9	2016/17	Aug-Nov 16	Mar 17	Feb-Apr 17	Jul 17	
10	2017/18	Sep-Dec 17	Mar 18	Feb-Apr 18	Jul 18	
11	2018/19	Sep-Dec 18	Feb 19	Feb-Apr 19	Jul 19	
12	2019/20	Aug-Dec 19	Mar 20	Mar-May 20	Jun 20	
13	2020/21	Oct-Dec 20	Feb 21	Mar 21	May 21	Aug 21
14	2021/22	Aug-Oct 21	Feb 22	Aug-Oct 22	Aug 22	
15	2022/23	Aug-Nov 22	Apr 23	Feb-Mar 23	Jul 23	
16	2023/24	Aug-Sep 23	Feb 24(*)			

(*) The present report is **Analytical Report 16** and provides an analysis of the 2023 Full Measures survey for Northumberland County 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 seabed sediment data collection, aerial photography, and walk-over visual inspections.

For purposes of analysis, the Cell 1 frontage has been split into the sub-sections listed in the **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
	Embelton 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)
	Staithes
Scarborough Borough Council	Staithes
	Runswick Bay
	Sandsend Beach, Upgang Beach and Whitby Sands
	Robin Hood's Bay
	Scarborough North Bay
	Scarborough South Bay
	Cayton Bay
	Filey Bay

1. Introduction

1.1 Study Area

Northumberland County Council's frontage extends from the Scottish border in the north to Hartley, just south of Blyth, in the south. For the purposes of this report and for consistency with previous reporting, it has been sub-divided into 15 areas, namely:

- Sandstell Point (Spittal A)
- Spittal (Spittal B)
- Goswick Sands
- Holy Island
- Bamburgh
- Beadnell Village
- Beadnell Bay
- Embleton Bay
- Boulmer
- Alnmouth Bay
- High Hauxley and Druridge Bay
- Lynemouth Bay
- Newbiggin-by-the-Sea
- Cambois
- Blyth South Beach

1.2 Methodology

Along the Northumberland frontage, the following surveying is undertaken:

Full Measures survey annually each autumn comprising:

- Beach profile surveys along 78 transect lines (commenced 2002)
- Beach profile surveys along an additional ten transect lines (commenced 2007)
- Beach profile surveys along an additional 26 transect lines (commenced 2010)
- Topographic survey along Holy Island (commenced 2004)
- Topographic survey along Alnmouth Bay (commenced 2005)
- Topographic survey along Sandstell Point (commenced 2009)
- Topographic survey along Lynemouth Bay (commenced 2020)
- Topographic survey along Newbiggin Bay (commenced 2010)

Partial Measures survey annually each spring comprising:

- Beach profile surveys along 29 transect lines (commenced 2002)
- Beach profile surveys along an additional ten transect lines (commenced 2007)
- Beach profile surveys along an additional one transect line (commenced 2010)
- Beach profile surveys along an additional two transect lines (commenced 2011)
- Topographic survey along Alnmouth Bay (commenced 2005)
- Topographic survey along Sandstell Point (commenced 2009)
- Topographic survey along Lynemouth Bay (to commence 2021)
- Topographic survey along Newbiggin Bay (commenced 2010)

Cliff top survey (bi-annually) at:

- Colliery spoil edge survey at Lynemouth Bay (commenced 2020)
- Cliff top survey at Newbiggin Point (commenced 2008)
- Cliff top survey at Cambois Bay (Sandy Bay) (commenced 2008)
- Cliff top survey at Cambois Bay (Cambois) (commenced 2009)

Sand extent survey (bi-annually) at:

- Edge of sand survey at Newbiggin Bay, Spital Carrs, (commenced 2011 to determine potential adverse impact on foreshore SSSI of the Newbiggin beach recharge scheme)

In addition to the above, laserscan surveys of the cliffs in Lynemouth have been undertaken on several occasions. These are reported separately to Northumberland County Council.

During late October / early November 2023, the UK was subject to a period of stormy weather where three named storms occurred within a 4-week period. To assess the impact of these storms on the coastline, a series of targeted Post Storm Beach Profile / Topographic / Cliff Top Recession Surveys were undertaken as part of the Cell 1 Regional Coastal Monitoring Programme at Cambois, Lynemouth and Newbiggin-by-the-Sea. These post-storm surveys have been used to supplement the Full Measures survey at these locations.

For all cliff-top surveys prior to Full Measures 2011, the data was previously saved in '.kmz' format for plotting and visual comparison in Google Earth. This data has been visualised in GIS, which revealed the quality was variable and reliable interpretations of short-term cliff change could not be made. For the present and future surveys, the data will be plotted in GIS and change will be qualified along a series of pre-defined transect lines. The resulting data on amount and rate of change is presented in tables and the survey results are compared.

The location of these surveys is shown in **Figure 2**. The Full Measures survey was undertaken on various dates along this frontage between 17th August and 19th September 2023. During this time, weather conditions varied considerably; refer to the survey reports for details of the weather conditions over this survey period.

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 website for storage and availability to others and 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 Edge Survey (Red line)
- Edge of Sand Survey (Yellow line)

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

Title:

Figure 2 - Map 1
SPITTAL A and B
Northumberland County Council Frontage

Report:

Survey Report

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	n/a	TC	NJC	A4	1:9,000

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 Edge Survey
- Edge of Sand Survey

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

Title:

Figure 2 - Map 2

GOSWICK SANDS

Northumberland County Council Frontage

Report:

Survey Report

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	n/a	TC	NJC	A4	1:35,000

Co-ordinate system: British National Grid

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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 Edge Survey (Red line)
- Edge of Sand Survey (Yellow line)

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

Title: **Figure 2 - Map 3**
HOLY ISLAND
Northumberland County Council Frontage

Report: **Survey Report**

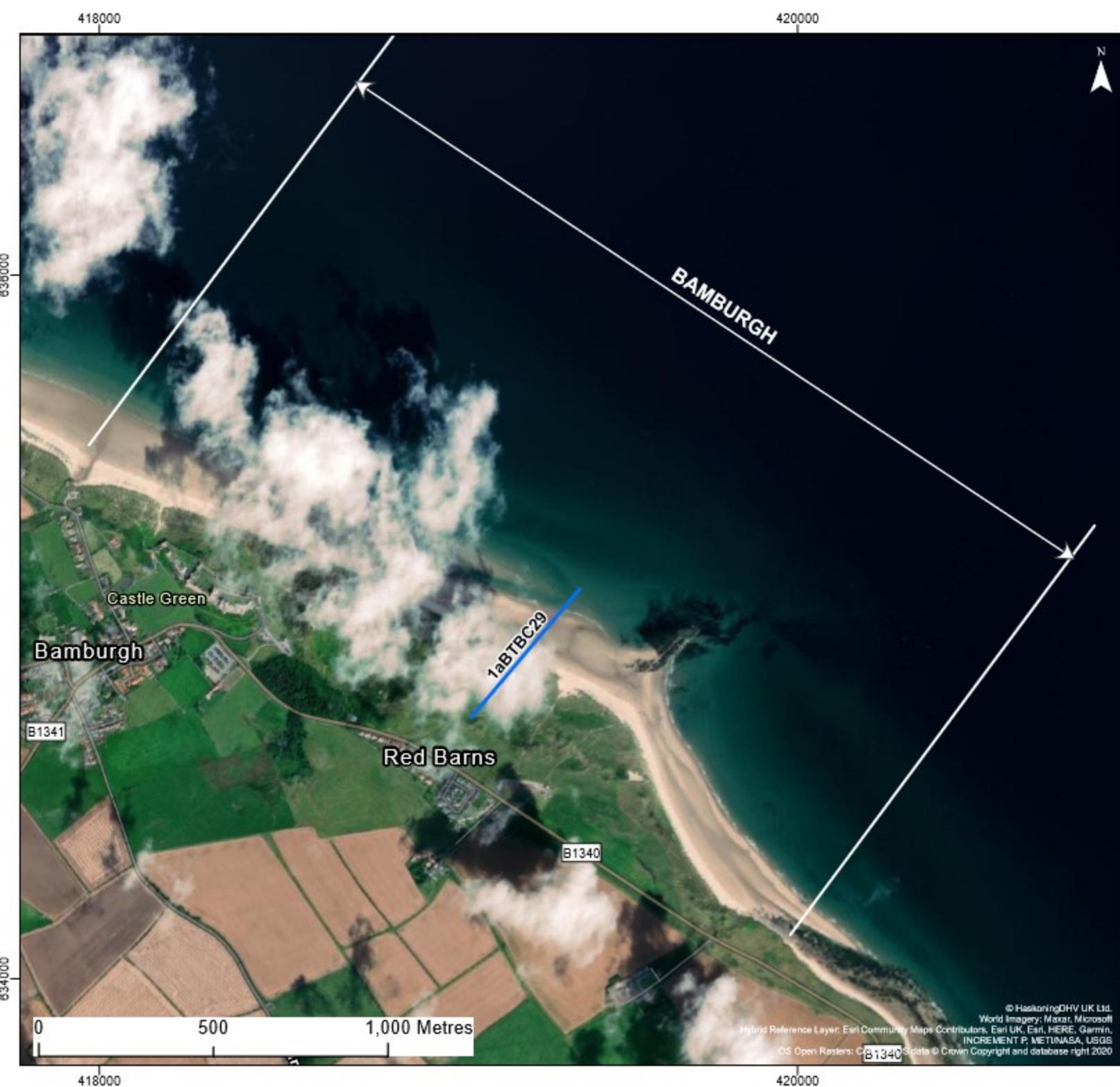
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Co-ordinate system: British National Grid

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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 Edge Survey (Red line)
- Edge of Sand Survey (Yellow line)

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

Title:

Figure 2 - Map 4

BAMBURGH

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

Topographic Area

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

- Cliff Top Edge Survey (Red line)
- Edge of Sand Survey (Yellow line)

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

Title:

Figure 2 - Map 5

BEADNELL VILLAGE AND BAY

Northumberland 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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SURVEY LOCATIONS

Topographic Profile

- Annual
- Bi-Annual

Topographic Area

- 6 monthly
- yearly
- 5 yearly

- Cliff Top Edge Survey
- Edge of Sand Survey

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

Title:

Figure 2 - Map 6

EMBLETON BAY

Northumberland County 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 Edge Survey
- Edge of Sand Survey

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

Title: **Figure 2 - Map 7**
BOULMER
Northumberland County Council Frontage

Report: **Survey Report**

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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SURVEY LOCATIONS

Topographic Profile

- Annual
- Bi-Annual

Topographic Area

- 6 monthly
- yearly
- 5 yearly

- Cliff Top Edge Survey
- Edge of Sand Survey

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

Title: **Figure 2 - Map 8**
ALNMOUTH BAY
Northumberland County Council Frontage

Report: **Survey Report**

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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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 Edge Survey (Red line)
- Edge of Sand Survey (Yellow line)

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

Title: **Figure 2 - Map 9**
HIGH HAUXLEY AND DRURIDGE BAY (NORTH)
Northumberland County 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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SURVEY LOCATIONS

Topographic Profile

- Annual
- Bi-Annual

Topographic Area

- 6 monthly
- yearly
- 5 yearly

- Cliff Top Edge Survey
- Edge of Sand Survey

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

Title: **Figure 2 - Map 11**
HIGH HAUXLEY AND DRURIDGE BAY (SOUTH)
Northumberland County Council Frontage

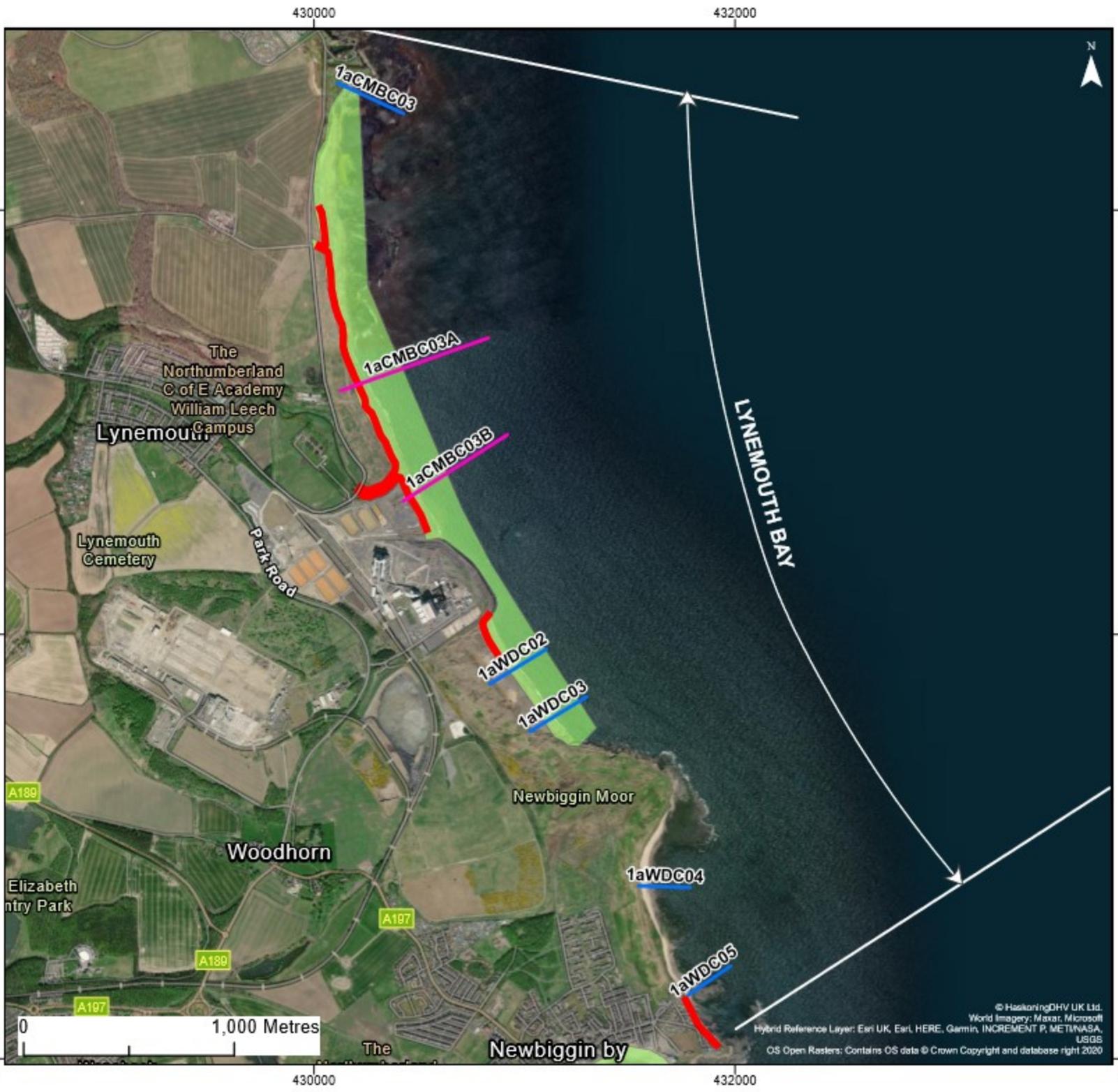
Report: **Survey Report**

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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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 Edge Survey (Red line)
- Edge of Sand Survey (Yellow line)

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

Title:

Figure 2 - Map 10

LYNEMOUTH BAY

Northumberland County Council Frontage

Report:

Survey Report

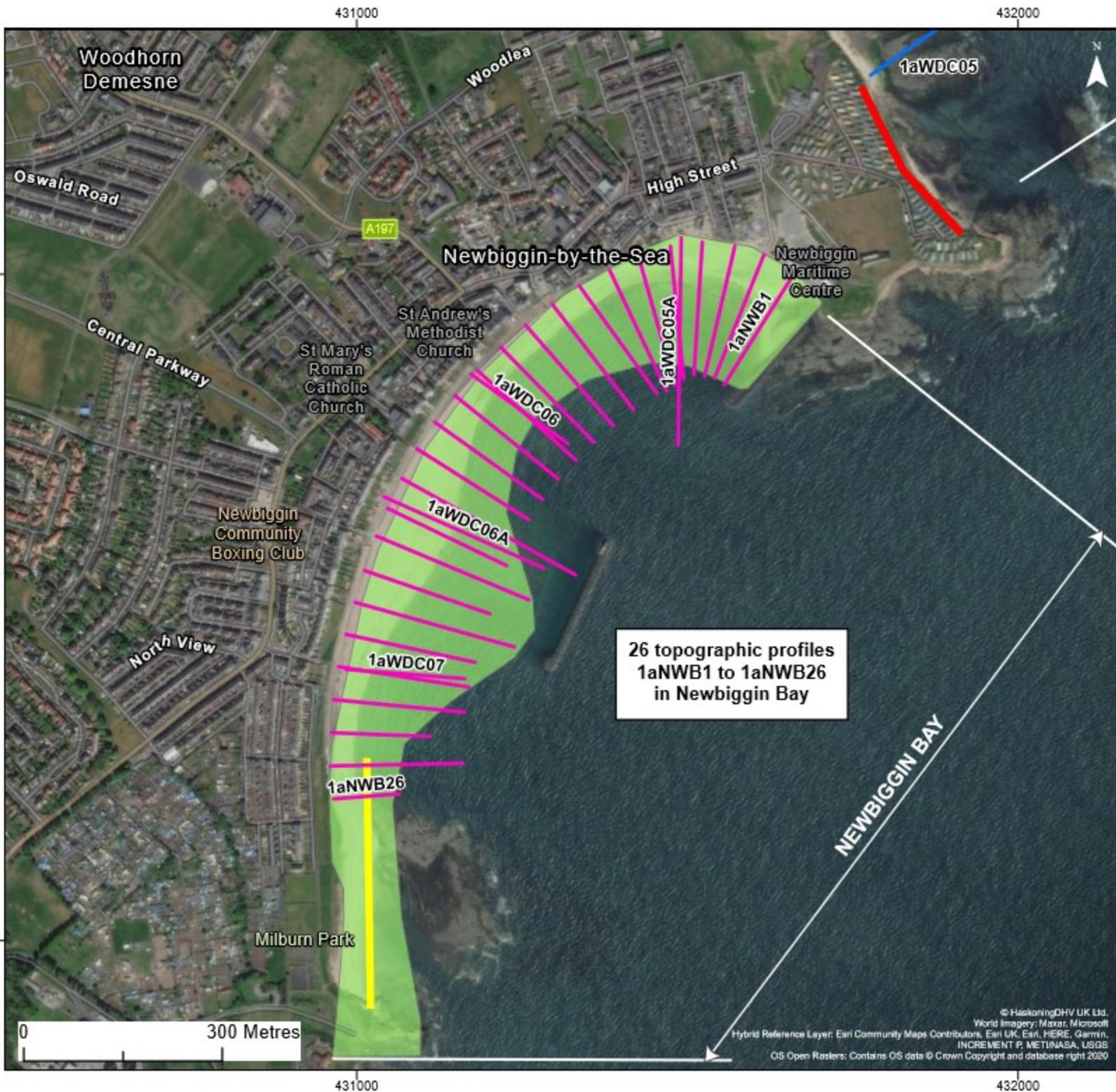
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SURVEY LOCATIONS

Topographic Profile

- Annual
- Bi-Annual

Topographic Area

- 6 monthly
- yearly
- 5 yearly

- Cliff Top Edge Survey
- Edge of Sand Survey

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

Title:

Figure 2 - Map 12

NEWBIGGIN BAY

Northumberland County Council Frontage

Report:

Survey Report

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	n/a	TC	NJC	A4	1:8,000

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 Edge Survey
- Edge of Sand Survey

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

Title: **Figure 2 - Map 13**
CAMBOIS BAY
Northumberland 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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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 Edge Survey (Red line)
- Edge of Sand Survey (Yellow line)

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

Title:

Figure 2 - Map 14

BLYTH SOUTH BEACH

Northumberland 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

Royal HaskoningDHV
Enhancing Society Together

North East Coastal Observatory

2. Analysis of Survey Data

2.1 Sandstell Point (Spittal A)

Survey Date	Description of Changes Since Last Survey	Interpretation
17 th August 2023	<p>Beach Profiles:</p> <p>Sandstell Point is covered by ten beach profile lines for the Full Measures survey (Appendix A). Profiles 1aBTBC02, 1aBTBC04, 1aBTBC05, and 1aBTBC06 were last surveyed during the Partial Measures Spring survey, 2023. Profiles 1aBTBC01, 1aBTBC03, and 1aBTBC7 to 10 were last surveyed during the Full Measures autumn survey 2022.</p> <p>Profiles 1aBTBC01 to 1aBTBC03 are located on the southern bank of the River Tweed in front of the dunes.</p> <p>At 1aBTBC01, the dunes have remained mostly stable, with only small sections of erosion and accretion occurring by up to ±0.1m. The crest of the foredune has risen by up to 0.2m. The face of the foredune has retreated landward by a further 0.2m since the previous survey. The beach from the toe of the dune to chainage 51m has risen by less than 0.1m, whilst the middle and lower beach has lowered by up to 0.2m. Overall, the profile is at a low level, particularly on the middle beach between chainages 52-59m which is at its lowest level recorded.</p> <p>At profile 1aBTBC02 the dunes have mostly risen, by up to 0.2m. The beach from the toe of the dune to chainage 58m has risen by up to 0.1m. The beach profile seaward of this point has lowered by up to 0.1m. The hollow present at chainage 35m has undergone negligible change since the previous survey. The back dunes are at a high level, whilst the foredune and rest of the beach profile are at a medium level compared to the range recorded from previous surveys.</p> <p>At profile 1aBTBC03, the dunes have mostly risen by up to 0.1m, however the face of the foredune has shown continuous retreat since November 2018. The upper beach profile has not changed since the previous survey, whilst the middle to lower beach has lowered by up to 0.2m. Overall, the dunes are at a medium-high level compared to the range recorded from previous surveys, whilst the beach is at a medium-low level.</p>	<p>Since the last survey, the dunes on the south bank of River Tweed have experienced a landward retreat of the dune face. The beach levels have generally lowered across this section, except on the upper beach of 1aBTBC01 and 1aBTBC02.</p> <p>The landward portion of the spit has widened in profile on the bottom of the spit but narrowed towards the top. The distal end of the spit has migrated slightly seaward but has maintained a similar height since the previous survey.</p> <p>The pattern in the profiles along the open coast generally show an alternating pattern of erosion and accretion across the profiles, associated with the seasonal migration of berms.</p> <p>Longer term trends: The dunes have generally remained stable since 2002 and are at a medium-high level compared to the range recorded from previous surveys. However, several profiles show a landward retreat of the dune face (1aBTBC01 and 1aBTBC03).</p> <p>Changes in beach levels are generally within the bounds of previous surveys.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>Profiles 1aBTBC04 (longitudinal section) and 1aBTBC05 and 1aBTBC06 (both cross-sections) cover the spit at Sandstell Point.</p> <p>At profile 1aBTBC04, there has been alternating sections of erosion and accretion across the beach profile. The upper beach from the toe of the dunes to chainage 130m has risen by up to 0.9m, forming a berm at chainage 110m. The middle beach between chainages 110-249m has lowered by up to 1.4m, switching to accretion between chainages 249-420m by up to 0.6m. The toe of the spit has shortened by up to 10m. The most landward portion of the profile is at a high level, whilst the rest of the spit is at a medium level.</p> <p>Profiles 1aBTBC05 and 1aBTBC06 are transects across the spit, with the open sea on the right-hand side of the plot and the river channel to the left.</p> <p>At 1aBTBC05, the crest of the spit has risen since the previous survey by up to 0.7m. The spit on the seaward side has undergone a small amount of erosion on the lower half by up to 0.3m. The spit on the riverside has slumped from the upper half to the lower half, with the erosion of up to 1.0m on the upper half and accretion of up to 0.8m on the lower half. Overall, the profile has narrowed at the top of the spit, and broadened on the bottom and remains in the middle range of surveys previously recorded.</p> <p>At profile 1aBTBC06, the spit structure has moved seaward by up to 60m, with little change in overall height. The riverside of the spit has mostly lowered since the previous profile by up to 0.9m. Overall, the spit profile is at a medium level compared to the range recorded from previous surveys and is in a seaward position compared to previous surveys.</p> <p>Profiles 1aBTBC07 to 1aBTBC10 are located along the open coast, at the intersection of the southern side of the spit at Sandstell Point and northern end of Spittal Beach.</p> <p>At profile 1aBTBC07, the beach profile has fluctuated between accretion and erosion. The upper beach has risen by up to 0.8m between chainage 24-50m, whilst the middle beach has lowered by up to 1.0m. The lower beach seaward of chainage 100m has risen by up to 1.0m. Overall, the dunes are at a high level, whilst the beach profile is at a medium level compared to the range recorded from previous surveys.</p> <p>At profile 1aBTBC08, there has been little change across the dunes to chainage 29m. The toe of the dunes has risen by up to 0.8m to chainage 55m. The middle-upper beach between chainages 55-</p>	

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>104m has lowered by up to 1.0m. The middle-lower beach has risen by up to 1.0m to chainage 175m before switching to erosion on the lower beach by up to 0.3m. Overall, the dunes are at a high level, whilst the beach profile is at a medium level compared to the range recorded on previous surveys.</p> <p>Profile 1aBTBC09 shows the dunes have risen by up to 0.1m. The beach from the toe of the dunes to chainage 51m has risen by up to 0.5m, switching to erosion between chainages 51-99m by up to 0.9m. The middle beach has risen by up to 0.8m to chainage 170m, before switching again to erosion on the lower beach by up to 0.4m. Overall, the dunes are at a high level and the beach is at a medium level compared to the range recorded on previous surveys.</p> <p>Profile 1aBTBC10 shows negligible change within the dunes to chainage 19m. The upper beach from the toe of the dunes to chainage 55m and the lower beach between chainages 100-190m has risen by up to 0.8m on the upper beach and up to 1.0m on the lower beach. The middle beach between chainages 55-100m has lowered by up to 0.6m. Overall, the beach is at a medium level compared to the range recorded in previous surveys, whilst the dunes are at a high level.</p>	
<p>Mar – Aug 2023</p>	<p>Topographic Survey:</p> <p>Due to the significant changes that have been observed from the beach profiles along the spit at Sandstell Point, and the three-dimensional nature of these changes, a topographic survey was introduced to the monitoring programme in November 2011. The previous survey was undertaken for the Partial Measures survey in spring 2023.</p> <p>Data from the most recent topographic survey (Full Measures, autumn 2023) have been used to create a digital ground model (DGM) (Appendix B – Map 1) using a Geographical Information System (GIS). A difference plot has also been produced using the DGM (Appendix B – Map 5) produced from the last topographic survey and the present survey.</p> <p>The difference plot for this survey generally shows; (i) little change in the dunes on the south bank of the River Tweed; (ii) parallel bands of alternating erosion and accretion from the centre of the spit to the seaward side, with high magnitude erosion found on the crest of the spit (2.0m); and (iii) high magnitude accretion on the distal end of the spit facing upstream.</p>	<p>Findings are similar to those seen between spring 2022 and autumn 2022.</p>

2.2 Spittal (Spittal B)

Survey Date	Description of Changes Since Last Survey	Interpretation
17 th Aug 2023	<p>Beach Profiles:</p> <p>Spittal B is covered by four beach profile lines for the Full Measures survey (Appendix A). Profiles 1aBTBC11 and 1aBTBC13 were last surveyed during the Partial Measures spring survey, 2023. Profiles 1aBTBC12 and 1aBTBC14 were last surveyed during the Full Measures autumn survey 2022.</p> <p>Profile 1aBTBC11 is located to the north of Spittal Beach. The upper and lower beach has risen by up to 0.6m on the upper beach and 0.7m on the lower beach. The middle beach between chainages 65-121m has lowered by up to 0.5m. Overall, the profile is at a medium-high level when compared with the range recorded from previous surveys.</p> <p>Profile 1aBTBC12 shows the beach profile has alternated between erosion and accretion. Accretion is generally located on the upper, middle-upper and middle-lower beach by up to 0.4m. Erosion is located across the middle beach and lower beach by up to 0.5m. Overall, the profile is at a medium level, except on the lower beach which has risen to a relatively high level compared to the range recorded from previous surveys.</p> <p>Profile 1aBTBC13 has risen on the upper and lower half of the beach by up to 0.9m. The middle beach between chainages 55-115m has lowered by up to 0.1m. Overall, the profile is at a medium-high level compared with the range recorded from previous surveys, particularly between chainages 130-157m which is at its highest level recorded.</p> <p>At profile 1aBTBC14, the beach profile has alternated between erosion and accretion. Accretion is predominantly found on the middle-upper and lower beach, rising by up to 0.6m. Erosion is predominantly found on the upper and middle beach by up to 0.5m. Overall, the beach is at a medium-high level compared to the range recorded from previous surveys, particularly between chainages 120-150m, which is at its highest level recorded.</p>	<p>Since the last survey, beach levels along Spittal have fluctuated, generally showing a steepening of the upper beach. The uppermost beach at 1aBTBC14 has recovered well since the extreme lows recorded in November 2018.</p> <p>Longer term trends: At all profile locations along Spittal Beach, the changes observed from the present survey are generally within the bounds of previous surveys. Several sections are now at their highest levels recorded (between chainages 130-157m at profile 1aBTBC13 and between chainages 120-150m at profile 1aBTBC14).</p>

2.3 Goswick Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
5 th Sept 2023	<p>Beach Profiles:</p> <p>Goswick Sands are covered by six beach profile lines for the Full Measures survey (Appendix A). Profiles 1aBTBC16 and 1aBTBC19 were last surveyed during the Partial Measures spring survey, 2022. Profiles 1aBTBC15, 1aBTBC17 to 1aBTBC18, and 1aBTBC20 were last surveyed during the Full Measures autumn survey, 2022.</p> <p>The profiles along this frontage extend from 1aBTBC15 to 1aBTBC20 in a north to south direction. The seaward face of the dunes along the survey extent at Goswick Sands (profiles 1aBTBC15 to 1aBTBC20) have remained stable.</p> <p>At profile 1aBTBC15, the dunes remain stable, with only short sections of erosion/accretion limited to $\pm 0.4\text{m}$. The majority of the beach profile has risen by up to 0.2m on the upper beach and up to 0.3m on the middle beach. The lower beach seaward of chainage 220m has lowered by up to 0.5m. Overall, the profile is at a high level compared to the range recorded from previous surveys.</p> <p>At profile 1aBTBC16, the dunes have remained stable with little change except at the dune toe which has lowered by up to 0.4m. The upper beach between chainages 45-100m has lowered by up to 0.3m. Seaward of this point, the beach has risen by up to 0.2-0.3m. Compared to the range recorded from previous surveys, the profile is at a high level in the dunes, and a medium level on the rest of the beach profile.</p> <p>At profile 1aBTBC17, the dunes have remained stable with little change occurring since the previous survey. The dune toe has risen by up to 0.6m to chainage 252m. The upper beach between chainages 252-286m has middle beach between chainages 325-395m has lowered by up to 0.8m, whilst the beach between chainages 286-325m and seaward of chainage 395m has risen by up to 0.4m. The dunes are at one of their highest levels recorded. The rest of the beach profile is at a medium-high level compared to the range recorded from previous surveys.</p> <p>At profile 1aBTBC18, the dunes have mostly lowered by up to 0.2m. The upper beach between chainages 210-450m has lowered by up to 0.2m. A berm has formed at chainage 540m has risen by up to 1.4m. The beach between chainages 560-710m has lowered by up to 0.2m, before switching to accretion on the lower beach seaward of chainage 710m by up to 0.2m. Overall, the seaward dune</p>	<p>Beach levels have undergone variable change along the length of Goswick Sands since the last survey. At the southern end of Goswick Sands, the beach has remained stable with no discernible change to the profile form or position.</p> <p>Longer term trends: The majority of change is a continuation of seasonal behaviour. The notable barrier feature developed further seaward in profile 1aBTBC18 has risen to a similar height as seen in Autumn 2004 and more recently in Autumn 2019.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>face remains at one of its most seaward positions recorded. The rest of the beach is at a medium-high level recorded compared to the range recorded from previous surveys.</p> <p>At profile 1aBTBC19 there has been very little change across the profile, with erosion or accretion limited to $\pm 0.1\text{m}$. Overall, the beach is at a medium level compared to the range recorded from previous surveys.</p> <p>At 1aBTBC20, the dunes and beach profile have generally remained stable since the last survey, with accretion / erosion of $\pm 0.1\text{m}$. Overall, the beach is at a medium-high level across its length compared to the range recorded from previous surveys.</p>	

2.4 Holy Island

Survey Date	Description of Changes Since Last Survey	Interpretation
<p>22nd August 2023</p>	<p>Beach Profiles:</p> <p>Holy Island is covered by eight beach profile lines for the Full Measures surveys (Appendix A). Profiles 1aBTBC21 and 1aBTBC23 were last surveyed during the Partial Measures spring survey, 2023. Profiles 1aBTBC22, 1aBTBC24 to 1aBTBC28 were last surveyed during the Full Measures autumn survey, 2022.</p> <p>1aBTBC21 to 1aBTBC23 are located on the northwest side of the island, along The Snook. 1aBTBC24 to 1aBTBC28 are located on the south side of the island in the vicinity of the castle and priory. 1aBTBC27 extends out to and across the small island upon which the remains of a chapel stand.</p> <p>At all profiles on the north side of the island, the dunes have not changed position since the last survey and have undergone little change limited to ± 0.1m.</p> <p>At profile 1aBTBC21 the toe of the foredune has risen by up to 0.1m. The rest of the beach profile has alternated between erosion and accretion by $\leq \pm 0.1$m. Over much of this extent, the profile is now at a medium-low level compared to the range from previously recorded surveys, except the dunes which are at a high level.</p> <p>The dunes at profile 1aBTBC22 have undergone erosion and accretion, mostly limited to 0.1m but a hollow has formed at chainage 19m with the erosion of up to 0.4m. The beach profile has mostly risen by up to 0.1m, with only a short section of erosion between chainages 180-208m by up to 0.1m. The crest of the foredune remains at one of its highest level recorded. The rest of the beach profile is at a high level when compared with the range from previously recorded surveys.</p> <p>Similarly, the profile 1aBTBC23 has remained generally stable, with small sections of accretion/erosion across the profile limited to less than 0.1m. The profile is at a high level when compared with the range from previously recorded surveys.</p> <p>On the south side of the island, the dunes at profile 1aBTBC24 have remained generally stable since the last survey with accretion limited to less than 0.1m, with only a few short sections of erosion on the duneface by up to 0.1m. The beach profile has risen by up to less than 0.1m on the upper beach,</p>	<p>The dunes, sandy foreshore and sand flats around The Snook on Holy Island have remained stable in both form and position since the last survey.</p> <p>On the south side of the island, the backshore and beach have remained stable since the last survey. The beach levels have alternated between minimal amounts of erosion and accretion limited to approximately ± 0.1m, with a few short sections experiencing change up to ± 0.3m.</p> <p>Longer term trends: Generally, the trends observed in the present survey are a continuation of those observed in the past, with the dunes and beach retaining the same form and position. The exception to this is at profiles 1aBTBC21 - BTBC23, where the dune front and toe have advanced by up to c.30.0m through the accumulation of nearly 2.0m of sand since 2002.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>increasing to 0.3m on the lower beach. The dunes are at the highest level recorded, whilst the beach profile is at a medium-high level compared with the range from previously recorded surveys.</p> <p>The dune crest at profile 1aBTBC25 has risen by up to 0.1m and the duneface has risen by up to 0.2m. The rest of the beach profile has risen by up to 0.1m on the upper beach, less than 0.1m on the middle beach and approximately 0.2m on the lower beach. The profile is at a medium level and dunes are at a relatively high level when compared with the range from previously recorded surveys.</p> <p>The dune crest at 1aBTBC26 and dune face has lowered by up to 0.1m. The beach profile seaward of chainage 40m has risen by less than 0.1m. Overall, the profile is at a medium level compared to the range recorded from previous surveys.</p> <p>There have been minimal changes at 1aBTBC27, with small areas of erosion and accretion across the dunes and beach profile of <0.1m. Overall, the profile is at a medium to medium-low level compared to the range recorded from previous surveys.</p> <p>The dunes at profile 1aBTBC28 have lowered by up to 0.4m to chainage 19m. The rest of the beach profile has alternated between erosion and accretion by <0.1m. Overall, the profile is at a medium to medium-high level compared to the range recorded from previous surveys, except the crest of the dune which is at its most landward position recorded.</p>	
<p>Sep 2022 – Aug 2023</p>	<p>Topographic Survey:</p> <p>Holy Island causeway and the adjacent sand flats are covered by an annual topographic survey, which commenced in October 2004. The purpose of this survey was to determine whether raising the level of the causeway had any adverse impacts on the adjacent sand flats.</p> <p>Data from the most recent topographic survey (Full Measures, autumn 2023) have been used to create a DGM (Appendix B – Map 2) using a Geographical Information System (GIS). A difference plot has also been produced using the DGM (Appendix B – Map 6) produced from the last produced topographic survey (Full Measures, autumn 2022) and the present survey.</p> <p>The difference plot shows overall stability with minimal pockets of elevation change in the order of +/- 0.75m. The main area of change is in the centre of the South Low channel.</p> <p>The survey report notes that new ditches are being dug on either side of the causeway in an attempt to trap sand from accumulating on the causeway.</p>	<p>The topographic survey shows that the causeway has remained stable since the last survey.</p>

2.6 Bamburgh

Survey Date	Description of Changes Since Last Survey	Interpretation
15 th September 2023	<p>Beach Profiles:</p> <p>Bamburgh is covered by one beach profile line for the Full Measures survey (Appendix A). Profile 1aBTBC29 was last surveyed during the Full Measures autumn survey, 2022.</p> <p>Profile 1aBTBC29 is located approximately 750m south-east of the castle. The dunes have remained relatively stable and have predominantly risen in small sections by up to 0.2m. The beach profile from the toe of the dunes across the profile has risen by up to 0.4m, except for a small section between chainages 485-520m which has lowered by up to 0.1m. The dunes are at their highest levels recorded in several places. The rest of the beach profile is now at a high level compared to the range recorded from previous surveys.</p>	<p>The dunes at Bamburgh have remained stable, and show several sections of accretion. The beach has predominantly risen since the previous survey.</p> <p>Longer term trends: The beach is at a high level compared to earlier surveys.</p>

2.7 Beadnell Village

Survey Date	Description of Changes Since Last Survey	Interpretation
9 th September 2023	<p>Beach Profiles:</p> <p>Beadnell Village is covered by two beach profile lines for the Full Measures survey (Appendix A). Profile 1aBTBC31 was last surveyed during the Partial Measures spring survey, 2023. Profile 1aBTBC30 was last surveyed during the Full Measures autumn survey, 2022.</p> <p>Profile 1aBTBC30 is around 300m to the north of the village. The dunes have risen by up to 0.2m, with little change on the dune face. The toe of the dunes has risen by up to 0.3m to chainage 51m. There has been minimal change of ± 0.1m between chainage 51-95m. Seaward of this point, the beach has risen by up to 0.2m. Overall, the top of the dunes are at their highest level recorded. The rest of the beach profile is at a medium-low level compared to the range recorded from previous surveys, particularly between chainage 54-62m which is at its lowest level recorded.</p> <p>Profile 1aBTBC31 is in Nacker Hole and extends across the promenade and seawall. The beach profile from the toe of the seawall to the rock platform at chainage 42m has lowered by up to 0.1m on the upper beach to 0.2m on the lower beach. Seaward of this point, the patch of boulders remains exposed. Overall, the profile is at a medium level on the upper beach, dropping to a low level on the lower beach compared to the range recorded from previous surveys.</p>	<p>The dunes and beach to the south of Beadnell Village have remained stable.</p> <p>Longer term trends: The changes observed since the last survey are within the bounds of previous surveys, except between chainages 54-62m which is at its lowest level recorded.</p>

2.8 Beadnell Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
<p>1st September 2023</p>	<p>Beach Profiles:</p> <p>Beadnell Bay is covered by nine beach profile lines for the Full Measures survey (Appendix A). Profiles 1aBTBC33 to 1aBTBC34, 1aBTBC37 and 1aADC01 to 1aDC02 were last surveyed during the Partial Measures spring survey, 2023. Profiles 1aBTBC32, 1aBTBC35 to 1aBTBC36 and 1aBTBC38 were last surveyed during the Full Measures autumn survey, 2022.</p> <p>1aBTBC32 to 1aBTBC34 are located at the northern end of Beadnell Bay, in Beadnell Harbour.</p> <p>At profile 1aBTBC32, the dunes have retained the same form since the previous survey, with small changes limited to ± 0.1m. The upper beach from the toe of the dunes at chainage 9m to chainage 30m has lowered by up to 0.5m. The middle beach between chainages 30-56m has risen by up to 0.2m. Seaward of this point, the lower beach has lowered by up to 0.2m. Overall, the dune ridge is at a medium-low level. The upper and lower beach is at a medium level, whilst the middle beach is at a high level compared to the range recorded from previous surveys.</p> <p>At profile 1aBTBC33, the dunes have remained stable since previous survey with very little change. The beach at the toe of the dunes has lowered by up to 0.2m to chainage 67m. Between chainages 67-110m the beach has risen by up to 0.3m since the previous survey, filling a hollow at chainage 80m. The majority of the rest of the profile has lowered by up to 0.1m to chainage 207m, before switching to accretion on the lower beach by up to 0.3m. Overall, the dunes and upper and lower beach is at a high level and the middle beach is at a low level compared to the range recorded from previous surveys.</p> <p>At profile 1aBTBC34, the dunes have mostly risen by up to 0.1m. The majority of the profile has risen by up to 0.2m, except for a short section between chainages 148-169m which has lowered by less than 0.1m. The boulder patch between chainages 94-122m remains covered. Overall, the profile is at a high level, compared to the range recorded from previous surveys, particularly the dune toe which is at its highest level recorded between chainages 2-16m.</p> <p>1aBTBC35 to 1aBTBC38 are located between Burn Carrs and the outfall of Brunton Burn/Long Nanny. The dunes along this northern section of coast have remained stable since the last survey.</p>	<p>Along the length of Beadnell Bay, the dunes have remained stable, with relatively little change since the previous survey. Beach levels generally remained stable throughout the bay with minor fluctuations indicating cross shore movement of sediment.</p> <p>Longer term trends: Along the length of Beadnell Bay, the majority of the dune and beach form are similar to those observed in the past and the profile form and position is generally within the bounds of previous surveys. There are several sections of the dunes that are at their highest levels recorded.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>At profile 1aBTBC35, the dune toe has accumulated sediment by up to 0.2m. The majority off the beach profile has risen by 0.1 – 0.2m, except between chainages 22-39m which has lowered by up to 0.1m. Overall, the profile is at a high level compared to the range recorded from previous surveys, with the dune toe remaining at its most seaward position recorded.</p> <p>At profile 1aBTBC36, the dunes have mostly risen by up to 0.1m, with the lower dune face moving seaward by up to 2.0m. The beach profile has risen by up to 0.2m on the upper and middle beach, switching to erosion seaward of chainage 204m by up to 0.9m. Overall, the crest of the foredune and the upper beach between chainages 50-150m are at their highest levels recorded. The rest of the beach profile is at a medium level compared to the range recorded from previous surveys.</p> <p>At profile 1aBTBC37, the dunes have remained stable except the dune toe which has lowered by up to 0.8m to chainage 39m. The upper and middle beach from chainages 39-210m have risen by up to 0.3m, switching to erosion on the lower beach by up to 0.5m. Overall, the dune toe remains at a seaward position, and the rest of the beach profile is at a high level compared with the range recorded from previous surveys.</p> <p>At profile 1aBTBC38, the dune toe and upper beach to chainage 130m has lowered by up to 0.4m. A short section on the middle beach between chainages 130-195m has risen by up to 0.4m. Erosion occurs on the lower beach seaward of chainage 195m by up to 0.2m. Overall, the dune toe and beach are at a high level compared to the range recorded from previous surveys.</p> <p>1aADC01 and 1aADC02 are located south of the outfall of Brunton Burn/Long Nanny. The dunes have not changed form or position.</p> <p>At profile 1aADC01, there has been very little change in the back dunes between chainages 0-258m, with some small areas of erosion and accretion limited to ± 0.1m. The only exception to this is the seaward face of the foredune which has accumulated sediment by up to 0.4m between chainages 254-280m. Similar to profiles north of this section, the beach exhibits alternating sections of erosion and accretion along the bay. The upper beach between chainages 300-350 and lower beach between chainages 420-455m have lowered by up to 0.4m. The middle beach between chainages 350-420m has risen by up to 0.2m. When compared to the range of previously recorded results, the crest of the foredune is at its highest level recorded. The rest of the beach profile is at a medium-high level compared to the range recorded from previous surveys.</p>	

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>At profile 1aADC02, the dune has remained relatively stable since the previous survey, with small sections of accretion limited to 0.1m. The beach profile has lowered from the dune toe at chainage 50m across the profile by up to 0.2m on the upper beach, 0.1m on the middle beach and 0.3m on the lower beach. Overall, the dunes are at a high level, whilst the rest of the profile is at a medium level compared with the range recorded from previous surveys.</p>	

2.9 Embleton Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
15 th September 2023	<p>Beach Profiles:</p> <p>Embleton Bay is covered by two beach profile lines for the Full Measures survey (Appendix A). Profiles 1aADC03 and 1aADC04 were last surveyed during the Full Measures autumn survey, 2022.</p> <p>1aADC03 is located towards the north of the bay, north of Embleton Burn mouth. Profile 1aADC04 is located towards the south of the bay.</p> <p>At profile 1aADC03, the dunes have remained stable, with only small sections of change limited to ± 0.1m. The toe of the dunes between chainages 67m and 99m has risen by up to 0.6m, whilst the lower beach seaward of chainage 140m has risen by up to 0.2m. The middle beach between chainages 99-140m has lowered by up to 0.6m. Overall, the toe of the dunes is at its most seaward position recorded. The rest of the beach profile is at a medium-high level.</p> <p>At profile 1aADC04, the dunes have remained mostly stable, with small sections of accretion and erosion occurring by up to 0.1m. The upper beach and lower beach have risen by up to 1.2m, whilst the middle beach between chainages 180-209m has lowered by up to 0.7m. Overall, the dunes are at a relatively low level compared to previous surveys, whilst the majority of the beach profile is at a high level, particularly between chainages 207-240m which is at its highest level recorded.</p>	<p>The dunes at Embleton Bay are generally stable, with small amount of erosion/accretion limited to ± 0.1m.</p> <p>The beach levels generally exhibit a seasonal movement of sand berms across the beach profile.</p> <p>Longer term trends: The dunes have remained stable over the longer term and beach levels are within the range of those surveyed since 2002.</p>

2.10 Boulmer

Survey Date	Description of Changes Since Last Survey	Interpretation
21 st Aug 2023	<p>Beach Profiles:</p> <p>Boulmer is covered by two beach profile lines for the Full Measures survey (Appendix A). These were added to the programme in October 2007. Profiles 1aADC04A to 1aADC04B were last surveyed during the Partial Measures spring survey, 2023.</p> <p>At profile 1aADC04A, the top of the dunes has risen by up to 0.2m to chainage 14m. The lower dune face has lowered by up to 0.2m. The rest of the beach profile remains similar to the previous survey, with all change limited to ± 0.1m. The rock platform remains exposed from chainage 54m and changes in level seaward of this point are most likely related to variations in survey points. Overall the top of the dunes is at one of its highest levels recorded and the lower dune face is at a medium-low level compared to the range recorded from previous surveys. The rest of the profile is at a medium level compared to the range recorded from previous surveys.</p> <p>At profile 1aADC04B the profile has lowered at the foot of the dunes by up to 0.1m to chainage 30m, and up to 0.2m on the middle beach between chainage 65-95m. The beach between chainage 30-65m has risen by up to 0.4m. The rock platform remains exposed from chainage 95m. Overall, the profile is at a medium-high level compared to the range recorded from previous surveys.</p>	<p>The changes to beach profile are minimal, showing alternating sections of erosion and accretion at both profiles. The rock platform remains exposed at both profiles.</p> <p>Longer term trends: Beach elevation is between medium-low to medium-high in comparison to the long-term record of surveys.</p>

2.11 Alnmouth Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
<p>21st August 2023</p>	<p>Beach Profiles:</p> <p>Alnmouth Bay is covered by ten beach profile lines for the Full Measures survey (Appendix A). Profiles 1aADC07 to 1aADC09 were last surveyed during the Partial Measures spring survey, 2023. Profiles 1aADC05, 1aADC06 and 1aADC10 to 1aADC14 were last surveyed during the Full Measures autumn survey, 2022.</p> <p>1aADC05 and 1aADC06 are located in the small pocket beach that is situated between the rock outcrops of Seaton Point and Marden Rocks.</p> <p>At profile 1aADC05, the beach profile has alternated between erosion and accretion. Erosion occurs at the toe of the dunes, in the middle-upper beach and on the middle-lower beach and is limited to 0.4m. Accretion occurs on the upper beach, middle beach and lower beach and is limited to 0.2m. Sediment is now covering up a rock patch previously exposed between chainages 210-265m (the end of the survey). Overall, the beach profile is generally at a low level compared to the range recorded from previous surveys.</p> <p>At profile 1aADC06 the beach at the toe of the dunes has lowered by up to 0.6m to chainage 58m. There is a short section of accretion occurring between chainages 58m and 90m by up to 0.2m, which switches to erosion on the lower beach seaward of chainage 90m by up to 0.4m. The entire beach profile is at a medium-low level compared to the range recorded from previous surveys, particularly between chainages 101-145m which is at its lowest level recorded.</p> <p>1aADC07, 1aADC08 and 1aADC09 are located to the north of Alnmouth Bay between Marden Rocks and the mouth of the River Aln Estuary.</p> <p>At profile 1aADC07, the top of the dunes has remained stable since the last survey, with only a small amount of erosion by less than 0.1m. The beach has alternated between erosion and accretion. Generally, the beach has lowered on the upper to middle beach by up to 1.1m to chainage 155m. Seaward of this point, the beach has generally risen by up to 0.7m (associated with the movement of a lower beach berm landward by 40m. Overall the beach alternates between a high level (at the toe of the</p>	<p>To the north of Alnmouth Bay, the dune cliffs have remained relatively stable. The beach levels alternate between accretion and erosion.</p> <p>To the north and south of the River Aln Estuary, the dunes have remained stable since the last survey. The beach at profiles 1aADC07-1aADC11 exhibit an alternating accretion and erosion indicating the movement of berms across the foreshore (except profile 1aADC08 which has generally lowered since the previous survey).</p> <p>At the south of the bay, the beaches generally show a similar pattern to the north of the bay, with alternating accretion and erosion.</p> <p>Longer term trends:</p> <p>The cliffs in the far north of the bay have retreated slowly since 2002, by around 1-2m in total. The dunes have generally demonstrated long-term stability.</p> <p>Changes in beach profile form and position observed since the last survey range from a low to high level of the ranges seen in previous surveys. Several sections are now at their highest or lowest levels recorded.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>dunes and at the lower beach berm) and a low level (middle beach) compared to the range recorded from previous surveys.</p> <p>At profile 1aADC08, the back of the dunes has risen by less than 0.1m and the lower dune face has lowered by up to 0.5m. The majority of the beach profile has risen by up to 0.5m to chainage 111m, before switching to a short section of erosion by up to 0.5m seaward of chainage 111m. Overall, the profile is at a medium level compared to the range recorded from previous surveys.</p> <p>At profile 1aADC09, the dunes have remained stable since the previous survey, with a small amount of erosion by up to 0.1m. Similar to previous profiles, the beach has alternated between erosion and accretion. The beach between chainages 26-31m, 44-64m and 76m to the end of the survey has lowered by up to 1.2m. The beach profile between these sections has risen by up to 0.3m. Overall, the foredune remains at one of its highest level recorded. The upper and middle beach is generally at a high level whilst the lower beach is at a low level compared to the range recorded in previous surveys.</p> <p>1aADC10 to 1aADC14 are located between the south bank of the River Aln Estuary and the north breakwater of Warkworth Harbour at the mouth of the estuary of the River Coquet.</p> <p>At profile 1aADC10, there has been alternating sections of erosion and accretion associated with the movement of berms. Accretion occurs on the upper and lower beach by up to 0.8m. The middle beach between chainages 120-311m has lowered by up to 0.6m. Overall, the upper beach is at a high level and at a medium-low level on the middle and lower beach compared to the range recorded from previous.</p> <p>At profile 1aADC11, the back of the dunes has risen by up to 0.2m and the crest of the dune has not changed since the previous survey. The top section and lower section of the dune has narrowed since the previous survey, with the erosion of up to 1.0m at the base of the dune. The rest of the beach profile has predominantly risen between chainages 51-69m and seaward of chainage 120m by up to 0.3m. A short section on the upper beach between chainages 69-120m has lowered by up to 0.6m. Overall, the profile is at a medium-high level compared to the range recorded from previous surveys.</p> <p>At profile 1aADC12, the dune face has remained stable since the previous survey, however, there has been some erosion on the dune crest and dune face by up to 0.3m. The majority of the beach profile has lowered since the previous survey by up to 0.2m, whilst a short section on the middle beach between chainages 110-140m has risen by up to 0.1m. Overall, the dune and dune toe are at a low</p>	

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>level, whilst the beach profile is at a medium level compared to the range recorded from previous surveys.</p> <p>At profile 1aADC13, the dunes and dune face have remained stable since the last survey, with only minor sections of erosion limited to 0.2m. The beach profile has predominantly risen by up to 0.5m, with only a short section of lowering on the middle beach between chainages 170-205m by up to 0.6m. Overall, the profile is at a medium-low level compared to the range recorded from previous surveys.</p> <p>At profile 1aADC14, there have been small sections of erosion within the dunes by up to 0.1m. The beach has undergone minimal change, with alternating of sections of erosion and accretion limited to ± 0.1m. The crest of the foredune remains at one of its highest levels recorded. The rest of the beach profile is at a high level compared to the range recorded from previous surveys.</p>	
<p>Mar – Aug 2023</p>	<p>Topographic Survey:</p> <p>The northern part of Alnmouth Bay (to the north of the River Aln Estuary) is covered by a bi-annual topographic survey, which commenced in April 2005. Data from the most recent topographic survey (Full Measures, autumn 2023) have been used to create a DGM (Appendix B – Map 3) using GIS. A difference plot has also been produced using the DGM (Appendix B – Map 7) comparing the last produced topographic survey (Partial Measures, spring 2023) with the present survey.</p> <p>The difference plot broadly shows the edge of the Aln channel at the point where it meanders north has undergone accretion by up to 1.5m, switching to erosion on the edge of the channel parallel to the coastline by up to 1.5m. The beach in the lee of the Aln channel shows erosion on the lower beach and amongst the dunes, with a small band of accretion on the middle-upper beach. The beach between the end of the Aln channel and the centre bay has risen by up to 0.75m across the beach profile. The centre of the bay exhibits erosion across the beach profile by up to 1.25m and patchy spots of erosion amongst the dunes. Moving north, there is a varying pattern of erosion and accretion across the beach profile with no clear trend, however the magnitude of change is generally lower compared to the south.</p>	<p>The findings of the topographic survey broadly show discontinuous bands of erosion and accretion across the survey extent associated with the seasonal movement of sediment in the form of berms.</p>

2.12 High Hauxley & Druridge Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
13 th Sept 2023	<p>Beach Profiles:</p> <p>High Hauxley to Druridge Bay is covered by nine beach profile lines for the Full Measures survey (Appendix A). Four of these (with 'A' or 'B' suffixes) were added to the programme in October 2007. All except 1aADC15 are resurveyed every 6-months.</p> <p>Profile 1aADC15 extends across the extensive dunes at Amble Links and foreshore. There has been some minor accretion and erosion across the dunes, within the range of $\pm 0.1\text{m}$. The dune toe has accumulated up to 0.6m of sediment to chainage 125m. The remaining beach profile has lowered by up to 0.2m on the upper beach and less than 0.2m elsewhere. Overall, the profile is at a low level compared to the range recorded from previous surveys.</p> <p>1aADC15A, 1aADC16 and 1aADC16A are located around Hauxley Haven. At all locations, the dunes have remained stable since the last survey (Partial Measures, spring 2023).</p> <p>At profile 1aADC15A, the start of the survey is missing due to access restrictions and therefore it has not been analysed. The profile from the dune toe across the beach profile has lowered by up to 0.5m on the upper beach, 0.2m on the middle beach and 0.6m on the lower beach. A rock patch at chainage 150m has been exposed since the previous survey. Overall, the profile is at one of its lowest levels recorded compared to the range recorded from previous surveys.</p> <p>At profile 1aADC16, the start of the survey is missing due to access restrictions and therefore it has not been analysed. The dune toe has lowered by up to 0.2m to chainage 70m. The upper beach between chainages 70-125m has risen by up to 0.1m, switching to erosion on the middle and lower beach by up to 0.5m. Overall, the beach is at a medium-low level compared to the range recorded from previous surveys, particularly between chainages 137-185m which is at its lowest levels recorded.</p> <p>At profile 1aADC16A, the profile between chainages 0m and 60m appears to have risen by up to 0.2m since the previous survey (the survey report notes that this section had dense vegetation). The upper beach profile from the toe of the dunes to chainage 125m has risen by up to 0.3m, switching to erosion on the middle and lower beach by up to 0.4m. Overall, the upper beach profile is at a high</p>	<p>At High Hauxley (profile 1aADC15), the dunes have remained stable, and the beach profile is dominated by erosion.</p> <p>At Hauxley Haven (profiles 1aADC15A to 1aADC16A), the dunes have remained stable since the last survey. Overall, the profiles have lowered, except the upper beach at chainage 1aADC16.</p> <p>In Druridge Bay, changes in beach levels generally showed variable sections of erosion and accretion associated with seasonal berm movement across the foreshore.</p> <p>Longer term trends: At High Hauxley, Hauxley Haven and north and south Druridge Bay, the dunes have remained stable except for limited changes at the dune toe. The beach levels are mostly within the bounds of previous surveys.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>level and the middle and lower beach are at a low level compared to the range recorded from previous surveys.</p> <p>1aADC16B, 1aADC17 and 1aADC17A are located to the north of Druridge Bay, between Bondi Carrs and Hadston Carrs and extend seawards from Togston Links. At all locations, the dunes have remained stable since the last survey (Partial Measures, spring 2023).</p> <p>At profile 1aADC16B, the beach profile has generally lowered by up to 0.5m on the upper beach, 0.2m on the middle beach and 0.3m on the lower beach. Accretion has occurred on a short section between chainages 110-130m by up to 0.1m. The rocks remain exposed between chainages 96-105m and 155-182m. Overall, the profile is at a high level compared to the range recorded from previous surveys.</p> <p>At profile 1aADC17, the beach profile alternates between erosion and accretion across the beach. Accretion is limited to 0.2m and erosion limited to 0.3m. Overall, the profile is at a medium-high level compared to the range recorded from previous surveys.</p> <p>At profile 1aADC17A, the beach from the toe of the dunes to chainage 155m has risen by up to 0.6m, with the formation of a shallow berm at chainage 70m. The beach seaward of chainage 70m has lowered by up to 0.2m. Overall, the profile is at a medium-high level when compared to the range recorded from previous surveys, particularly where the berm has formed which is now at its highest level recorded.</p> <p>1aCMBC01 and 1aCMBC02 are located in the southern section of Druridge Bay.</p> <p>At profile 1aCMBC01, the dunes have mostly risen by up to 0.1m and the dune crest is now at one of its highest levels recorded. The duneface has risen by up to 0.3m to chainage 198m. The upper and middle beach between chainages 198-285m have lowered by up to 1.0m, before switching to accretion on the lower beach by up to 1.4m. Overall, the dunes are at a high level and the beach is at a medium level compared to the range recorded from previous surveys.</p> <p>At profile 1aCMBC02, the dune has remained mostly stable since the previous survey. The beach at the dune toe to chainage 230m and the middle beach between chainages 272m and 315m has risen by up to 0.6m. The rest of the beach has lowered by up to 0.4-0.5m. Overall, the profile is at a high</p>	

Survey Date	Description of Changes Since Last Survey	Interpretation
	level on the upper and lower beach and a low level on the middle beach compared to the range recorded from previous surveys.	

2.13 Lynemouth Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
27 th November 2023	<p>Beach Profiles:</p> <p>Lynemouth Bay is covered by six beach profile lines for the Full Measures survey (Appendix A). Profiles CMBC03A and CMBC03B were added to the programme in October 2007.</p> <p>Profiles 1aCMBC03a to 1aWDC01 were last surveyed during the Partial Measures spring survey, 2023. Profiles 1aCMBC01 and 1aWDC02 to 1aWDC05 were last surveyed during the Full Measures autumn survey, 2023.</p> <p>1aCMBC03 is located just to the south of Snab Point. The profile extends across the cliff and the rock platform below. The profile has experienced very little change since the last survey, with only minor differences in positions of rock being recorded, indicating a stable cliff and rocky foreshore.</p> <p>1aCMBC03A is located opposite Lynemouth and extends across the extensive area of historically tipped colliery spoil before reaching the foreshore. The colliery spoil areas from chainage 0-80m have risen by up to 0.2m, indicating the accumulation of sediment washed over during times of high tides or storms. The face of the colliery soil has retreated landward by up to 1.5m. The upper beach from chainage 82m to 106m has risen by up to 0.3m, increasing to 0.8m on the middle-lower beach. Overall, the colliery spoil has reached its most landward position recorded and the beach profile is at a low level compared to the range recorded from previous surveys. The post-storm survey undertaken in November 2023 shows a further retreat of up to 2.0m of the colliery spoil which is now at its most landward position recorded. The beach has undergone accretion on the upper beach and erosion on the lower beach, but remains within the bounds of previous surveys.</p> <p>1aCMBC03B is located to the north of Lynemouth Power Station and extends across the extensive area of historically tipped colliery spoil before reaching the foreshore. The process of colliery spoil erosion has been progressively ongoing for some years. Since the last survey, the colliery spoil cliff has retreated by approximately 0.2m, whilst the toe of the spoil cliff appears to have risen by up to 1.0m (this is most likely due to slumping of colliery spoil material). The beach profile has risen by up to 0.3m to chainage 24m, with a short section of erosion between chainages 24-44m by up to 0.1m. The lower beach seaward of chainage 44m has risen by up to 0.4m. Overall, the profile is at a low level compared to the range recorded from previous surveys, particularly the face of the colliery spoil</p>	<p>To the south of Snab Point, the shoreline has not significantly changed in form or position since the last survey.</p> <p>North of the Power Station, the historically tipped colliery spoil has retreated to record levels, which has accelerated further after the November 2023 storms.</p> <p>A remediation scheme between profile 1aCMBC03A and the River Lyne and along the riverbanks around the mouth of the river is due to commence in March 2024, where a considerable quantity of refuse material, including rubber tubing, plastics, construction waste is eroding from the colliery spoil cliff. This scheme will locally alter the morphology of the coast as material is excavated, treated and re-usable soils are backfilled.</p> <p>To the south of the power station, between Lyne Sands and Beacon Point, accumulation has occurred on top of the colliery spoil cliffs at profiles 1aWDC02 and 1aWDC03, however they remain at one of the most landward positions recorded. The post-storm survey shows slumping at the colliery spoil cliff at profile 1aWDC02.</p> <p>Longer term trends:</p> <p>To the south of Snab Point, the changes observed from the present beach profiles are within the bounds of previous surveys. Total recession between the first survey in spring 2002 and the most recent survey in</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>cliff which is at its most landward / level recorded. The post-storm survey undertaken in November 2023 shows a significant erosion of the toe of the colliery spoil cliff by up to 1.1m since the Autumn 2023 survey. It is now at its lowest level recorded.</p> <p>Profile 1aWDC01 extended from seaward of the rock revetment down to low water but is no longer measured.</p> <p>1aWDC02 is located to the south of the Power Station. The dunes up to chainage 120m have risen by up to 0.1m and remain in a similar form as the previous survey. The gravel berm/colliery spoil cliff face between chainage 120-192m has lowered by up to 0.2m and retreated landward by 3m. The beach has risen by up to 0.7m. The area of colliery tipped spoil is at one of its most landward positions recorded. The post-storm survey undertaken in November 2023 shows an increase in profile of the colliery spoil and a seaward advancement of up to 10m. This is most likely associated with slumping of colliery spoil caused by storms. The beach level has dropped by up to 0.8m.</p> <p>1aWDC03 is located to the south of the Power Station and to the north of Beacon Point. The top of the colliery spoil berm has alternated between erosion and accretion limited to 0.1m. The colliery spoil cliff has lowered by 0.4m and retreated landward by up to 5m. The beach profile has risen by up to 1.0m. The beach profile is at its lowest level recorded compared to the range recorded from previous surveys, whilst the landward side of the colliery spoil berm between chainages 30-89m is at its highest level recorded. The post-storm survey undertaken in November 2023 shows an increase in profile of the top of the colliery spoil by up to 0.4m, and a retreat of the crest of the colliery spoil by 10m. The beach level has dropped by up to 1.0m. The colliery spoil cliff is now at its most landward position recorded.</p> <p>1aWDC04 and 1aWDC05 are located between Beacon Point and Newbiggin Point.</p> <p>At profile 1aWDC04, the dunes have remained stable, with only small sections of accretion and erosion limited to 0.1m to chainage 36m. The lower dune face has retreated by 2.0m and the upper to middle beach to chainage 106m has lowered by up to 0.6m. The lower beach seaward of chainage 106m has risen by up to 0.2m, covering up previously exposed rocks at chainage 80m and 140-200m. Overall, the profile is at a high level at the dunes and a medium level on the rest of the beach profile compared to the range recorded from previous surveys. The post-storm survey undertaken in</p>	<p>autumn 2022 is 2.0m. The rate of erosion remains the same as last year (0.1m/yr).</p> <p>Opposite Lynemouth, the colliery spoil has demonstrated a total recession between the first survey in autumn 2007 and the most recent survey in autumn 2023 of 39.0m overall. The rate of erosion has slightly increased from 1.9m/yr to 2.4m/yr since the last survey. The backing coastal slopes have remained relatively stable over this time.</p> <p>To the north of the power station, total recession between the first survey in autumn 2007 and the most recent survey in autumn 2023 is 58.0m. The average annual rate of erosion has increased from 2.4m/yr to 3.6m/yr.</p> <p>To the south of the power station, the prominent colliery spoil berm has retreated landward since the first survey in spring 2002 to the most recent survey in autumn 2023 by up to 66m. The average annual rate of erosion has decreased from 3.2m/r to 3.1m/yr at 1aWDC02 and increased from 2.8m/yr to 2.9m/yr at 1aWDC03.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>November 2023 shows an increase by up to 0.6m in profile of the beach from the toe of the dunes to chainage 112m, followed by erosion on the lower beach by up to 0.3m.</p> <p>At 1aWDC05, the cliffed section has remained stable. The beach between chainages 8-44m has risen by up to 0.6m. Seawards of chainage 44m the rock platform remains exposed, and the profile is largely unchanged. Overall, the profile is at a medium level compared to the range recorded from previous surveys. The post-storm survey undertaken in November 2023 shows the profile has lowered by up to 0.3m. The beach profile is now at a medium level compared to the range recorded from previous surveys.</p>	

Survey Date	Description of Changes Since Last Survey	Interpretation
<p>Feb 2023 to Aug 2023</p>	<p>Beach Topographic Survey:</p> <p>Lynemouth Bay is covered by a 6-monthly topographic survey, which was added to the programme in December 2020. This first survey represents a useful pre-scheme baseline against which future beach topographic surveys can be compared to determine locations and rates of change (landward recession or foreshore lowering/accretion). Data from the most recent topographic survey (Full Measures, autumn 2023) have been used to create a digital ground model (DGM) (Appendix B – Map 4) using a Geographical Information System (GIS). A difference plot has also been produced using the DGM (Appendix B – Map 9) produced from the last topographic survey and the present survey.</p> <p>Appendix B (Map 4) shows that the beach contours from the August2023 survey are generally parallel to the shore, except for in the vicinity of the rock outcrops at Headagee towards the northern part of the bay. Here, the shoreline has prograded seawards in the lee of the rocks.</p> <p>Appendix B (Map 9) shows that change to the north of the River Lyne is characterised by patchy erosion and accretion, generally limited to $\pm 0.5\text{m}$. The beach towards the central survey area is dominated by erosion on the upper beach, transitioning to accretion on the lower beach.</p> <p>The beach profile between the River Lyne and the Power Station is once again patchy accretion and erosion with no discernible pattern. Change is generally limited to 0.75m.</p> <p>The beach profile immediately in the lee of the rock revetment is dominated by erosion across the upper to lower beach by up to 2.0m, however this transitions into accretion on the southernmost survey extent by up to 1.75m.</p>	<p>The seaward progradation of the shore in the lee of Snab Point is facilitated by the shelter against wave energy provided to the leeward side by these rocks.</p> <p>Change since the previous survey is variable, however the survey area appears to be dominated by erosion, particularly south of the rock revetment where the greatest magnitude of erosion is recorded.</p> <p>Longer term trends: Future repeat surveys are expected to identify areas of the beach that are relatively stable (likely to be towards the northern end of the bay and in the lee of Headagee) and areas where landward recession continues to occur as the historically tipped colliery spoil is eroded on an ongoing basis.</p> <p>The remediation scheme to the north of the Power Station planned commence in March 2024.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
September 2023	<p>Colliery Spoil Edge Survey:</p> <p>Colliery spoil edge survey data was collected for a baseline survey in December 2020. Subsequent surveys have been taken in spring 2023 and autumn 2023 (Figure 3).</p> <p>In the very north of the bay, the colliery spoil forms a beach and the survey of the low cliffed edge of this spoil beach shows a progradation of sediment in the lee of the Headagee rock outcrops. The edge of the colliery spoil beach then merges back into the colliery spoil cliff toe just to the south of the rock outcrops. It has been observed empirically that the spoil beach is eroding landwards and the point where it merges into the cliff is moving northwards, causing the cliffs to become exposed and start eroding. Further north, the remaining spoil beach protects natural cliffs/coastal slopes. The cliff edge has largely remained stable in this part of the bay since the previous survey, except for a short section of erosion occurring by up to 3.0m.</p> <p>In the centre of the bay (immediately north of the power station north towards Headagee), the colliery spoil cliff is no longer protected by a distinct fronting colliery spoil beach (although the natural beach is very much intermixed with spoil, it does not form a distinct spoil beach like that present in the north of the bay). Colliery spoil between the Power Station and the River Lyne has remained relatively stable, with only some short sections of erosion occurring by up to 2.5m.</p> <p>In the south of the bay (south of the power station), the colliery spoil extends some distance seaward of the backing (and underlying) natural dunes, forming a 'berm' (rather than a distinct cliff edge) at the seaward edge. The edge of this berm has remained stable since the previous survey, with only a short section retreating by 1.4m. The survey for Autumn 2023 extends further south than previous surveys and therefore cannot be compared against any earlier baseline.</p>	<p>Where a spoil beach is present on the foreshore, the backing spoil cliffs or natural cliffs/dune are stable because they are not currently affected by marine processes.</p> <p>Where the spoil beach is absent, the backing colliery spoil cliffs are actively eroding, generally causing measurable landward recession. The most recent survey however shows that the colliery spoil has remained relatively stable since the previous survey, with only isolated sections of erosion occurring compared to previous years.</p> <p>Longer term trends: Since cliff top surveys began in December 2020, cliff movement has been greatest in the centre of the bay (north of the River Lyne - with up to 19.0m of colliery spoil edge retreat) and in the lee of the rock revetment surrounding the power station (up to 13.0m retreat). The northern part of the survey area has shown less movement with smaller sections of retreat up to 3.0m.</p> <p>Future repeat cliff top surveys are expected to help quantify rates of erosion (landward recession) of the historically tipped colliery spoil on a wider basis than is possible from the beach profile surveys alone.</p>

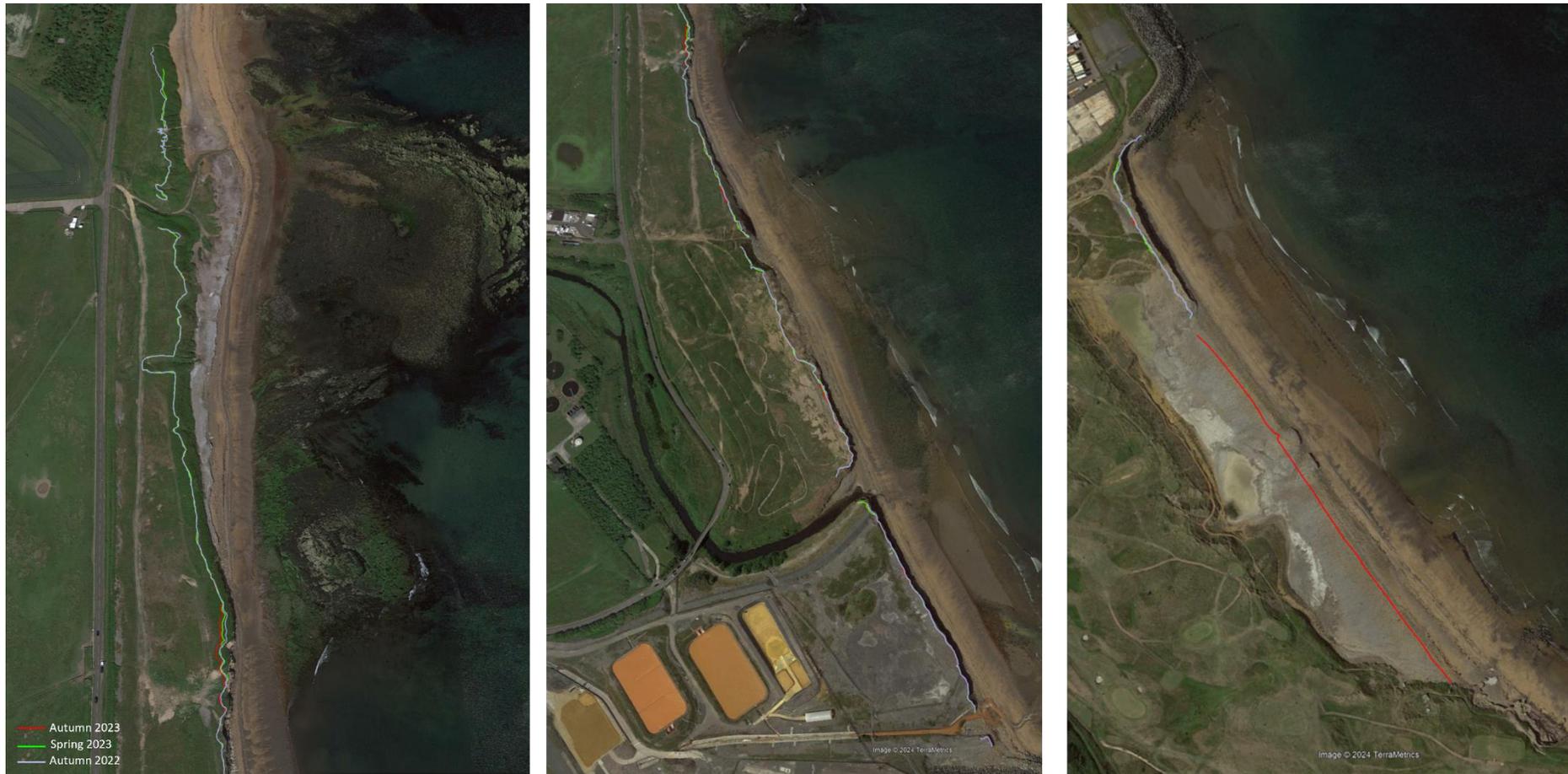


Figure 3 Lynemouth cliff top surveys Autumn 2022, Spring 2023 and Autumn 2023 (north: left, centre: middle, and south: right)

2.14 Newbiggin-by-the-Sea

Survey Date	Description of Changes Since Last Survey	Interpretation
18 th August 2023	<p>Beach Profiles:</p> <p>Newbiggin-by-the-Sea is covered by four beach profile lines for the Full Measures survey (Appendix A). Two of these, profiles WDC05A and WDC06A, were added to the programme in October 2007 specifically to help assess the performance of the capital scheme involving beach replenishment and construction of an offshore breakwater. Profiles 1aWDC05A and 1aWDC06A were last surveyed during the Partial Measures spring survey, 2023. Profiles 1aWDC06 and 1aWDC07 were last surveyed during the Full Measures autumn survey, 2022.</p> <p>In addition, a further 26 profiles (1aNWB1 to 1aNWB26) have been surveyed since September 2010 as part of a topographic survey of Newbiggin Bay. These profiles are not individually described.</p> <p>Beach profiling works were completed here in September 2012. Four areas were re-profiled; 2 sections to the east of profile 1aWDC05A, one section at 1aWDC06A and a narrow section at the top of 1aWDC07.</p> <p>1aWDC05A is in the north of Newbiggin Bay. The beach at the toe of the seawall has lowered by less than 0.2m. The upper beach has lowered by less than 0.1m to chainage 48m, switching to accretion between chainages 48-66m by less than 0.1m. The middle beach between chainages 66-110m has lowered by up to 0.5m. The rock platform remains exposed seaward of chainage 110m. The upper beach profile is at a medium level, dropping to a low level across the middle and lower beach compared to the range recorded from previous surveys. The post-storm survey undertaken in November 2023 shows a large berm has formed at chainage 30m with the increase in profile by up to 0.6m on the upper beach. The beach seaward of chainage 40m has lowered and led to a steeper profile than the survey in August 2023.</p> <p>1aWDC06 is located in the centre of the northern part of Newbiggin Bay, between the two breakwaters. The beach at the toe of the seawall has lowered by up to 0.2m to chainage 16m, switching to accretion by up to 0.3m to chainage 30m. The middle beach between chainages 30-48m has remained stable since the previous survey. The lower beach between chainages 48-84m has lowered by up to 0.75m, before switching to accretion seaward of chainage 84m by up to 0.1m.</p>	<p>Since the last survey, the profiles have generally lowered except profile 1aWDC07 which has mostly risen. The post-storm survey has shown a steepening of several profiles.</p> <p>Longer term trends: Data since monitoring began in May 2002 reflects the change in beach width resulting from the beach nourishment scheme implemented at Newbiggin-by-the-Sea. This change is also reflected in the beach profile plot in Appendix A.</p> <p>The changes in beach profile form and position observed since the last survey are within the bounds of previous surveys.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>Overall, the upper beach profile is at a high level, and a low level on the middle and lower beach compared to the range recorded from the previous surveys. The post-storm survey undertaken in November 2023 shows the upper beach between chainages 12-29m has risen to its highest level recorded since the beach replenishment in October 2007.</p> <p>1aWDC06A is located in the centre of Newbiggin Bay, behind the offshore breakwater. There has been very little change from the seawall to chainage 75m. The beach level between chainage 75m and 225m has lowered by up to 0.5m, before switching to accretion on the lower beach by up to 0.2m. Overall the upper beach profile is at a high level, dropping to a medium-low level on the middle and lower beach when compared to the range recorded from previous surveys. The post-storm survey undertaken in November 2023 shows a steepening of the beach profile, with an increase in profile by up to 0.2m on the upper beach and a lowering across the rest of the profile by up to 1.4m. The profile is now at one of its lowest levels recorded.</p> <p>1aWDC07 is located towards the south of Newbiggin Bay. There is no change in position of the boulders. The beach at the toe of the boulders has lowered by less than 0.1m to chainage 12m. The beach between chainages 12-84m has risen by up to 0.4m. The beach between chainages 84-111m has lowered by up to 0.2m before switching to accretion at the end of the profile by up to 0.1m. Overall, the profile is at a low level (compared to surveys recorded post-2007) across much of its extent compared to the range of the surveys recorded. The post-storm survey undertaken in November 2023 shows the beach profile has risen by up to 0.4m across the profile, and is now at a more medium level compared to the range recorded from previous surveys.</p>	
<p>Feb-Aug 2023</p>	<p>Topographic Survey:</p> <p>Newbiggin-by-the-Sea is covered by bi-annual topographic survey, which commenced in September 2010. The surveys are planned to help assess the performance of a capital scheme constructed in 2007, which involved beach replenishment and construction of an offshore breakwater. Prior to incorporation in the programme, these surveys were undertaken on occasions between 2007 and 2010 as part of the scheme development.</p> <p>Data from the most recent topographic survey (Full Measures, autumn 2023) have been used to create a DGM (Appendix B – Map 4) using a GIS. A difference plot has also been produced using the</p>	<p>The topographic survey shows areas of both gain and loss across the beach of generally low magnitude. Overall, the beach has remained mostly stable, with a band of erosion and accretion occurring in the middle beach extending north and south. The northern and southern extents are patchy with no discernible pattern.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>DGM (Appendix B – Map 8) produced from the last produced topographic survey (Partial Measures, spring 2023) and the present survey.</p> <p>The difference plot generally shows that the northernmost and southernmost extents of the survey are dominated by patchy areas of erosion and accretion, with slightly higher magnitudes of change (± 0.1-1.25m) in the south compared to the north (± 0.1-0.75m). The patches of erosion mostly occur at the toe of the seawall in the north, whilst erosion is mostly concentrated in the middle of the beach in the south.</p> <p>The upper and lower beach of the central survey extent is dominated by little change (± 0.1m), with a band of erosion on the middle beach limited to 0.75m which extends to the north of the survey area. A continuous band of accretion also occurs on the middle to upper beach along the south of the survey area.</p>	
<p>August 2023</p>	<p>Sand Extent Survey:</p> <p>Spital Carrs is located to the south of Newbiggin Bay and is covered by a bi-annual sand extent survey, which commenced in 2012. The survey was designed to address concerns that the beach recharge scheme undertaken in the Newbiggin Bay may have impacts on the Spital Carrs SSSI and SPA if sand from the recharge scheme moves to the south. The sand extent survey therefore identifies the boundary of the sand beach on the rock platform.</p> <p>Data from the most recent sand extent survey (Full Measures, autumn 2023) has been plotted onto aerial imagery (refer to Appendix C – Map 1). The plot shows there has been an advance of the sand extent across the entire survey area, by up to 4m in the northern and southern extents of the survey and up to 39m in the centre of the survey area. One short section (approximately 8m located in the central – south survey area) of erosion has occurred by up to 9.0m. The sand extent has shown good recovery from the record landward position recorded in Spring 2023.</p>	<p>Since the last survey, there has been an advancement of sand cover across the majority of the survey extent.</p> <p>Longer term trends: Since 2014, there has been a general trend for advance in the summer and retreat in the winter.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
<p>September 2023</p>	<p>Cliff-top Survey:</p> <p>Cliff top survey data collected for baseline survey (autumn, 2008), the previous Partial Measures survey (spring 2023) and the present Full Measures survey (autumn, 2023) is presented in this report.</p> <p>The cliff top survey is carried out as a continuous cliff edge line survey at the Newbiggin Caravan Park at Newbiggin Point. The results from the cliff top monitoring are anticipated to have an accuracy of $\pm 0.2\text{m}$ due to the technique used. Furthermore, problems in precisely locating the cliff top, due to vegetation growth or the indistinct form of the cliff top, have also affected the data quality.</p> <p>There has been very little change in the position of the cliff top since the previous survey in spring 2023 and the present Full Measures survey in autumn 2023. There are several short sections in the central survey area that show a landward retreat of the cliff top by less than 0.5m. Some caravans remain extremely close to the edge of the cliff top.</p>	<p>Since the last survey there has been relatively little movement recorded.</p> <p>Longer term trends: Since surveys began in October 2008, cliff movement has been greatest in the north of the survey area with up to 3.3m of cliff top retreat, whilst the central and southern parts of the survey area have shown less movement with retreat of less than 2.0m.</p>

2.15 Cambois Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
19 th September 2023	<p>Beach Profiles:</p> <p>Cambois Bay is covered by seven beach profile lines for the Full Measures survey (Appendix A). Profiles. All profiles are resurveyed every 12-months.</p> <p>1aWDC08 and 1aWDC09 are located to the north of the River Wansbeck estuary in front of Sandy Bay Caravan Park. The survey report notes that the cliff was not surveyed at profile 1aWDC08 or 1aWDC09 due to loose material and therefore has not been analysed.</p> <p>1aWDC08 extends from the cliff across the rock revetment onto the foreshore. The beach at the toe of the rock revetment has risen by less than 0.1m. The middle beach between chainages 42-86m has risen by up to 0.8m, before switching to erosion between chainages 86-160m by up to 0.3m. The lower beach seaward of chainage 160m has risen by up to 0.4m. Overall, the beach profile is at a medium-high level compared to the previous surveys.</p> <p>1aWDC09 extends from the cliffs at the very southern end of the Caravan Park. The rocks exposed at the base of the cliff have been covered by sediment by up to 0.3m between chainages 8-18m. The middle beach between chainages 18-110m has lowered by up to 0.4m, before switching to accretion seaward of chainage 110m by up to 1.0m. Overall, the beach level alternates between a medium to high level compared to the previous surveys.</p> <p>Profiles 1aWDC10 to 1aWDC14 are all located along Cambois Bay, between the River Wansbeck and River Blyth estuaries. The survey report notes that the cliff was not surveyed at profile 1aWDC10 due to loose material and therefore has not been analysed.</p> <p>1aWDC10 is located on the southern side of the Wansbeck Estuary, just to the south of Cambois House. The entire profile has risen from the cliff toe to the end of the survey by up to 1.2m, but generally up to 0.5m. A berm has formed at chainage 105m. Overall, the beach profile is at a high level compared to the range recorded from previous surveys, particularly between chainages 85-130m which is at its highest level recorded.</p> <p>1aWDC11 extends across the rock revetment fronting the now disused foundry. The beach at the toe of the cliffs has risen by up to 0.8m across the upper beach to chainage 110m. The middle beach</p>	<p>The cliff top to the north of the River Wansbeck has not been assessed due to safety concerns during the time of the survey. Beach levels north and south of the River Wansbeck have undergone variable change since the previous survey, with beach levels rising at the toe of the cliffs and lower beach and lowering in the middle of the beach. The only exception is profile 1aWDC10 which has risen across the profile.</p> <p>At the centre of Cambois Bay, the cliff top and cliff face has remained stable at 1aWDC12, however at 1aWDC13 the dune face and dune toe are at their most landward positions recorded. Beach levels have undergone variable change.</p> <p>At the southern extent of Cambois Bay, beach levels at 1aWDC13 have undergone variable change whilst 1aWDC14 has lowered across the profile.</p> <p>Longer term trends: Beach profiles are within the bounds of previous surveys and are generally at a medium-high level across the survey area. Several profiles show progressive erosion of the till and dune cliffs, with several sections showing the most landward positions recorded.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>between chainages 110-170m has lowered by up to 1.0m, before switching to accretion on the lower beach by up to 0.5m. Overall, the beach profile is at a medium-high level on the upper and lower beach, and a low level on the middle beach compared to the range recorded from previous surveys.</p> <p>1aWDC12 is situated approximately mid-way along Cambois Bay. Since the last survey, the beach level has generally risen by up to 0.2m on the upper beach and 0.6m on the lower beach. Two short sections of erosion have occurred between chainages 26-35m and 65-97m which have lowered by up to 0.3m. Overall, the upper beach profile is at a medium- level, whilst the lower beach is at a high level compared to the range recorded from previous surveys.</p> <p>At 1aWDC13 is located to the centre-south of Cambois Bay. There has been a retreat of the dune face and dune toe by 1.0m. The beach level at the toe of the dunes has risen by up to 0.2m to chainage 34m with very little change occurring to chainage 60m. The middle beach between chainages 60-90m has lowered by up to 0.2m, switching tot accretion on the middle-lower beach by up to 0.2m. The lower beach seaward of chainage 90m has lowered by up to 0.6m. The dune face is at its most landward positions recorded. The rest of the beach profile is at a medium-high level compared to the range recorded from previous surveys.</p> <p>1aWDC14 is located to the south of Cambois Bay, at North Blyth. The dune face has retreated by approximately 0.2m. The rest of the beach profile, except for a short section between chainages 95-120m, has lowered by up to 0.3m. Accretion is limited to less than 0.1m. A rock patch has been exposed between chainages 21-50m. Overall, the cliff face is at its most landward positions recorded. The beach is at a relatively low level compared to the range recorded from previous surveys.</p>	
September 2023	<p>Cliff-top Survey: Cliff top survey data collected for baseline survey (spring, 2009), the previous Partial Measures survey (spring 2023) and the present Full Measures survey (autumn, 2023) is presented in this report.</p> <p>The cliff top survey is carried out as a continuous cliff edge line survey in two locations within Cambois Bay; at Sandy Bay Caravan Park to the north of the River Wansbeck estuary, and Cambois Bay from south of the River Wansbeck to the breakwater at the southern end of the bay. The results from the cliff top monitoring are anticipated to have an accuracy of $\pm 0.2\text{m}$ due to the technique used. Furthermore, problems in precisely locating the cliff top, due to vegetation growth or the indistinct form of the cliff top, have also affected the data quality.</p>	<p>Since the last survey in spring 2023, the cliff top along Sandy Bay Caravan Park and Cambois Bay appears to have been relatively stable along its full frontage, with relatively little change recorded.</p> <p>Longer term trends: At Sandy Bay Caravan Park the cliff top retreat has been more significant in the southern part of the survey area with up to 10m of erosion since 2008, whilst the northern part has eroded by c.1.0-3.0m.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>There has been relatively little change between the spring 2023 and autumn 2023 survey, with only a few small sections of cliff edge eroding by <0.5m.</p> <p>Along the Cambois Bay frontage the cliff tops have remained relatively stable along much of the extent of the survey. There are minor variations in cliff top positions, mostly limited to <0.3m. A blowout opposite the more 'southern' public car park has retreated landward by approximately 7.0m.</p>	<p>In Cambois Bay, the area of greatest cliff top retreat since the surveys began in 2009 is the centre of the bay opposite Ridley Terrace, Cambois, where up to 12.0m of erosion has occurred. The north and south of the bay have retreat more typically c.1.0-5.0m.</p>

2.16 Blyth South Beach

Survey Date	Description of Changes Since Last Survey	Interpretation
16 th September 2023	<p>Beach Profiles:</p> <p>Blyth South Beach is covered by six beach profile lines for the Full Measures survey (Appendix A). All profiles are resurveyed every 6-months.</p> <p>1aBVBC01 is located towards the north of South Beach, in front of the area of land owned by the Port of Blyth. There have been some minor changes to the form of the dunes, limited to $\pm 0.1\text{m}$, but their position remains unchanged since the last survey (Partial Measures, spring 2023). The dune toe has lowered by up to 0.3m to chainage 75m. The rest of the beach profile has undergone alternating sections of erosion and accretion by up to $\pm 0.2\text{m}$ on the upper – middle beach and up to $\pm 0.9\text{m}$. Overall, the profile is at a high level on the dunes, upper and middle beach, particularly on the dunes between chainages 36-44m which is at its highest level recorded. The lower beach is at a low level compared to the range recorded from previous surveys.</p> <p>1aBVBC02 shows a lowering of the beach profile by up to 0.4m on the upper beach, $< 0.1\text{m}$ on the middle beach and 0.5m on the lower beach. Overall, the beach profile is generally at a medium level compared to the range recorded from previous surveys.</p> <p>At 1aBVBC03 the dunes have lowered by up to 0.2m between 0-70m chainage and risen by up to 0.2m between chainages 75-100m. The lower dune face and upper beach to chainage 180m has lowered by up to 0.6m. Seaward of this point, the middle and lower beach has risen by up to 0.1m on the middle beach and 0.6m on the lower beach. Meggie's Burn channel has remained in a relatively straight alignment since the previous survey (last being surveyed in autumn 2021) from Google Earth imagery taken in June 2023 and may run parallel to this profile for now. Overall, the beach profile is at a medium-low level compared to the range recorded from previous surveys.</p> <p>At 1aBVBC04, the crest of the dunes has lowered by less than 0.1m. The toe of the dunes has risen by up to 0.8m to chainage 83m and the middle beach between chainages 100-171m by up to 0.5m. There is a small section of lowering between chainages 83-100m however this is limited to less than 0.1m. The lower beach has also lowered seaward of chainage 171m by up to 0.6m. Overall, the beach is at a medium level compared to the range recorded from previous surveys.</p>	<p>Since the last survey, the dunes and dune face at Blyth South Beach have remained largely stable, retaining the same form and position and some small areas of erosion/accretion limited to $\pm 0.2\text{m}$.</p> <p>There has been variable accretion and erosion across the beach at Blyth South Beach, associated with the seasonal migration of berms across the profile.</p> <p>Longer term trends: At Blyth South Beach, the dunes have generally demonstrated a long-term trend of stability.</p> <p>The changes in beach profile form and position observed since the last survey are generally within the bounds of previous surveys. Meggies Burn remains in a 'straighter' alignment (adjacent to the coast) and is missed by the survey profile 1aBVBC03.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>At 1aBVBC05, there has been little change to the form or position of the dunes since the last survey (Partial Measures, spring 2023), with minor sections of erosion/accretion of up to ± 0.1m. The upper and middle beach has risen by up to 1.2m to chainage 180m. Seaward of this point, the beach lowers by up to 0.8m. The dunes remain at a high level compared to the range recorded from previous surveys. The beach profile is at a medium-high level compared to the range recorded from previous surveys.</p> <p>At profile 1aBVBC06, there has been no significant change to the position or form of the dunes since the last survey (Partial Measures, spring 2023) with only small areas of erosion/action of ± 0.1m. The beach has alternated between accretion on the upper (up to 1.0m) and lower beach (up to 0.5m) and erosion in the middle beach (up to 0.5m). The dunes and beach profile are at a medium-high level, when compared to the range recorded from previous surveys.</p>	

4. Problems Encountered and Uncertainty in Analysis

Individual Profiles

- At profiles 1aBTBC19 and 1aBTBC20, the survey report states that the offshore extent of the survey is limited by a drain. This drain is likely a runnel which separates the barrier feature in the lower foreshore from the rest of the beach.
- At profile 1aBTBC26, the survey report notes that it was unsafe to survey the end of the section as the mud was too thick.
- Profiles 1aADC08 and 1aADC09 end at the river.
- The start of sections 1aAD15A and 1aADC16 were unable to be surveyed due to access being denied by homeowner.
- At profile 1aADC16B, the section starts at a new fence.
- Profile 1aWDC01 is no longer measured.
- At profiles 1aWDC08 – WDC10, there was unsafe loose material which prevented the survey of the cliff face.
- Profile 1aWDC10 terminates at a river.
- New ditches are being dug to help keep sand off the causeway at Holy Island.

Topographic Survey

- The surveyor's report notes that the River Lyne was too deep to survey bed levels.

Cliff Top Surveys

- At Cambois Bay, the surveyors noted that very thick dense vegetation at north end of the cliffs hindered surveying. This was also noted in all previous reports.

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

At Lynemouth, the refuse in amongst the colliery spoil has become exposed in the cliff face prompting Northumberland County Council to develop a waste management scheme at Lynemouth Bay to prevent this material being released into the wider environment, causing unwanted adverse aesthetic and environmental effects. A *Site Restoration & Aftercare* report was submitted which recommended that enhanced coastal monitoring be undertaken to define the ongoing rates of coastal erosion along the frontage, both before and after the waste management scheme is implemented.

It was recommended that the pre-existing Cell 1 monitoring will continue at Lynemouth Bay and, from December 2020 onwards, was enhanced with the following additions:

- 6-monthly topographic survey of the beach (from the toe of the cliffs/slopes down to low water);
- 6-monthly survey of the cliff-top and/or cliff-toe position of the colliery spoil cliffs.

A baseline bathymetric survey will also be undertaken in the near future (possibly 2024), extending profile 1aCMBC03B seaward to the 20m sea bed contour along a shore-normal corridor.

The scope of the enhanced coastal monitoring is shown in **Figure 6**.

All surveys within the proposed construction works area will temporarily be suspended during the construction works (which are currently scheduled to commence in March 2024) and will re-commence thereafter upon completion of the waste management scheme.

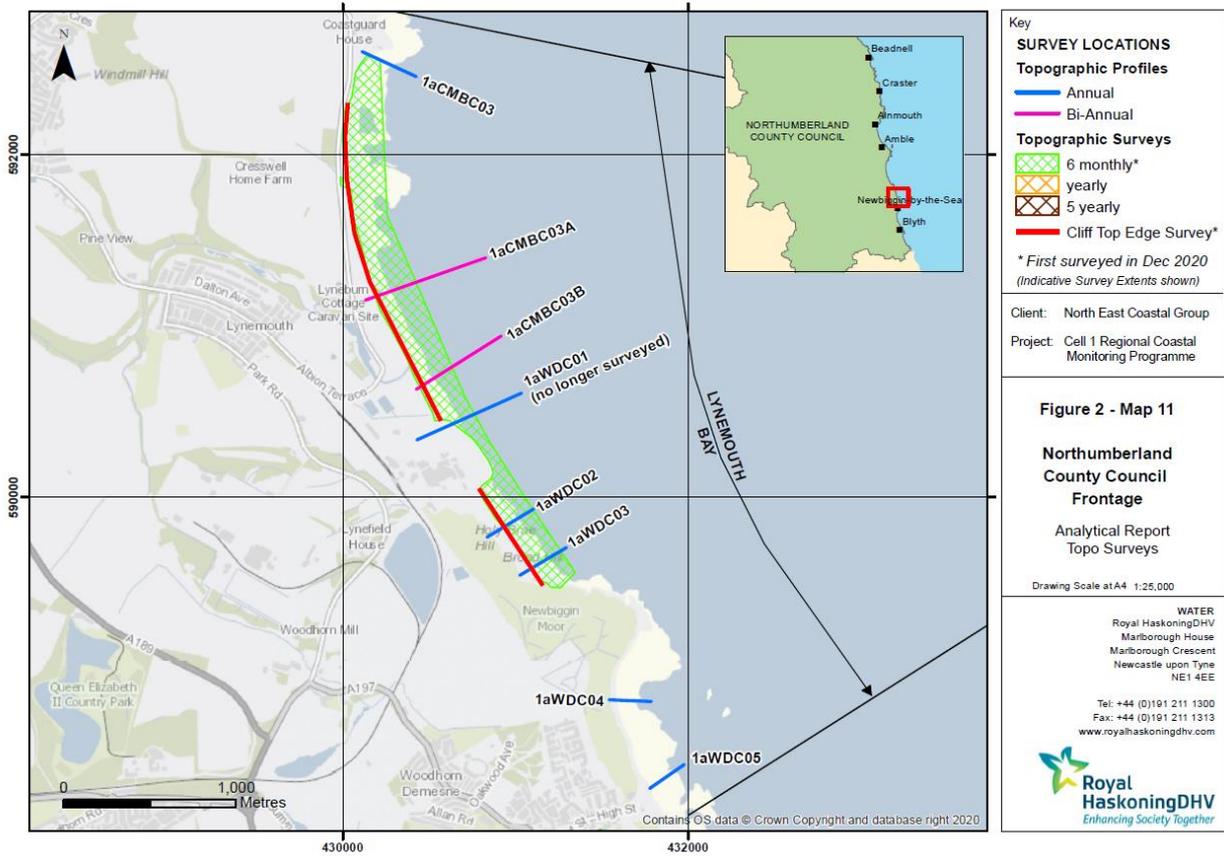


Figure 6 – Scope of Enhanced Coastal Monitoring

6. Conclusions and Areas of Concern

- At Sandstell Point (Spittal A), the recorded profiles and topographic survey present no causes for concern. However, the seaward face of the dune at profiles 1aBTBC01 and 1aBTBC03 have shown a continued landward recession since October 2017.
- At Spittal (Spittal B), the recorded profiles present no causes for concern.
- At Goswick Sands, the recorded profiles present no causes for concern. The barrier feature in the seaward end of profile 1aBTBC18 shows movement and is likely to be a cyclical feature.
- At Holy Island, the recorded profiles and topographic survey present no causes for concern.
- At Bamburgh, the recorded profiles present no causes for concern.
- At Beadnell Village, the recorded profiles present no causes for concern.
- At Beadnell Bay, the recorded profiles present no causes for concern.
- At Embleton Bay, the recorded profiles present no cause for concern.
- At Boulmer, the recorded profiles present no cause for concern.
- At Alnmouth Bay, the recorded profiles present no cause for concern.
- At High Hauxley & Druridge Bay, the recorded profiles present no cause for concern (although it is known that erosion has subsequently occurred to the coastal slope at Hauxley after the Full Measures 2023 survey).
- At Lynemouth Bay, the recorded profiles show a continuous retreat of the colliery spoil cliff, particularly post-storm season (November 2023).
- At Newbiggin-by-the-Sea, the recorded profiles present no causes for concern. Results from the sand extent survey show a considerable advancement across much of the survey extent. There has been no significant movement in cliff top position since the previous survey.
- At Cambois Bay, the recorded profiles present no cause for concern, however several sections of the till and dune cliffs are now at their most landward positions recorded. This should be monitored.
- At Blyth South Beach, the profiles present no cause for concern. There is known to be an issue with the channel of Meggies Burn extending across the foreshore and in places undermining the beach groyne, however, for now, the channel appears to be in a 'straighter' alignment (adjacent to the coast) and is missed by the survey profile 1aBVBC03. It is possible that the channel will 'swing' around to the north once again and will be picked up in the next survey (Spring 2024).

Appendices

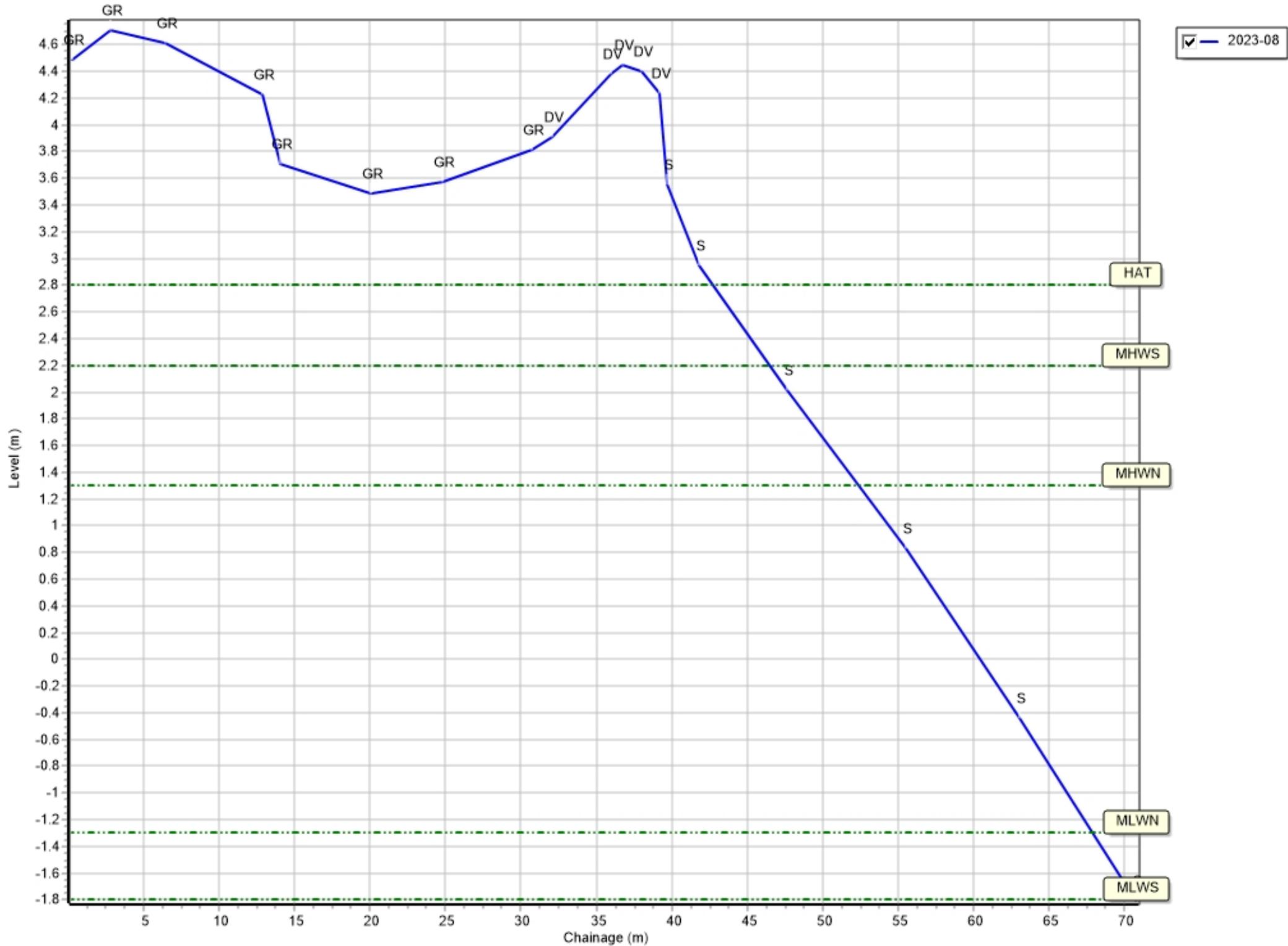
Appendix A

Beach Profiles

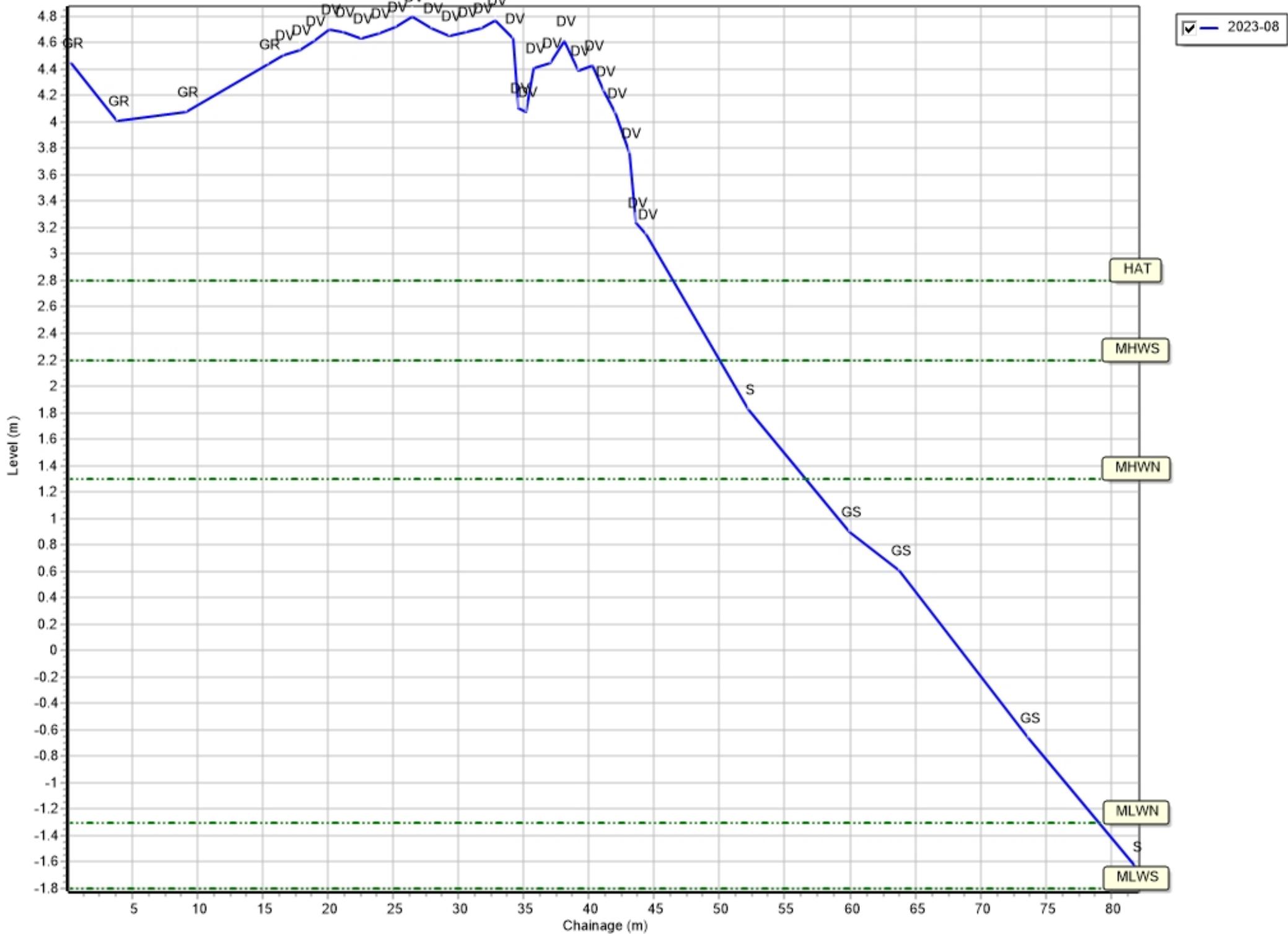
The following sediment feature codes are used on some profile plots:

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

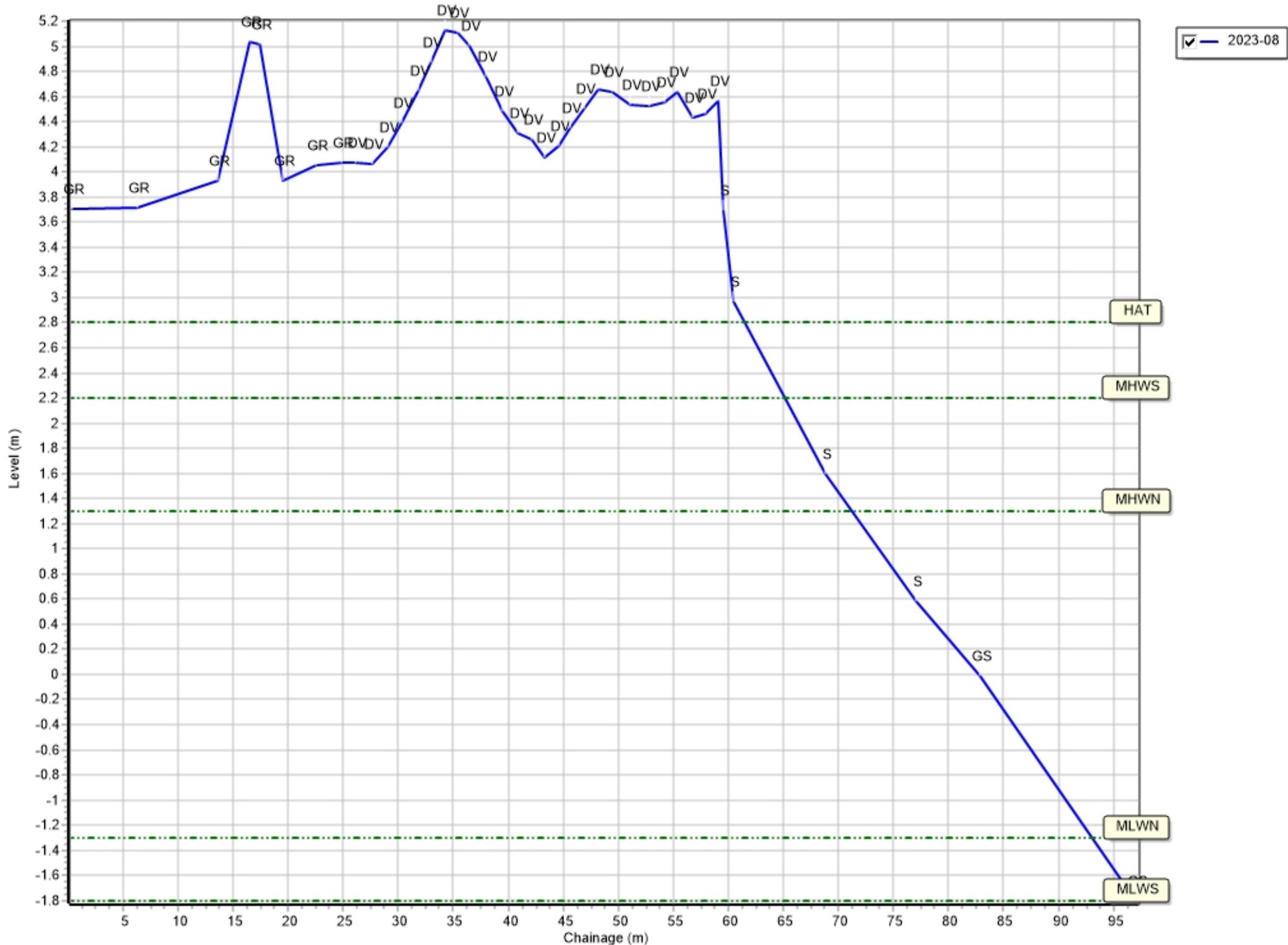
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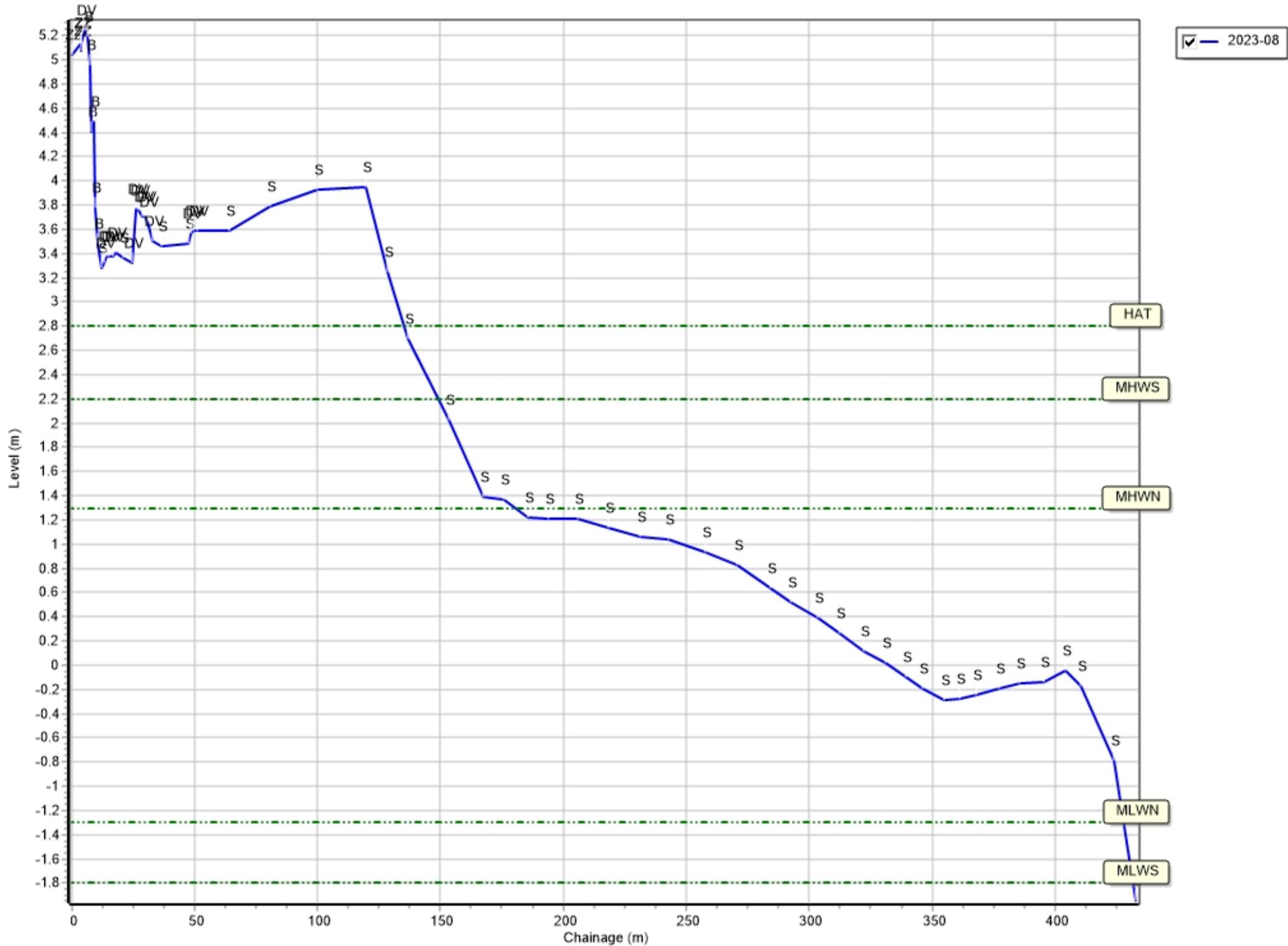
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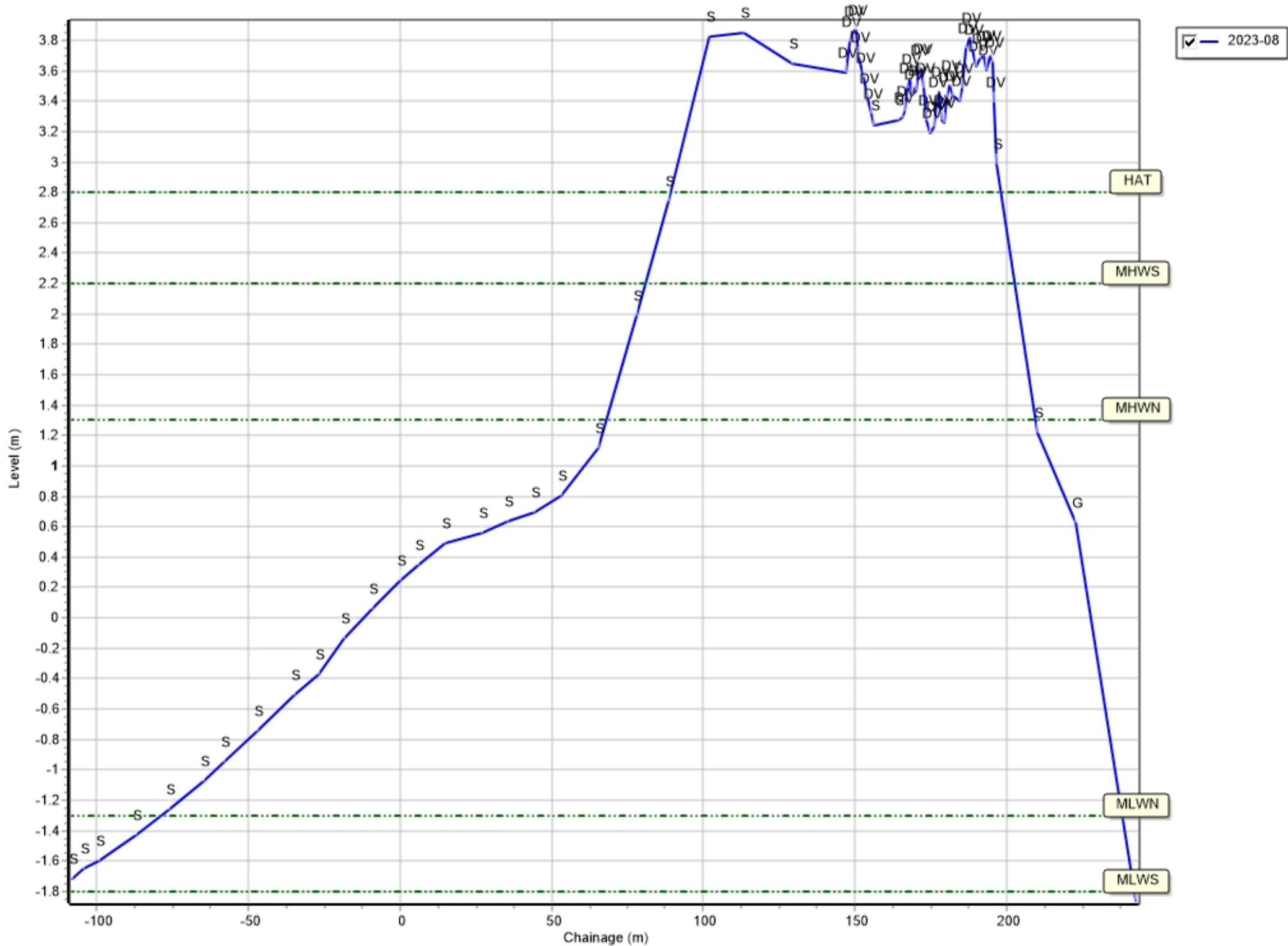
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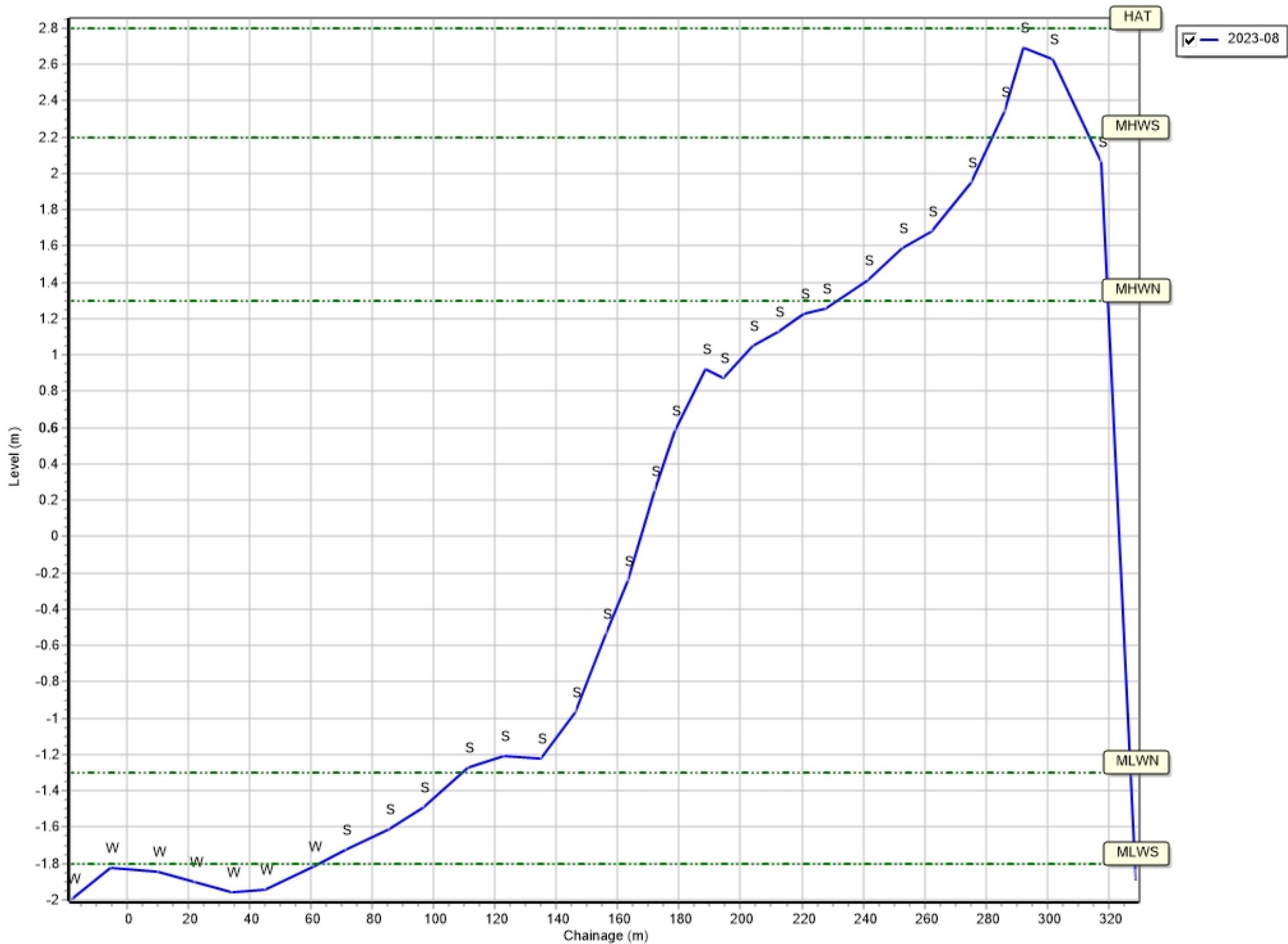
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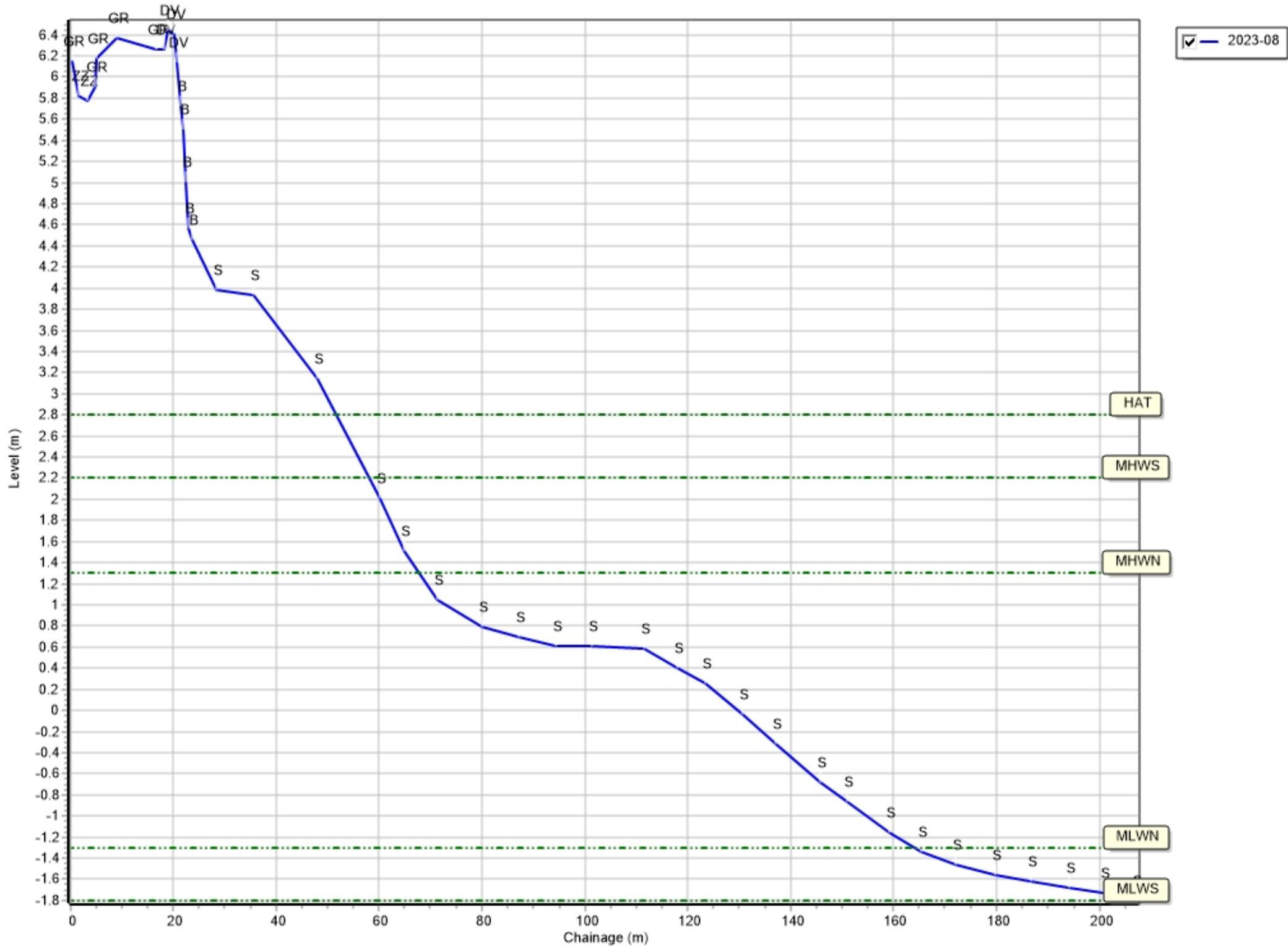
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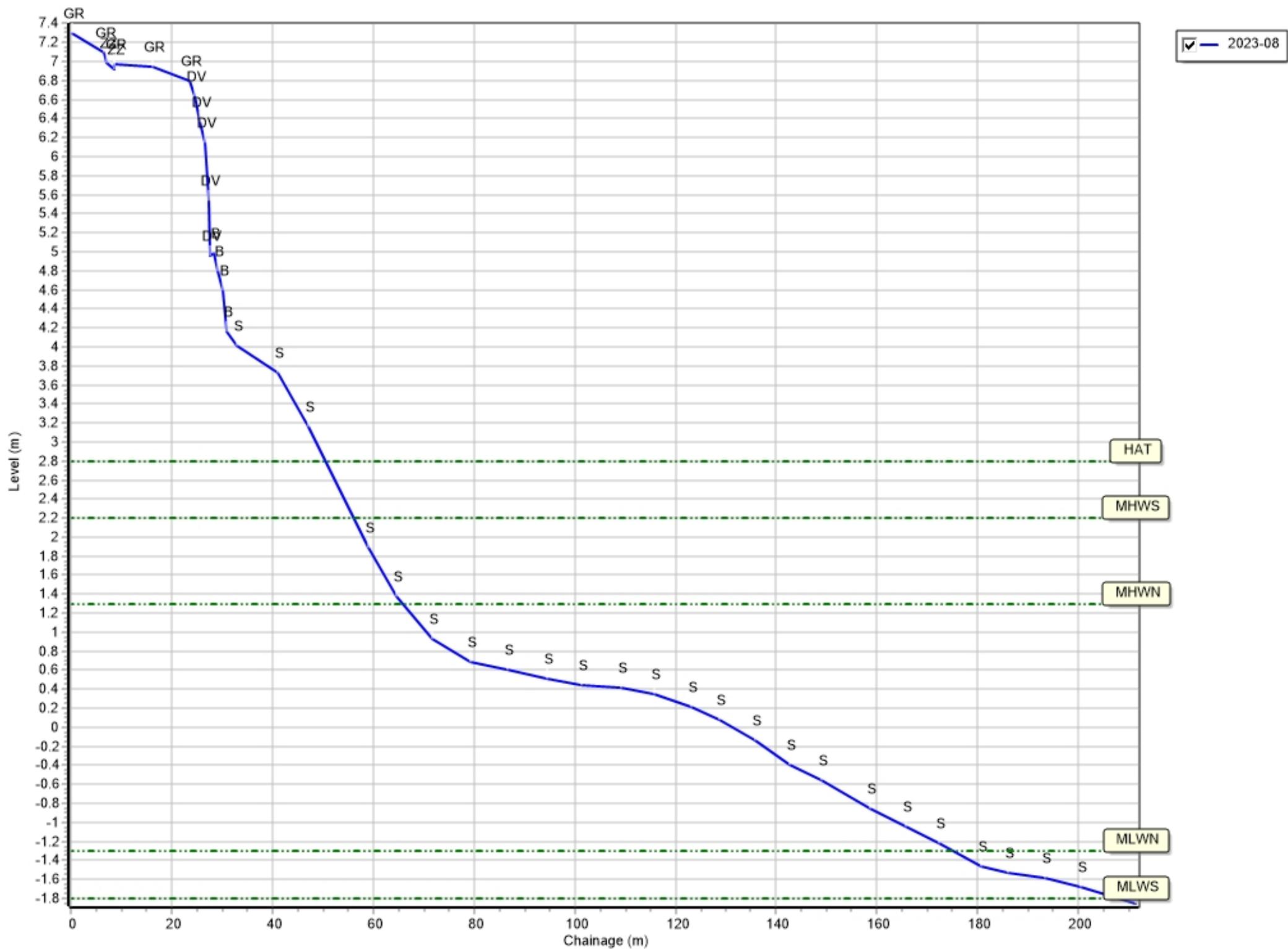
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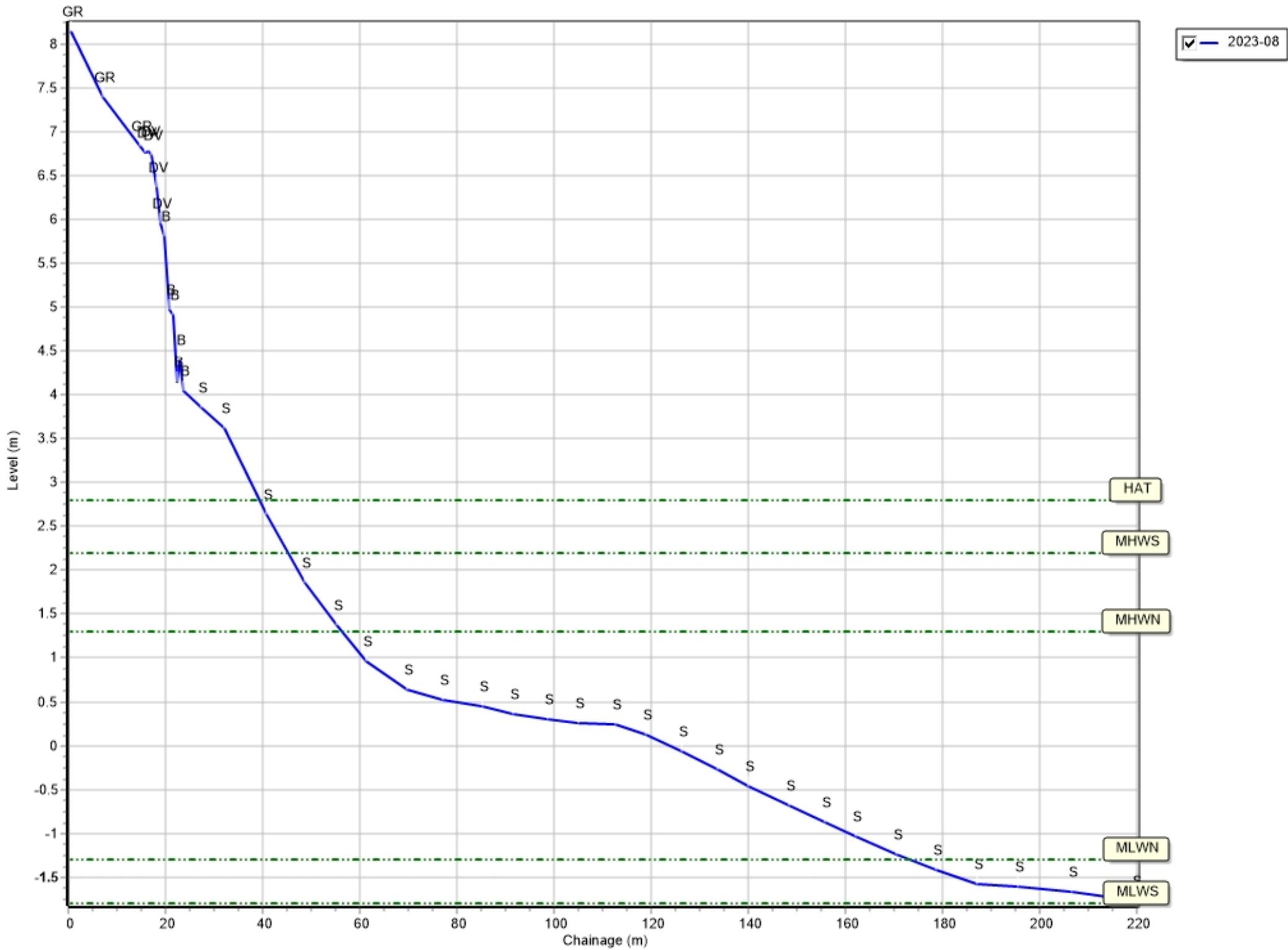
Profiles: 1aBTBC07



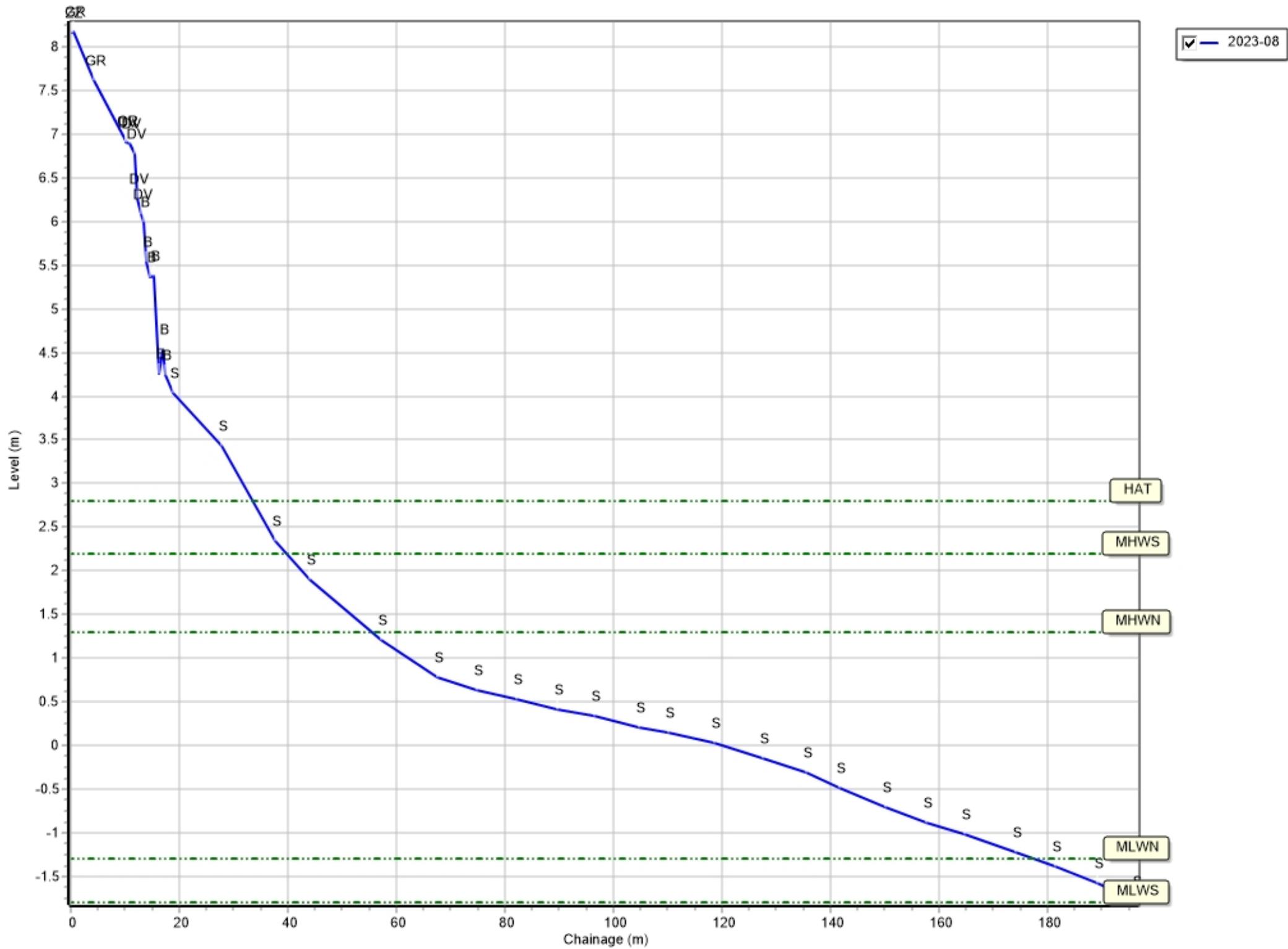
Profiles: 1aBTBC08



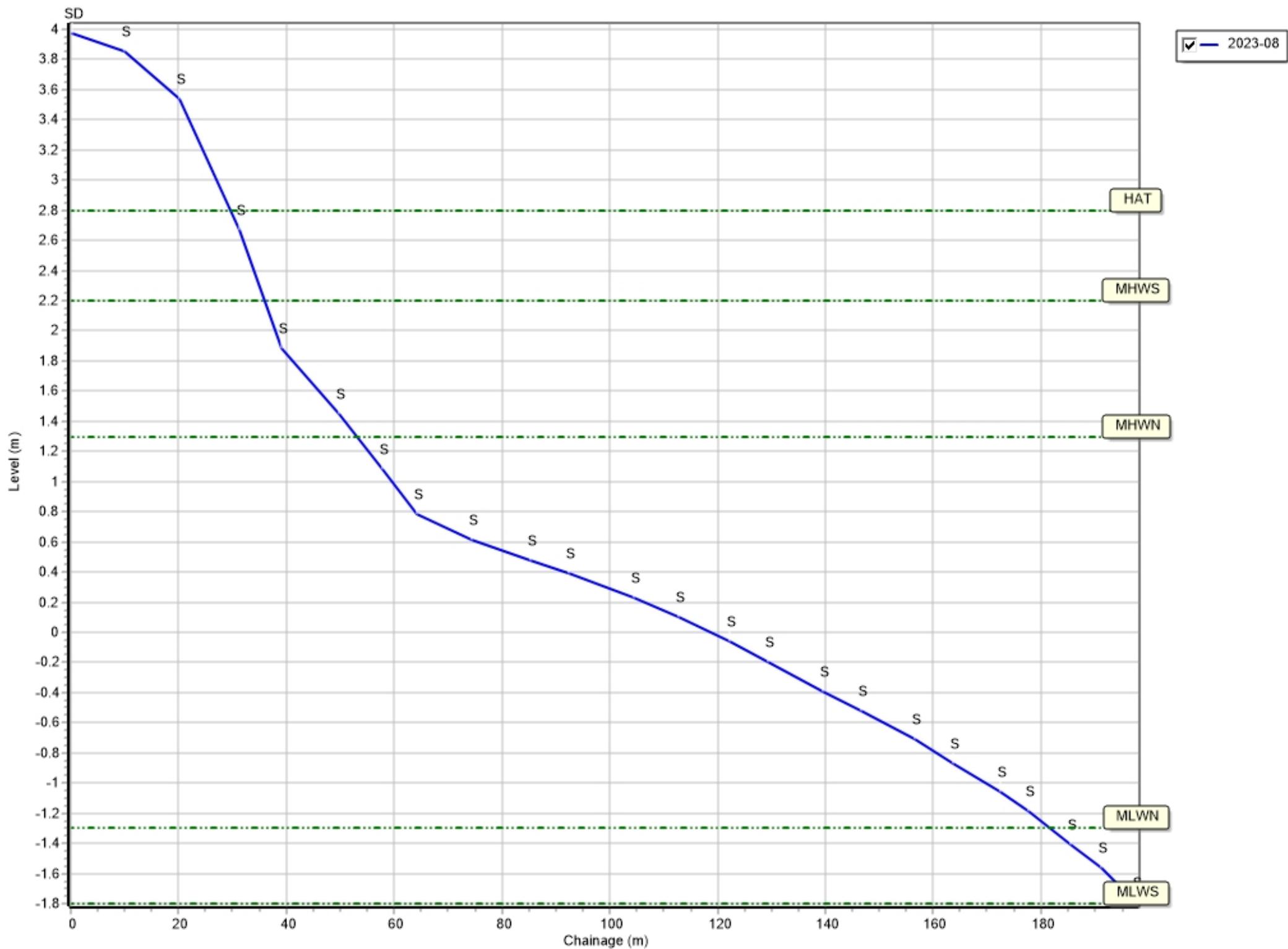
Profiles: 1aBTBC09



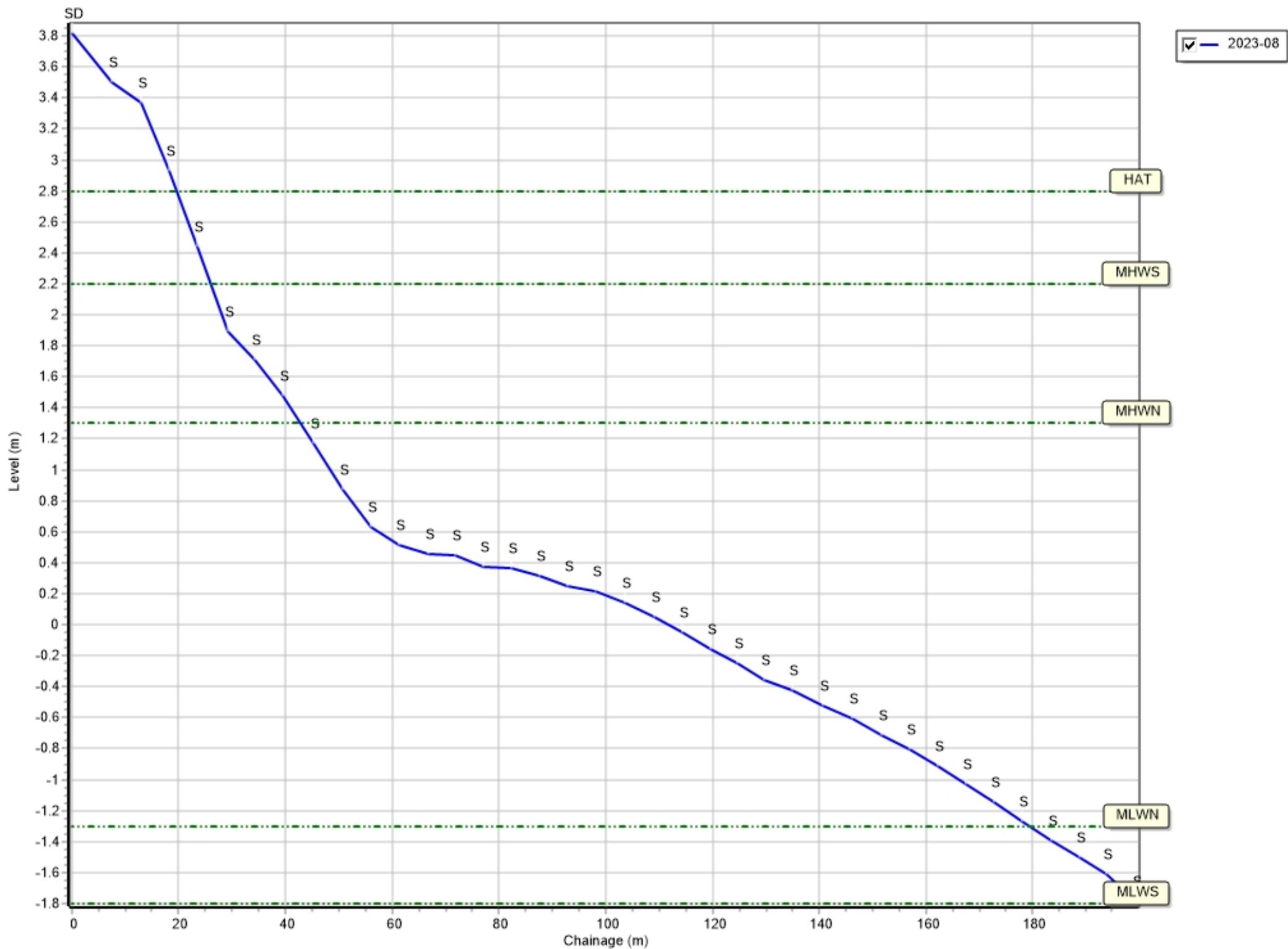
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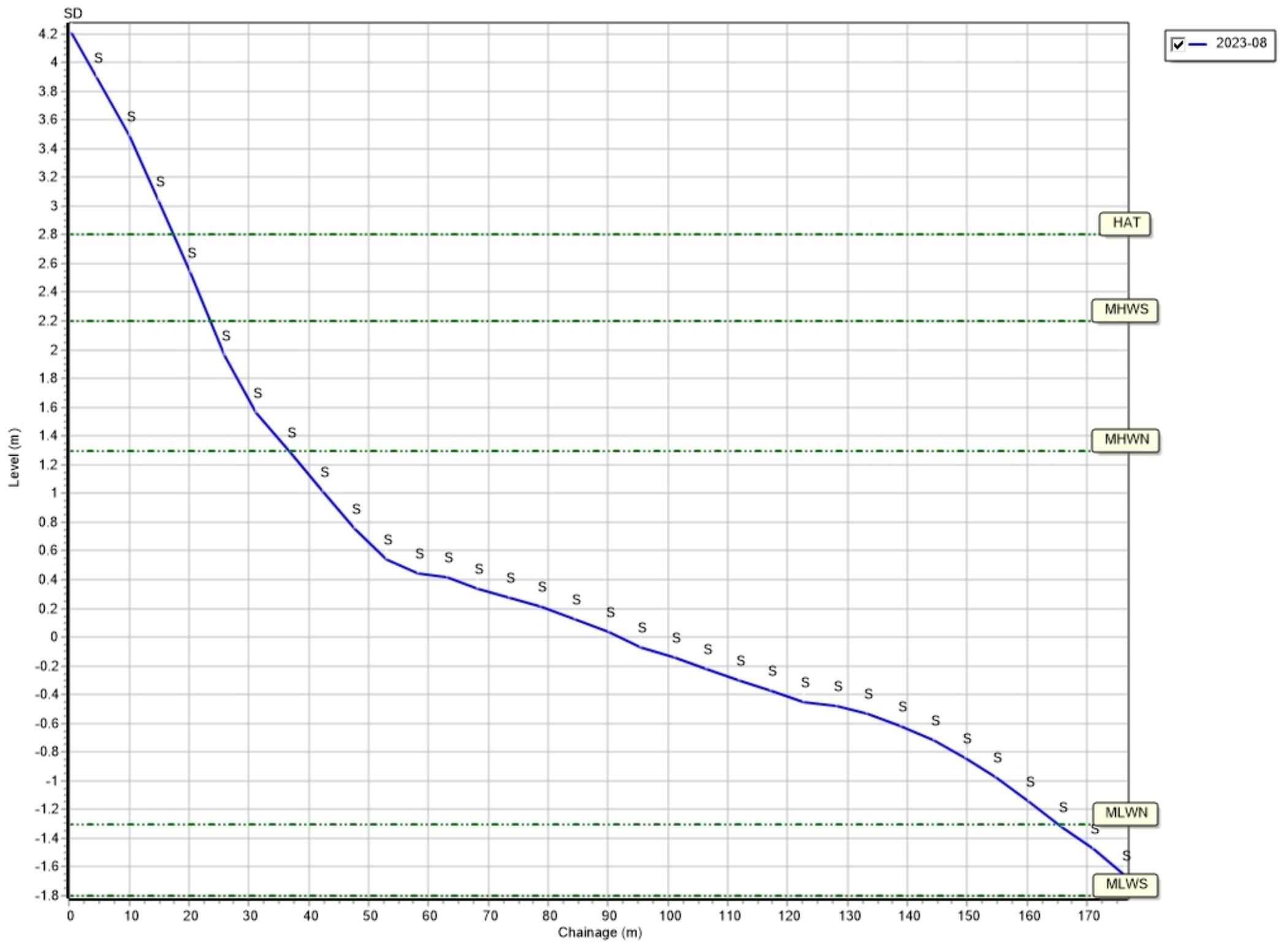
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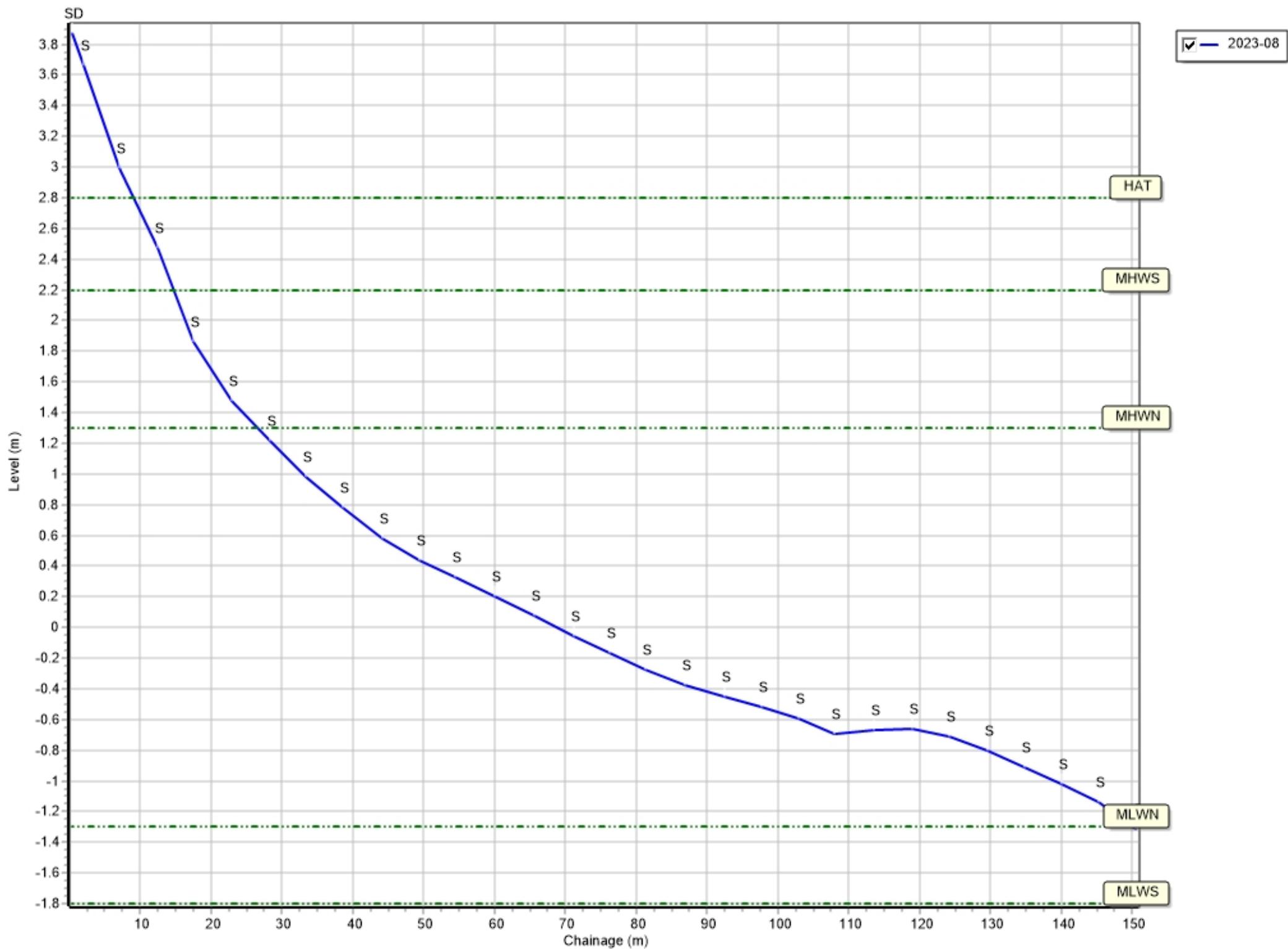
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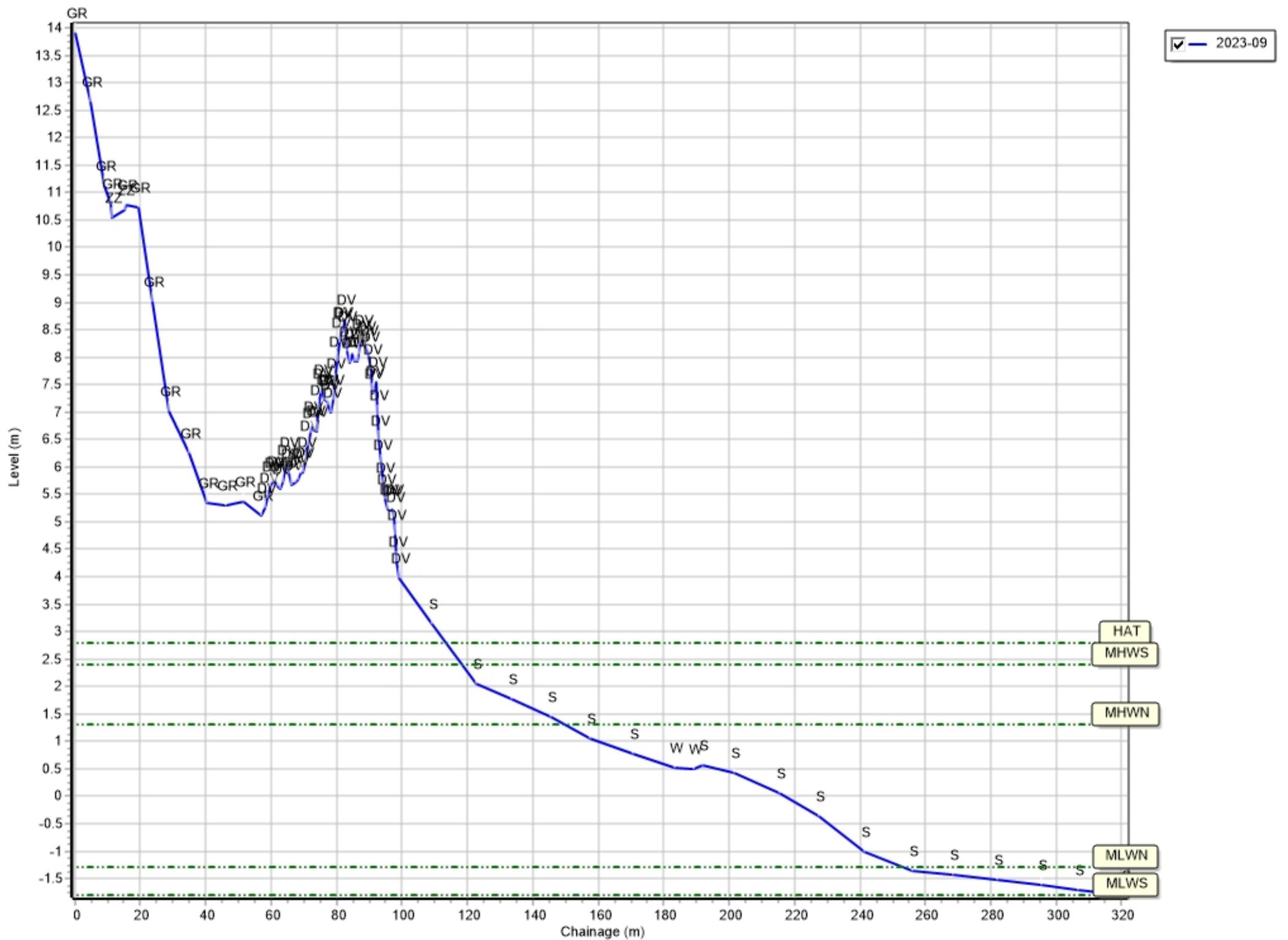
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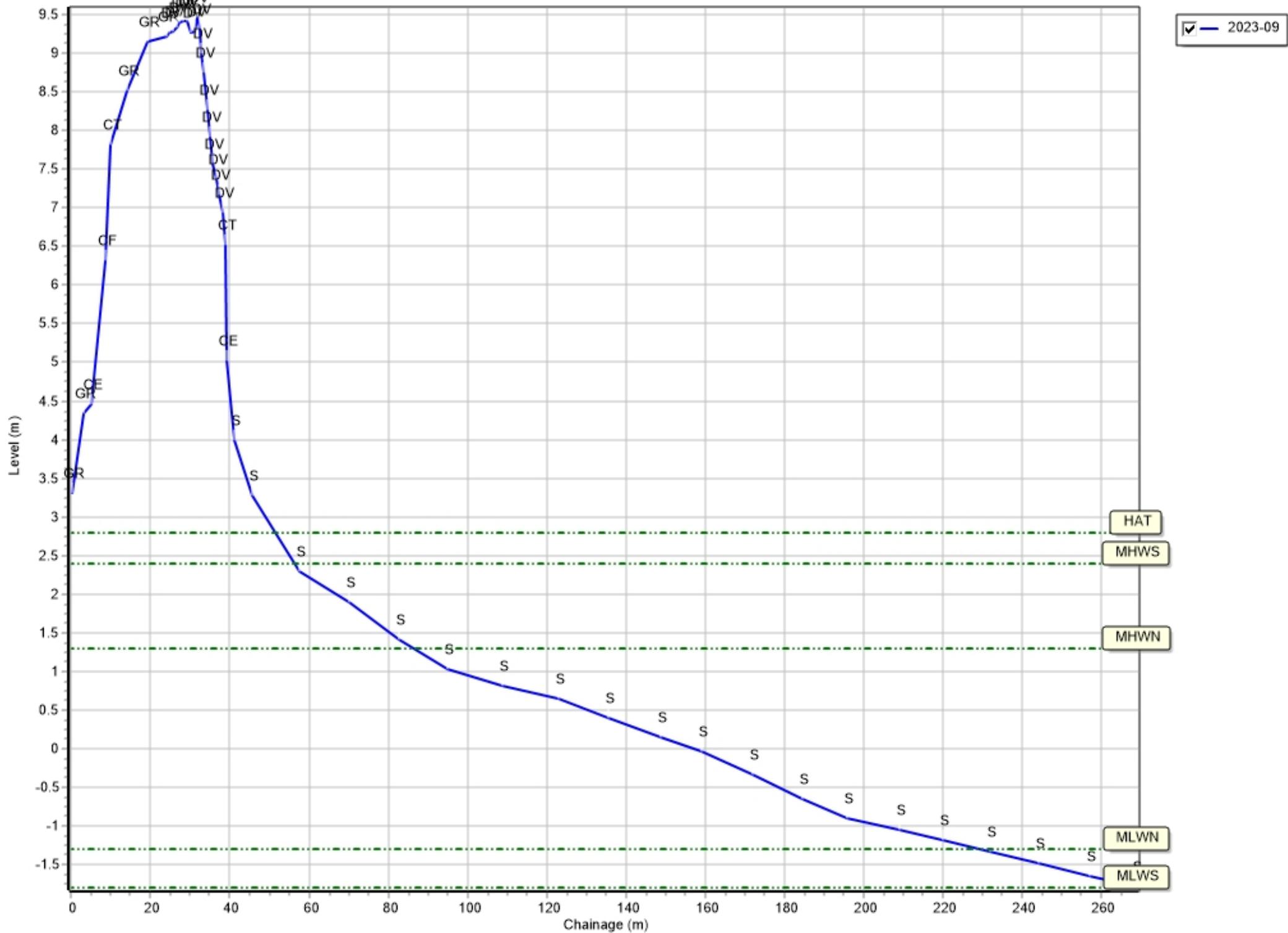
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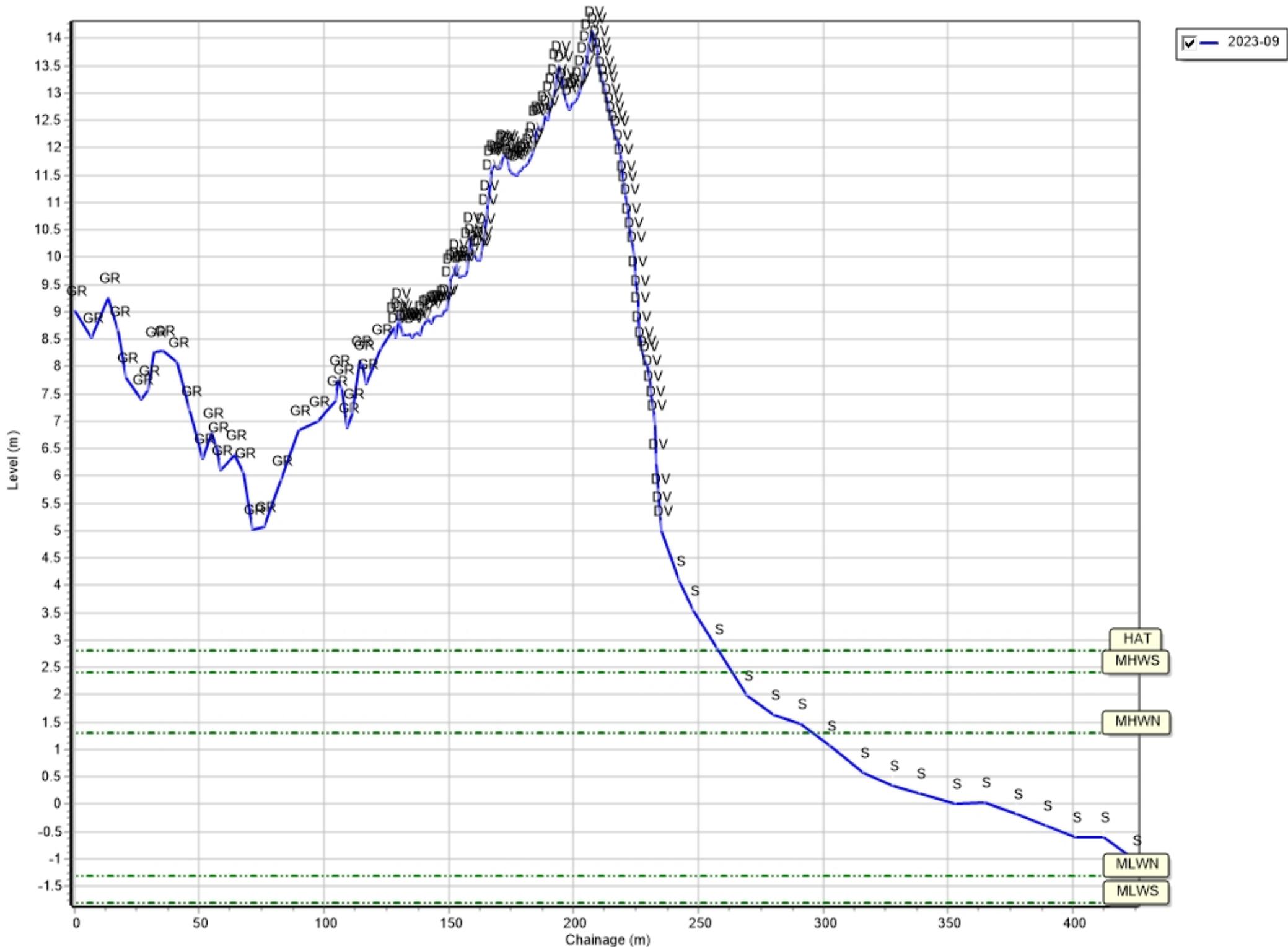
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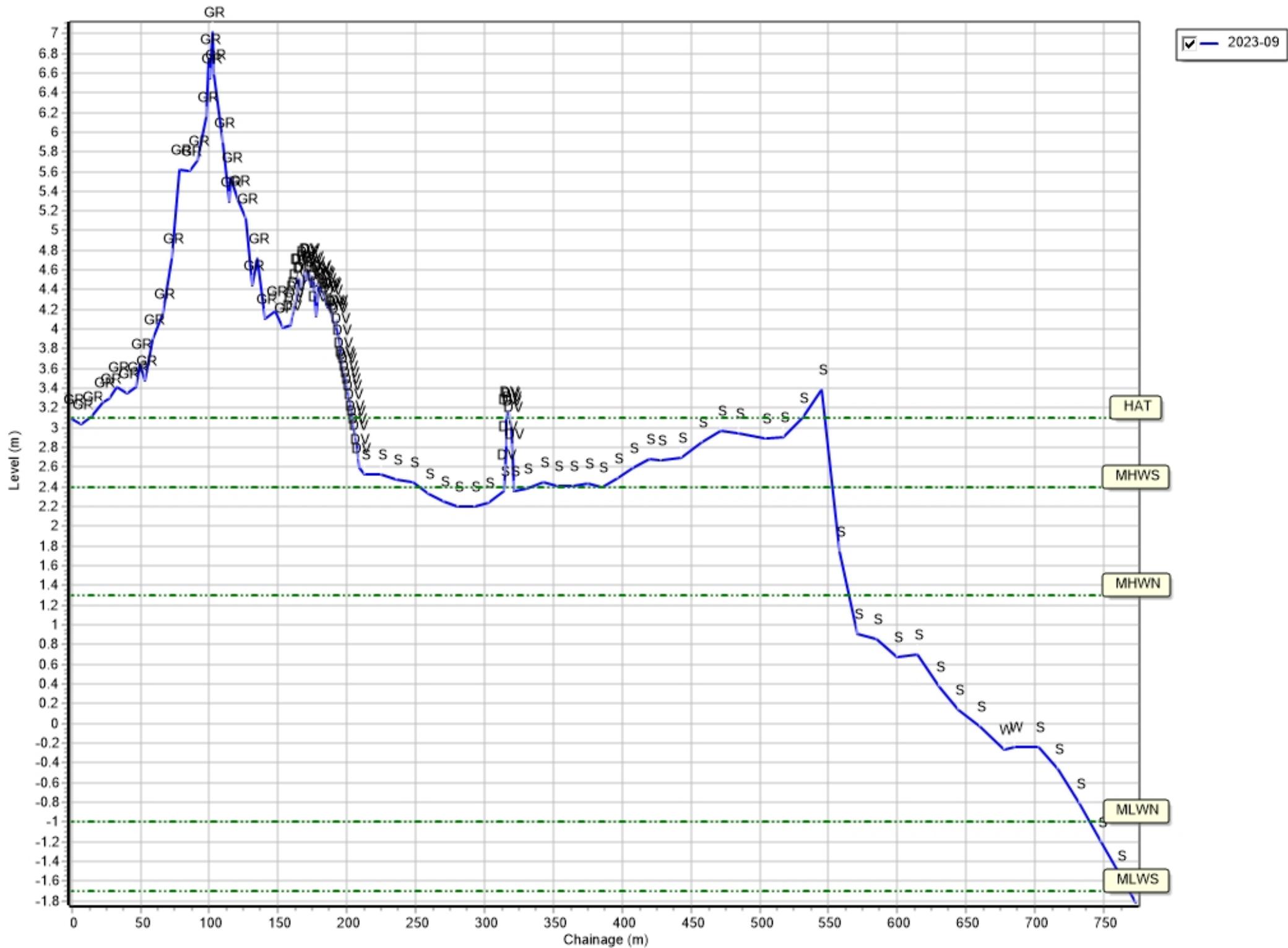
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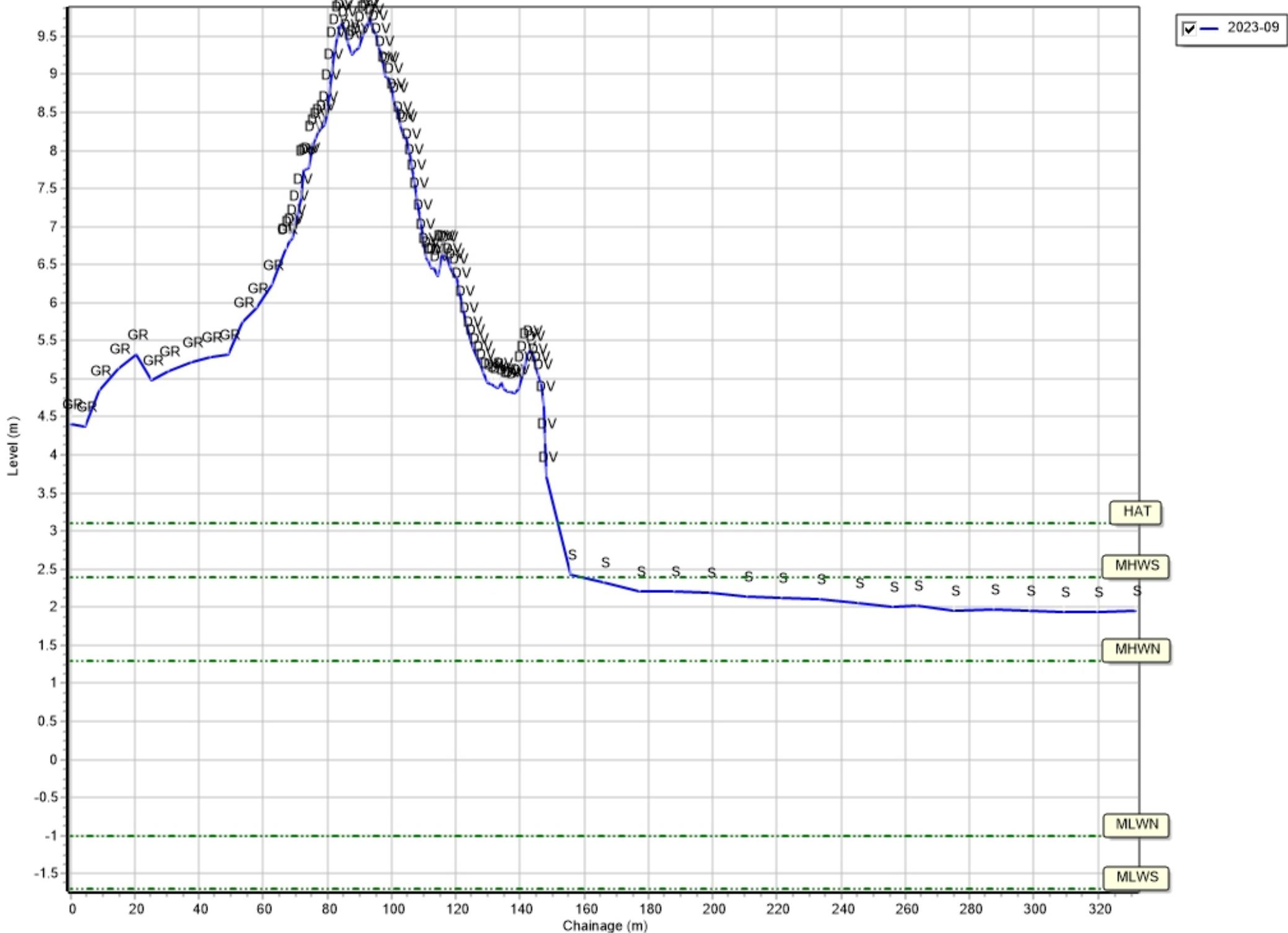
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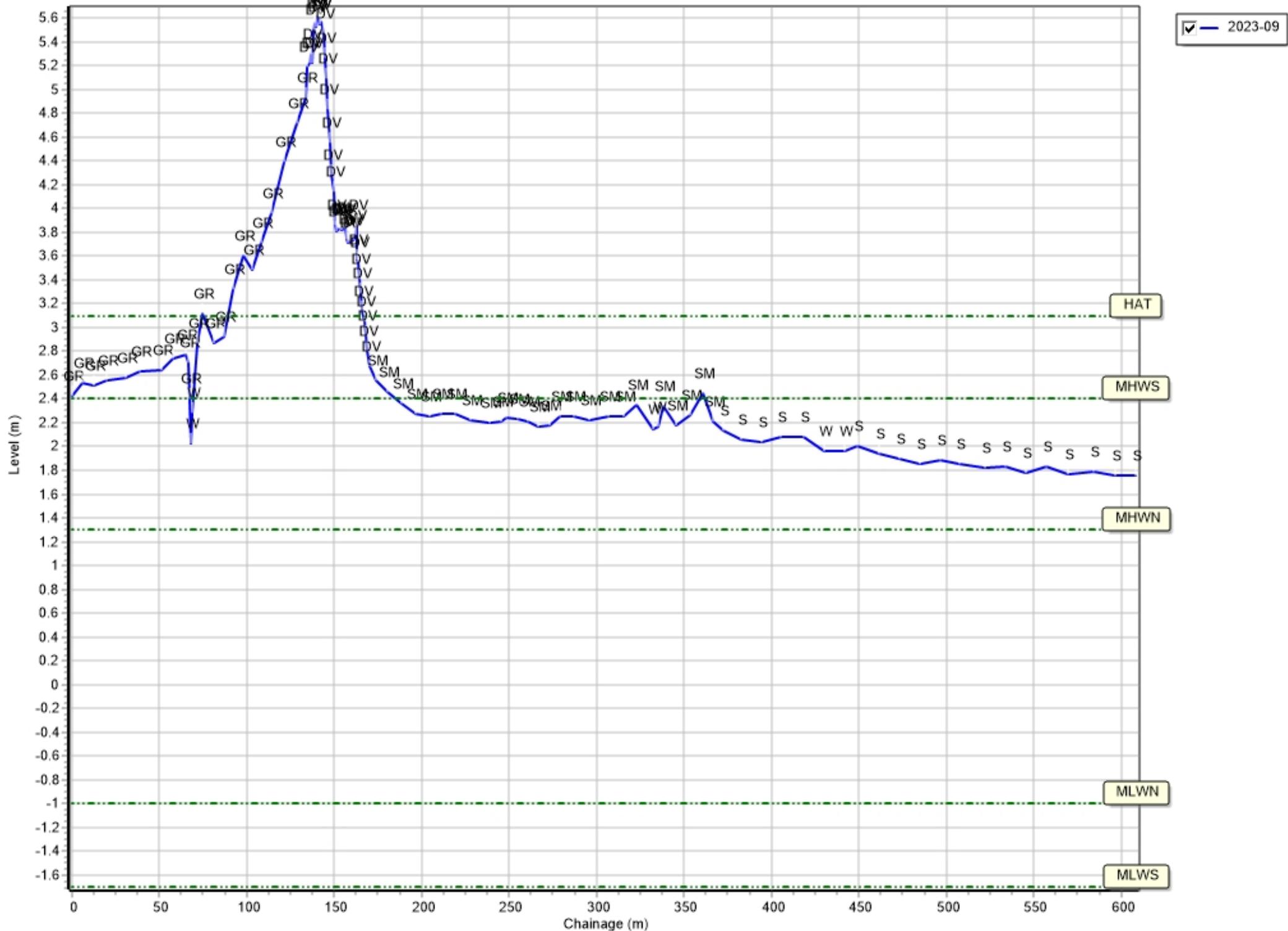
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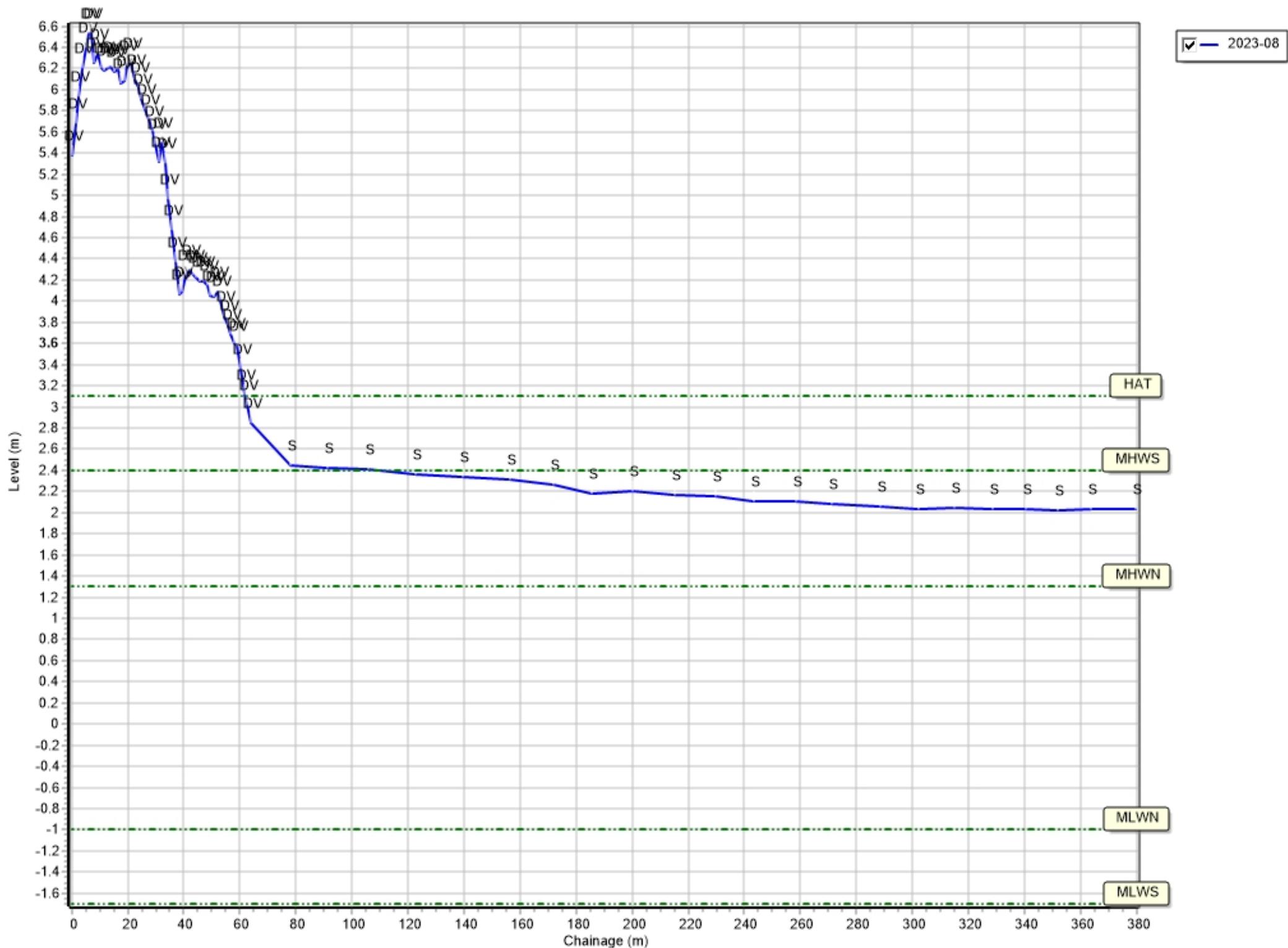
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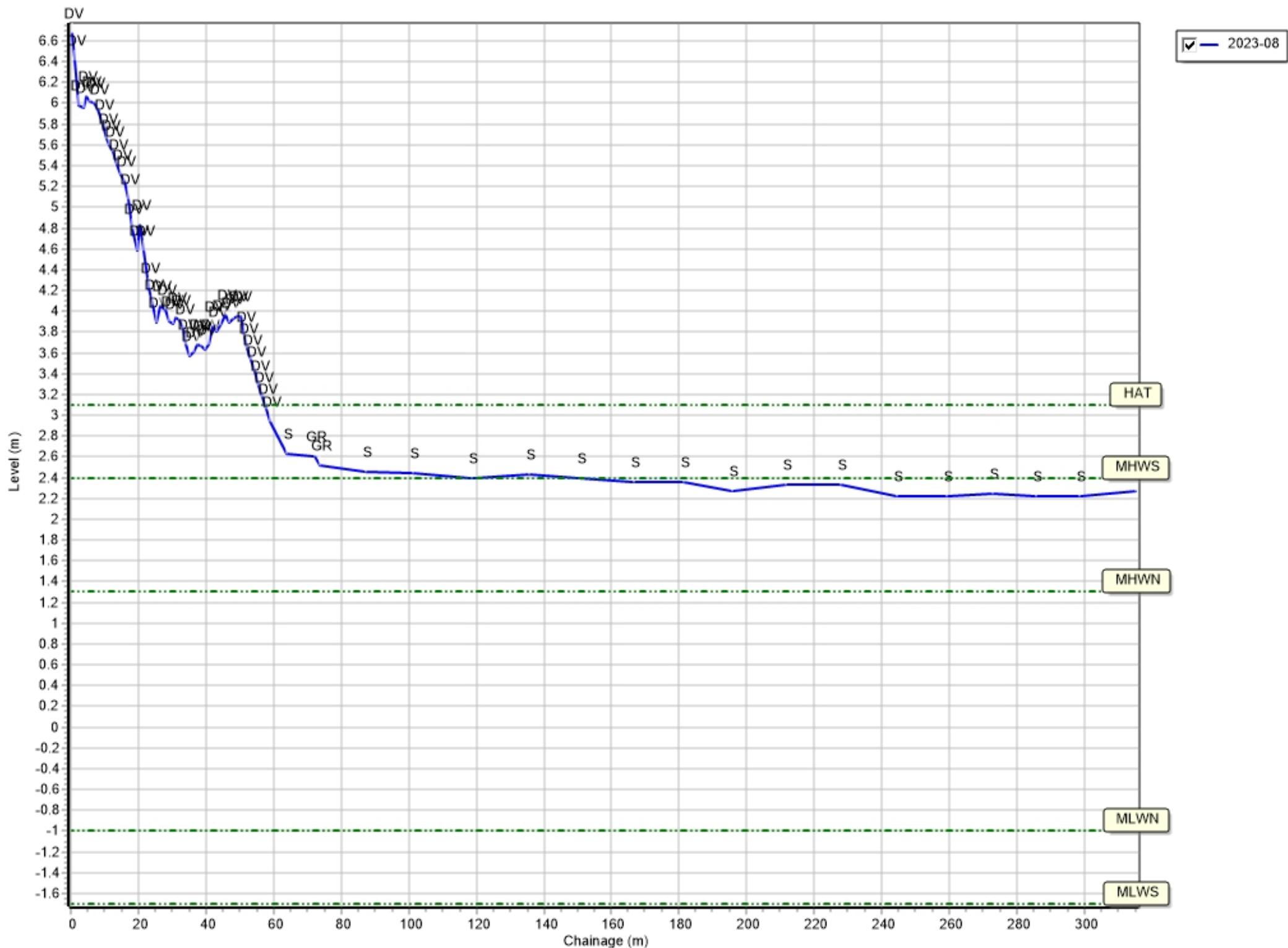
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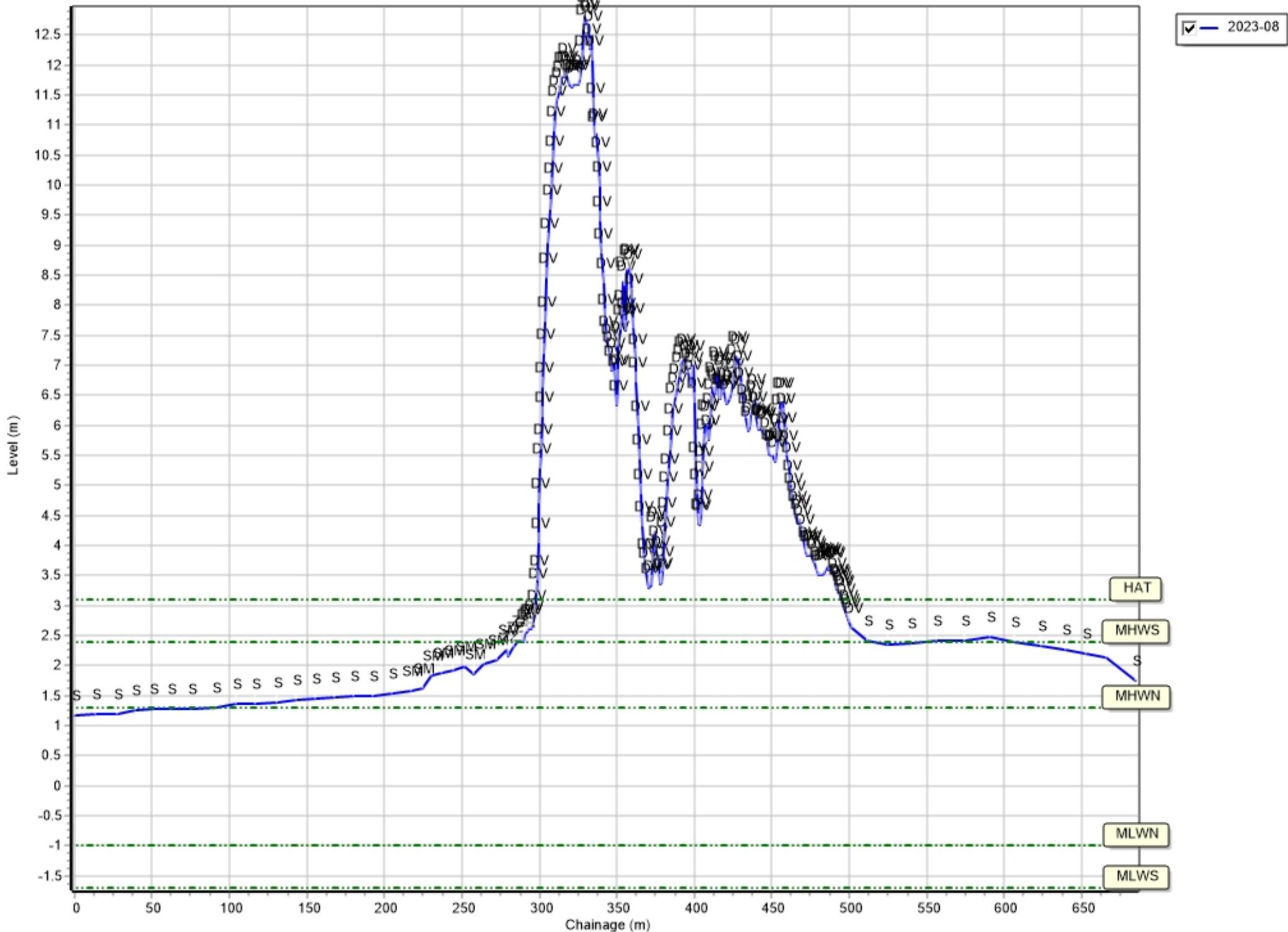
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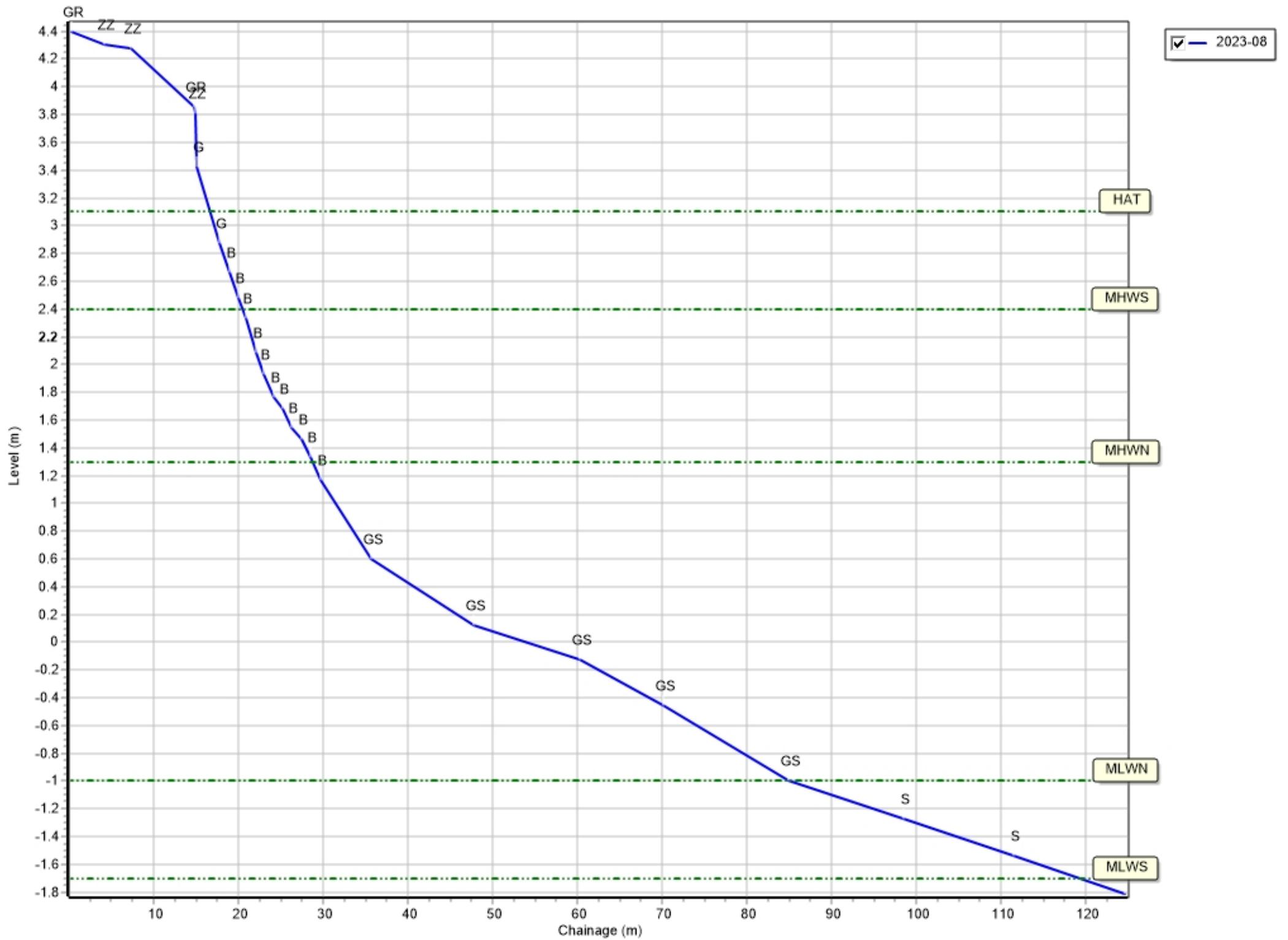
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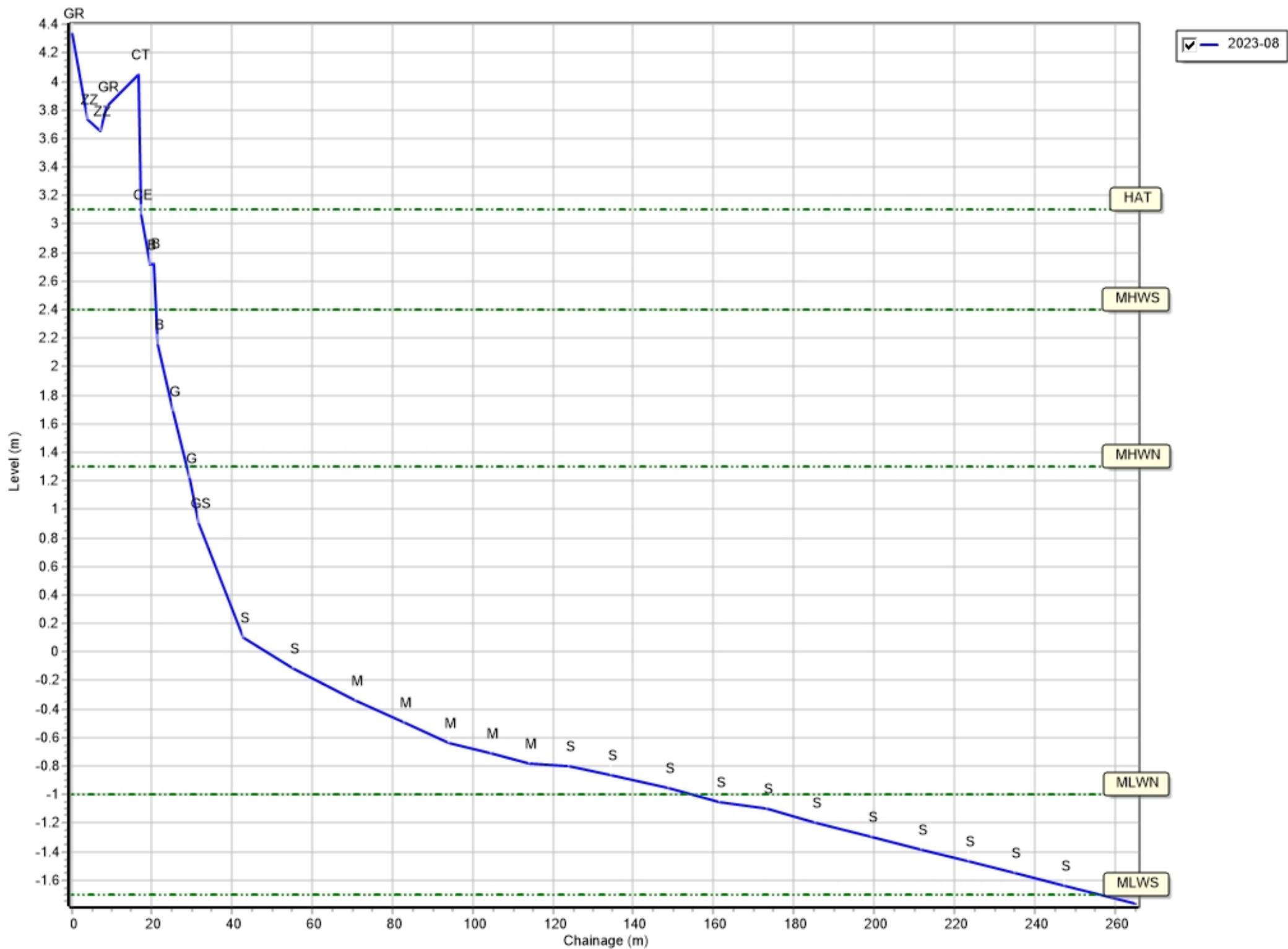
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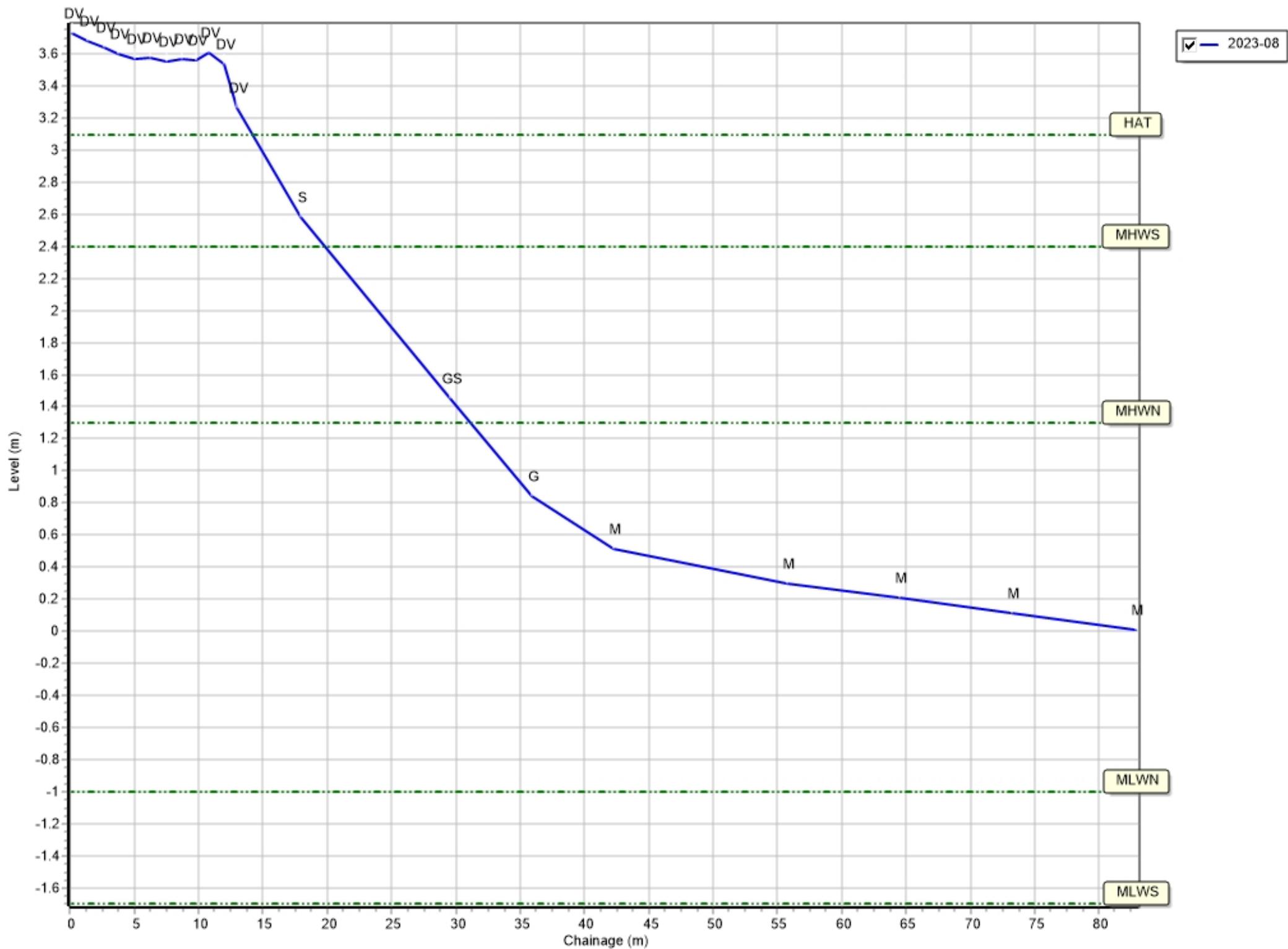
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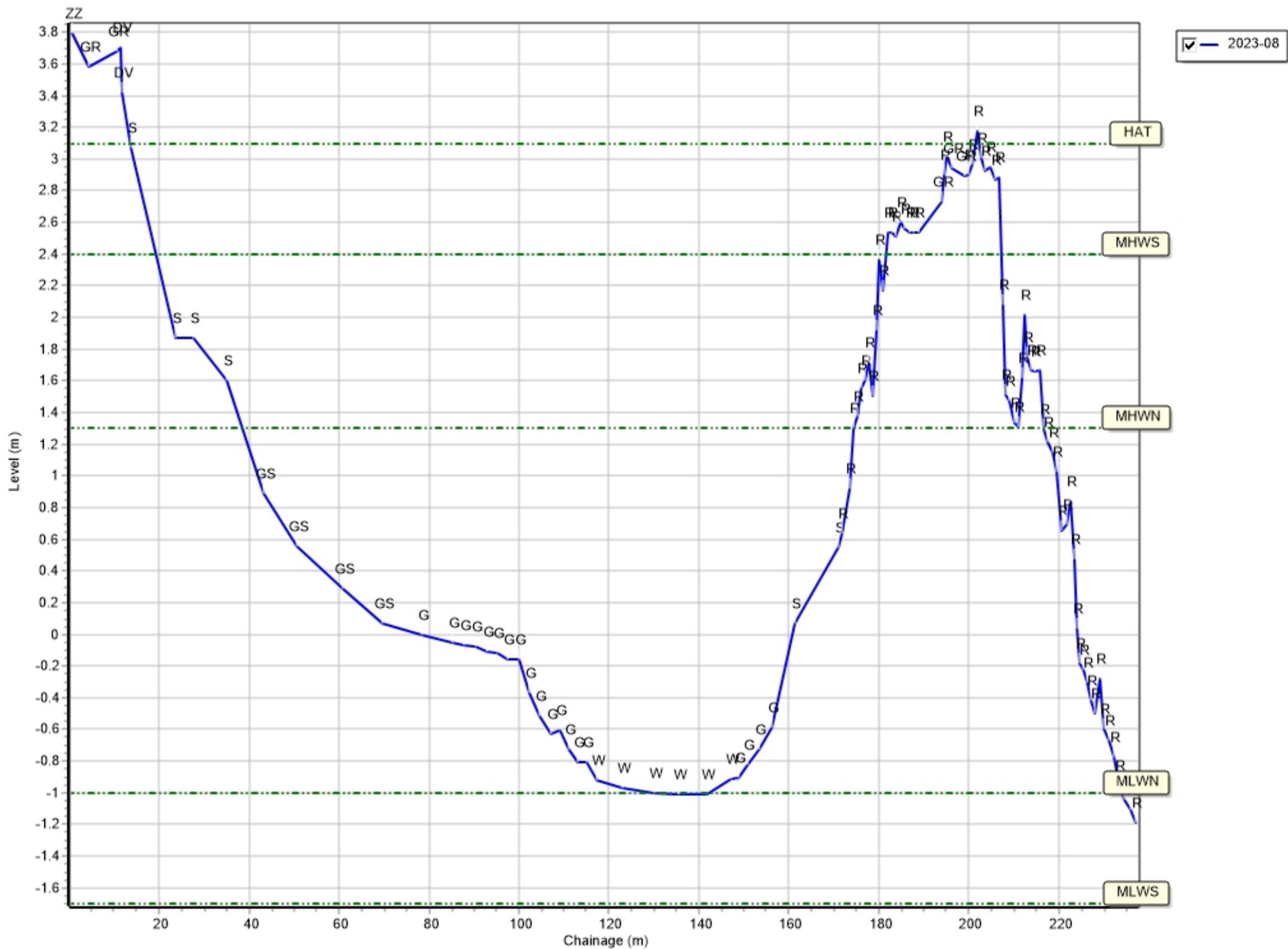
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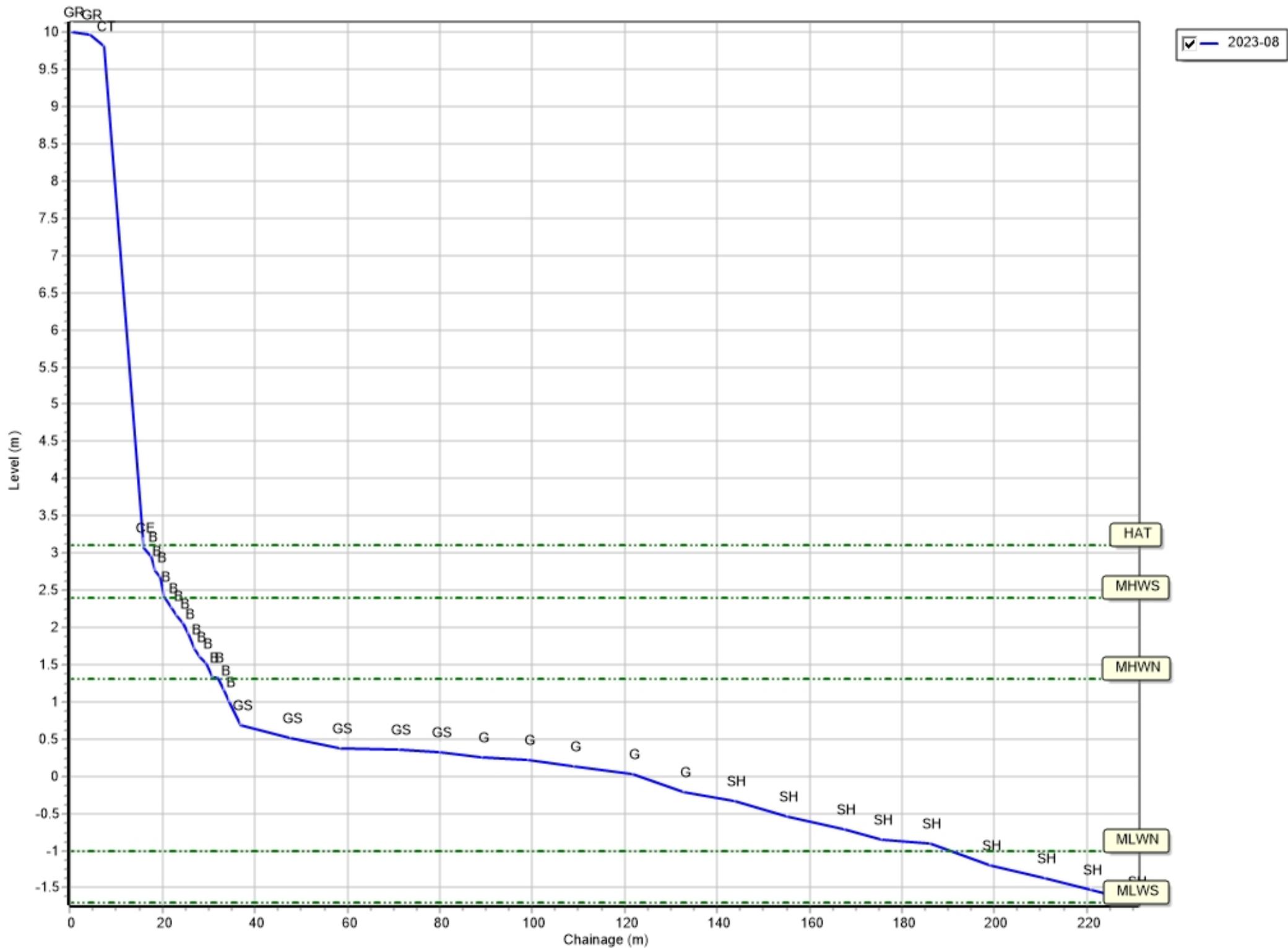
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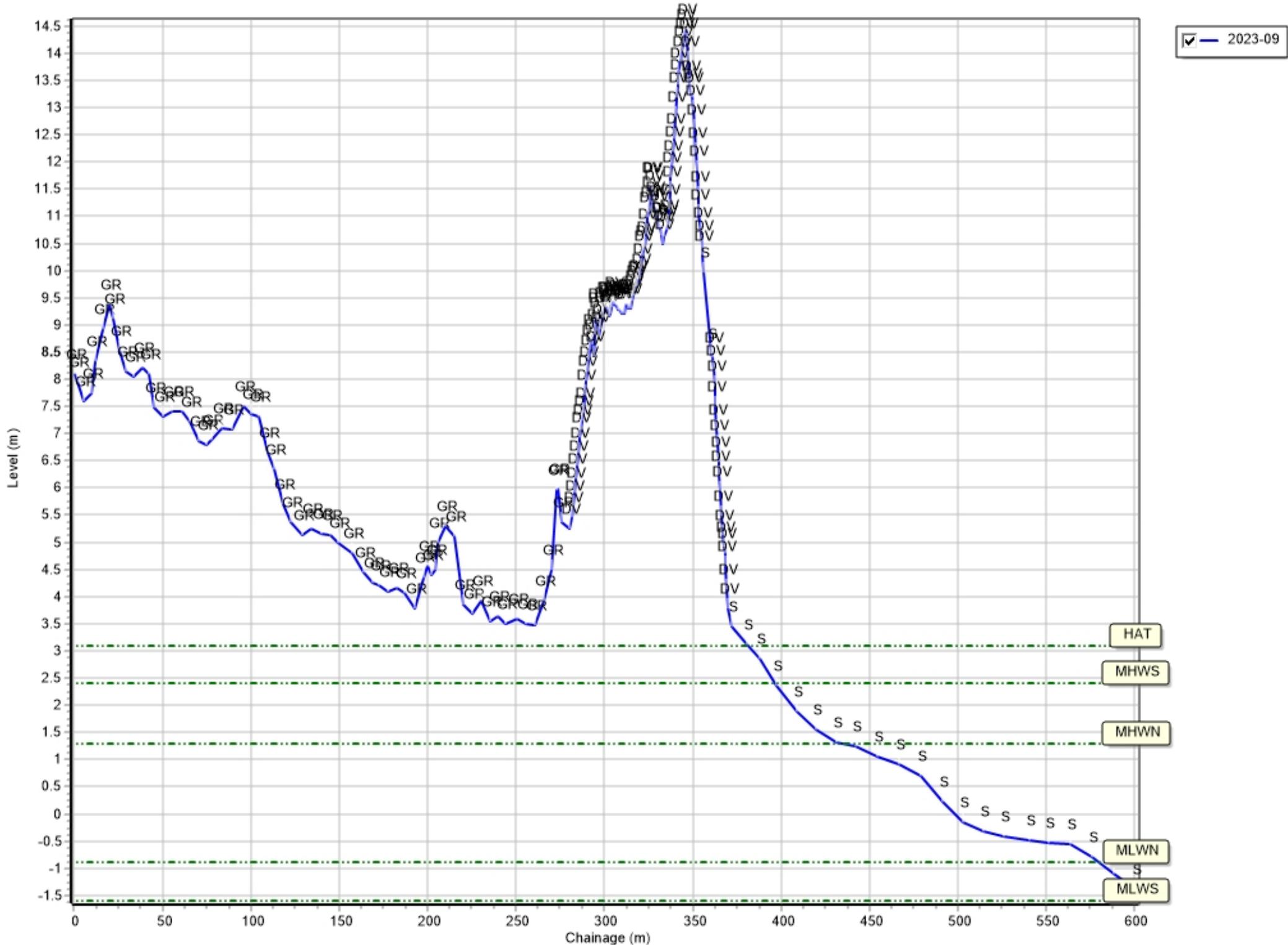
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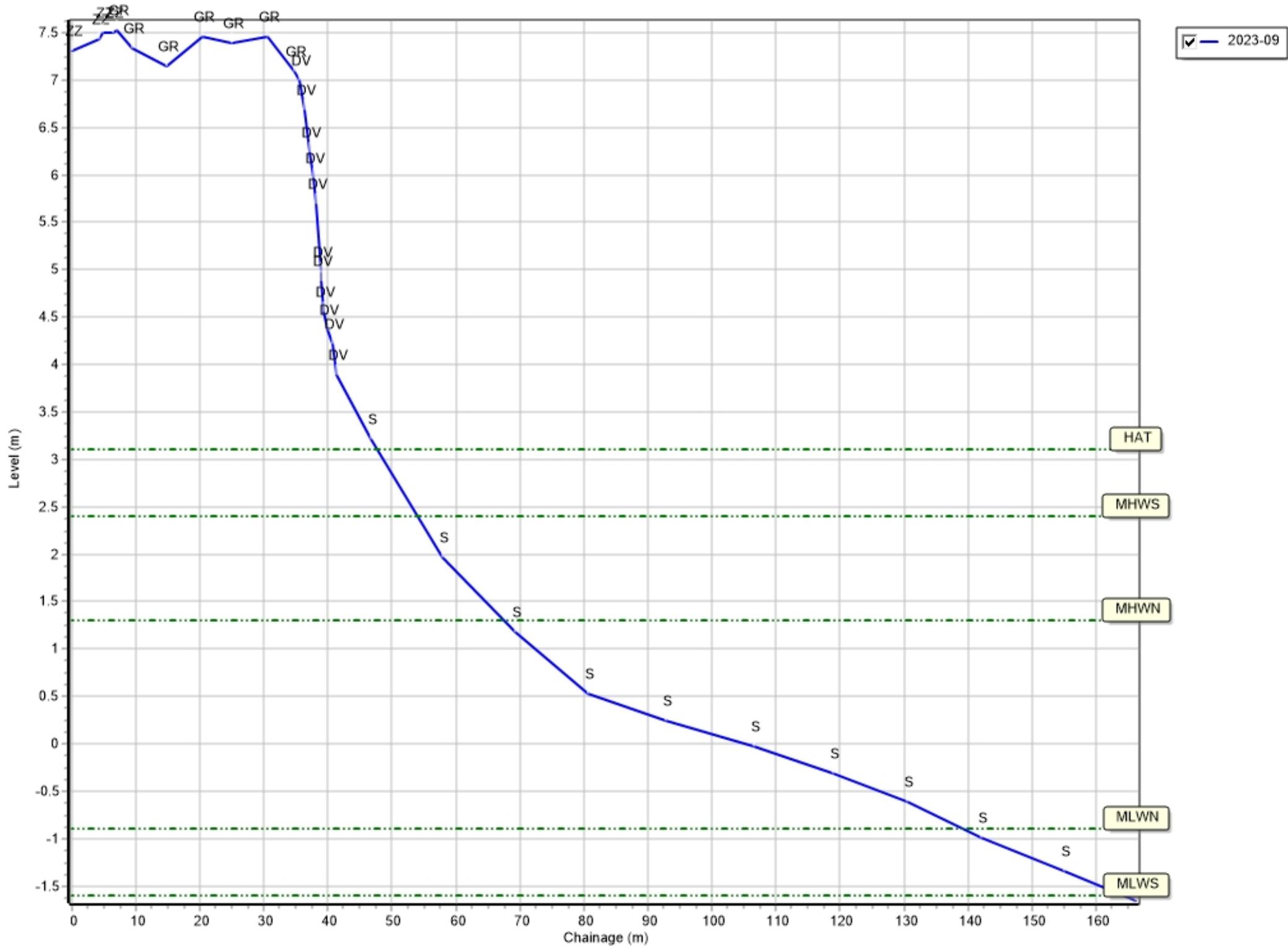
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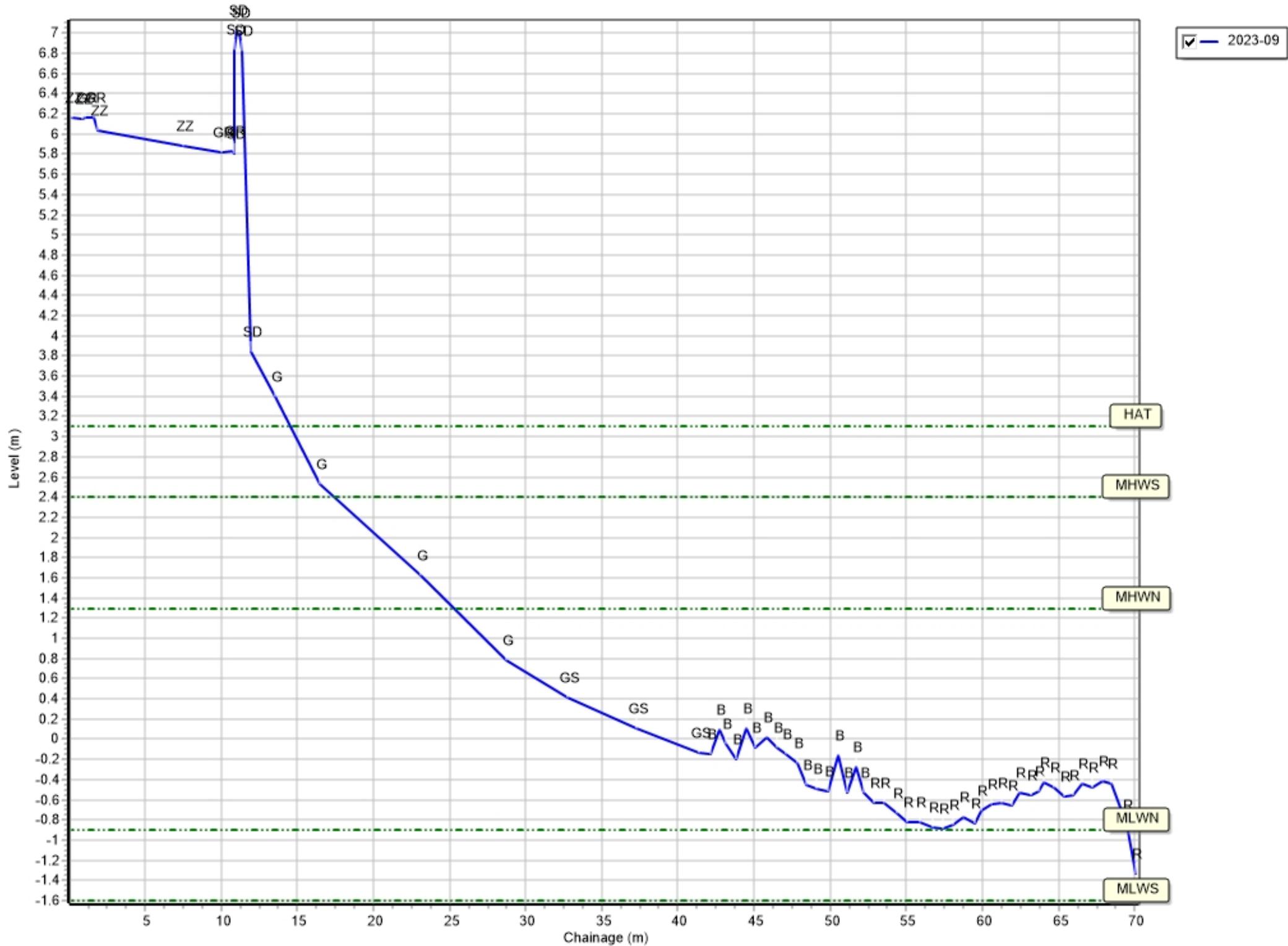
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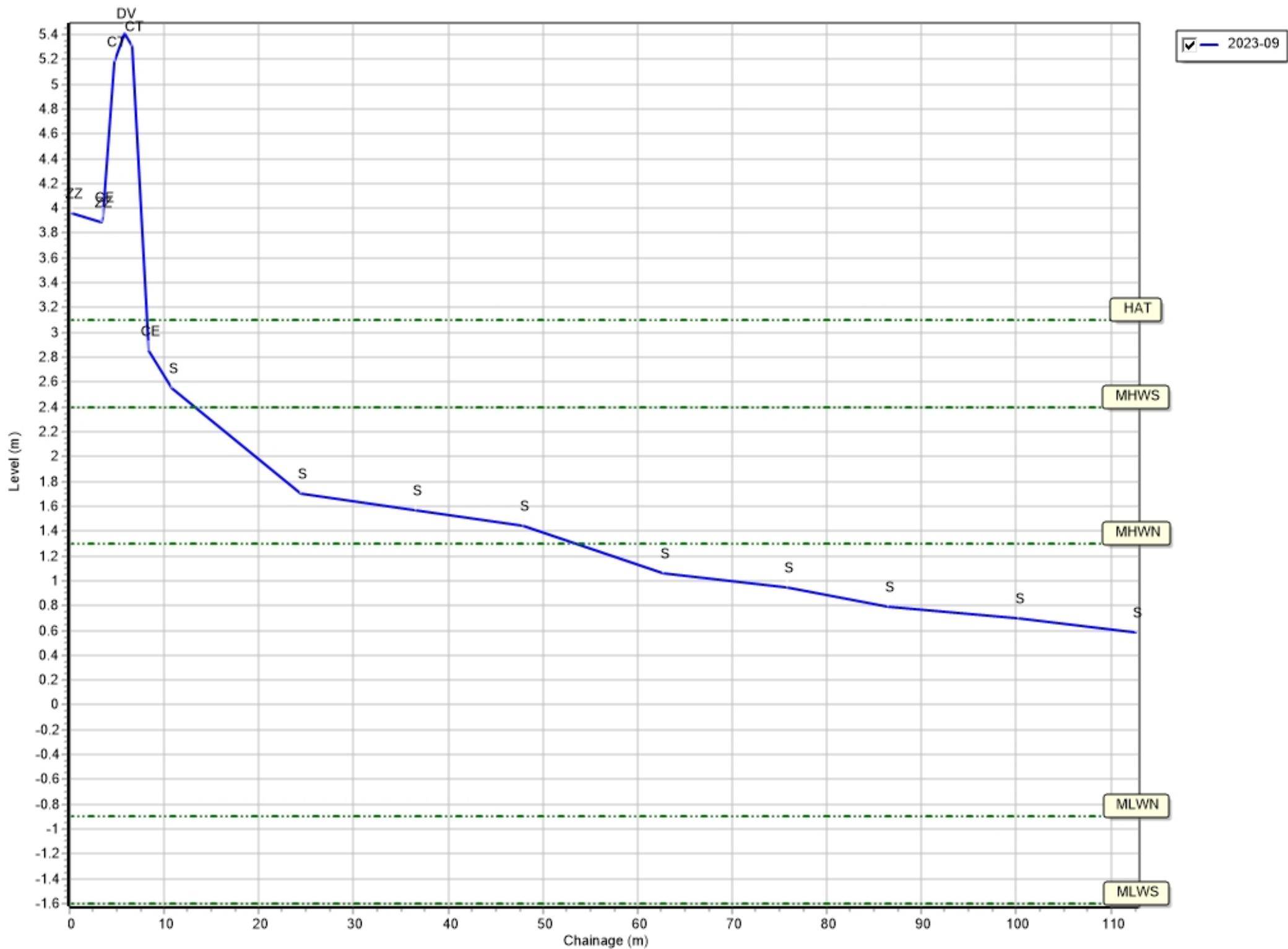
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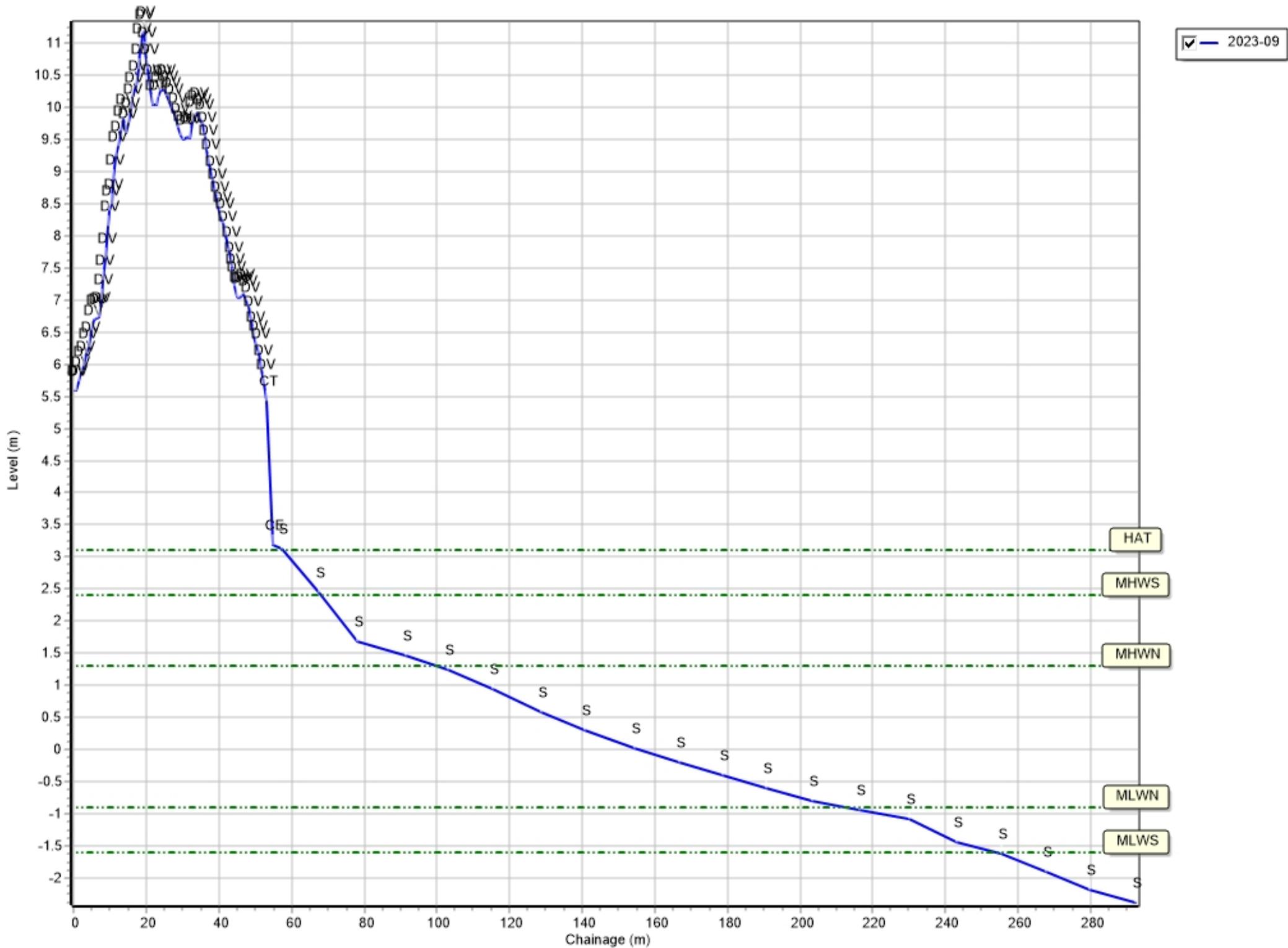
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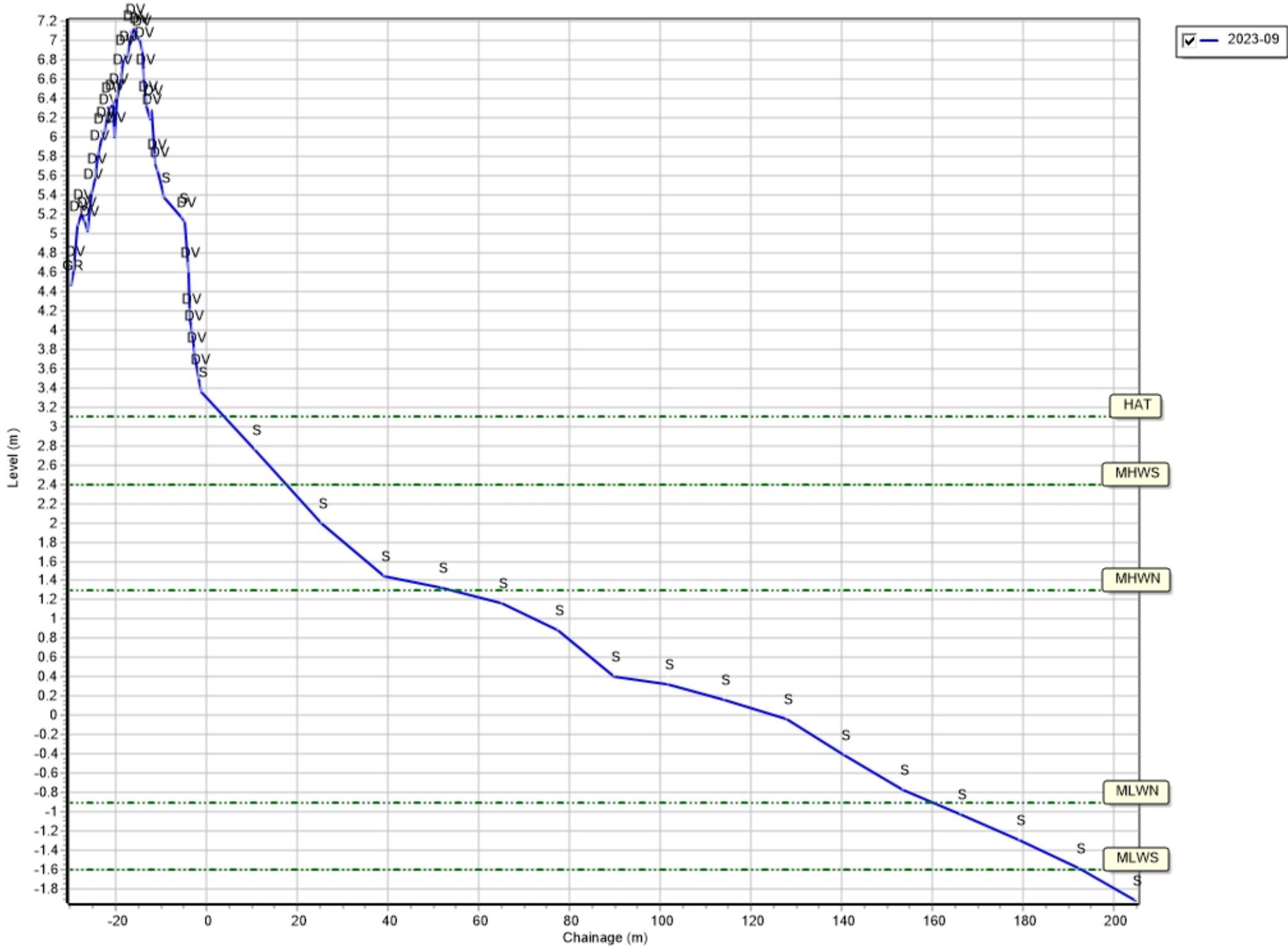
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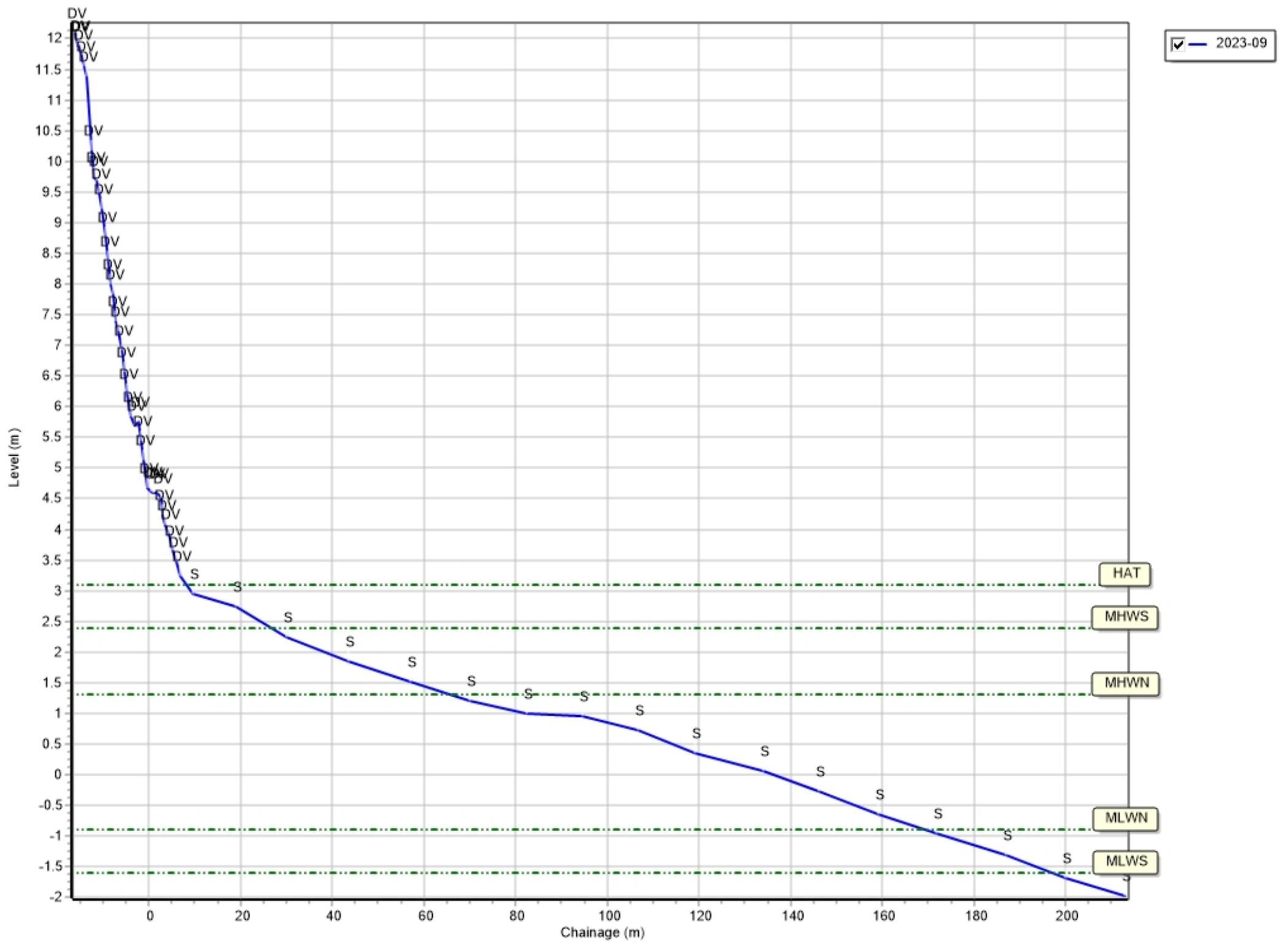
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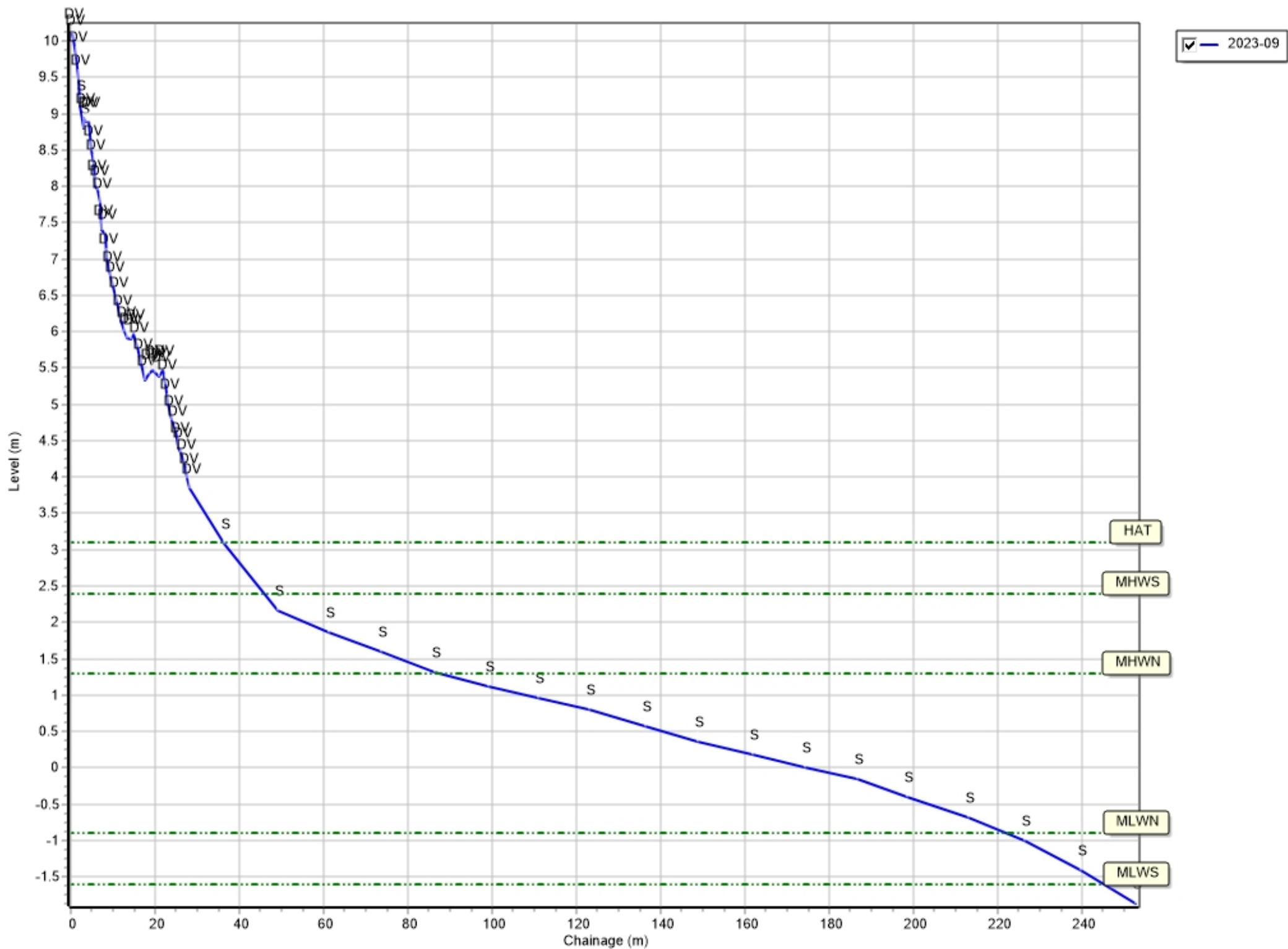
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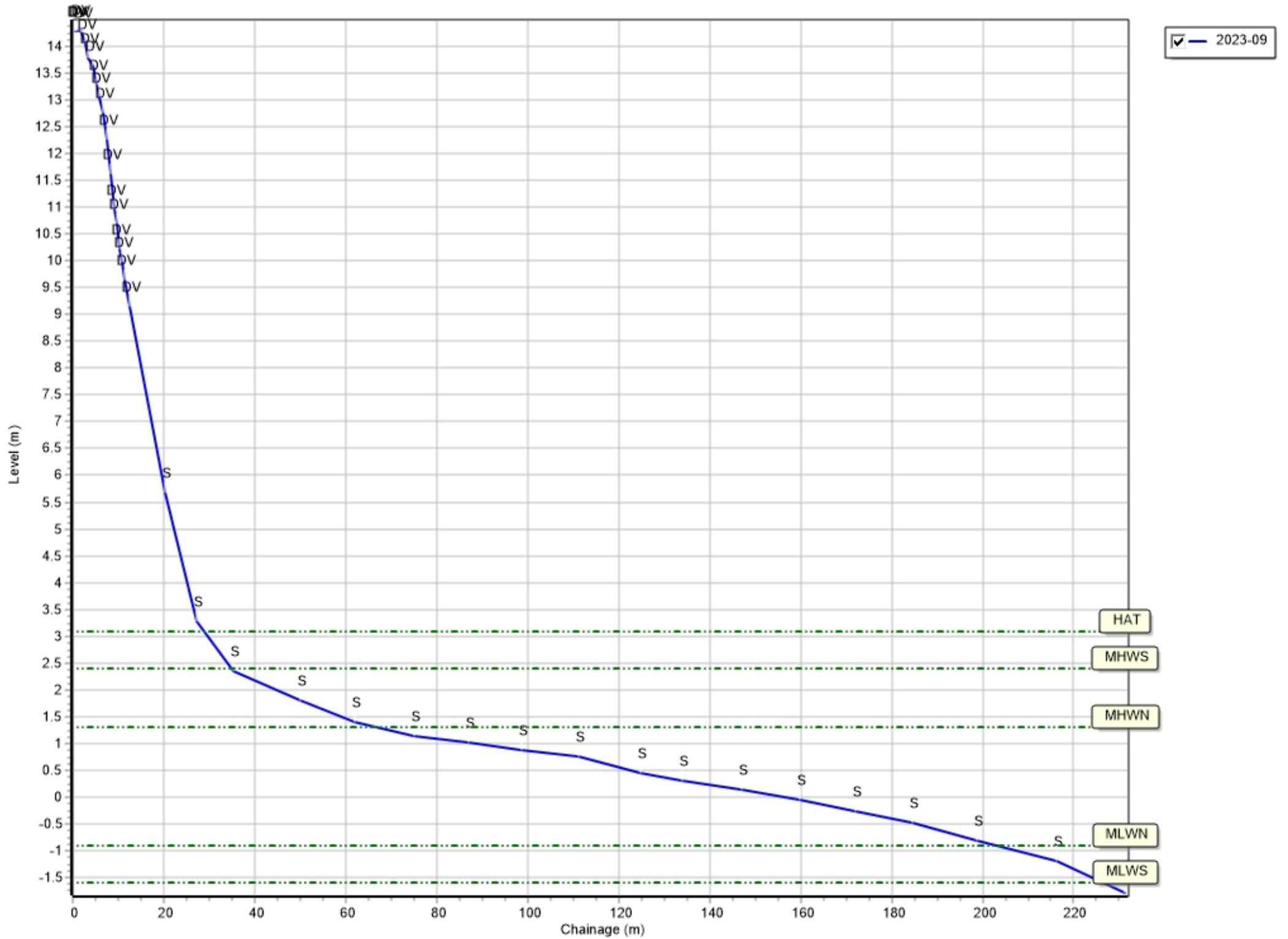
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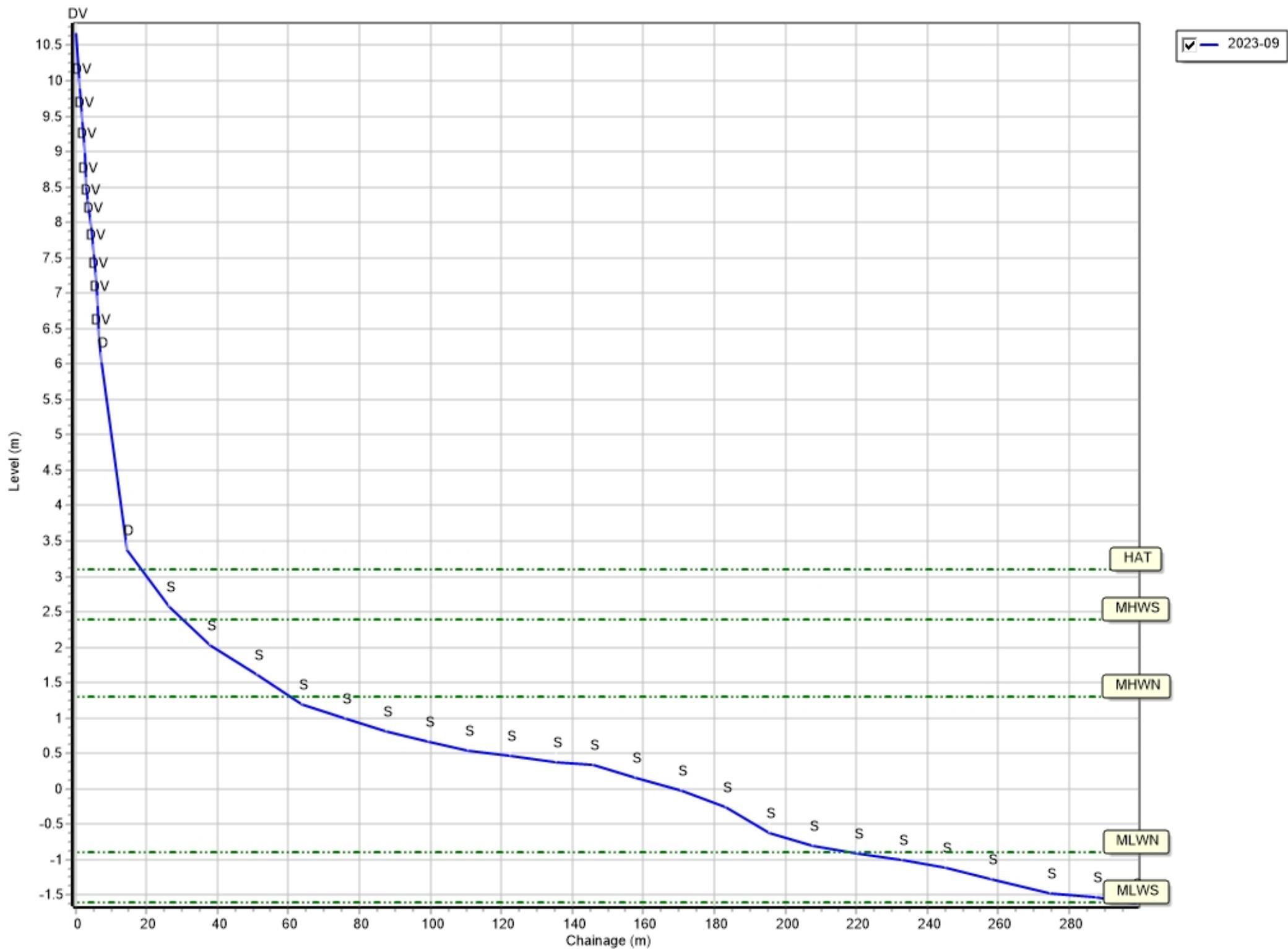
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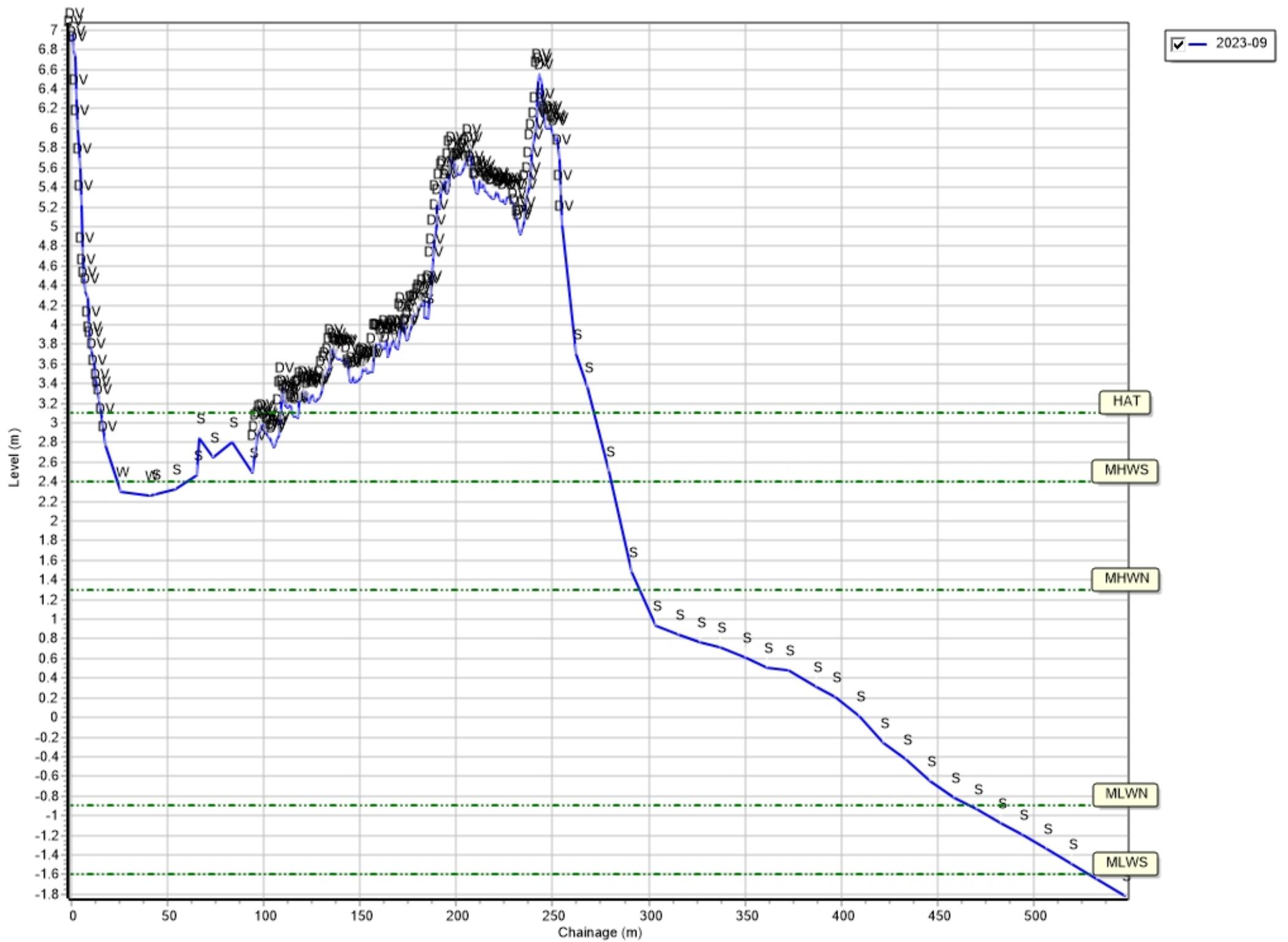
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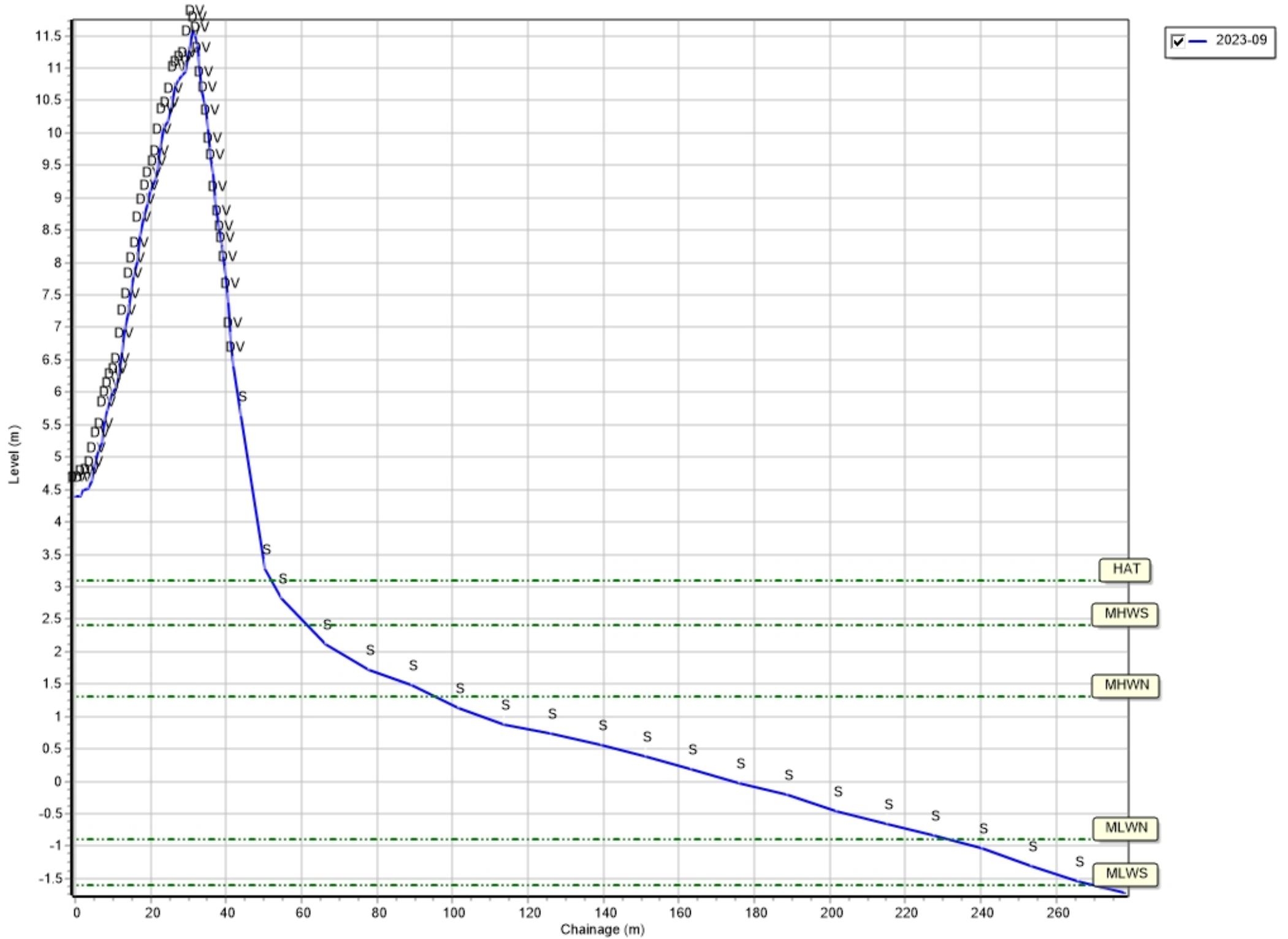
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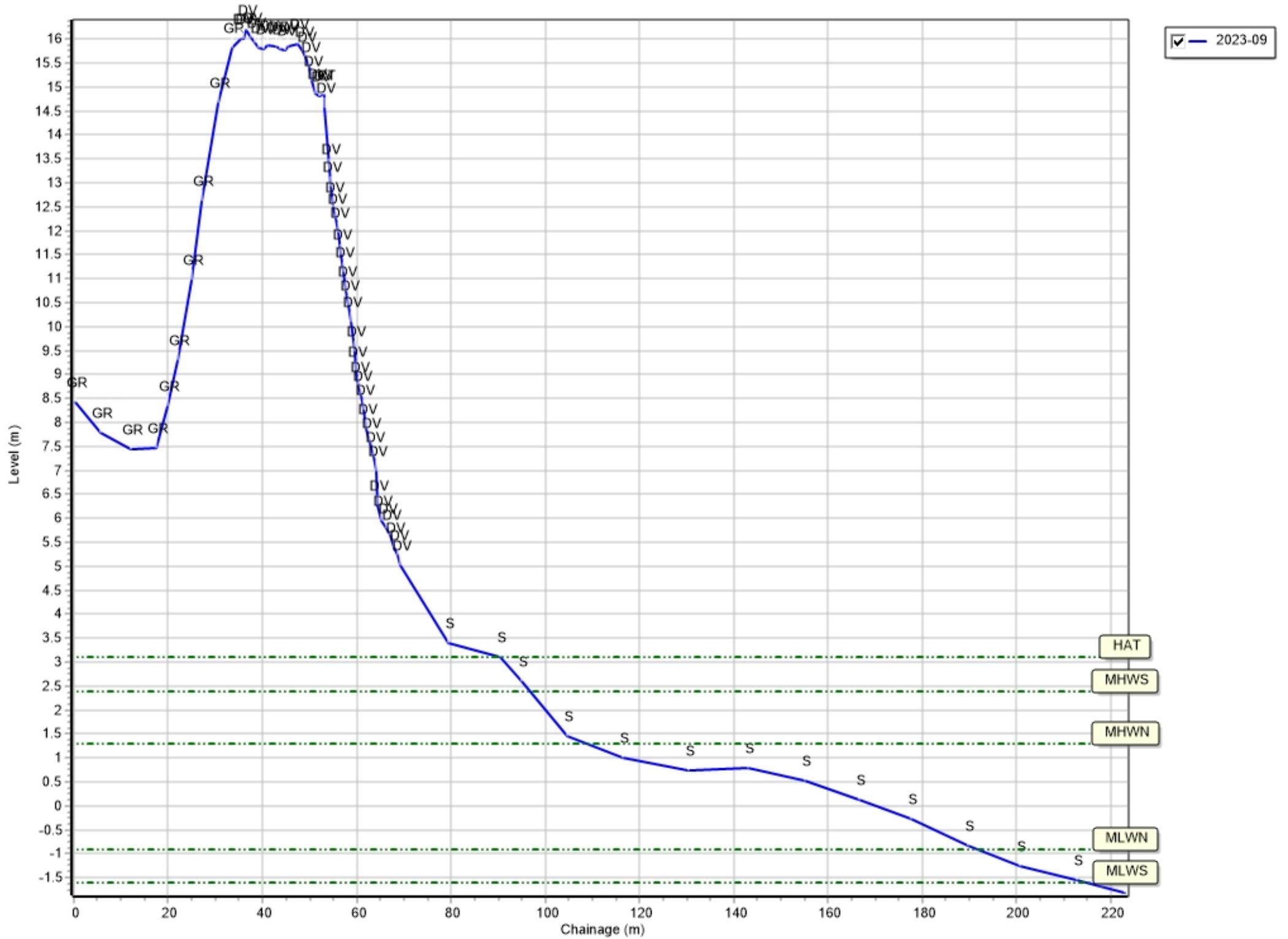
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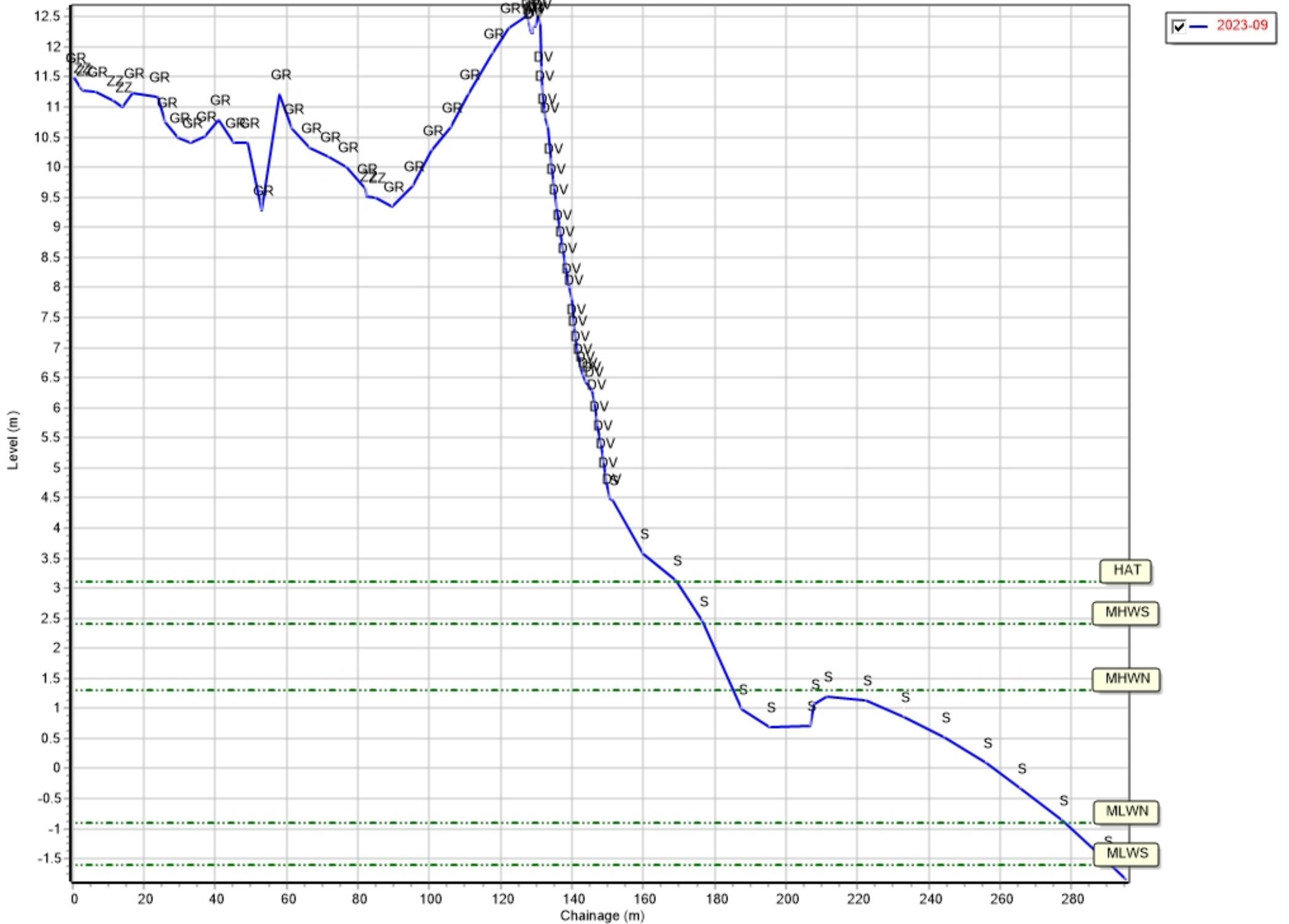
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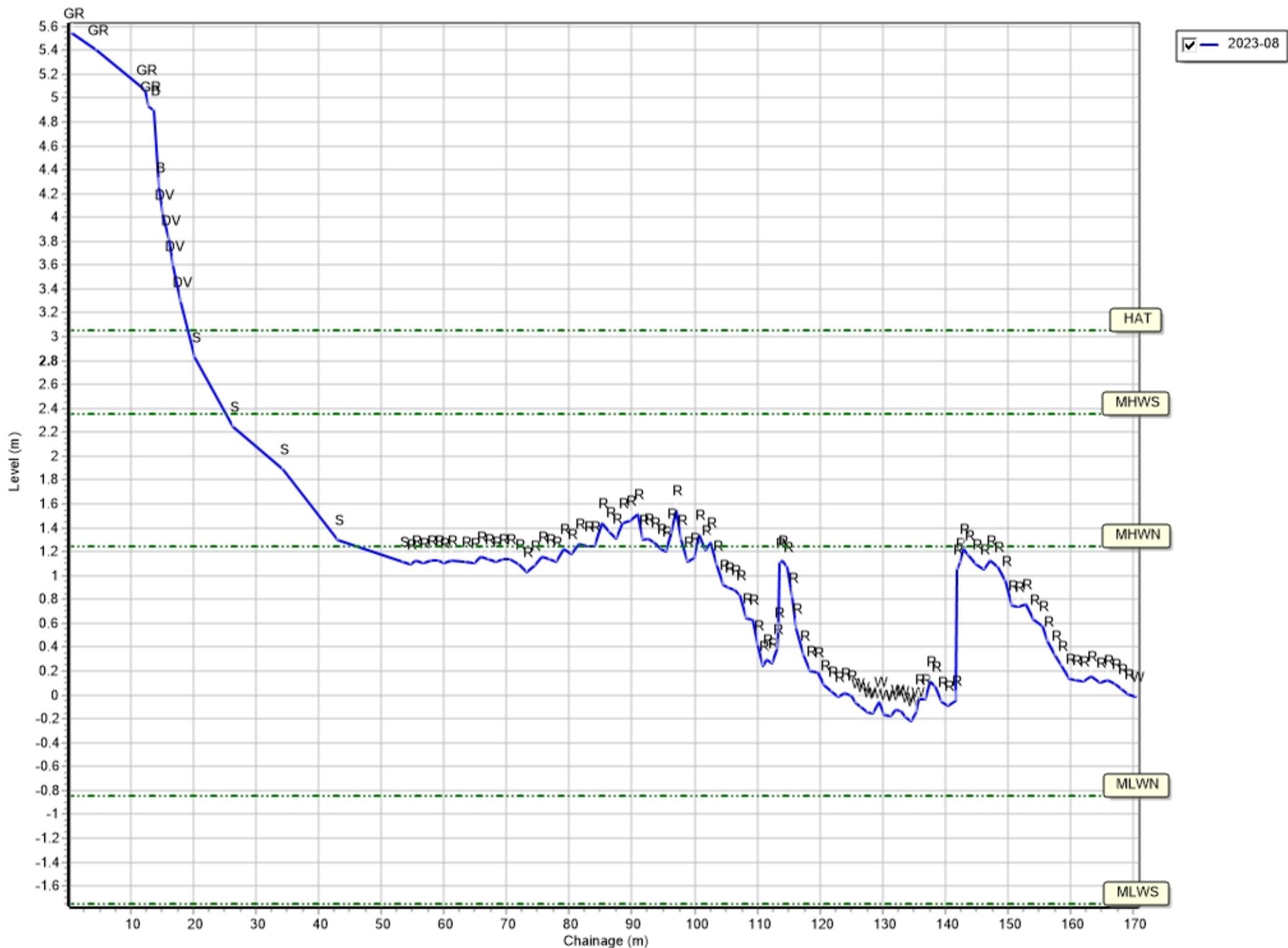
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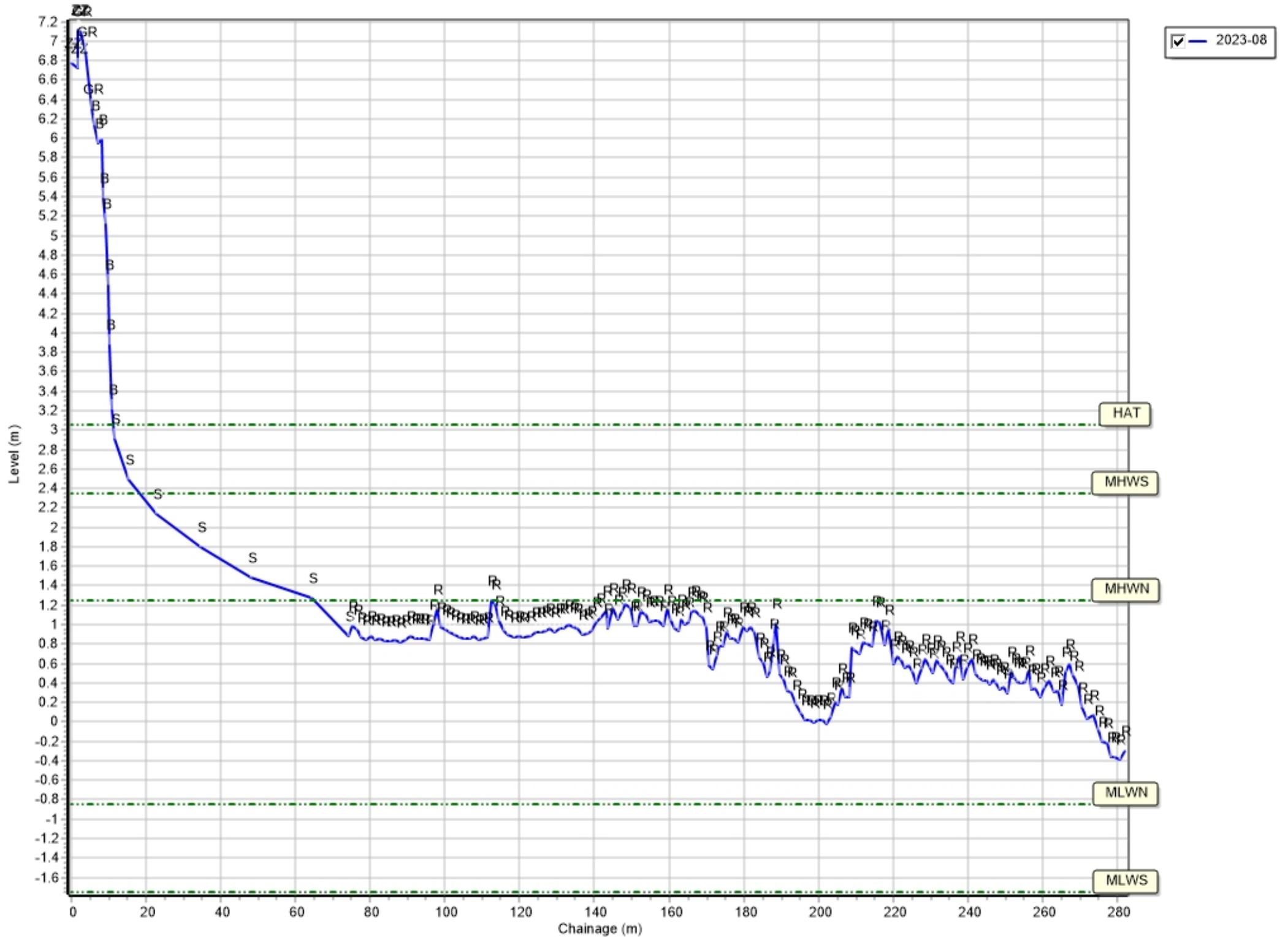
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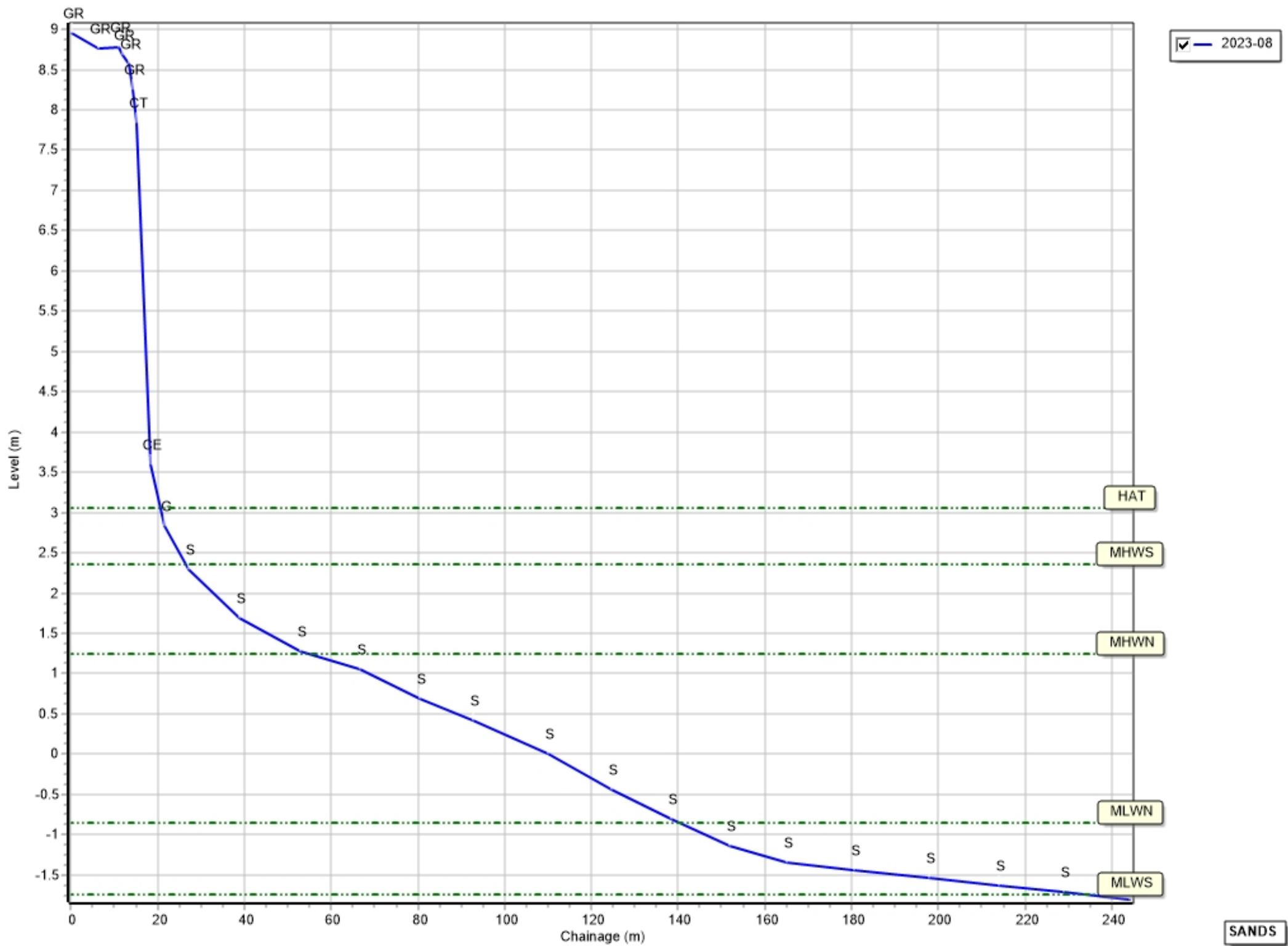
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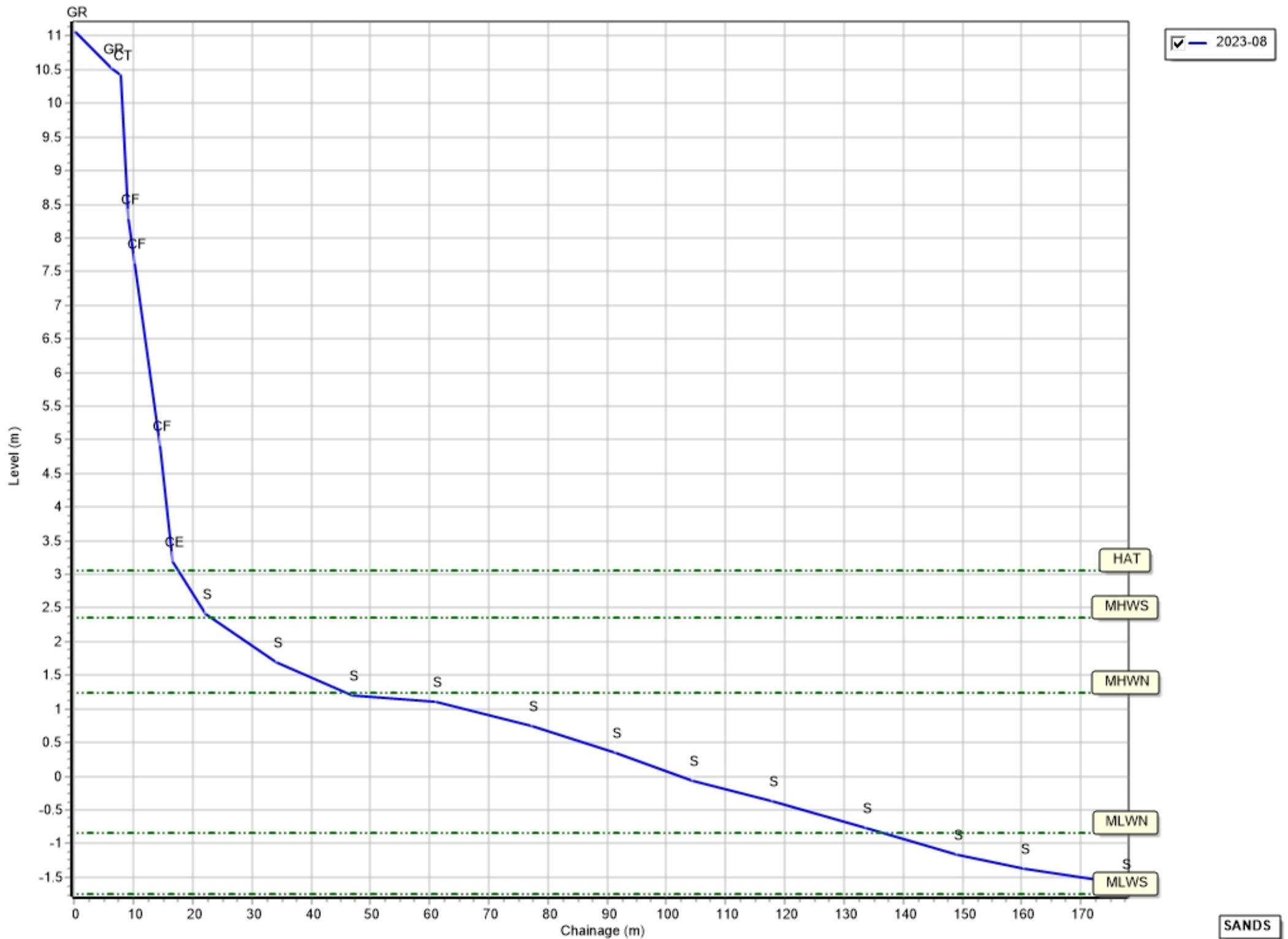
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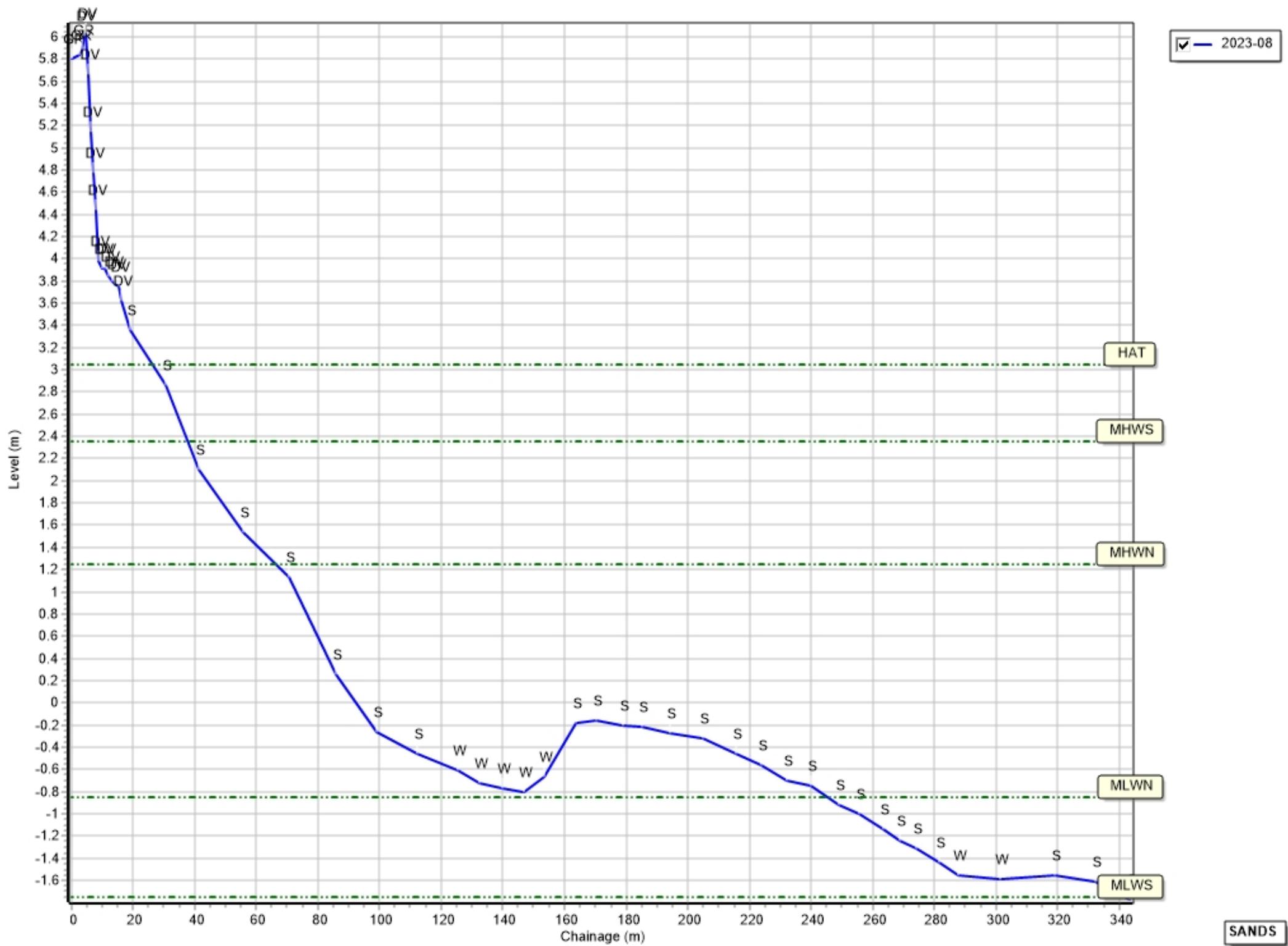
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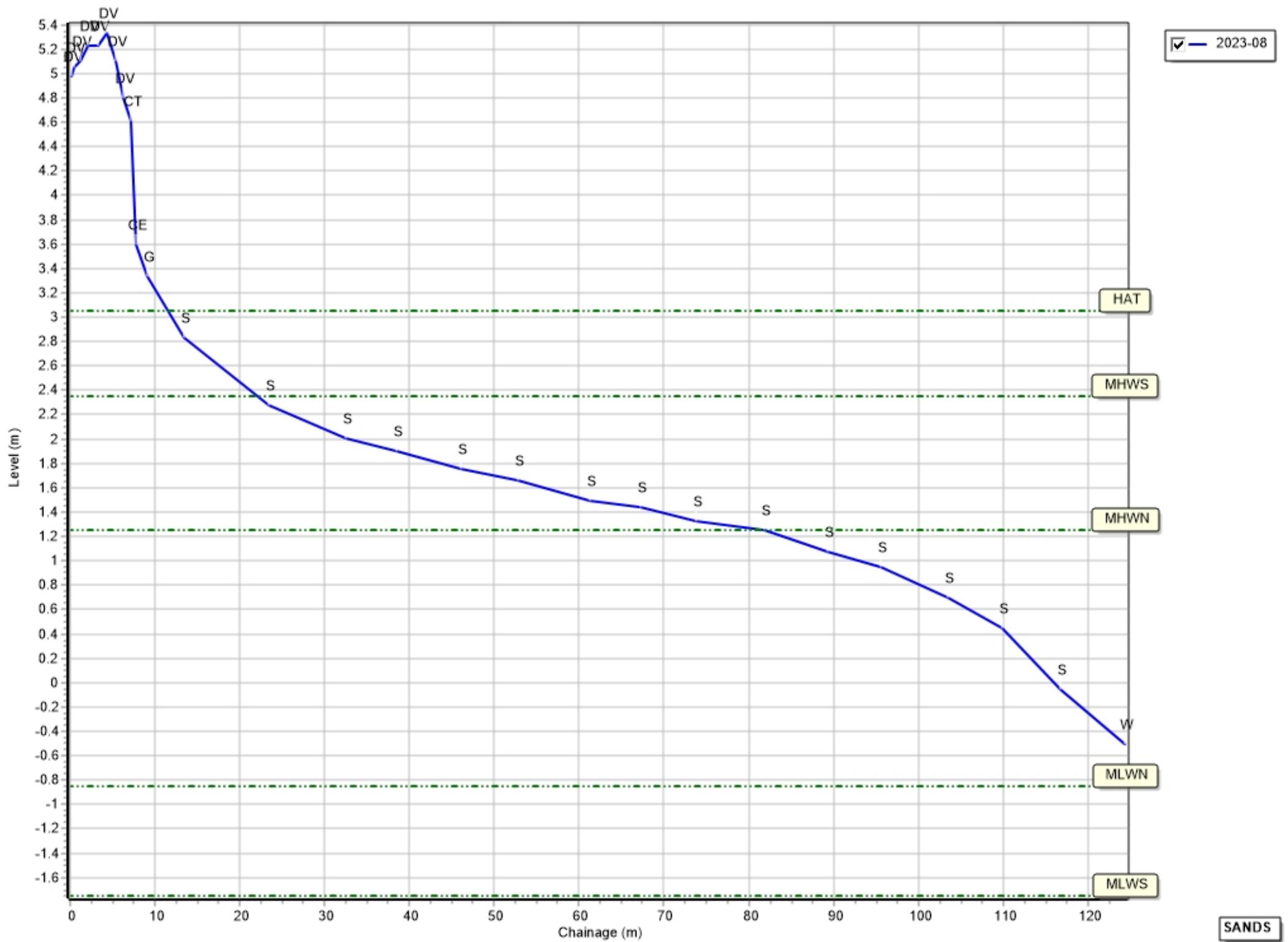


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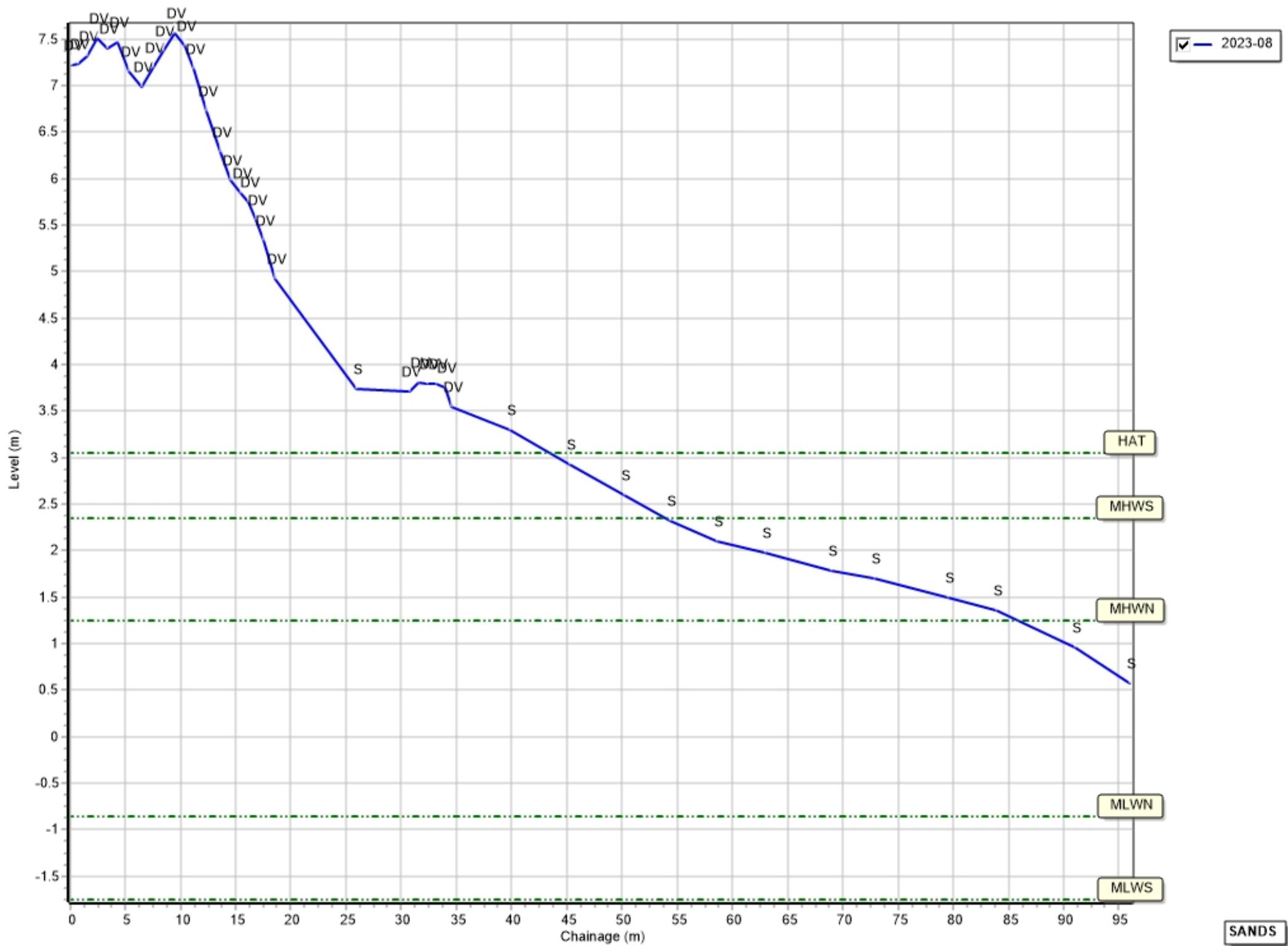


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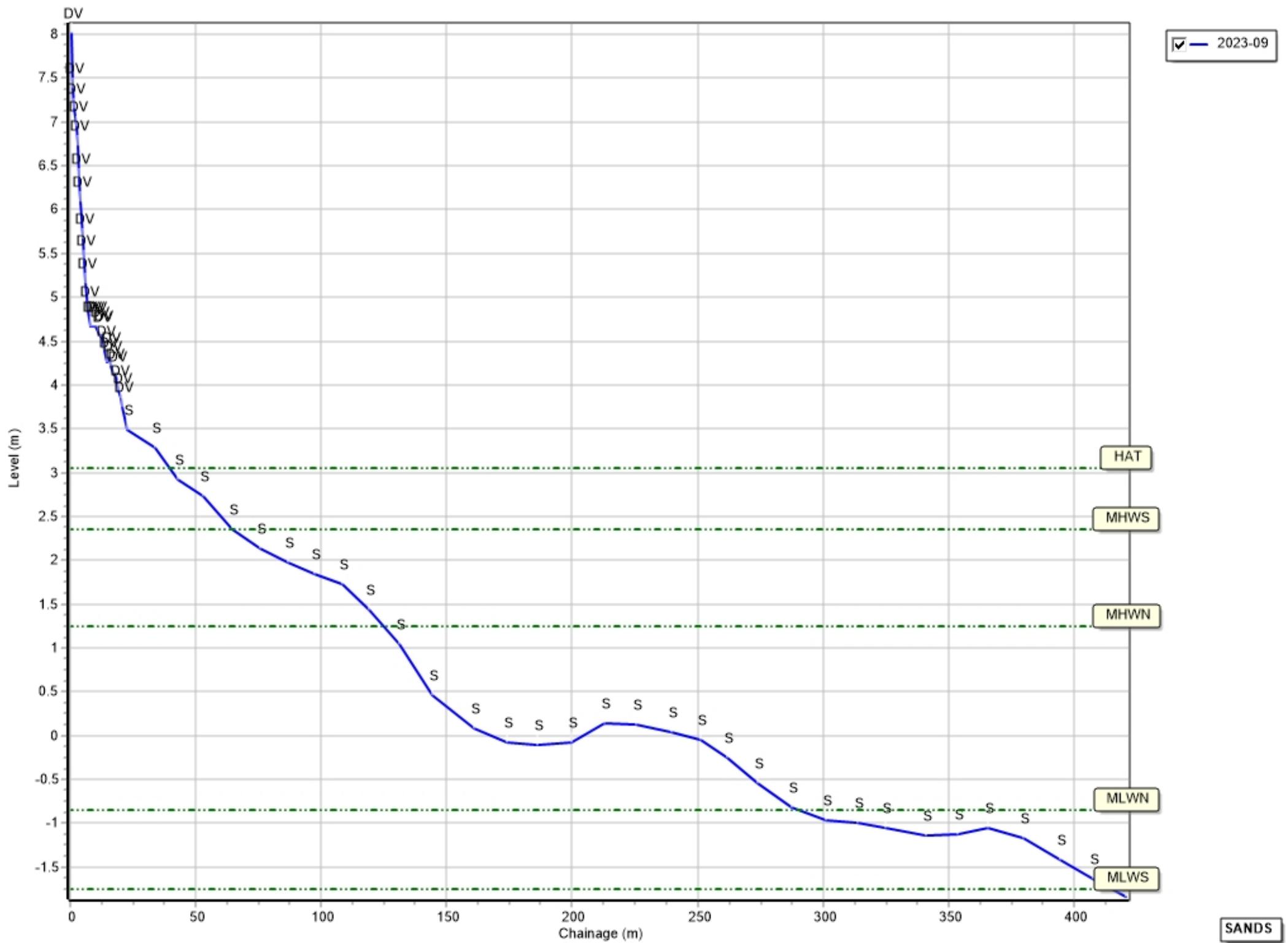
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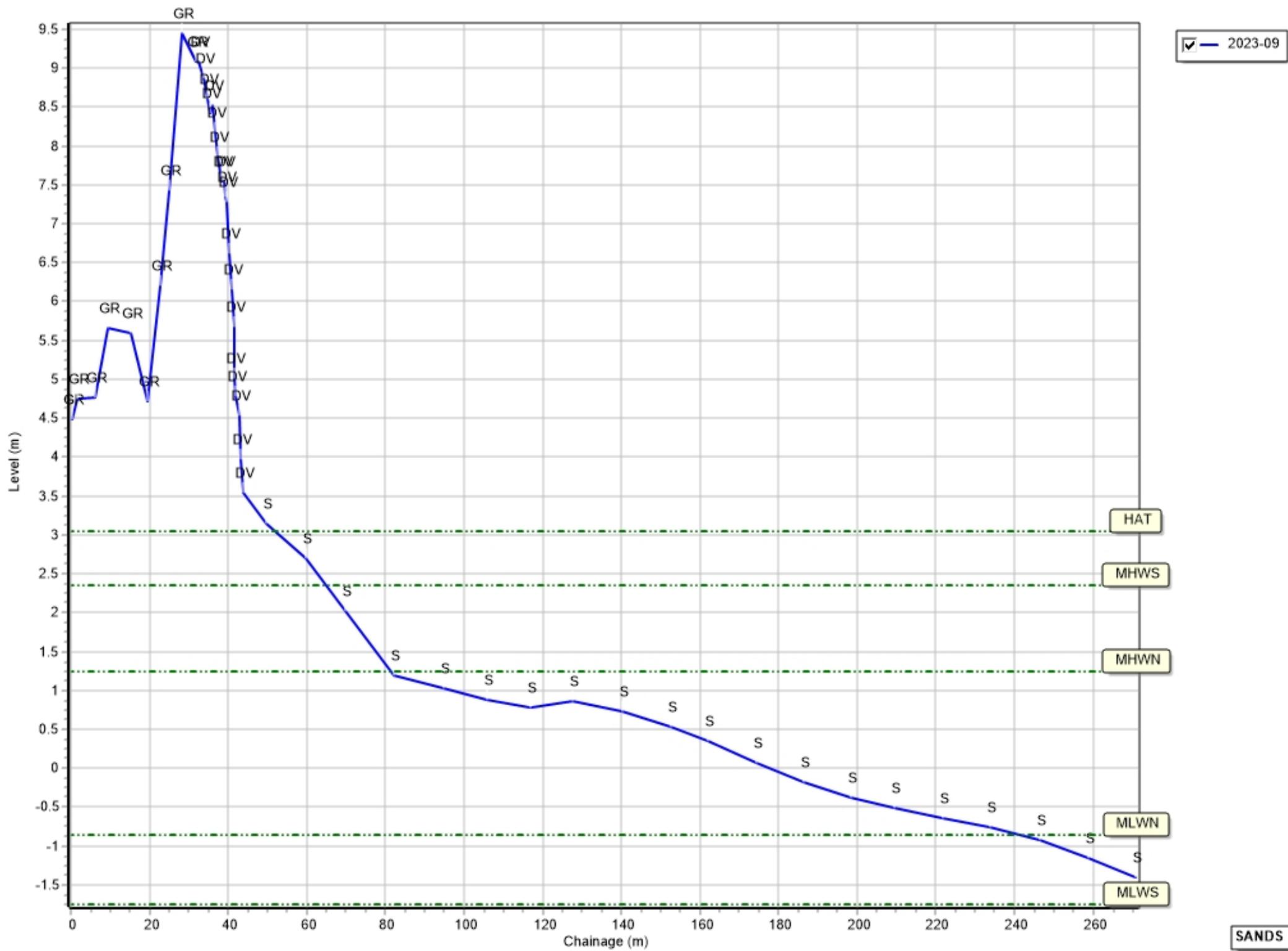
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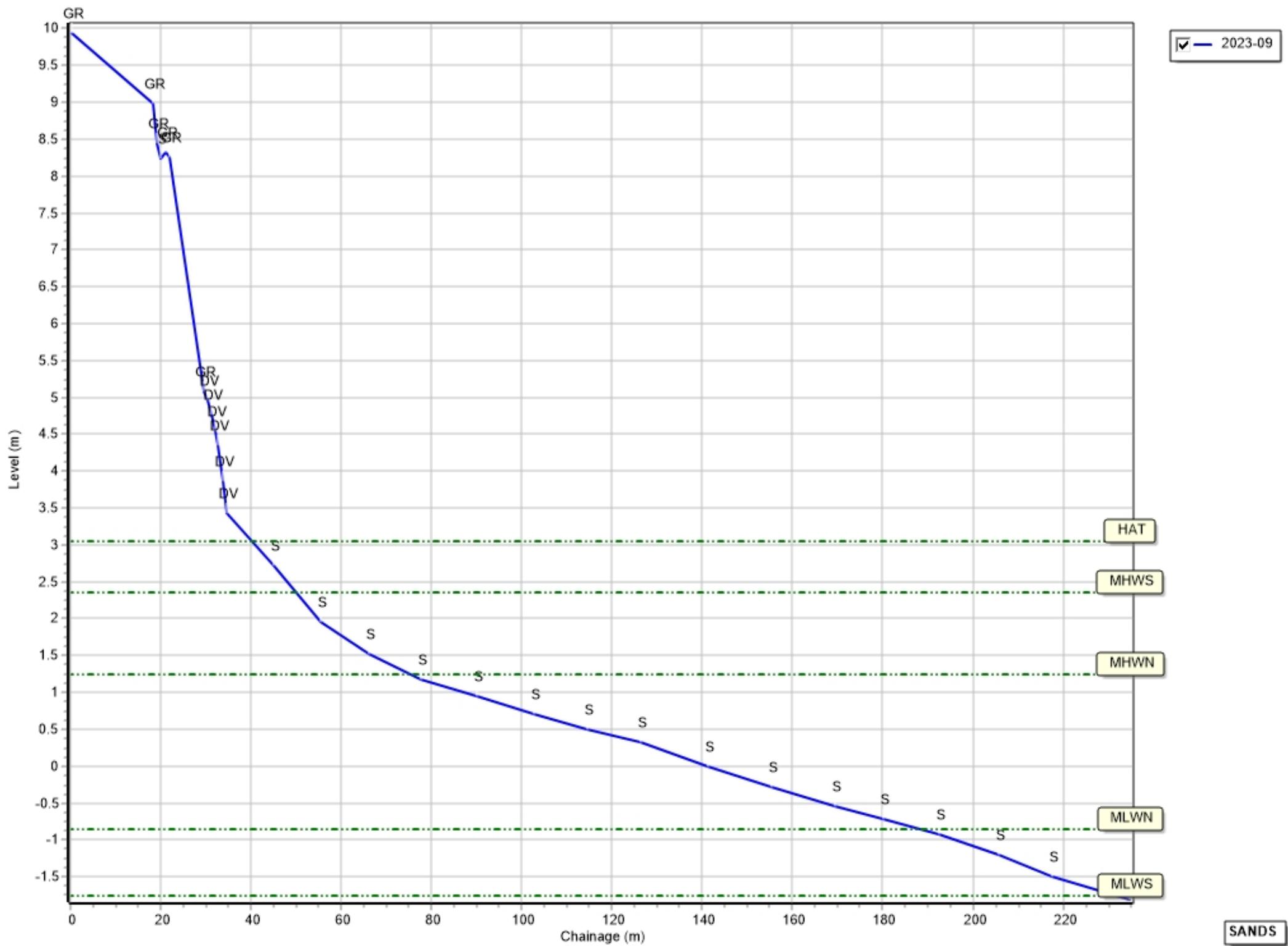
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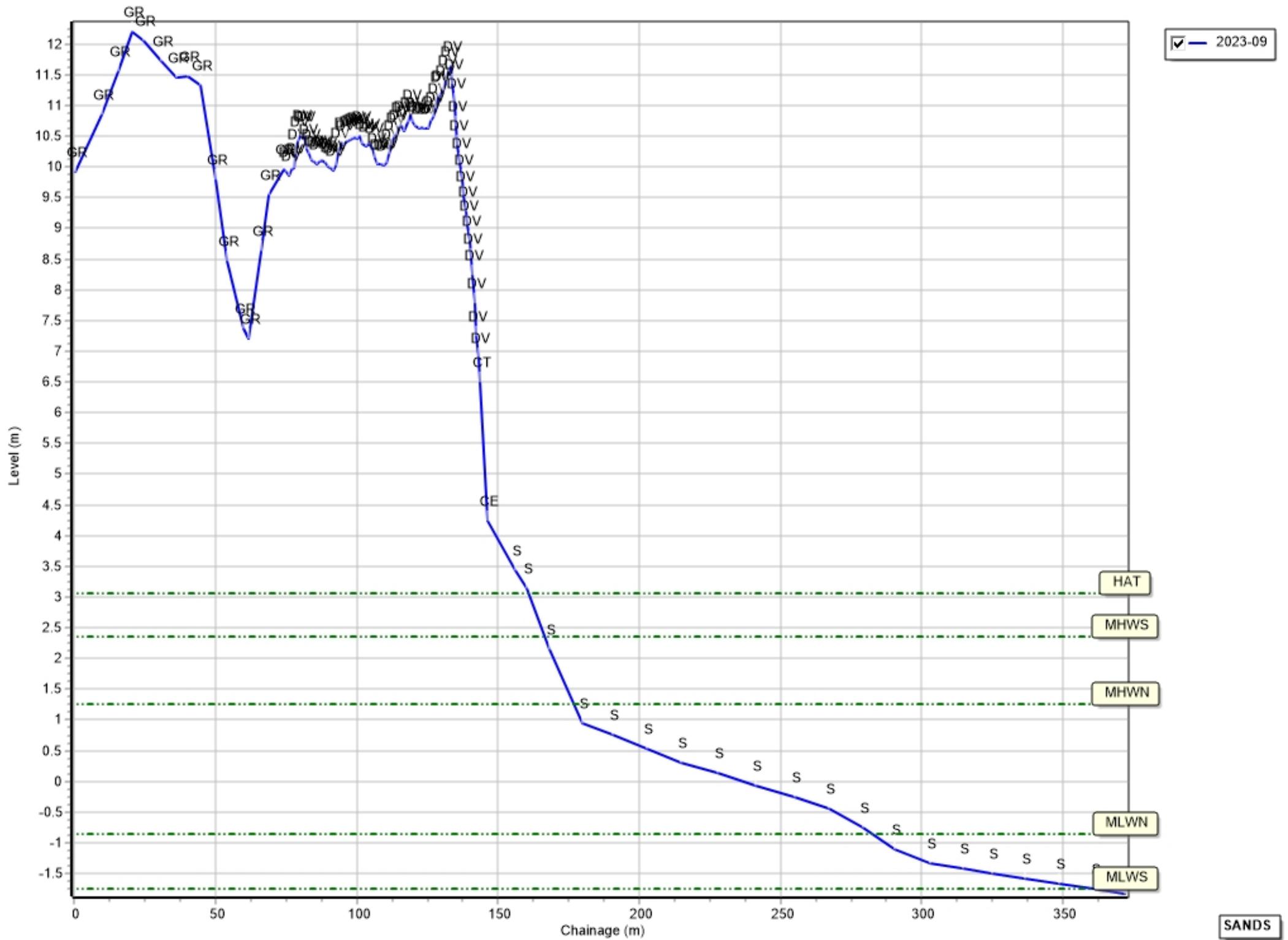
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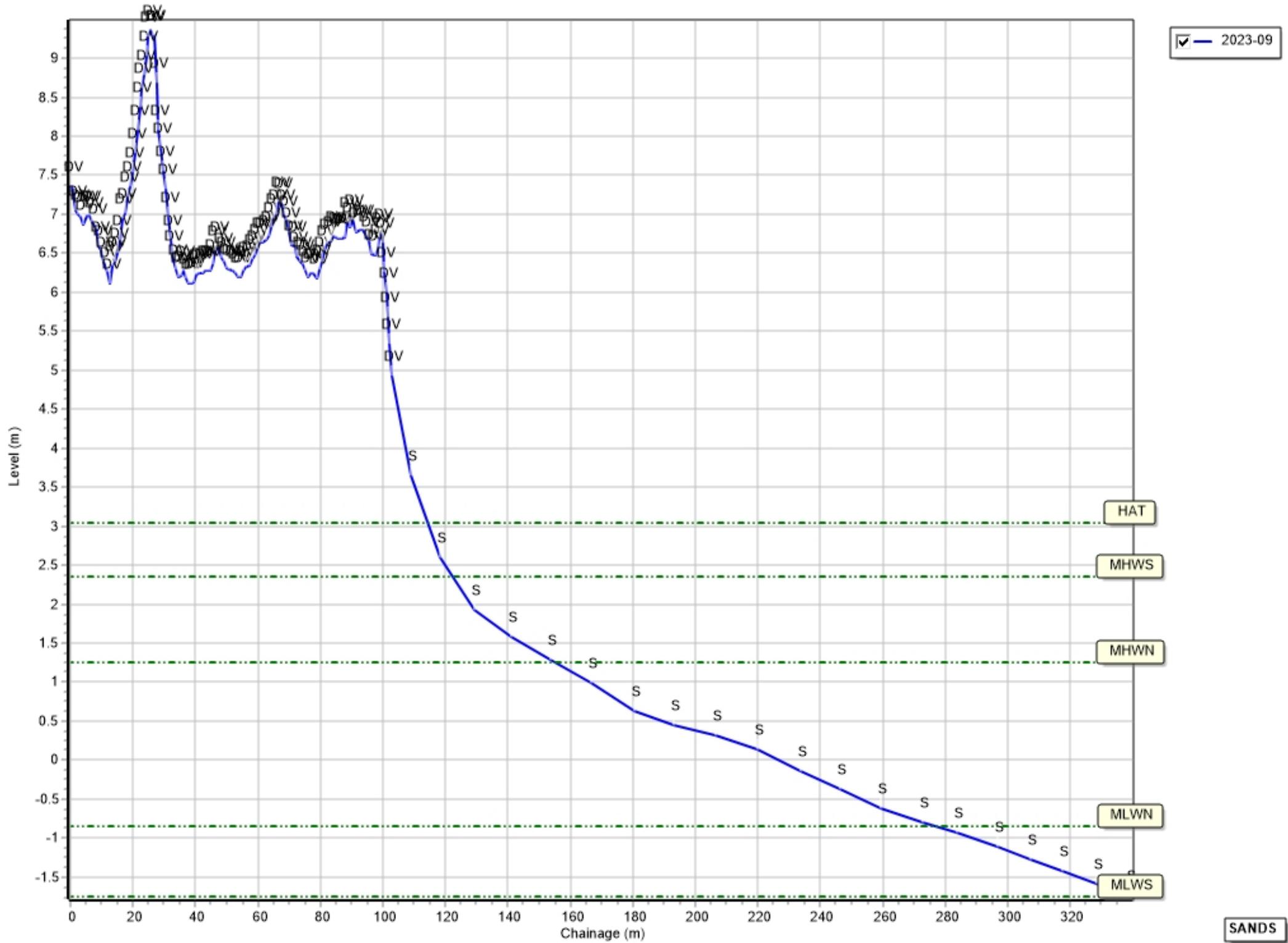
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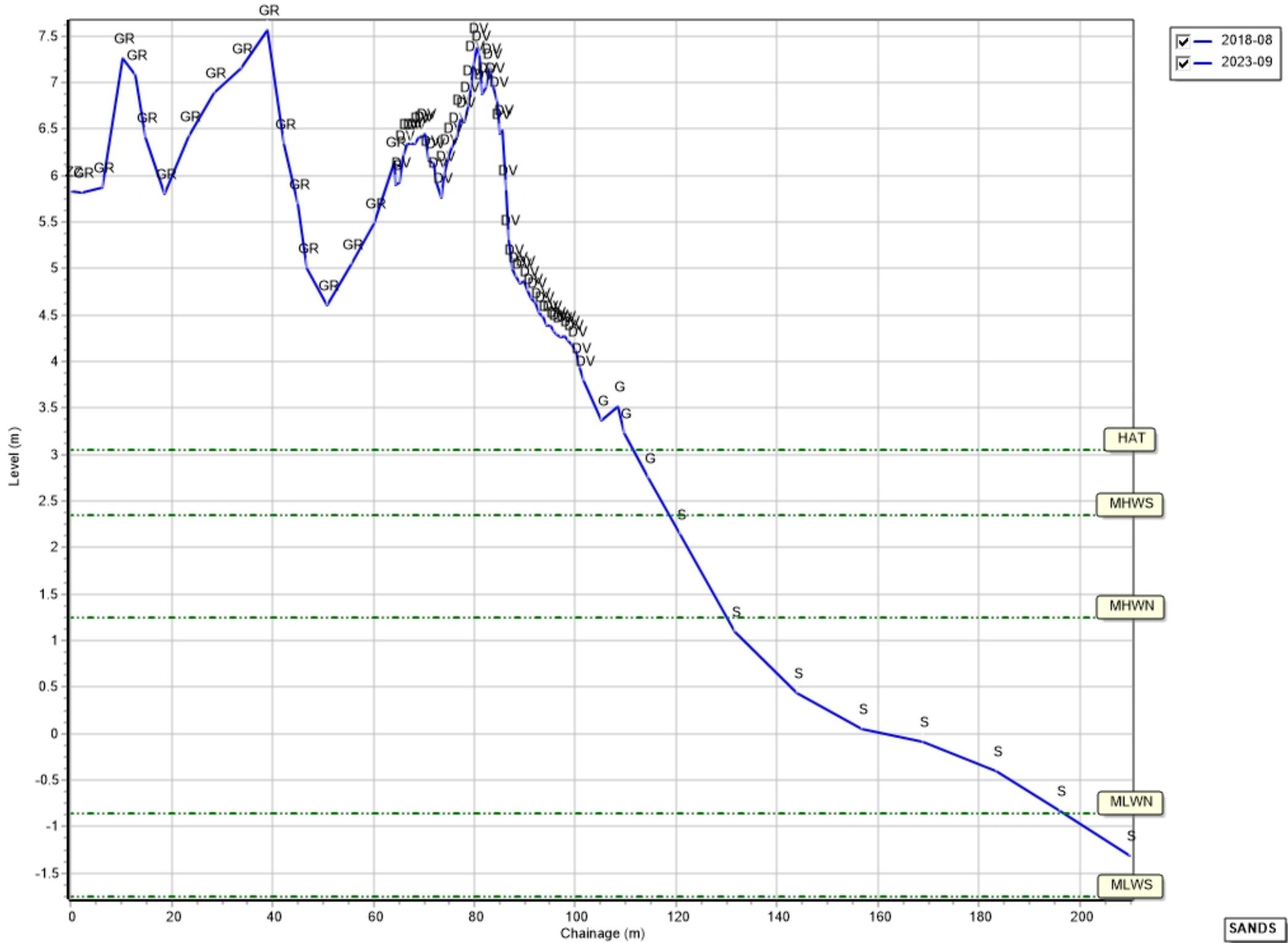
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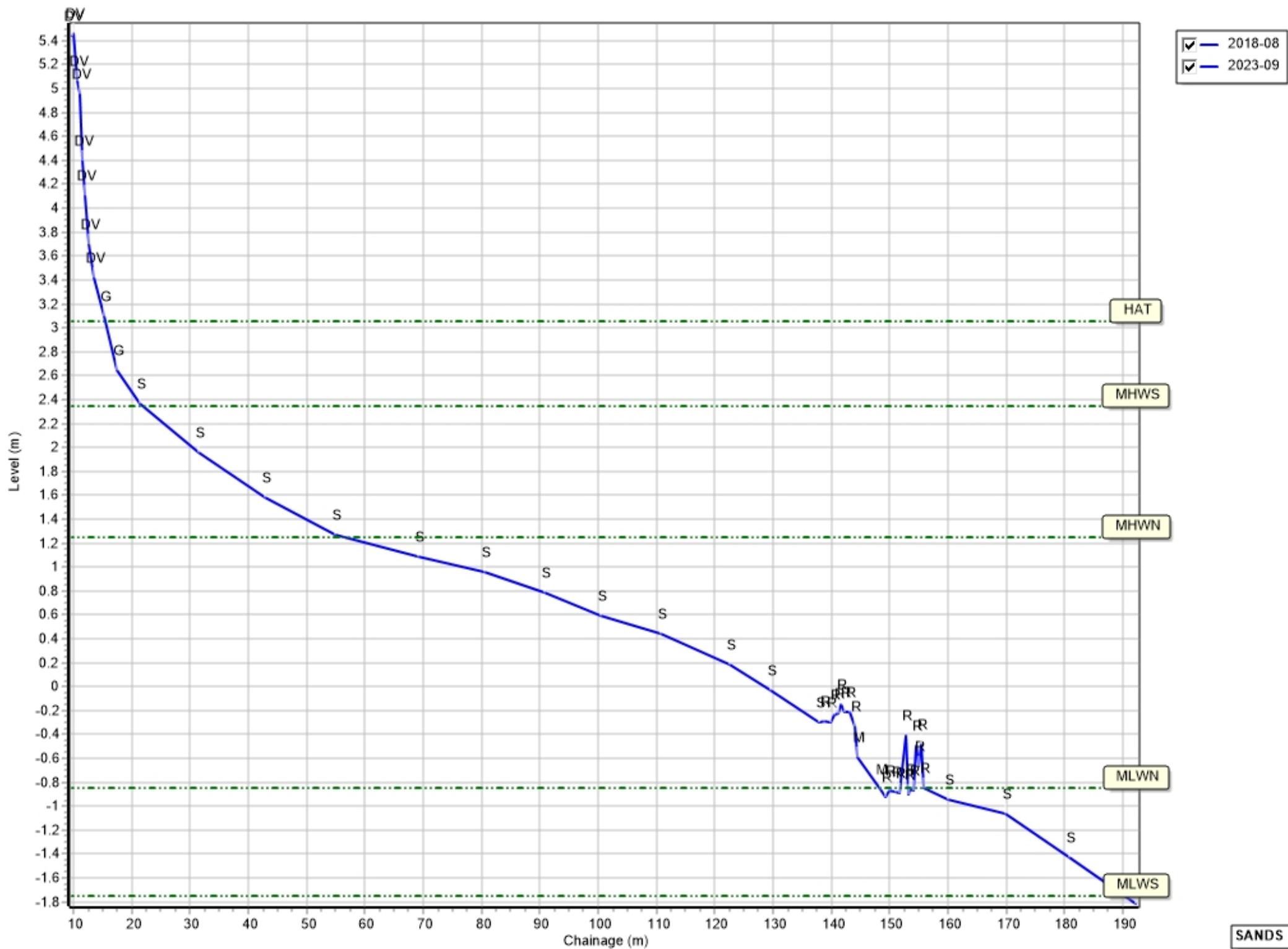
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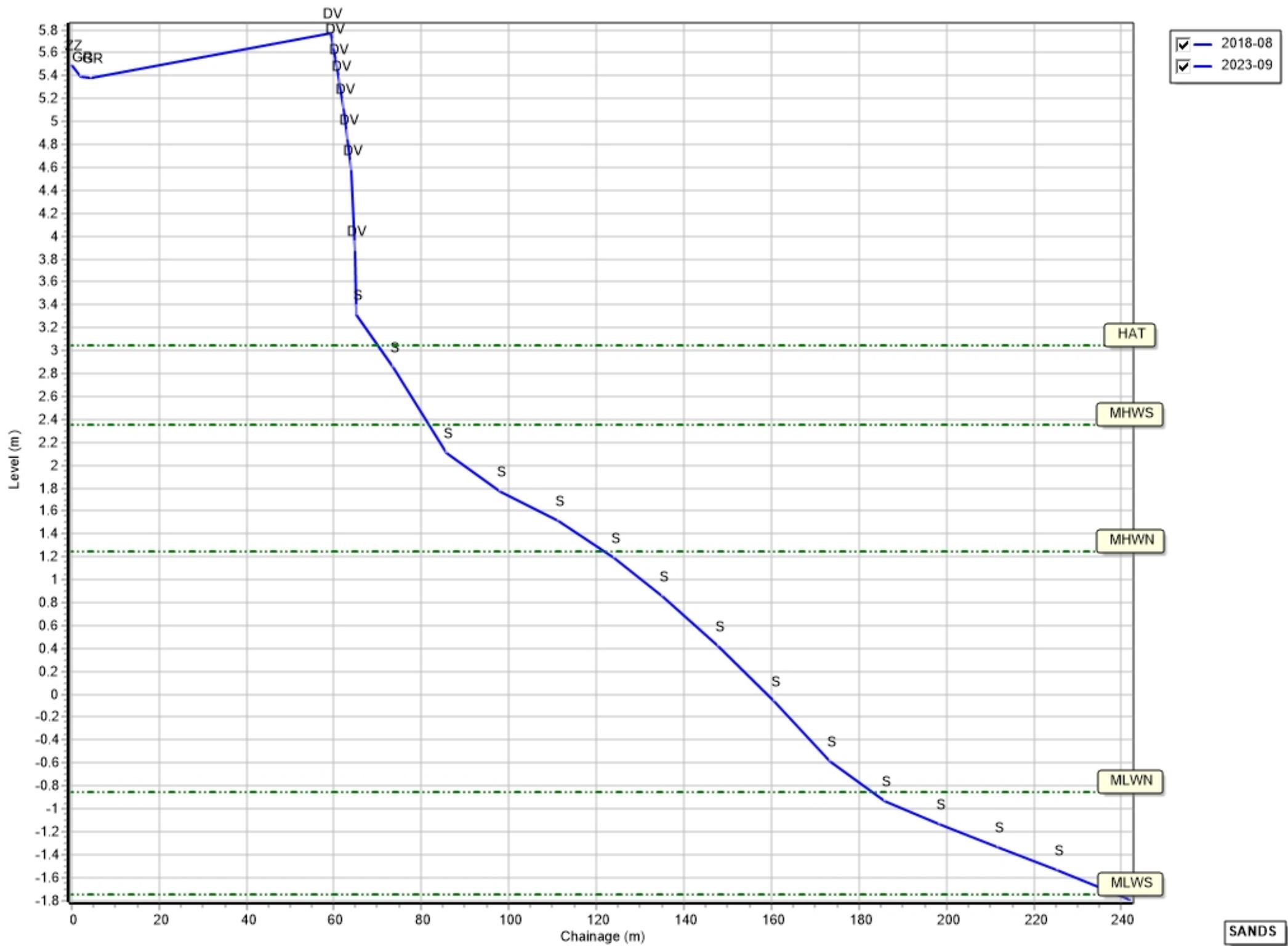
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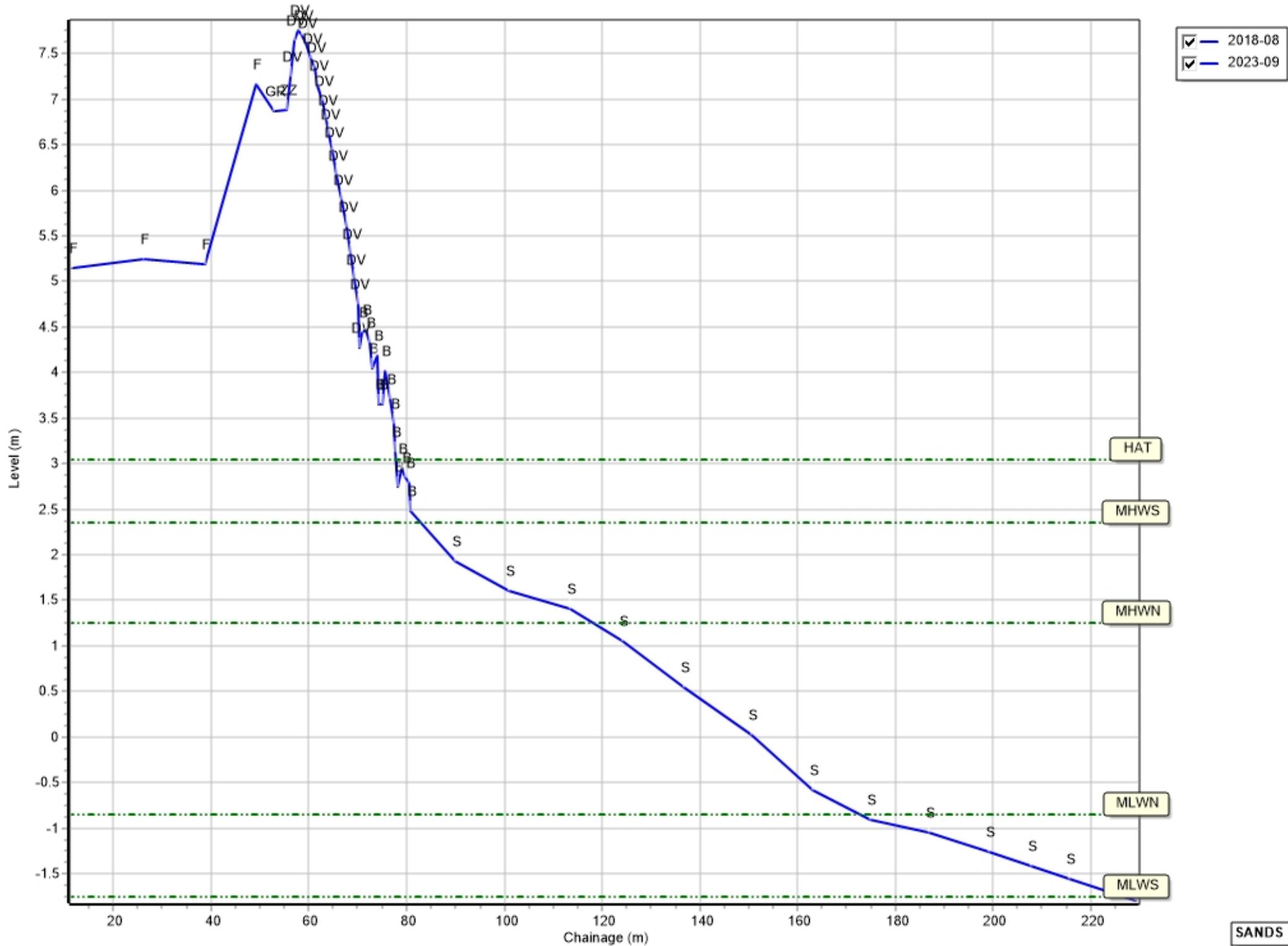
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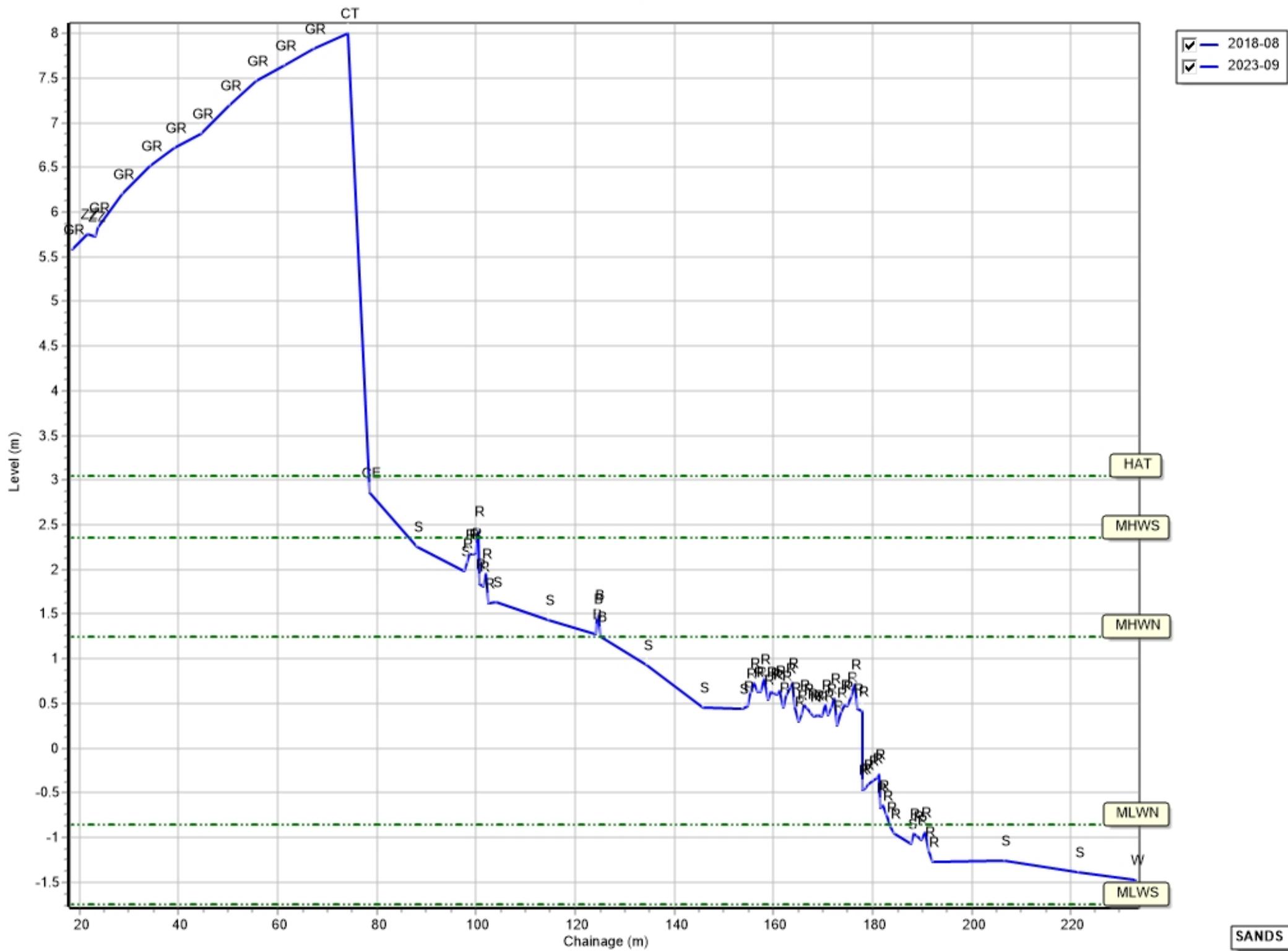
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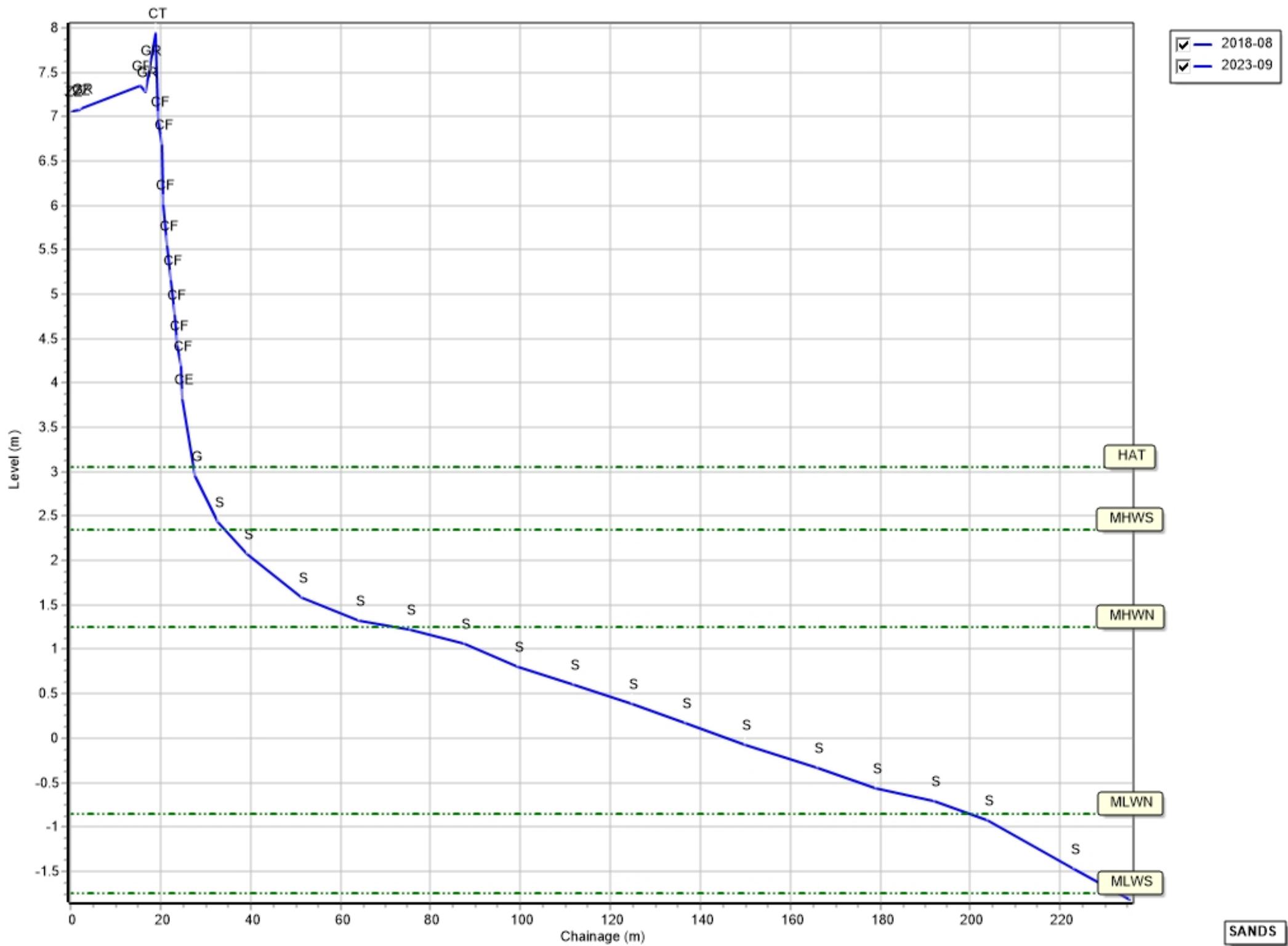
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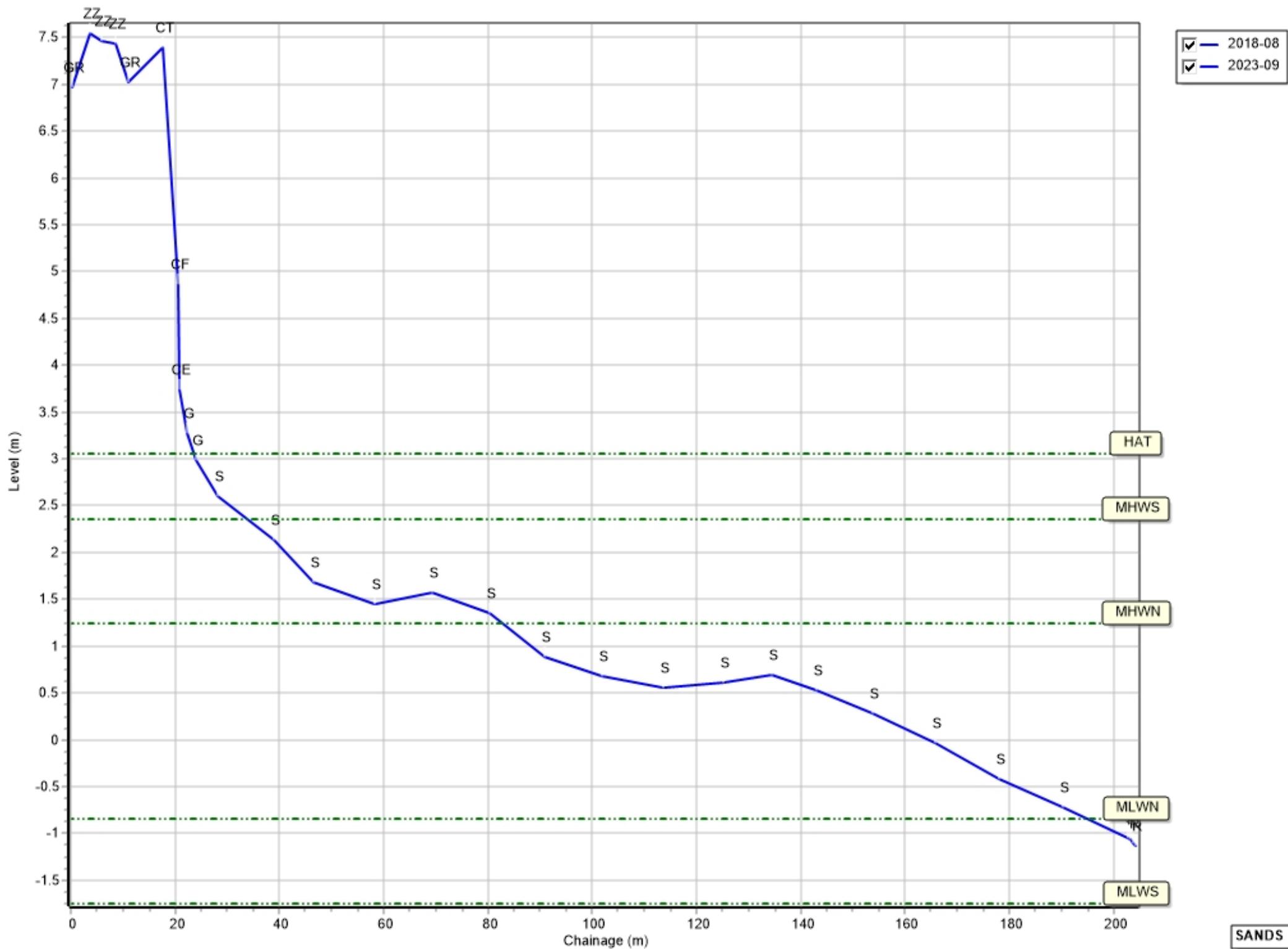


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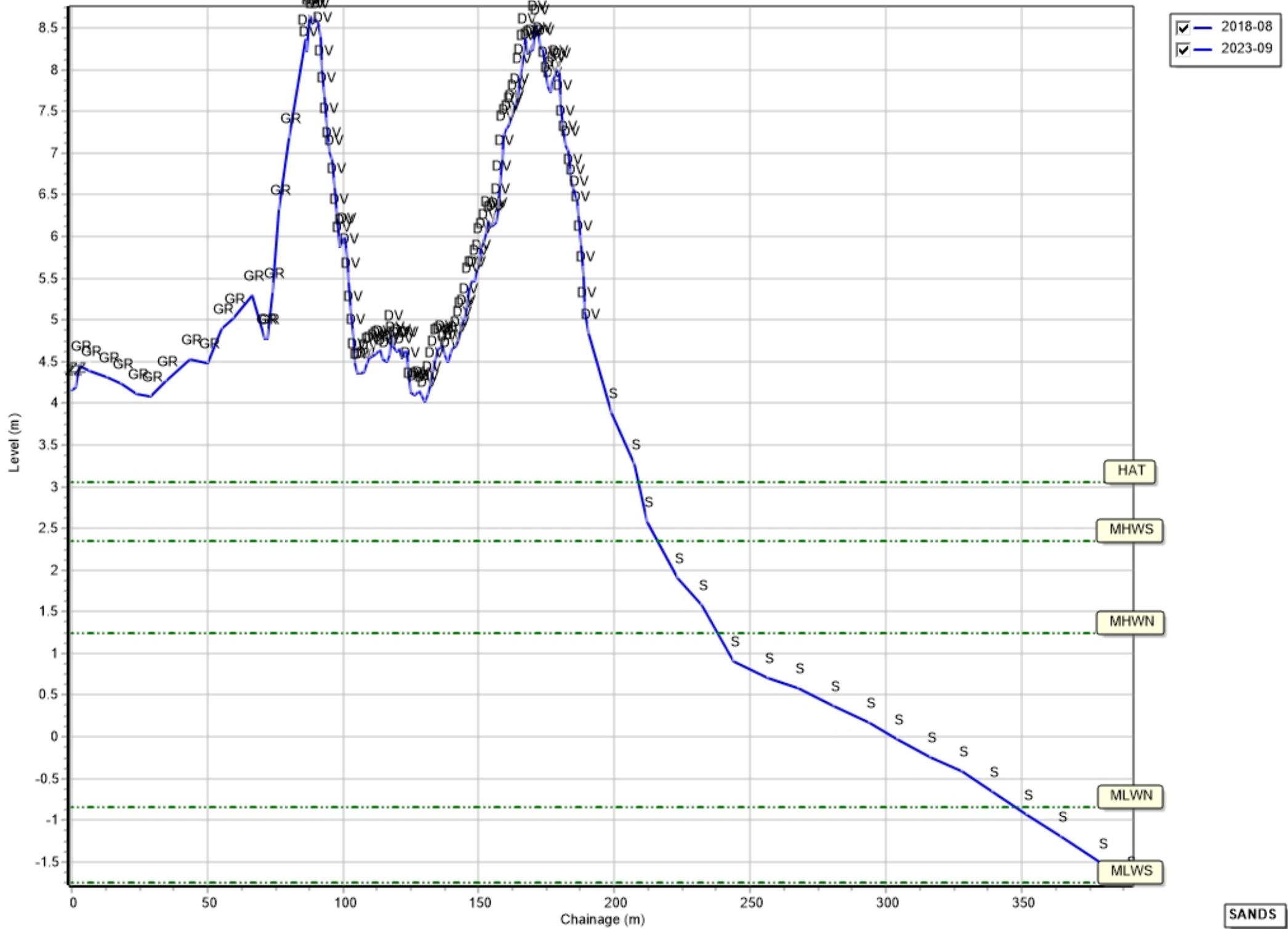


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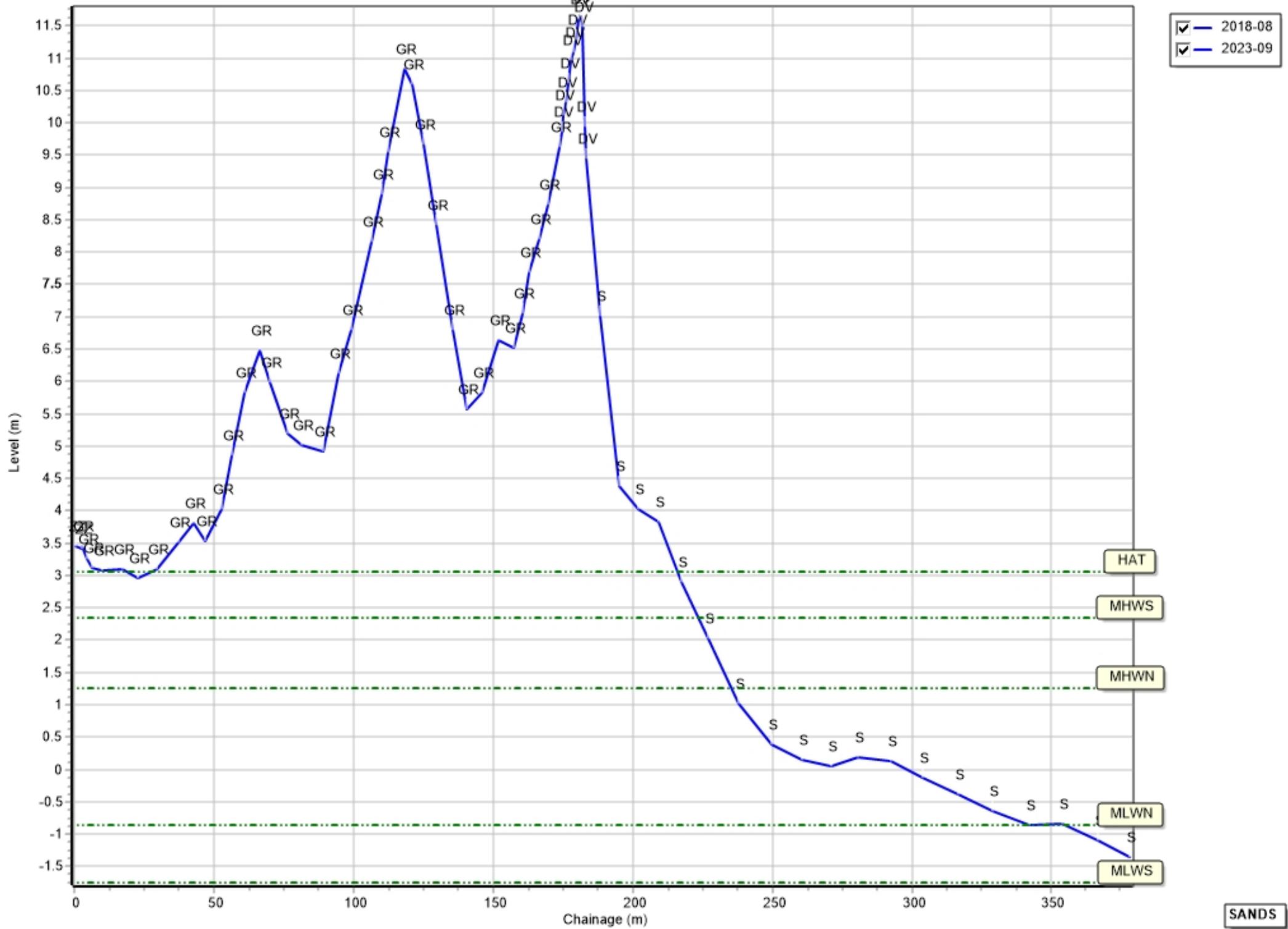
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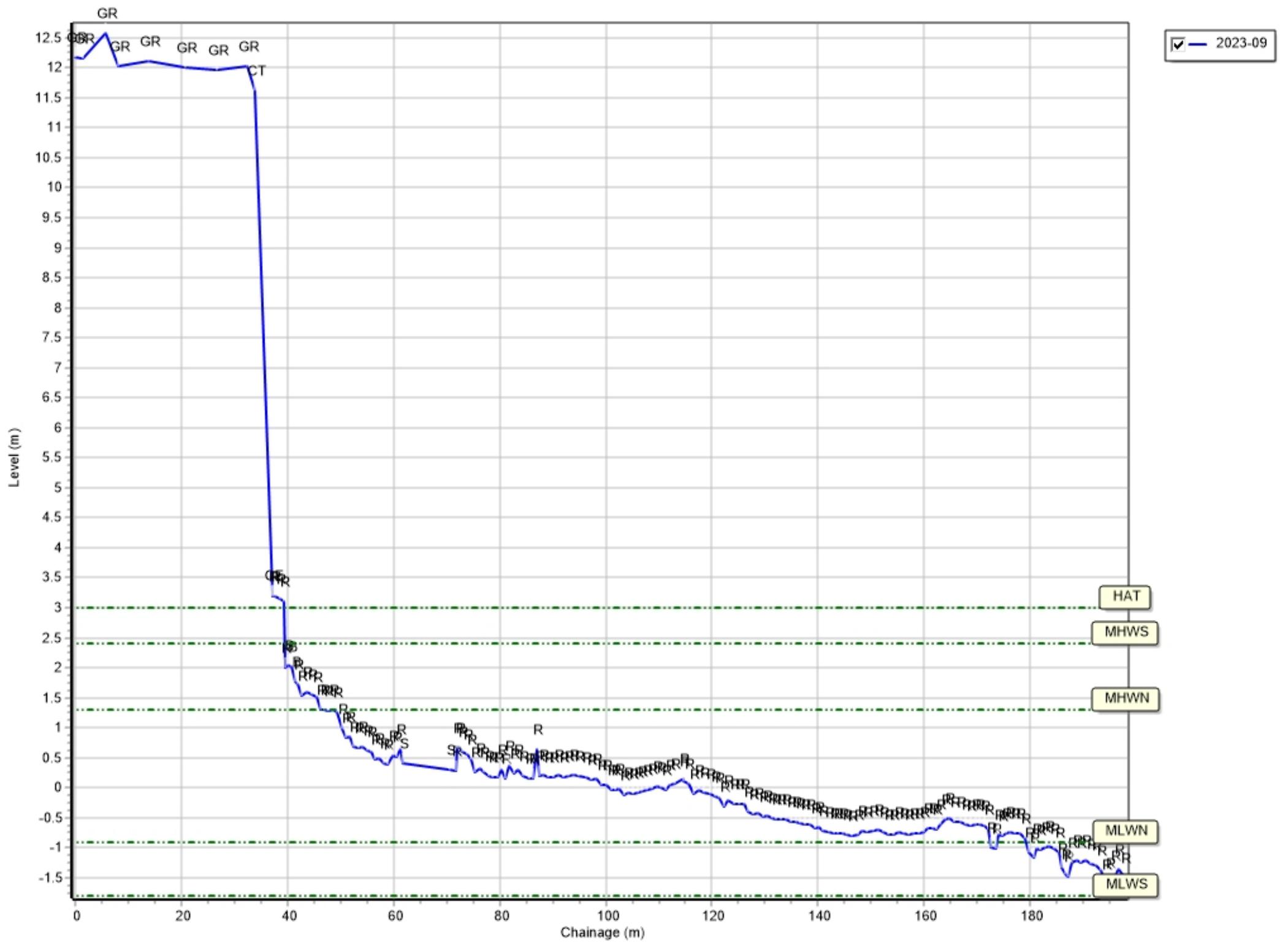


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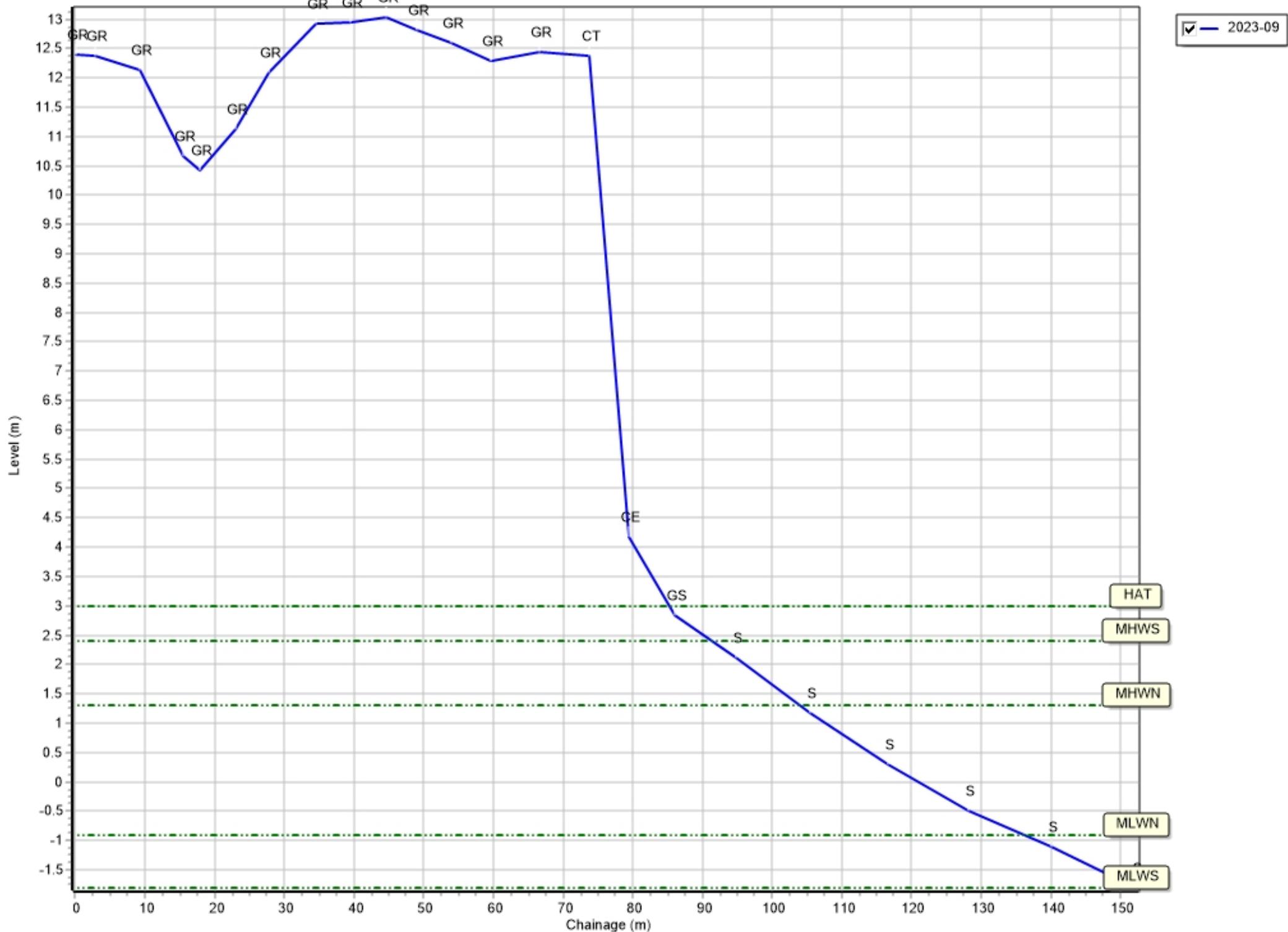


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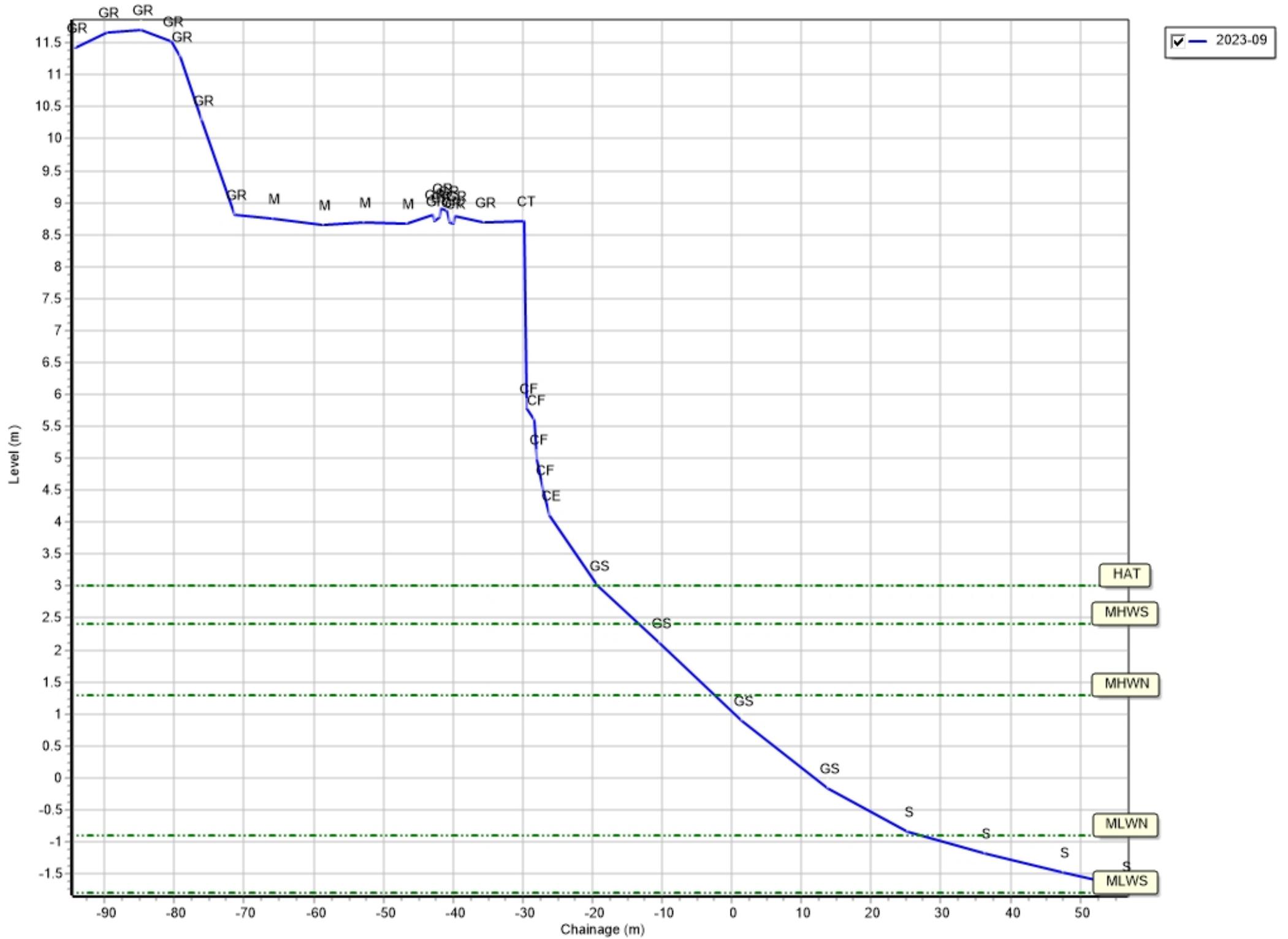
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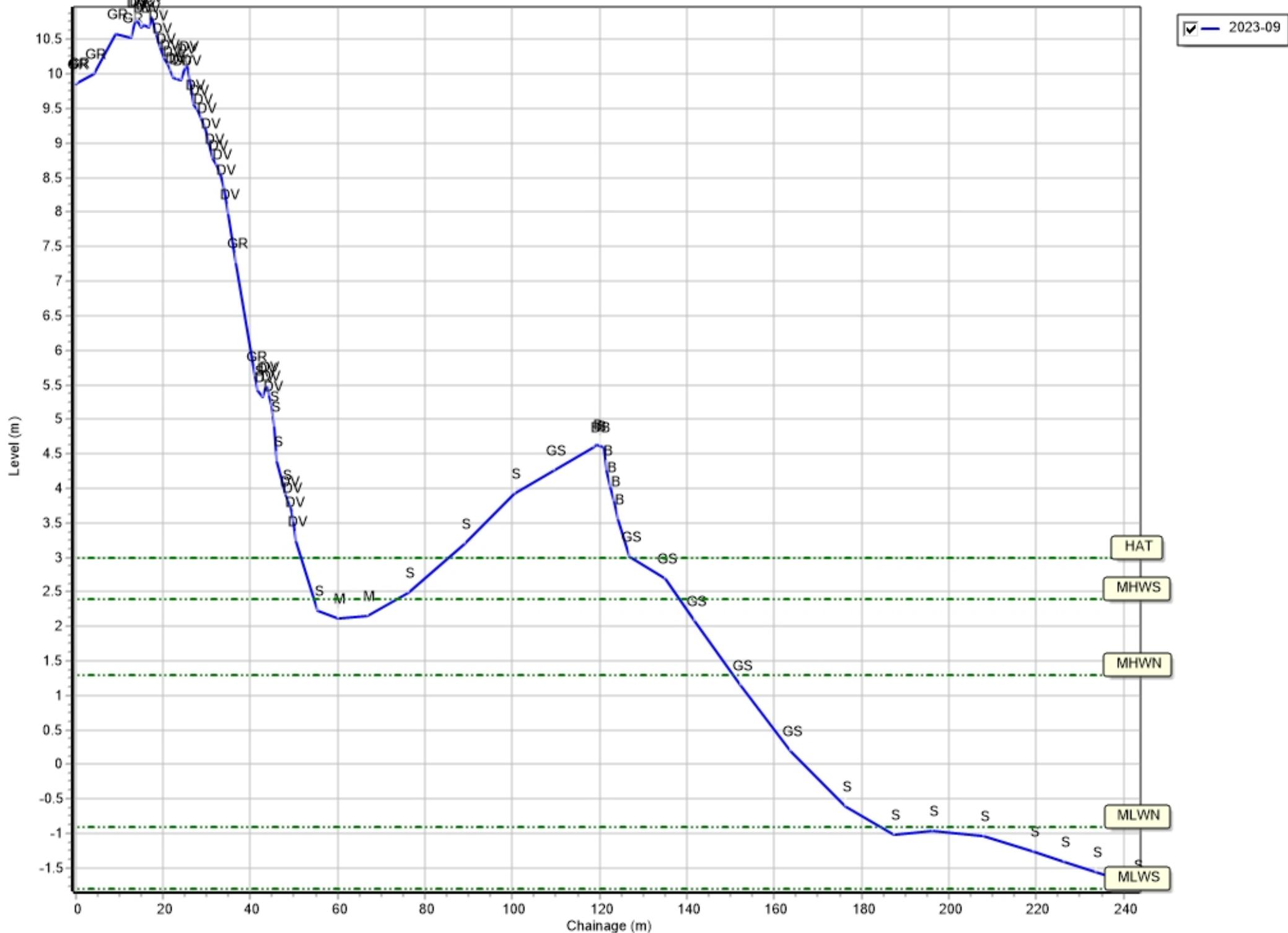
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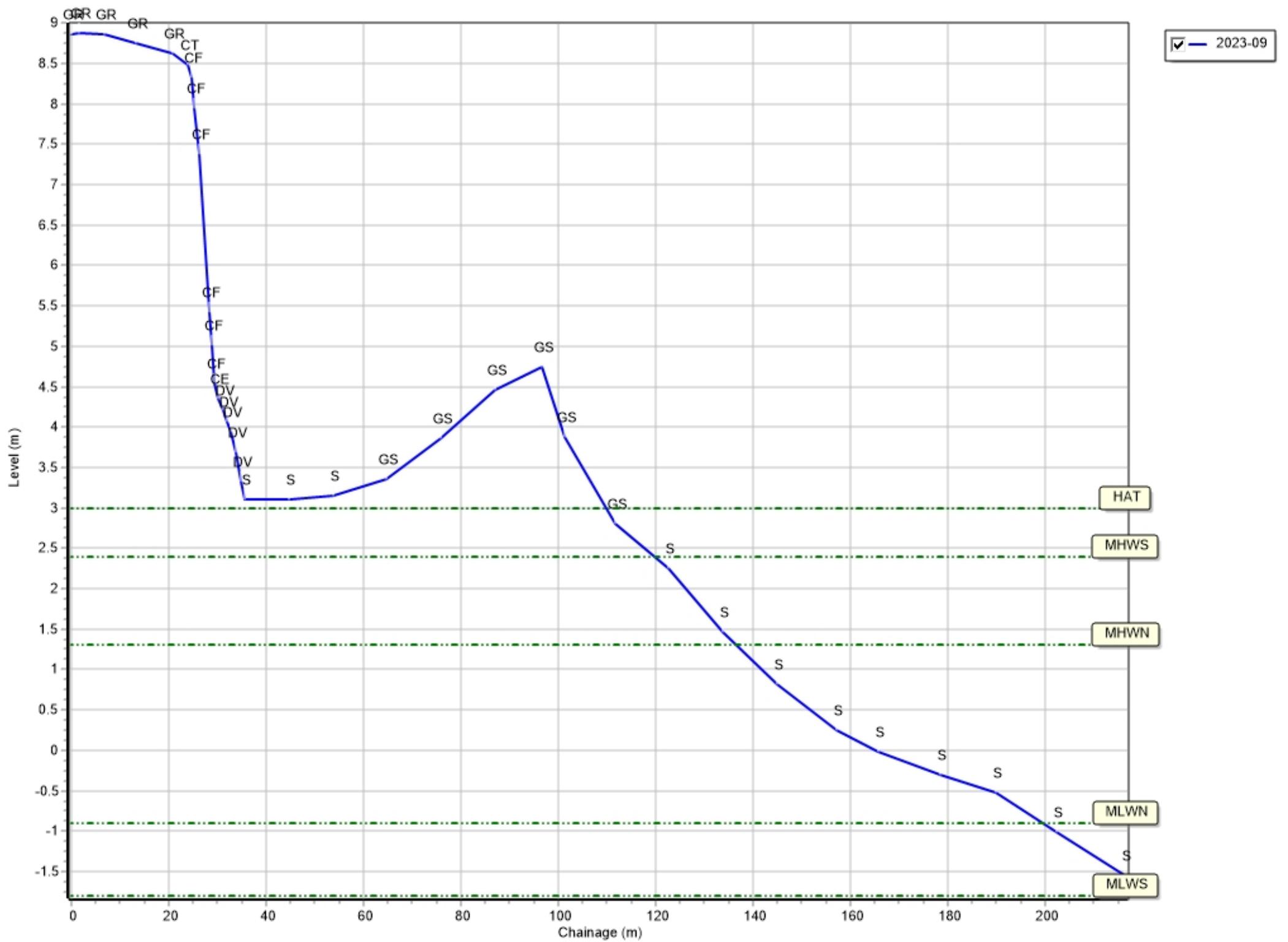
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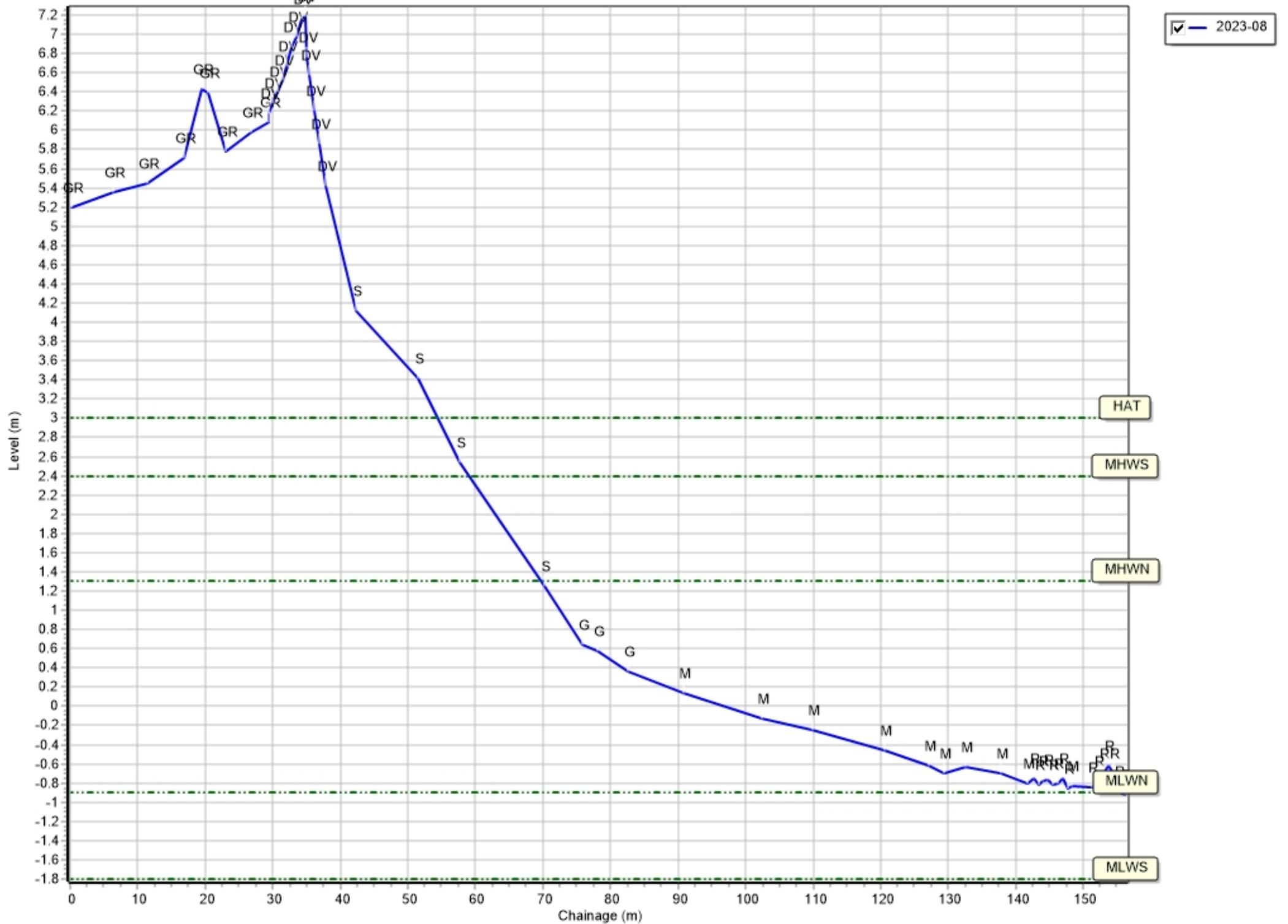
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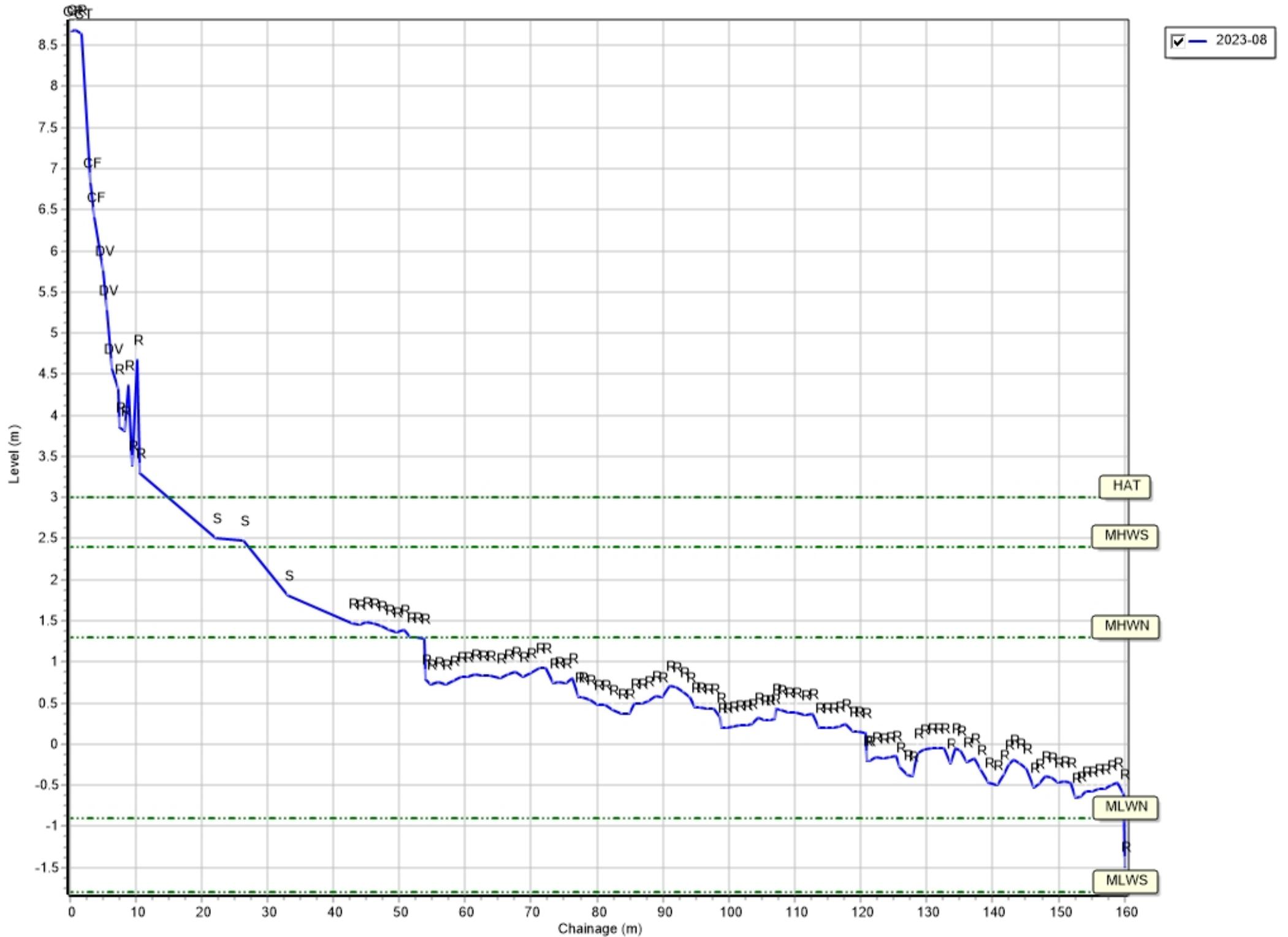
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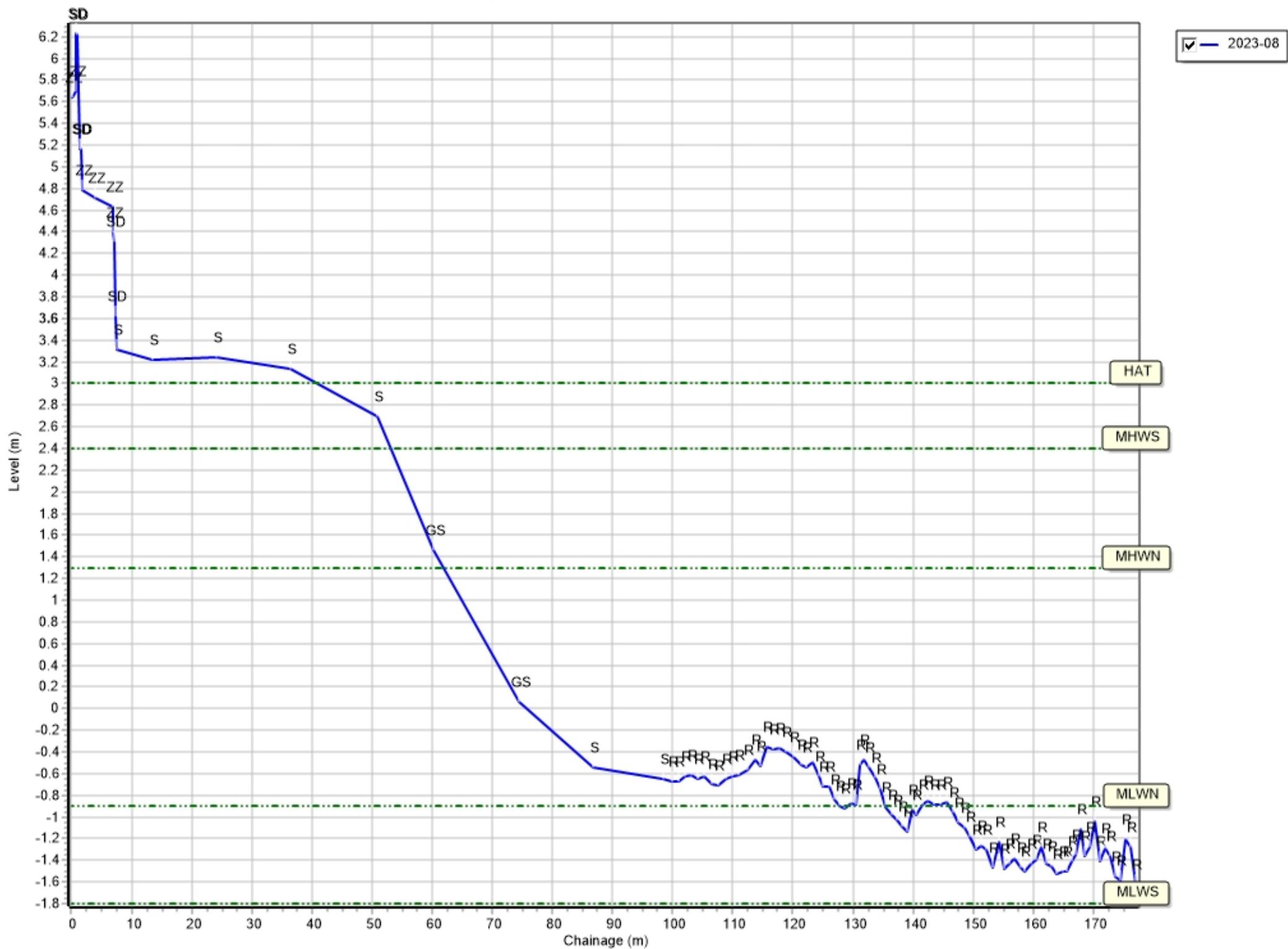
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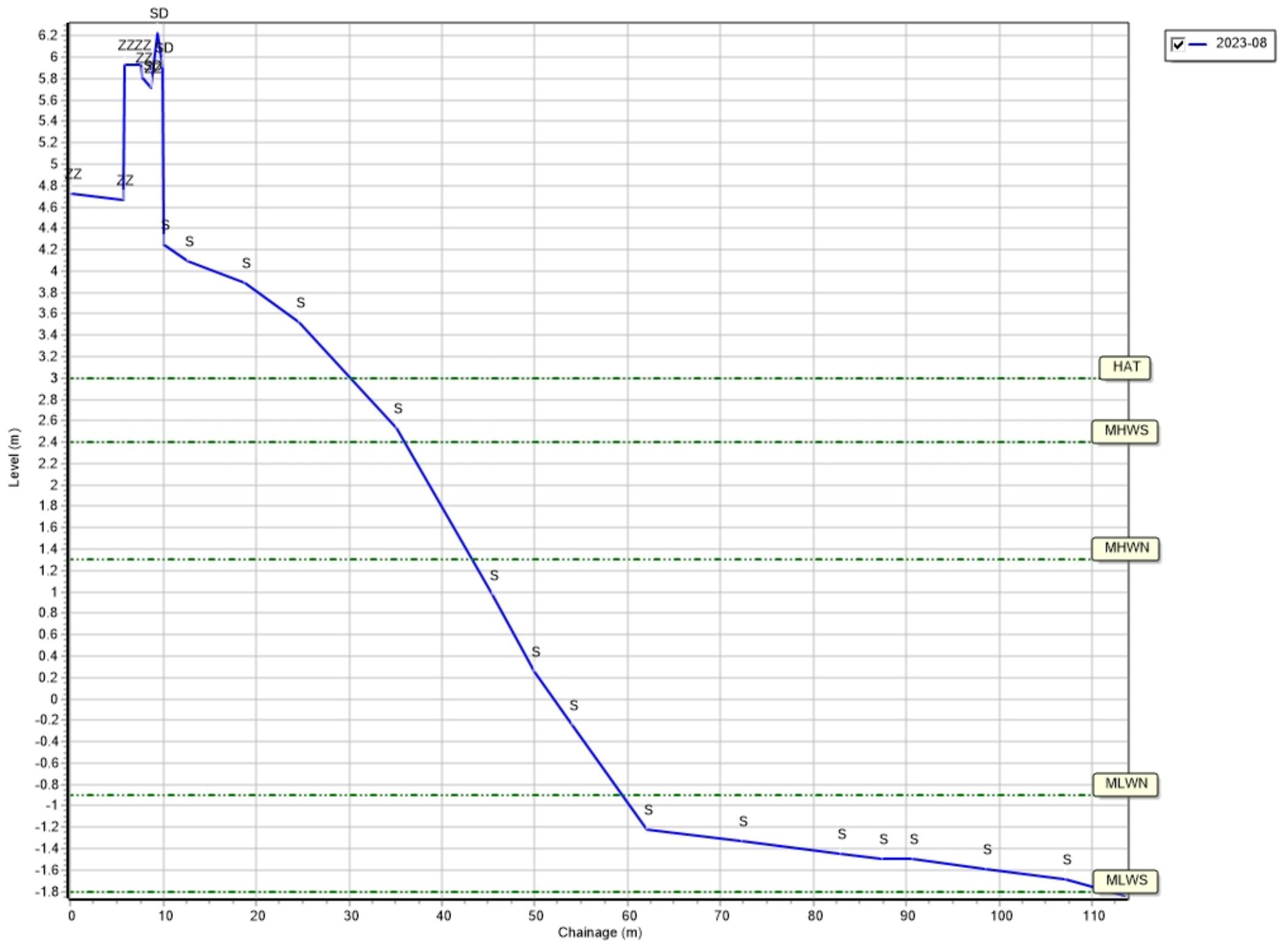
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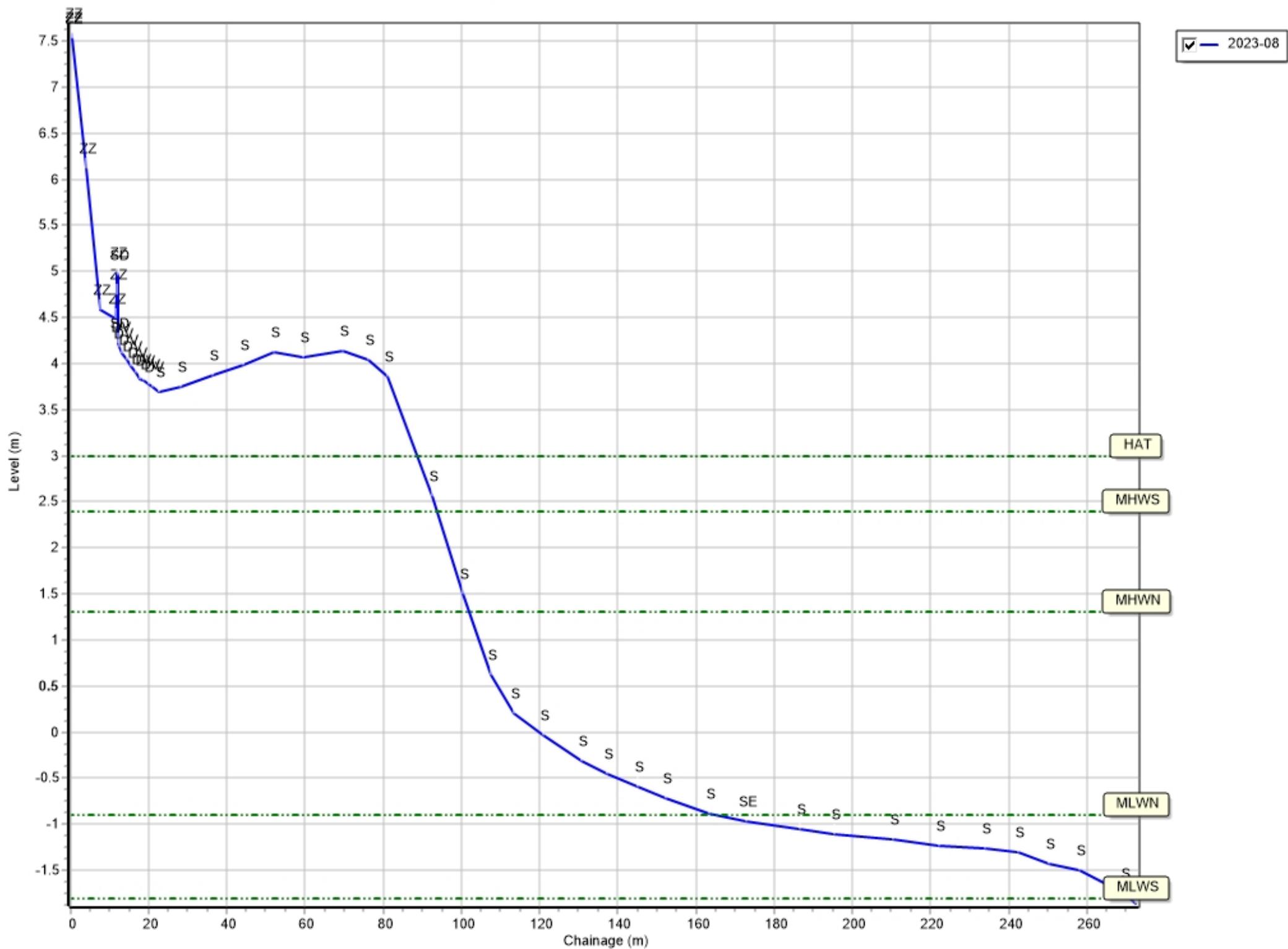
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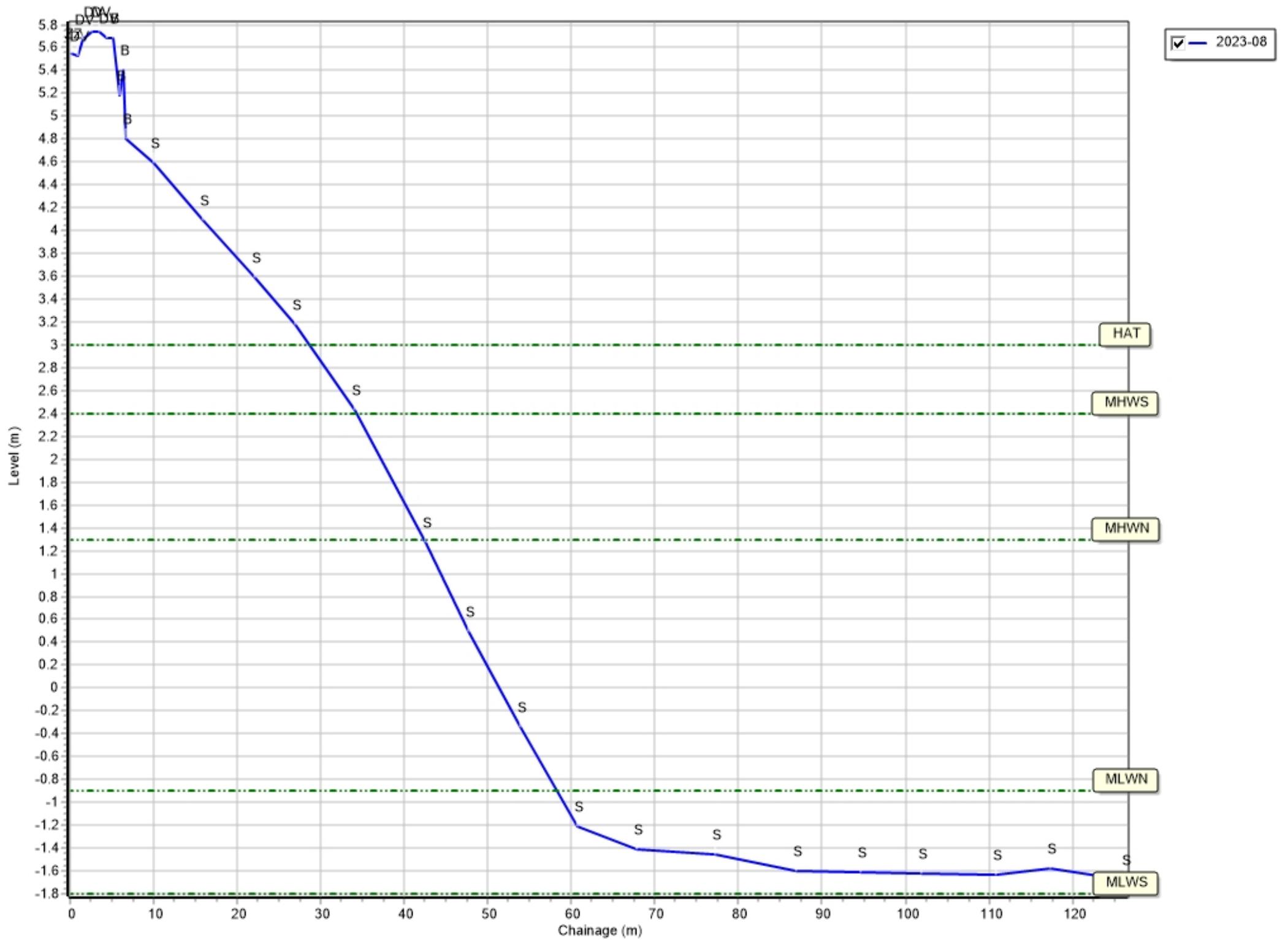
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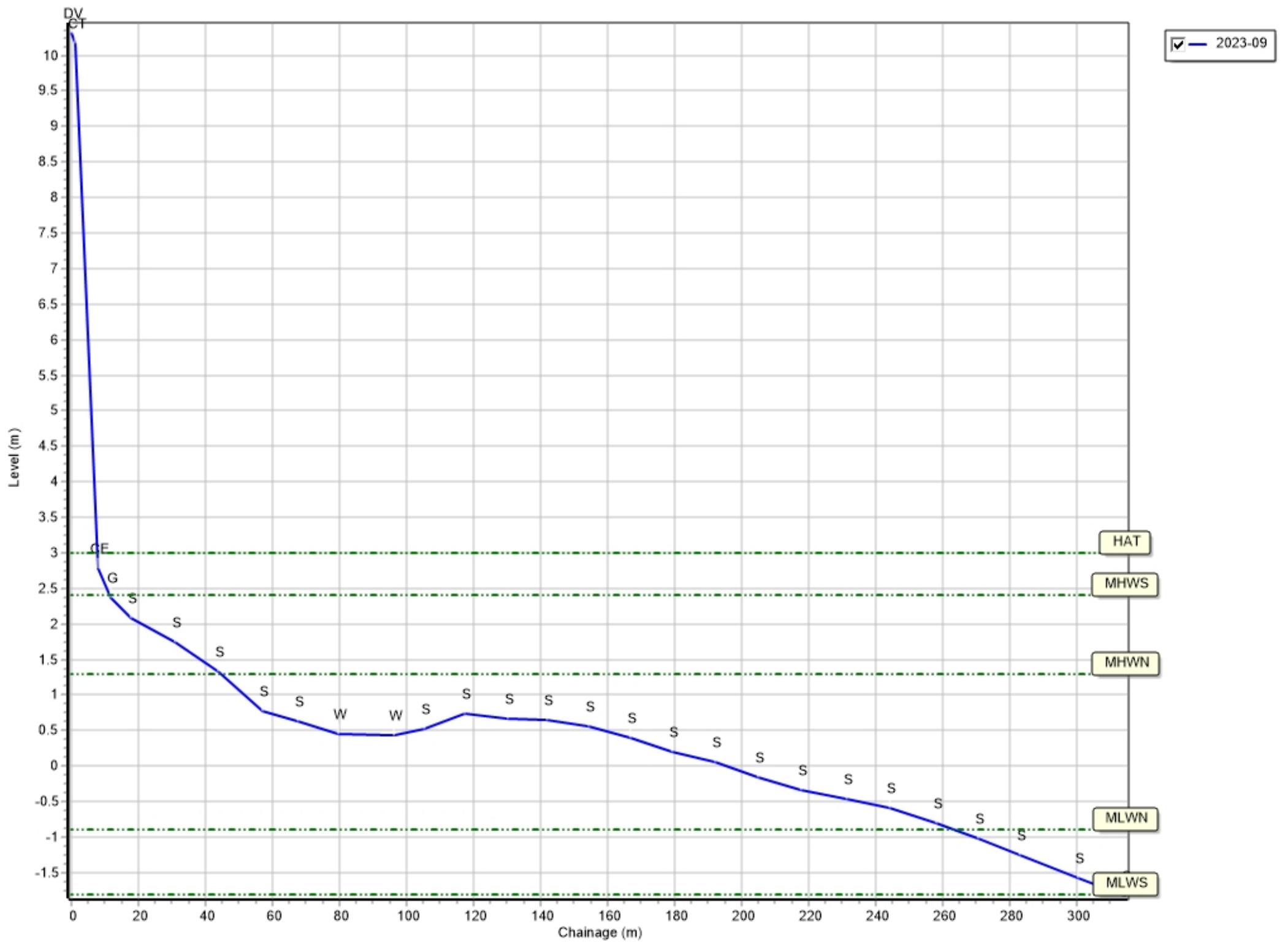
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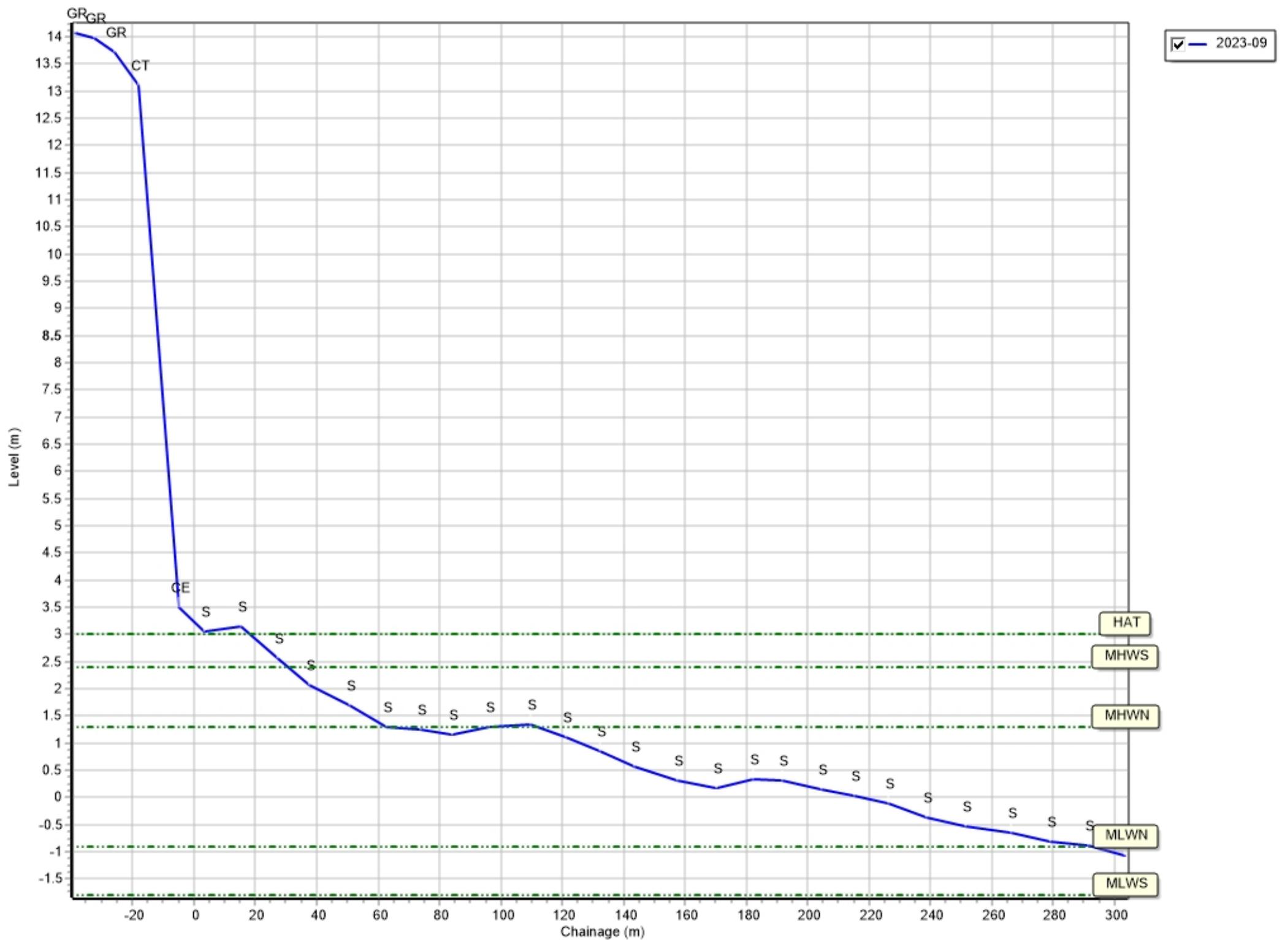
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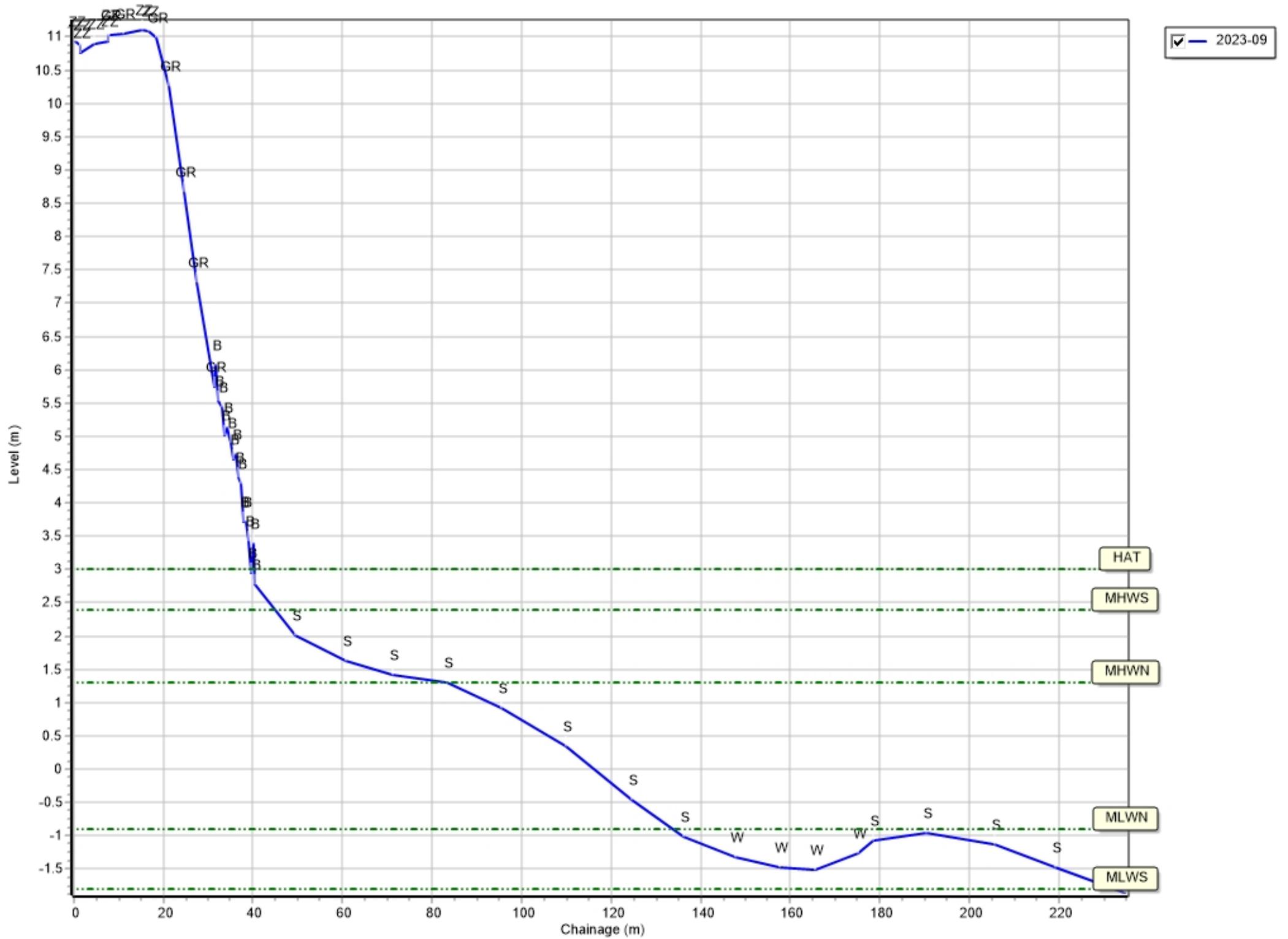
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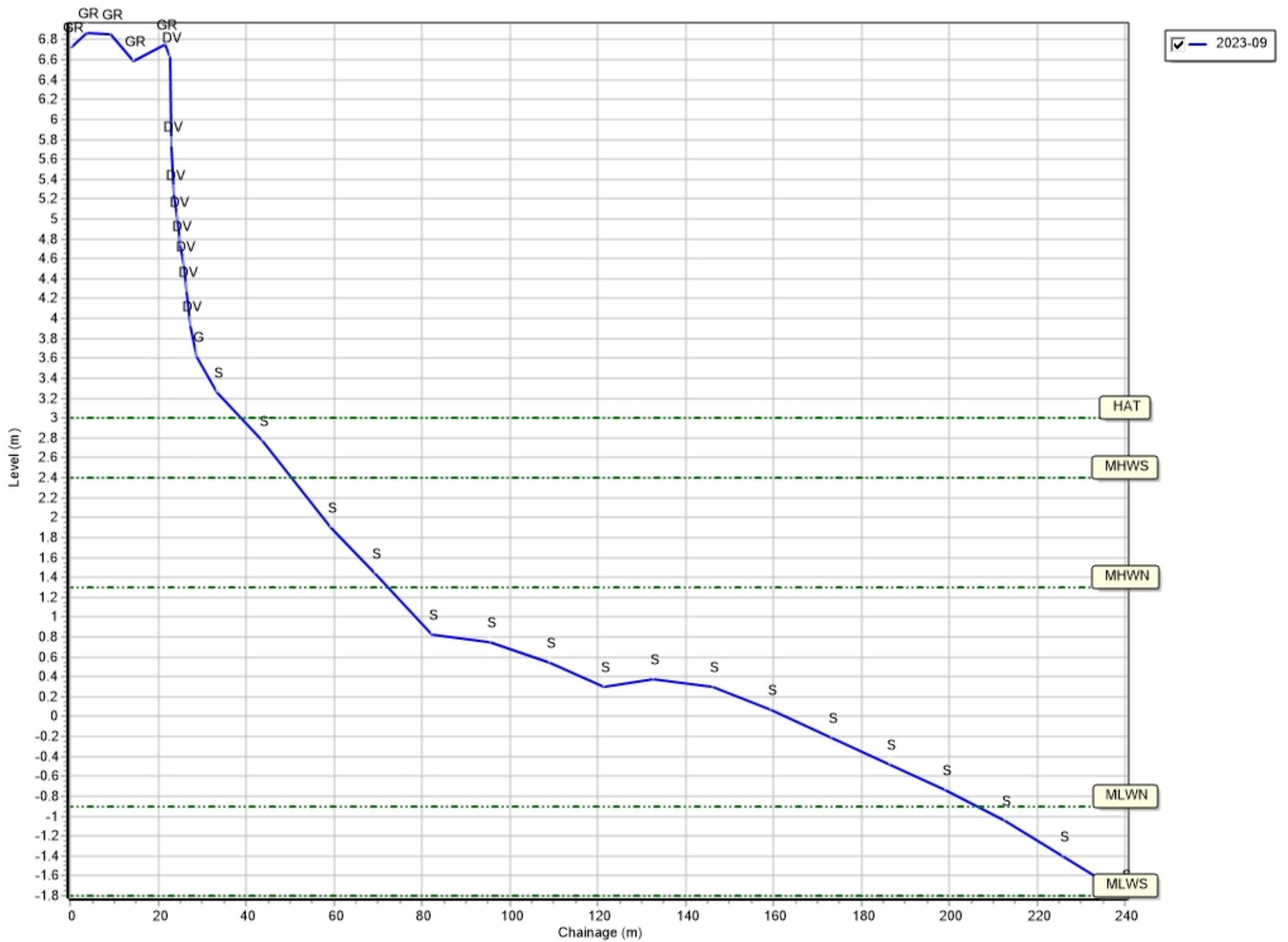
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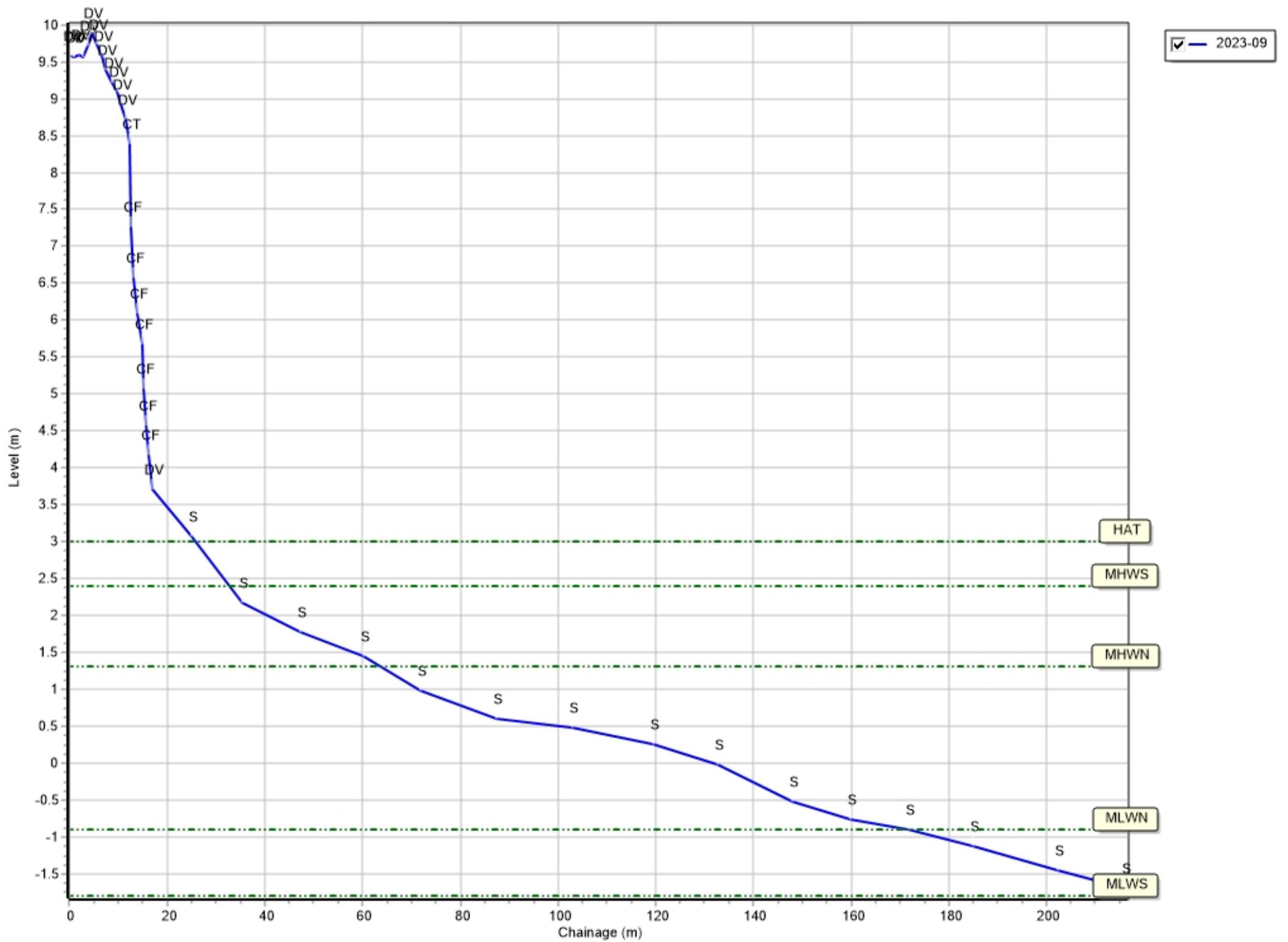
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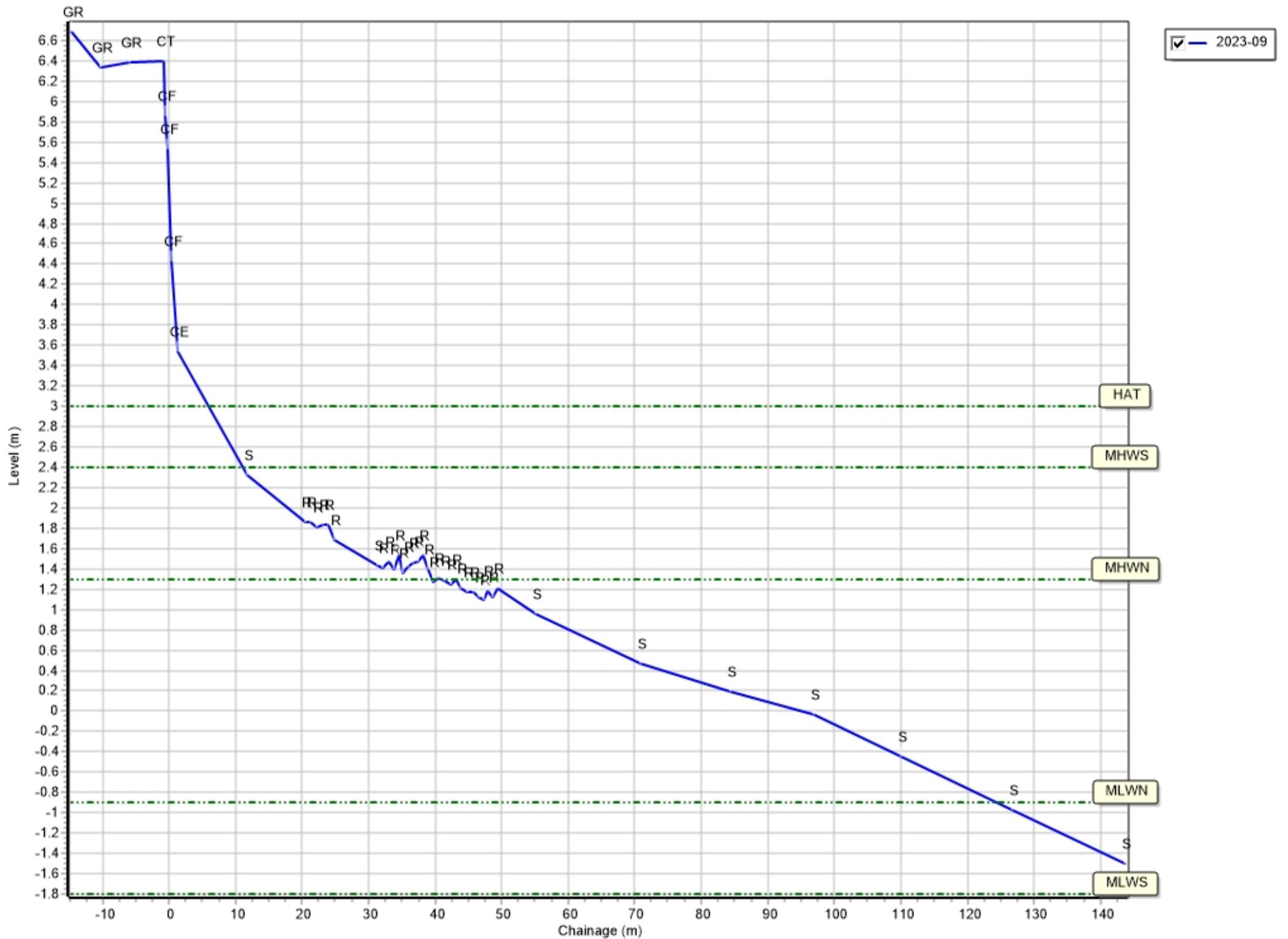
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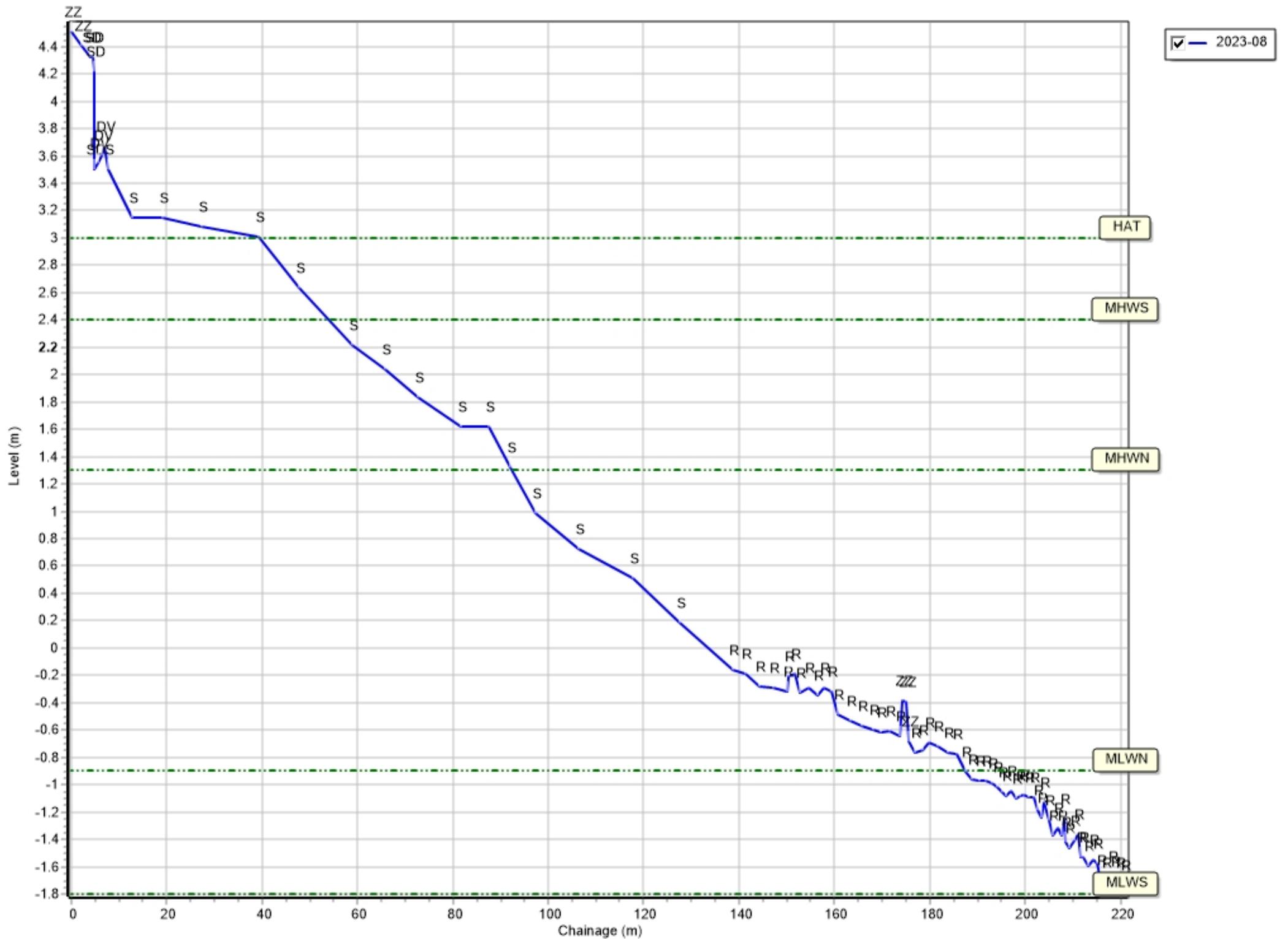
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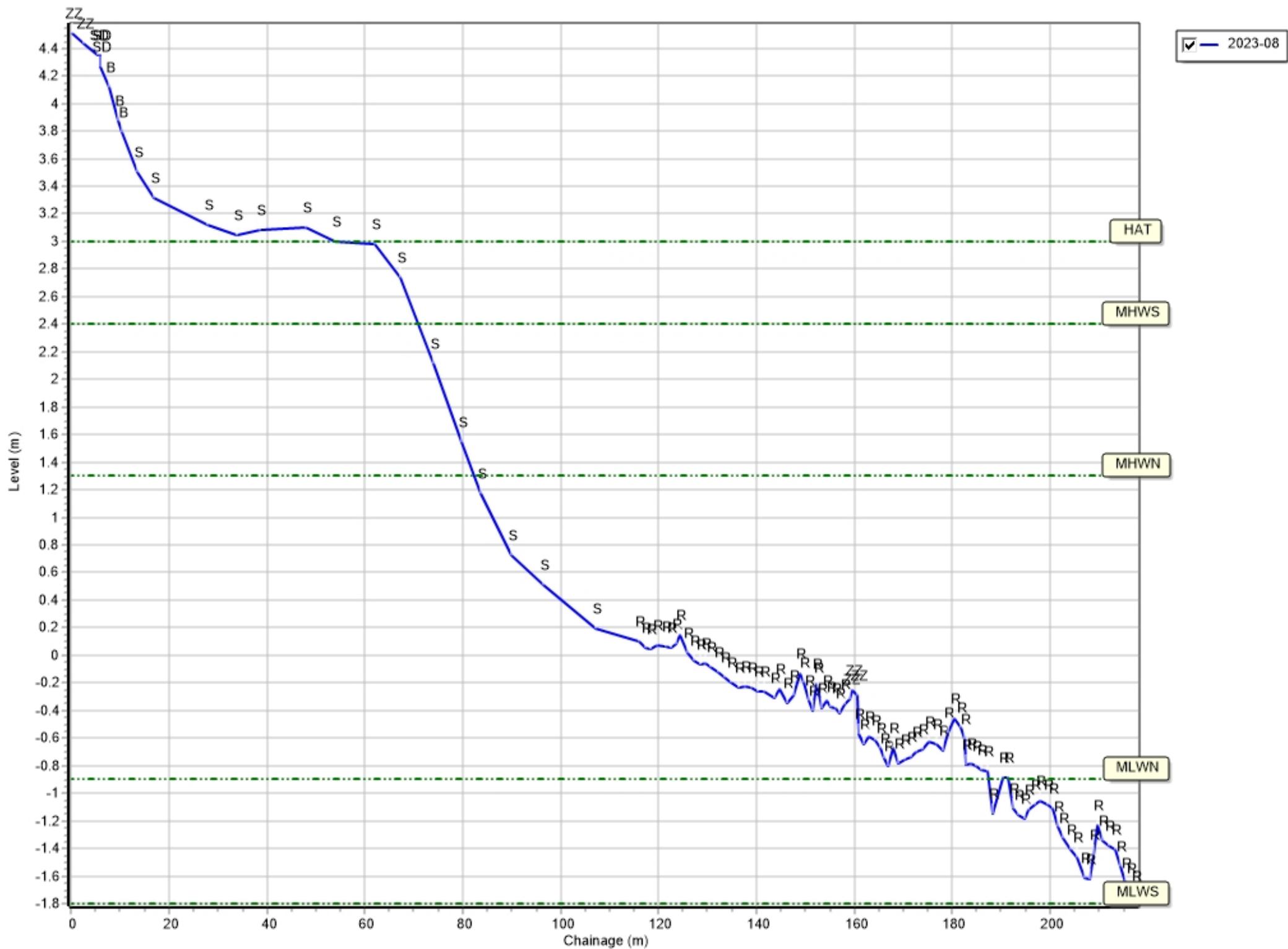
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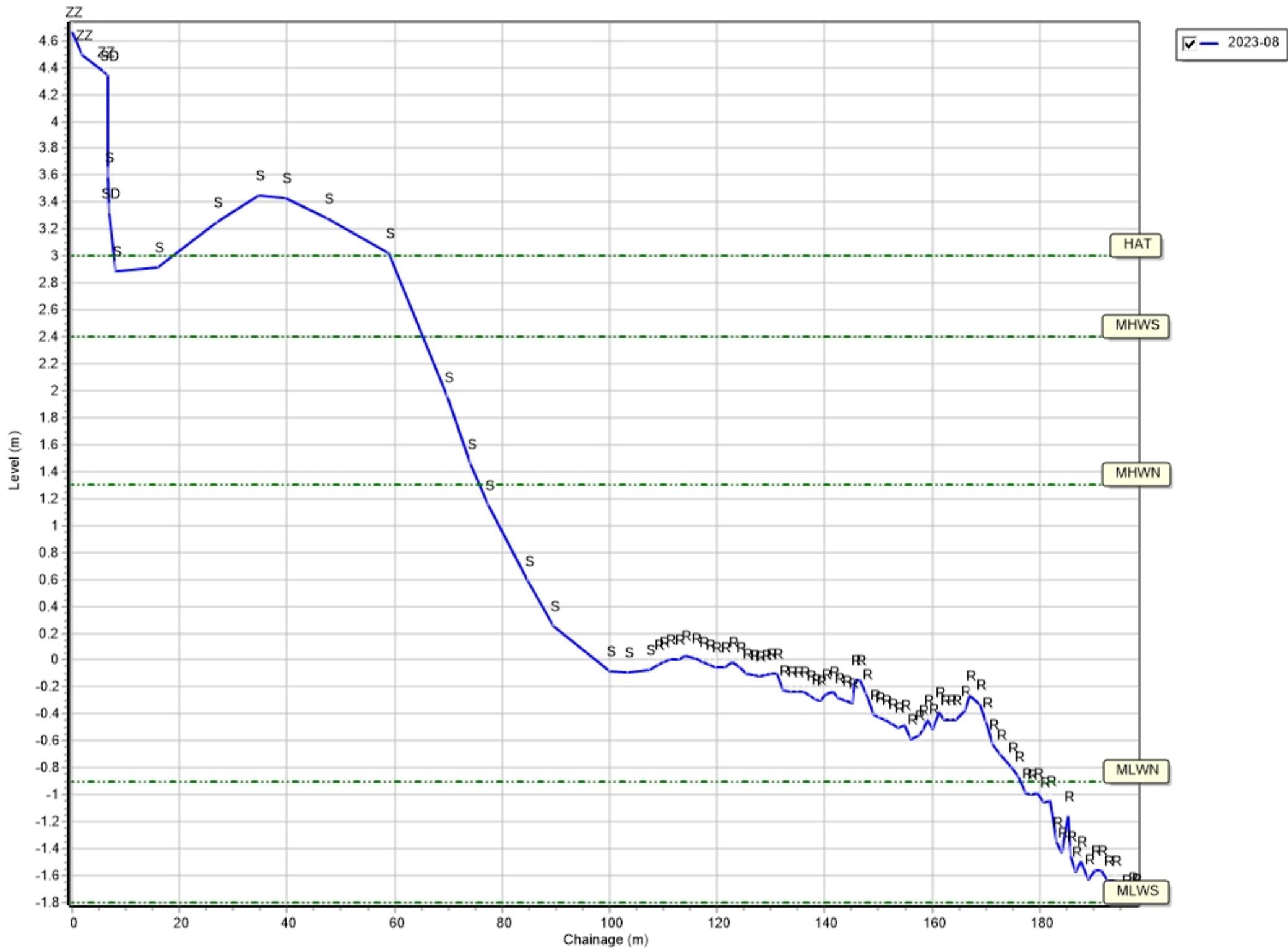
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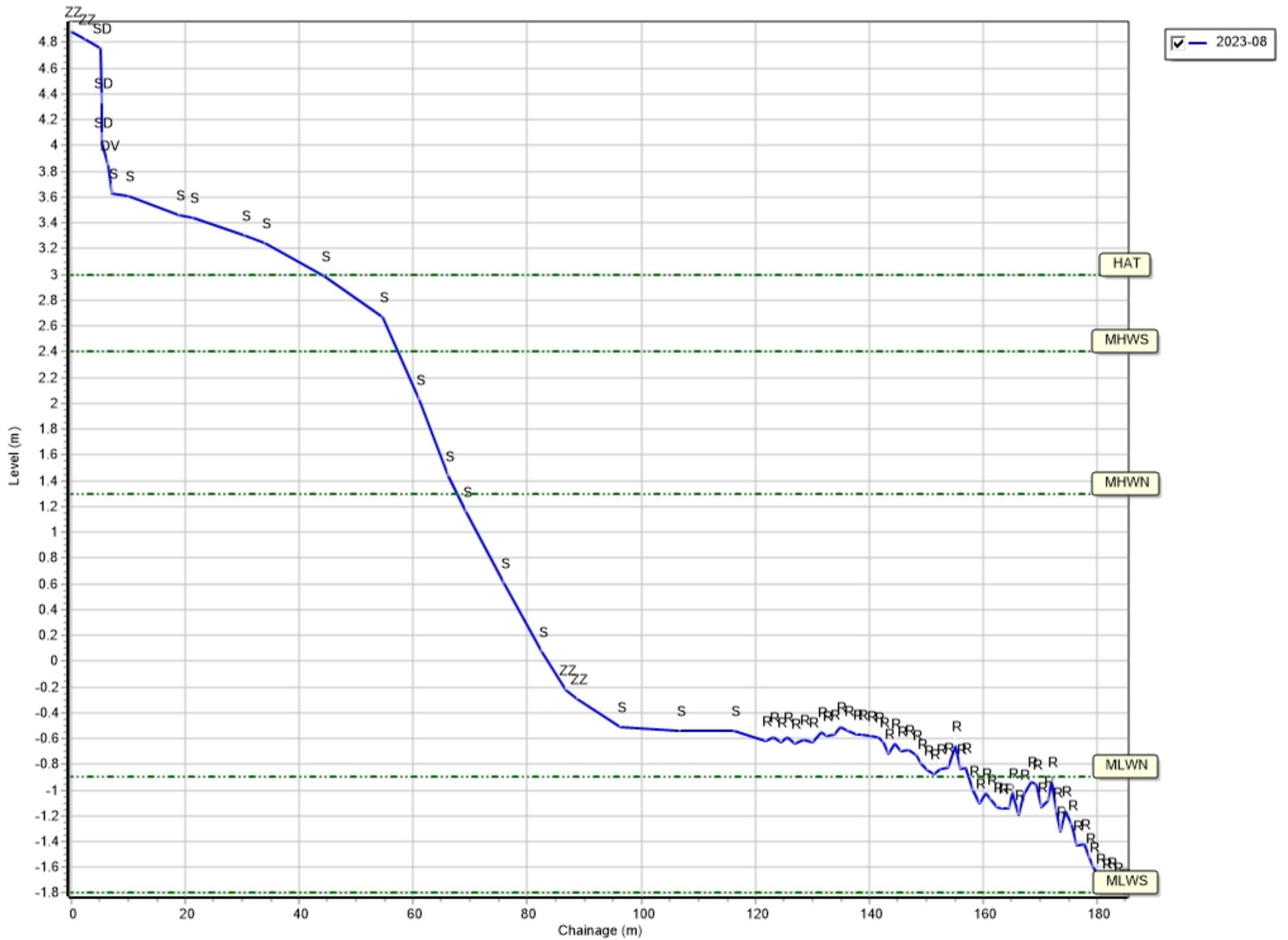
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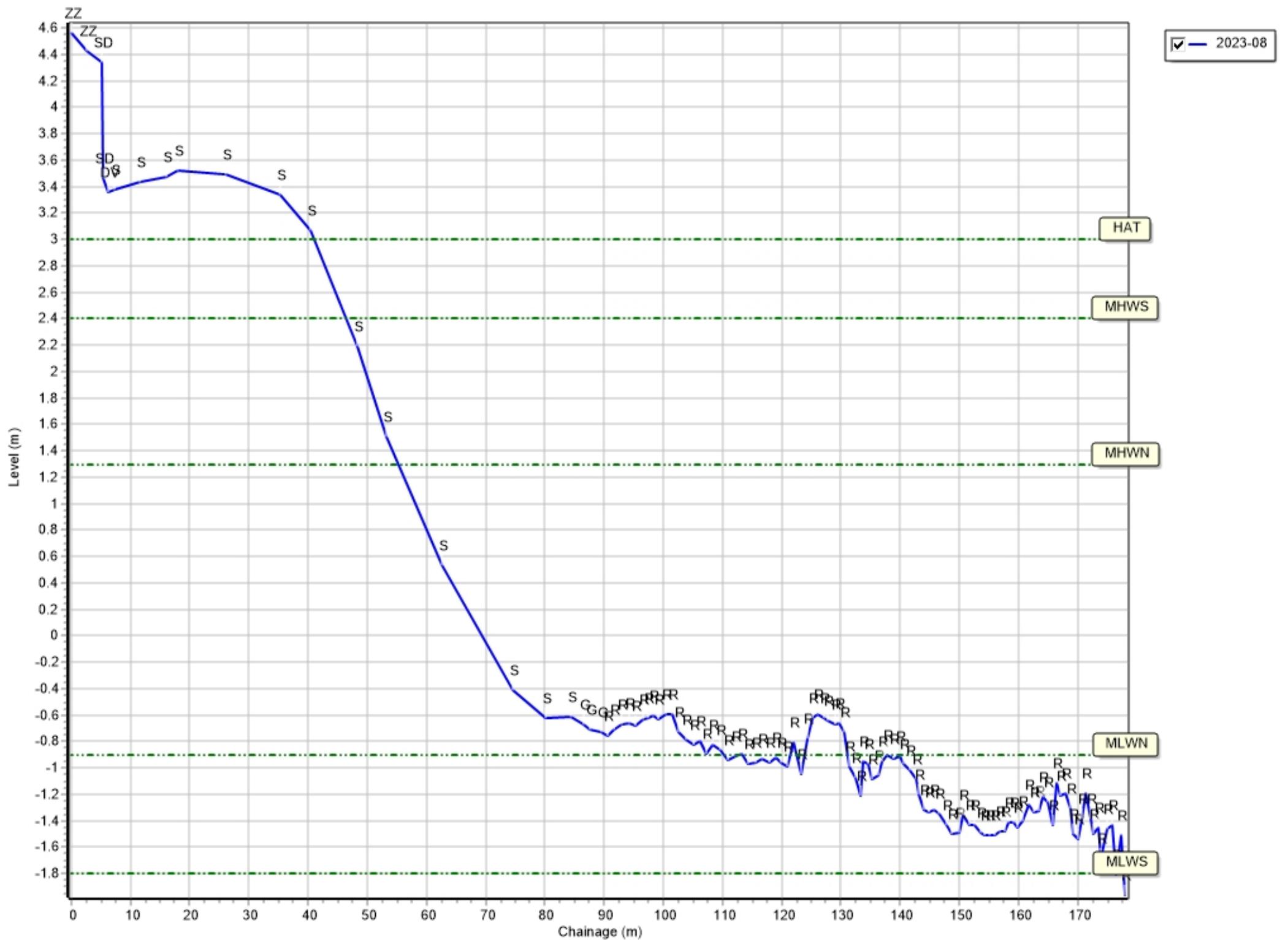
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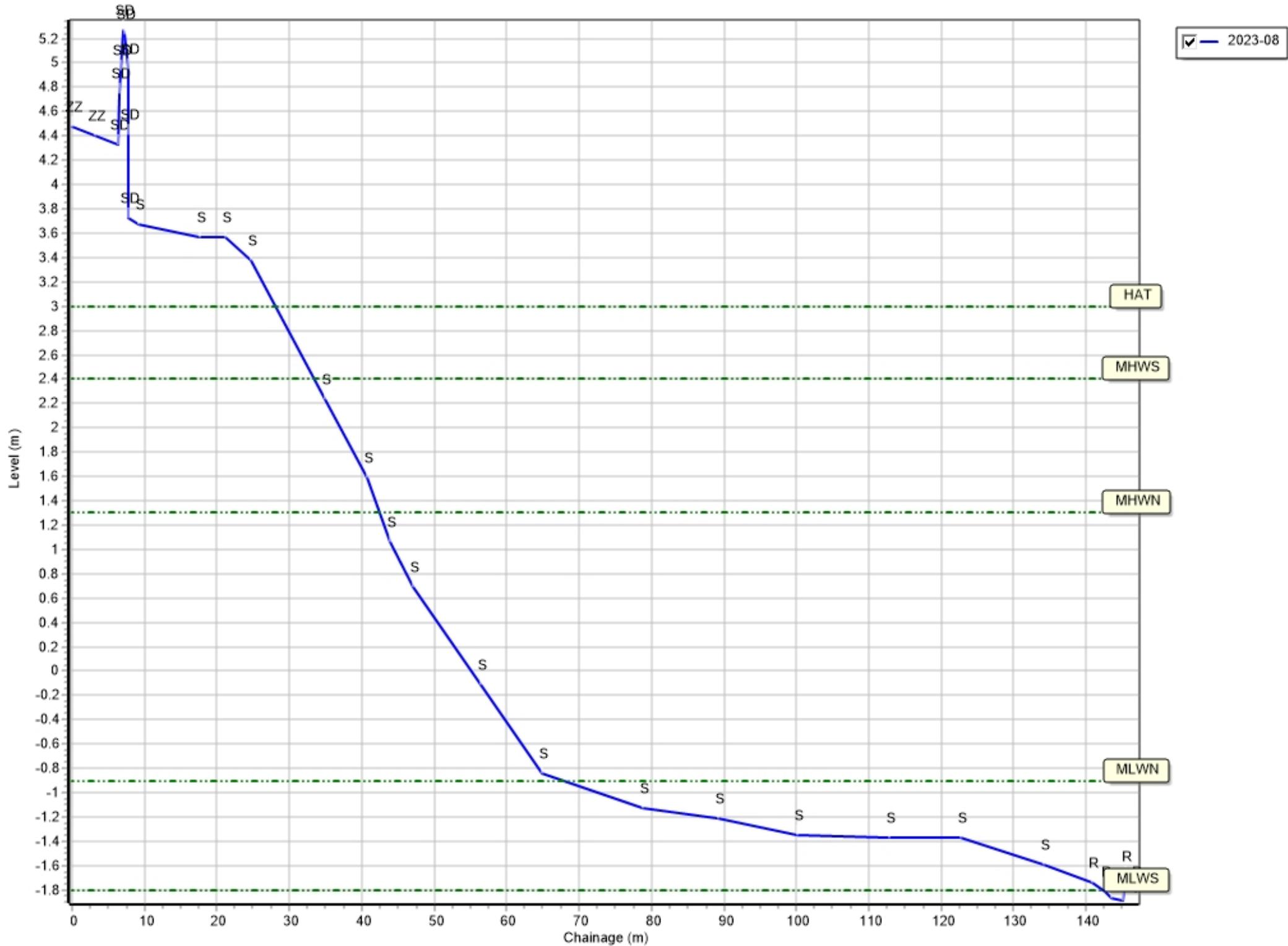
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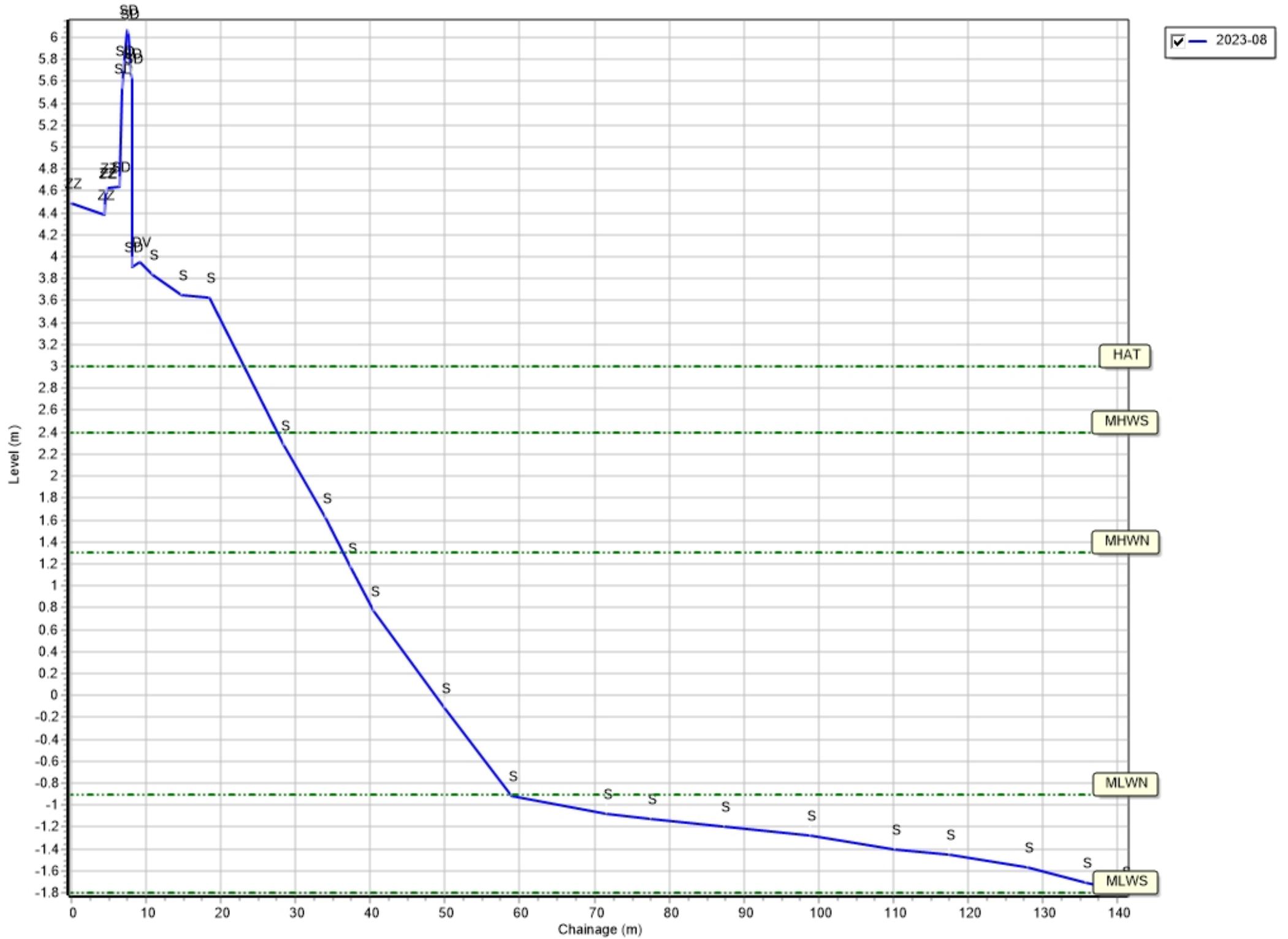
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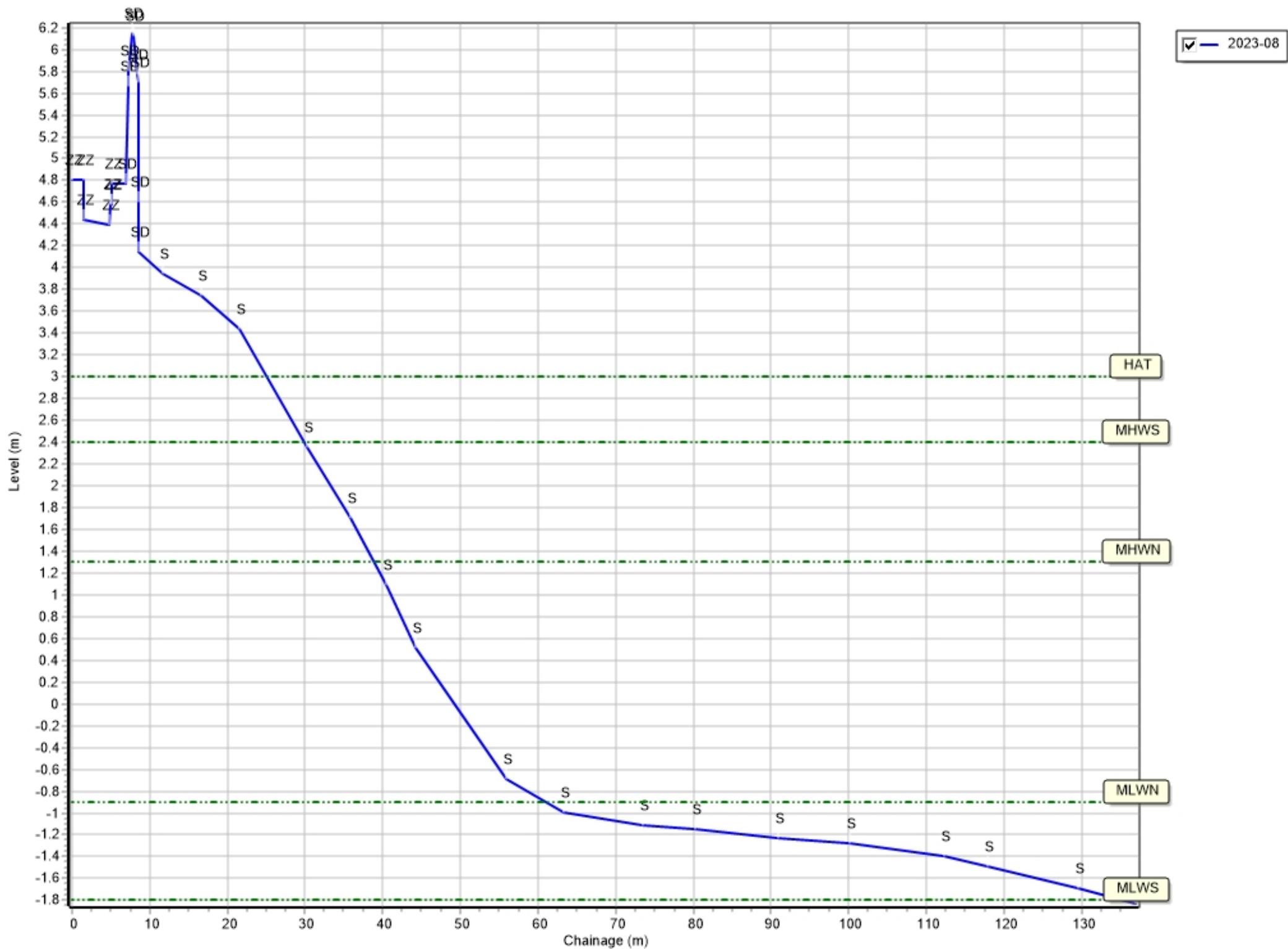
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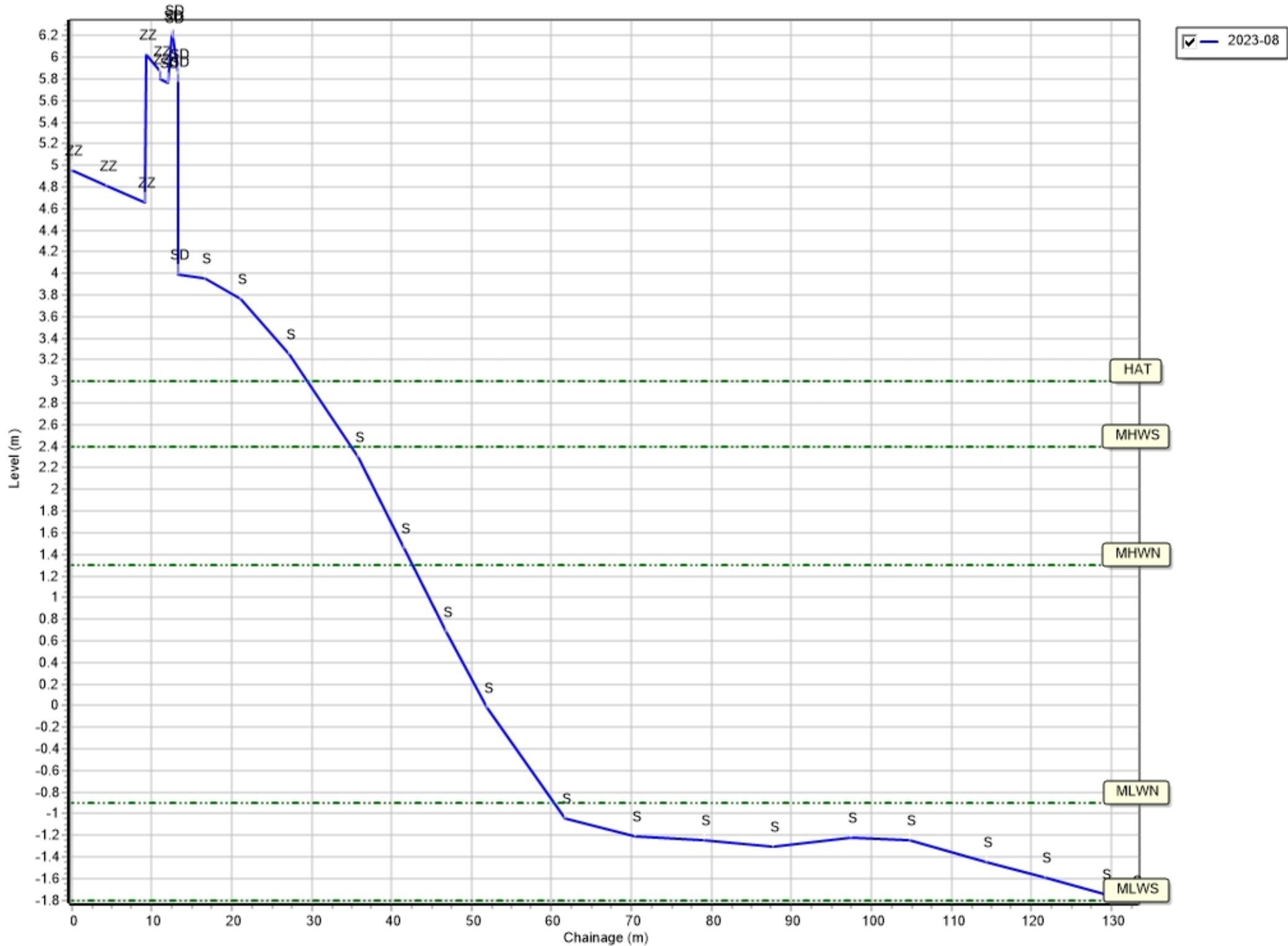
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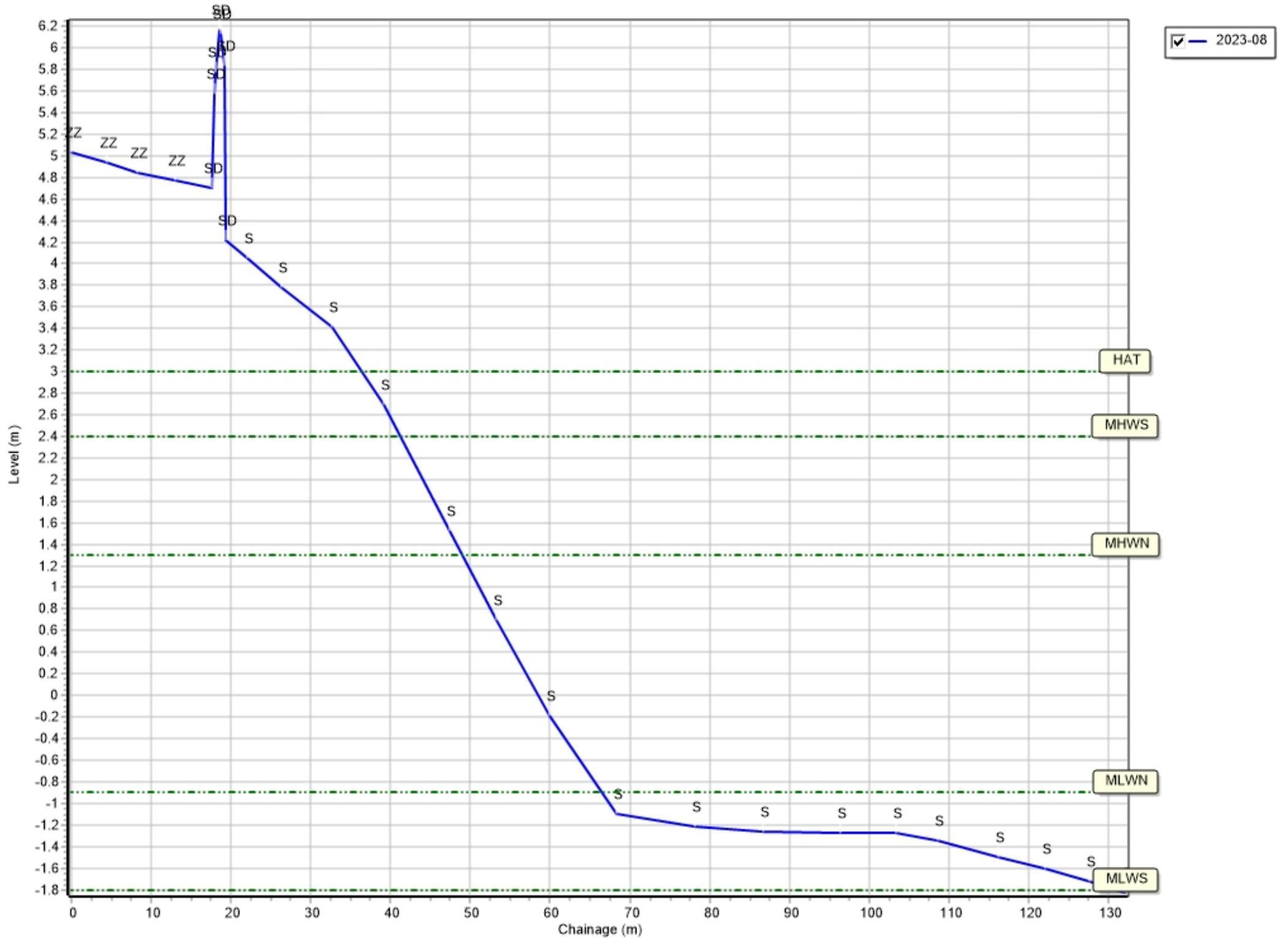
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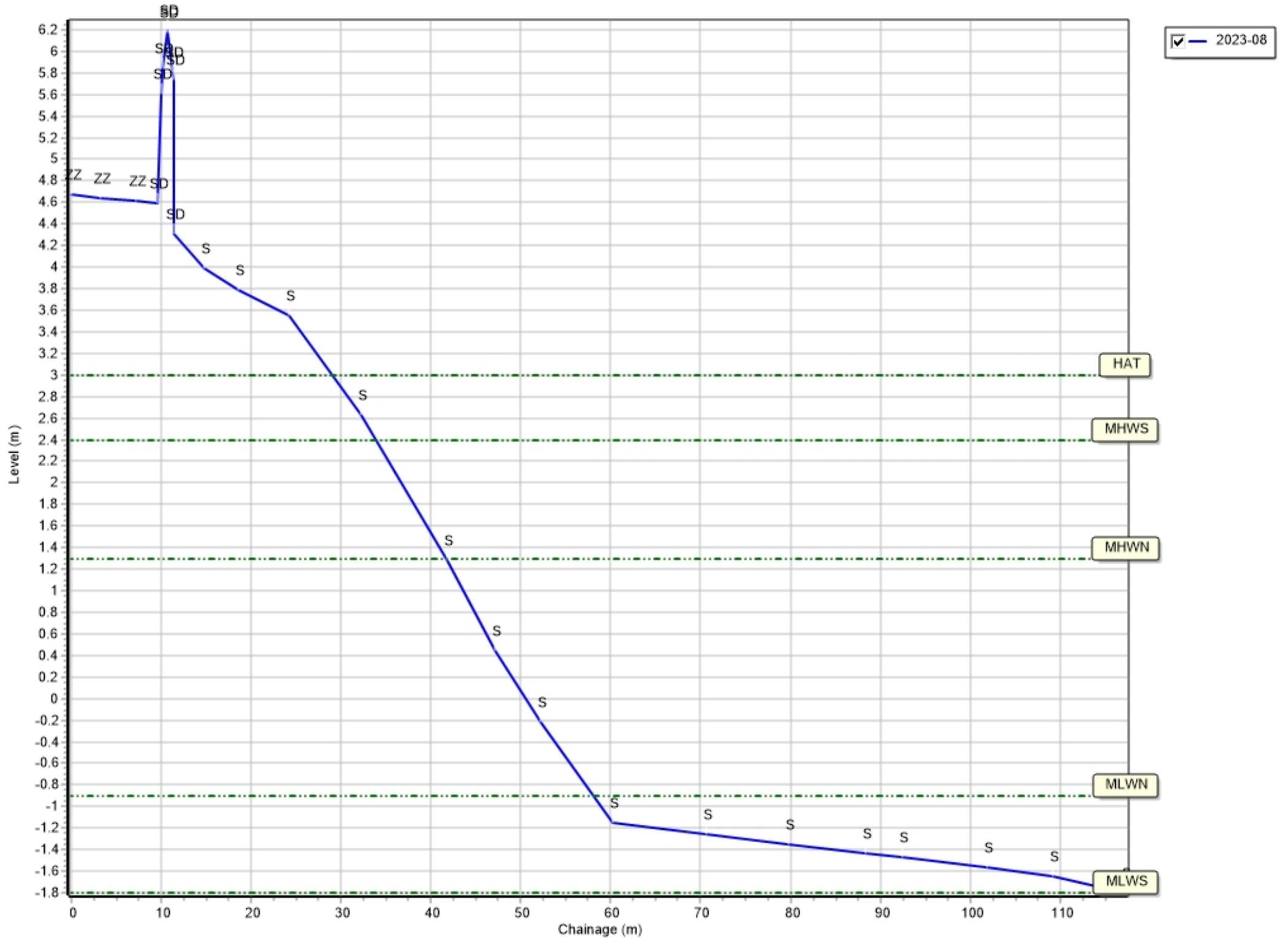
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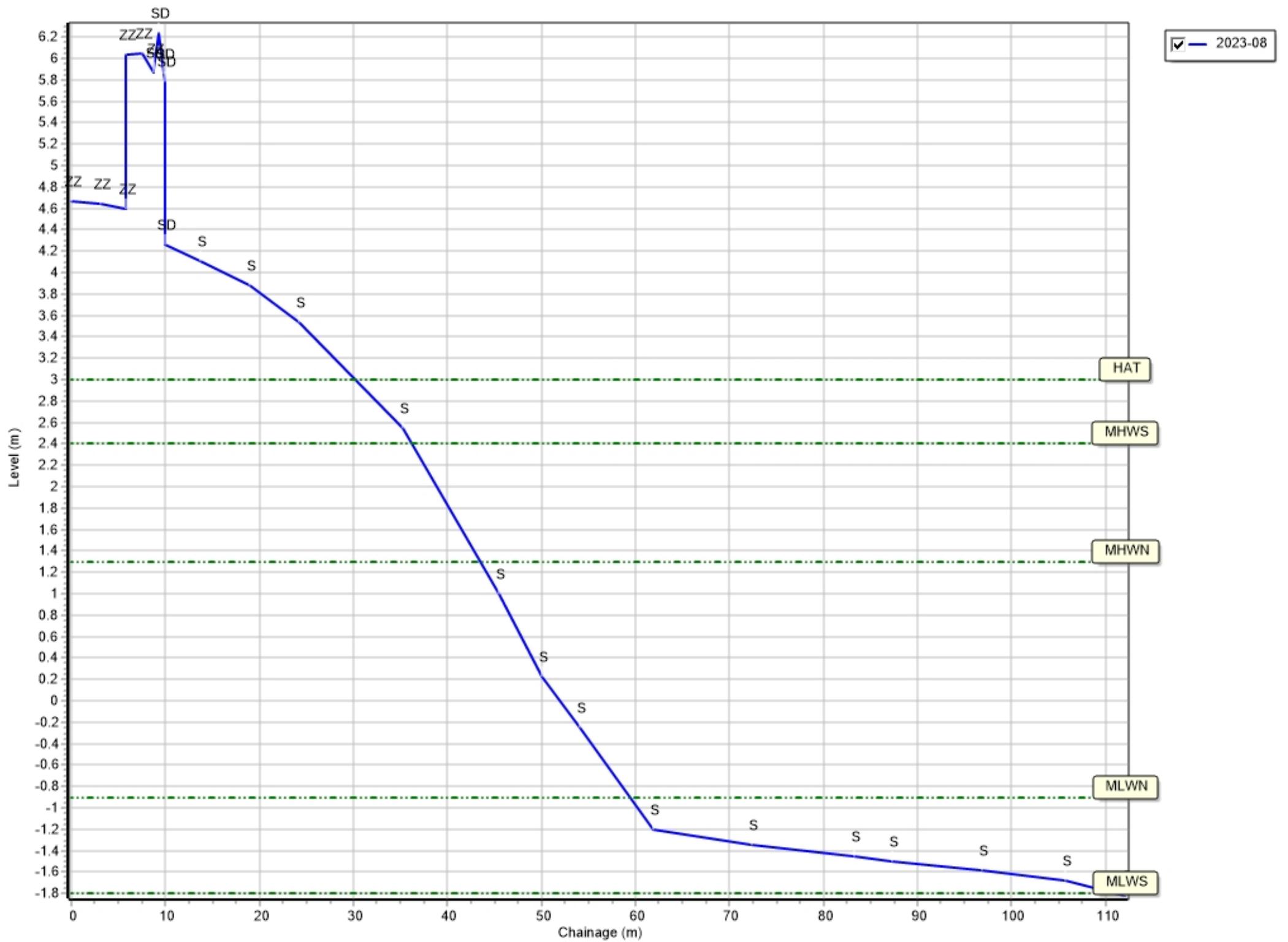
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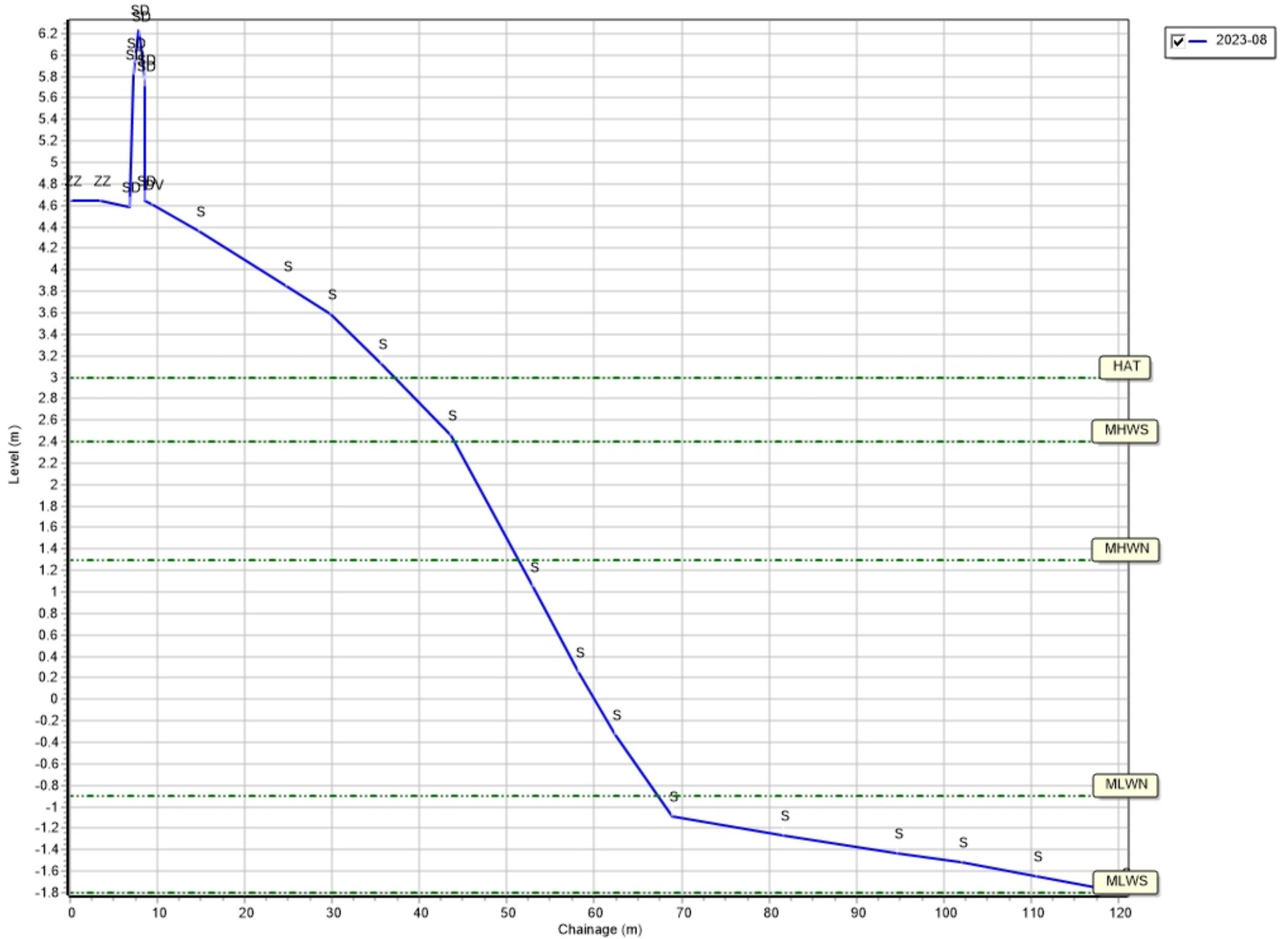
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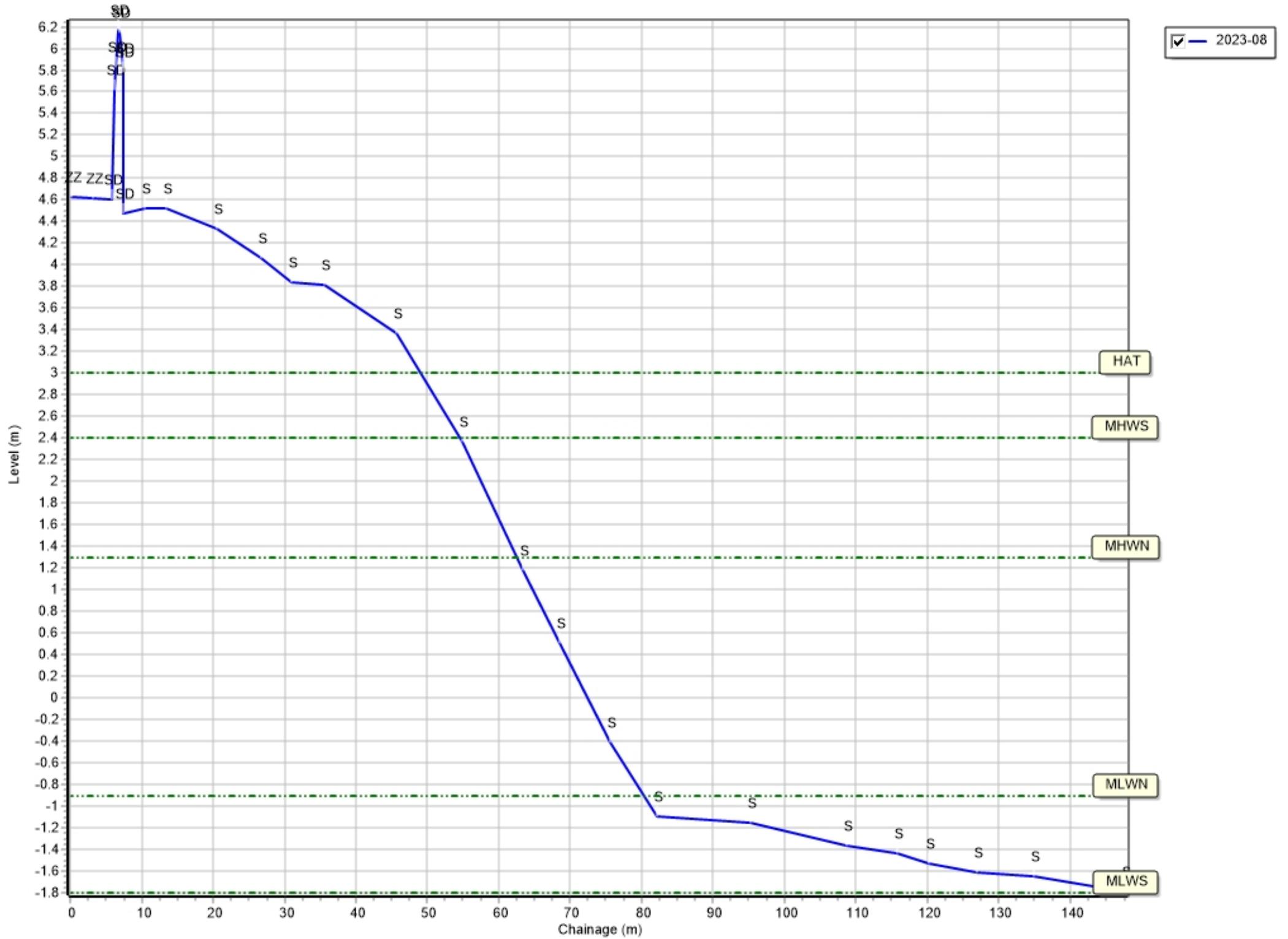
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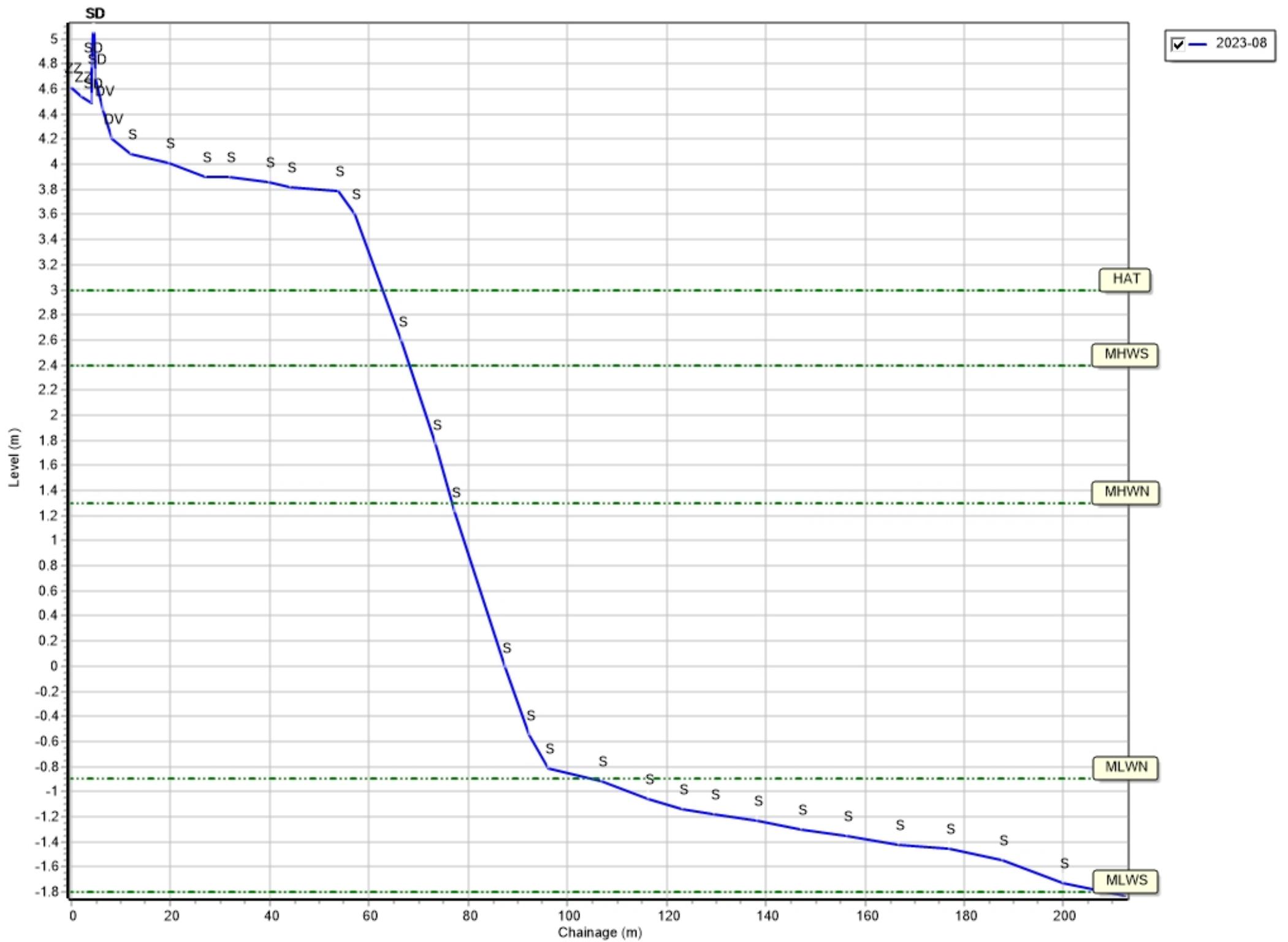
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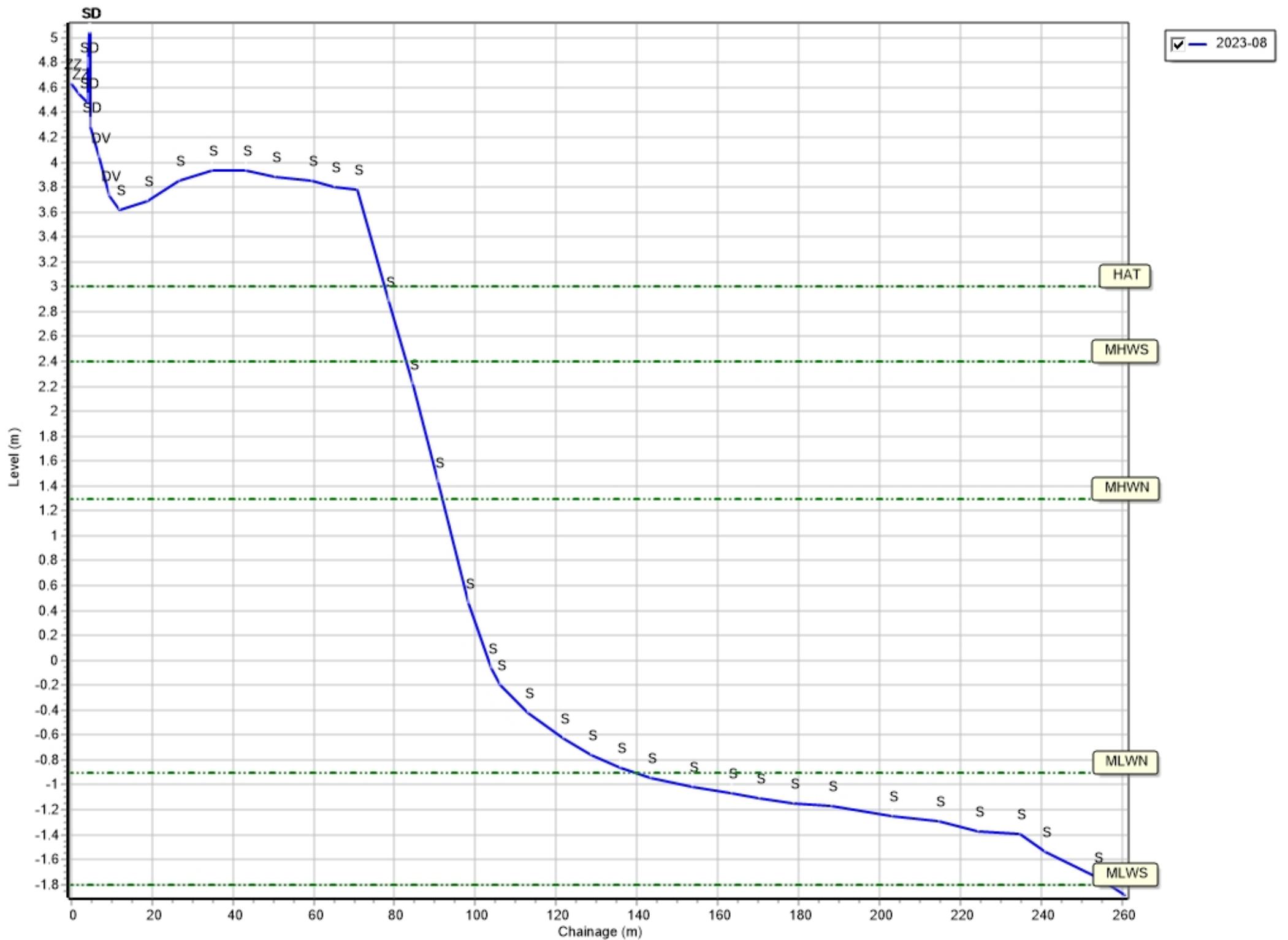
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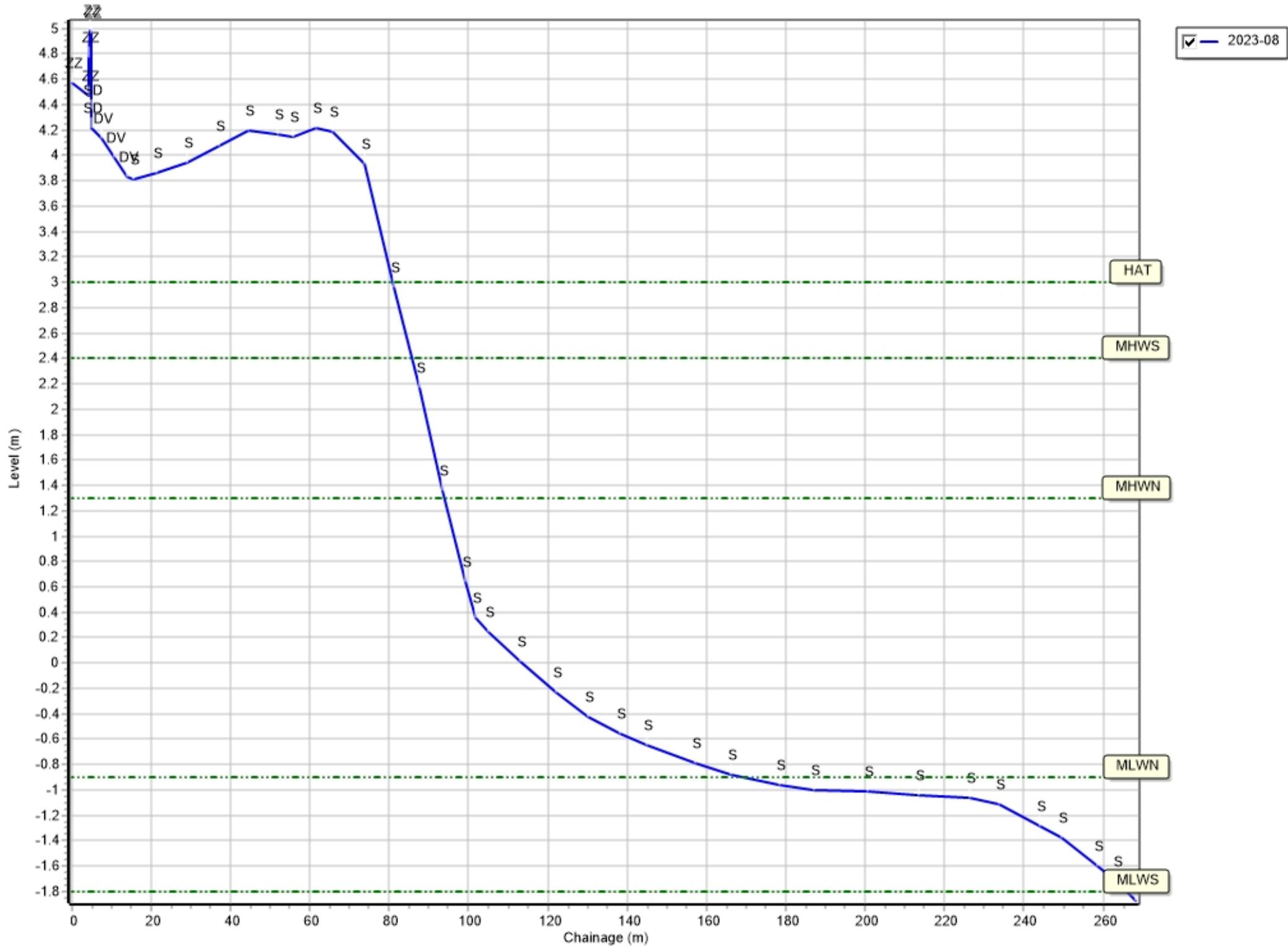
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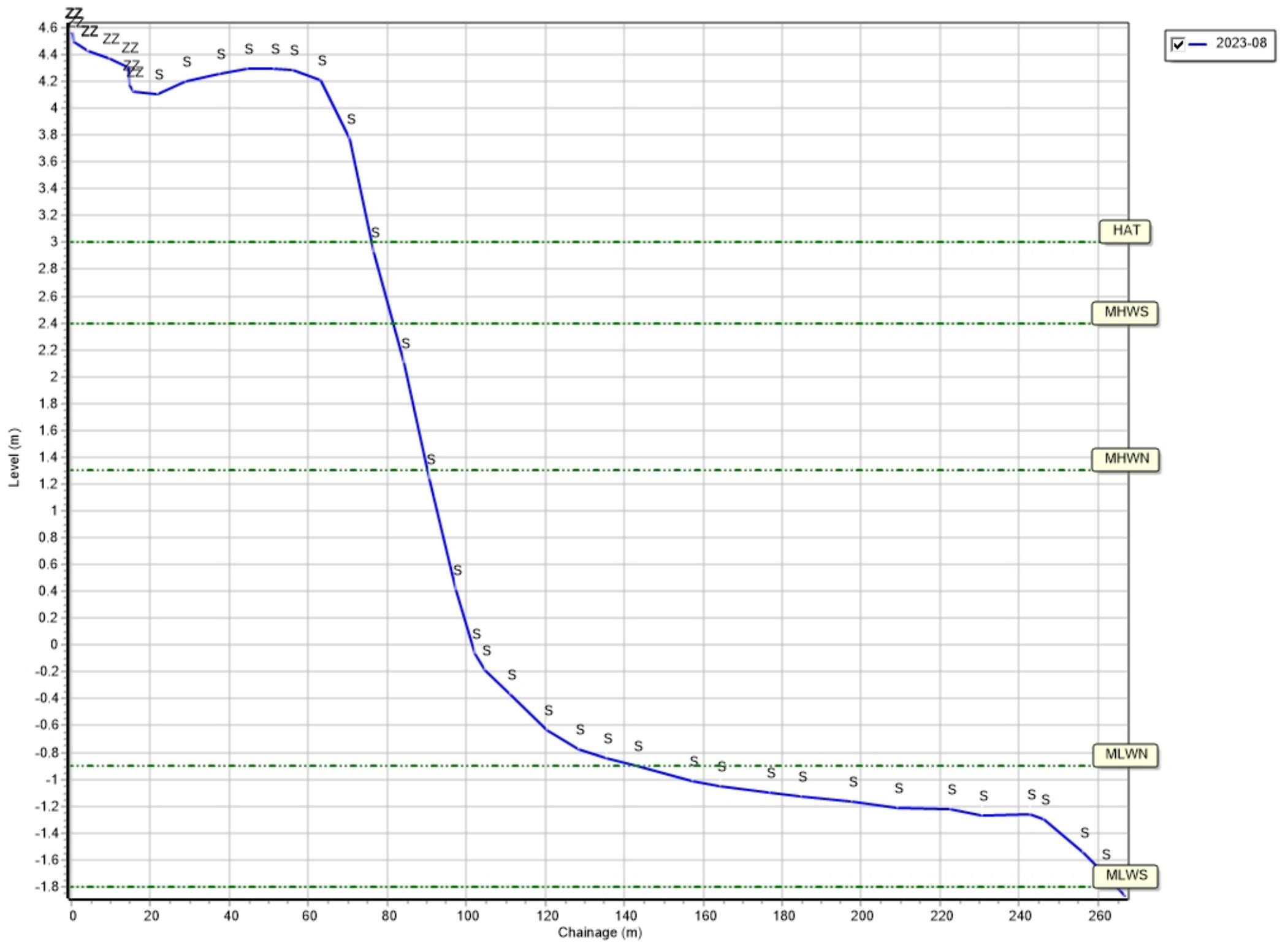
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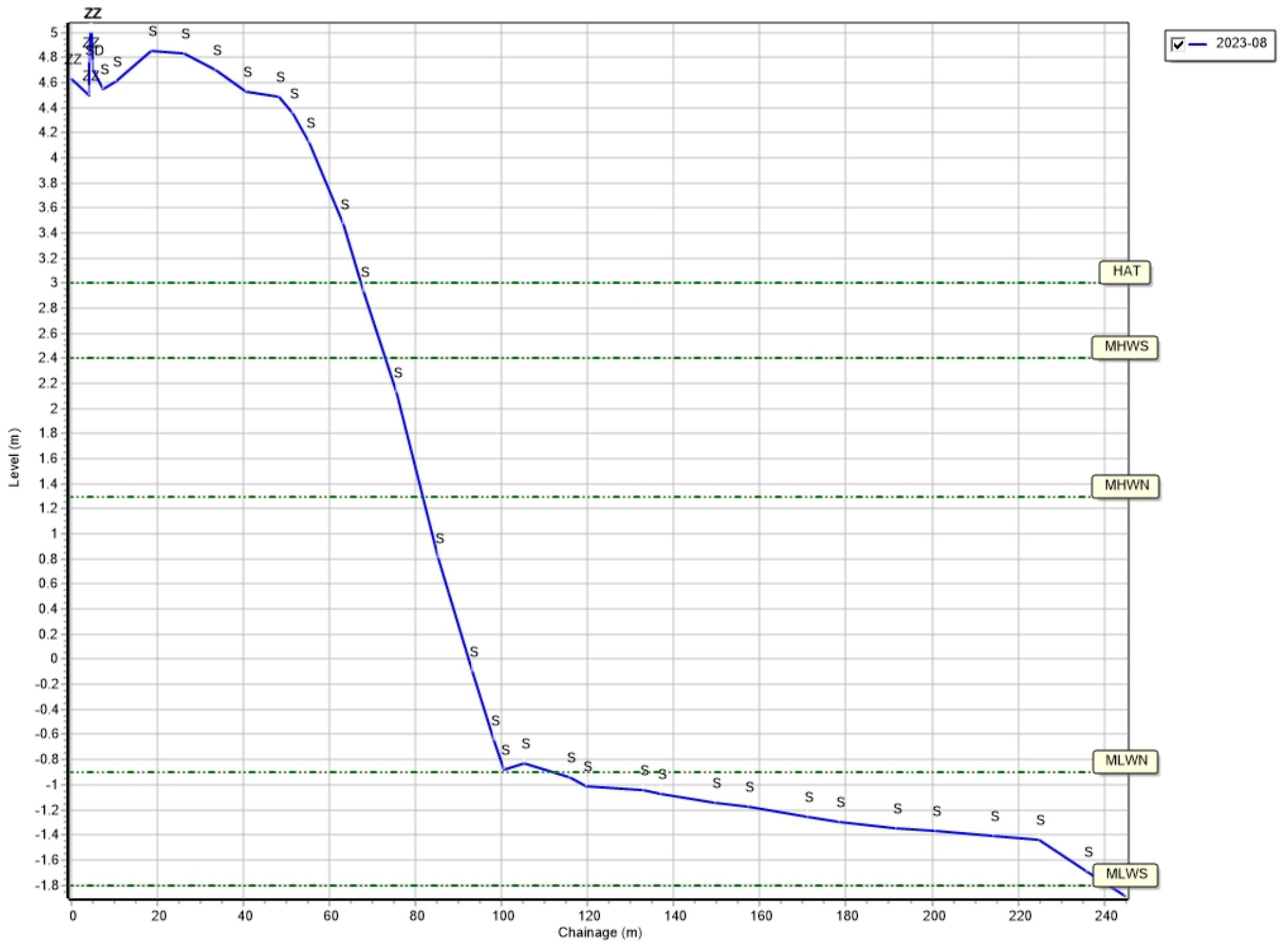
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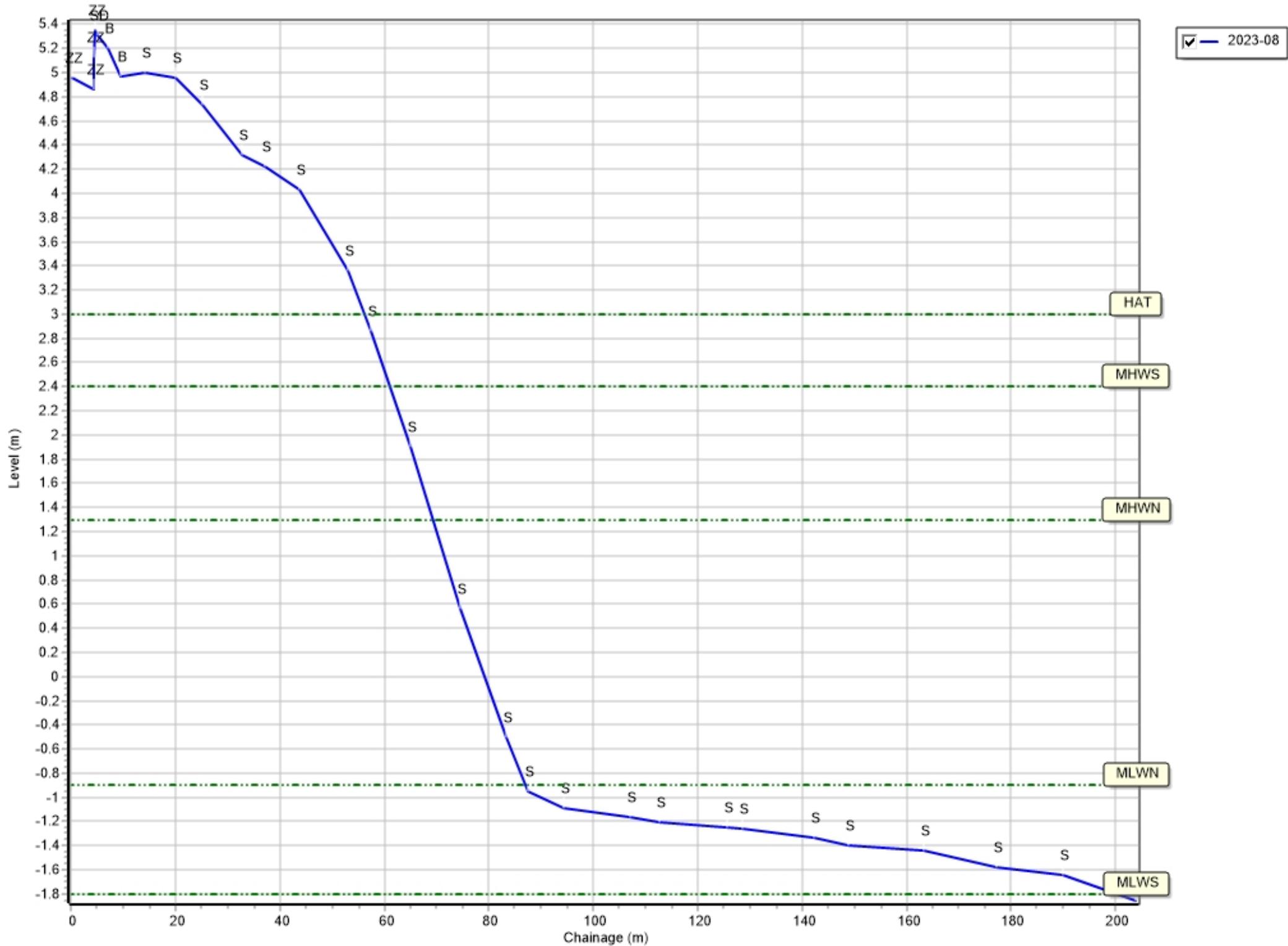
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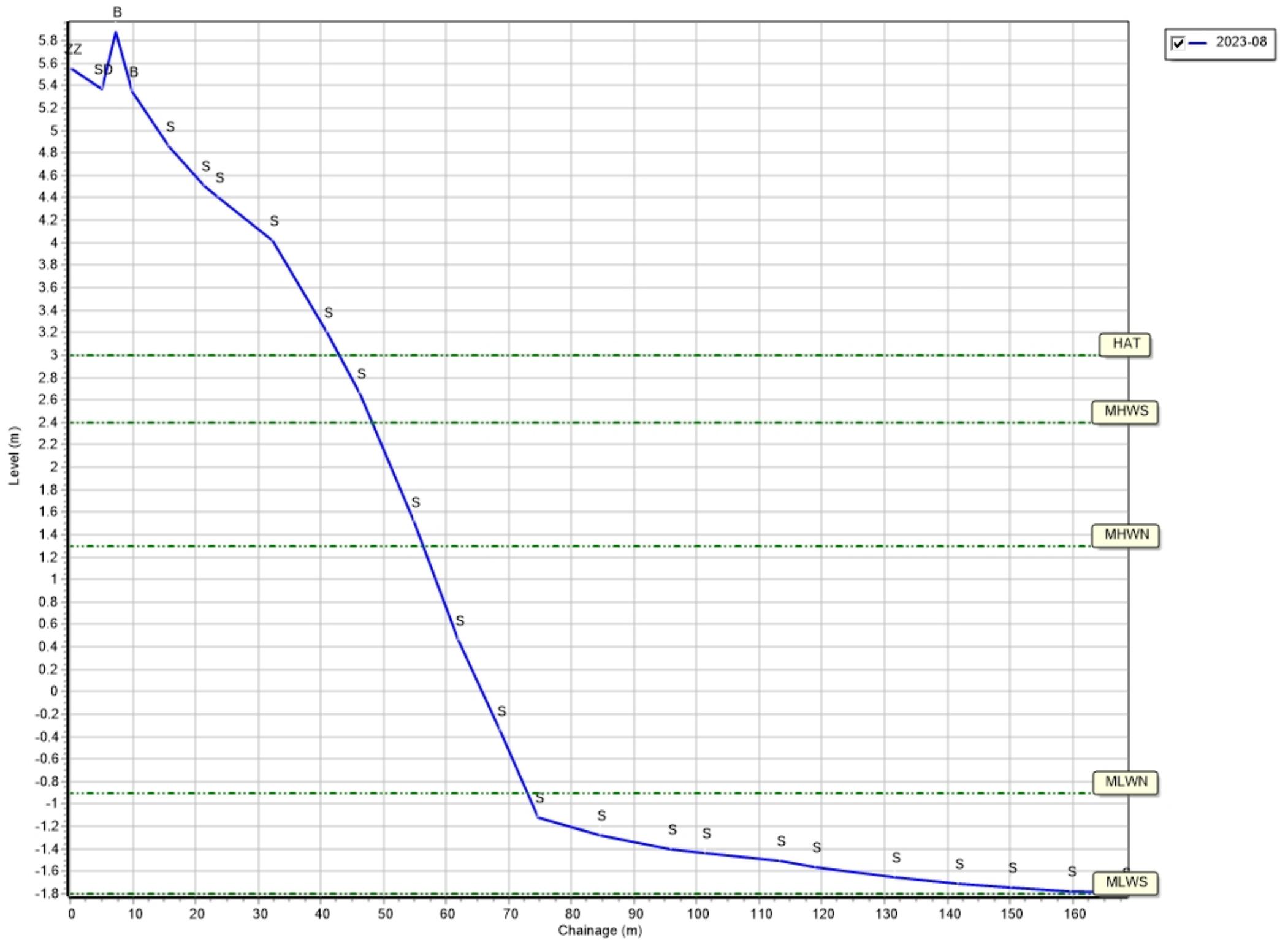
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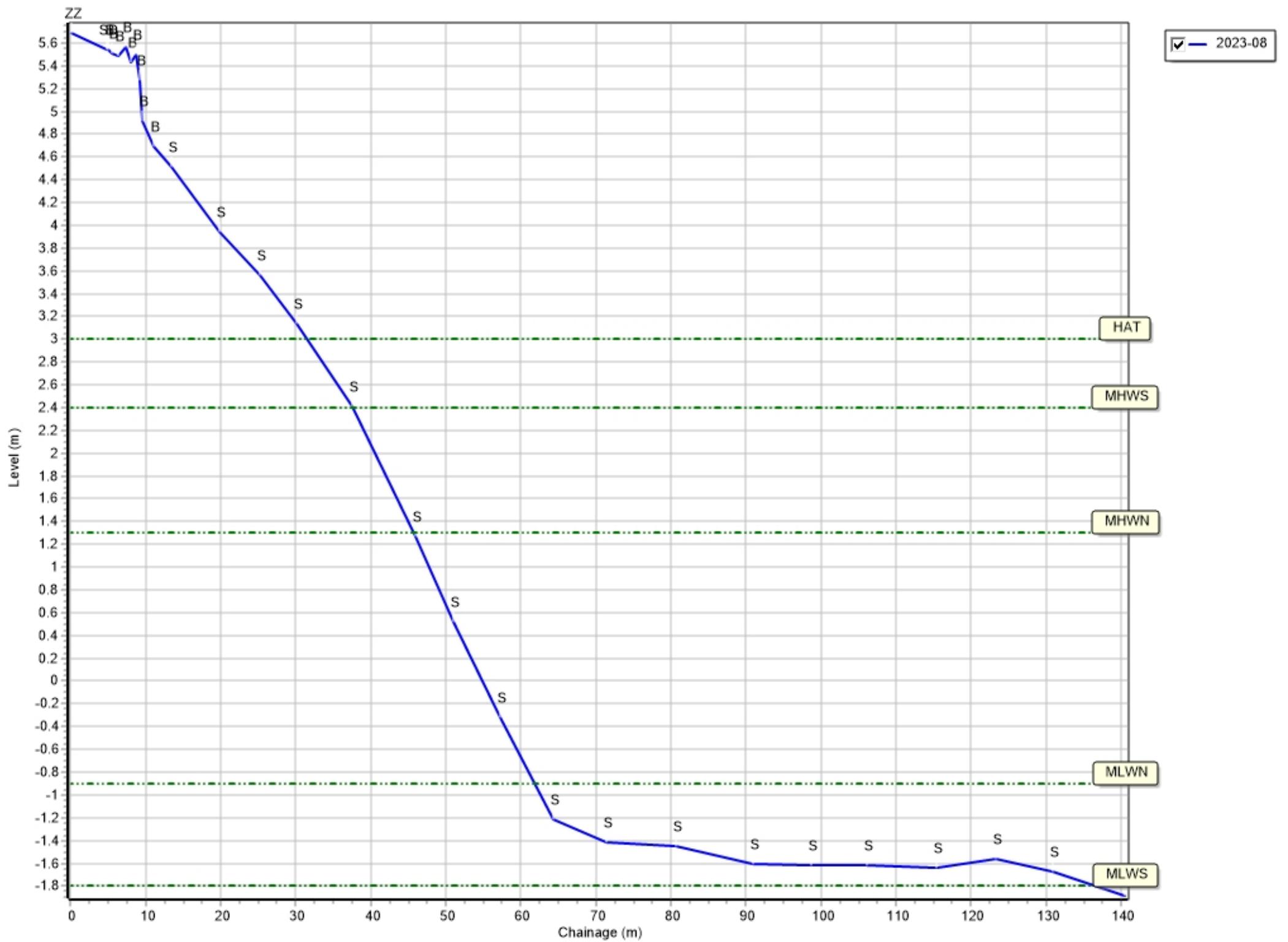
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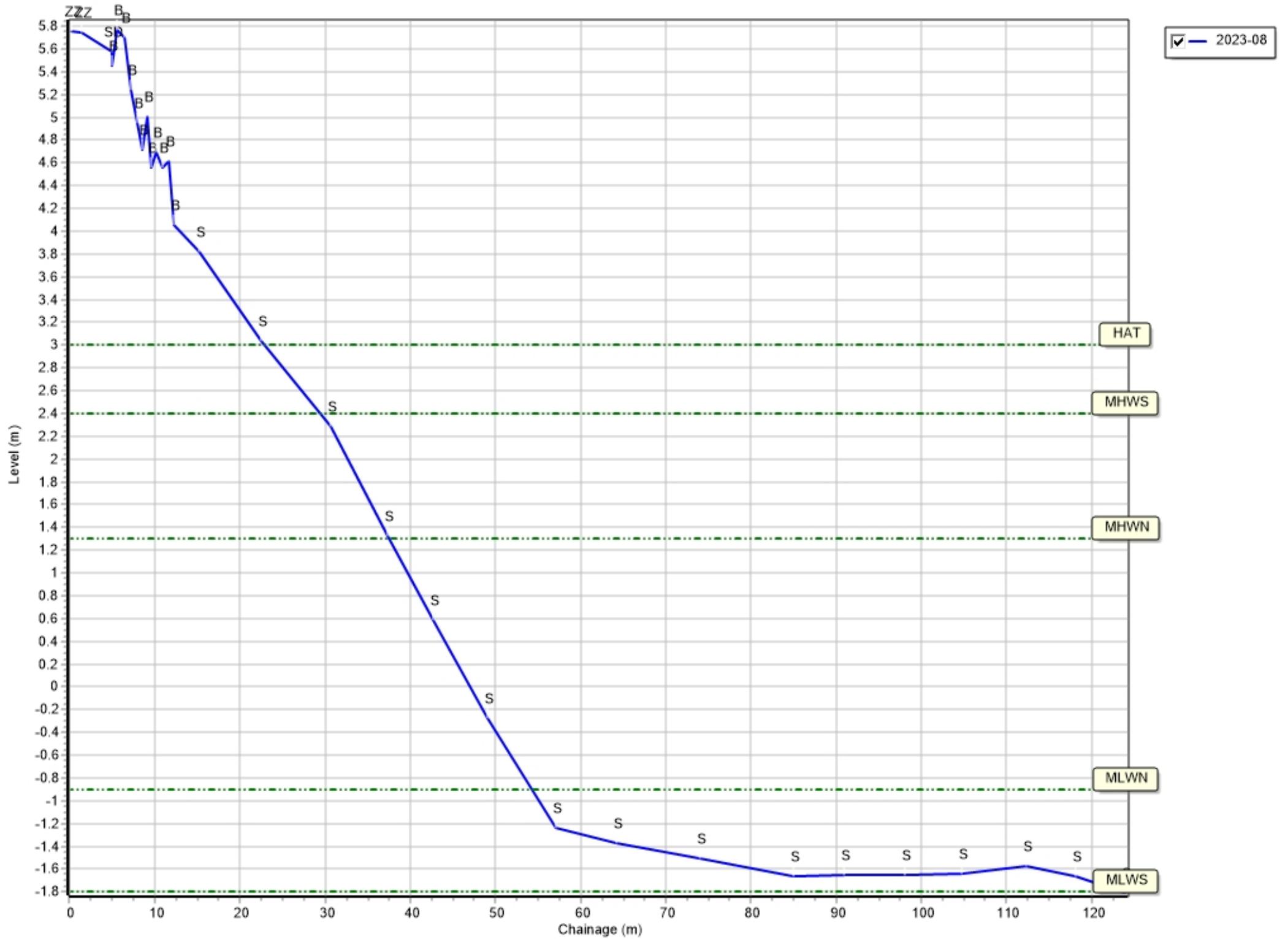
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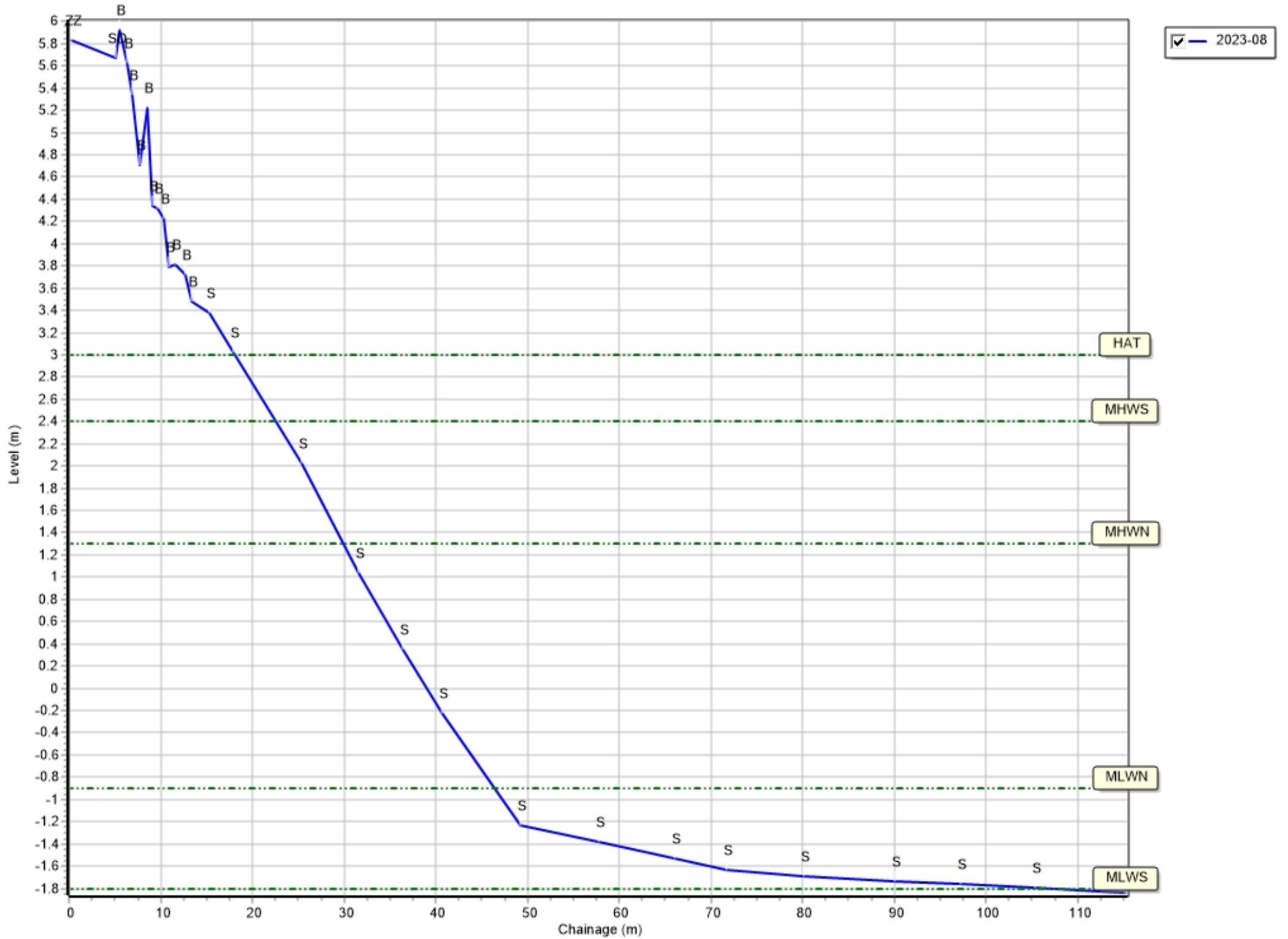
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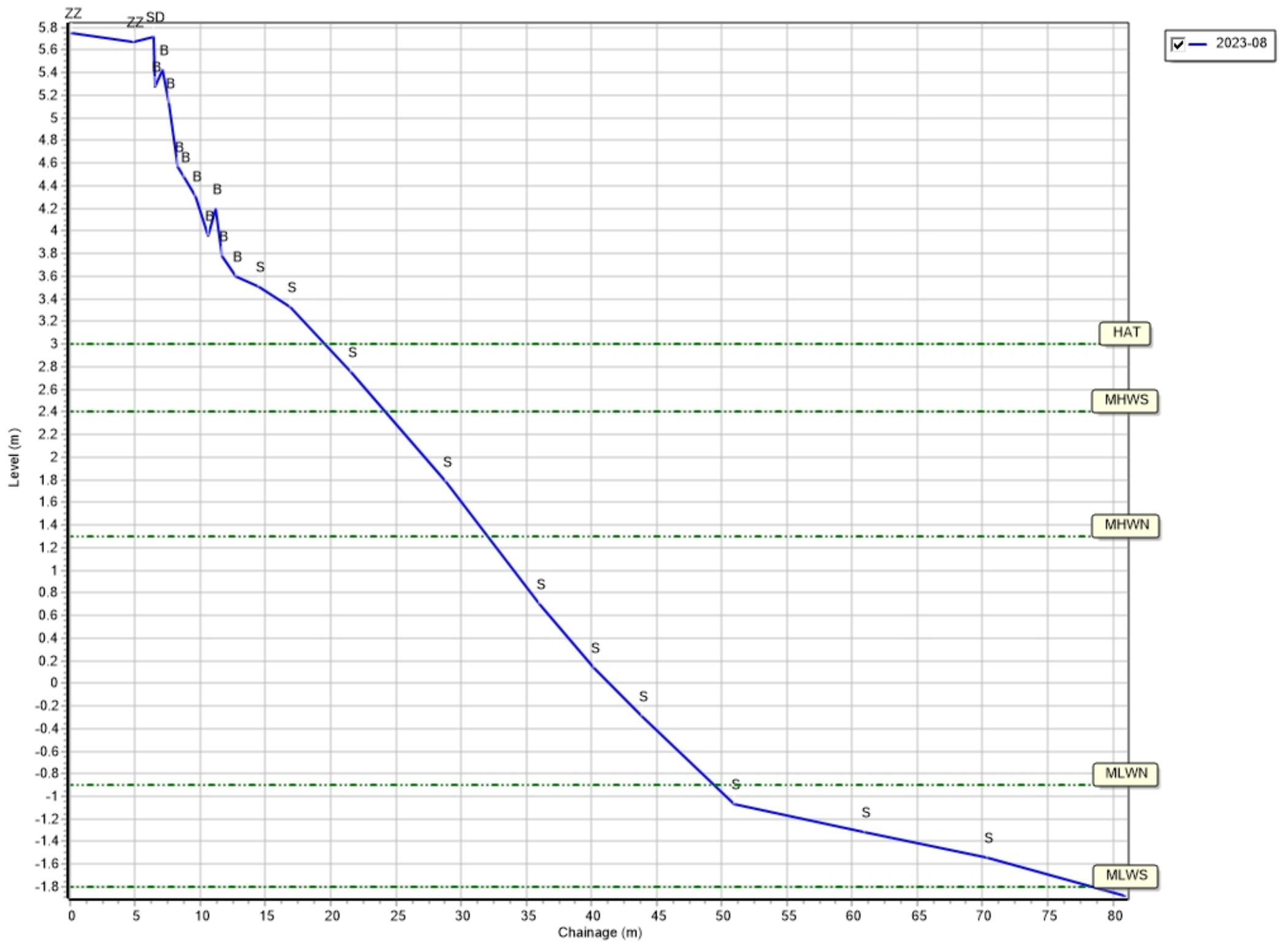
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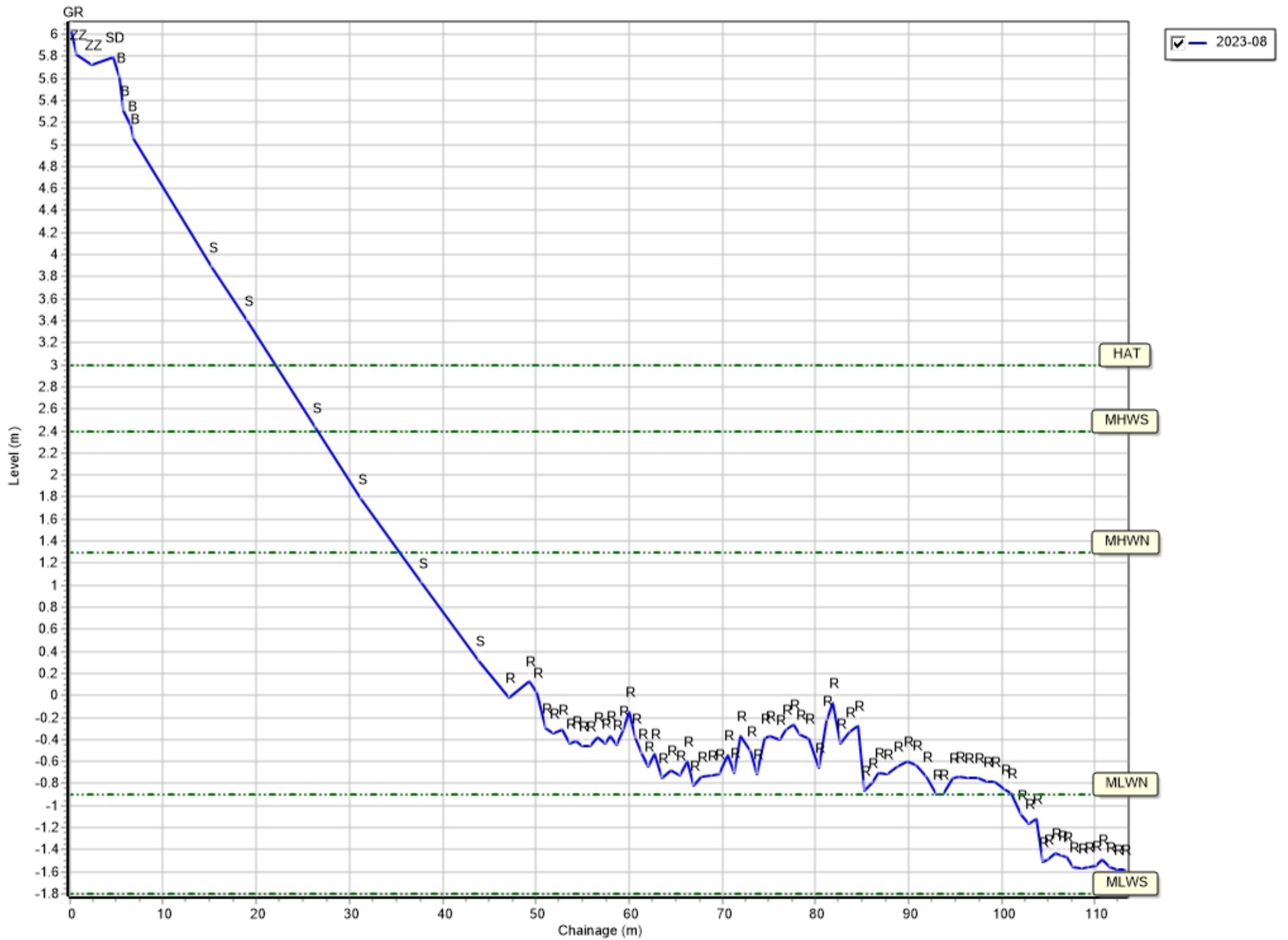
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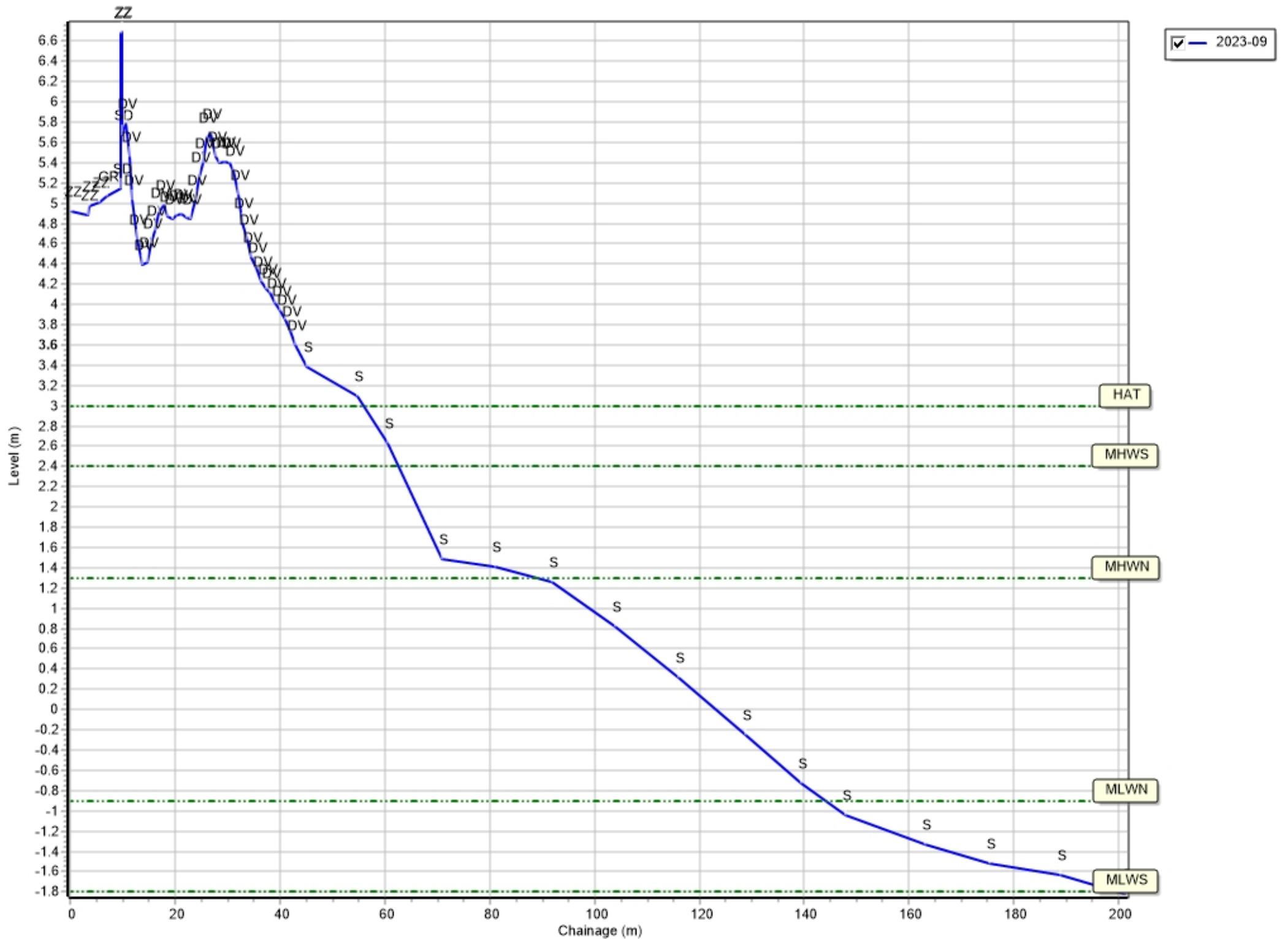
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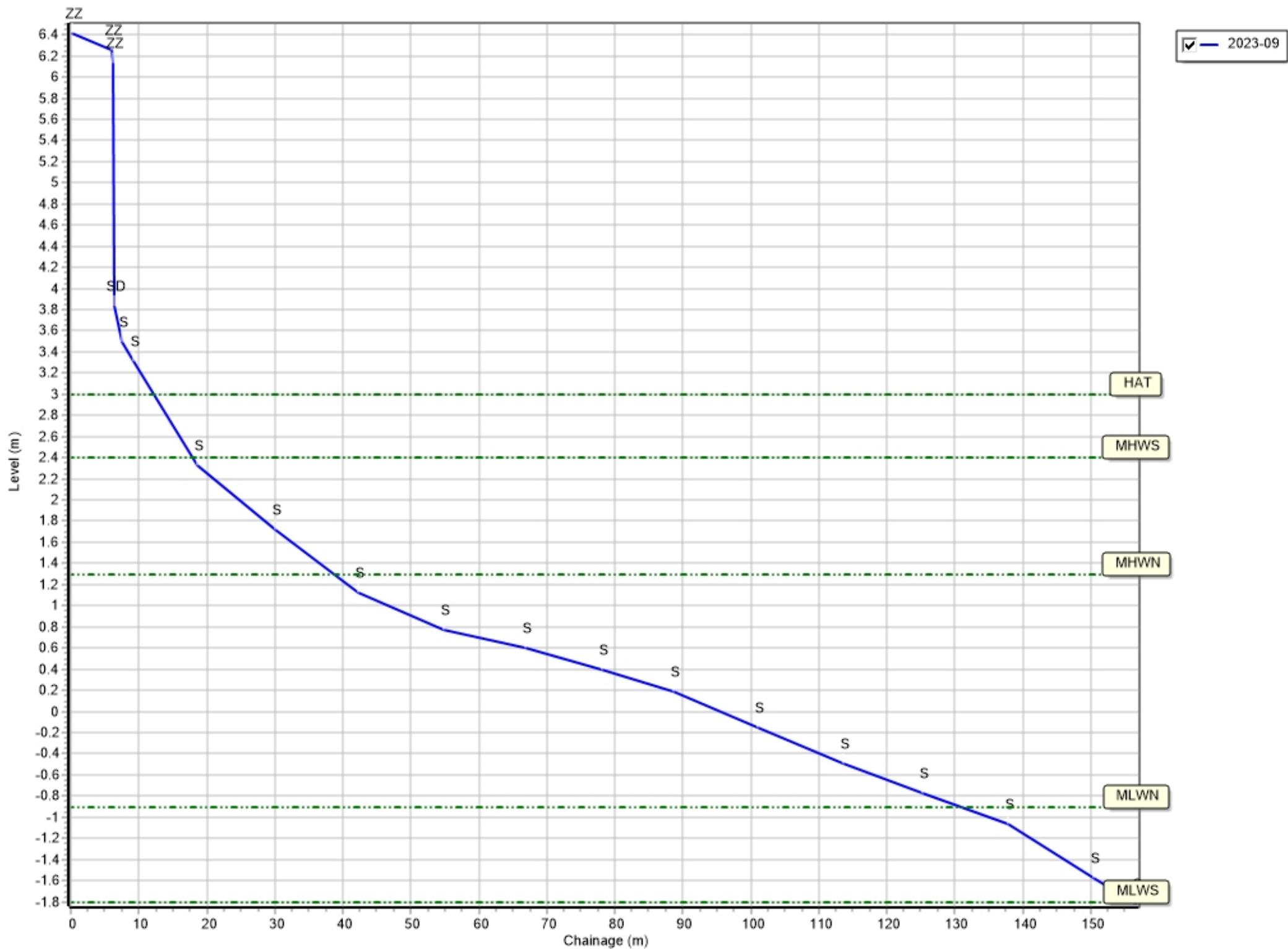
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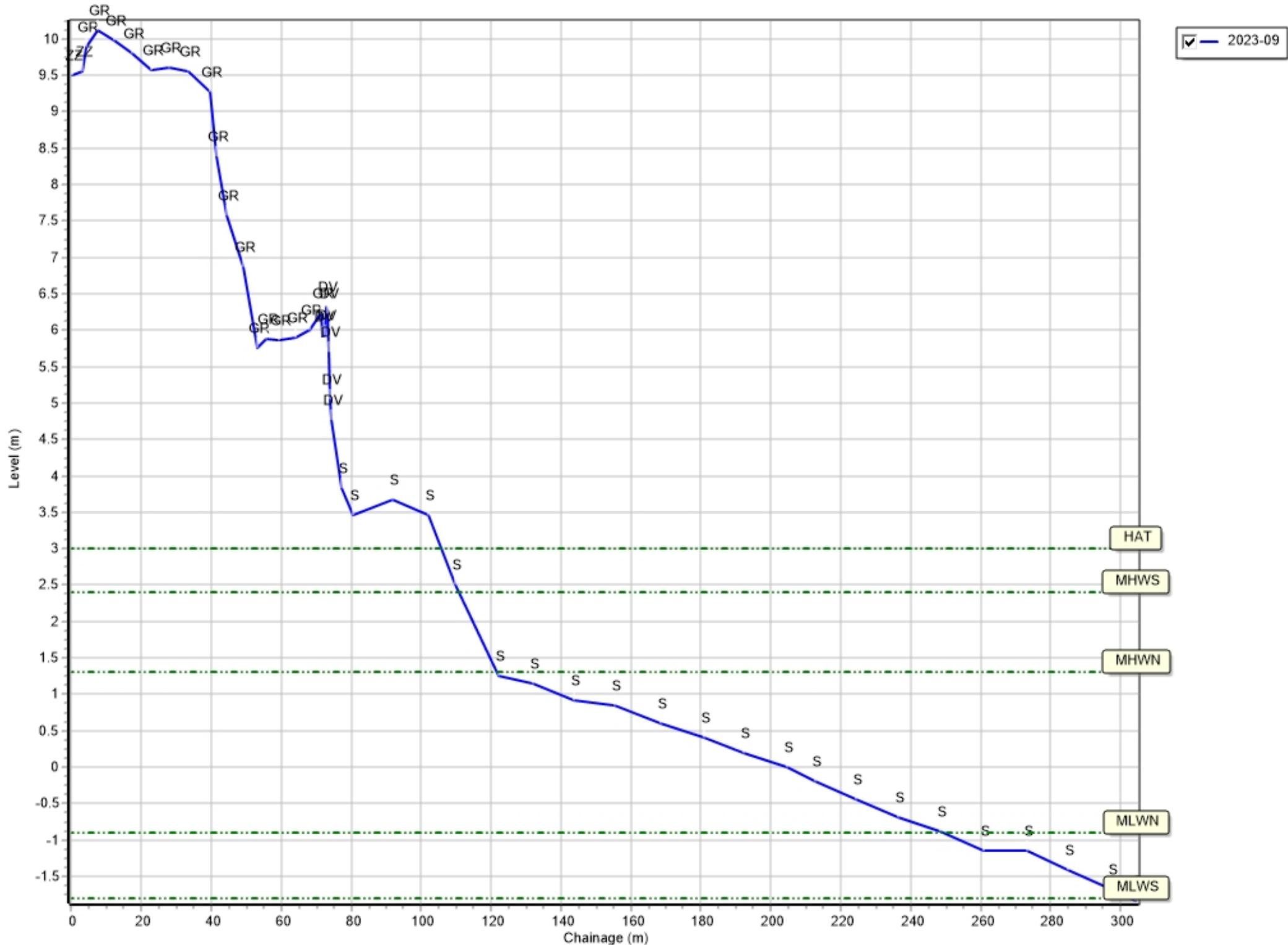
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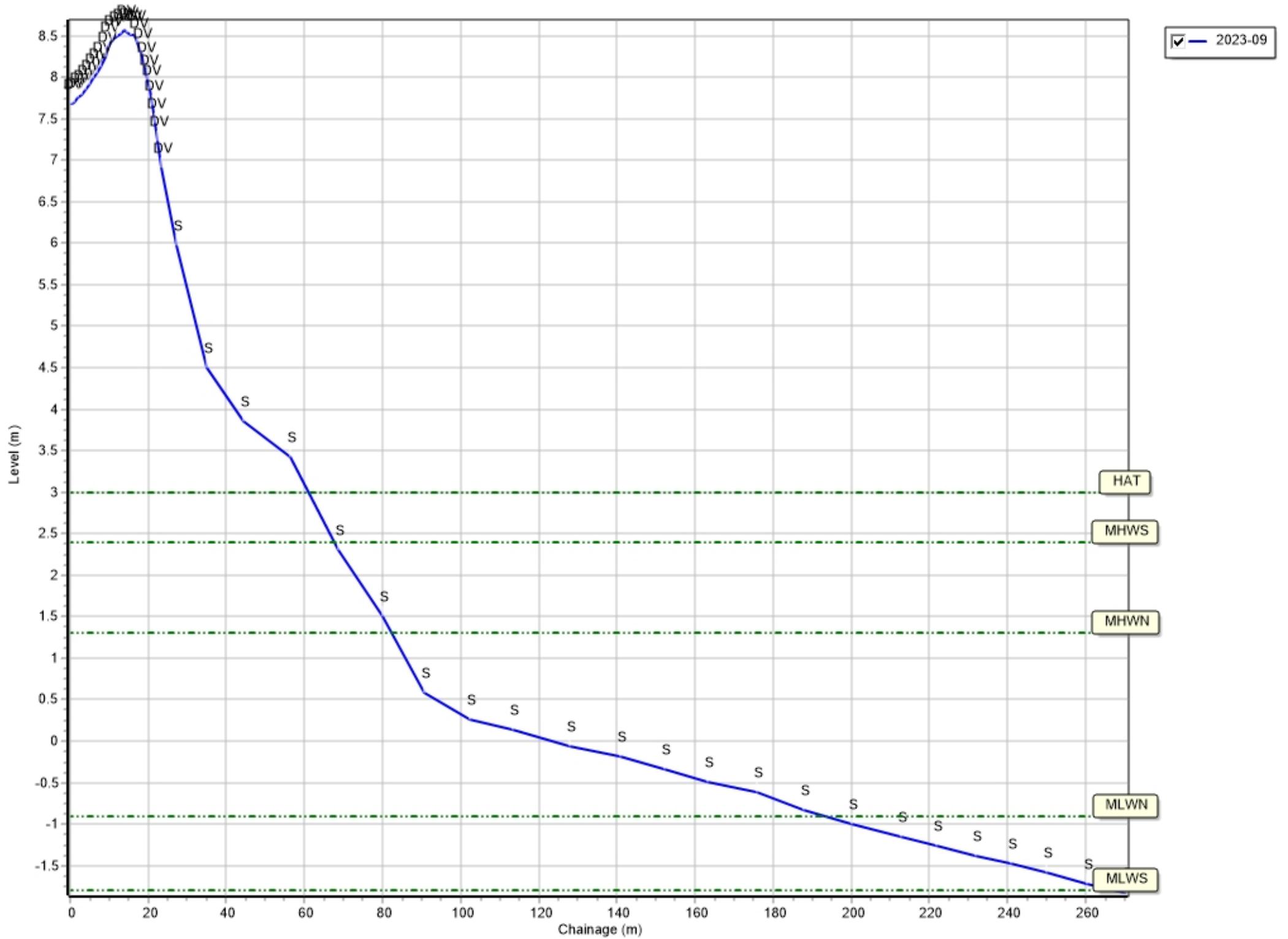
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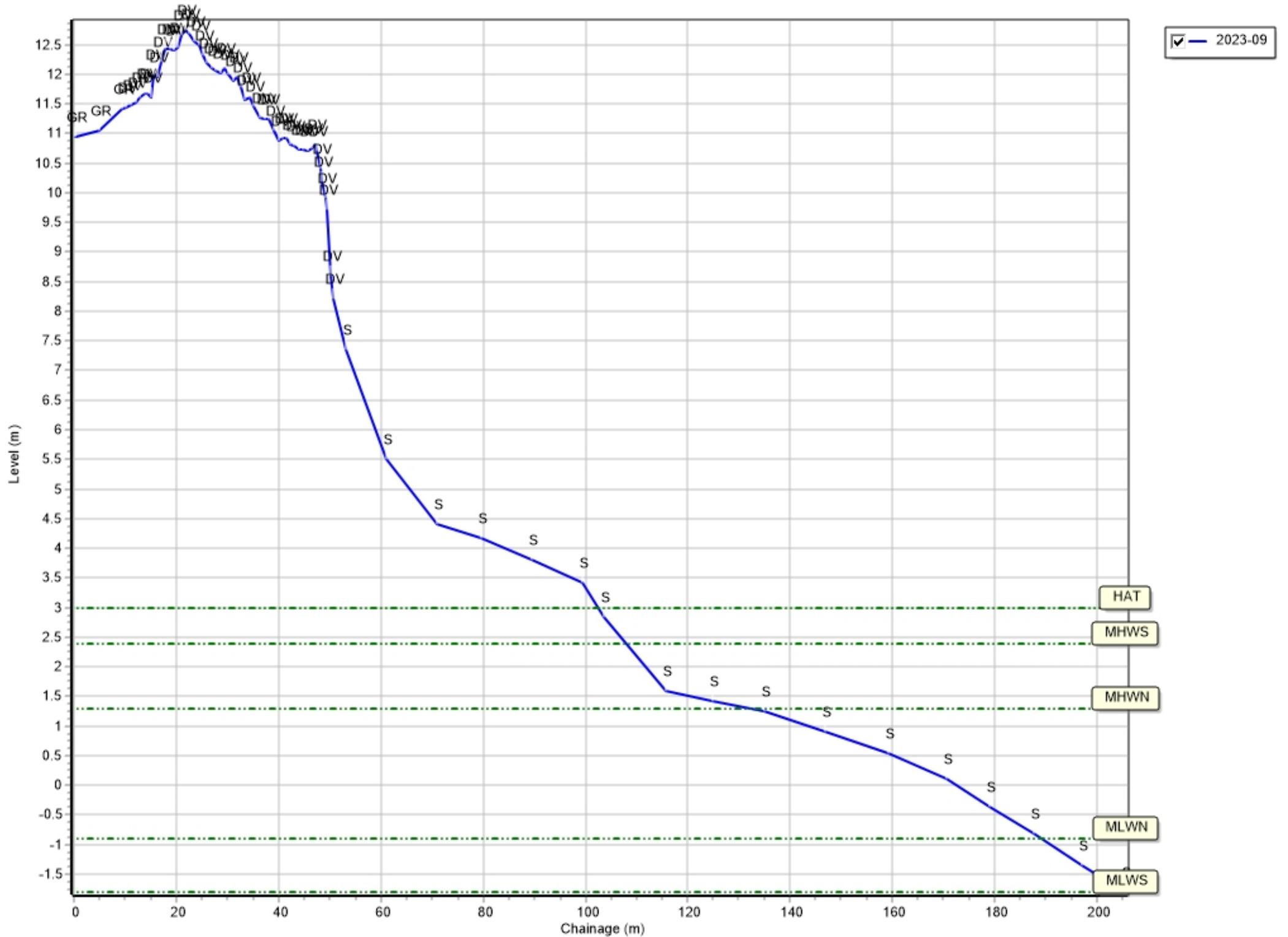
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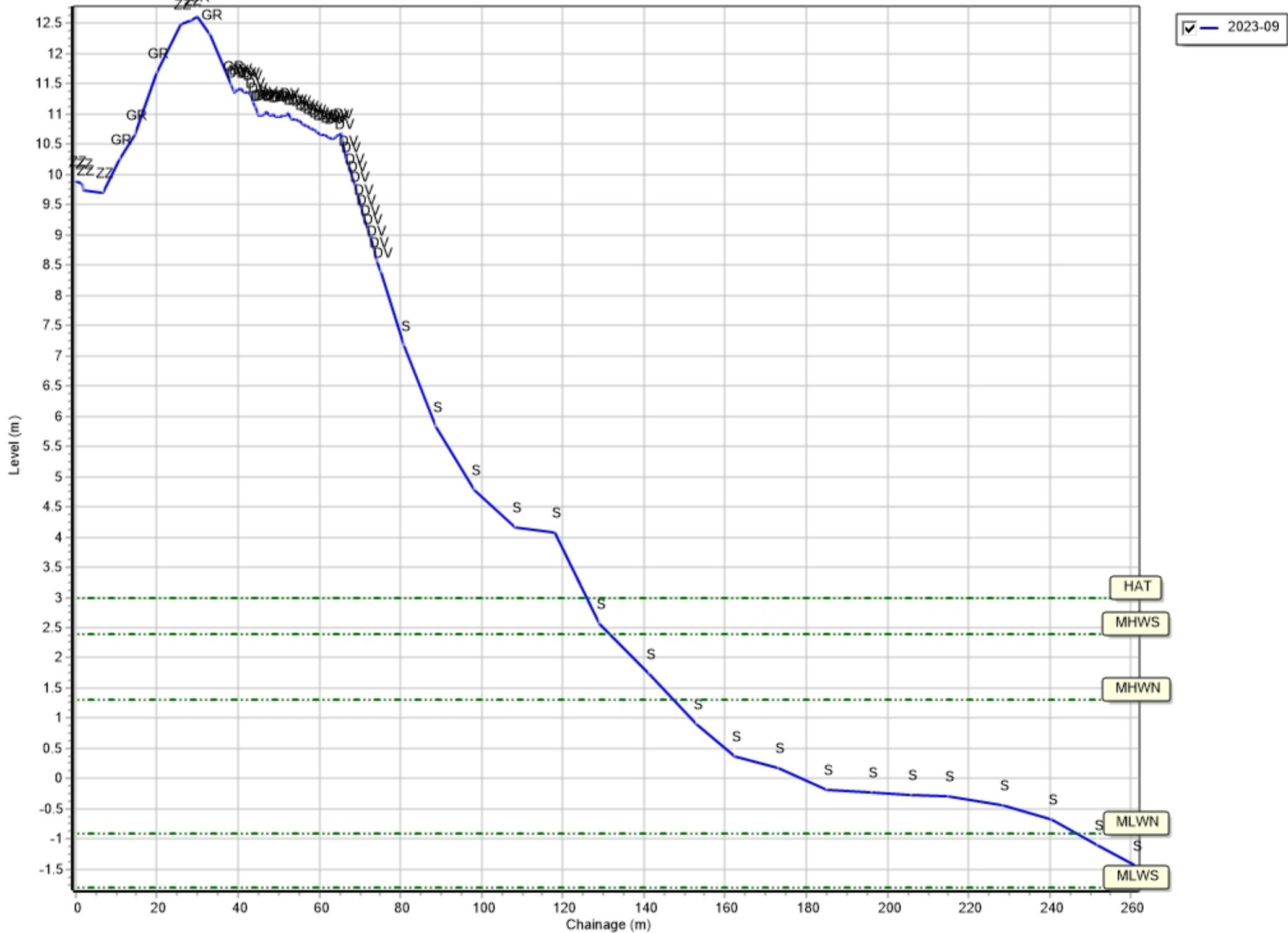
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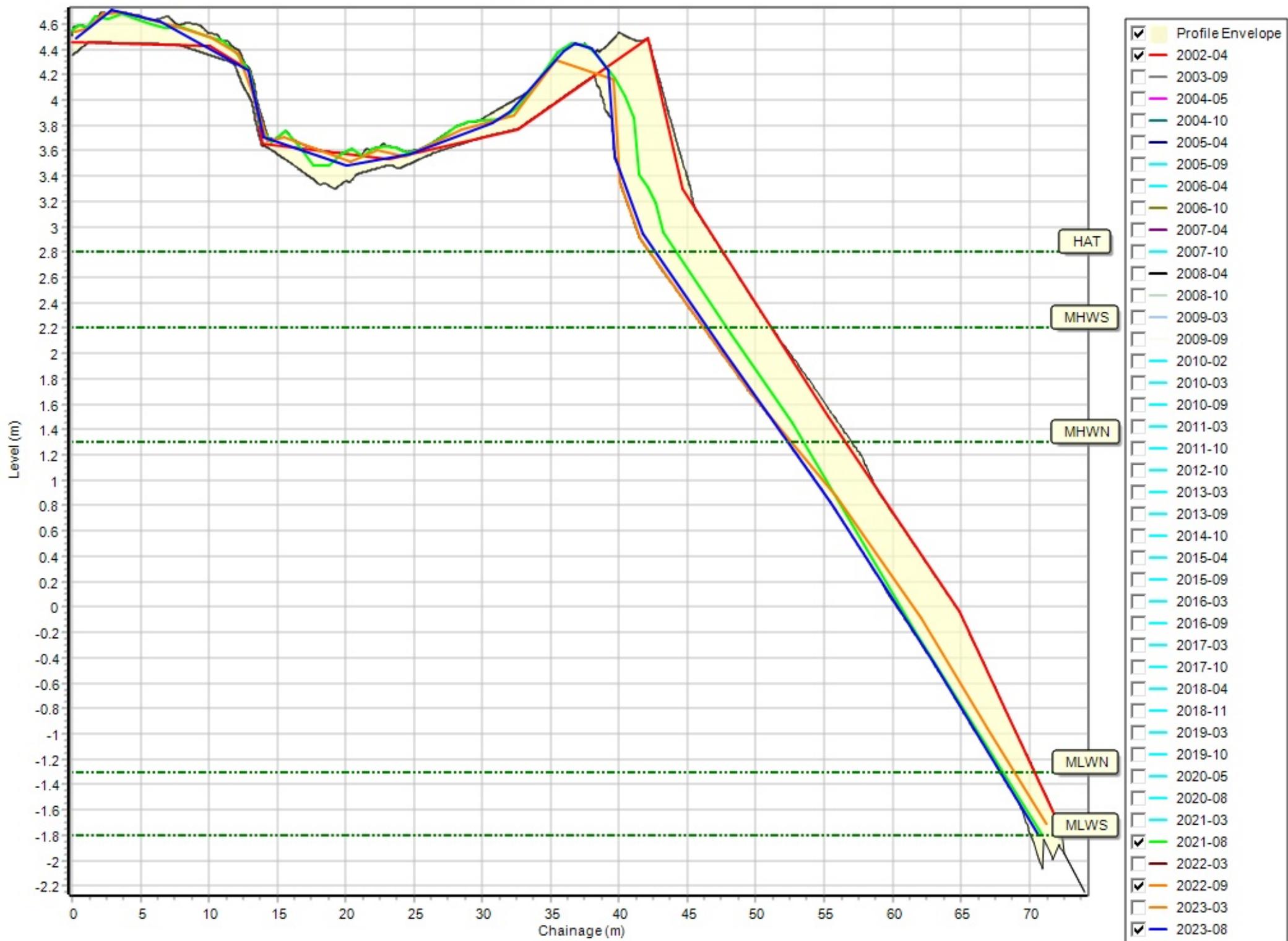
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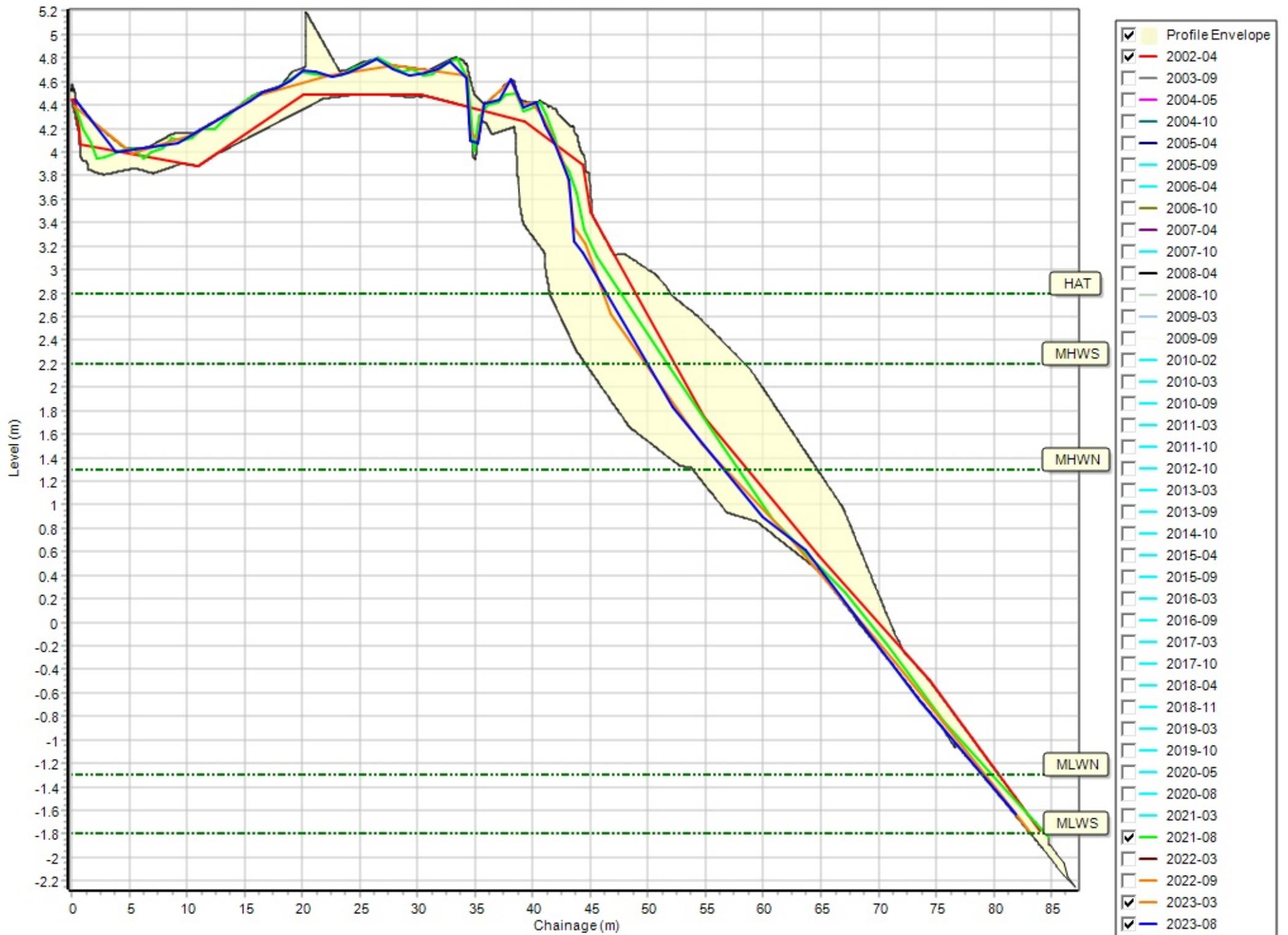
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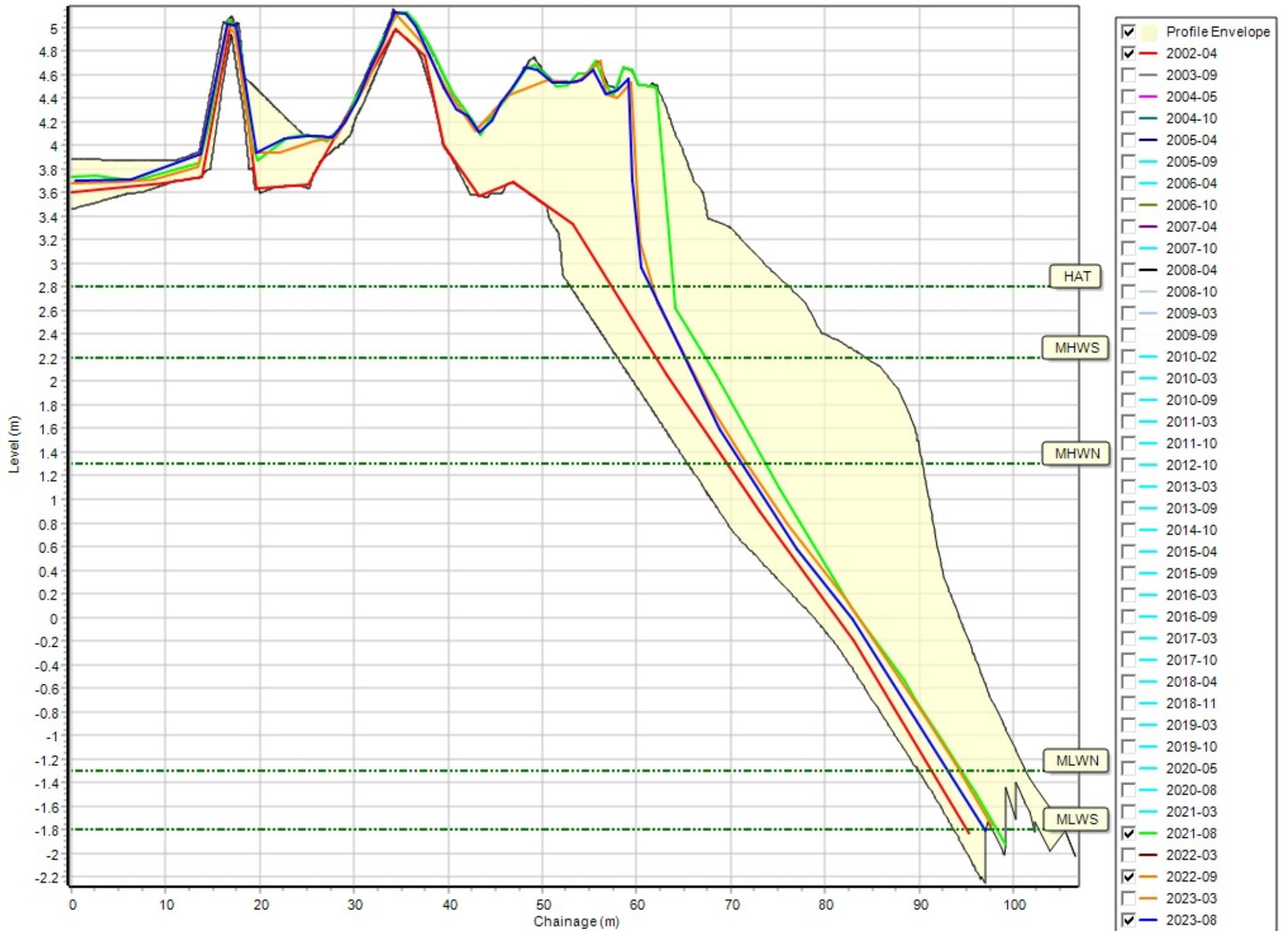
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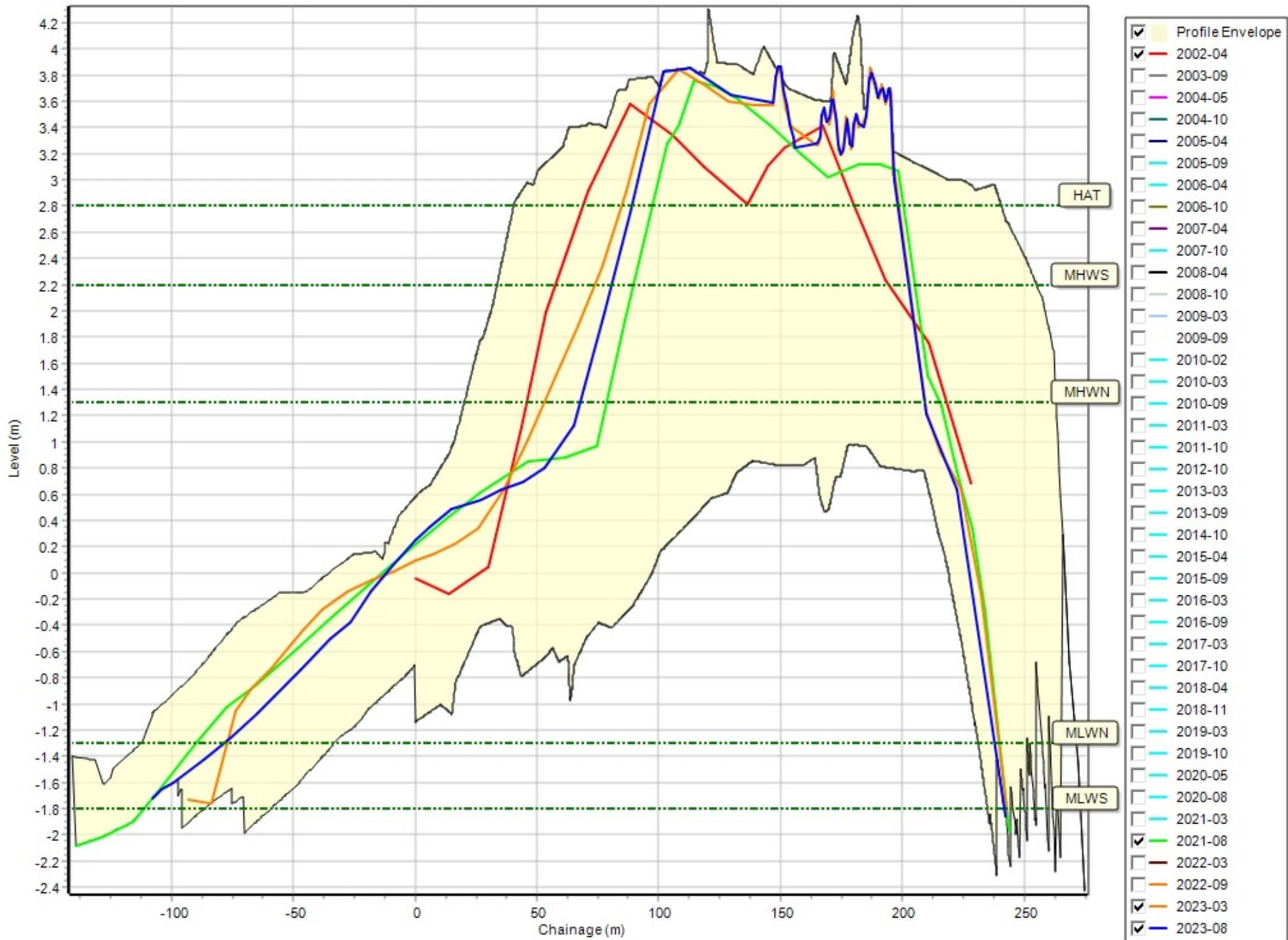
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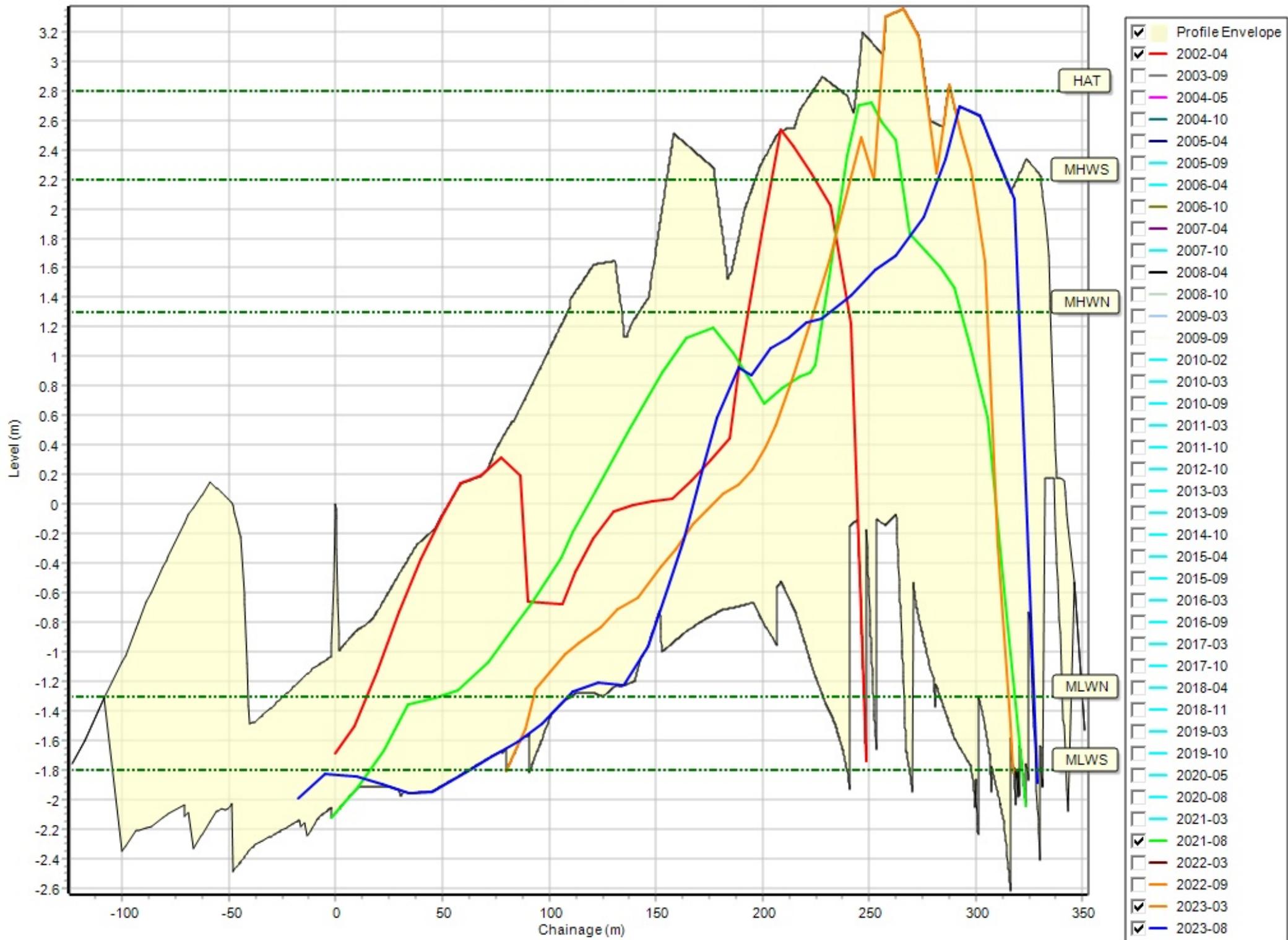
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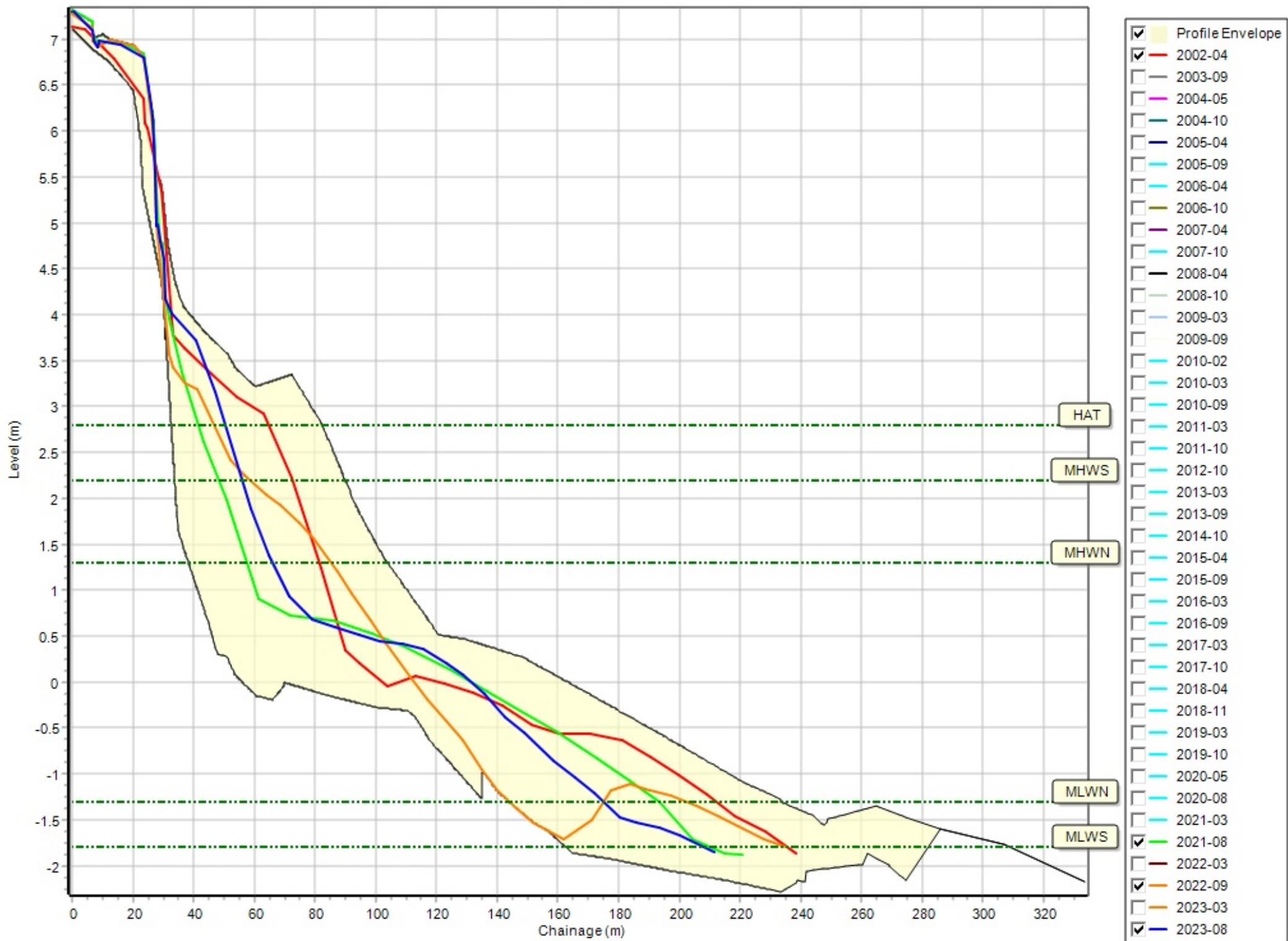
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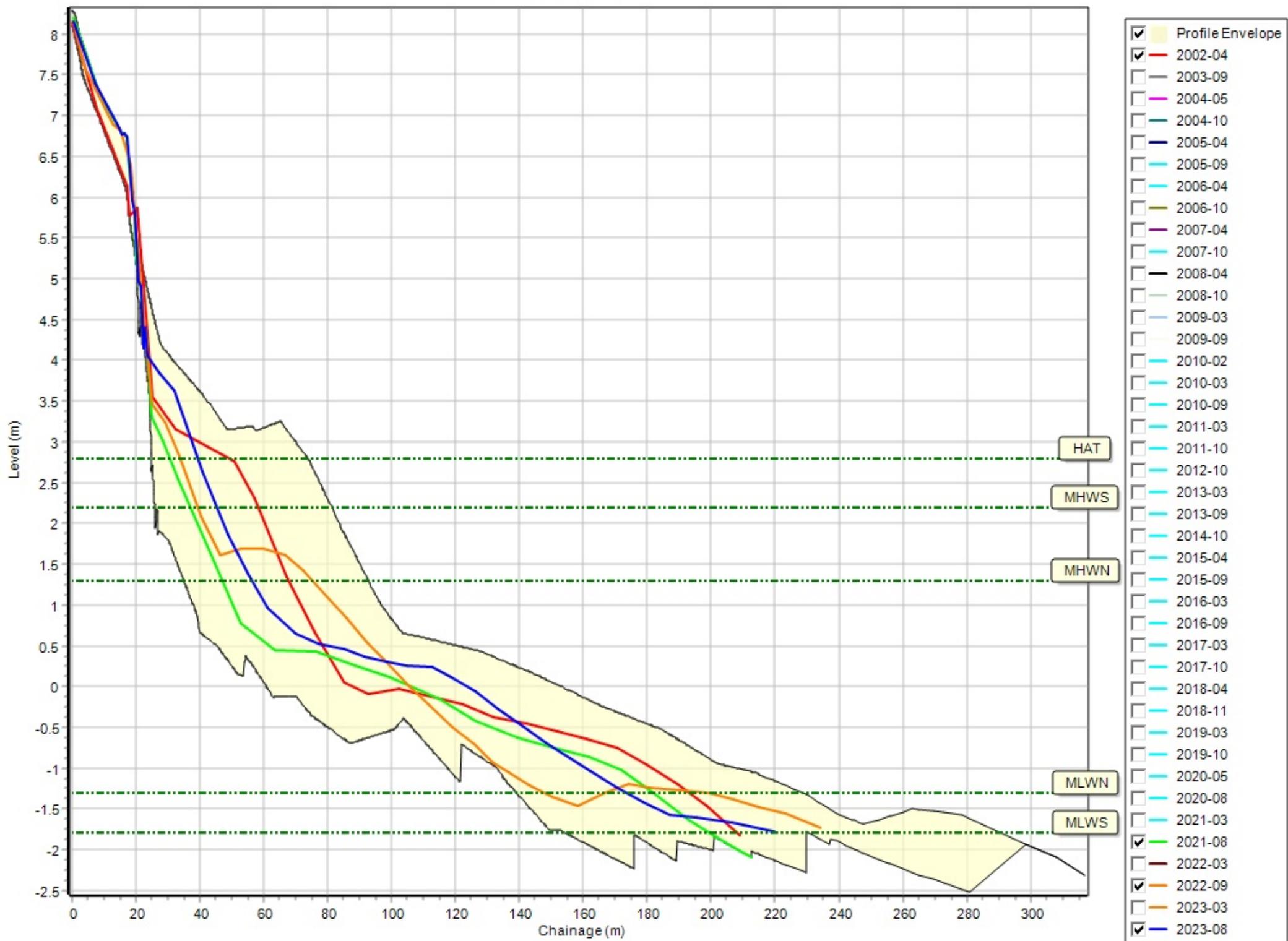
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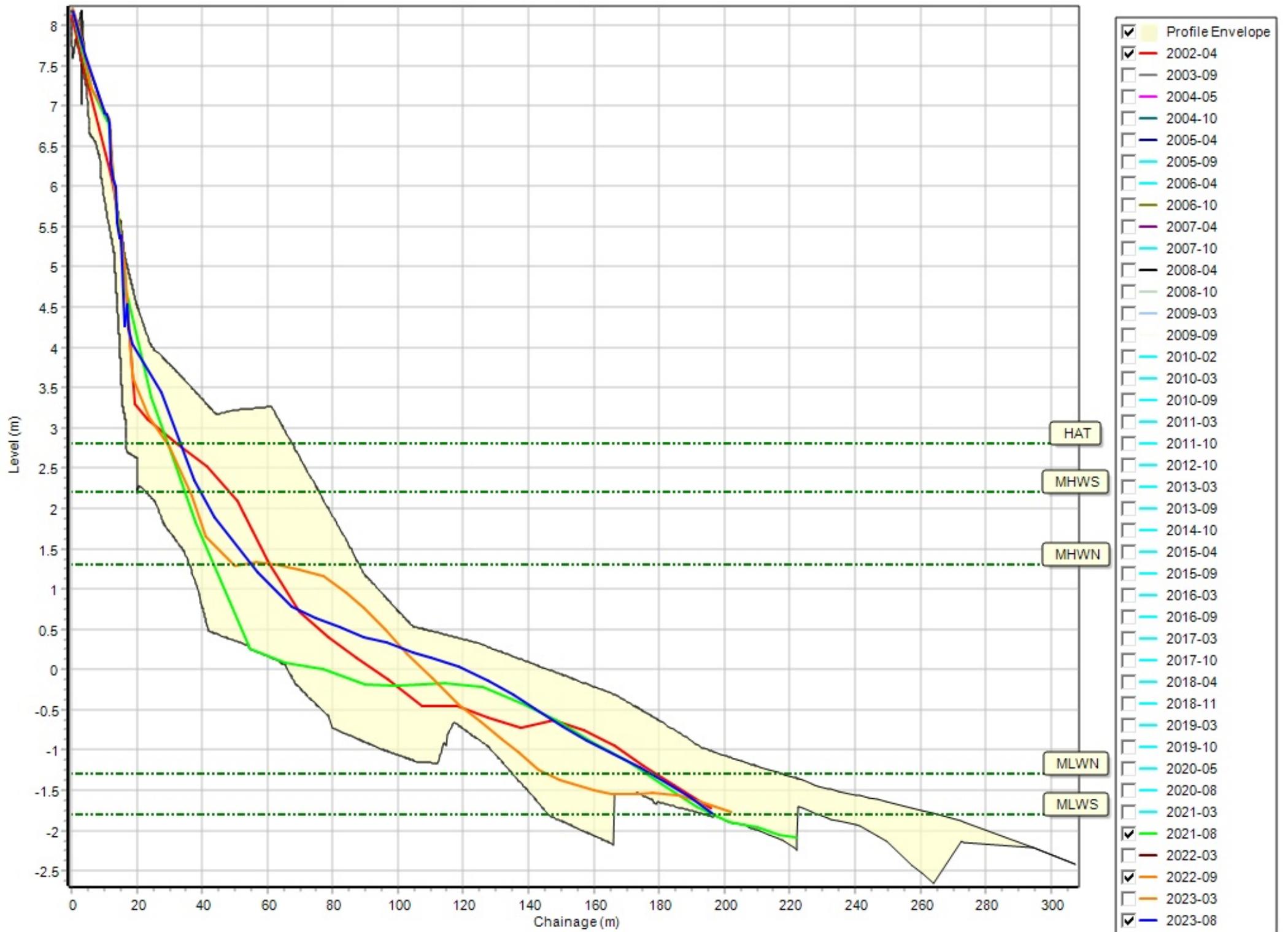
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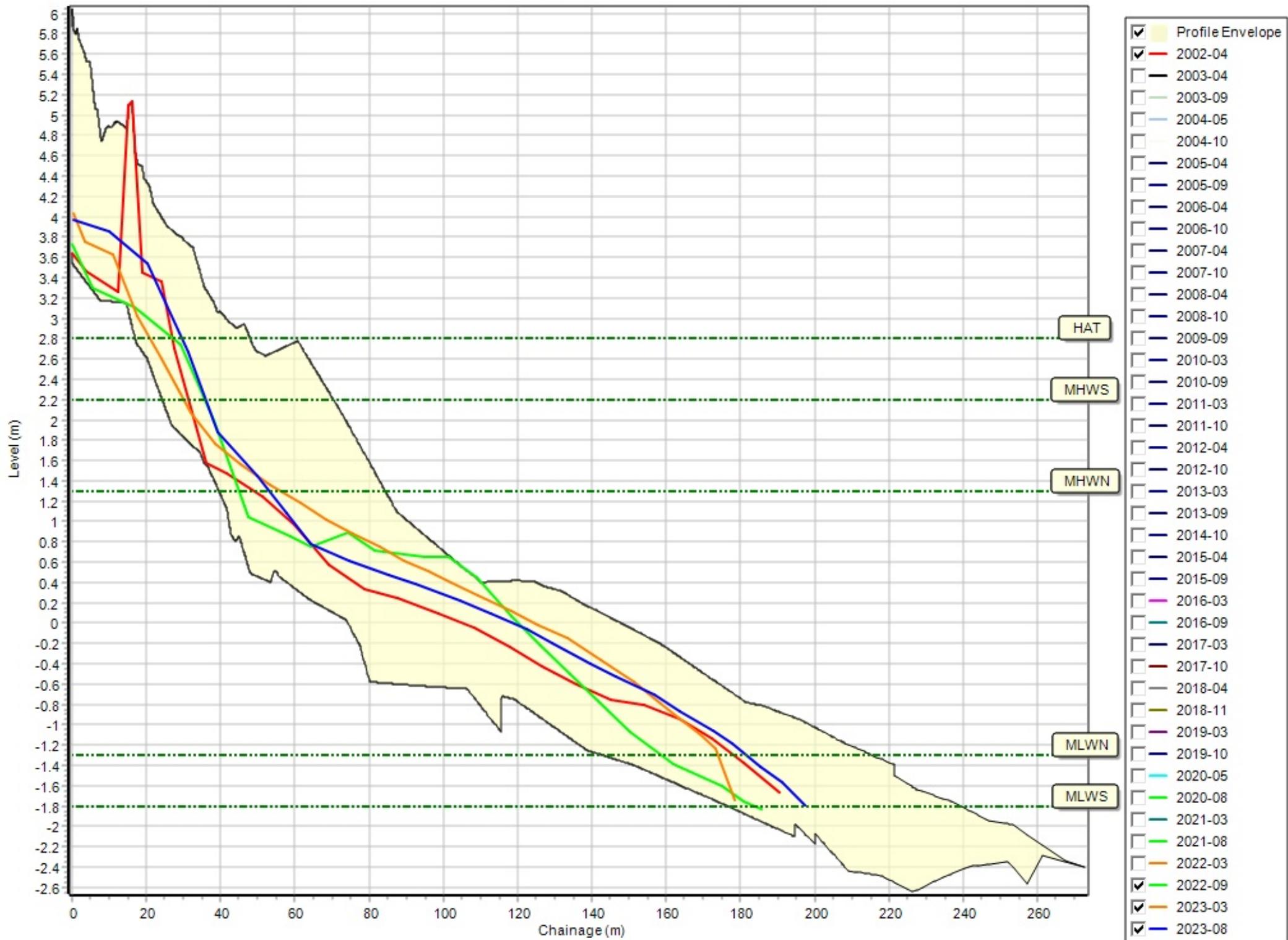
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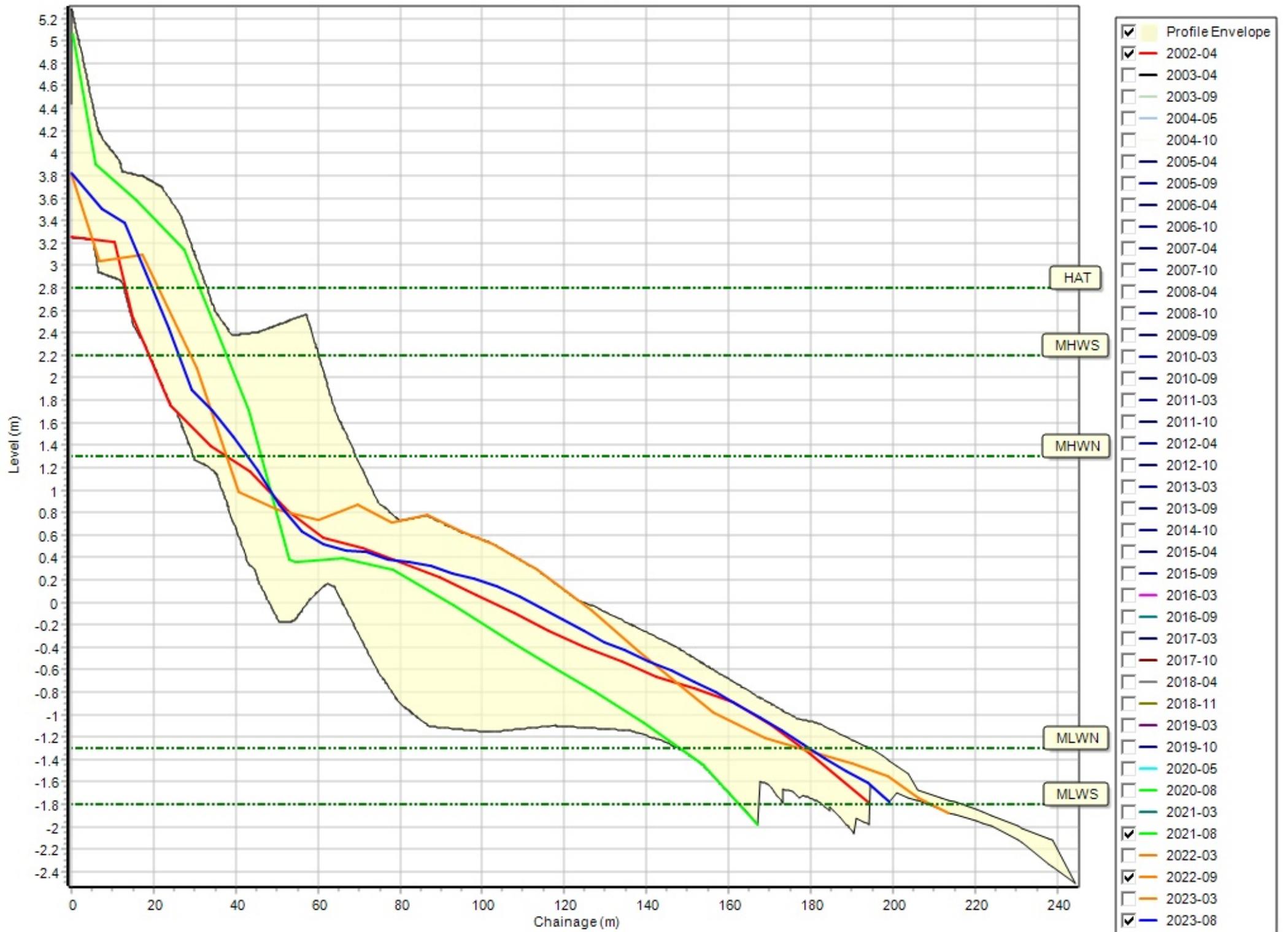
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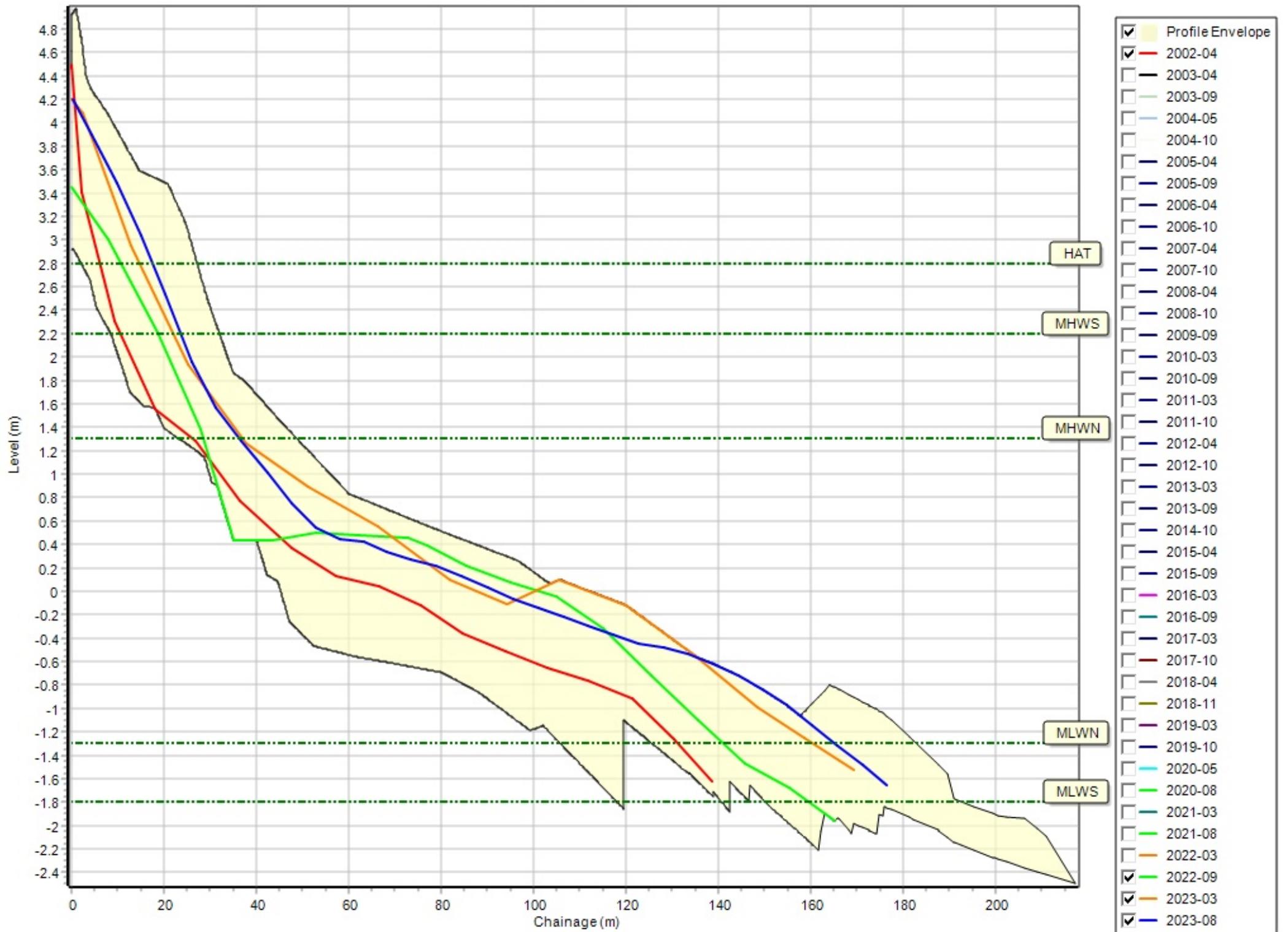
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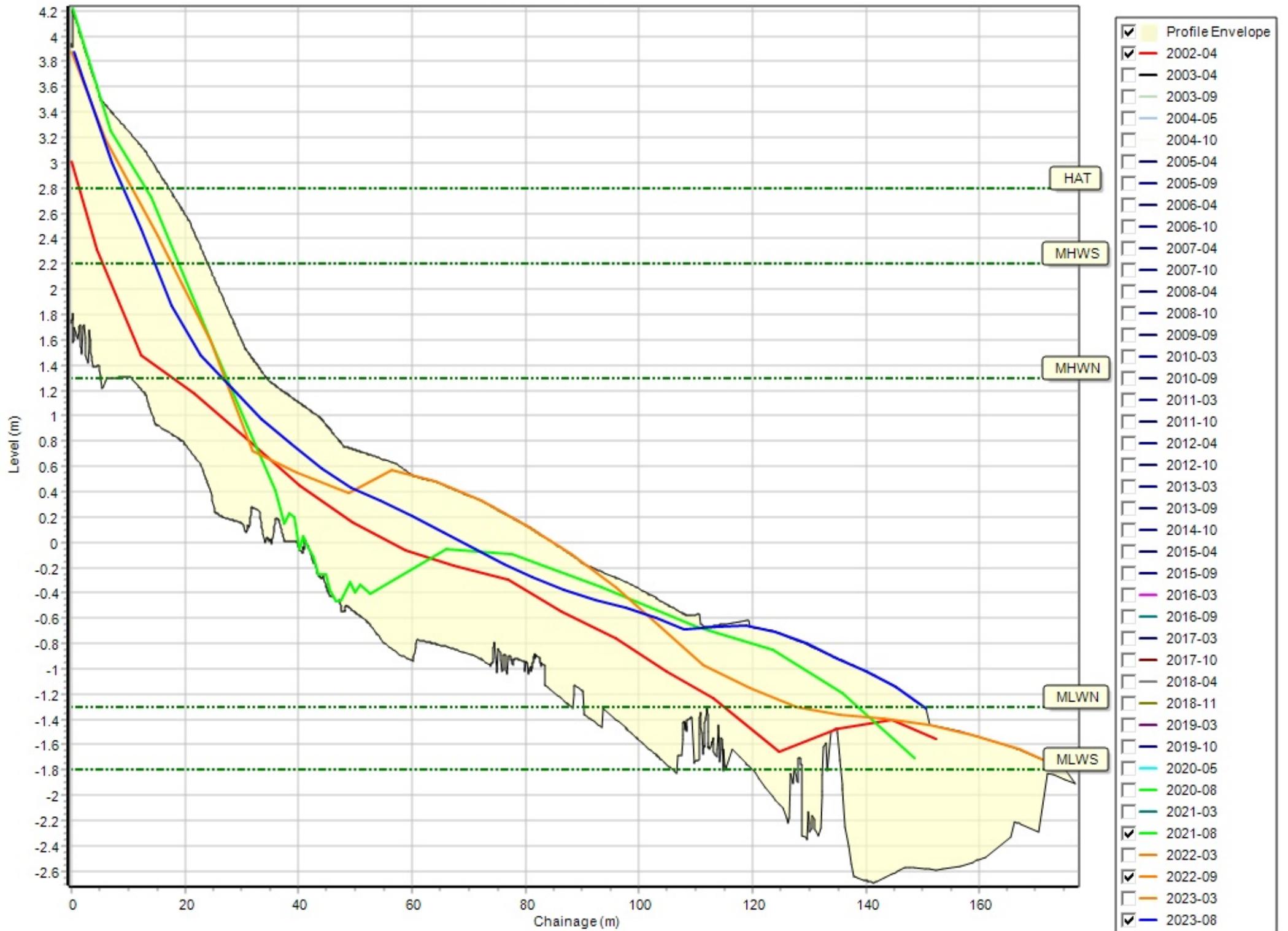
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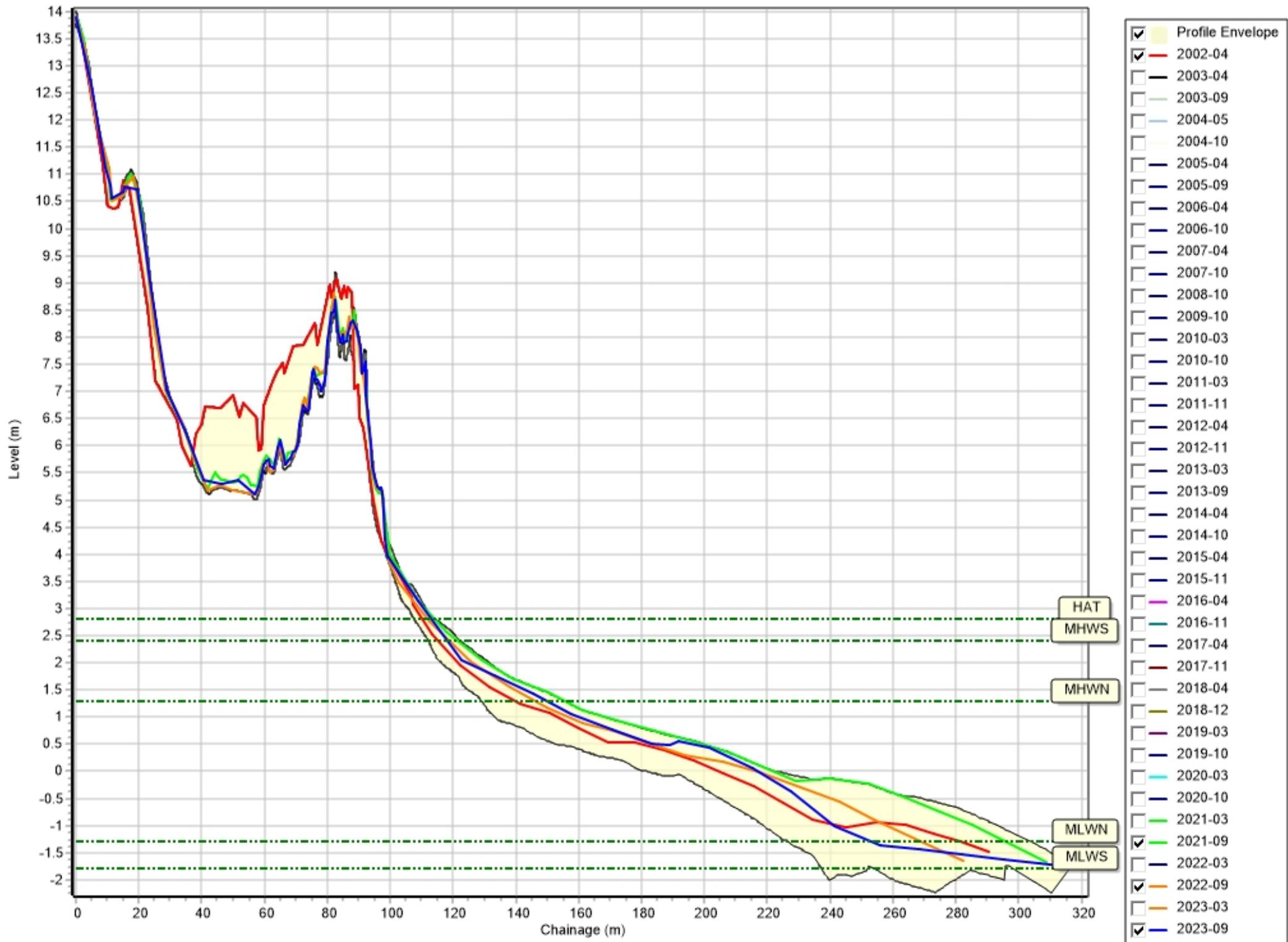
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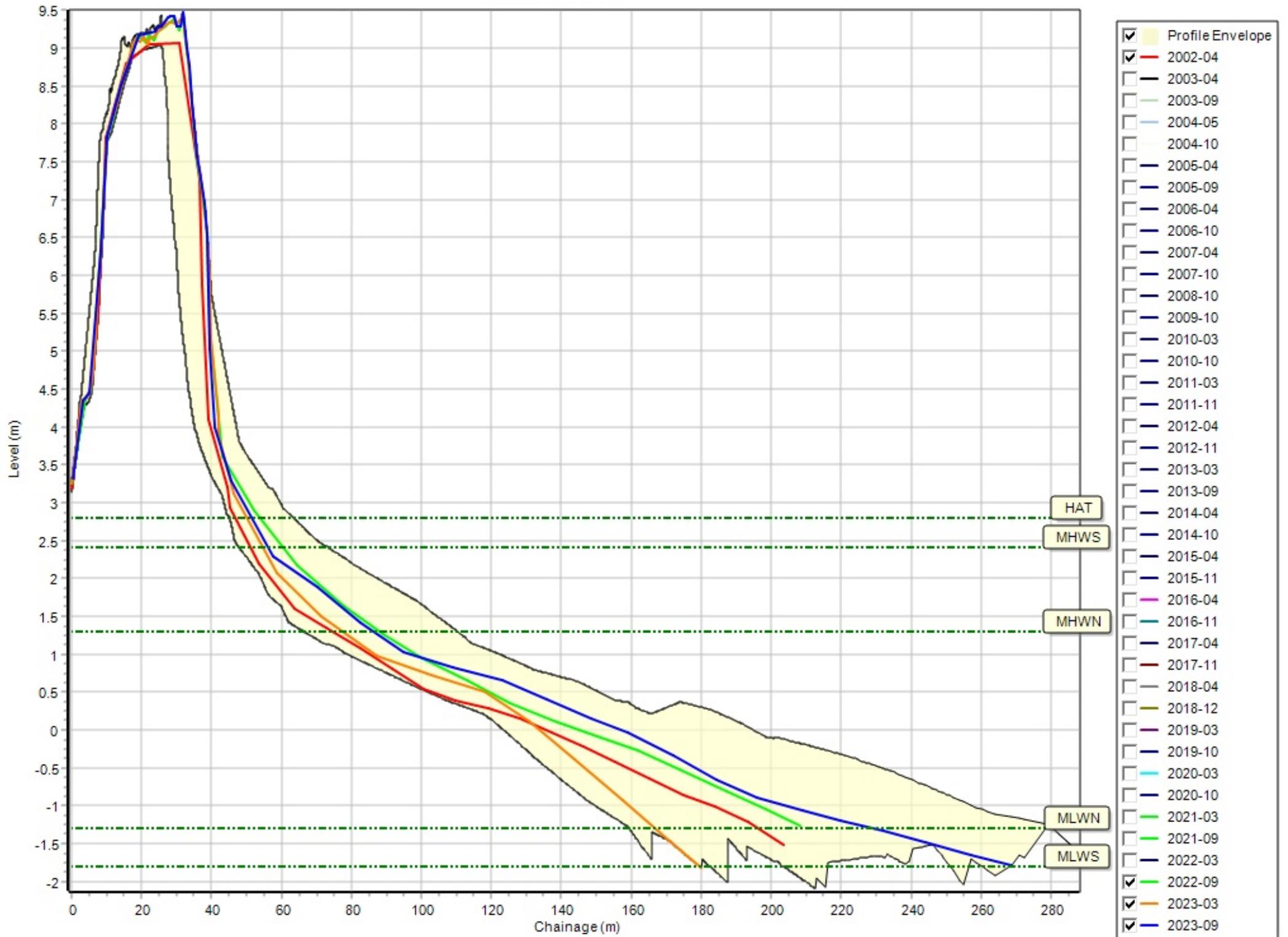
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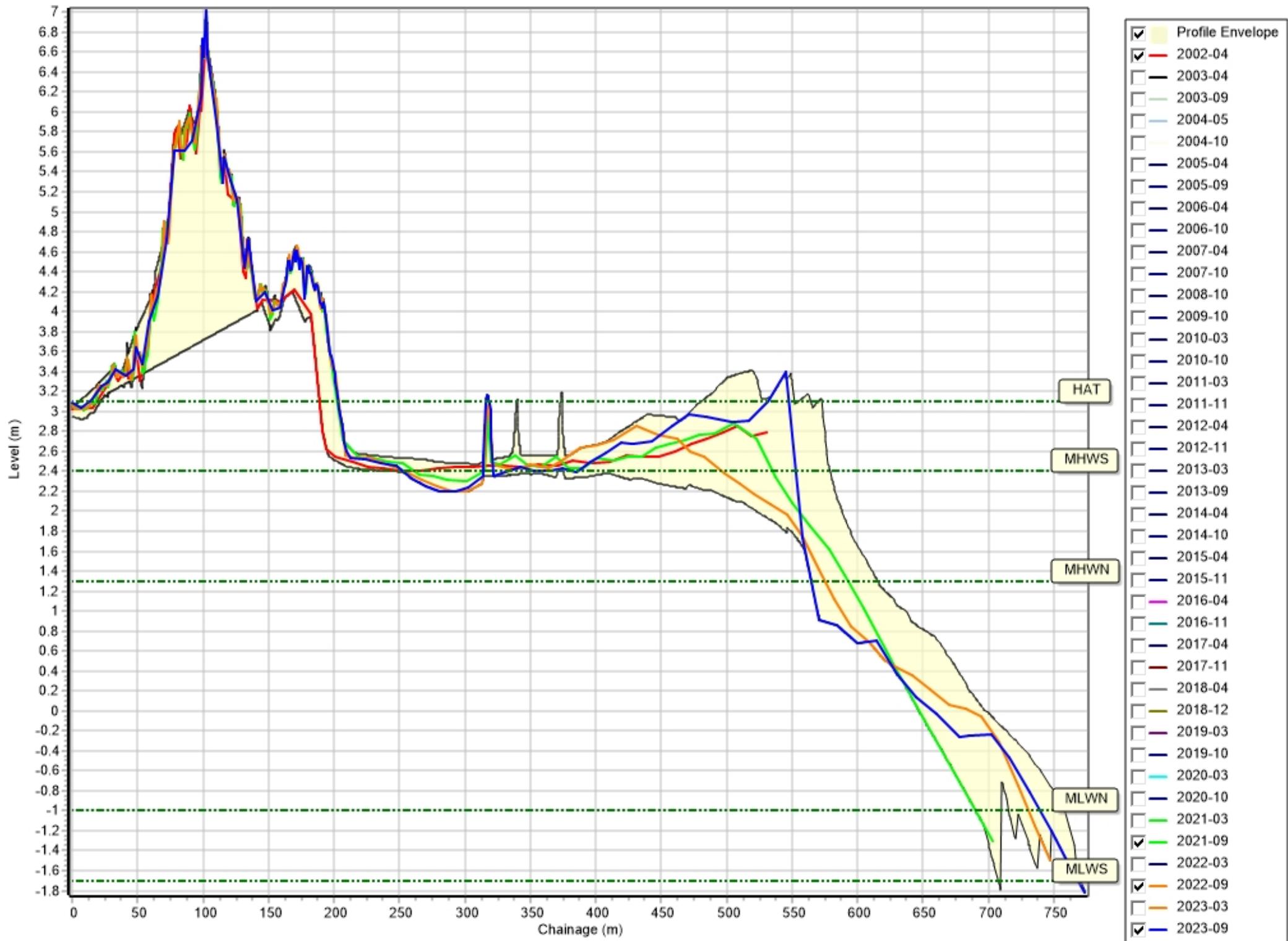
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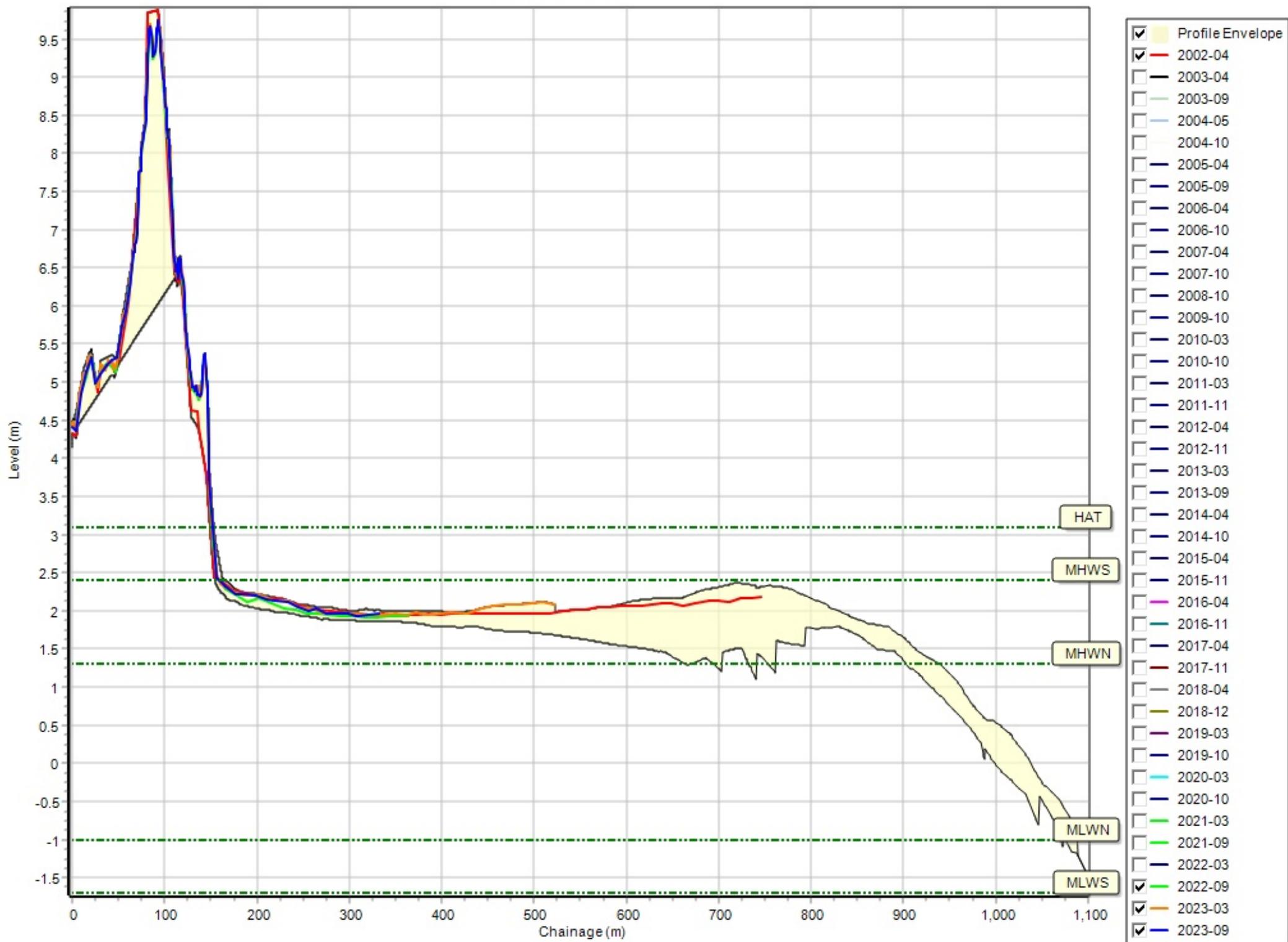
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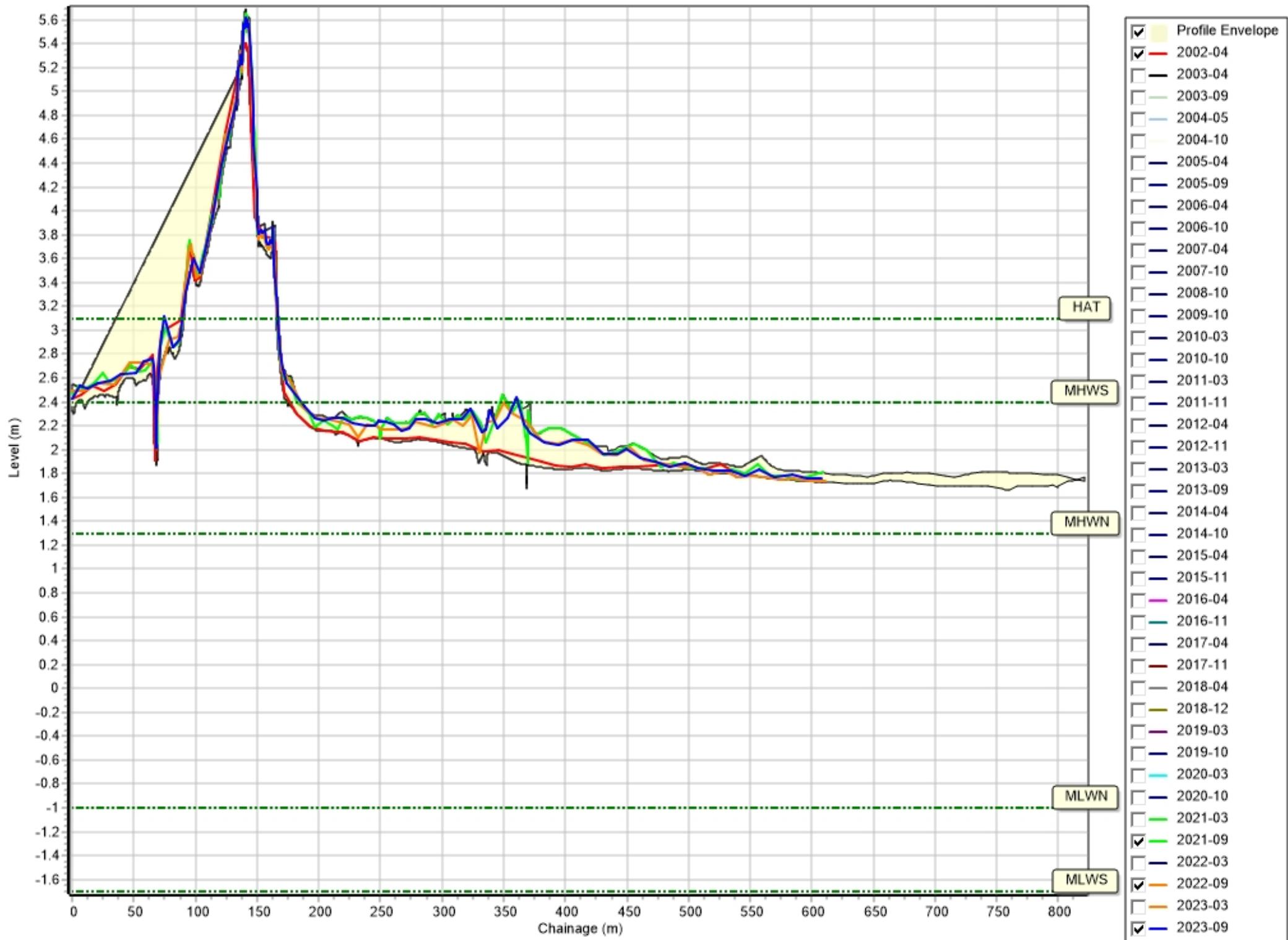
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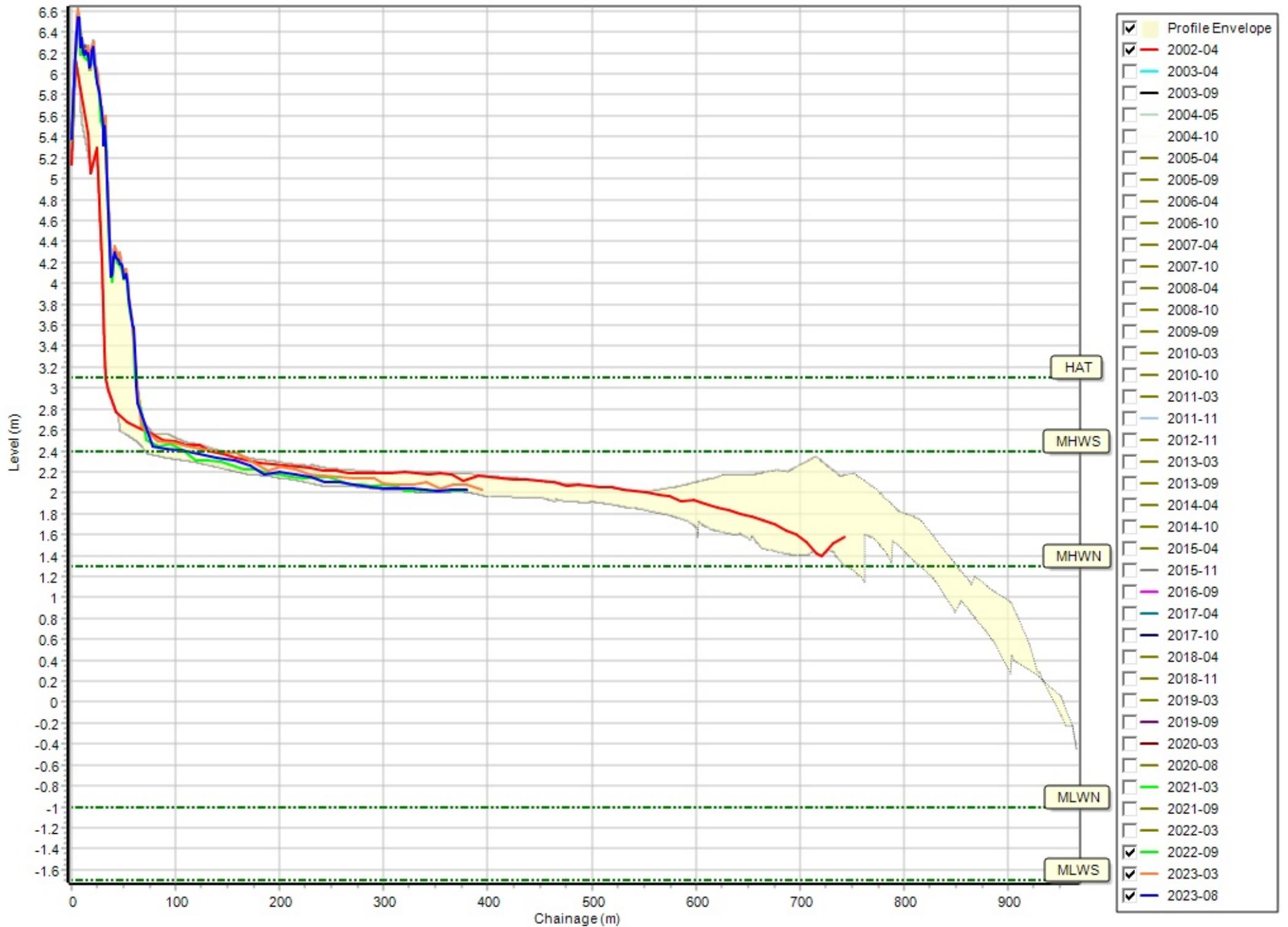
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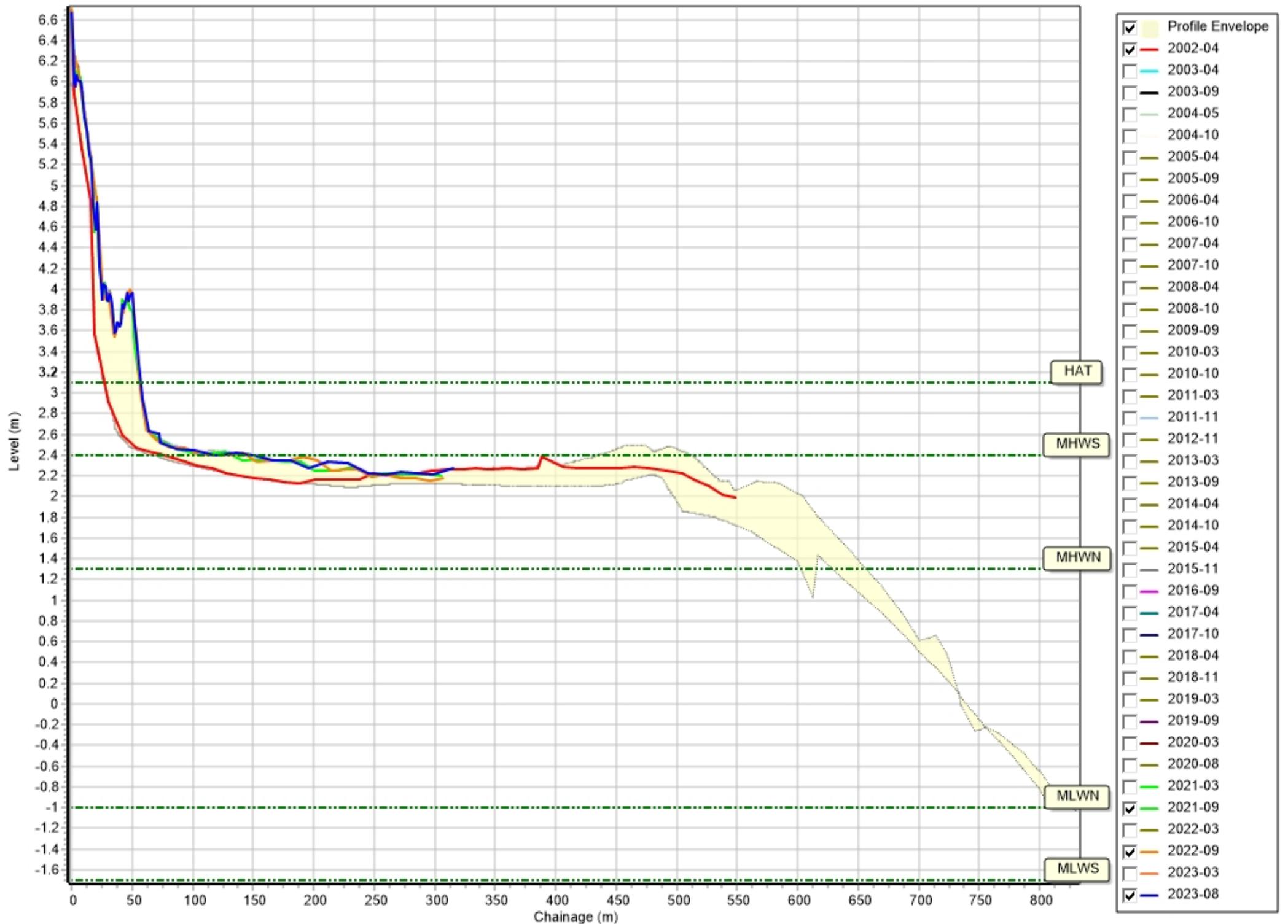


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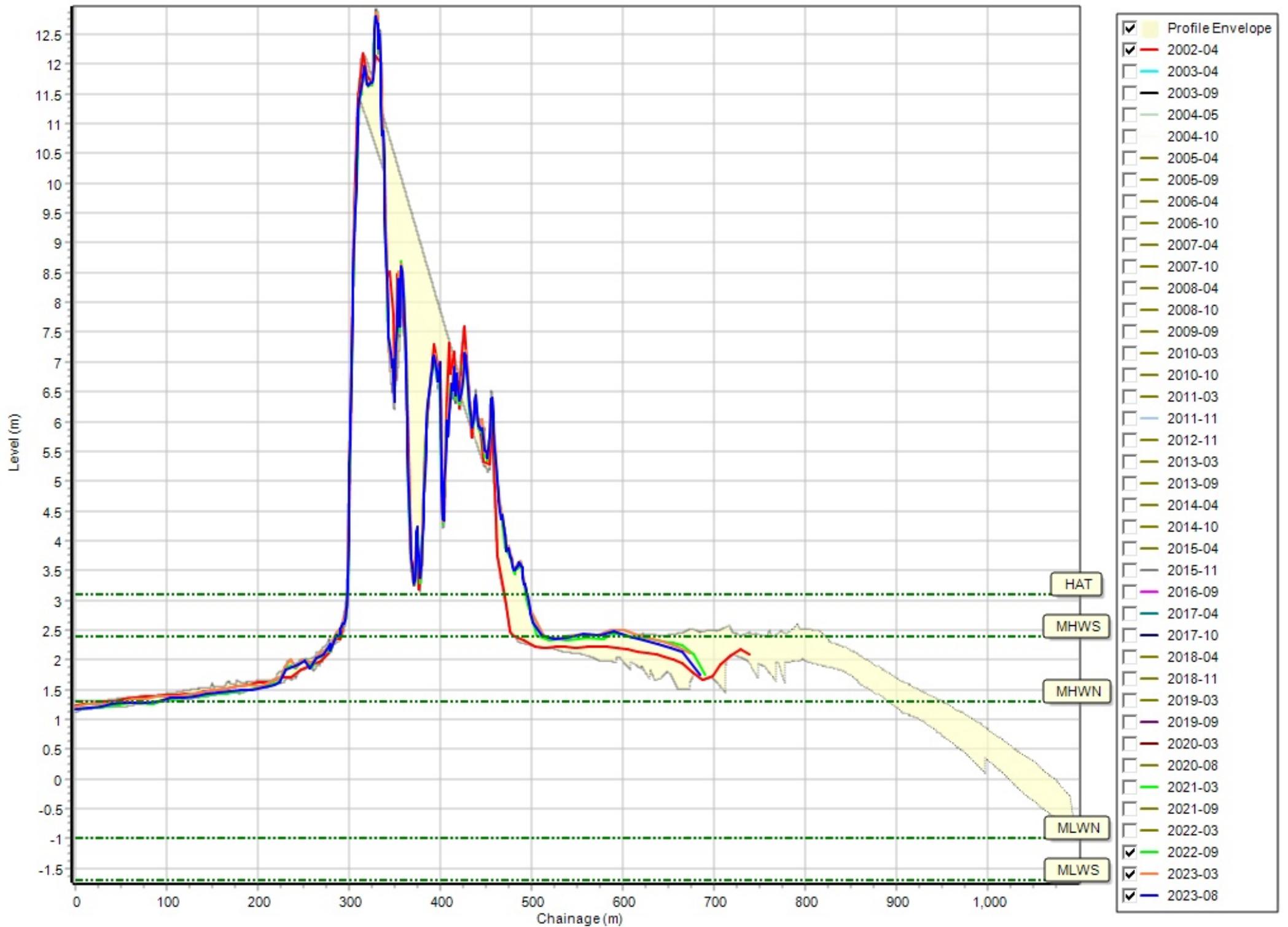


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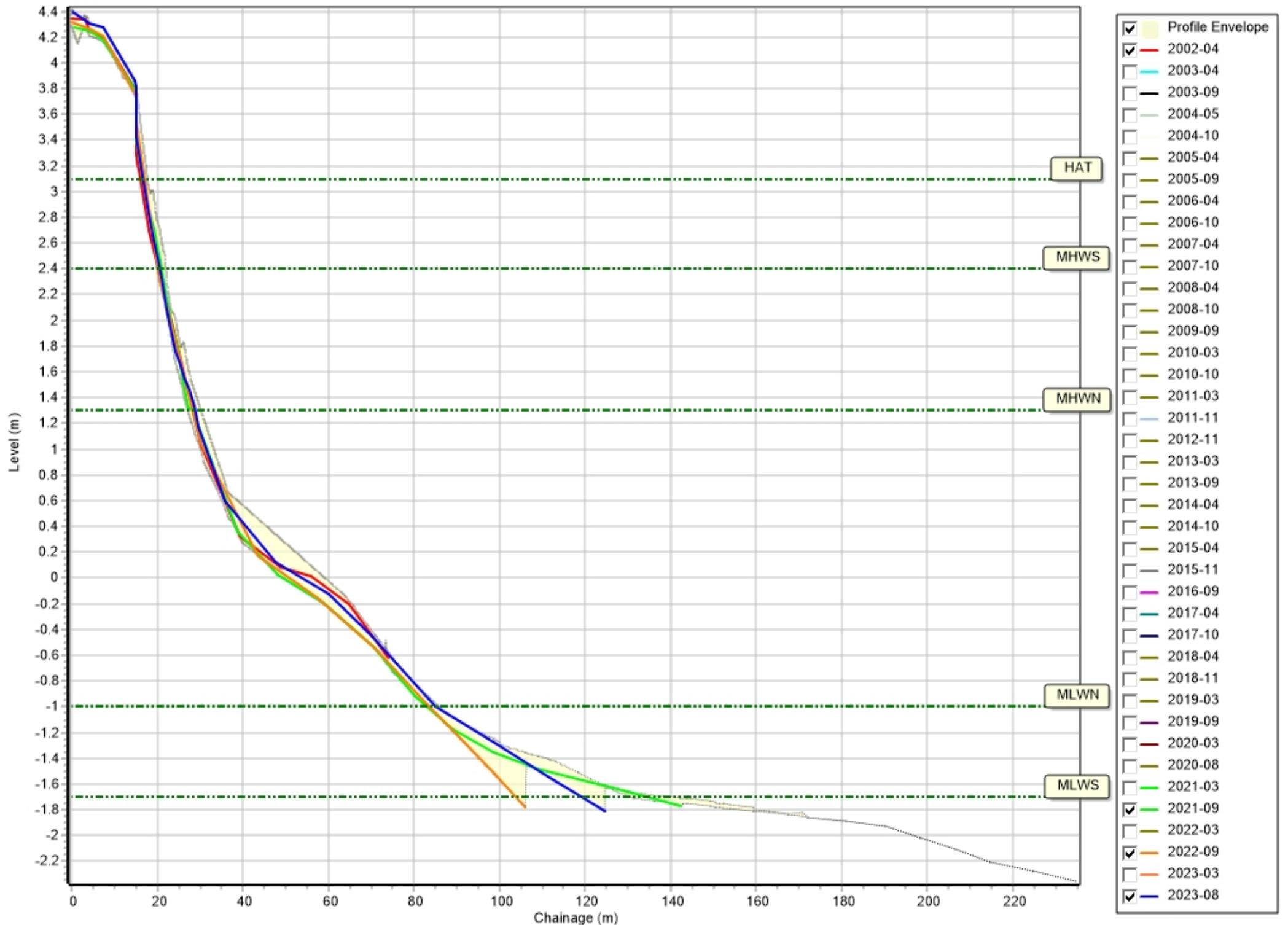
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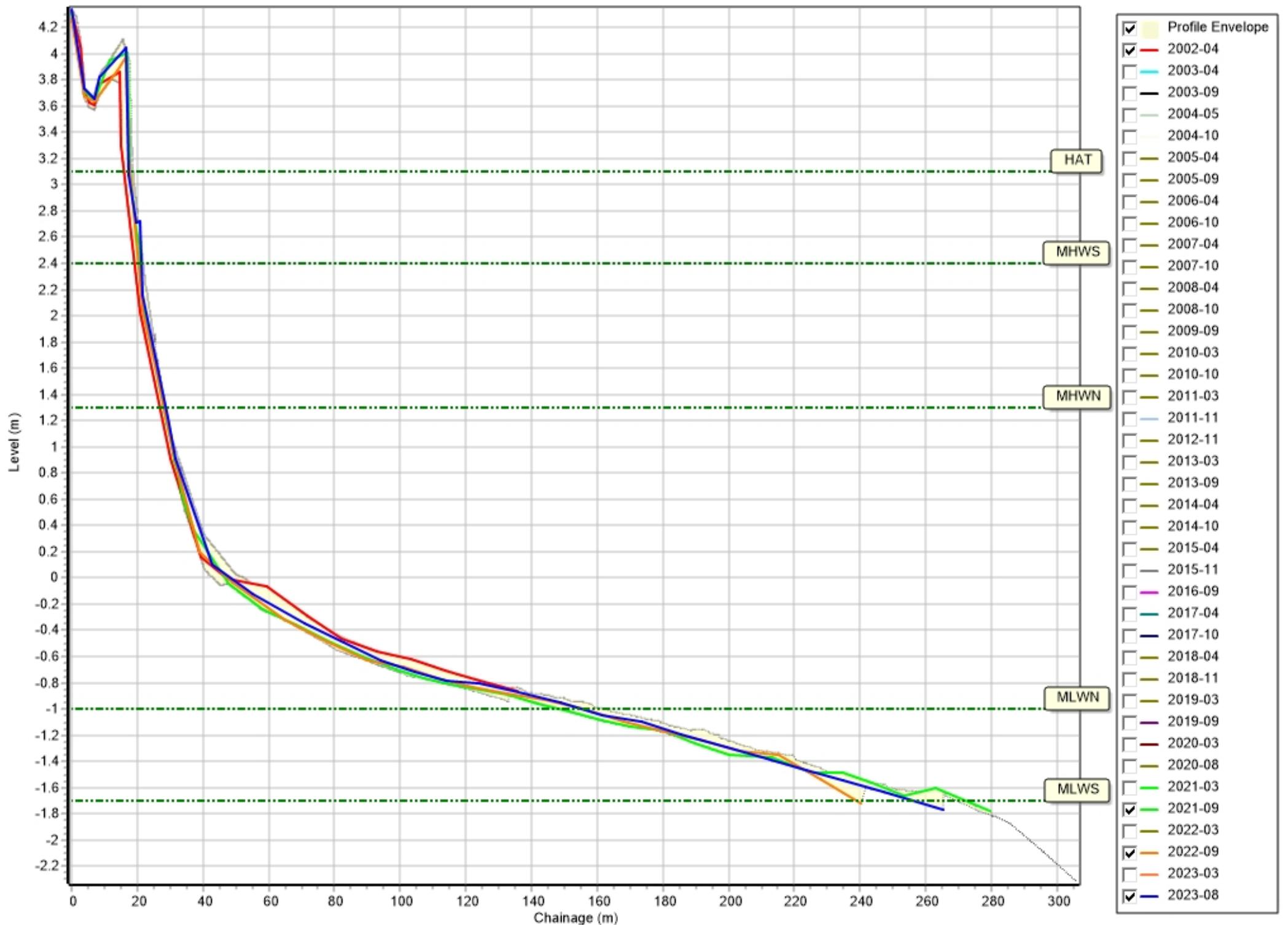
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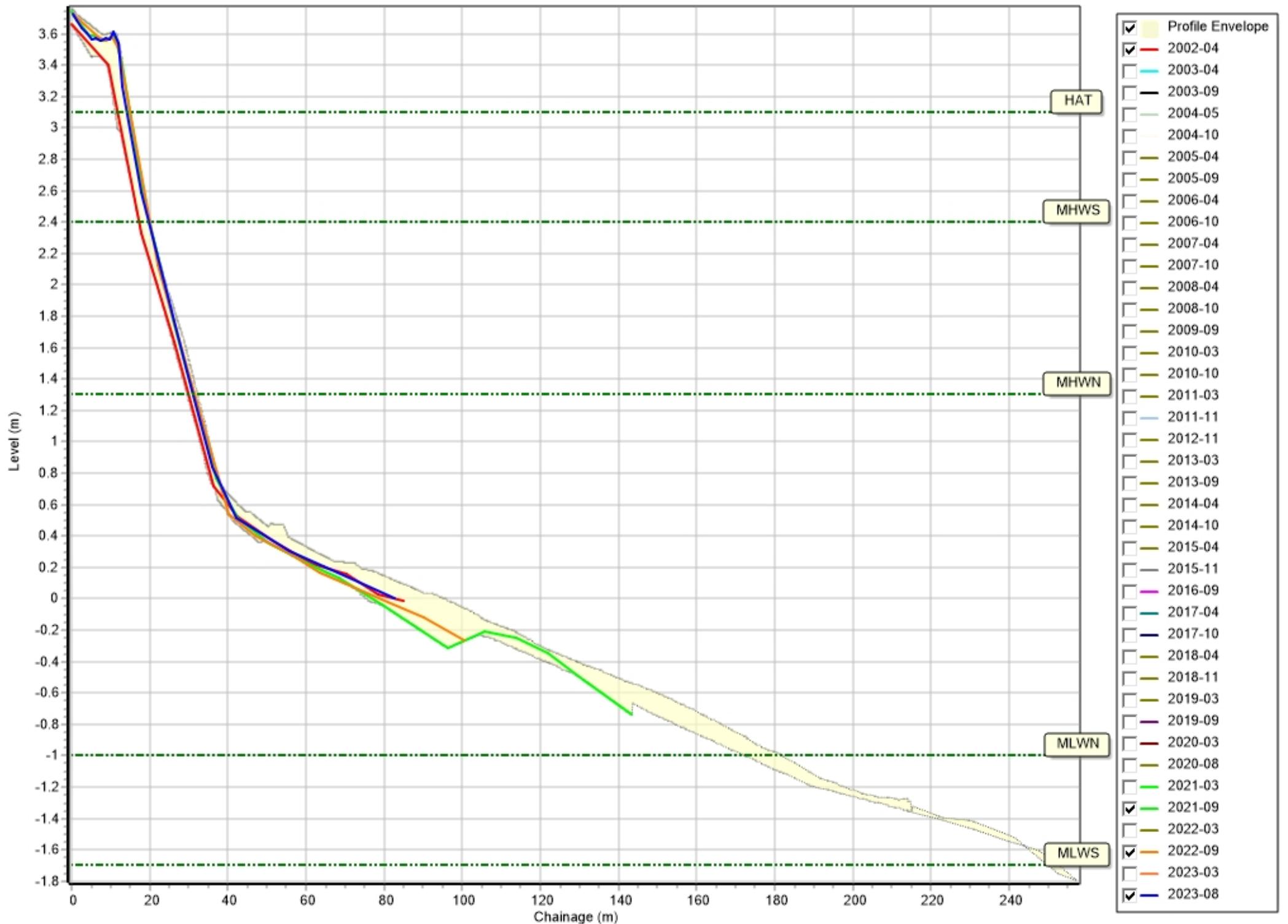
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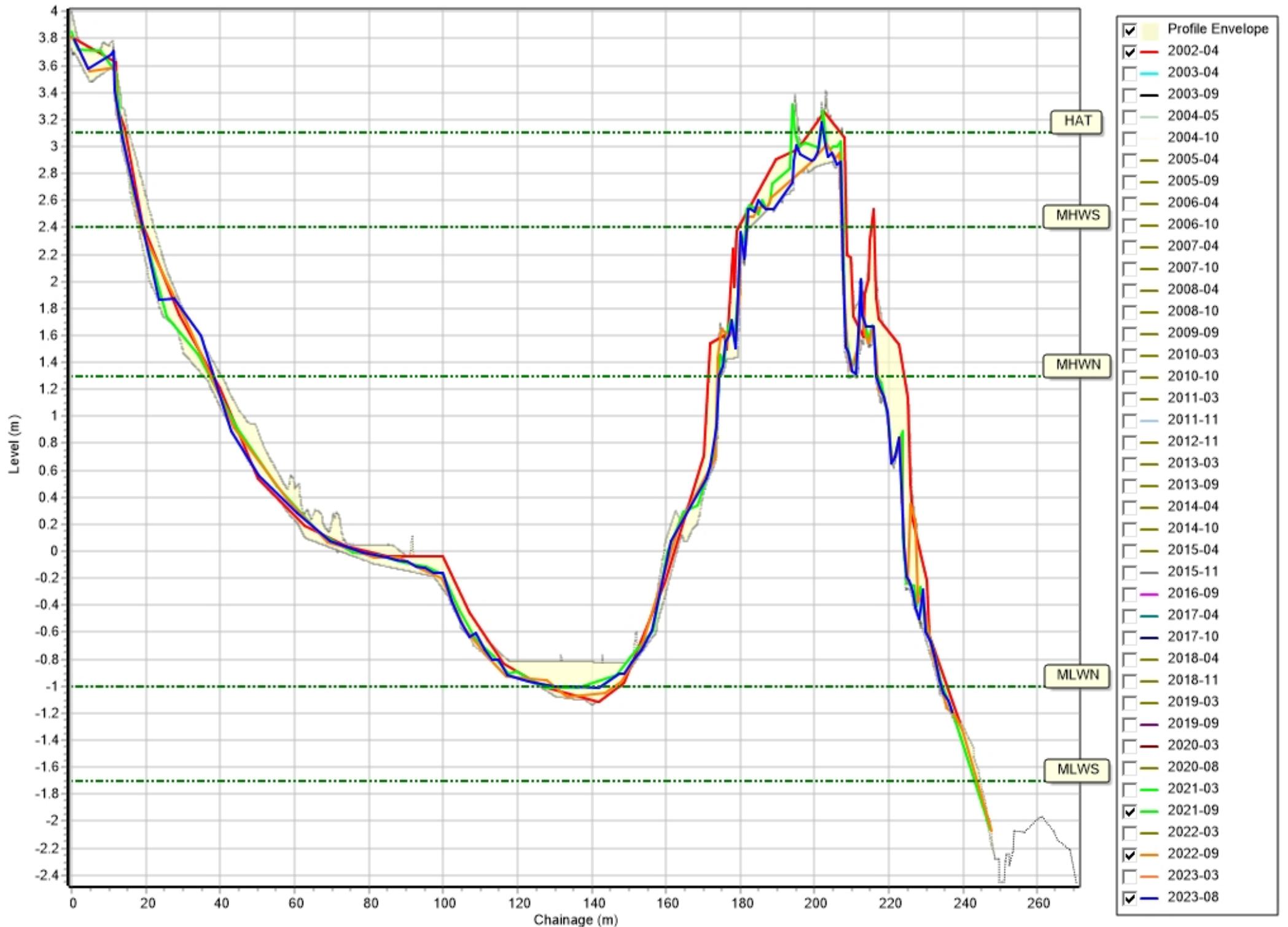
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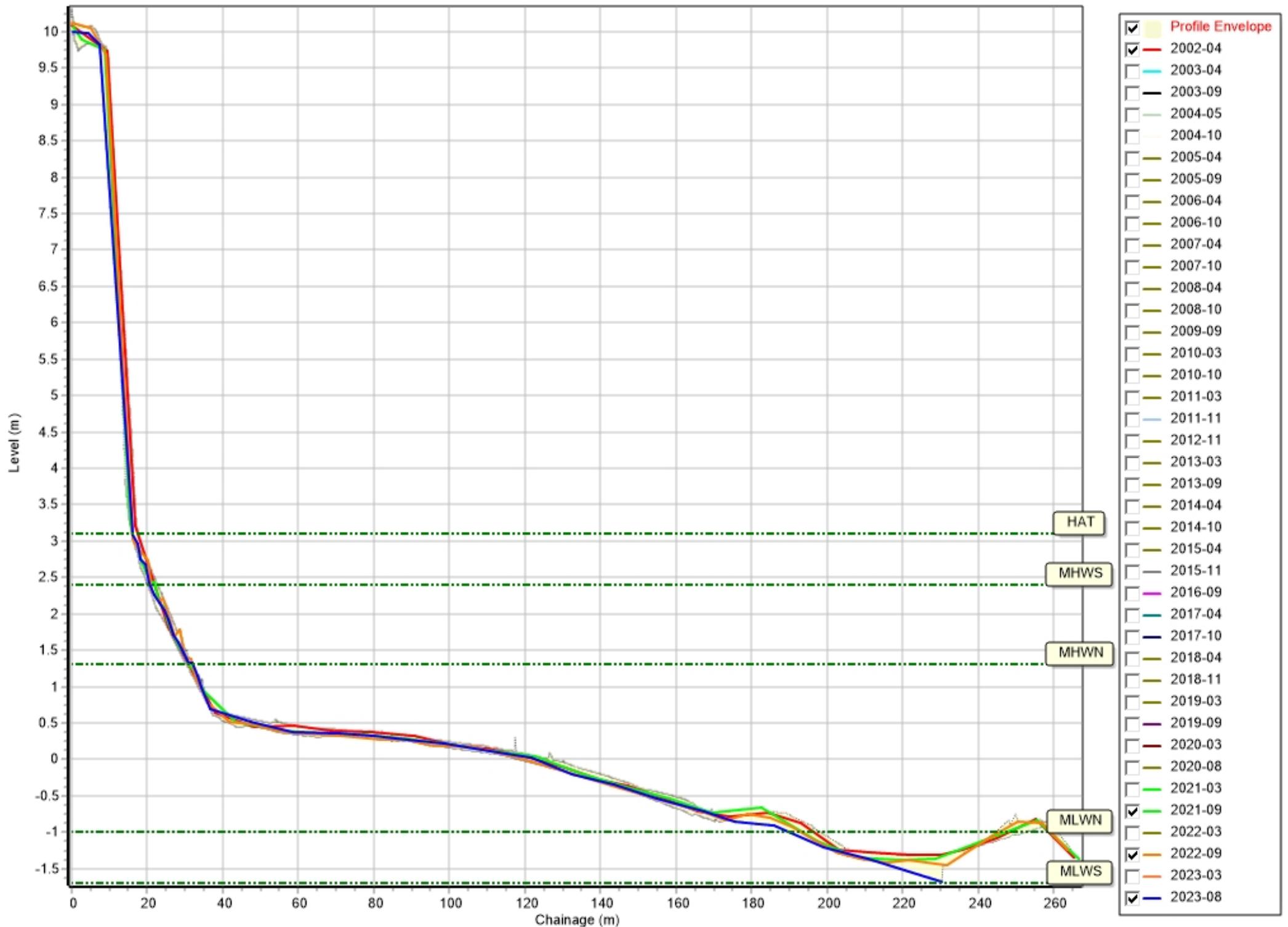
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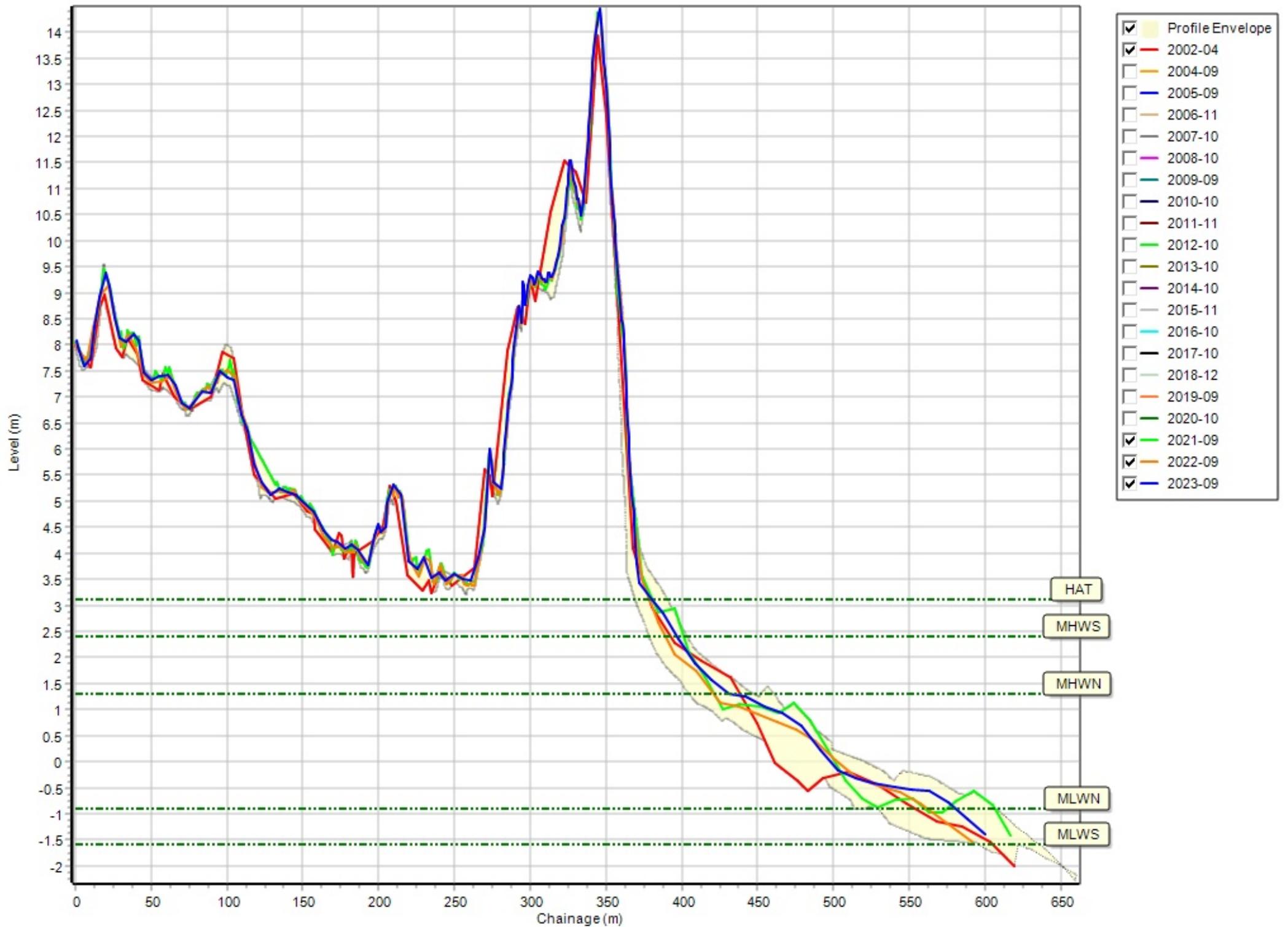
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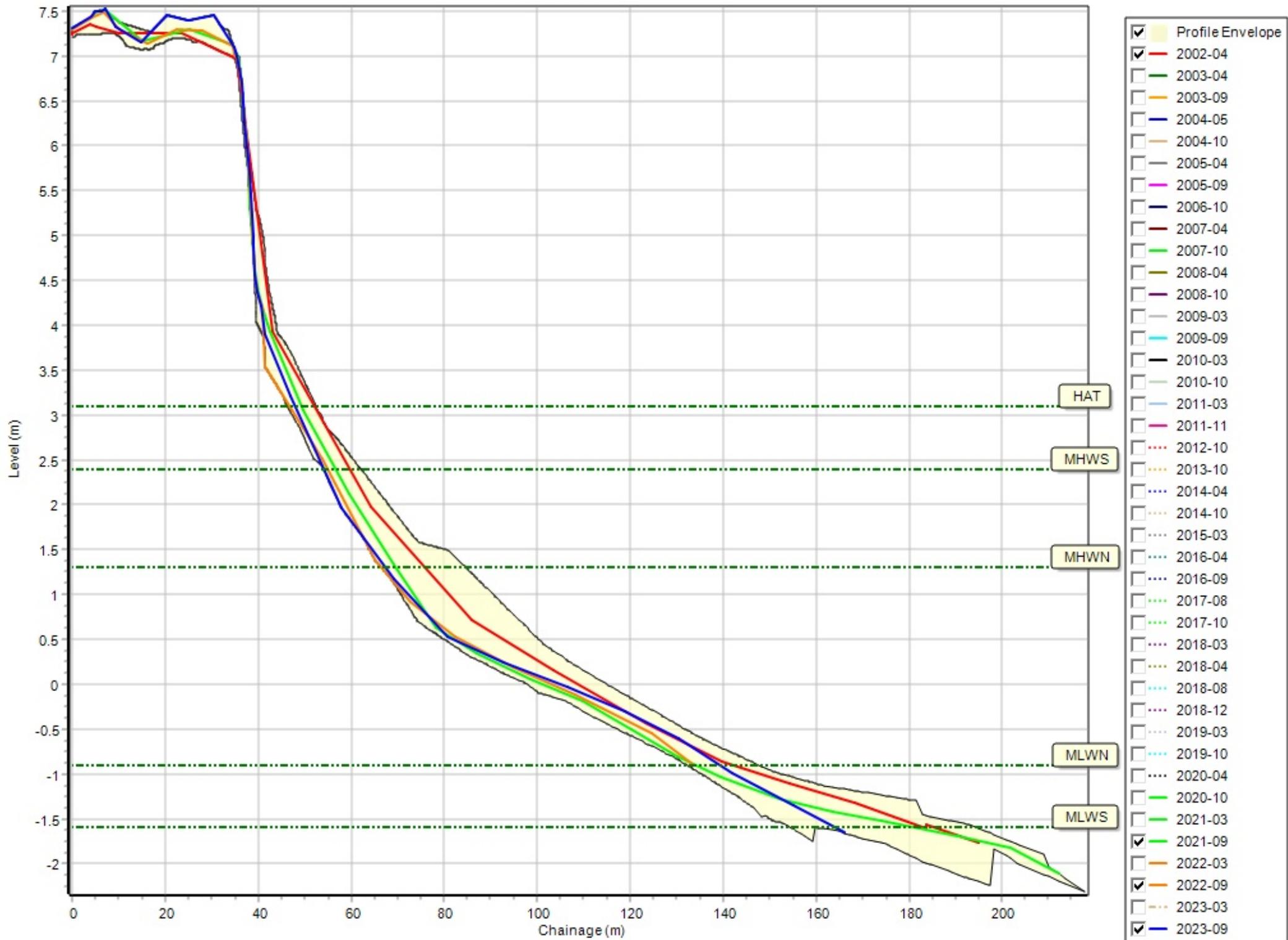
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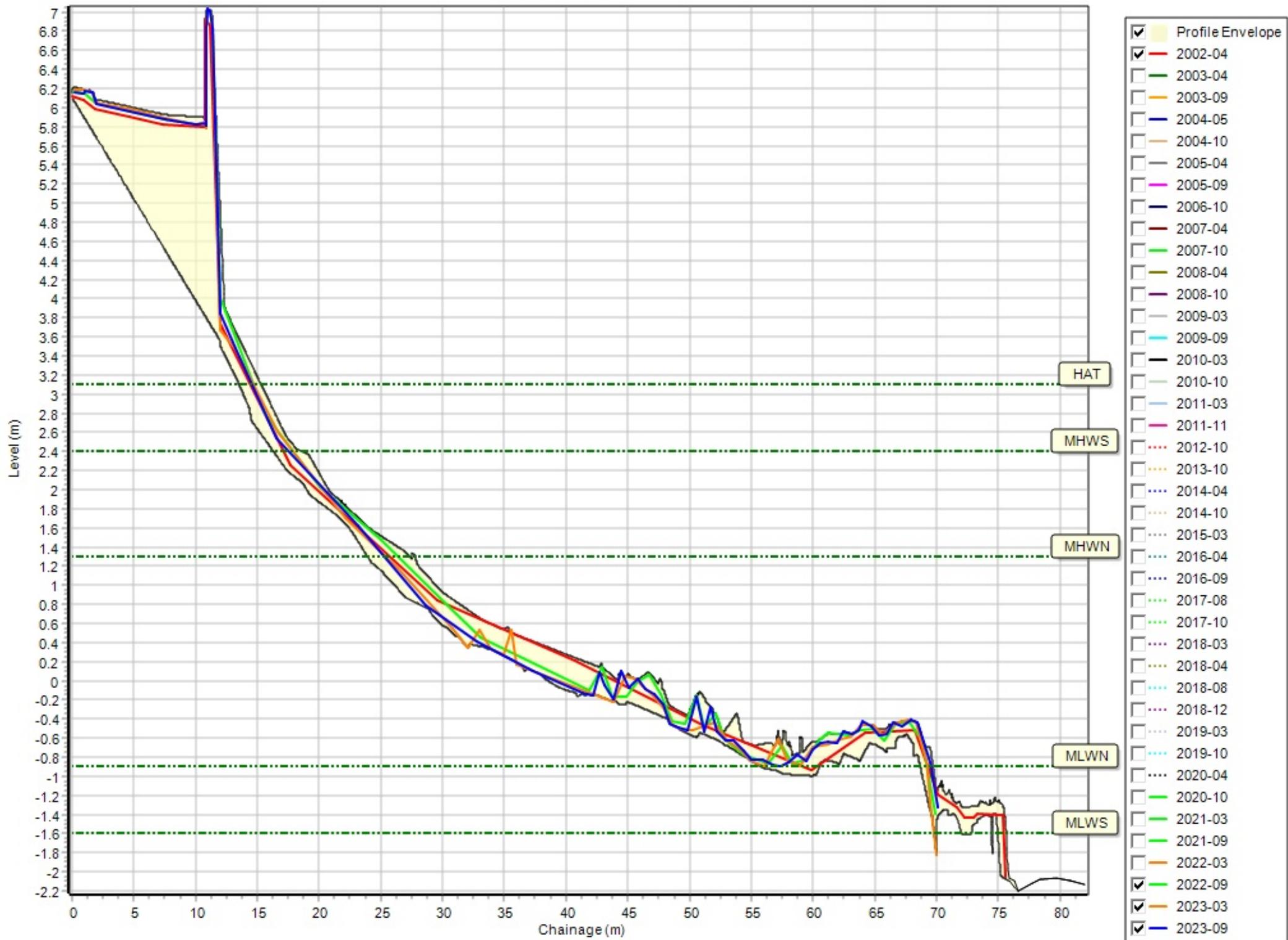
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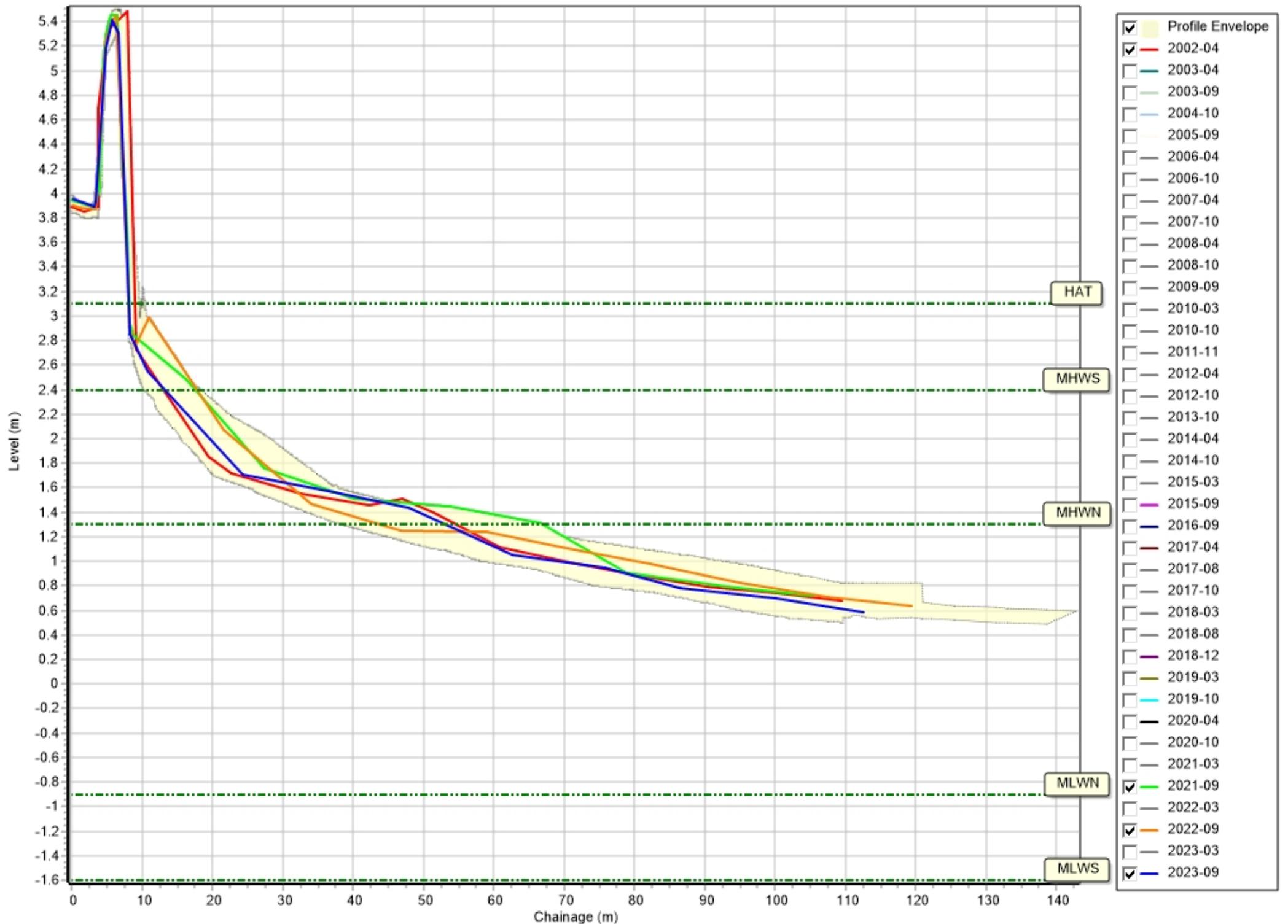
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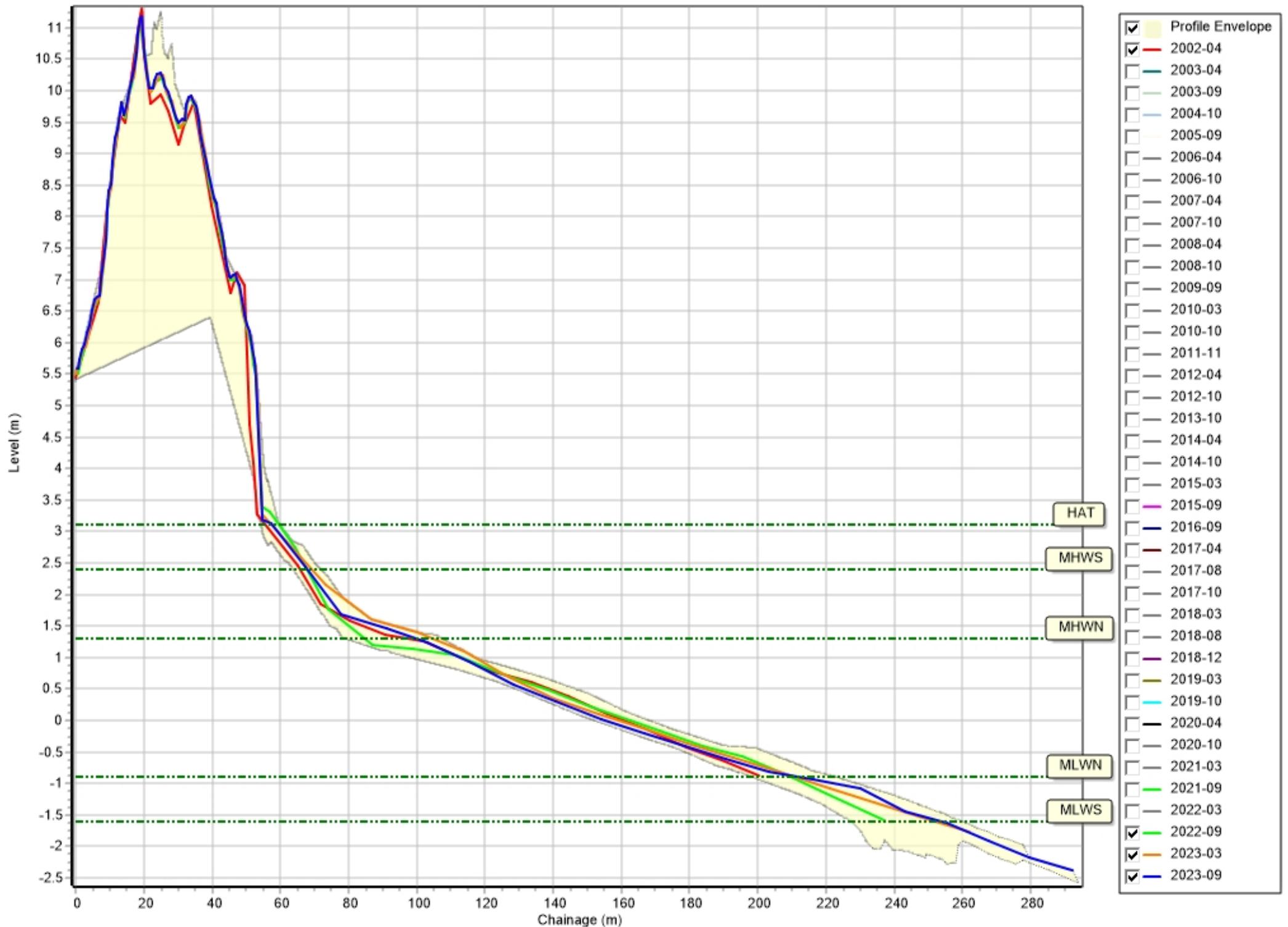
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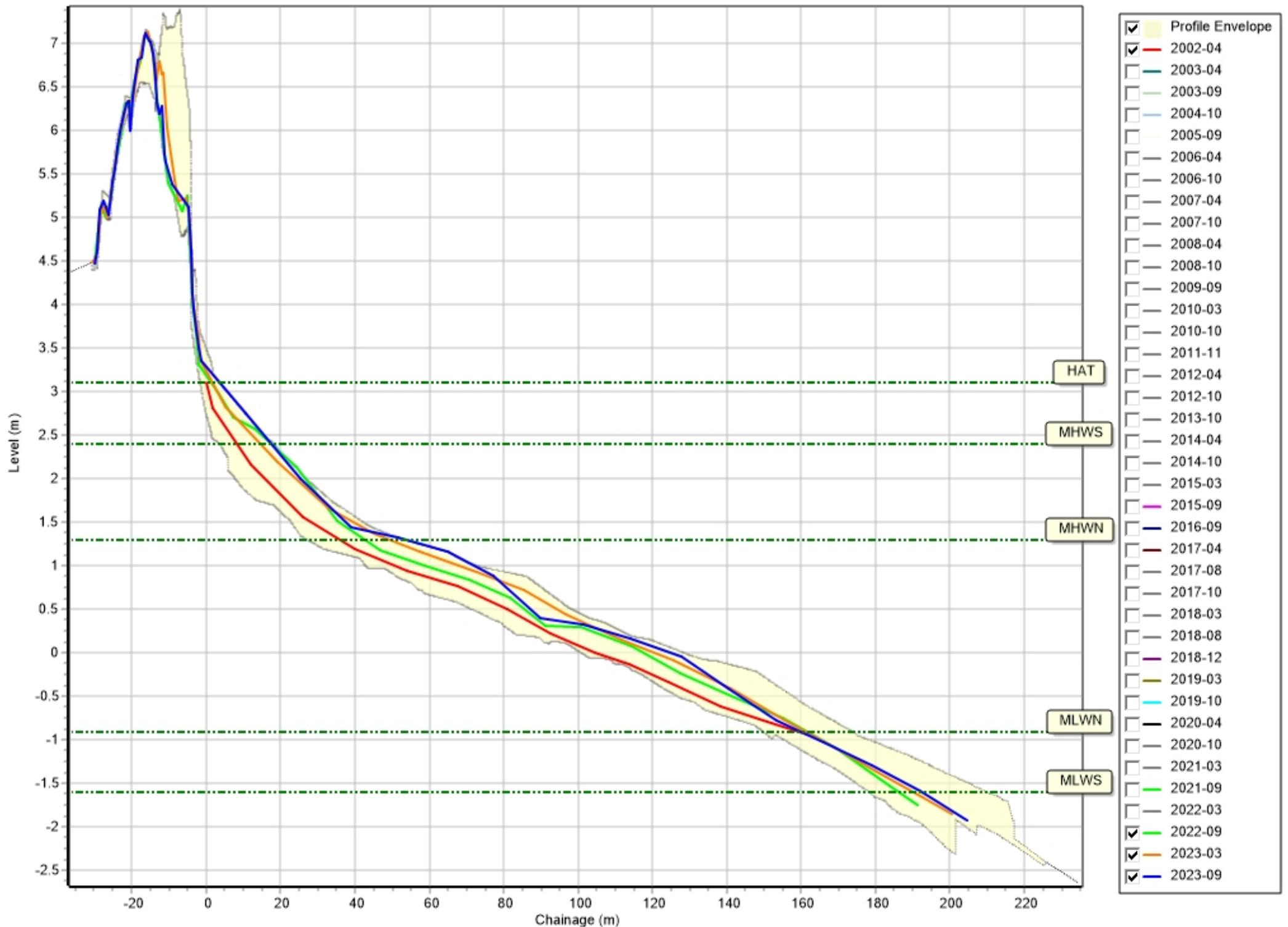
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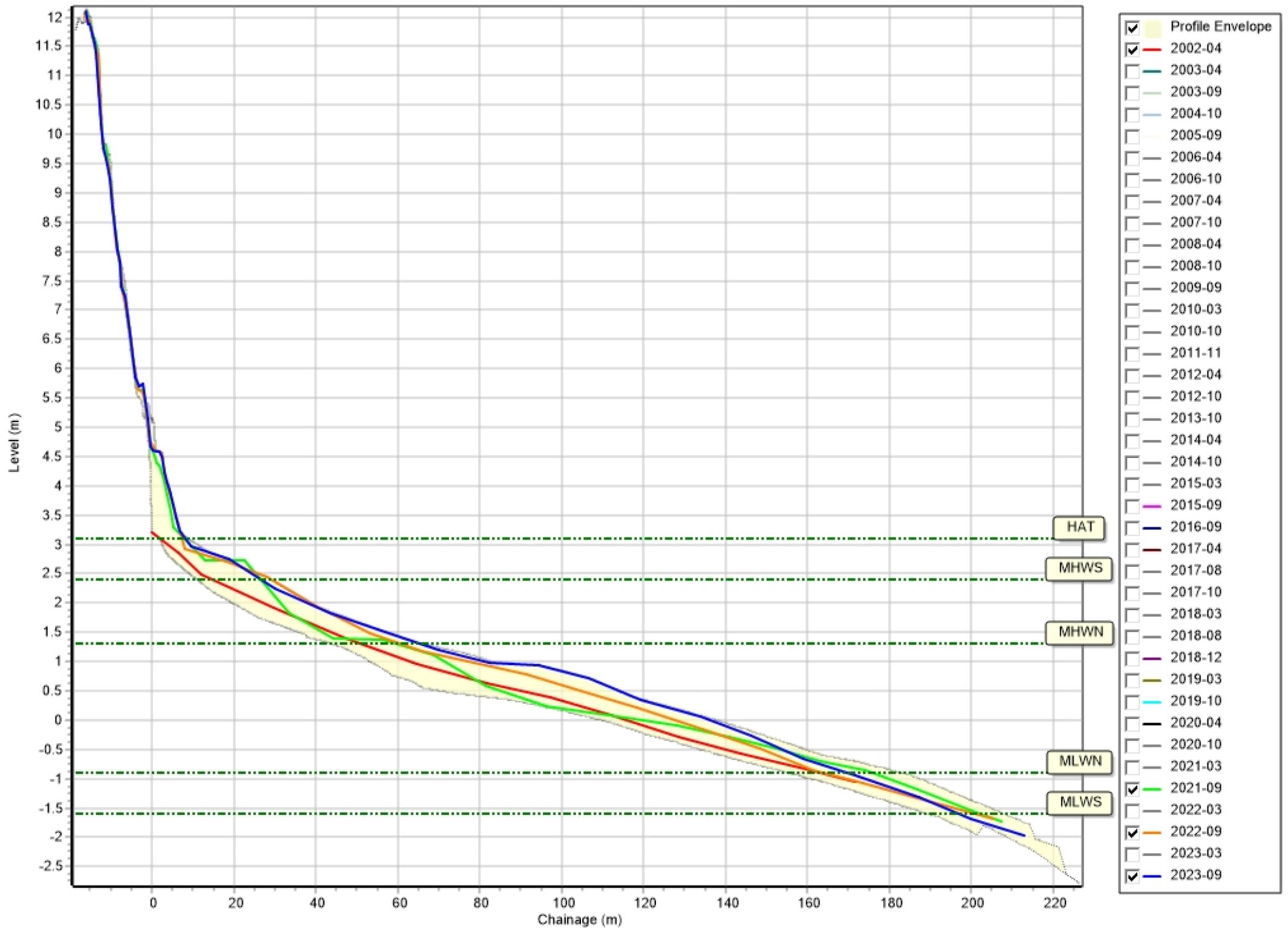
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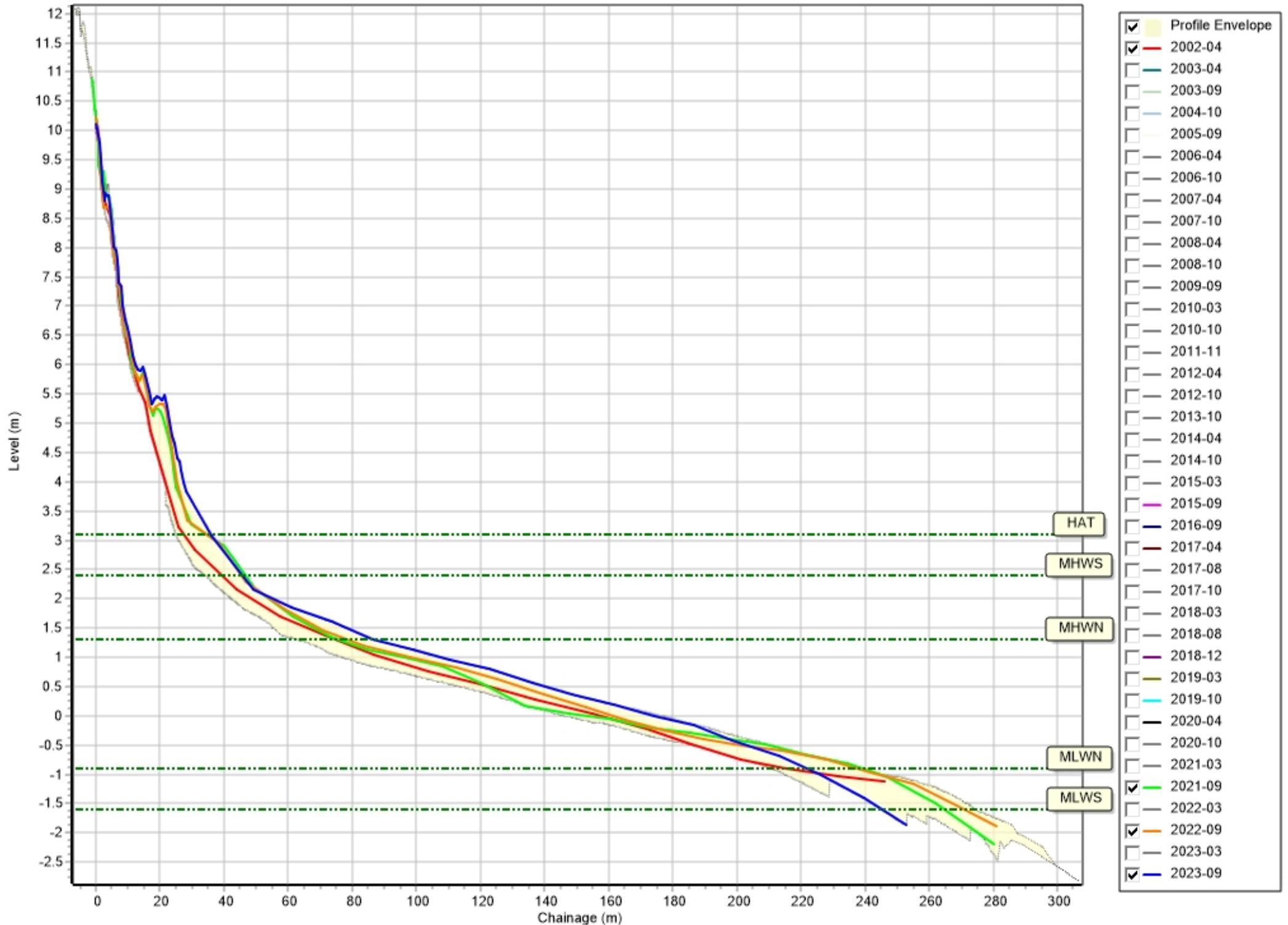
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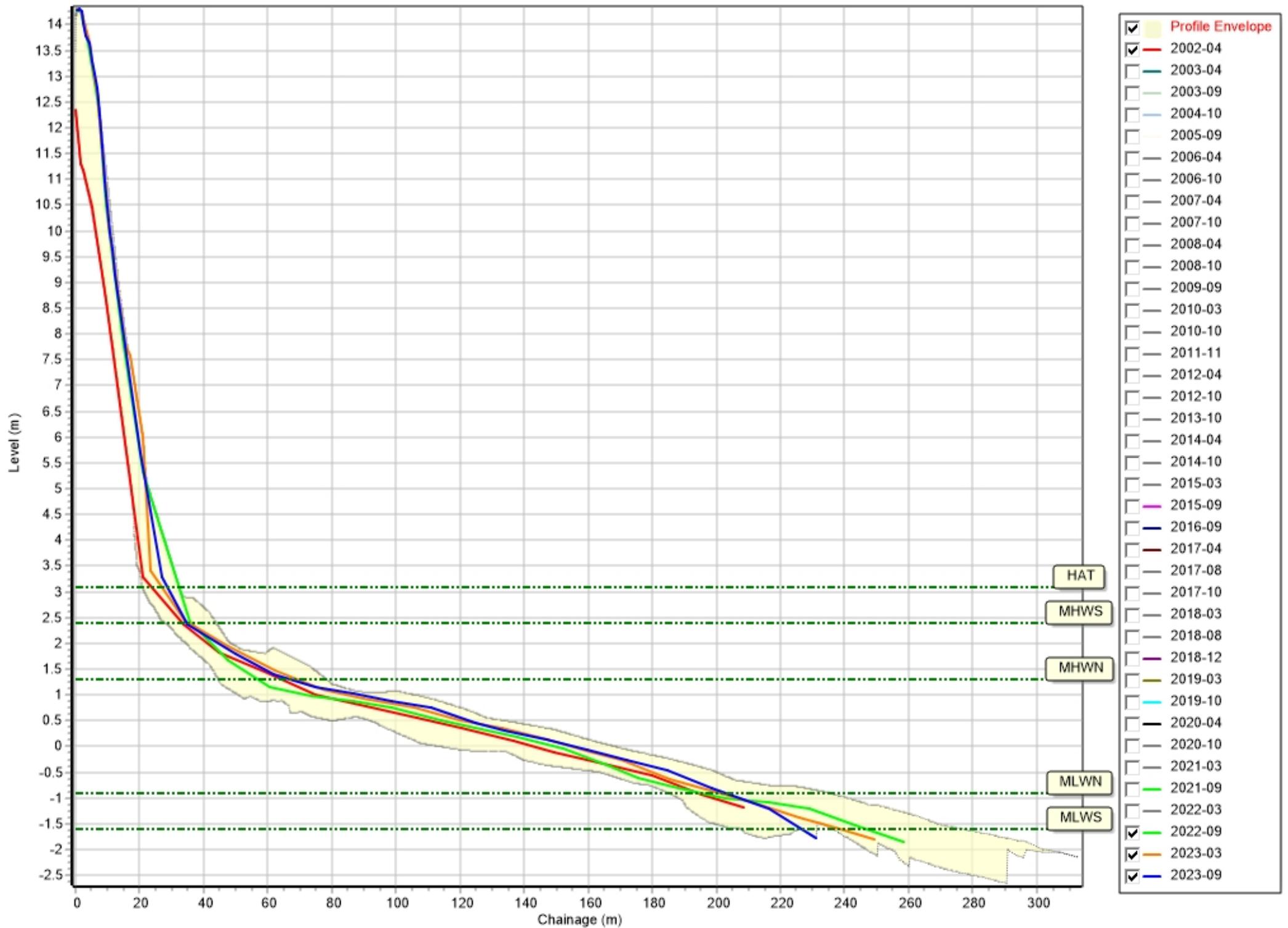
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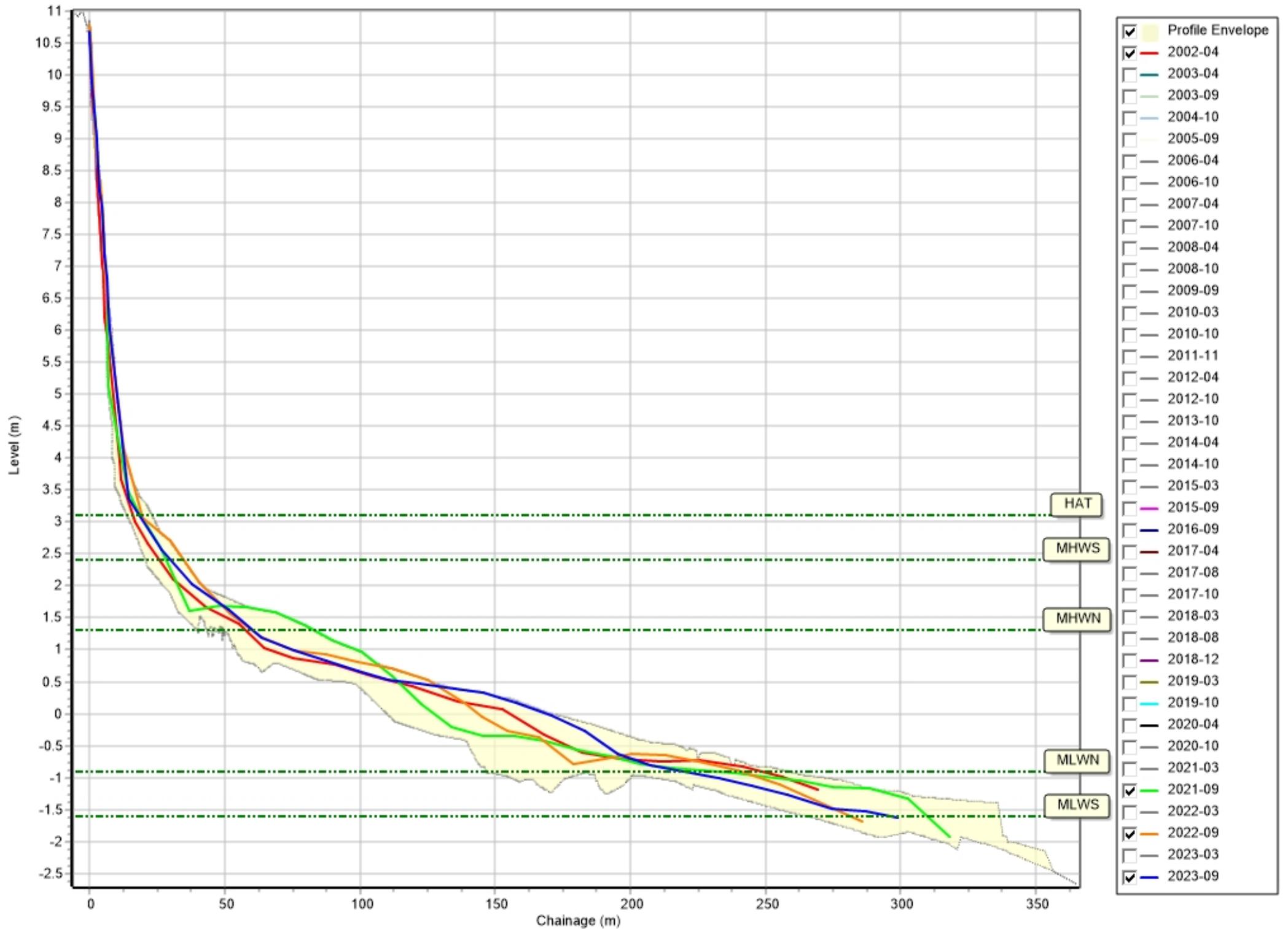
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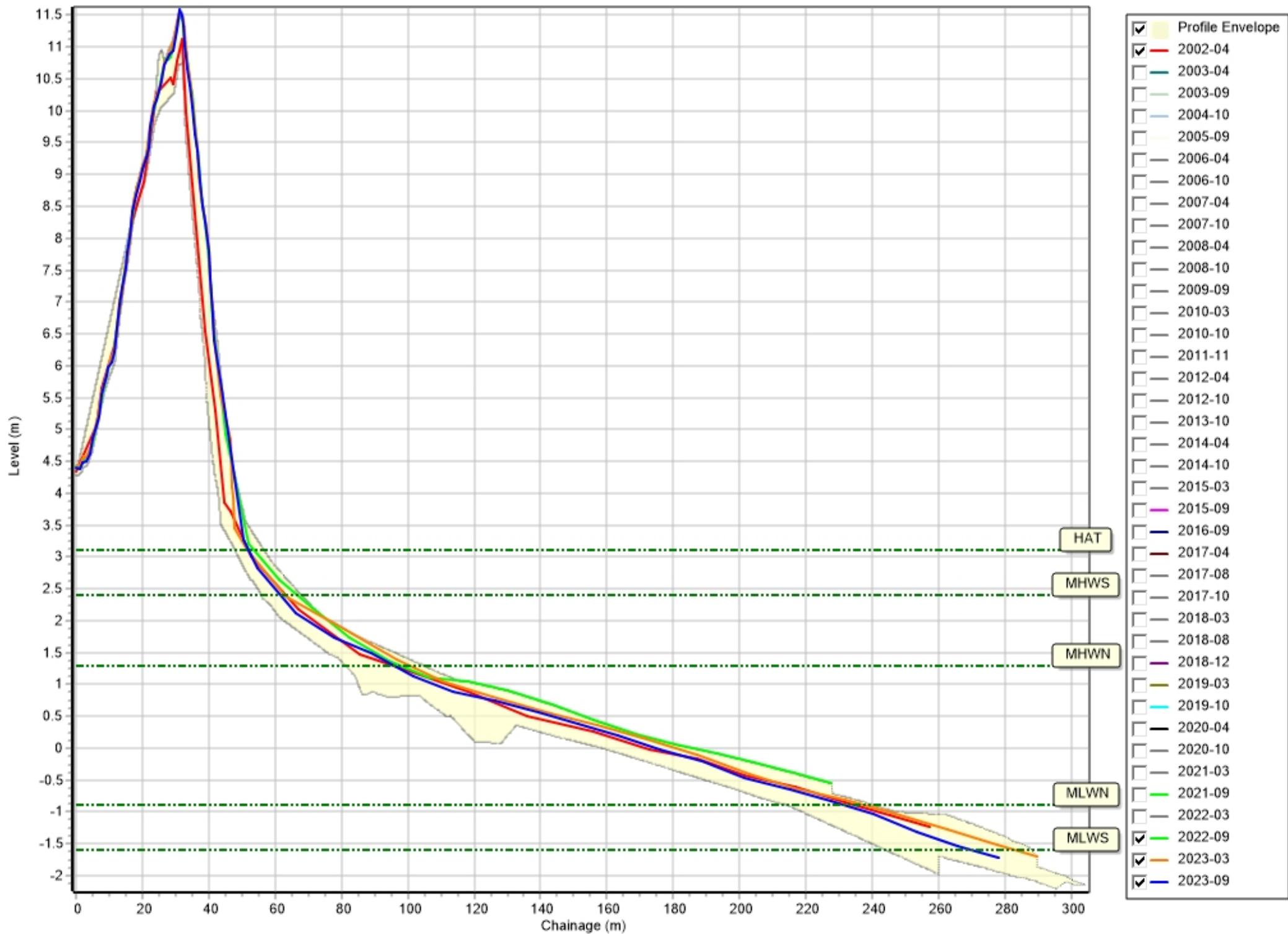
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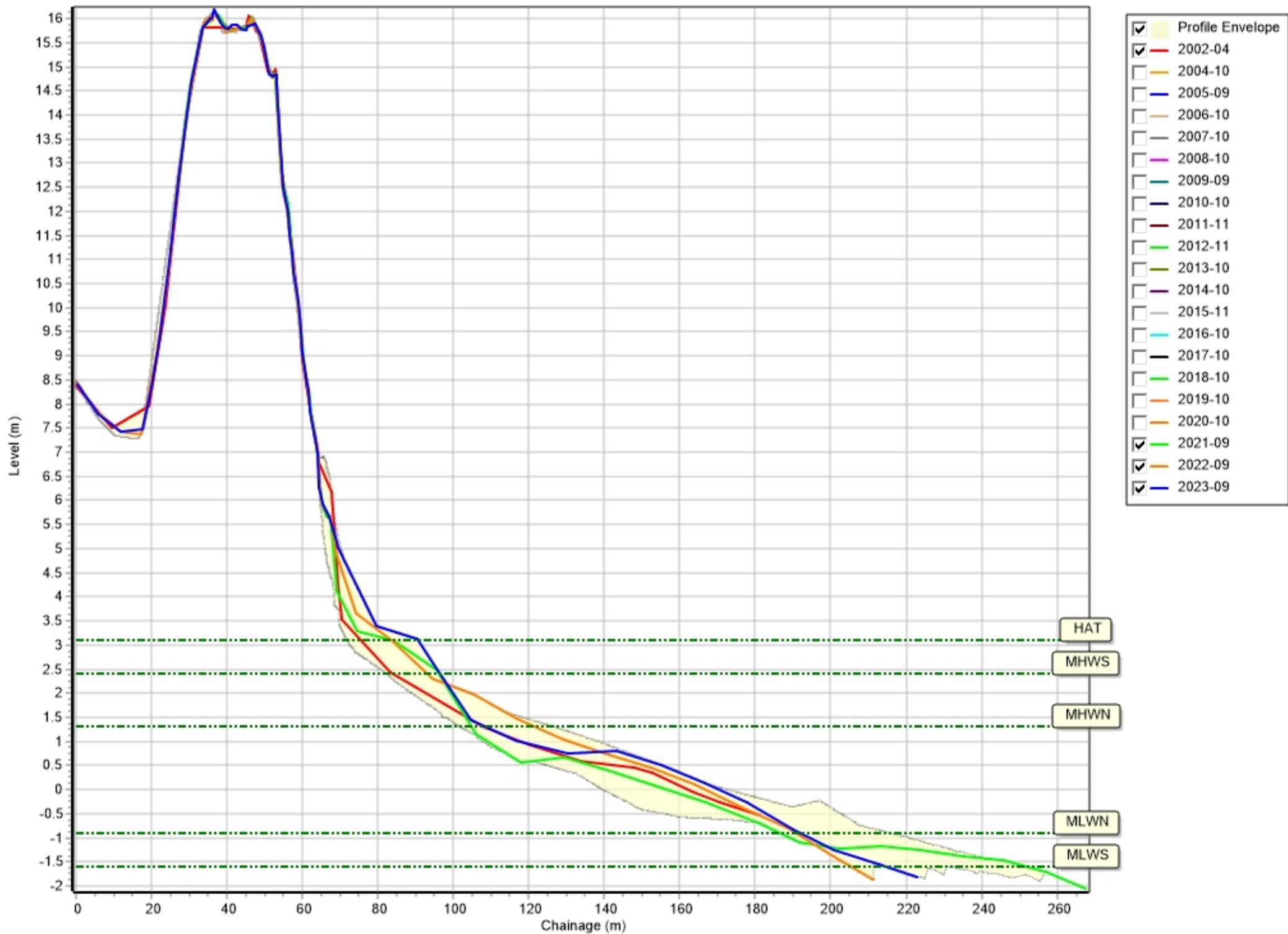
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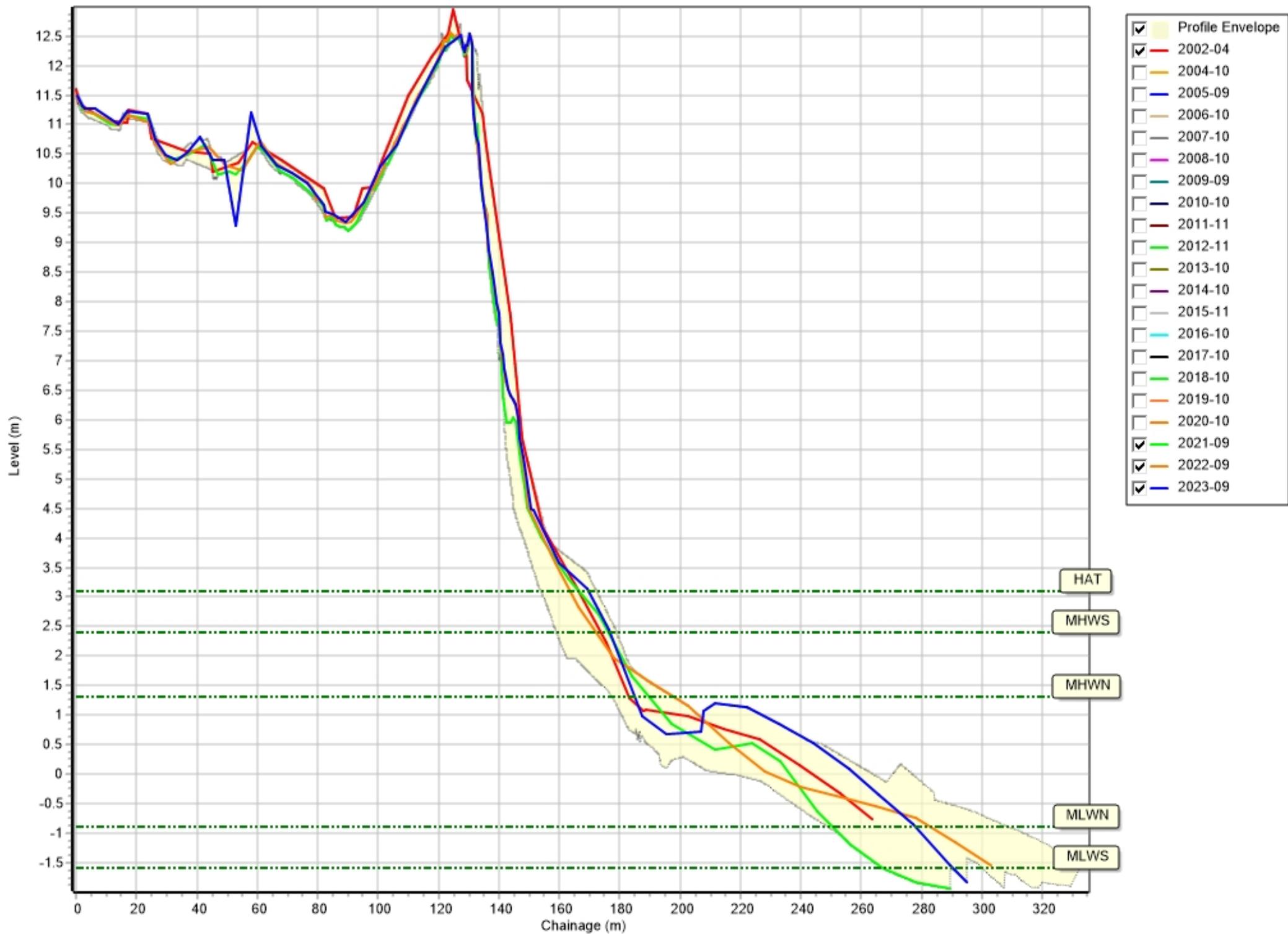
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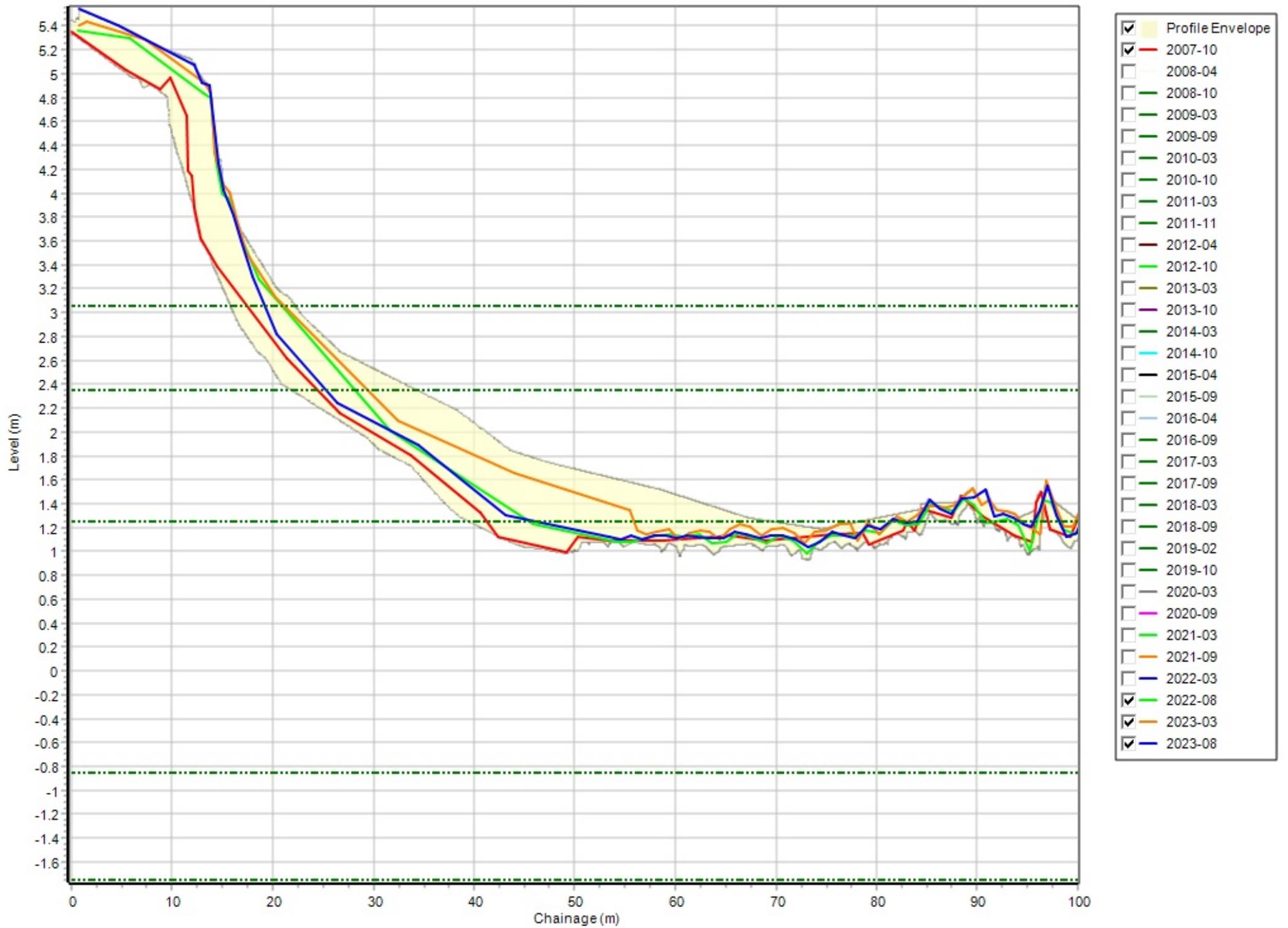
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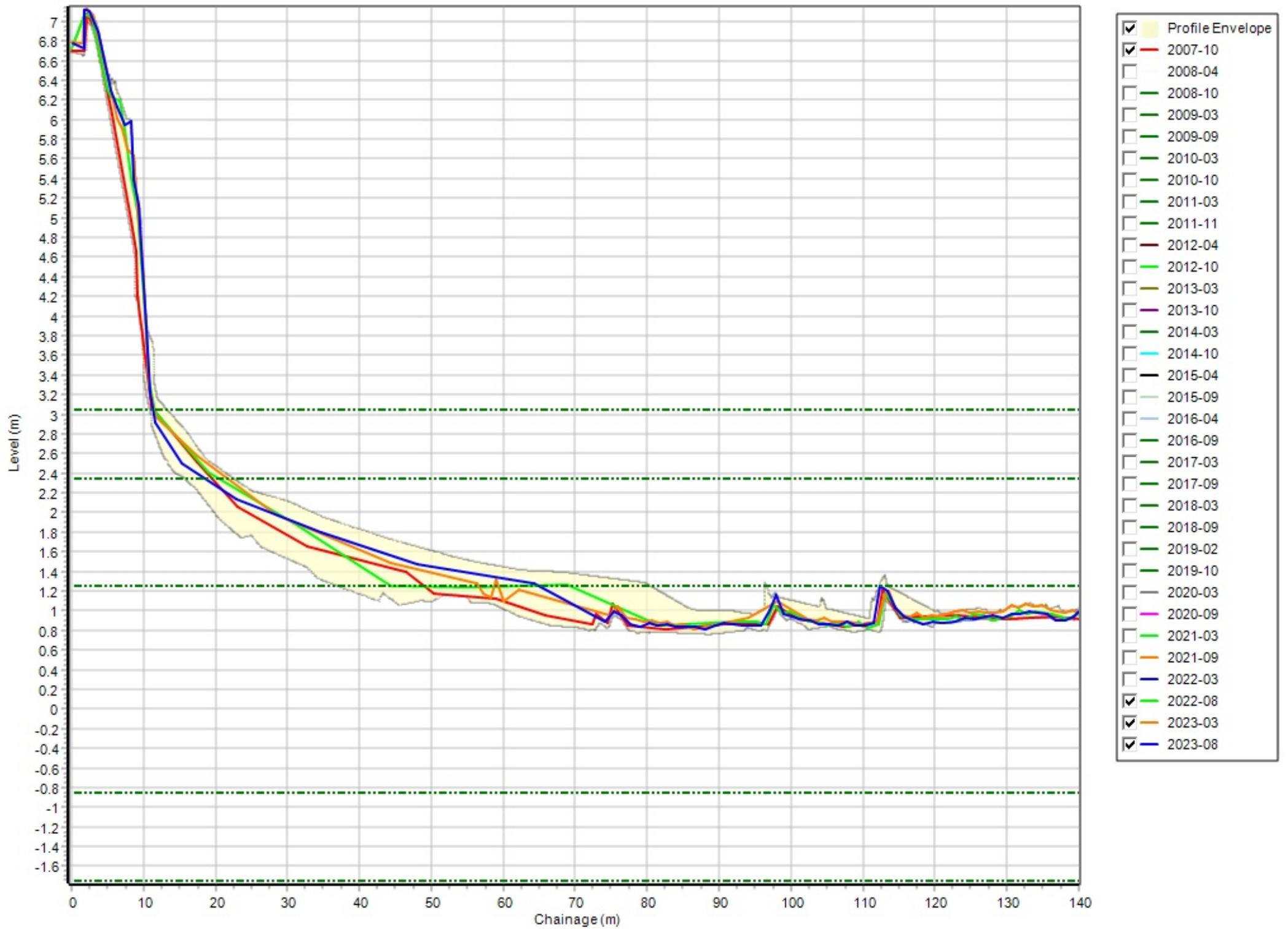
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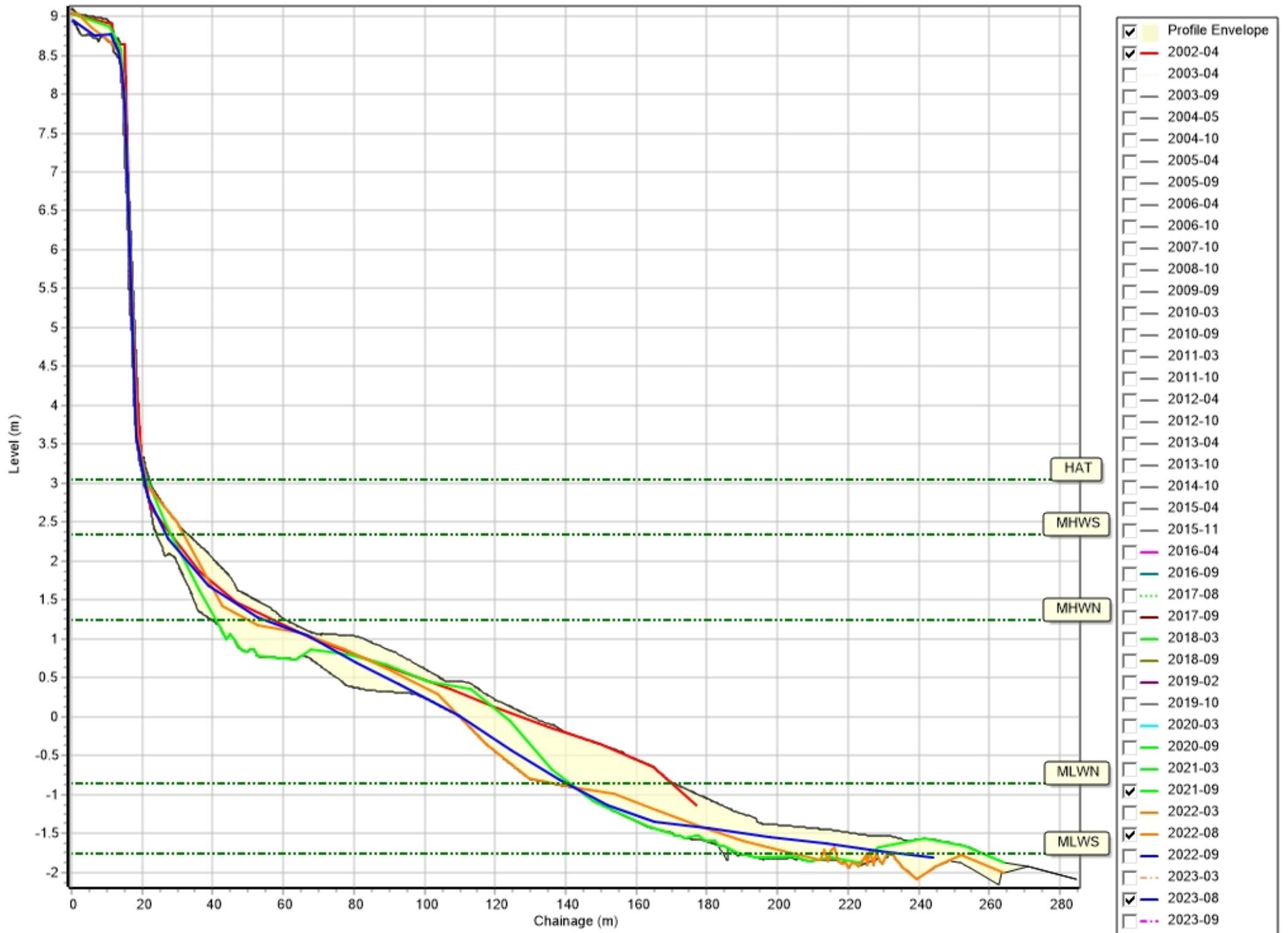
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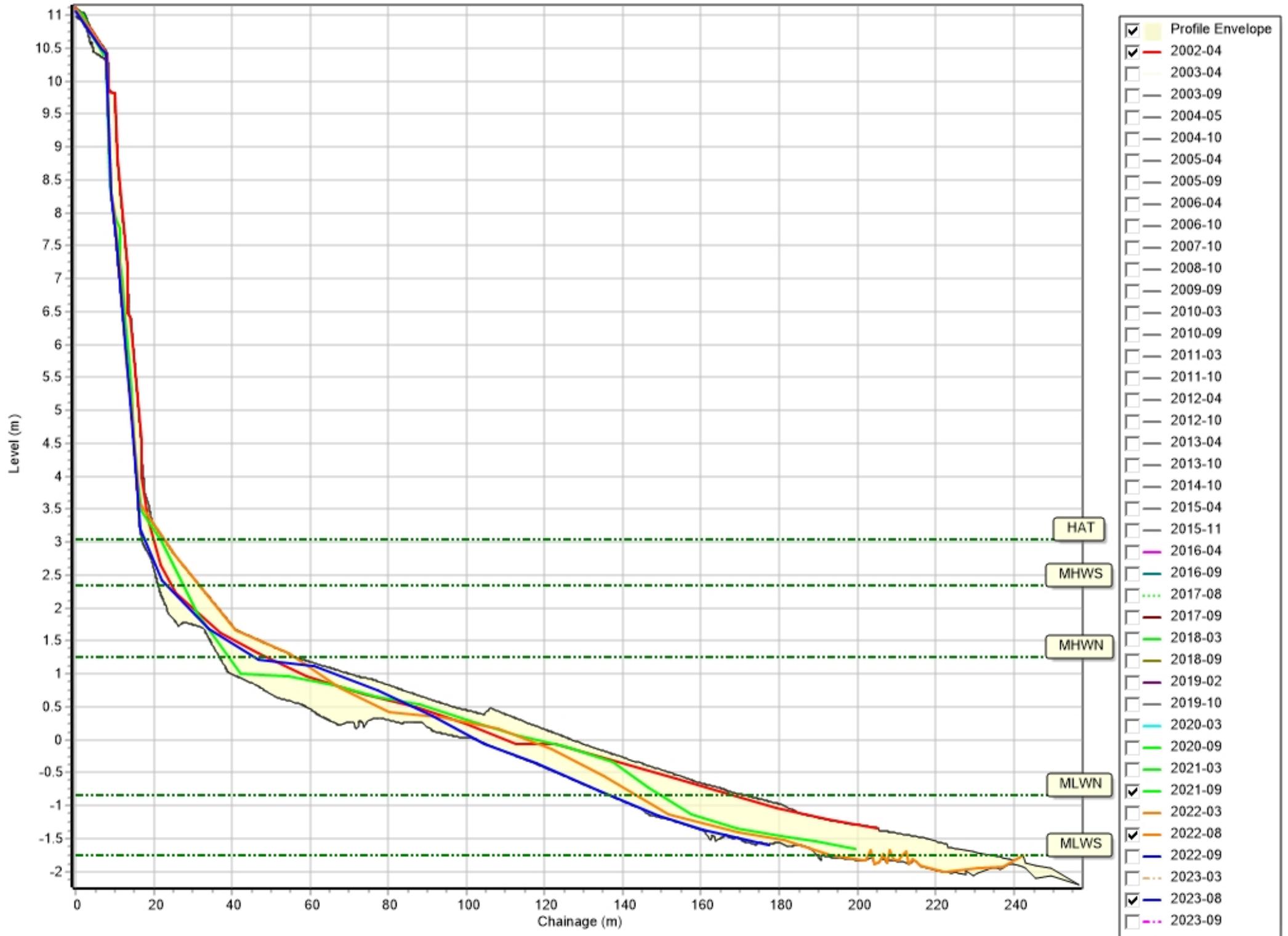
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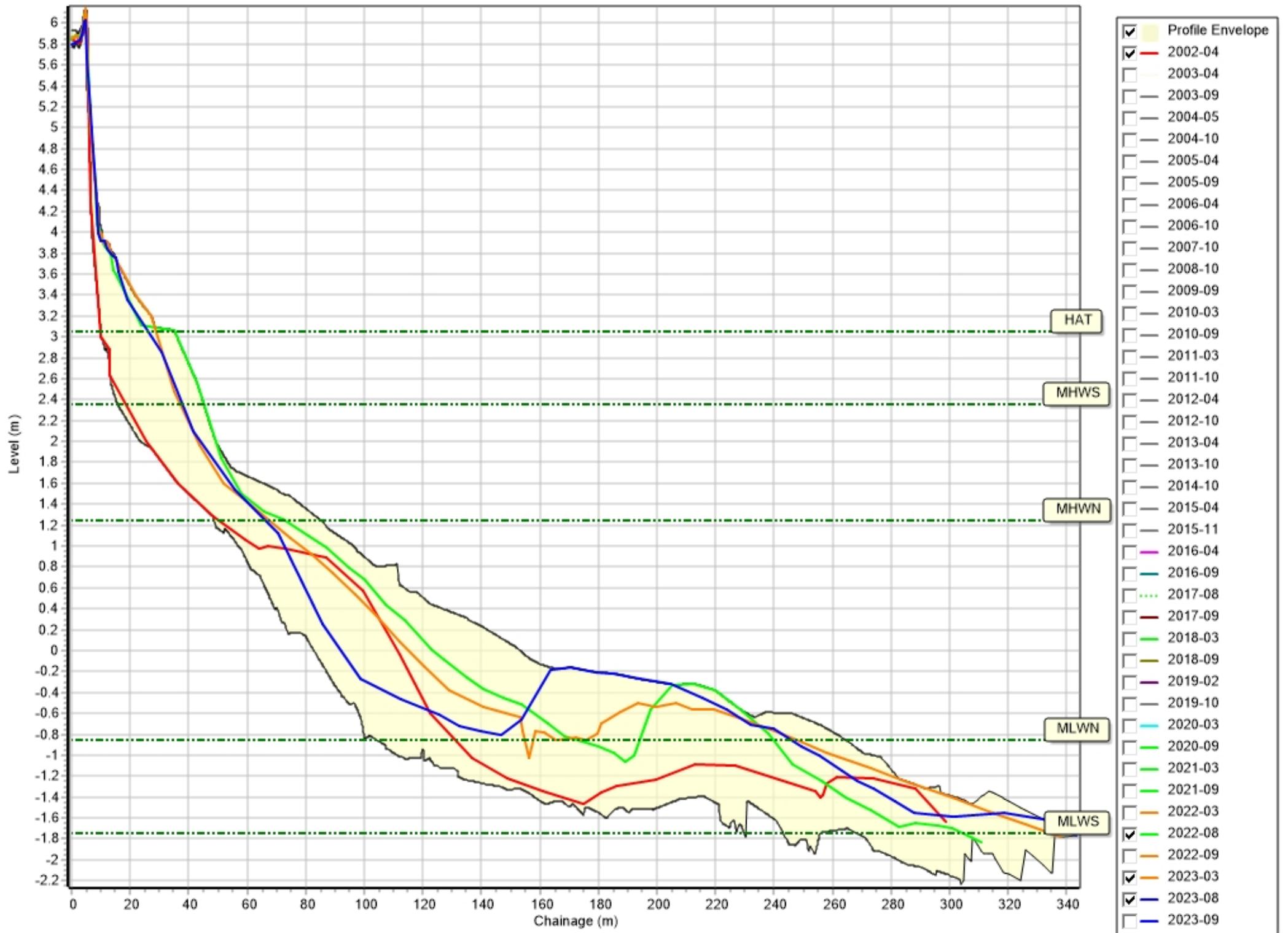
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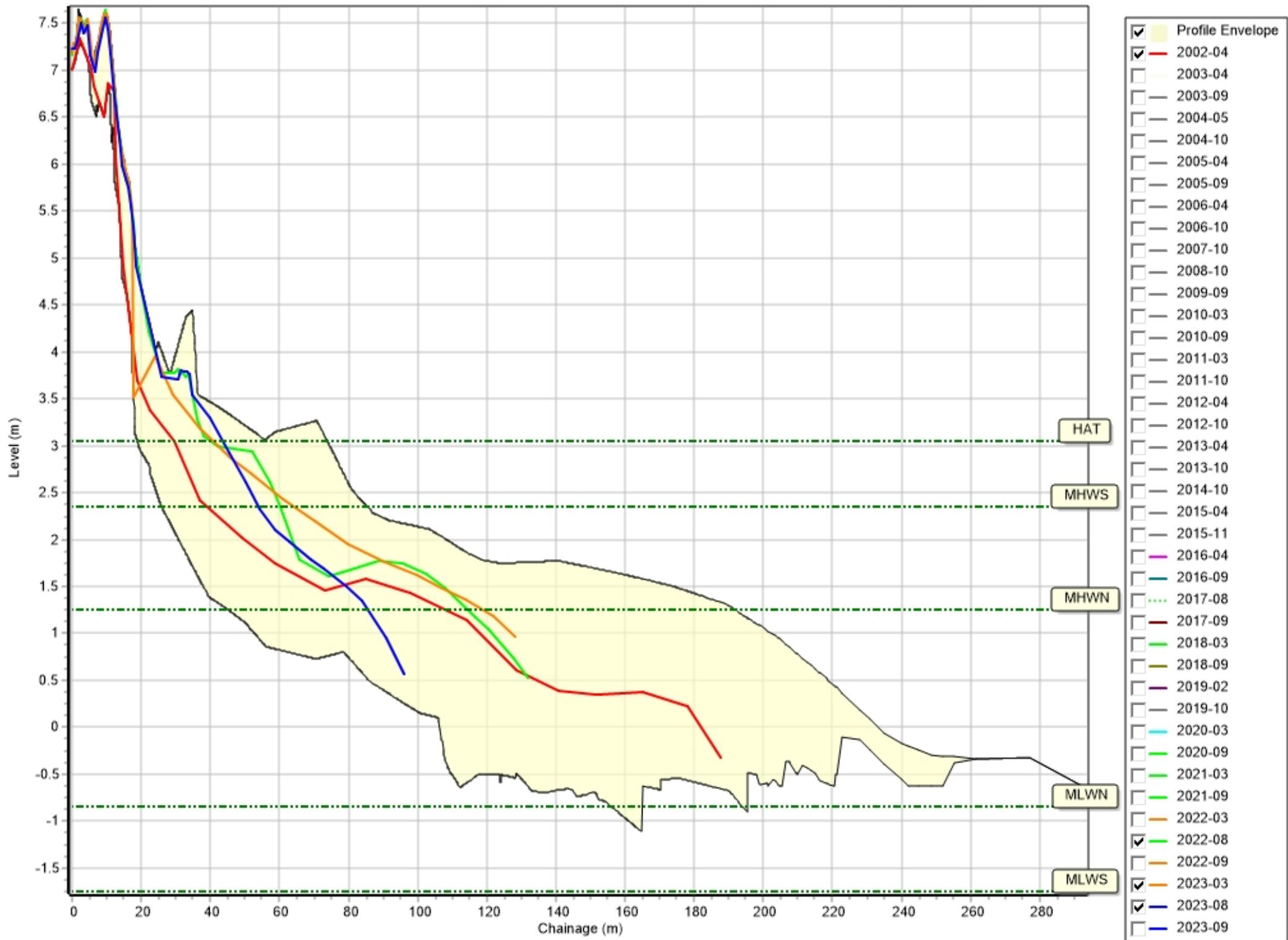
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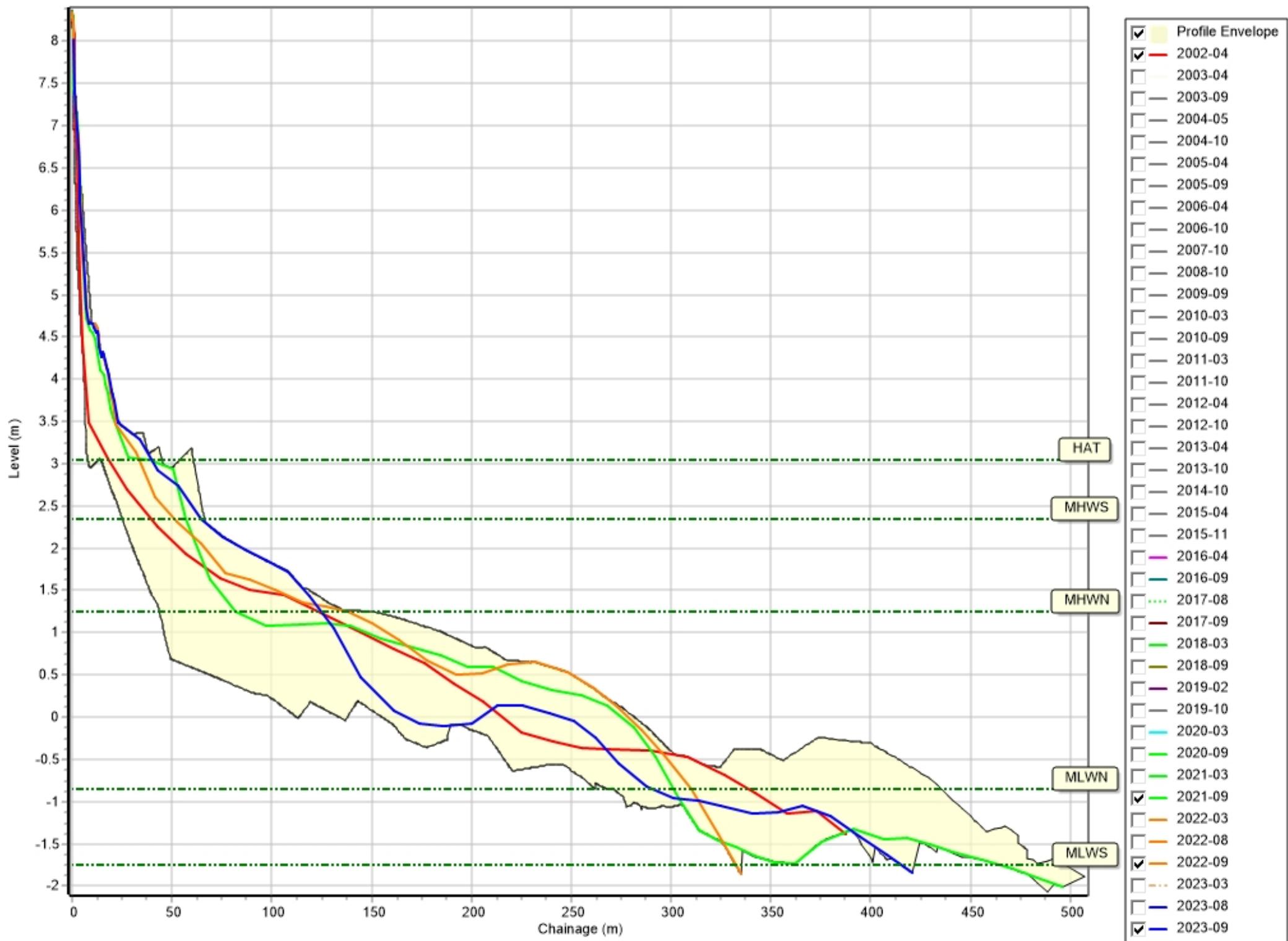
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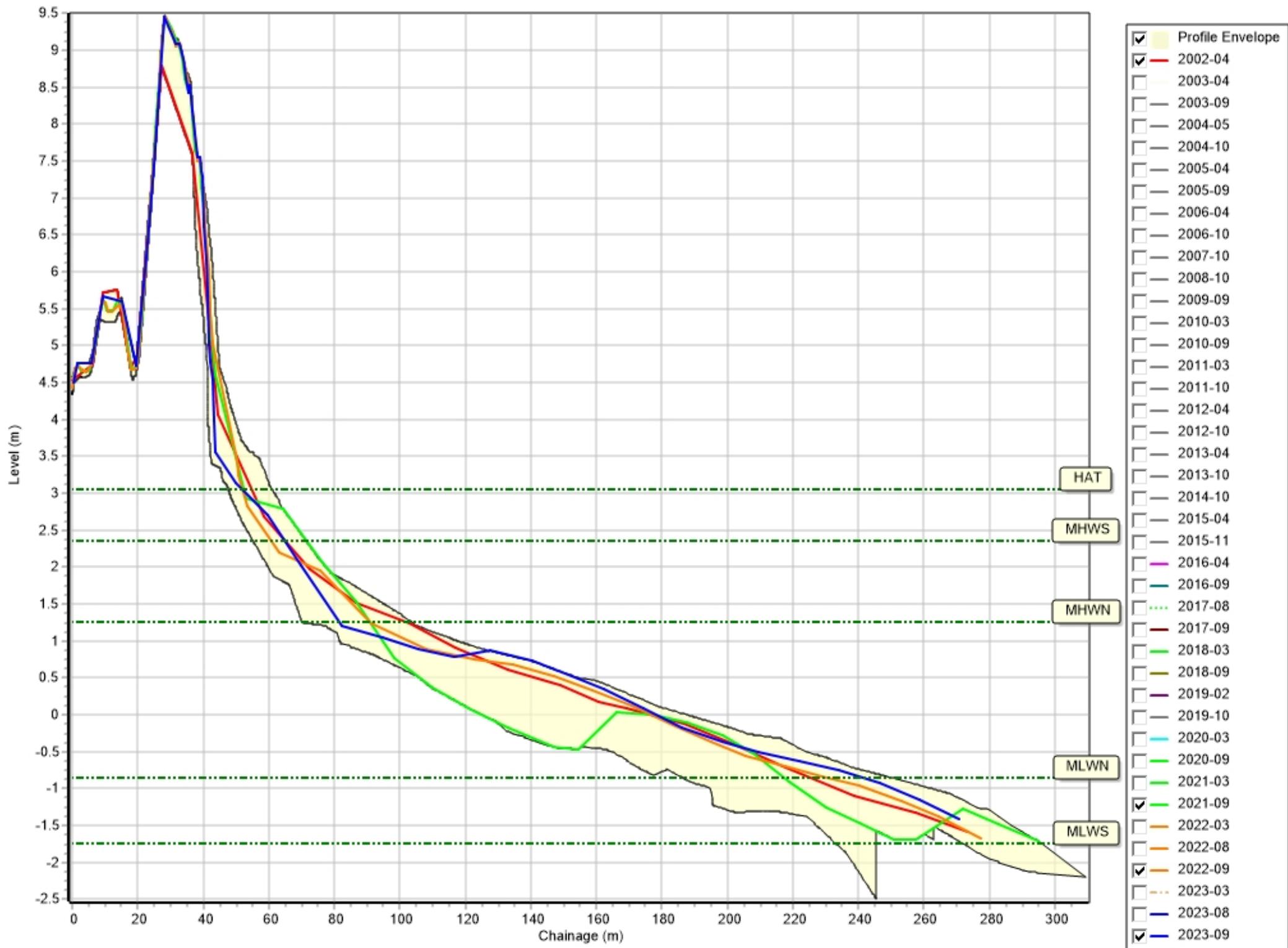
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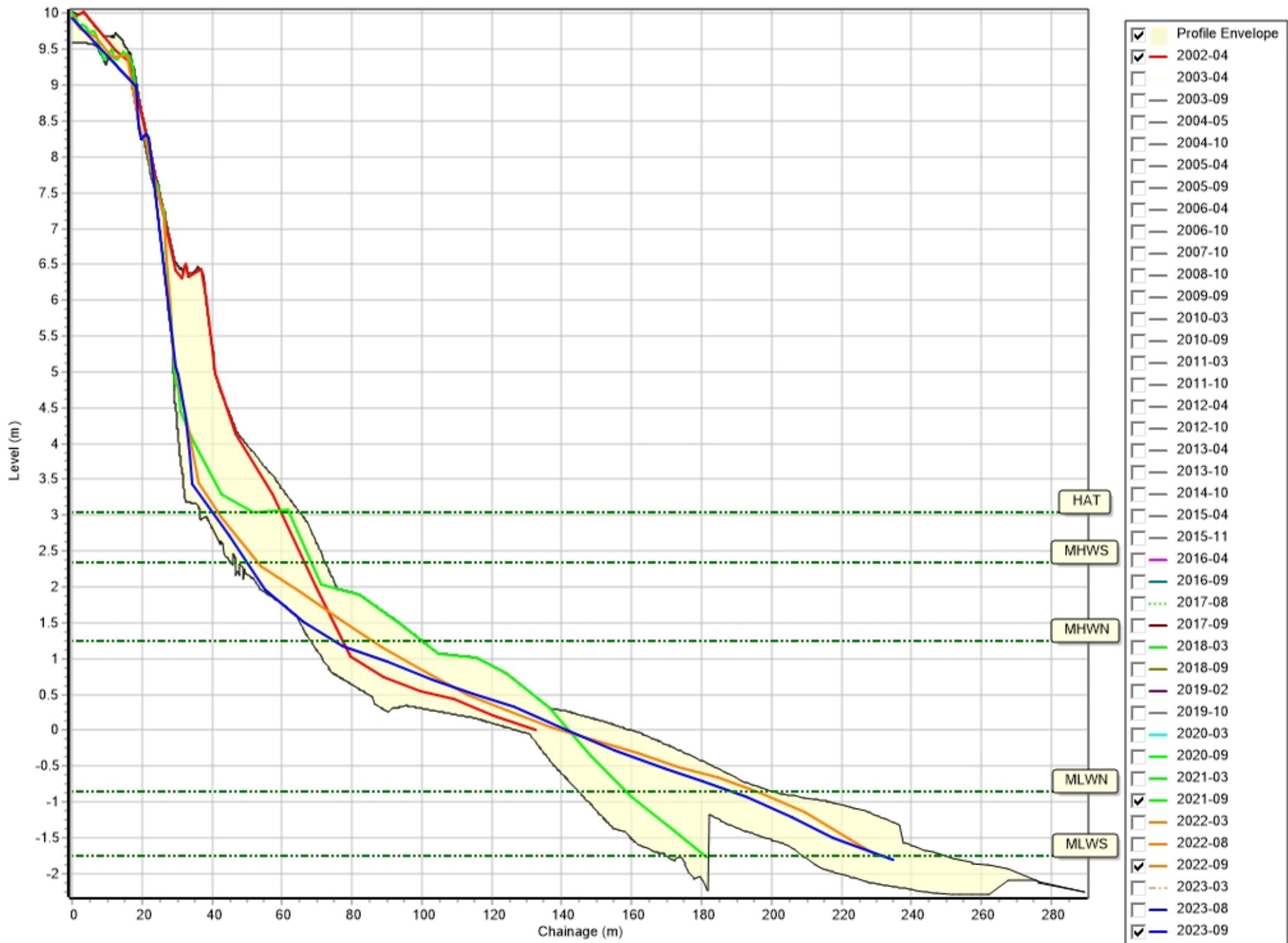
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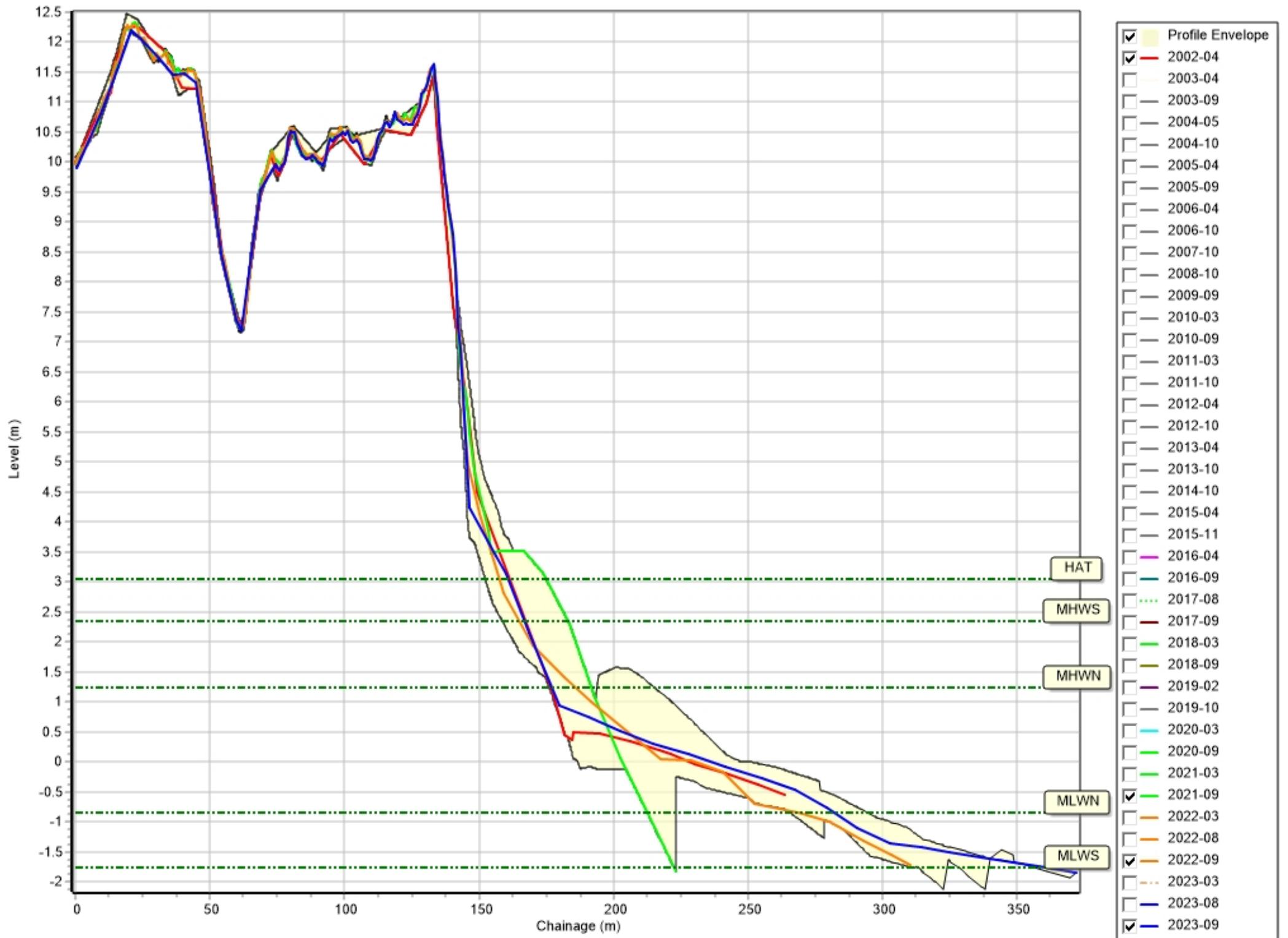
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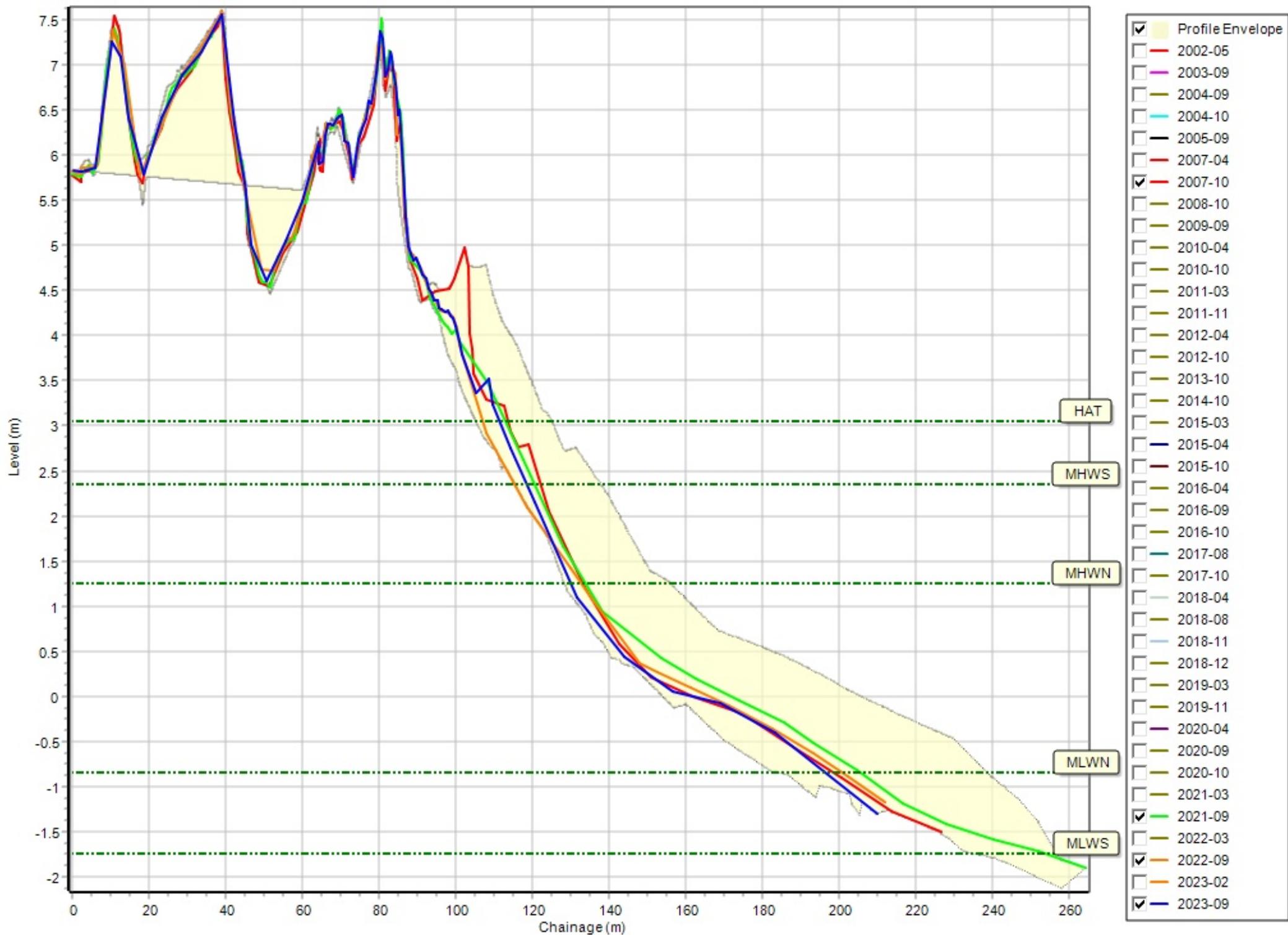
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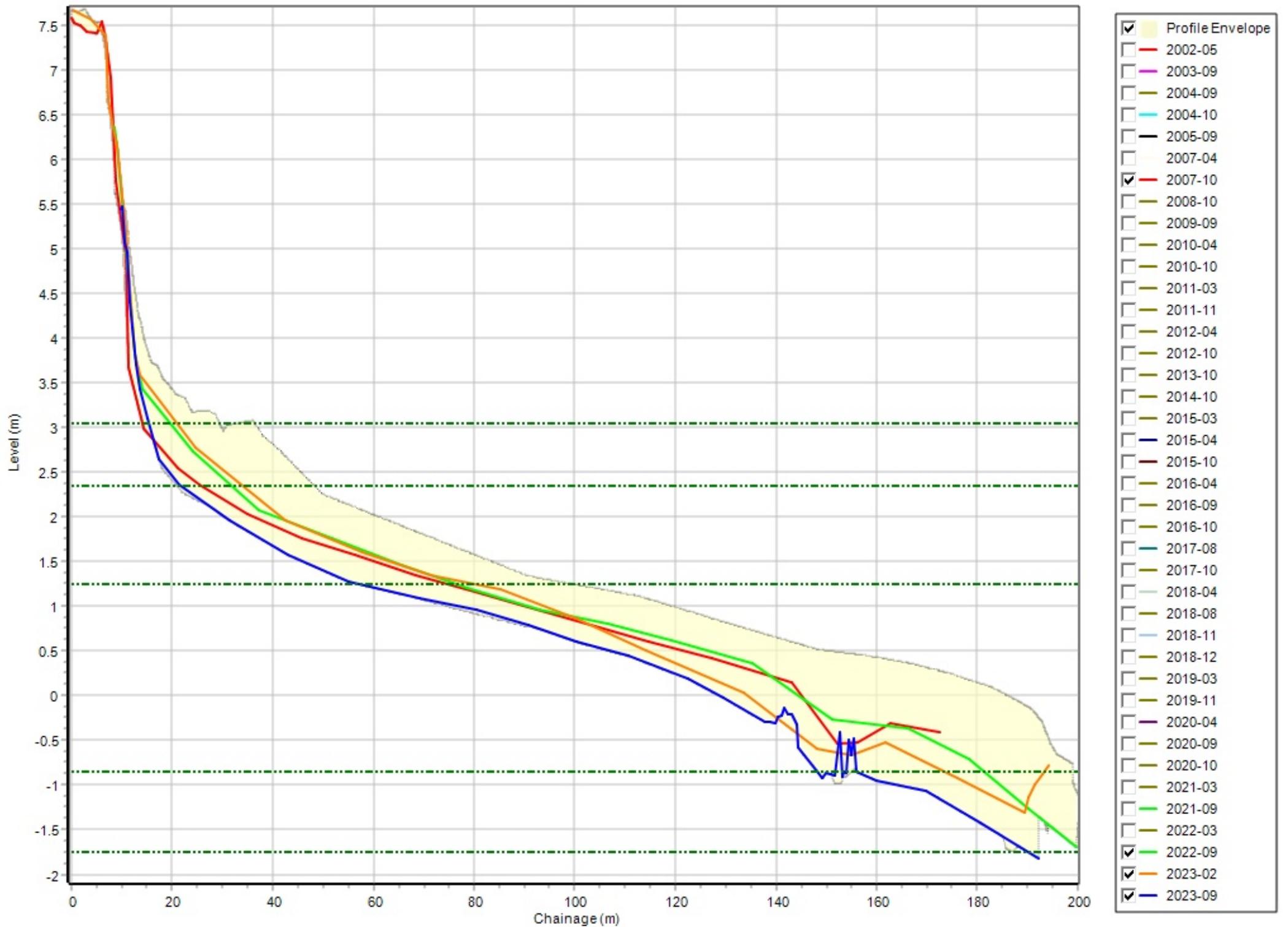
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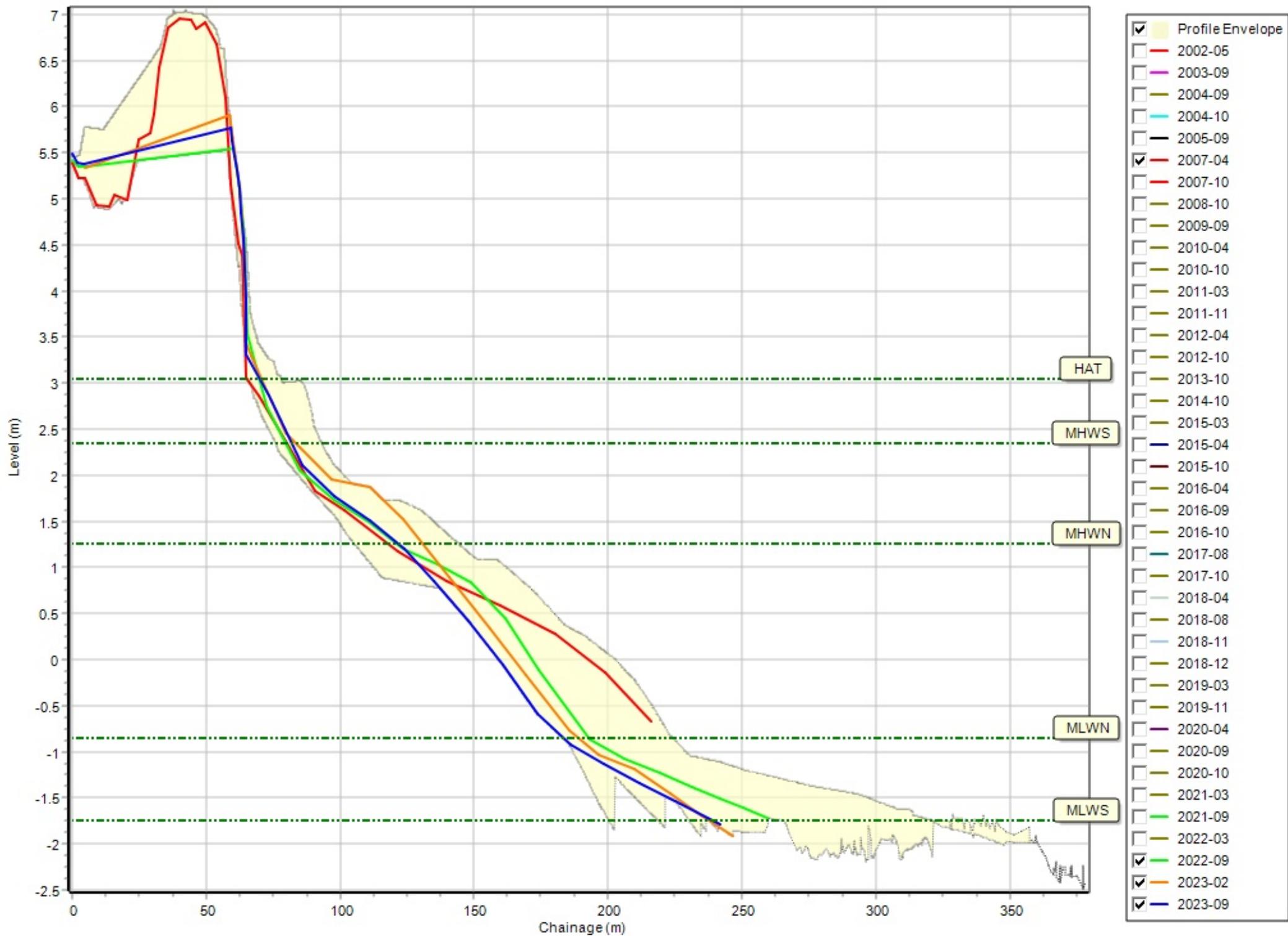
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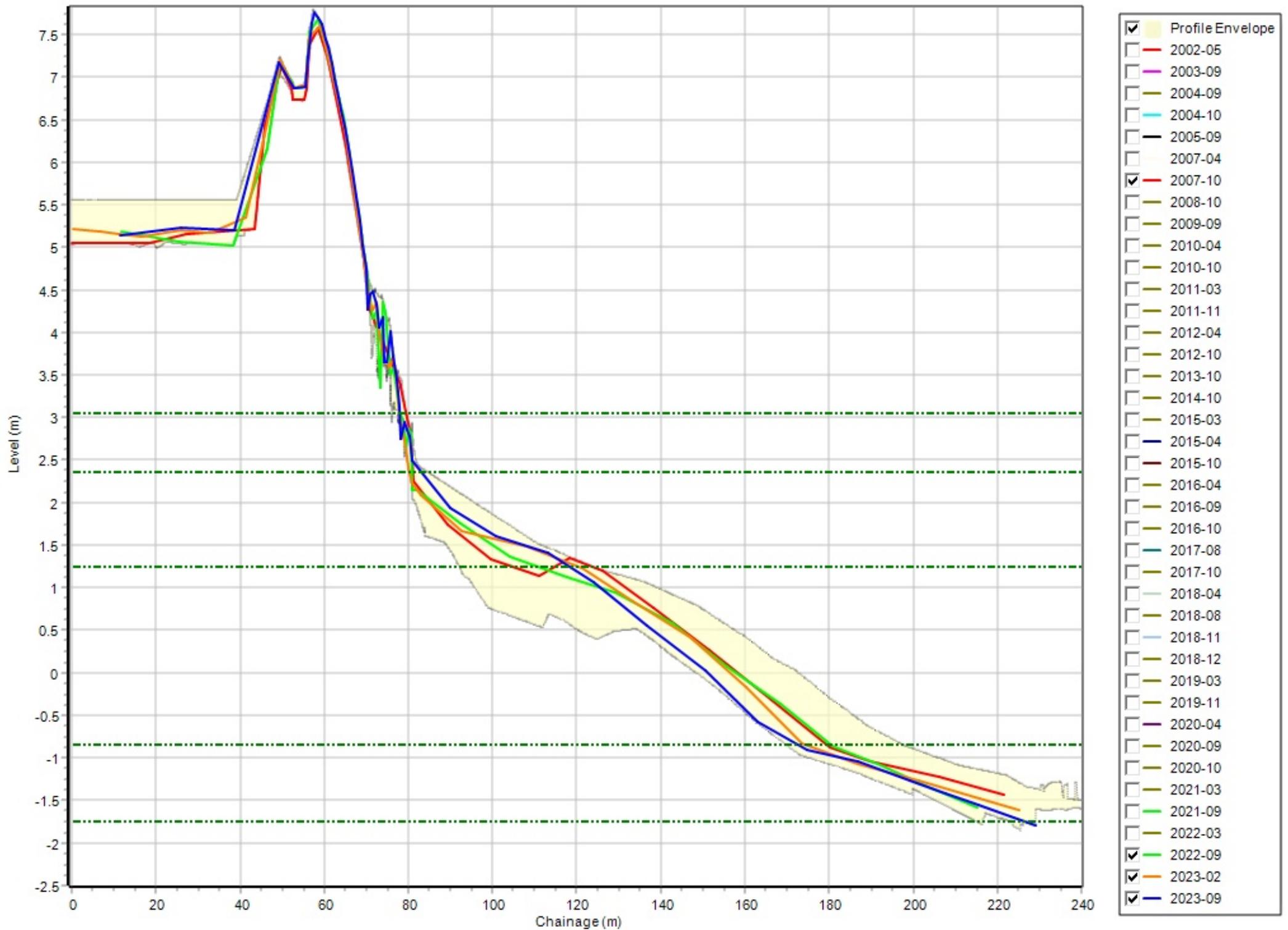
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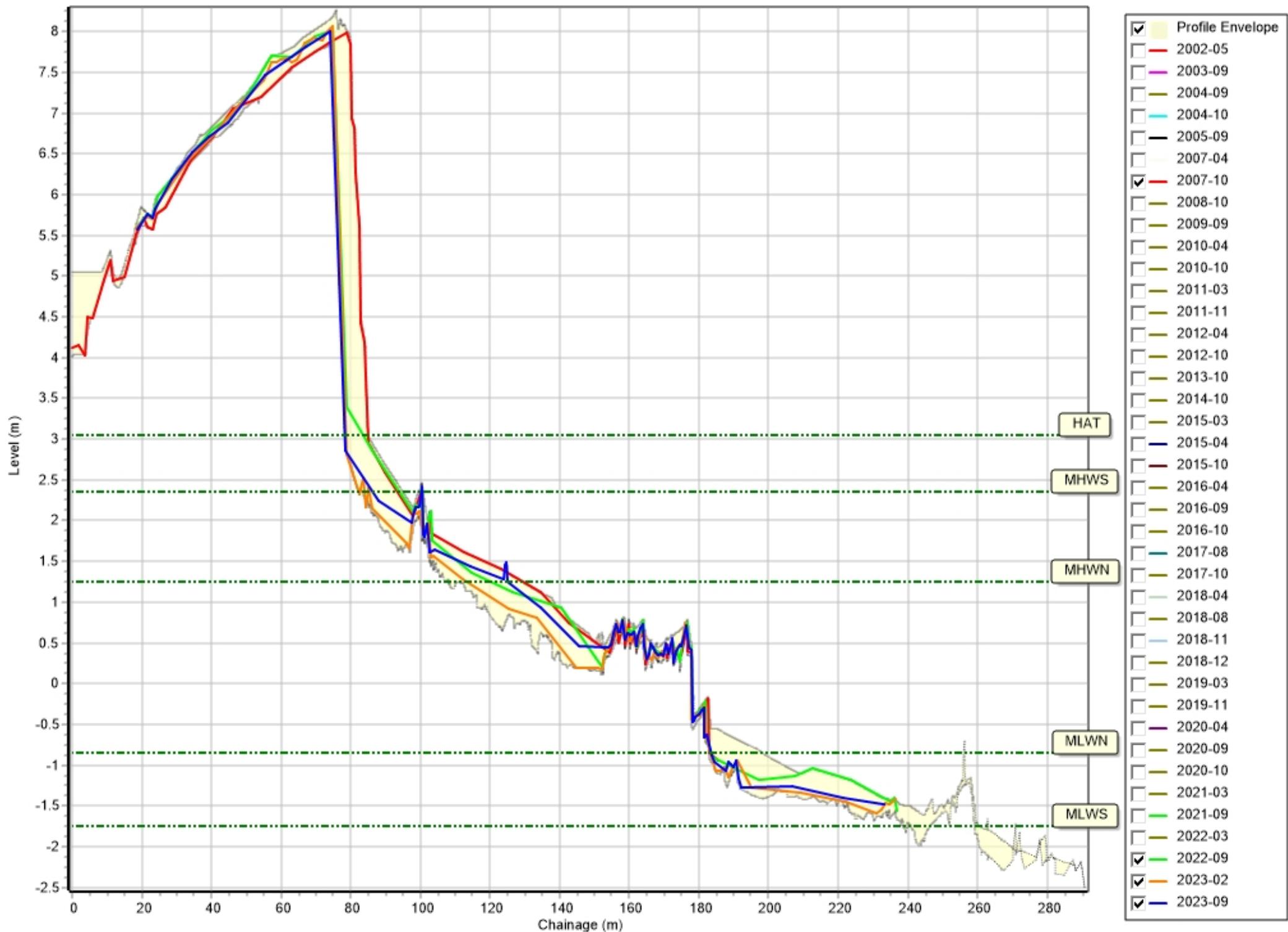
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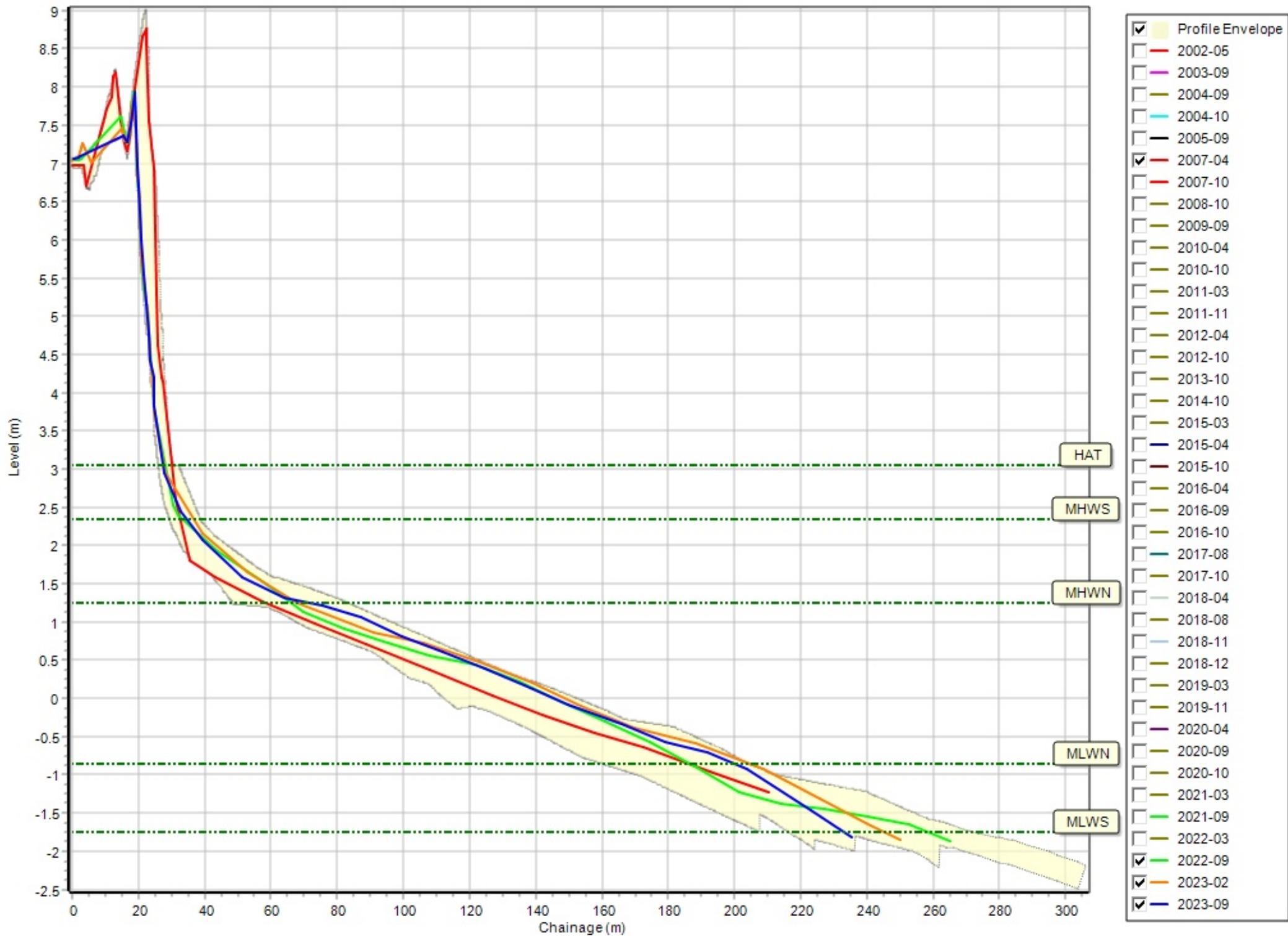
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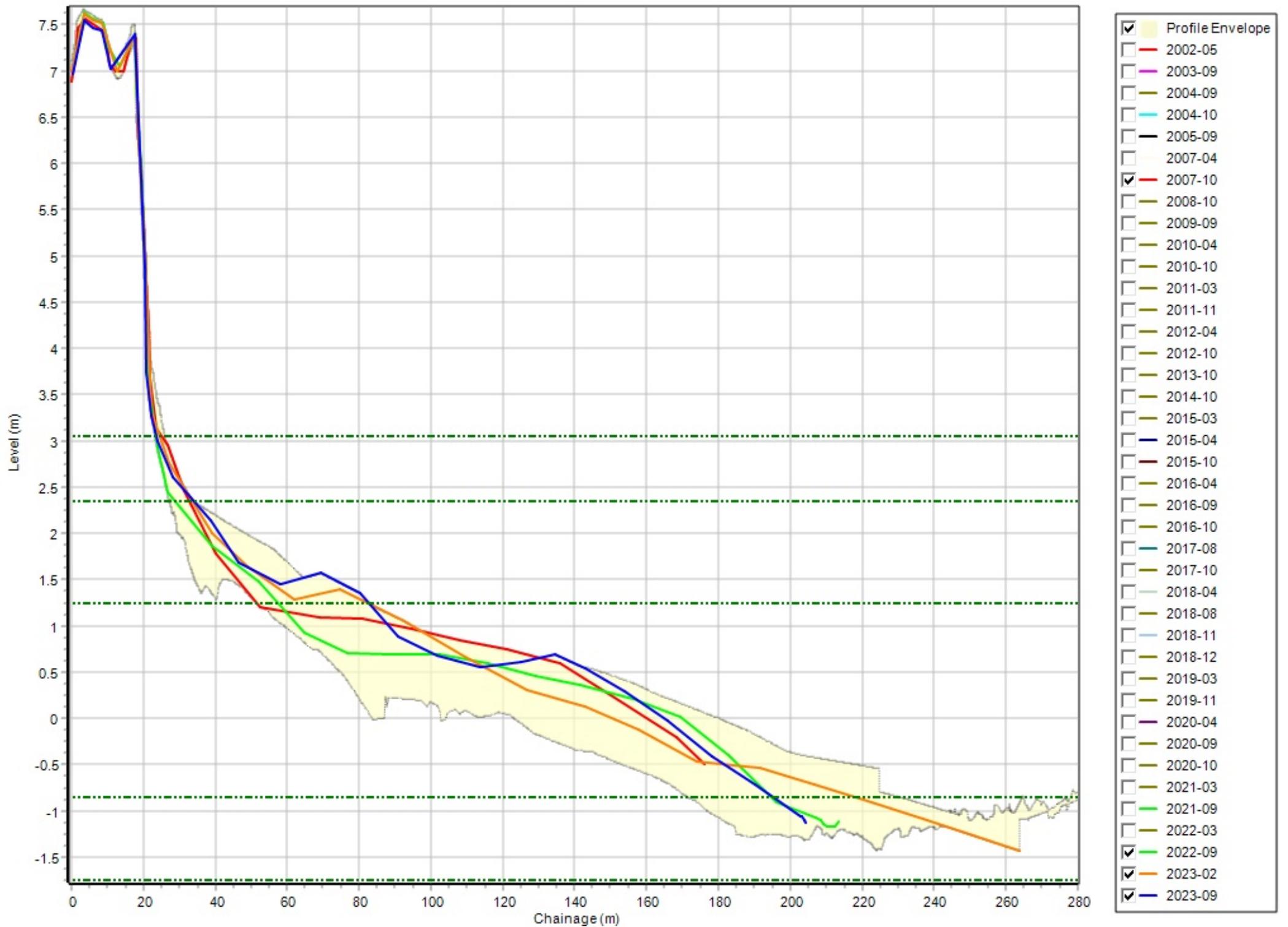
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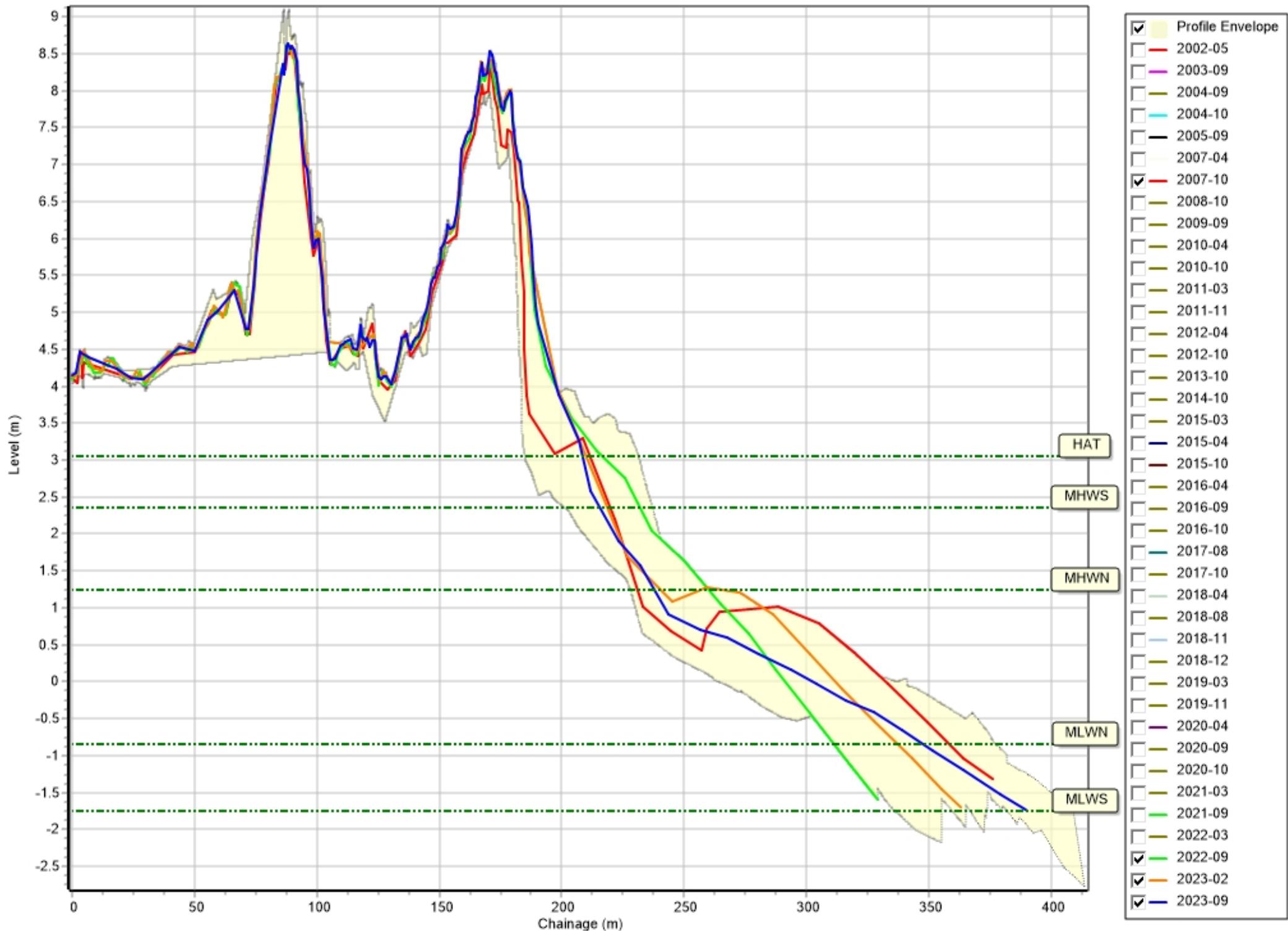
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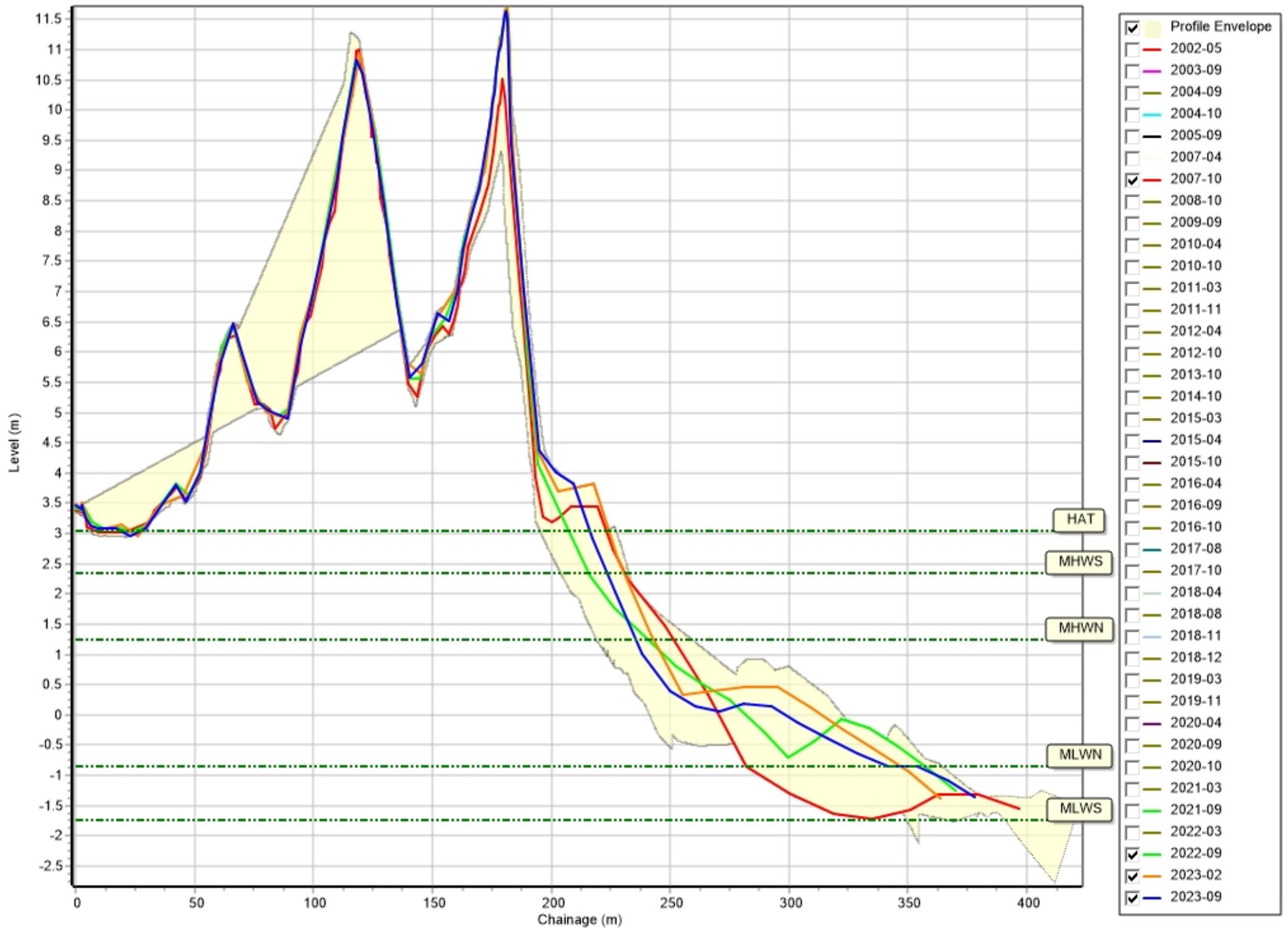
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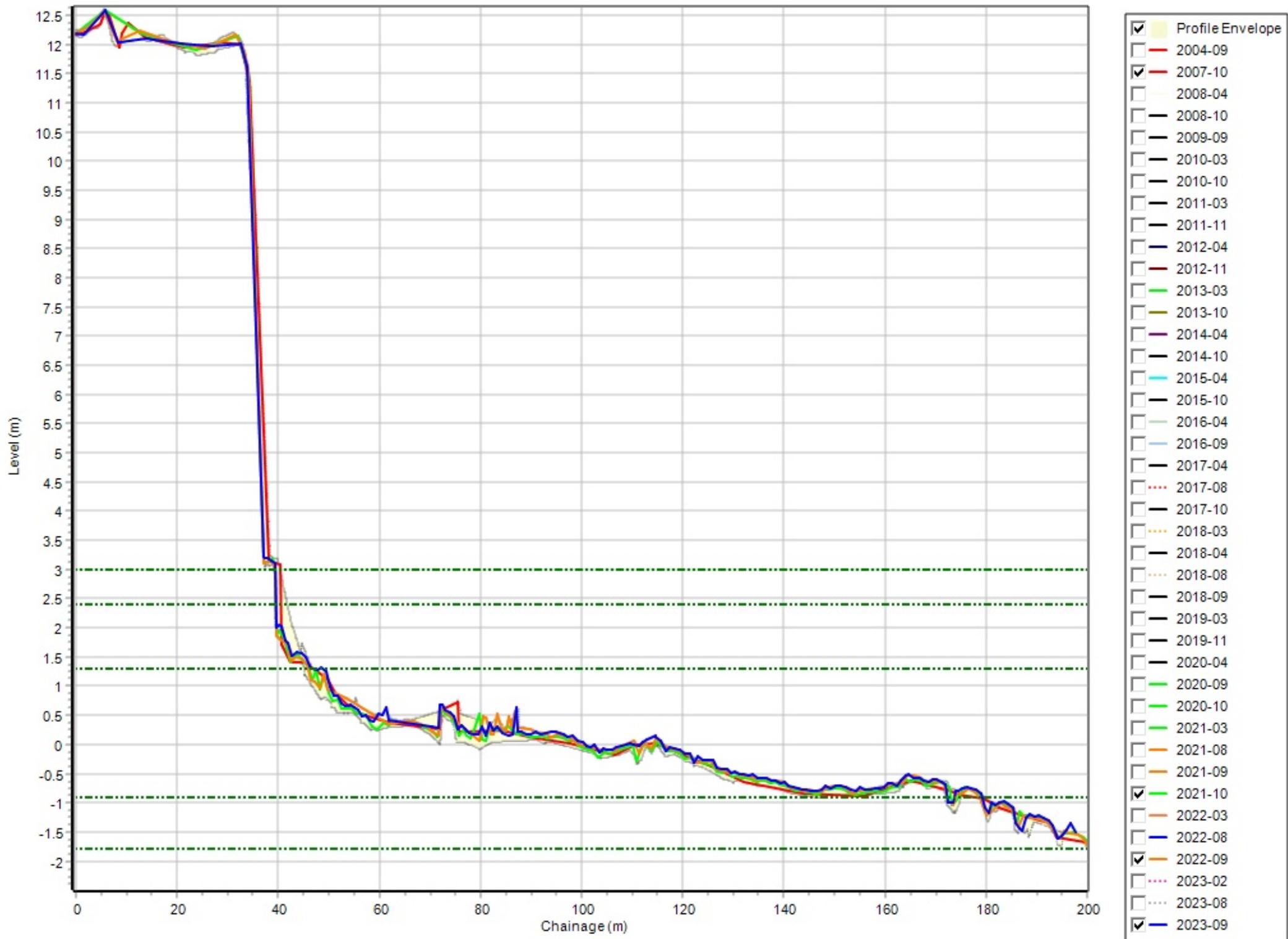
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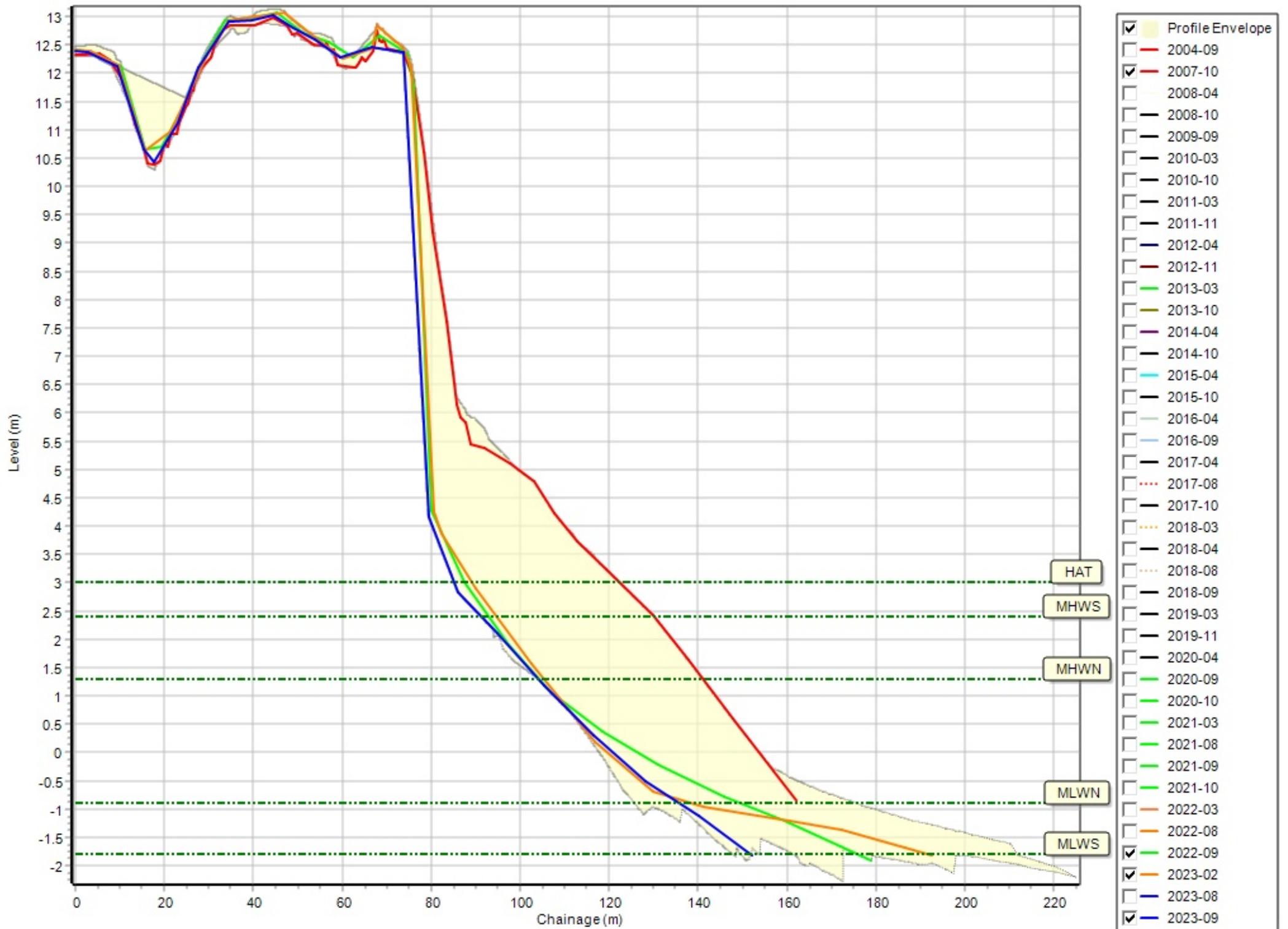
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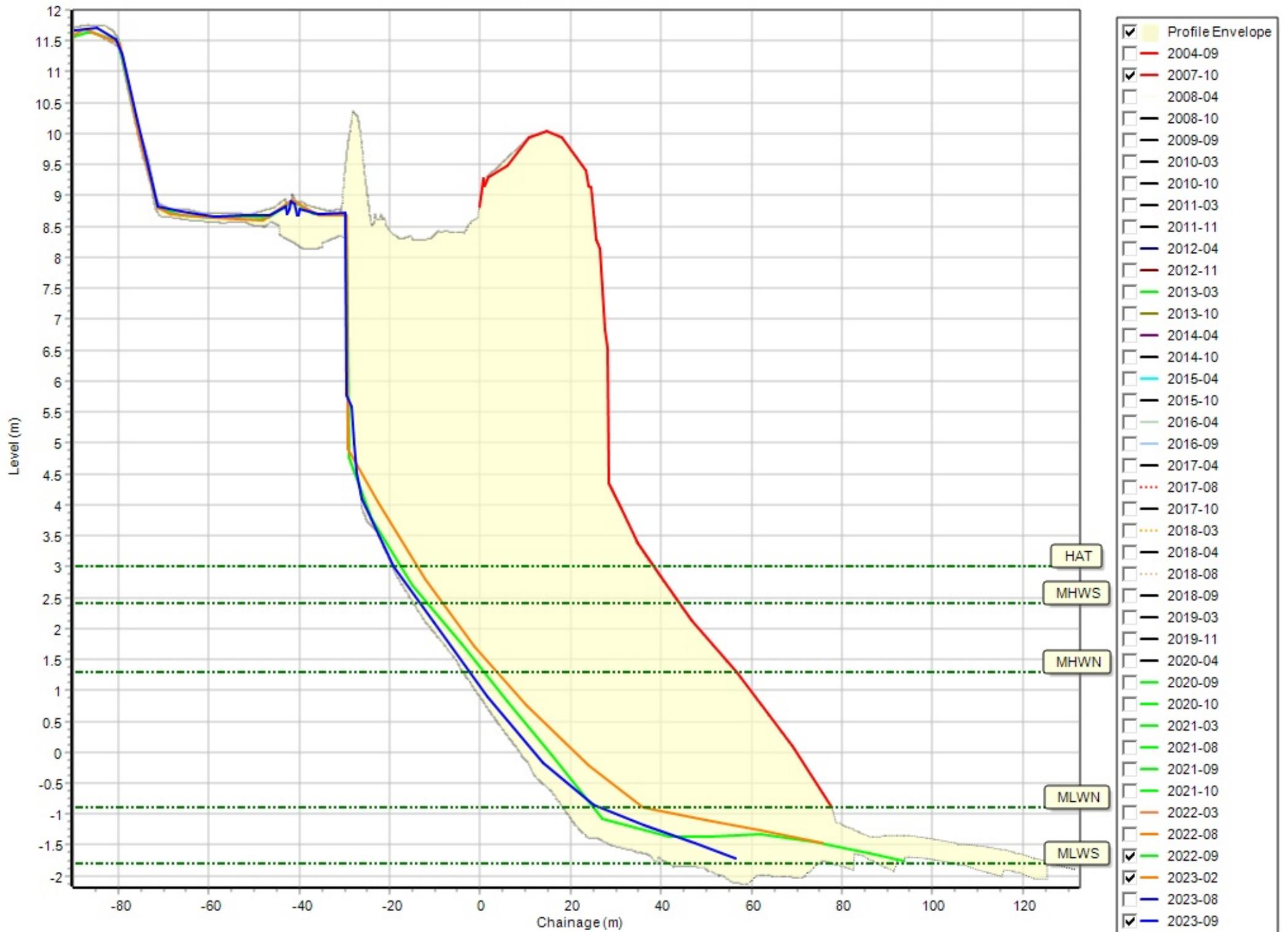
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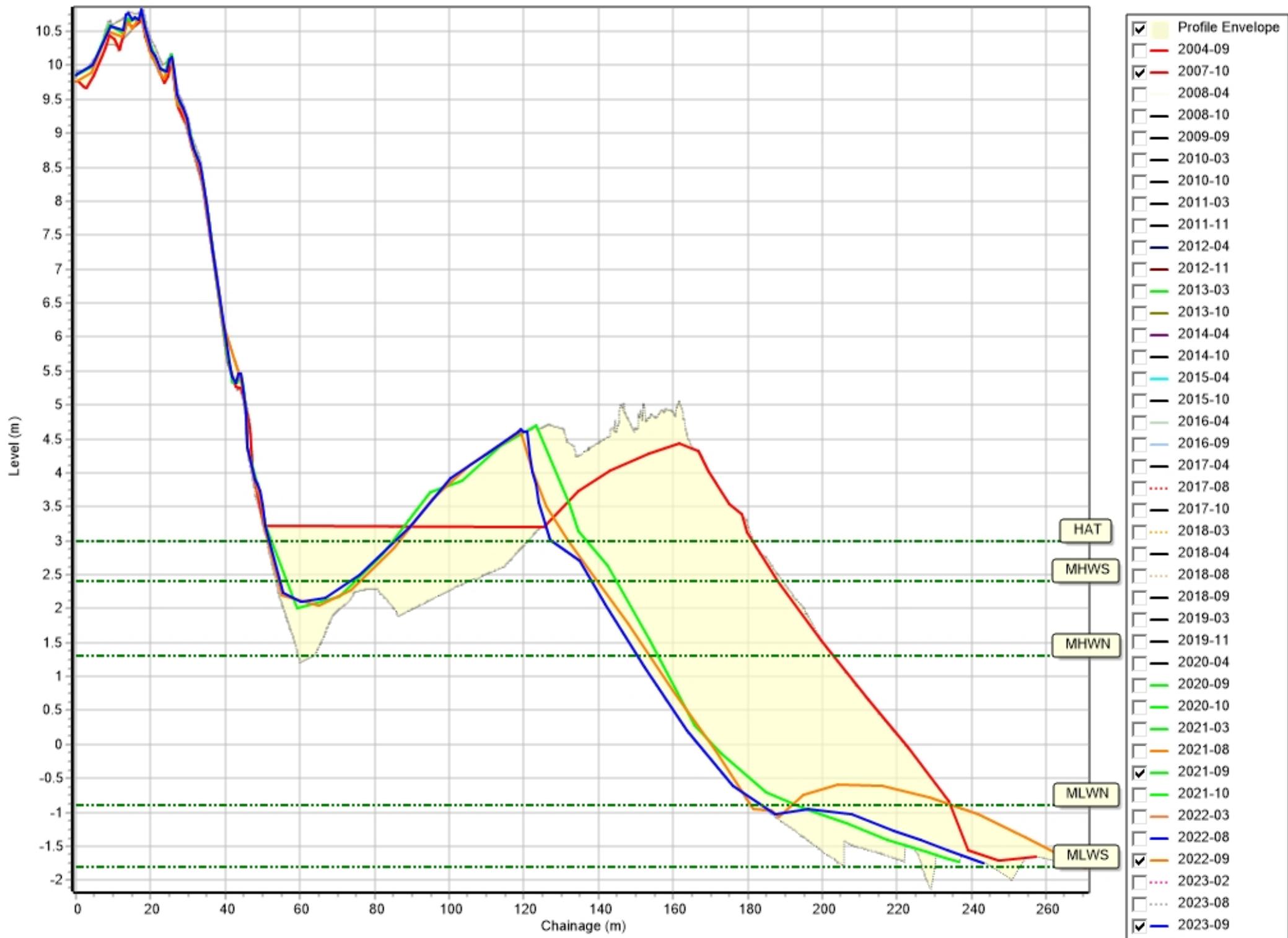
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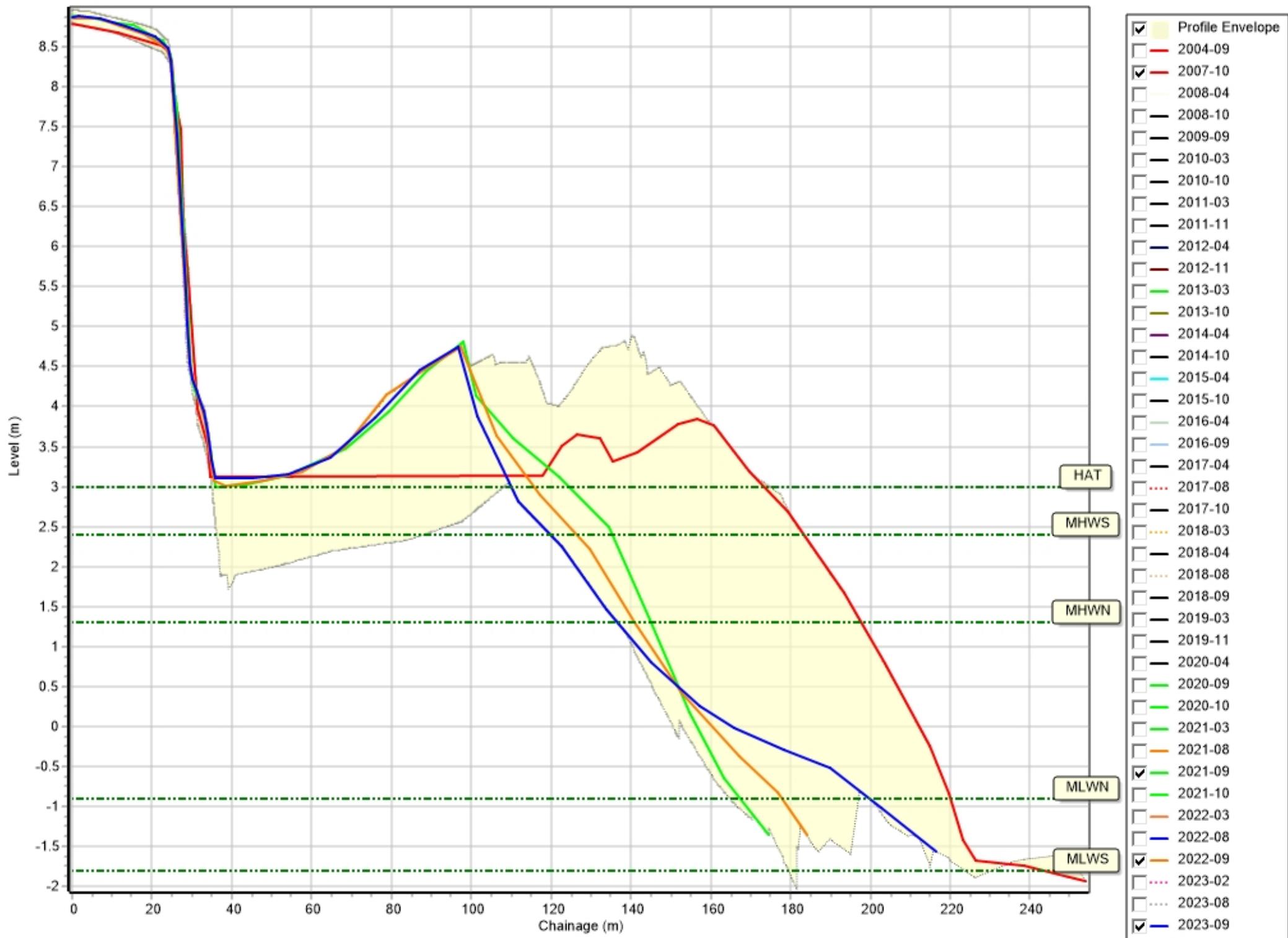
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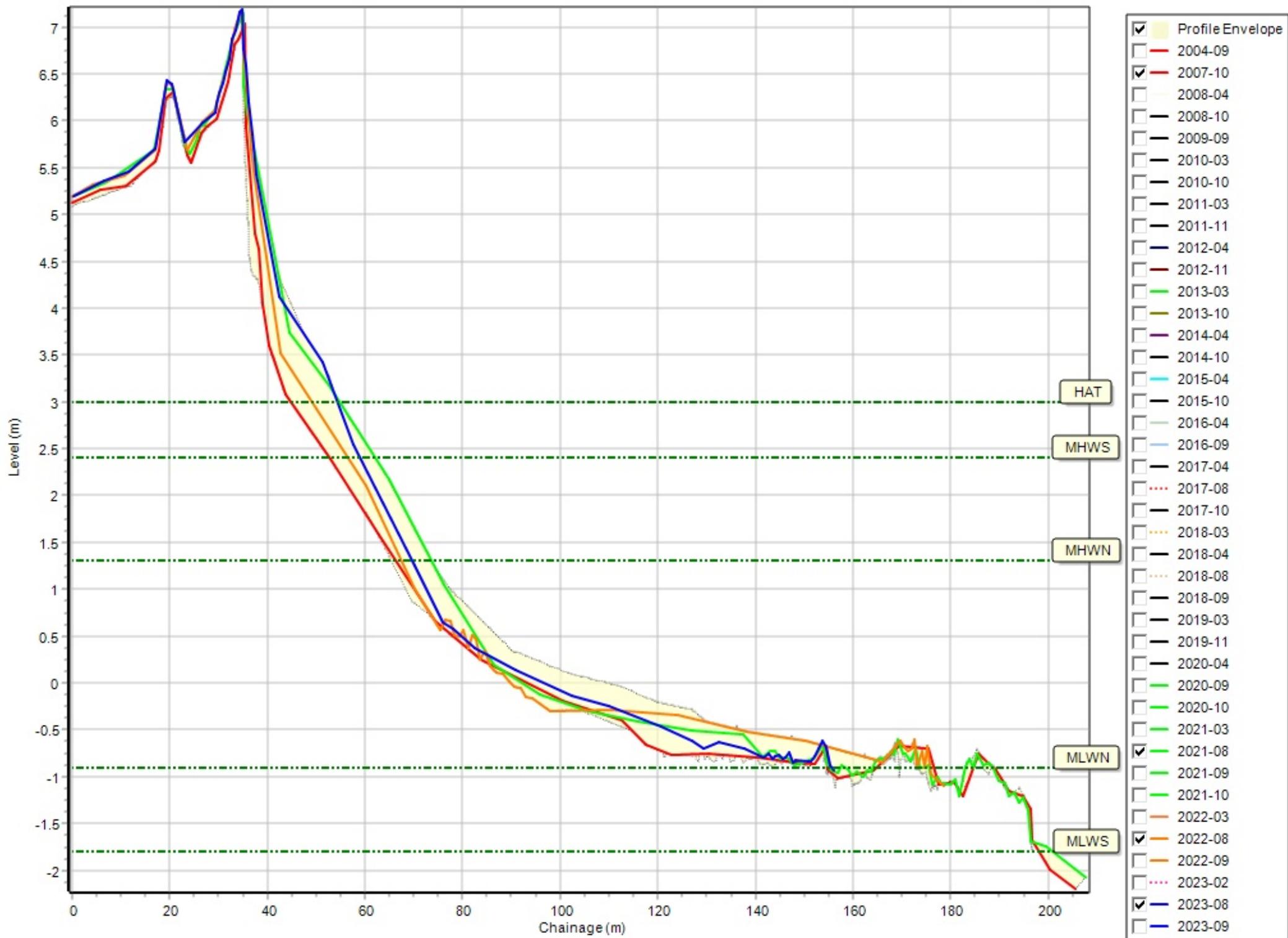
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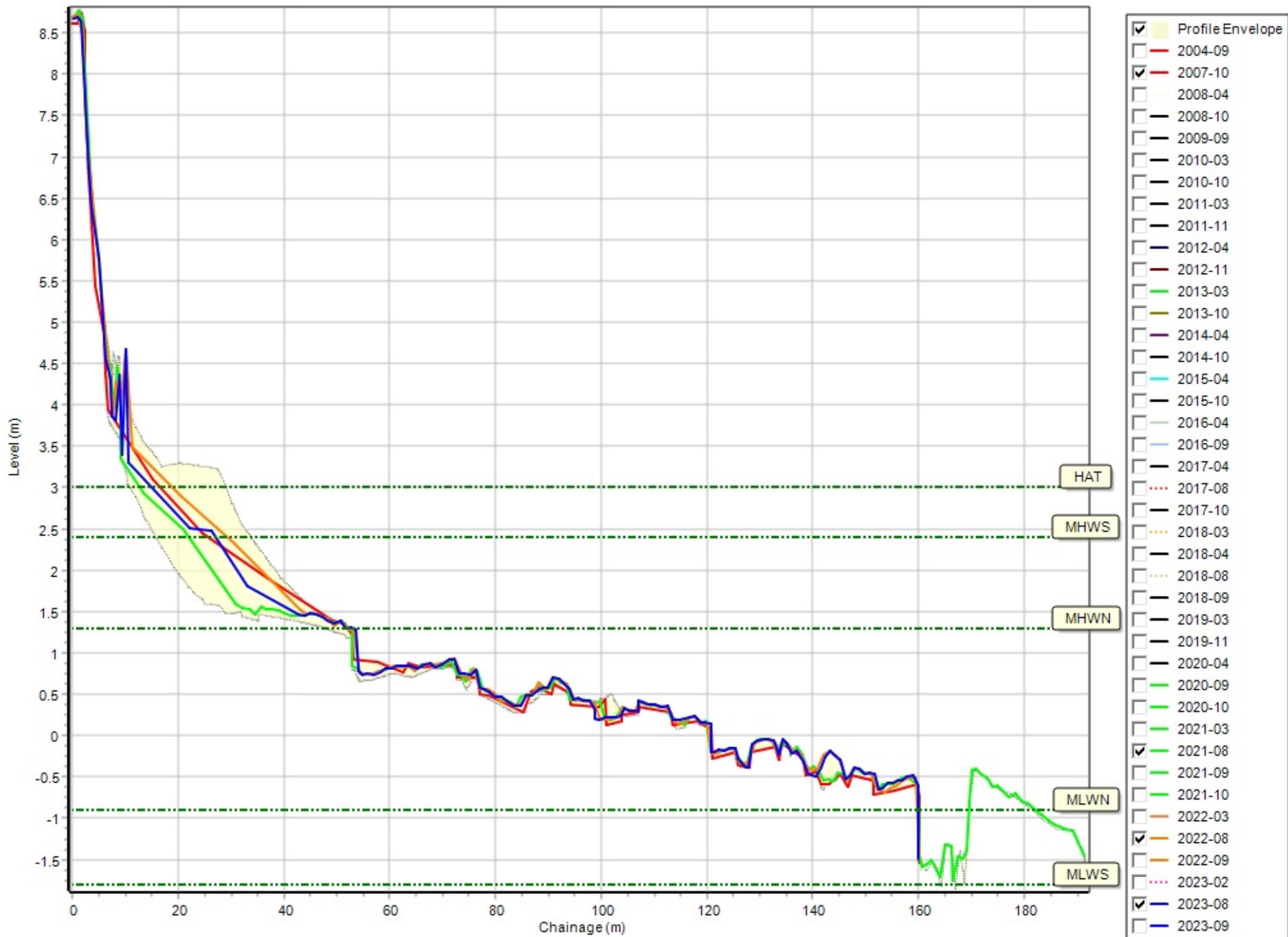
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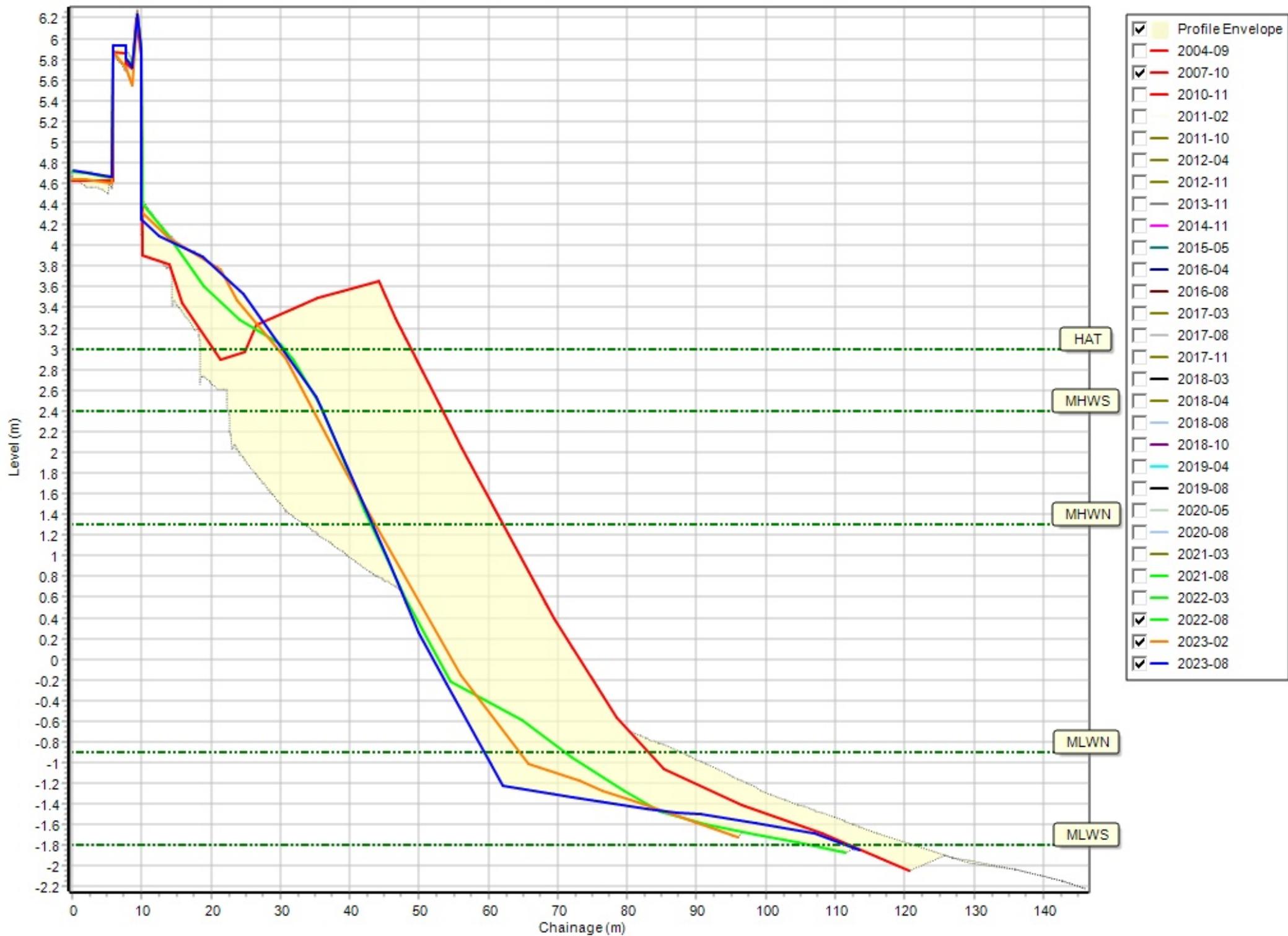
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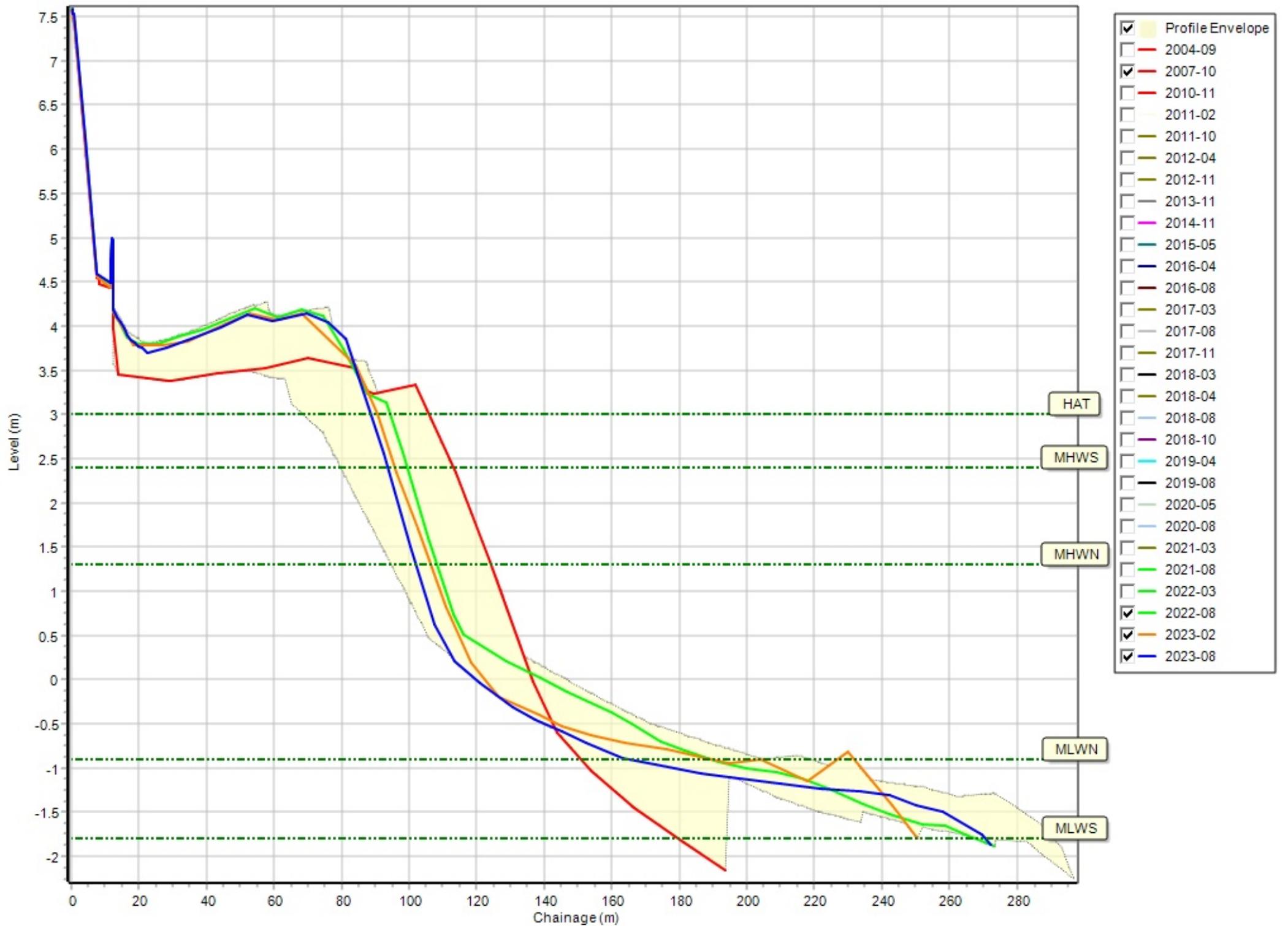
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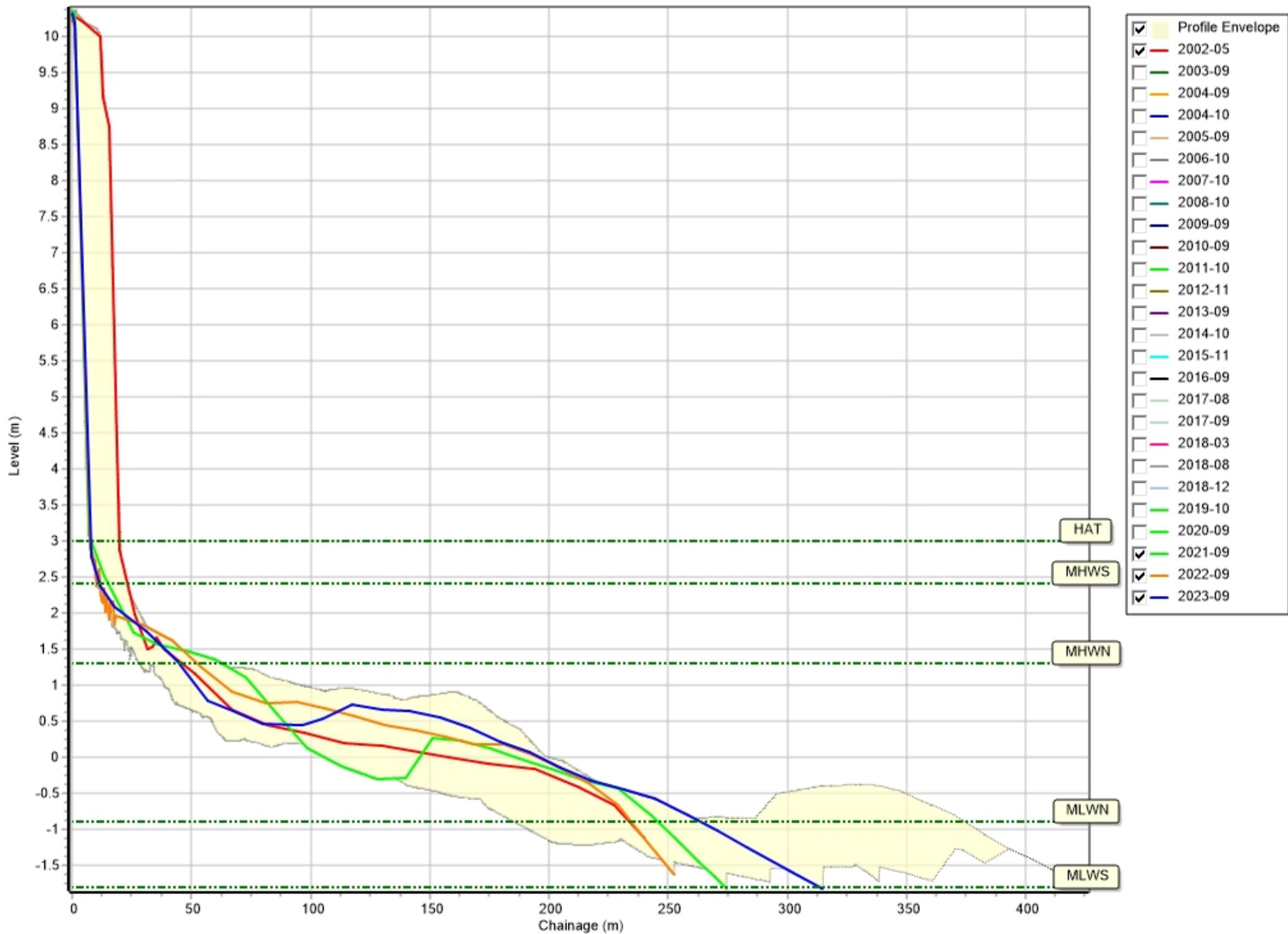
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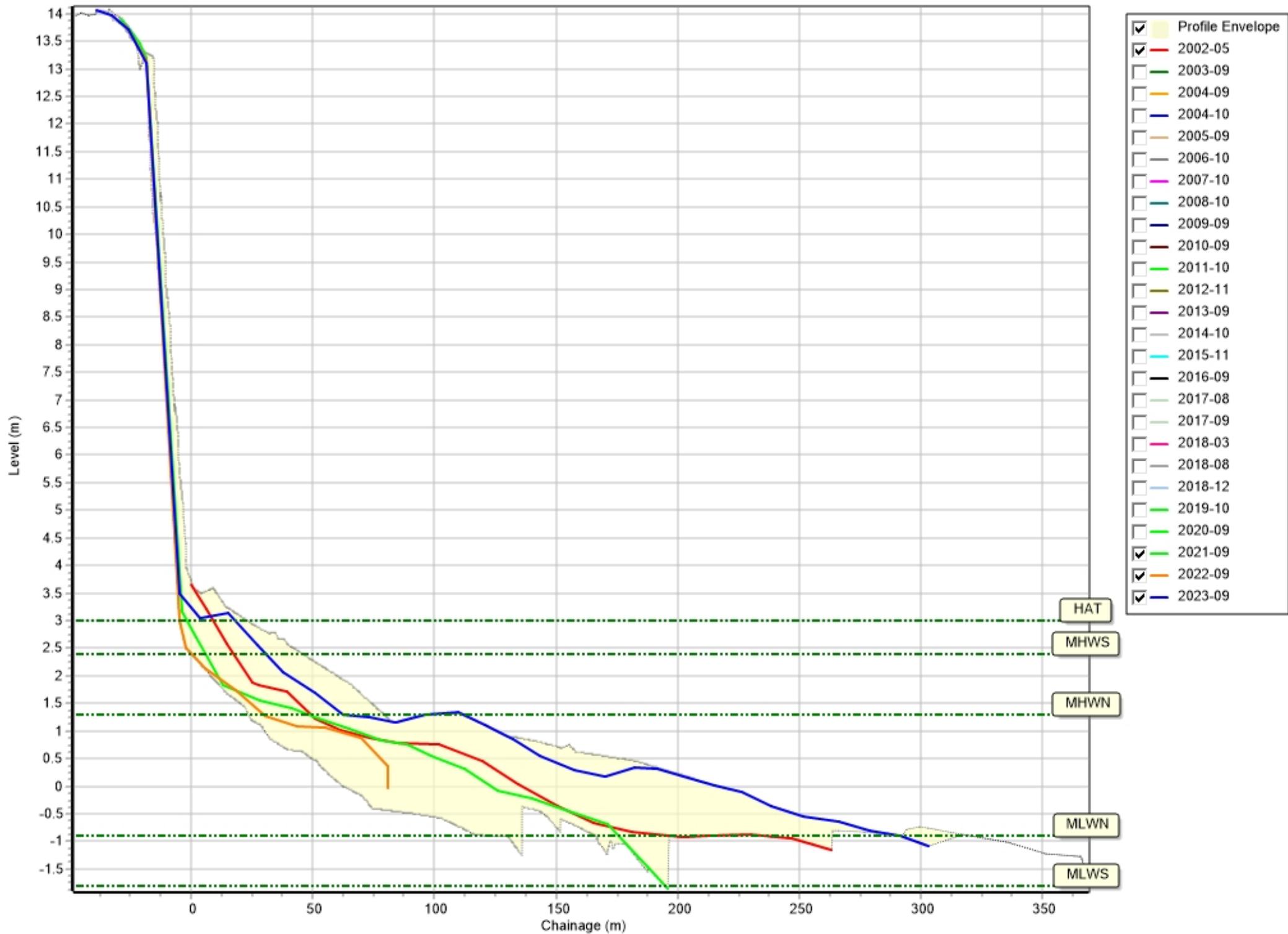
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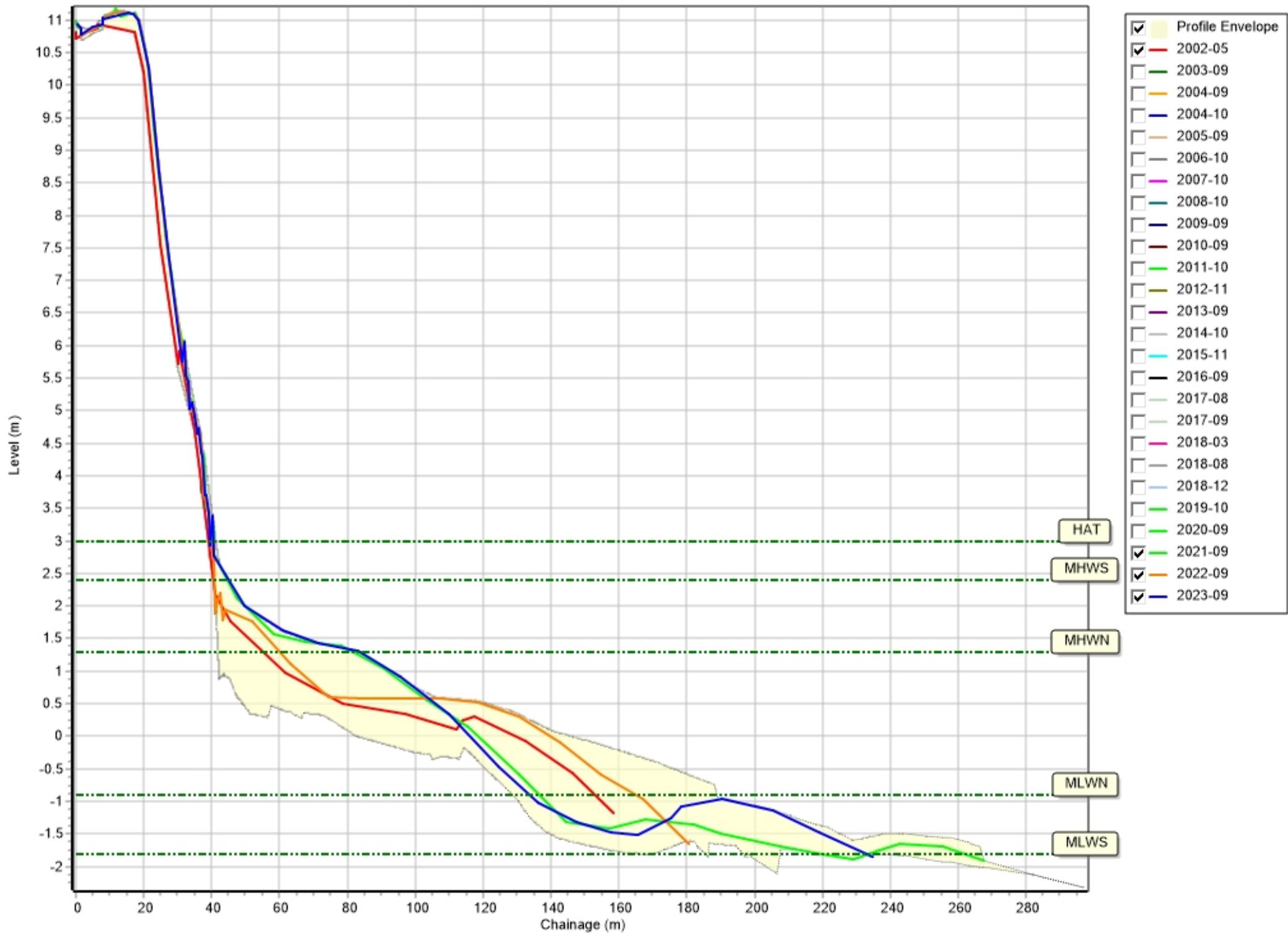
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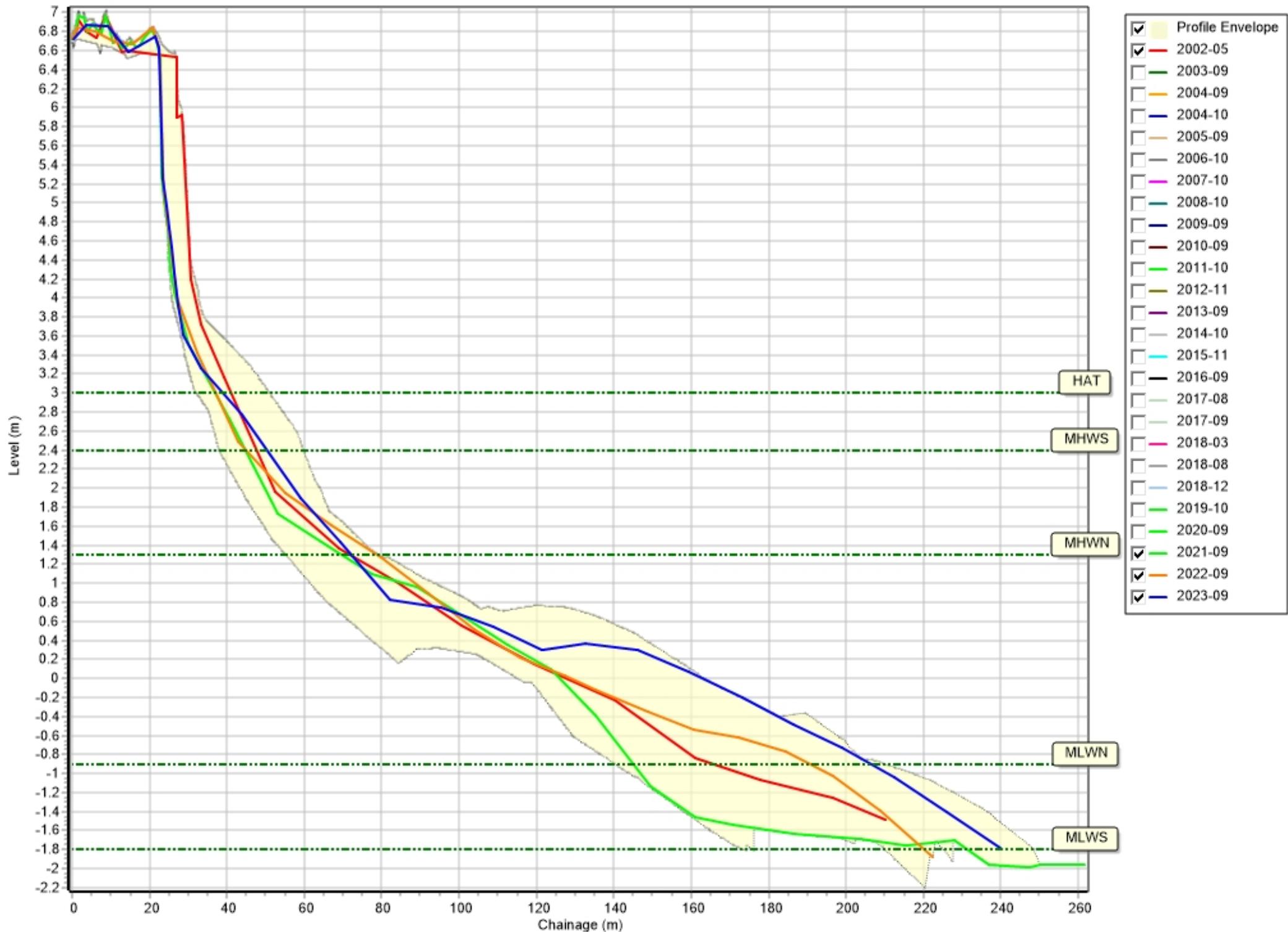
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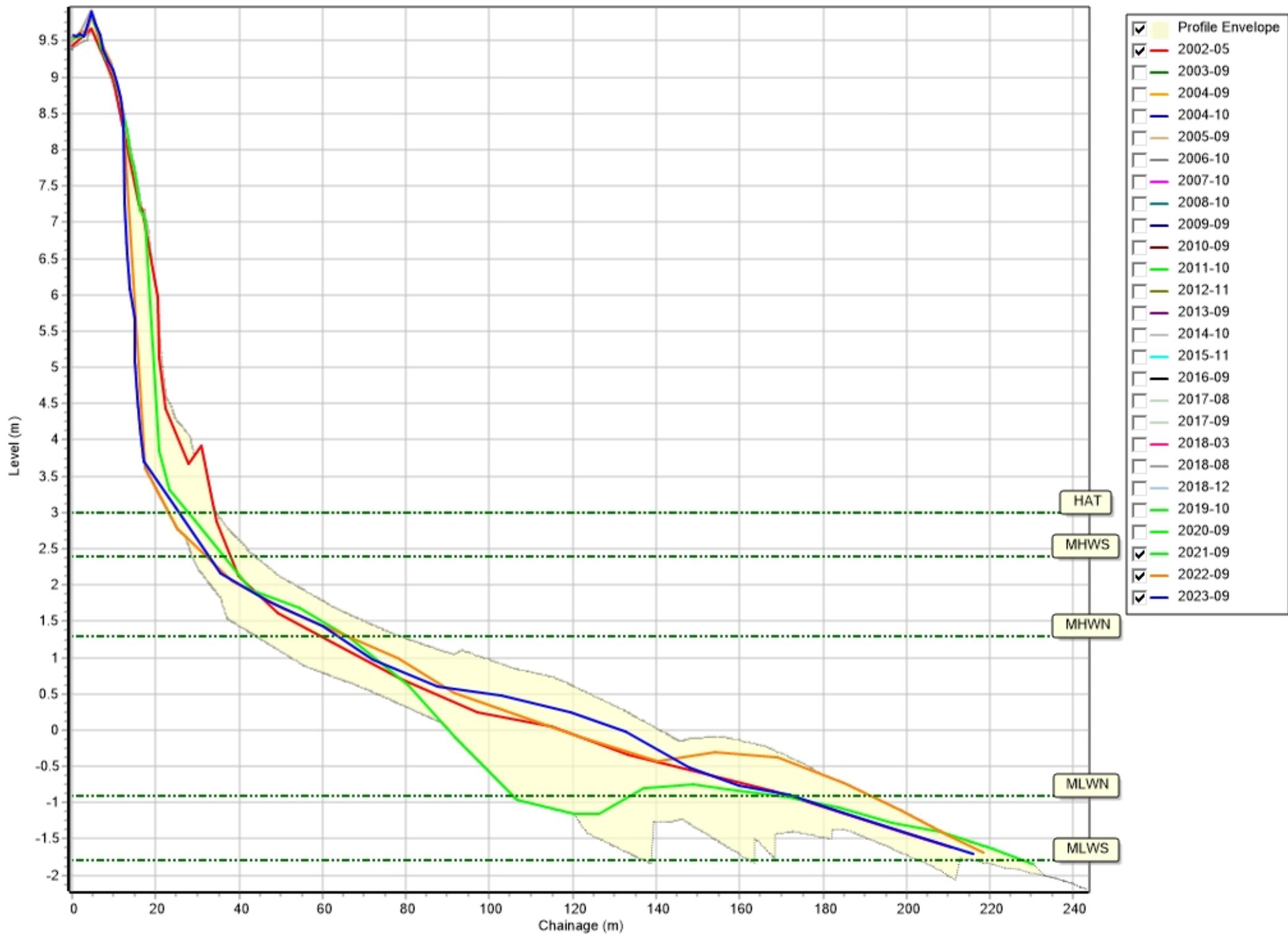
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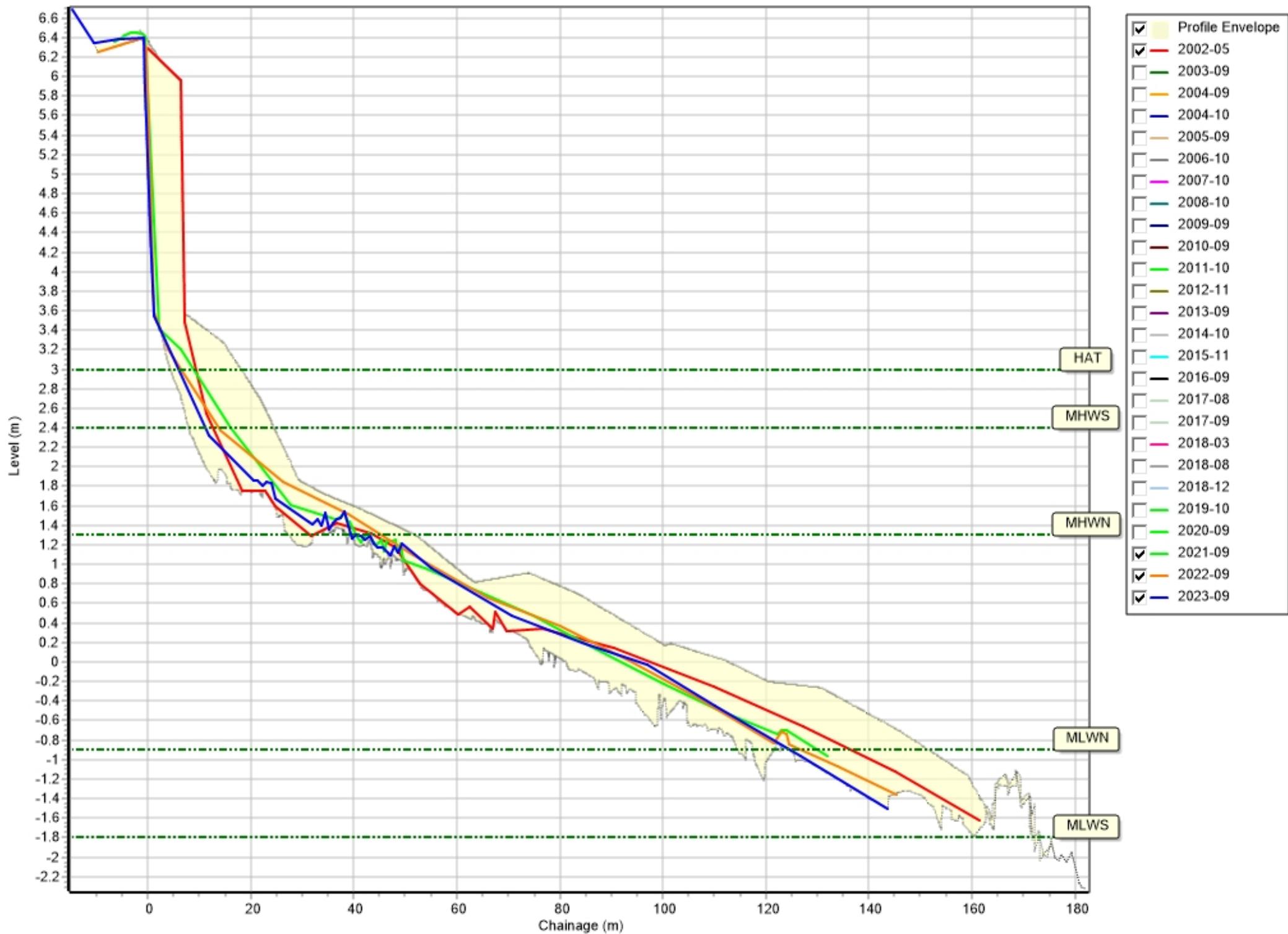
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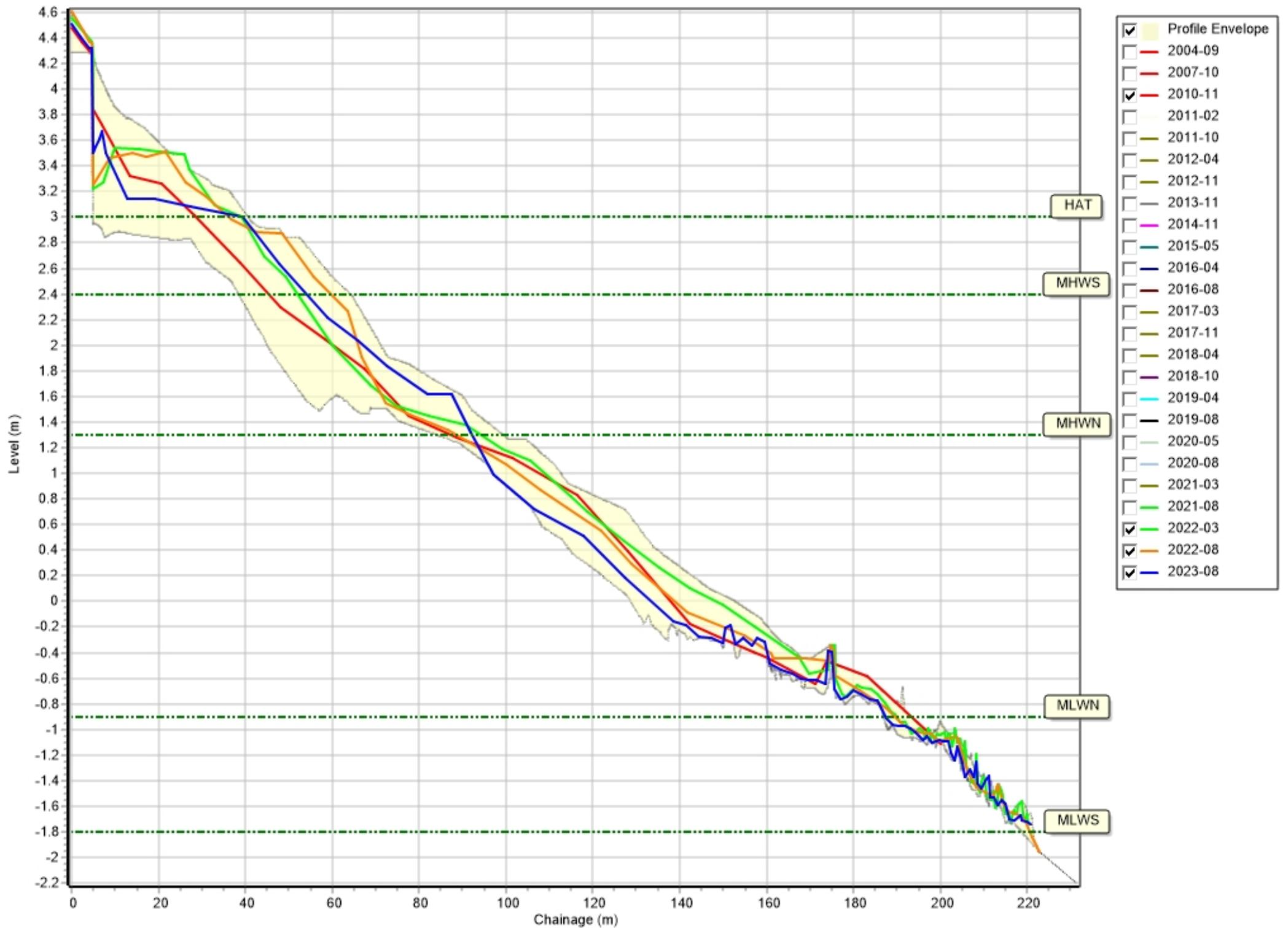
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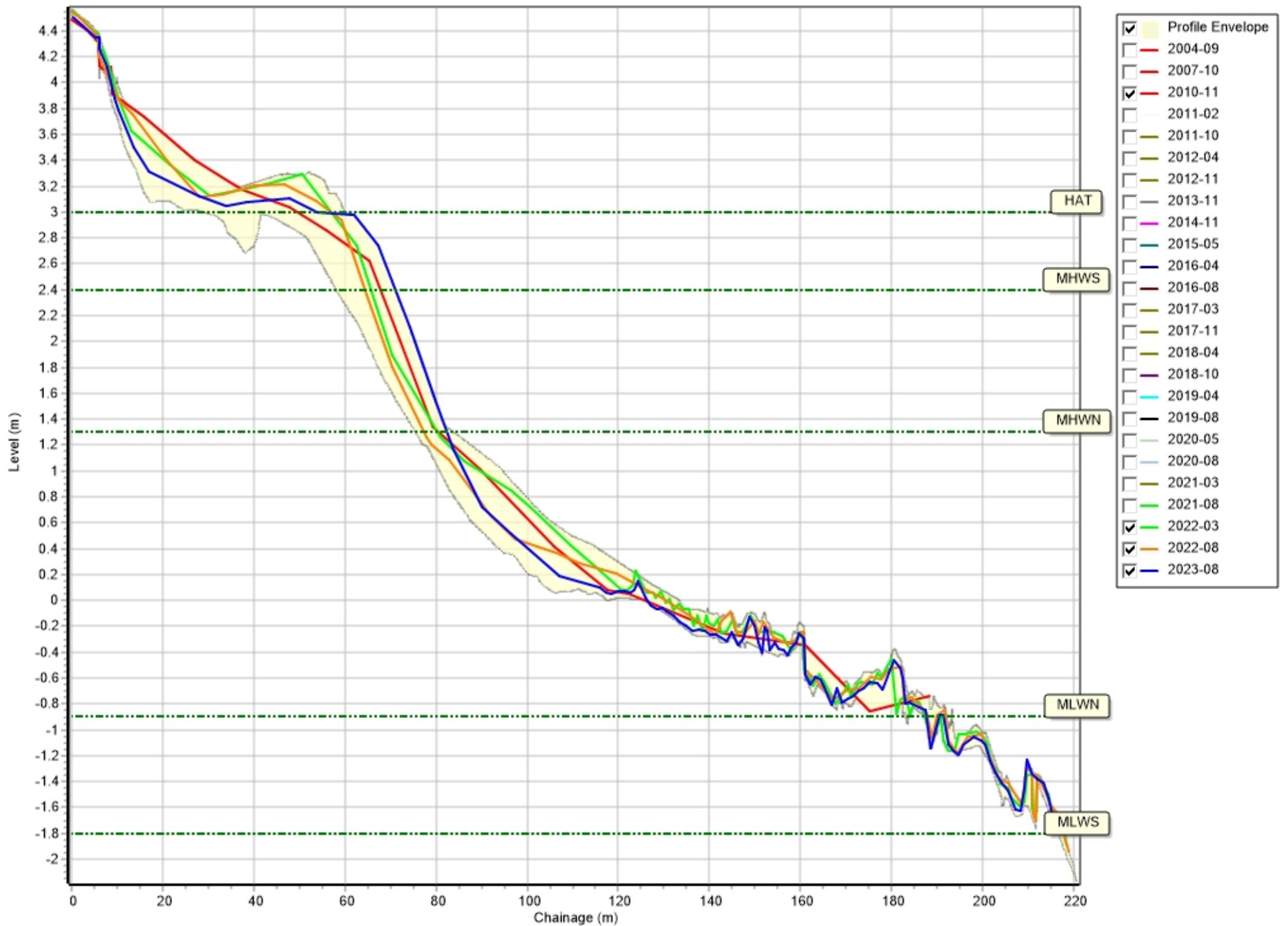
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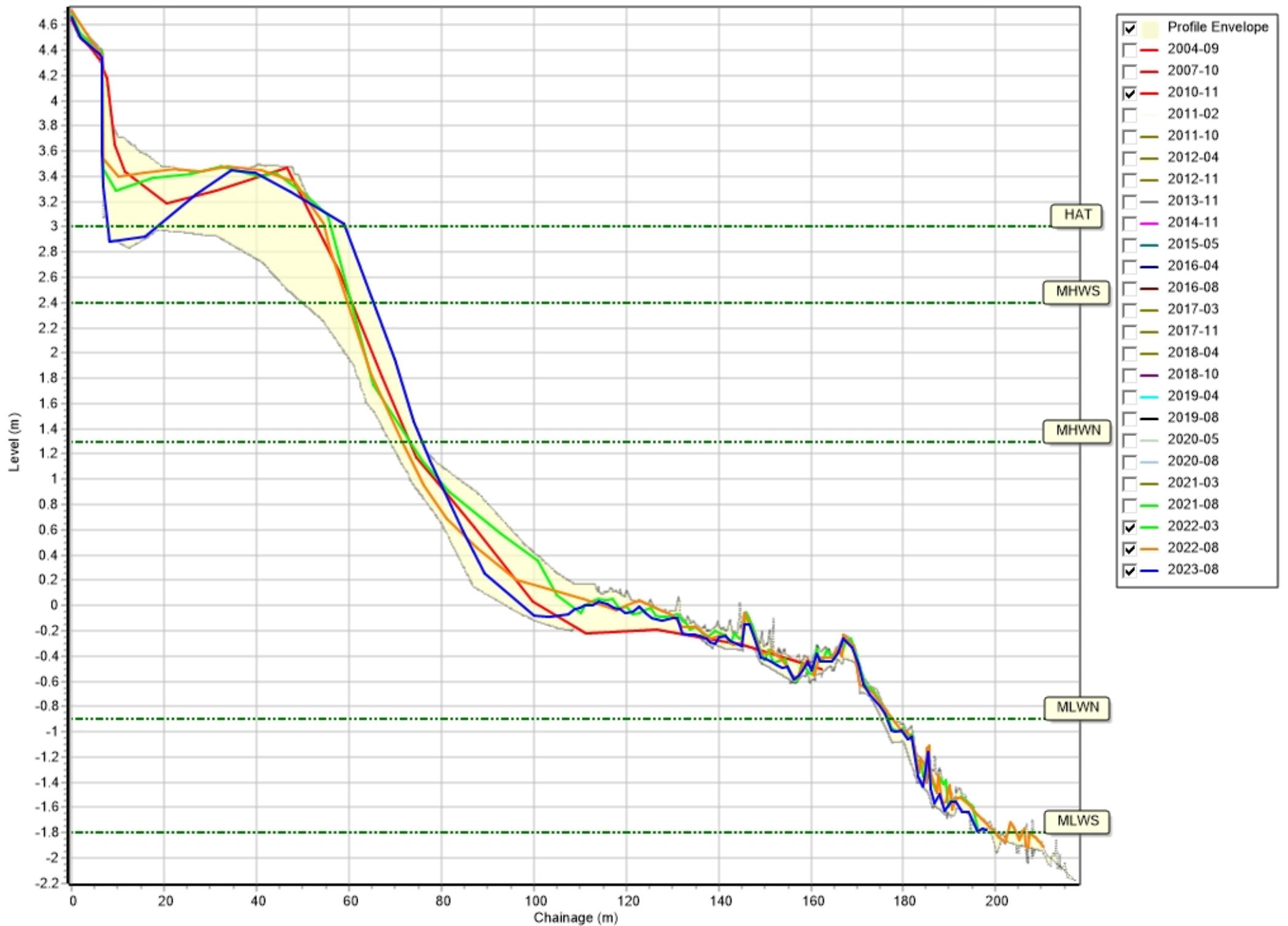
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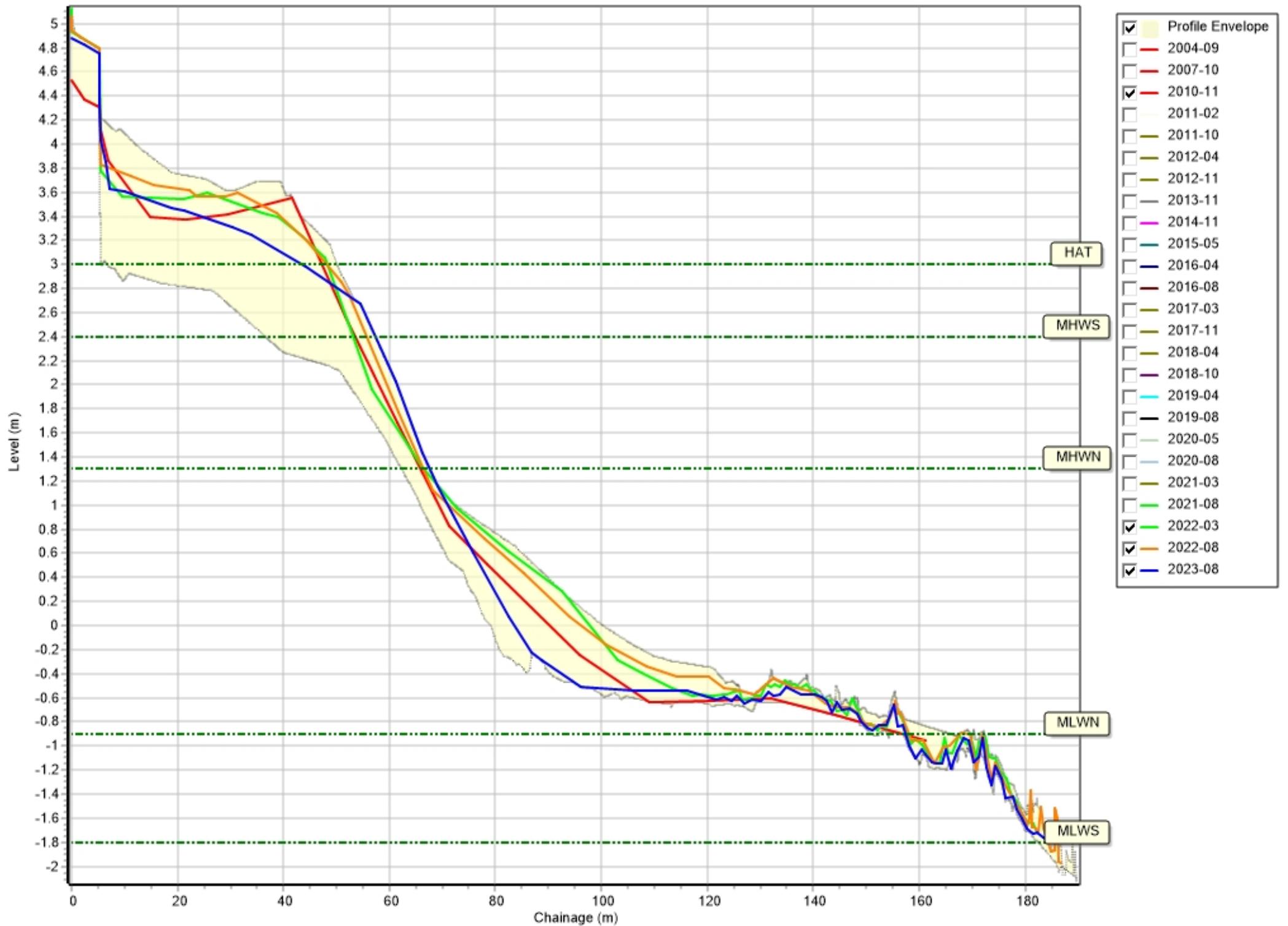
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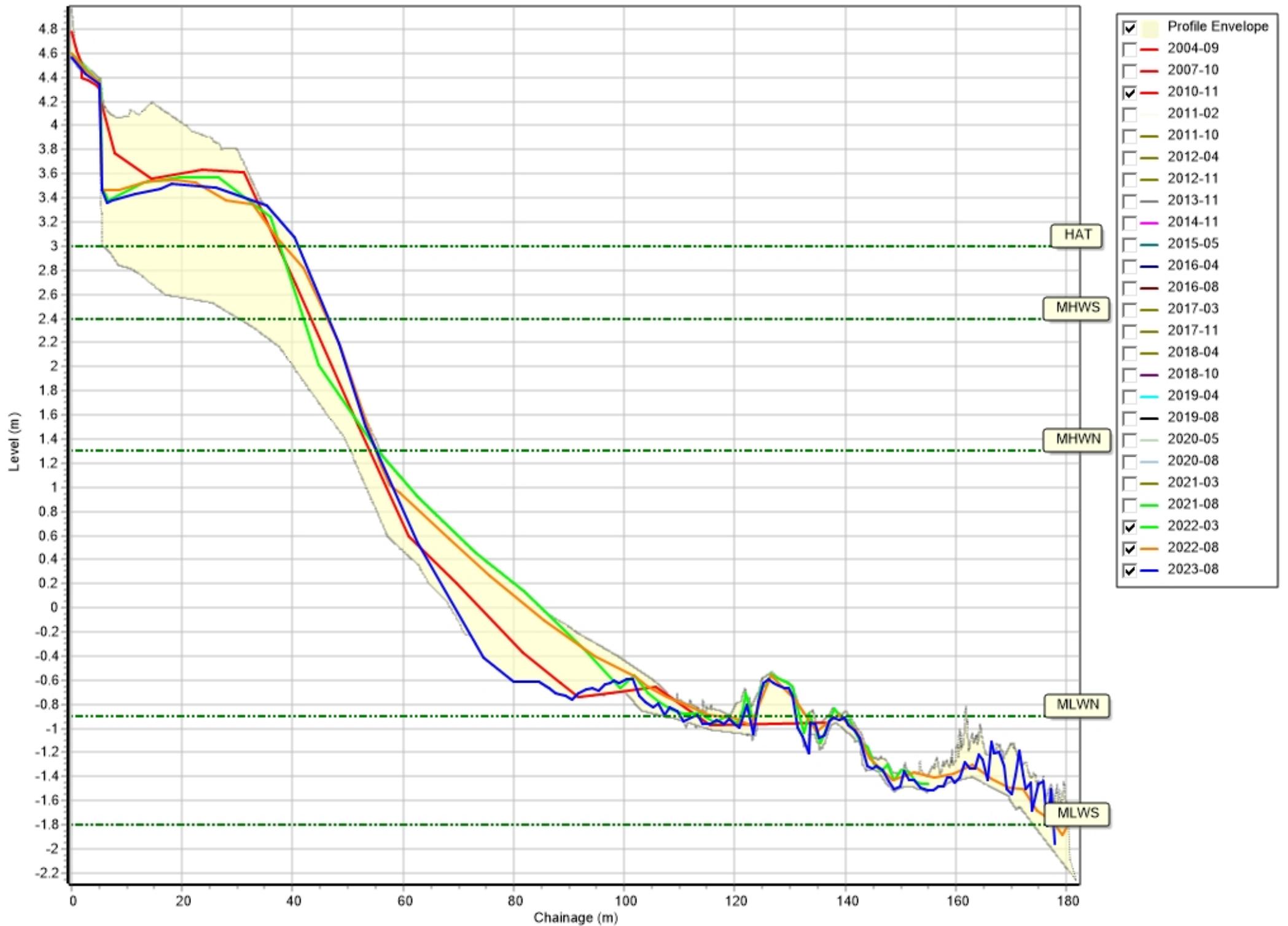
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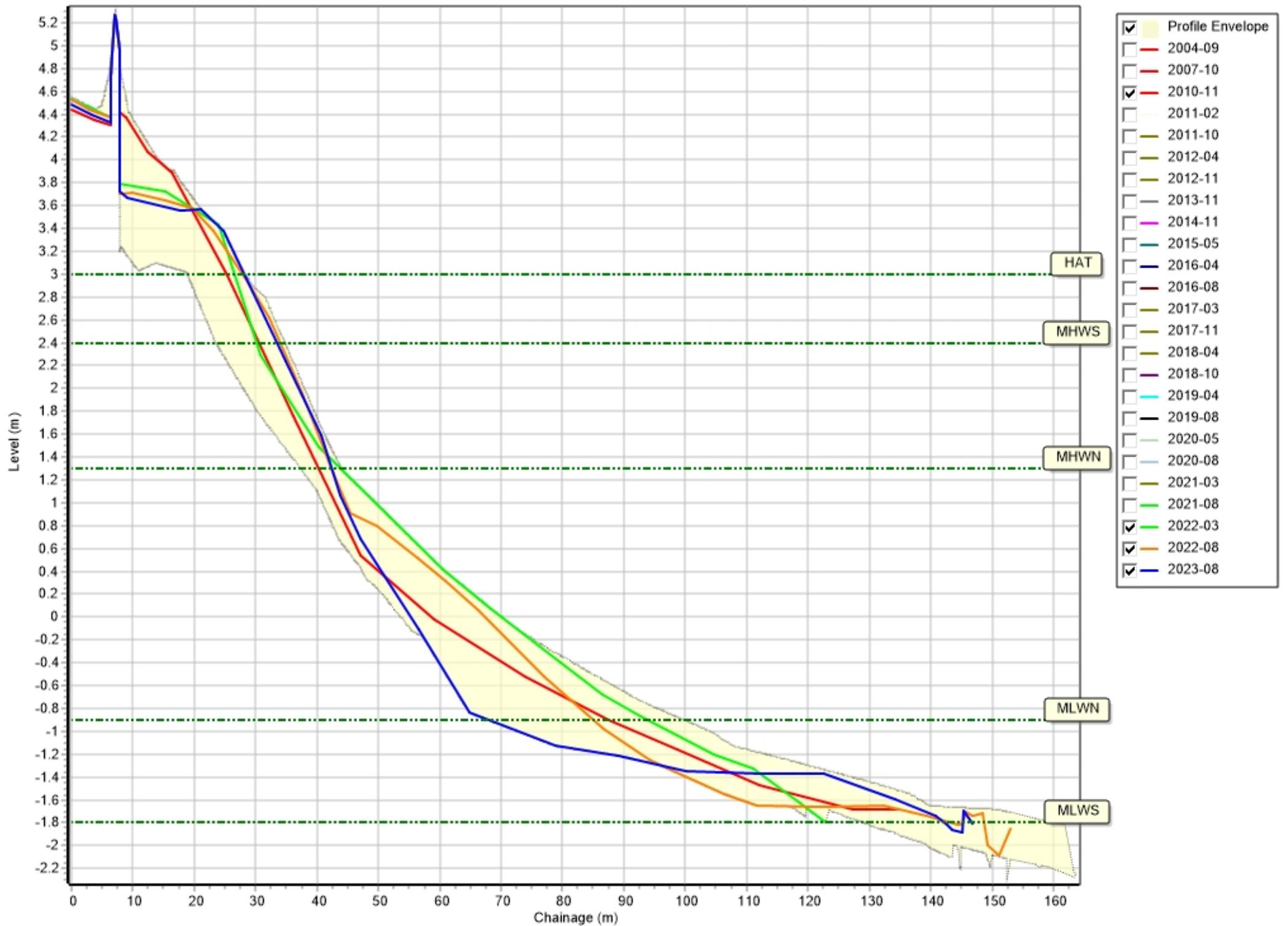
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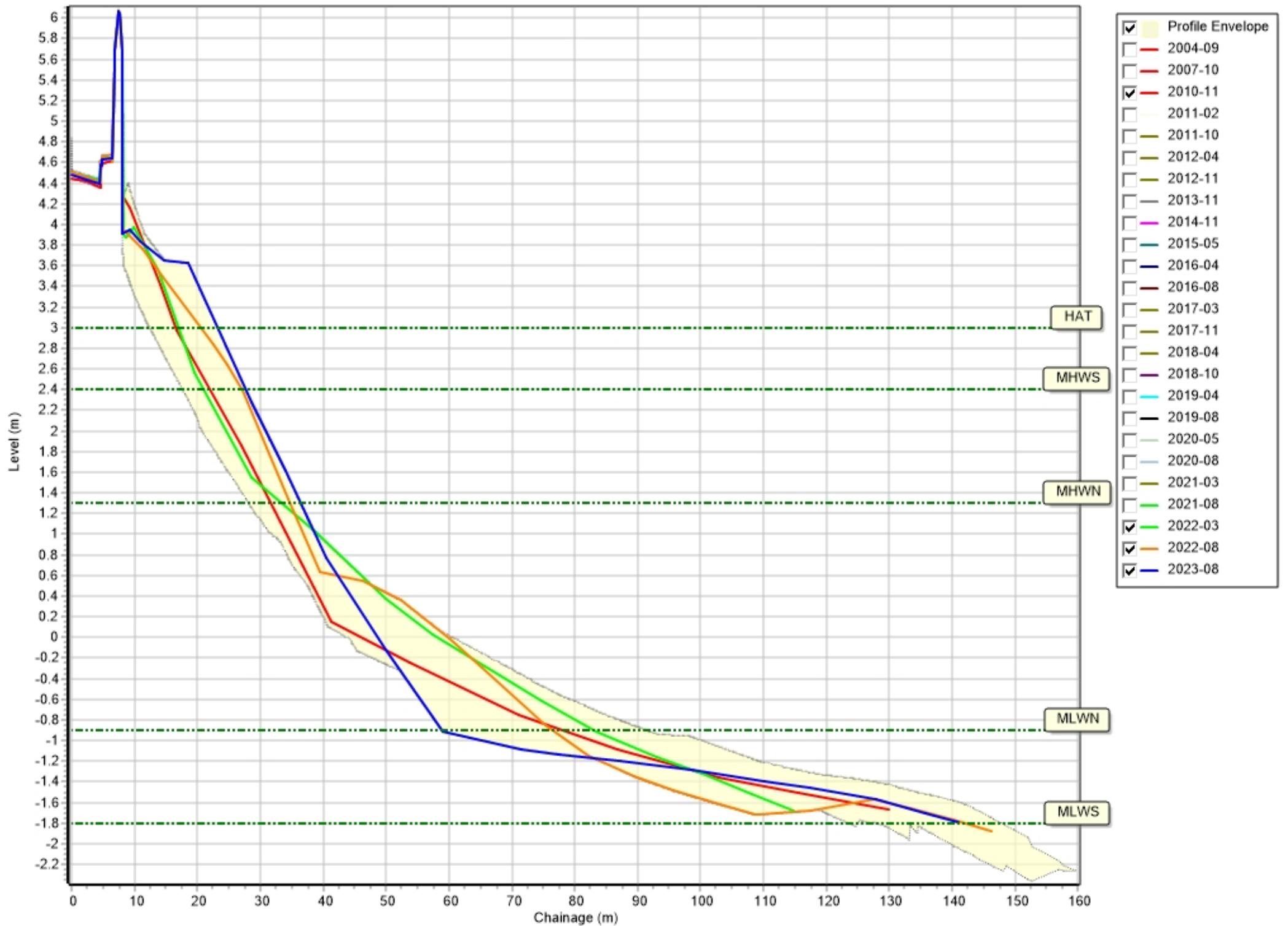
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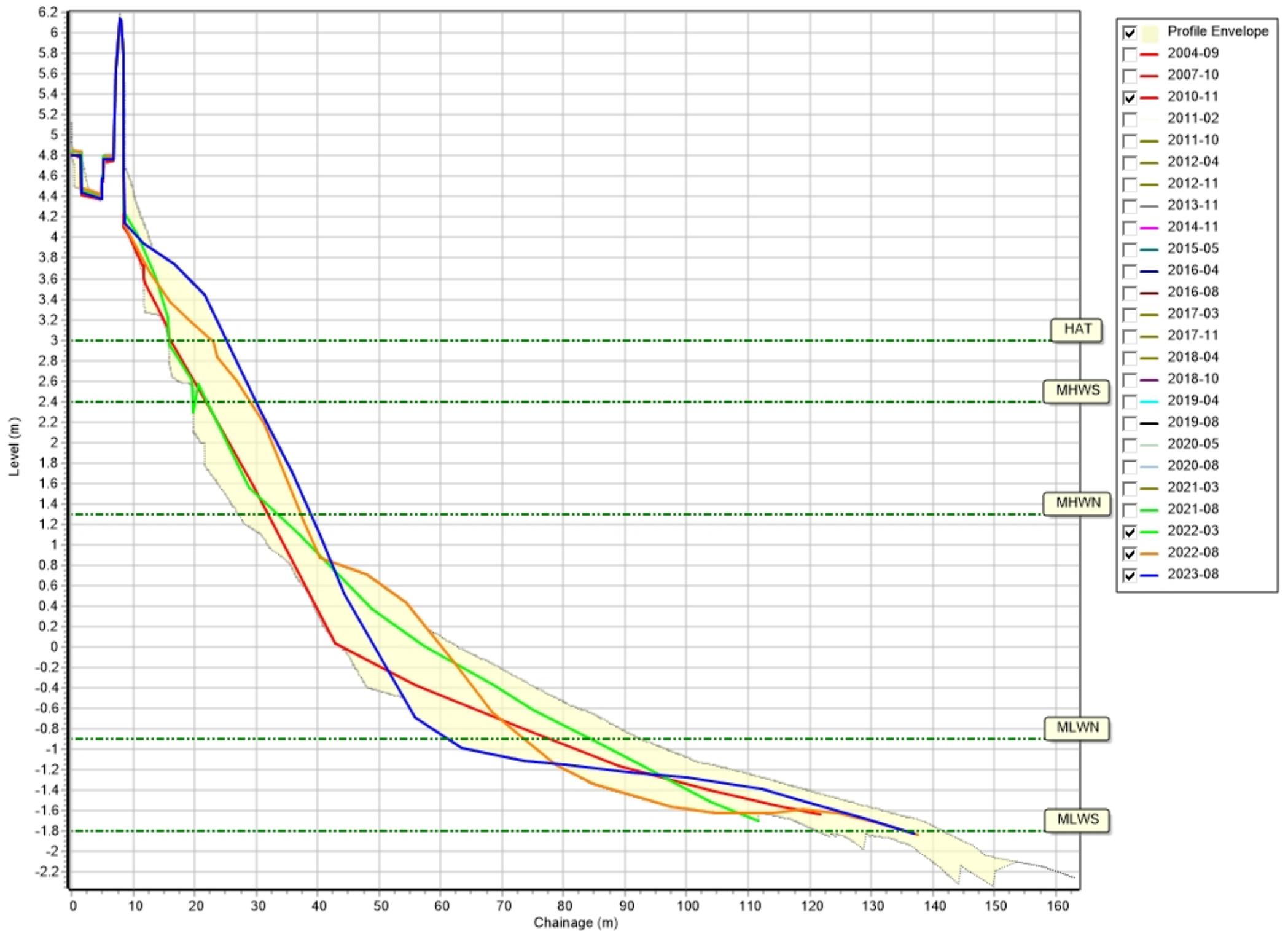
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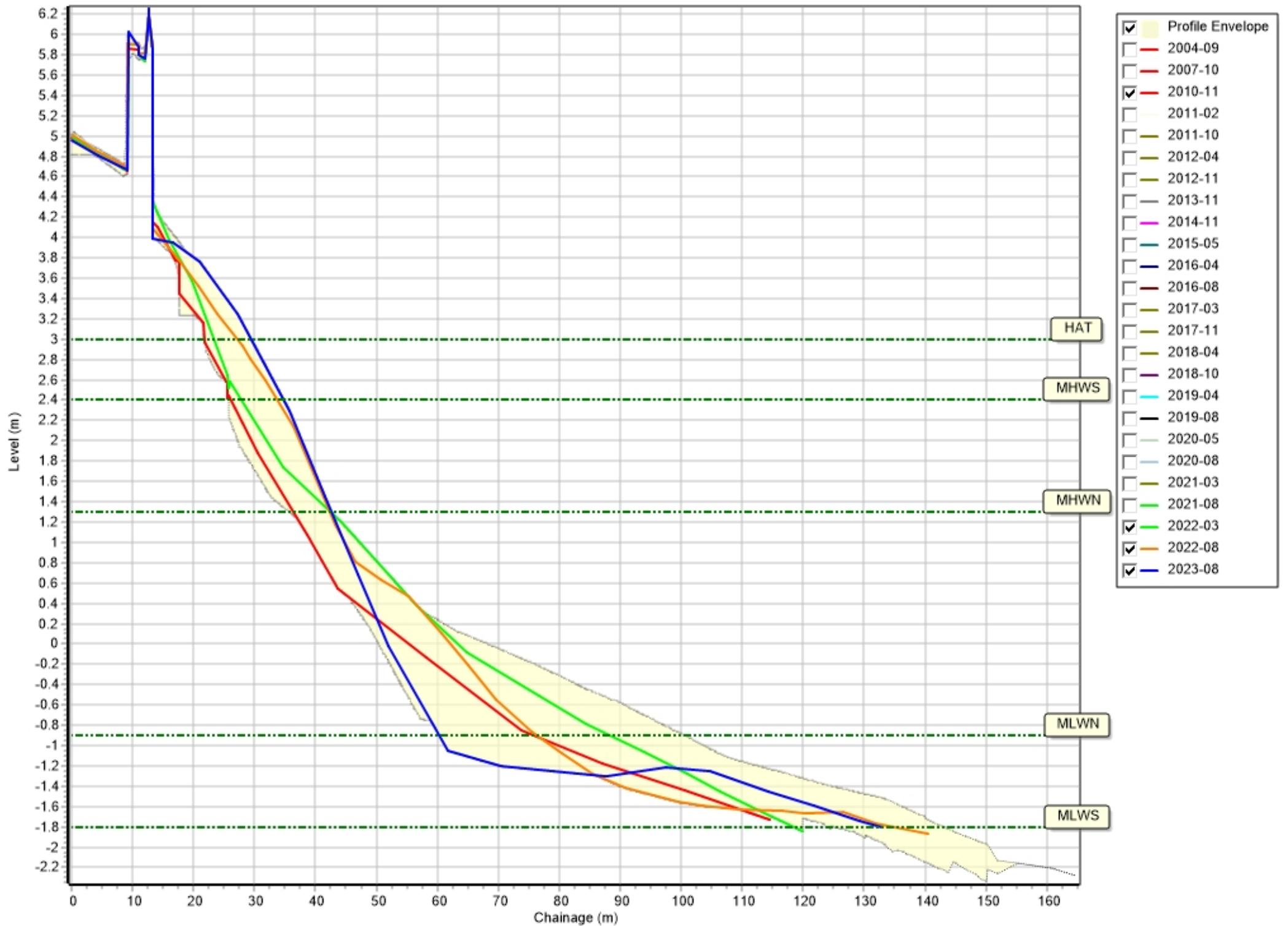
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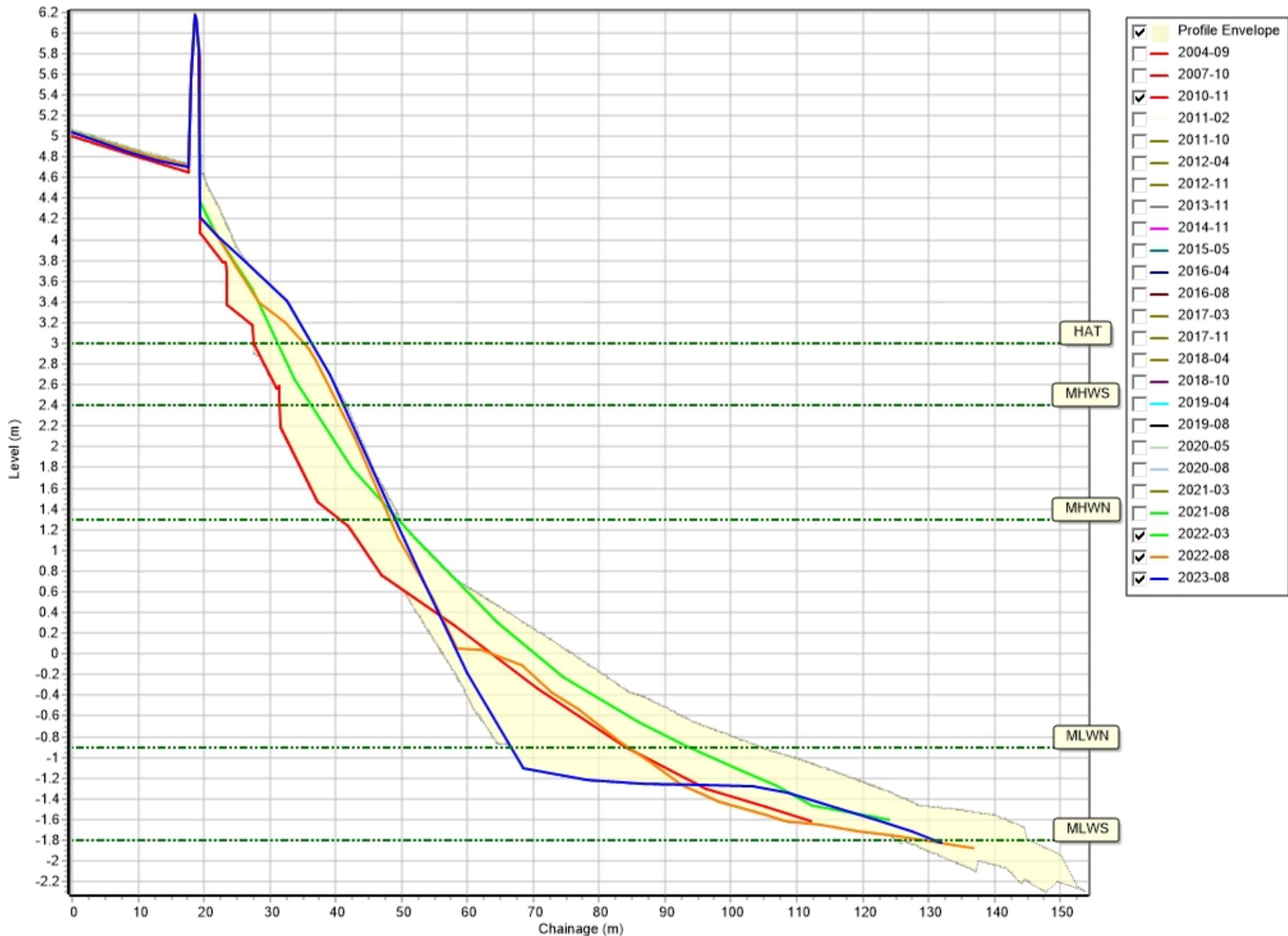
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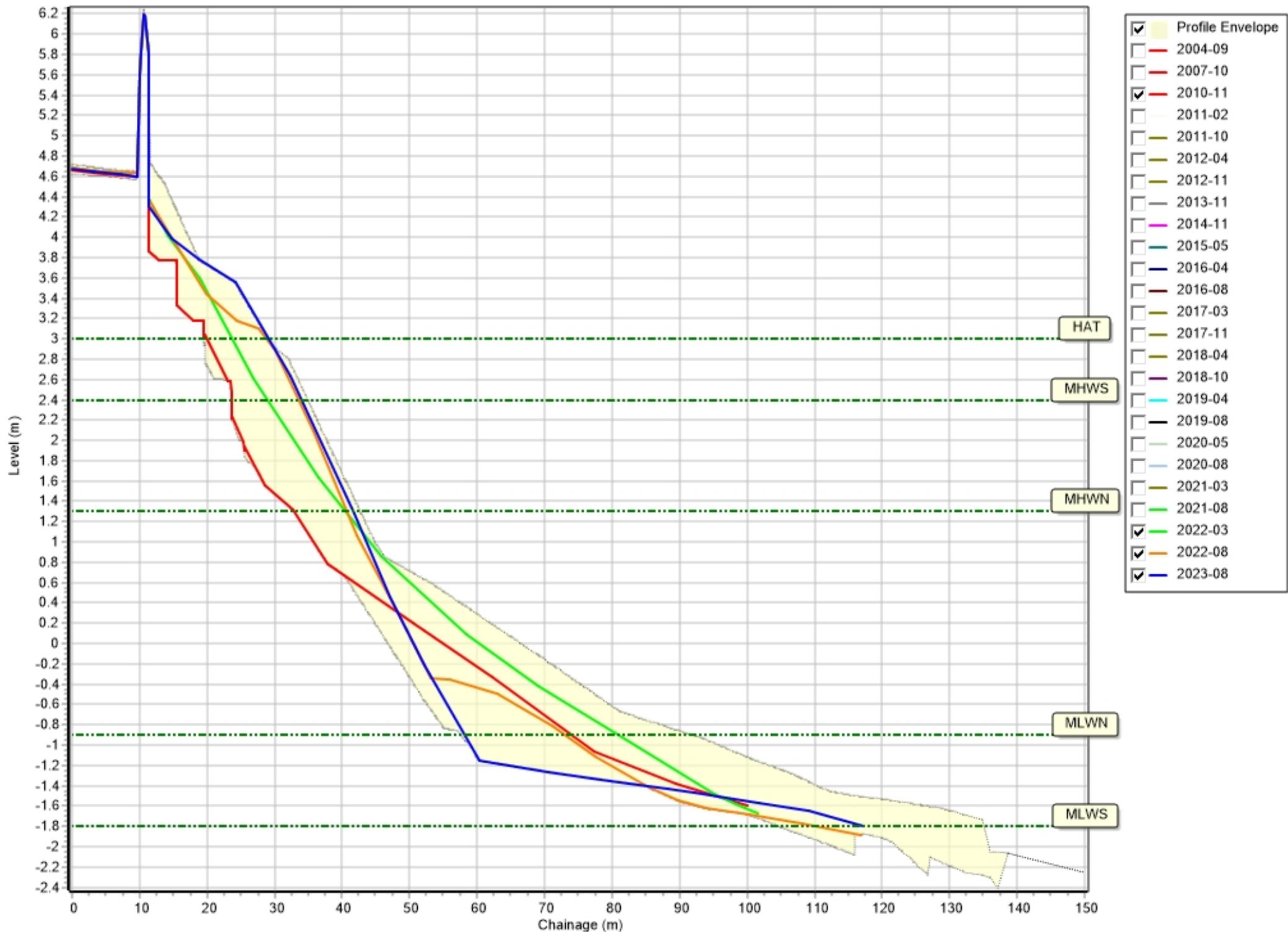
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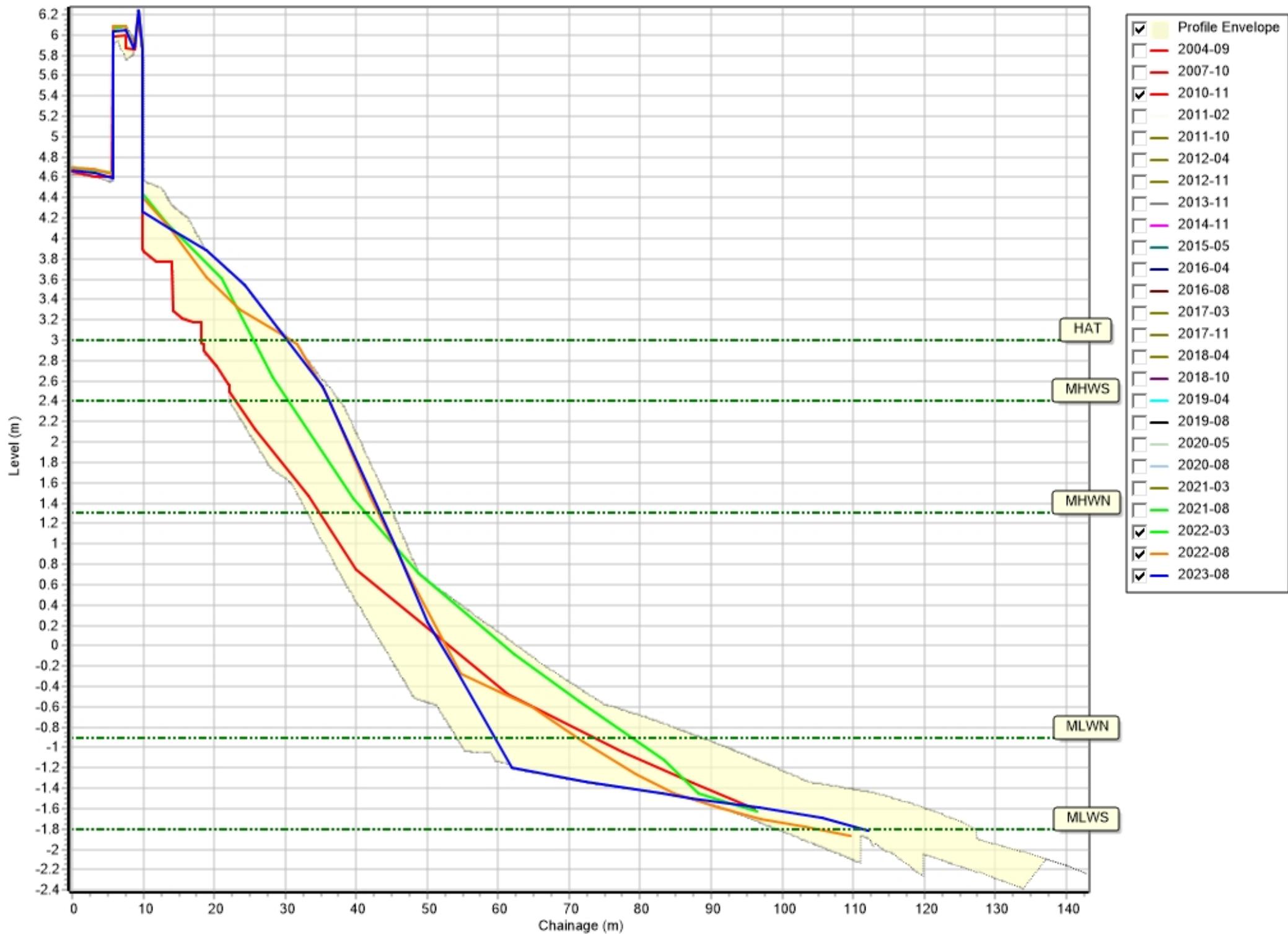
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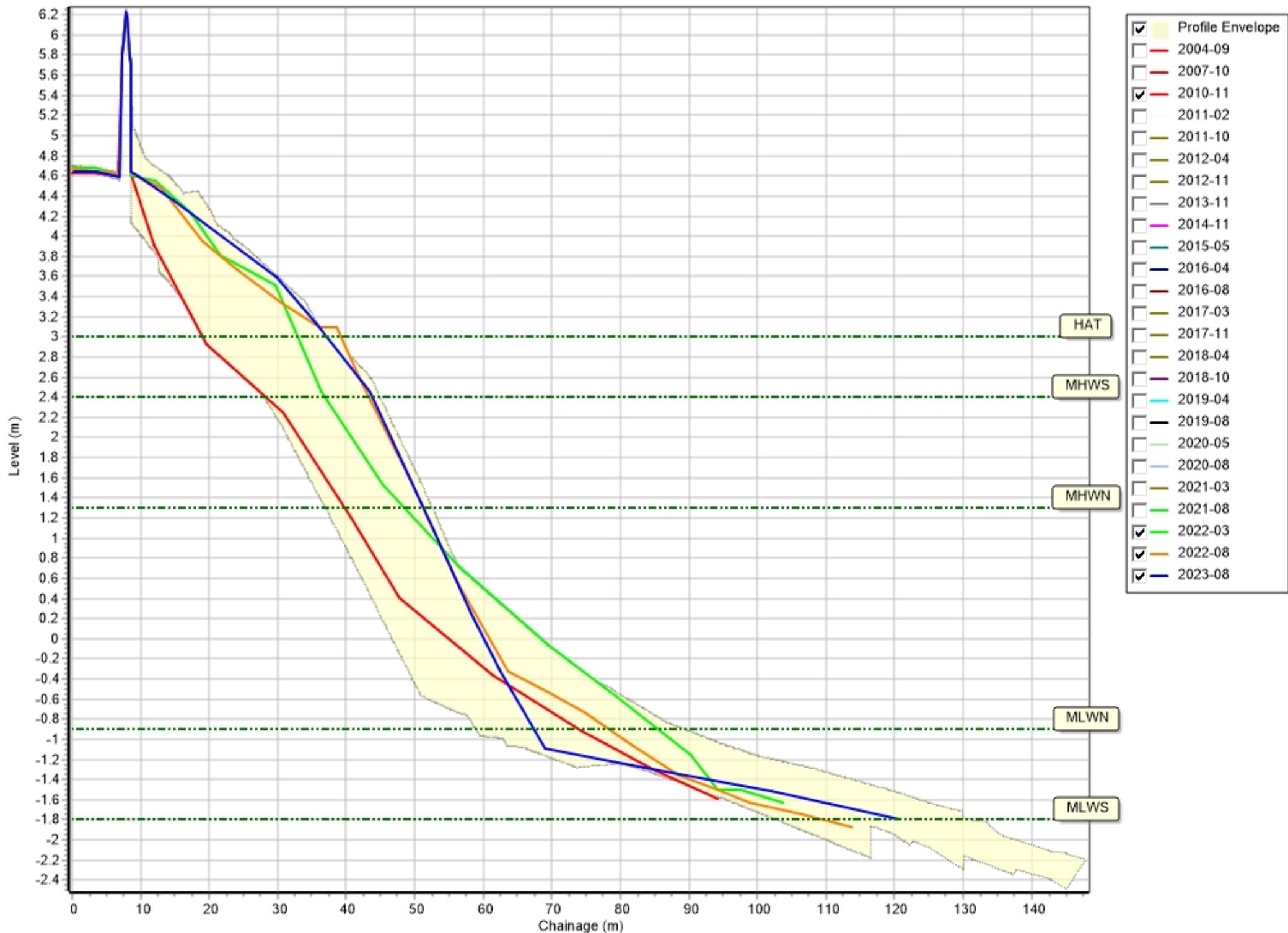
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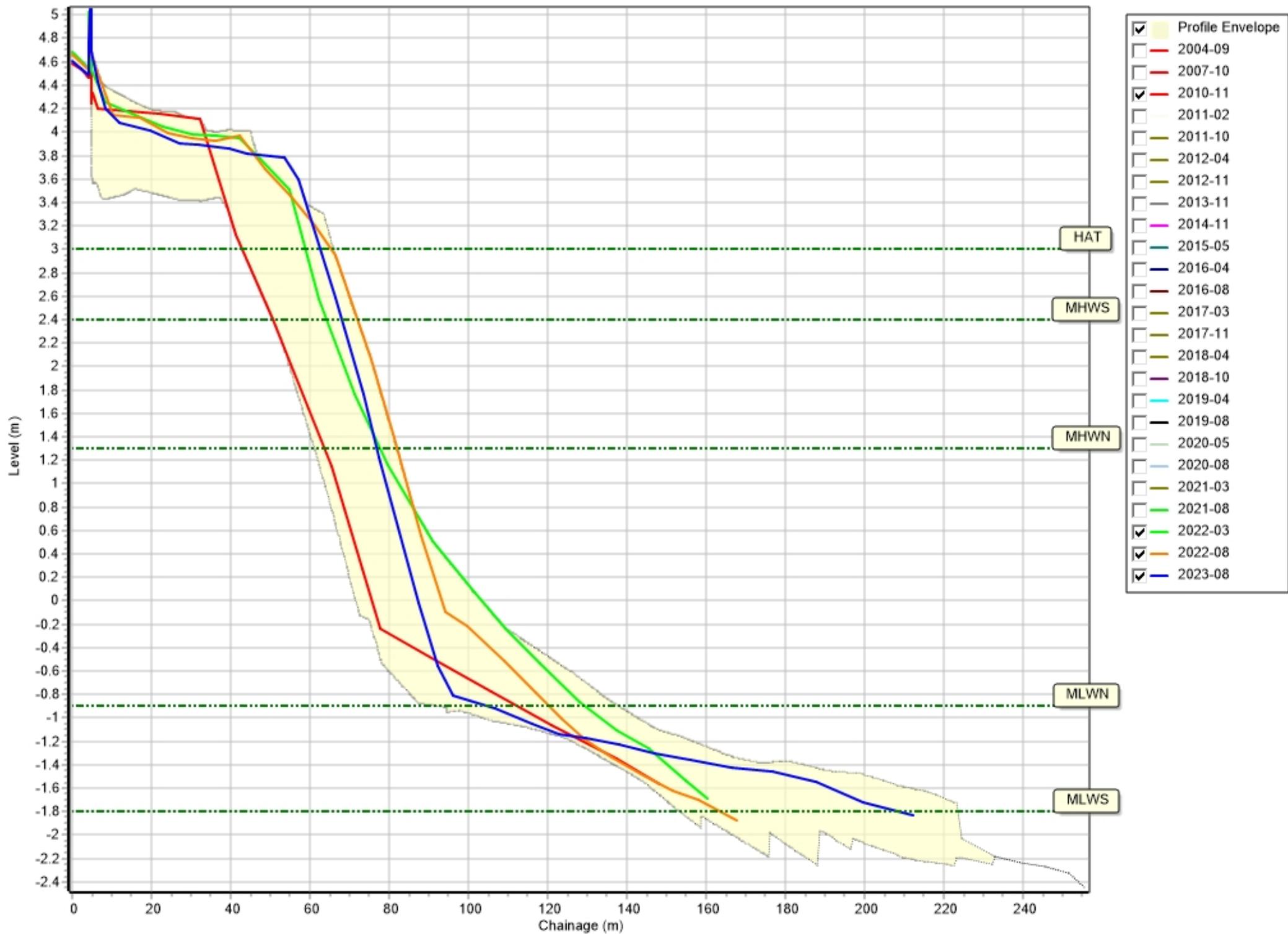
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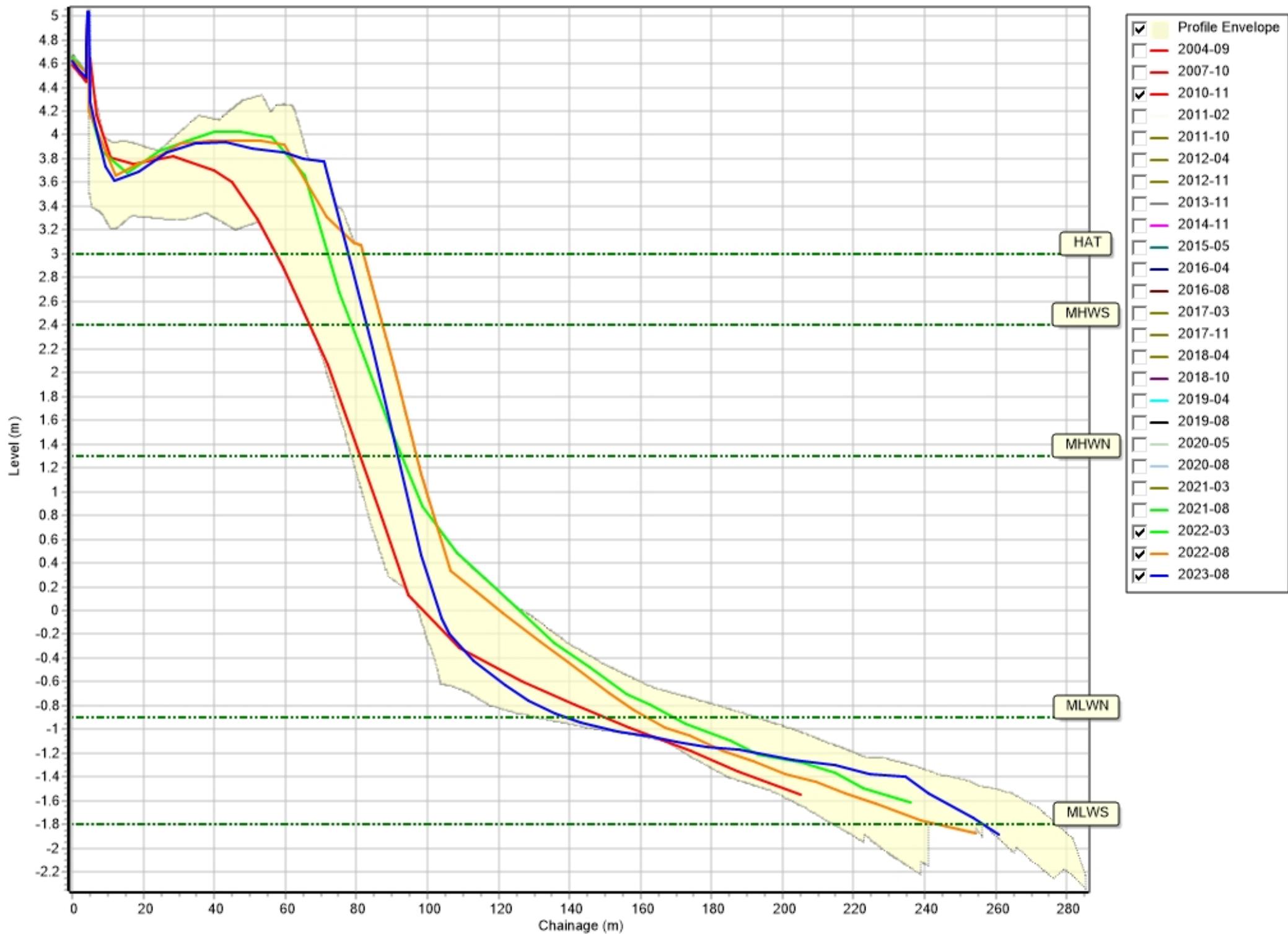
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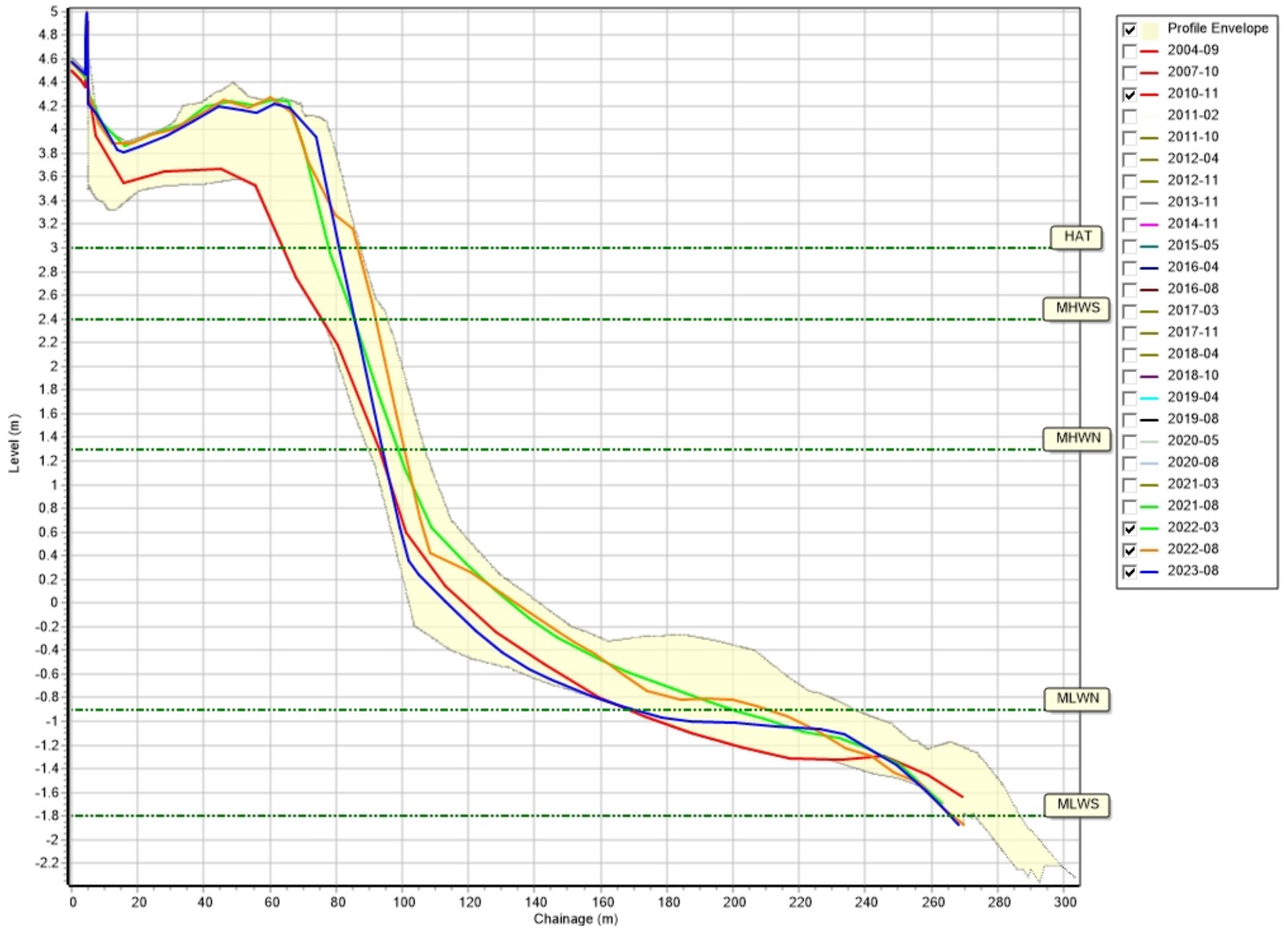
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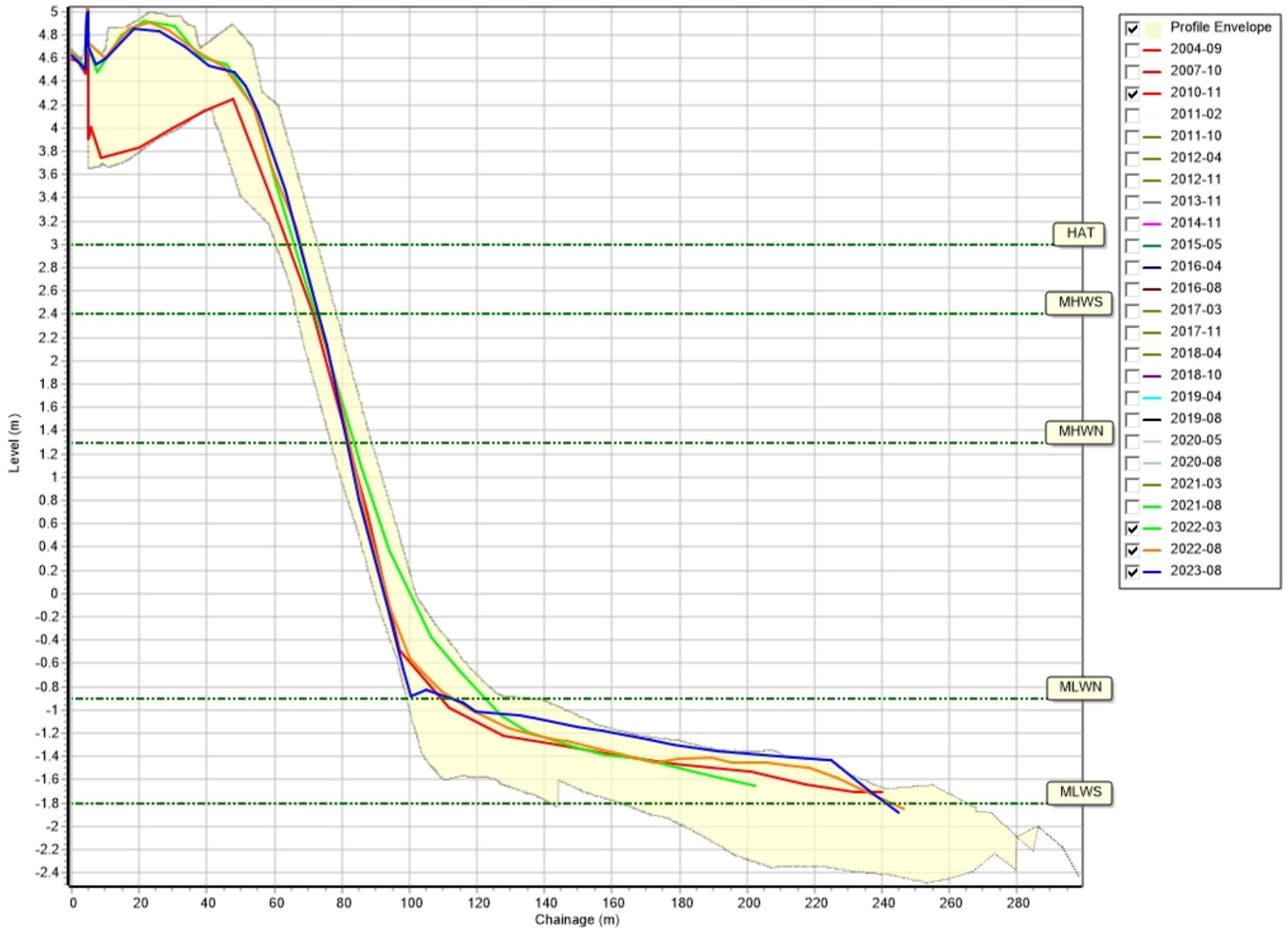
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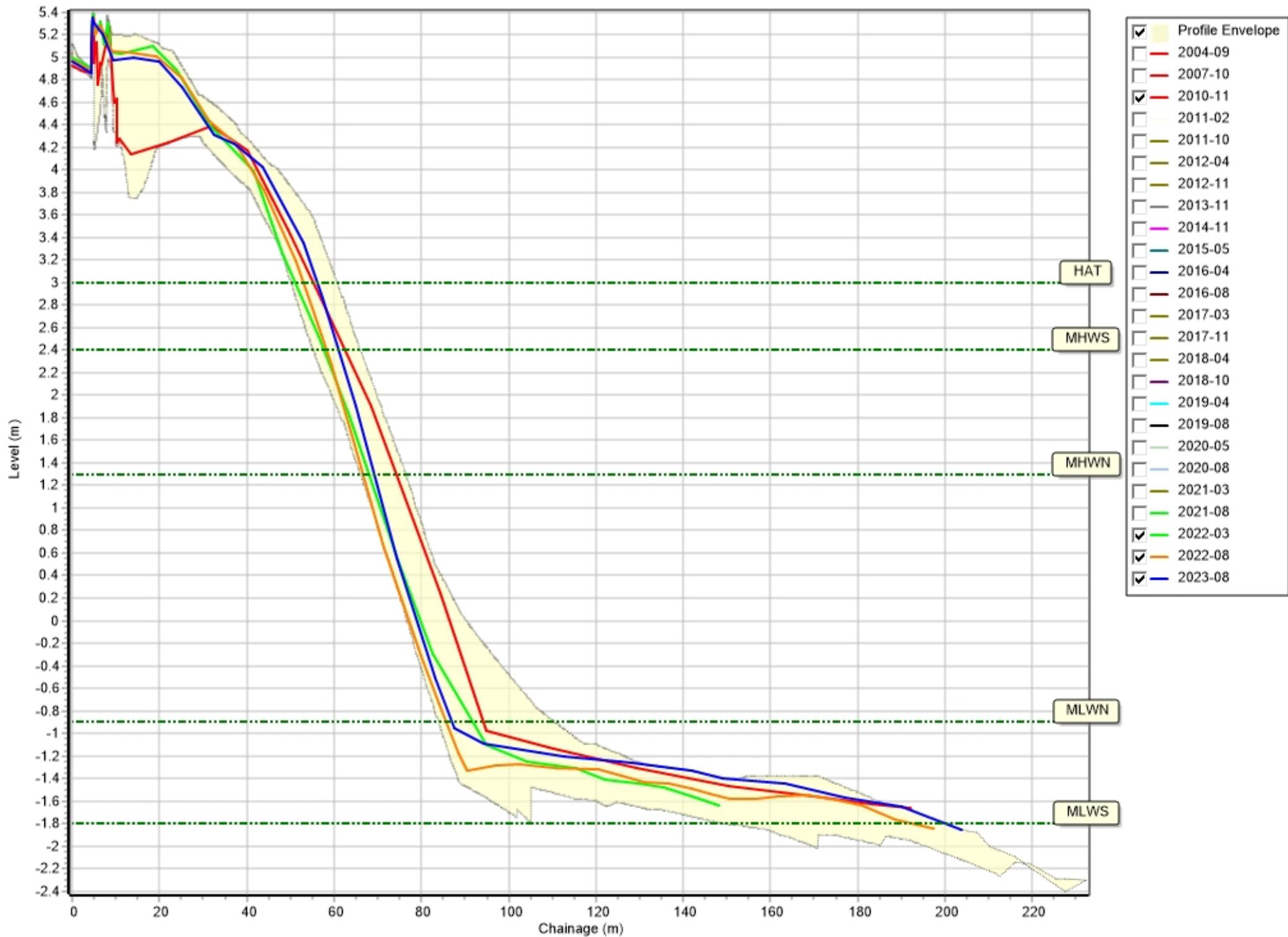
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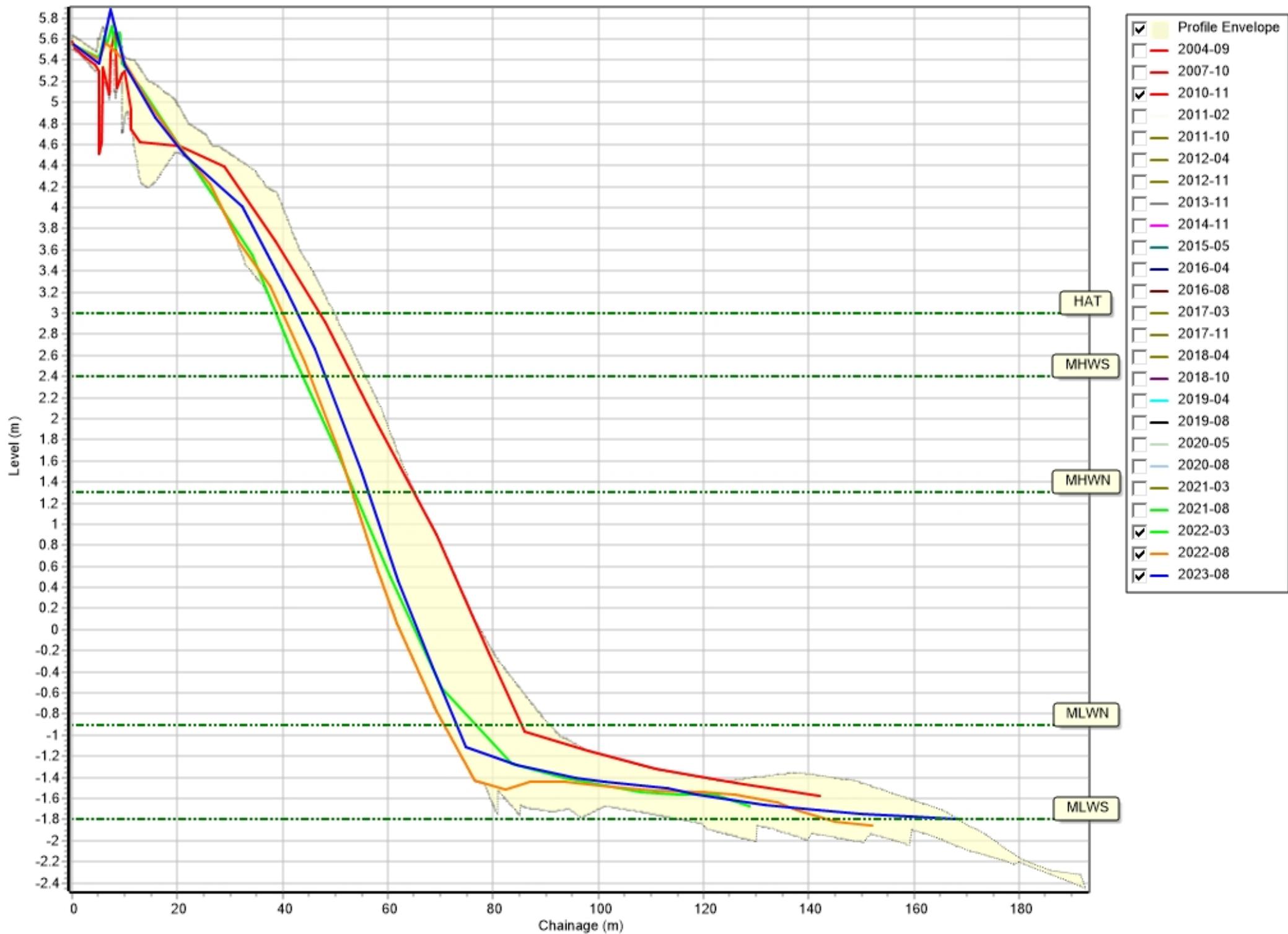
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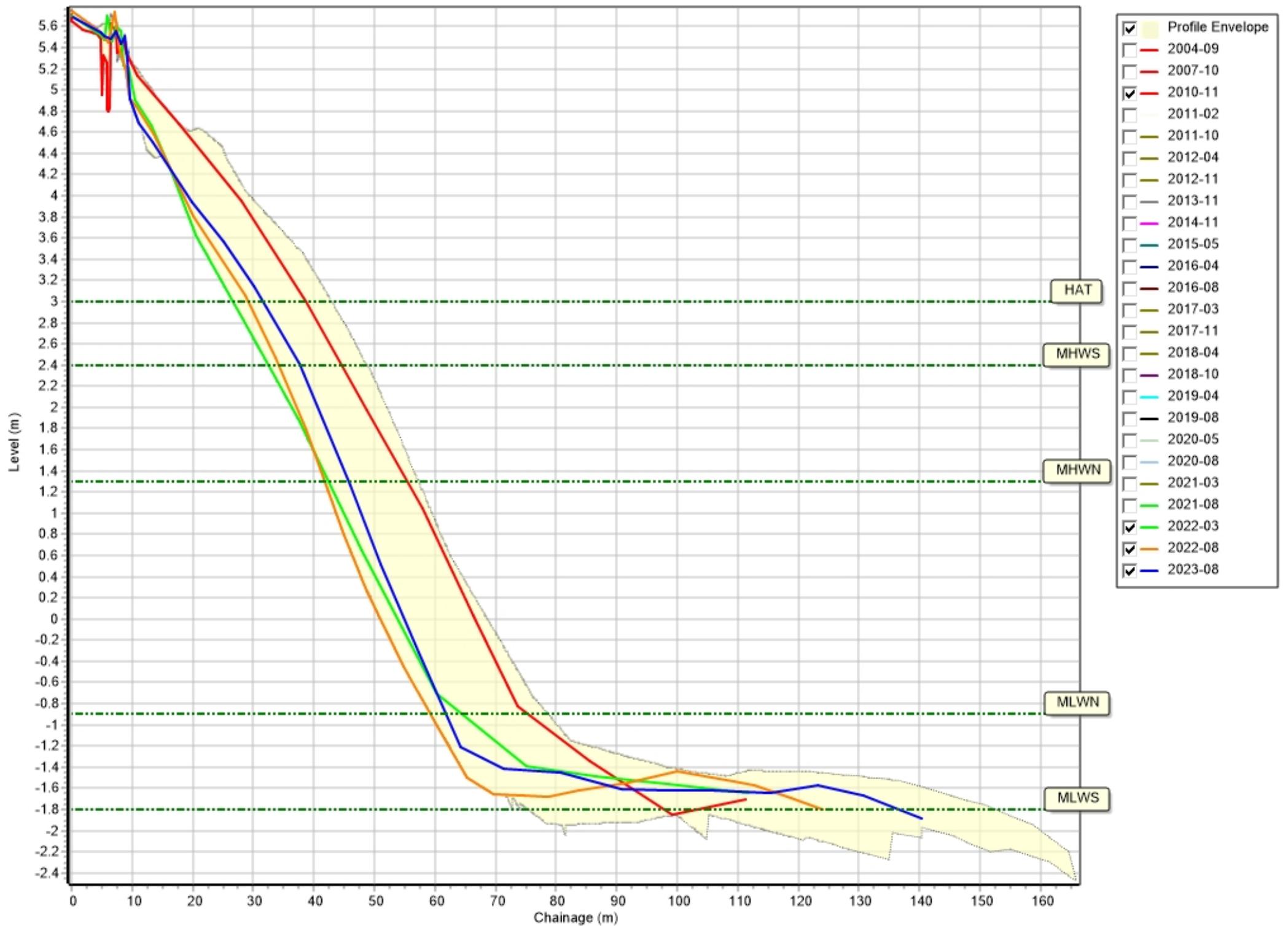
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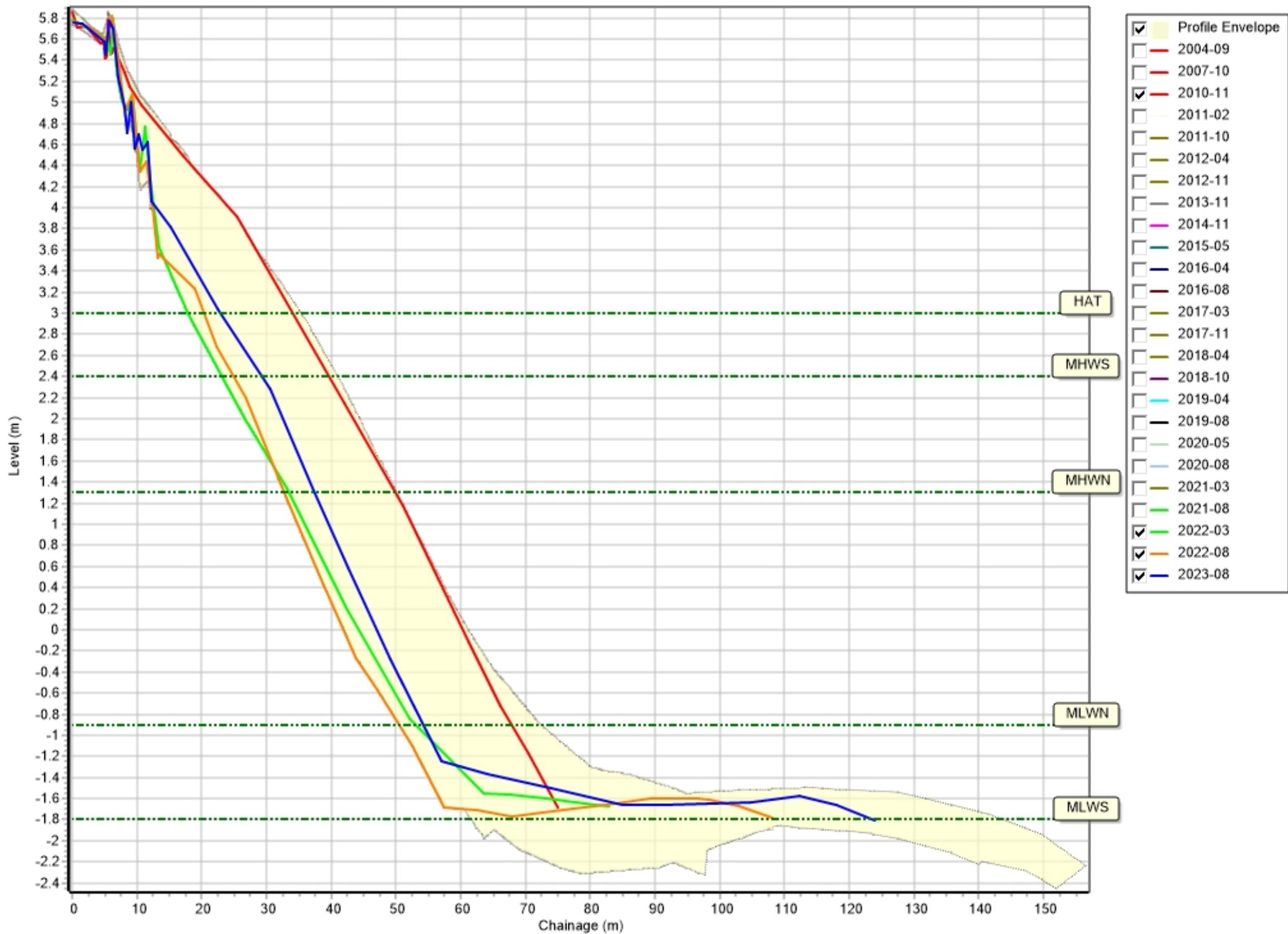
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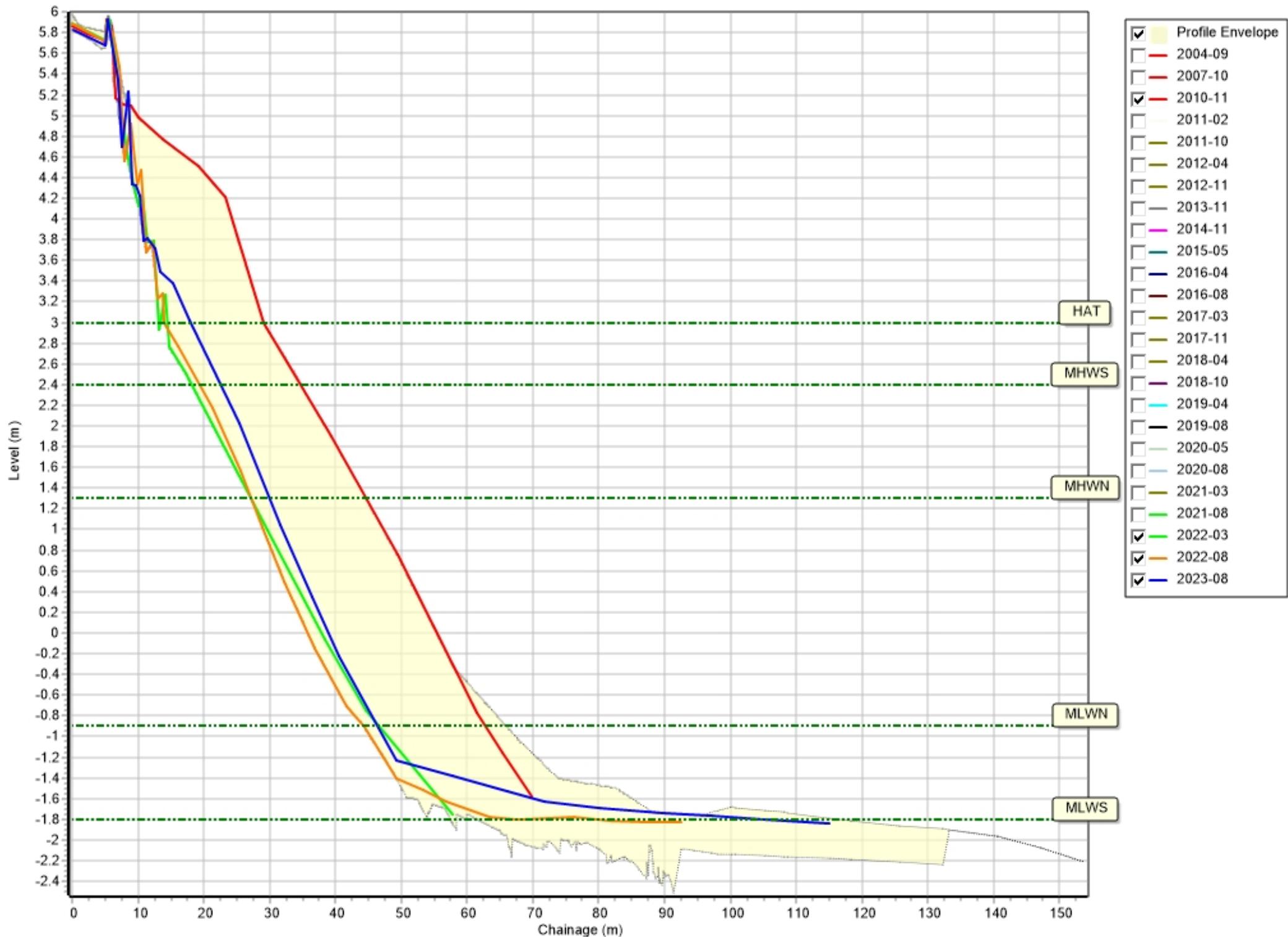
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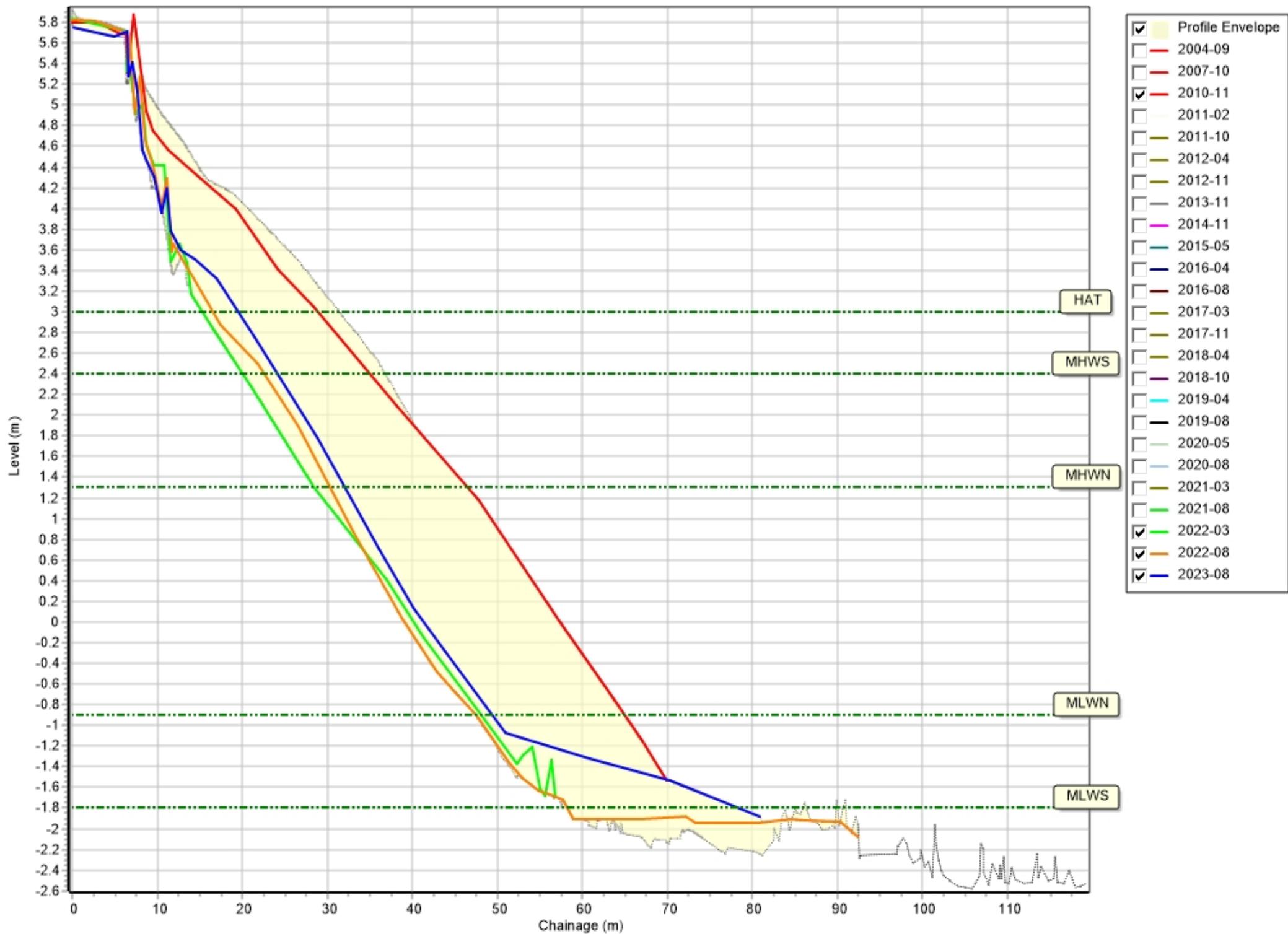
Profiles: 1aNWB23



Profiles: 1aNWB24



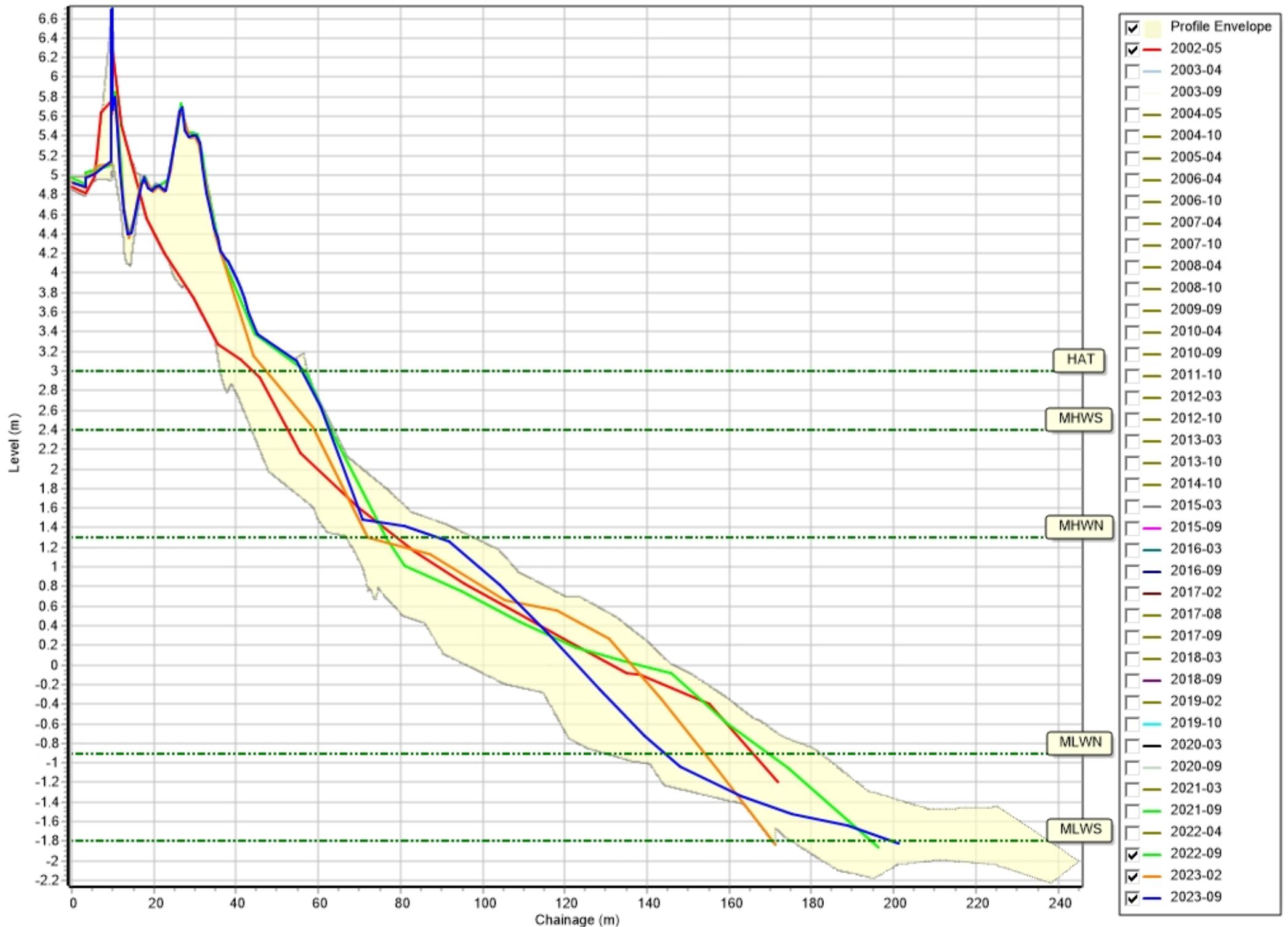
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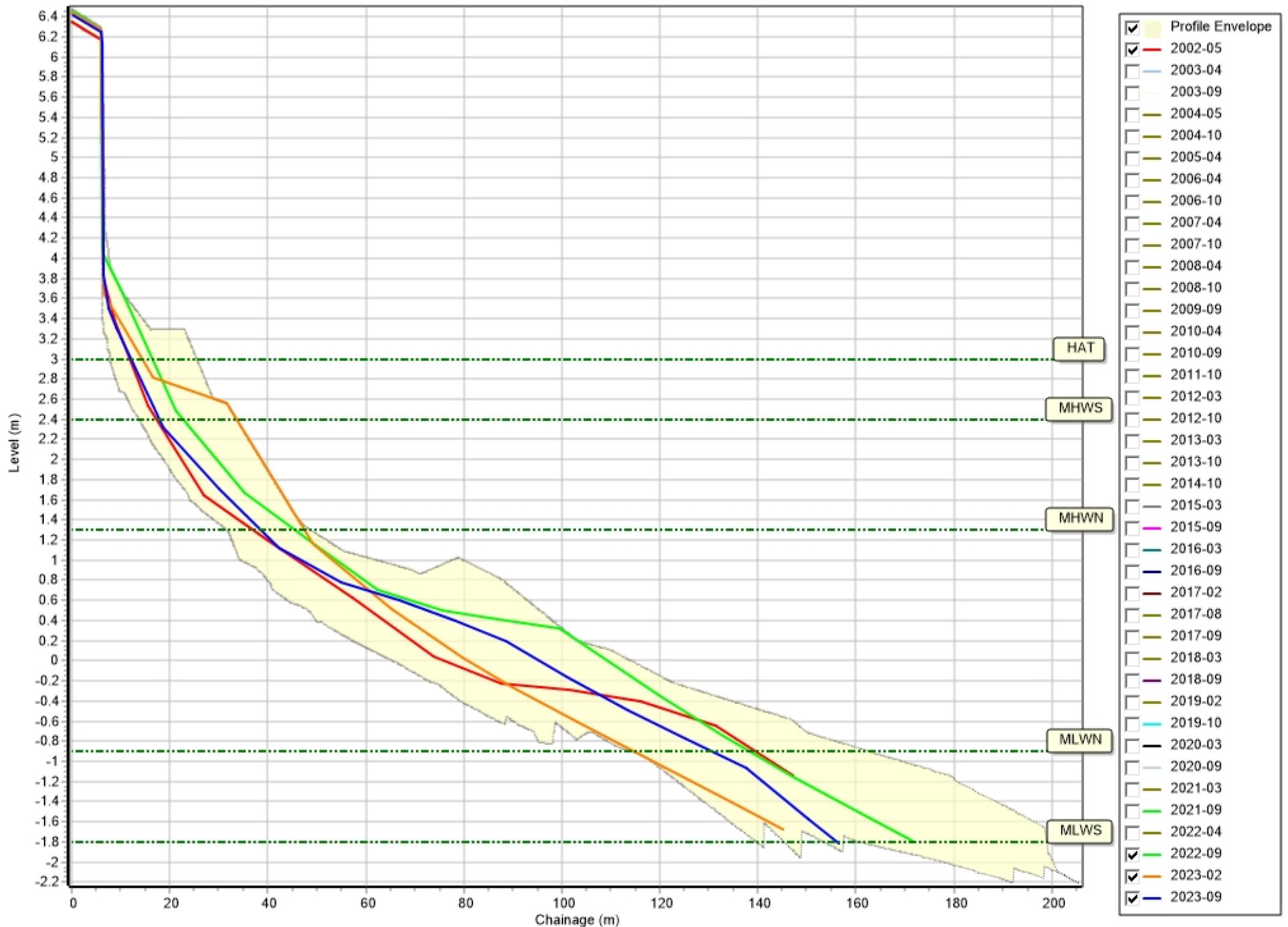
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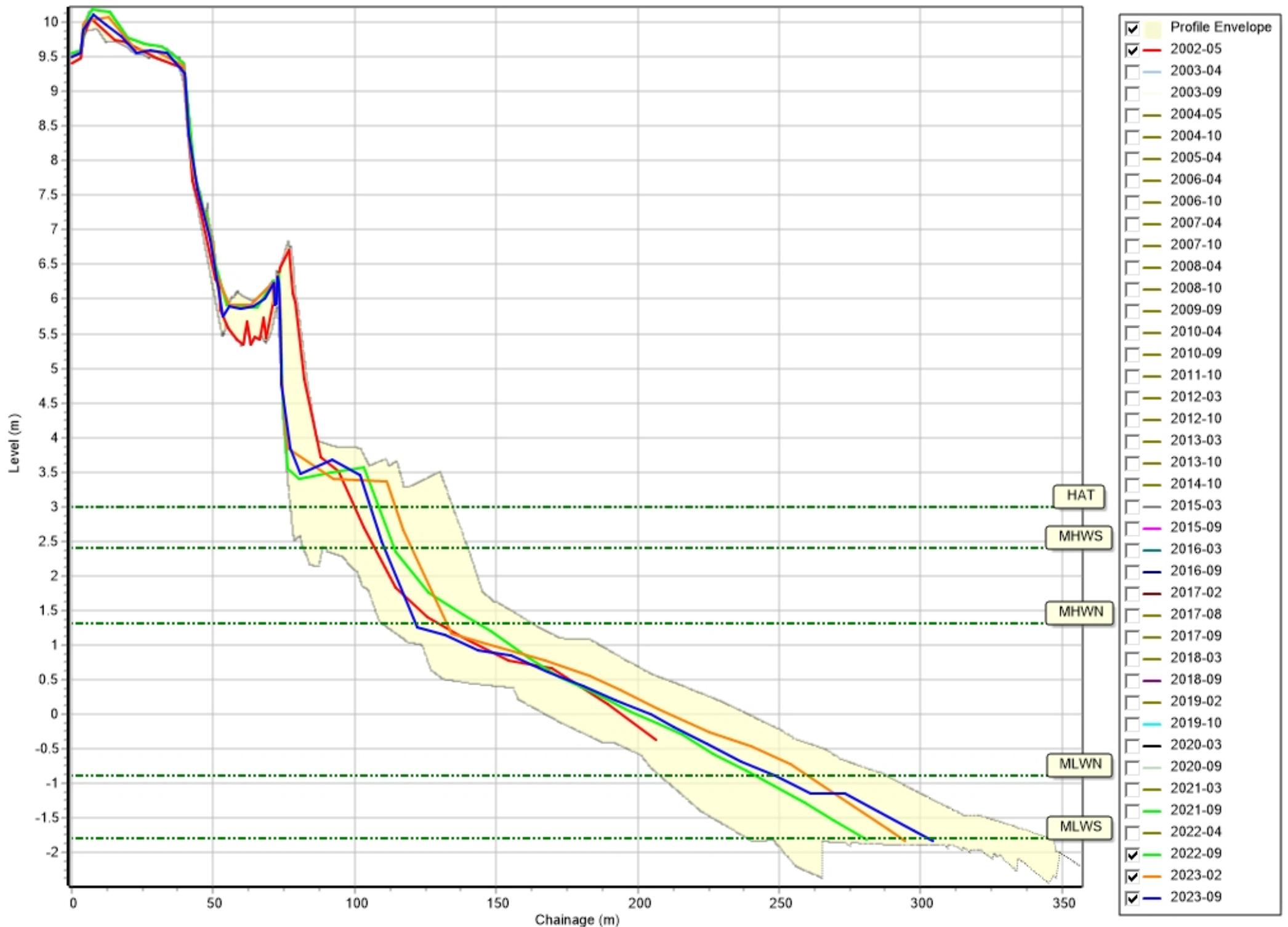
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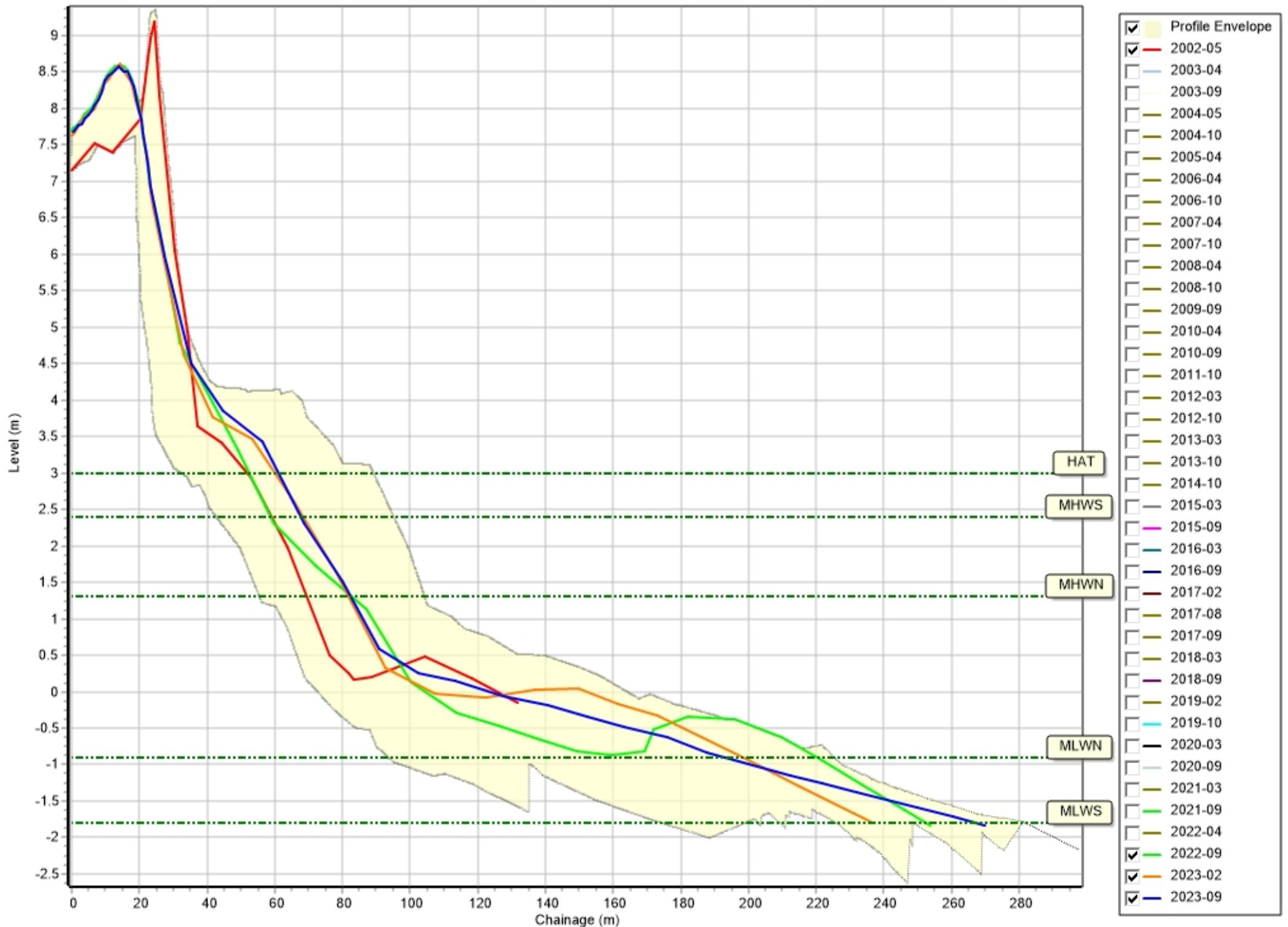
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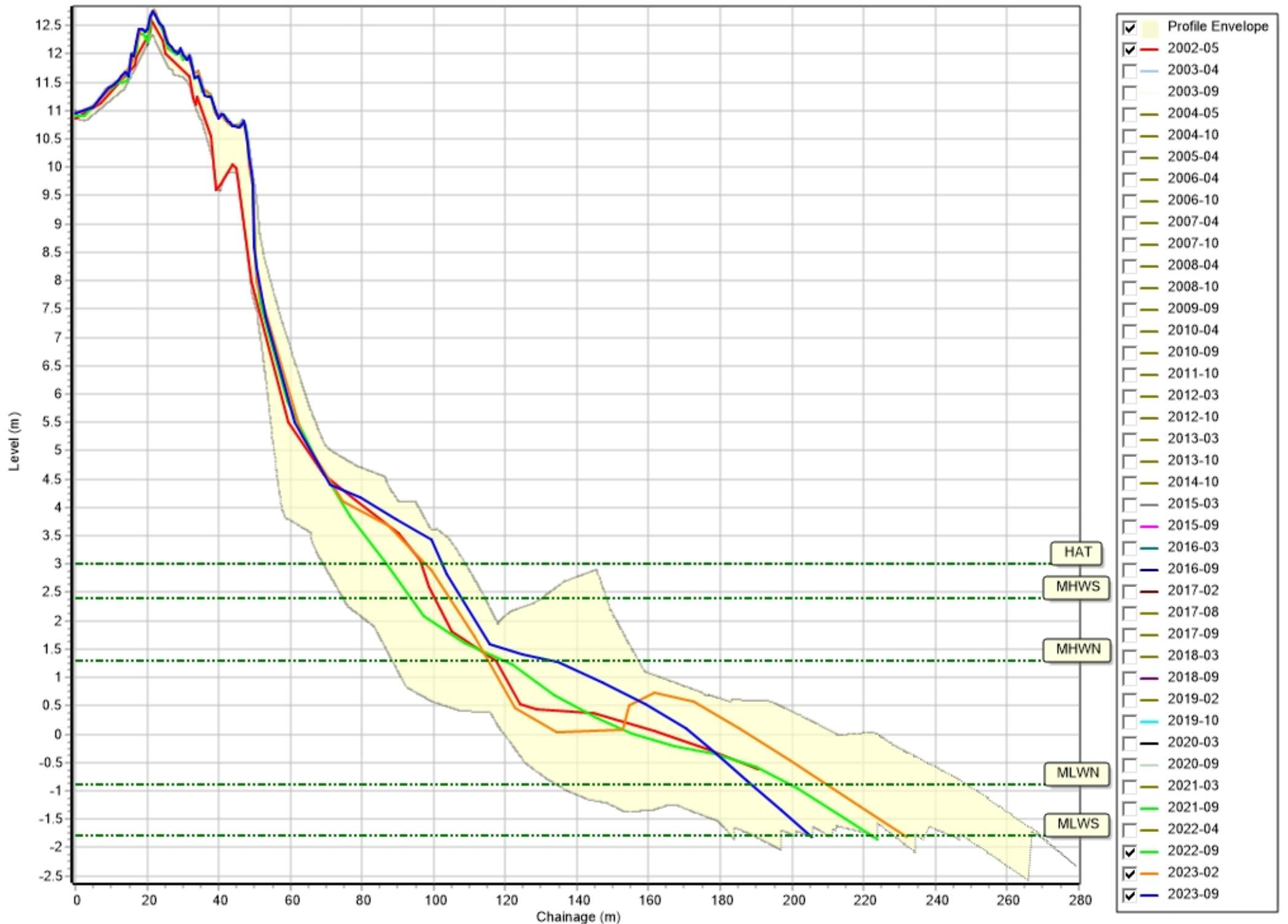
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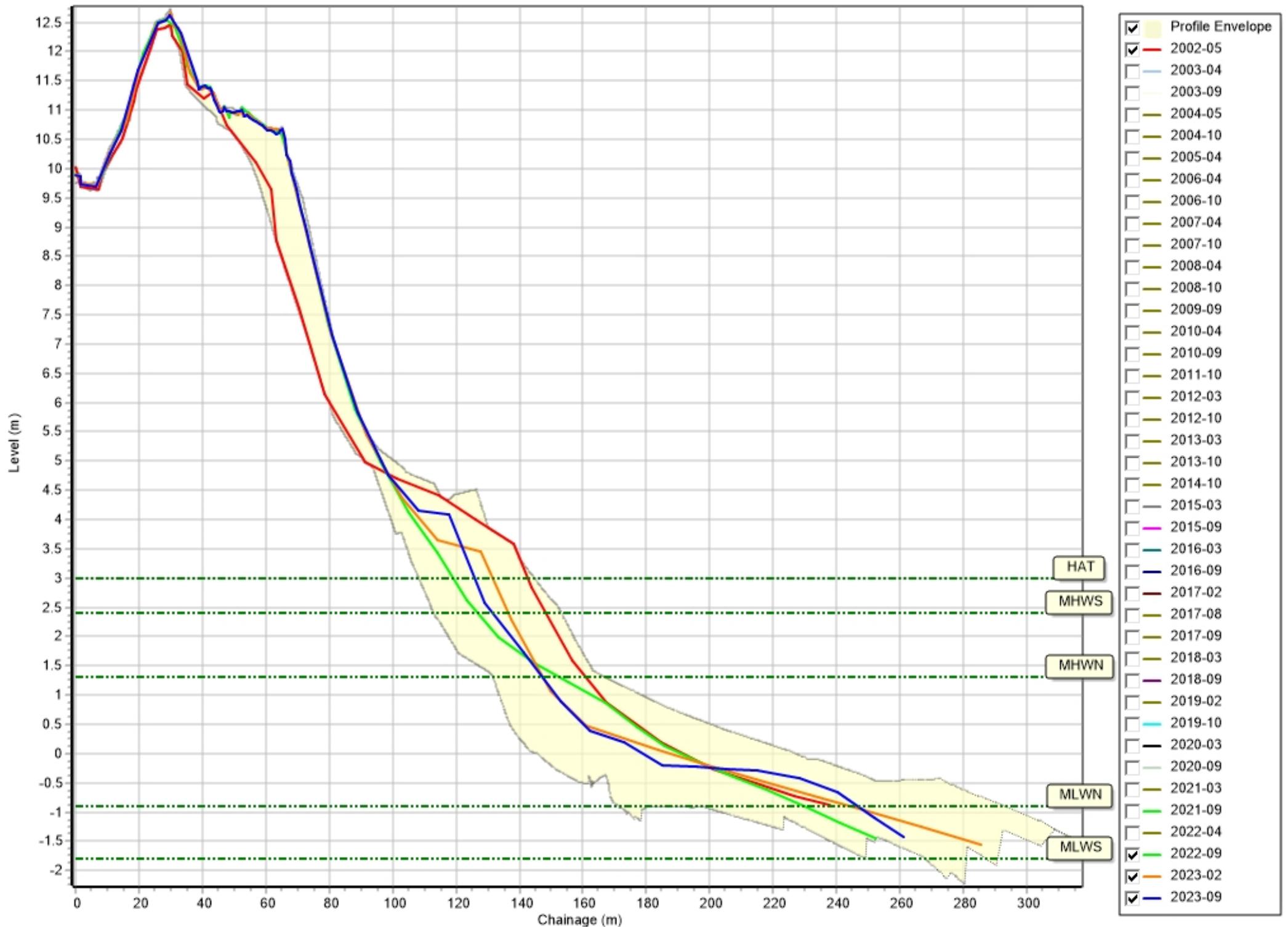
Profiles: 1aBVBC04



Profiles: 1aBVBC05

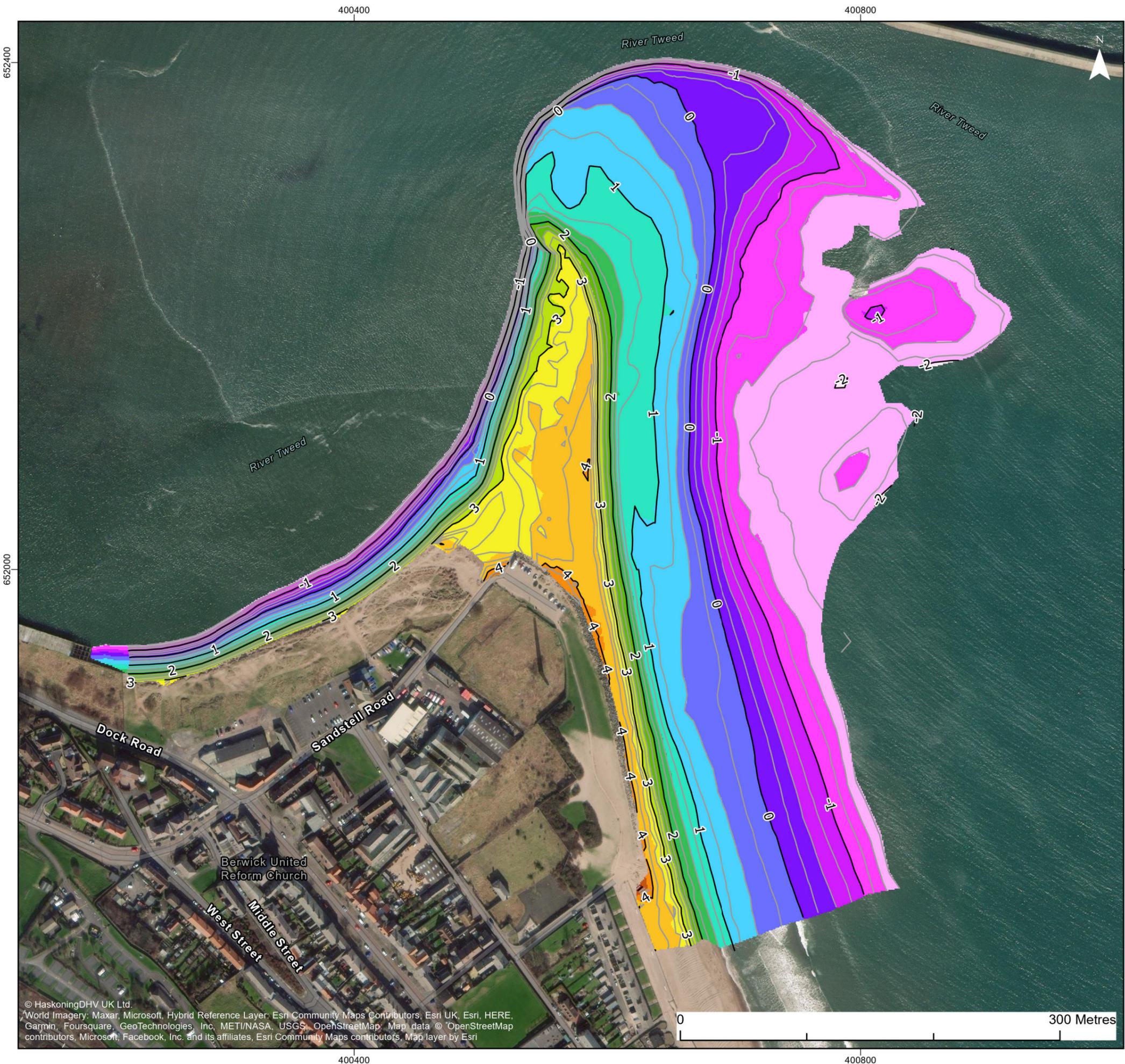


Profiles: 1aBVBC06



Appendix B

Topographic Survey



TOPOGRAPHIC SURVEY (August 2023)

Elevation (mOD)	Contours (mOD)*
-2.1 - -2	— 1.0m interval
-1.9 - -1.5	— 0.25m interval
-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 only cover sandy beach areas.

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

Title:

Appendix B - Map 1

Spittal A and B

Northumberland County Council Frontage

Report:

Analytical Report
'Full Measures' Survey 2023

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	20/09/2023	TC	AS	A3	1:3,000

Co-ordinate system: British National Grid



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TOPOGRAPHIC SURVEY (August 2023)

Elevation (mOD)	Contours (mOD)*
0.3 - 0.4	— 1.0m interval
0.5 - 0.6	— 0.25m interval
0.7 - 0.8	
0.9 - 1	* Contours only cover sandy beach areas.
1.1 - 1.2	
1.3 - 1.4	
1.5 - 1.6	
1.7 - 1.8	
1.9 - 2	
2.1 - 2.2	
2.3 - 2.4	
2.5 - 2.6	
2.7 - 2.8	
2.9 - 3	
3.1 - 3.2	
3.3 - 3.4	
3.5 - 3.6	
3.7 - 3.8	

Client: North East Coastal Group	Project: Cell 1 Regional Coastal Monitoring Programme
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Title:
Appendix B - Map 2
Holy Island
Northumberland County Council Frontage

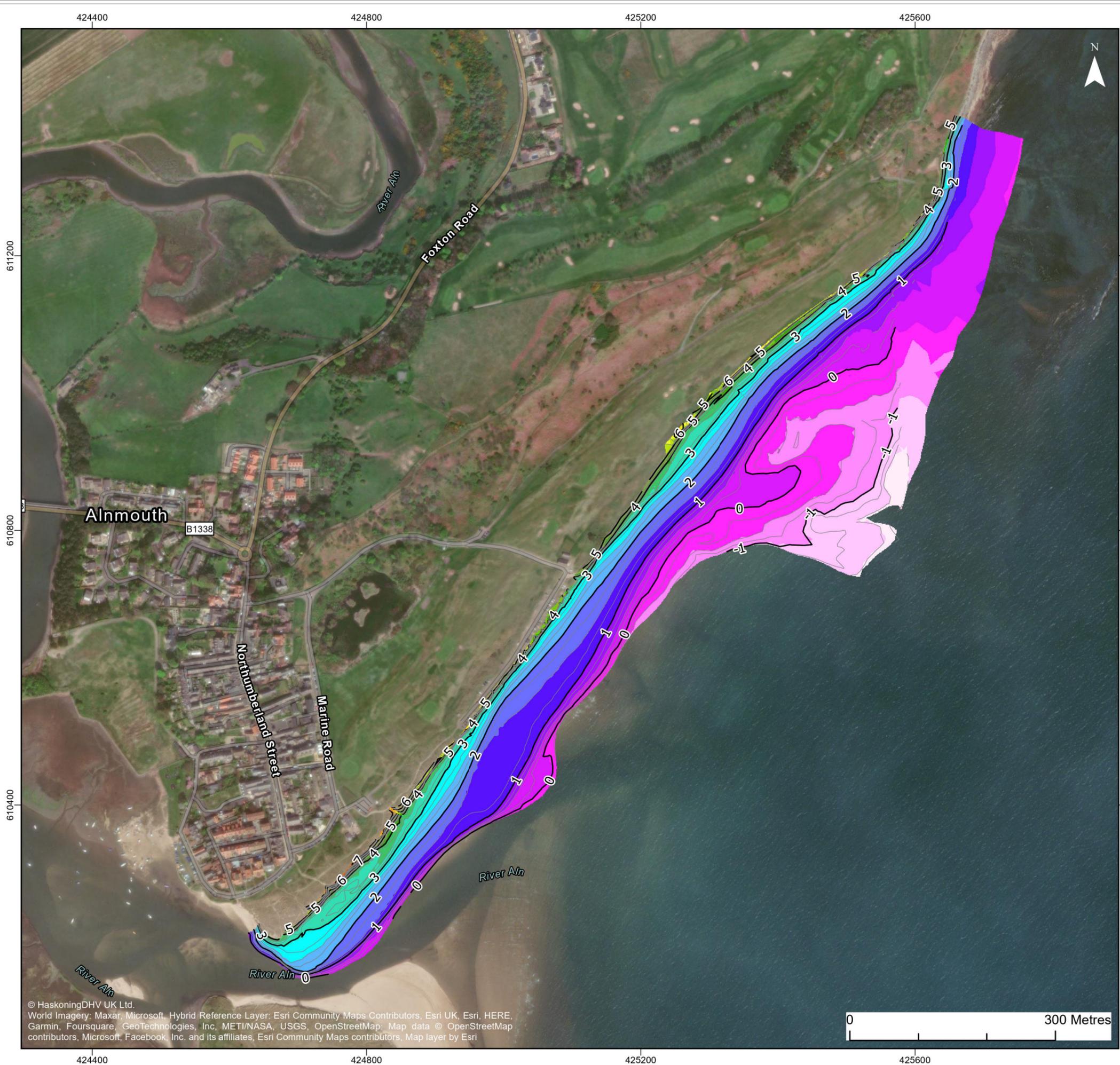
Report:
Analytical Report
'Full Measures' Survey 2023

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

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TOPOGRAPHIC SURVEY (August 2023)

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
- 4.6 - 5
- 5.1 - 5.5
- 5.6 - 6
- 6.1 - 6.5
- 6.6 - 7
- 7.1 - 7.5
- 7.6 - 8
- 8.1 - 8.5

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

Alnmouth Bay

Northumberland County Council Frontage

Report:

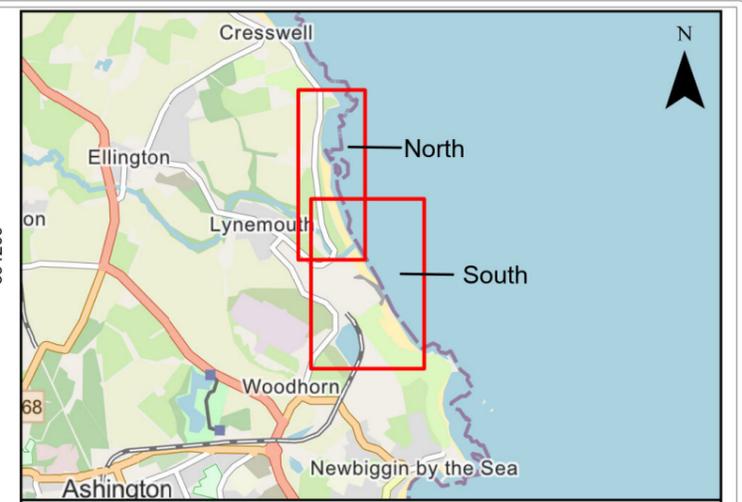
Analytical Report
 'Full Measures' Survey 2023

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	20/09/2023	TC	AS	A3	1:5,500

Co-ordinate system: British National Grid

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 Enhancing Society Together

North East Coastal Observatory



TOPOGRAPHIC SURVEY (August 2023)

Elevation (mOD)	Contours (mOD)*
-1.6 - -1.5	— 1.0m interval
-1.4 - -1	— 0.5m interval
-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 only cover sandy beach areas.

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

Title:

Appendix B - Map 4

LYNEMOUTH

Northumberland County Council Frontage

Report:

Analytical Report
'Full Measures' Survey 2023

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	17/10/2023	TC	AS	A3	1:8,000

Co-ordinate system: British National Grid




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TOPOGRAPHIC SURVEY (August 2023)

Elevation (mOD)	Contours (mOD)*
-1.8 - -1.5	— 1.0m interval
-1.4 - -1	— 0.25m interval
-0.9 - -0.5	
-0.4 - 0	* Contours only cover sandy beach areas.
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	
6.6 - 7	

Client: North East Coastal Group	Project: Cell 1 Regional Coastal Monitoring Programme
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Title:
Appendix B - Map 5
Newbiggin Bay
Northumberland County Council Frontage

Report:
Analytical Report
'Full Measures' Survey 2023

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	20/09/2023	TC	AS	A3	1:5,000

Co-ordinate system: British National Grid



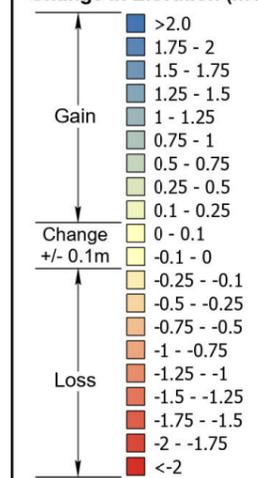
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Difference between topographic surveys

(Mar 2023 to Aug 2023)

Change in Elevation (mOD)



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

Title:

Appendix B - Map 6

Spittal A and B

Northumberland County Council Frontage

Report:

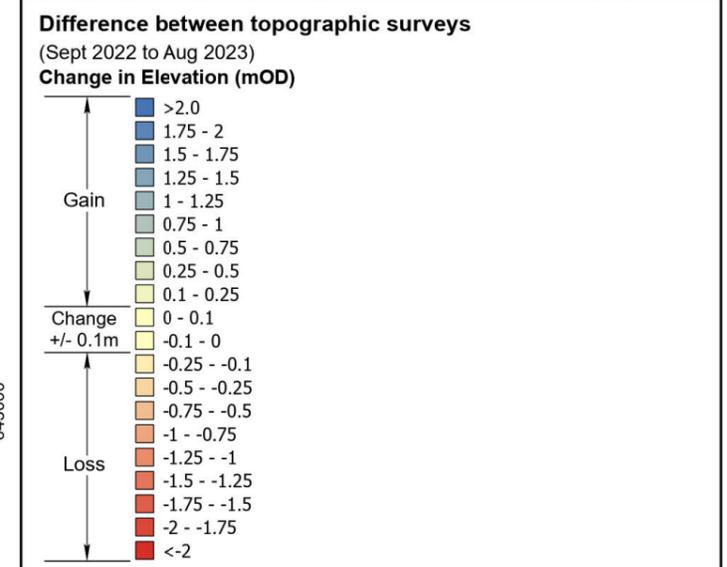
Analytical Report
'Full Measures' Survey 2023

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	20/09/2023	TC	AS	A3	1:3,000

Co-ordinate system: British National Grid



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Client: North East Coastal Group	Project: Cell 1 Regional Coastal Monitoring Programme
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Title:
Appendix B - Map 7
Holy Island
Northumberland County Council Frontage

Report:
Analytical Report
'Full Measures' Survey 2023

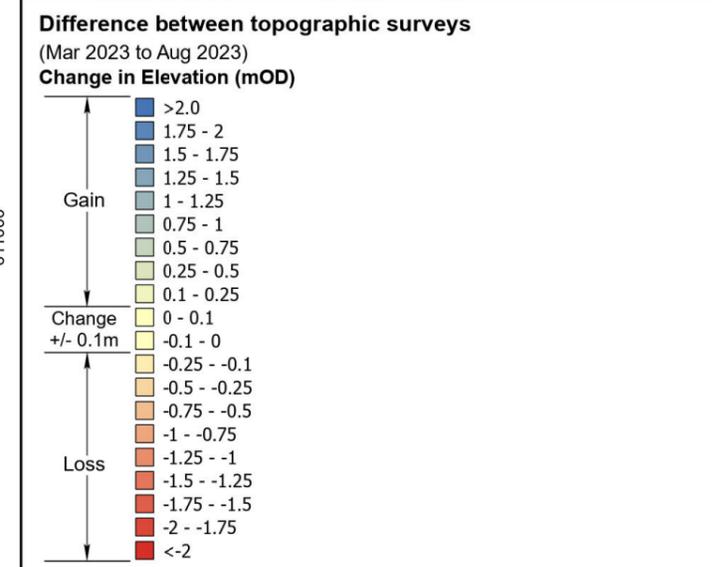
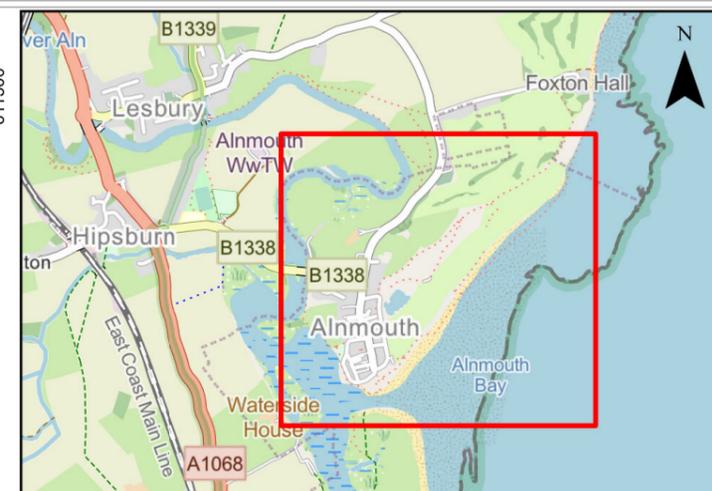
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	20/09/2023	TC	AS	A3	1:7,000

Co-ordinate system: British National Grid



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

Title:

Appendix B - Map 8

Alnmouth Bay

Northumberland County Council Frontage

Report:

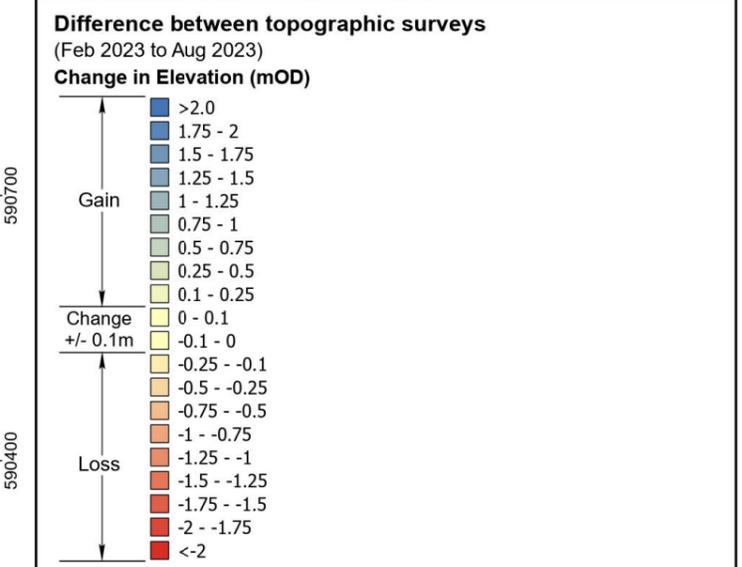
Analytical Report
'Full Measures' Survey 2023

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Co-ordinate system: British National Grid



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

Title:

Appendix B - Map 9

LYNEMOUTH

Northumberland County Council Frontage

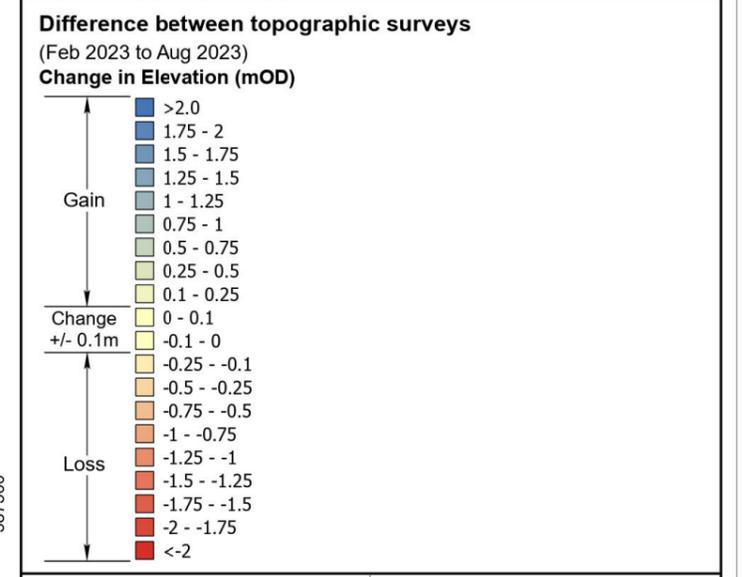
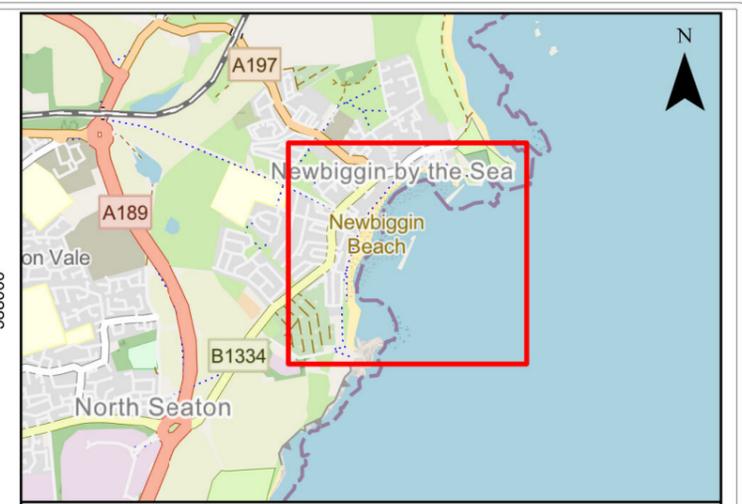
Report:

Analytical Report
'Full Measures' Survey 2023

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	17/10/2023	TC	AS	A3	1:8,000

Co-ordinate system: British National Grid





Client: North East Coastal Group	Project: Cell 1 Regional Coastal Monitoring Programme
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Title:
Appendix B - Map 10
Newbiggin Bay
Northumberland County Council Frontage

Report:
Analytical Report
'Full Measures' Survey 2023

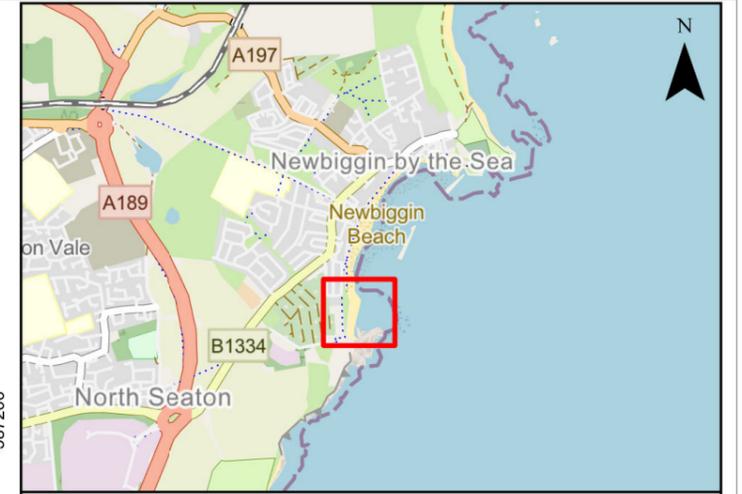
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	20/09/2023	TC	AS	A3	1:5,000

Co-ordinate system: British National Grid

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Appendix C

Sand Extent Survey



SAND EXTENT

— Autumn 2023	— Autumn 2011
— Spring 2023	— Spring 2012
— Autumn 2022	— Autumn 2012
— Spring 2022	— Spring 2013
— Autumn 2021	— Autumn 2013
— Spring 2021	— Spring 2014
— Autumn 2020	— Autumn 2014
— Spring 2020	— Spring 2015
— Autumn 2019	— Autumn 2015
— Spring 2019	— Spring 2016
— Autumn 2018	— Autumn 2016
— Spring 2018	— Spring 2017
— Autumn 2017	□ Site of Special Scientific Interest (SSSI)

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

Title:
Appendix C - Map 1
Newbiggin-by-the-Sea Sand Extent
Northumberland County Council Frontage

Report:
Analytical Report
'Full Measures' Survey 2023

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	20/09/2023	TC	AS	A3	1:1,500

Co-ordinate system: British National Grid

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