



**Cell 1 Regional Coastal Monitoring Programme
Lynemouth 'Post Storm' Beach Monitoring Survey
Report 2023**



**Northumberland County
Council**

December 2023

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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.

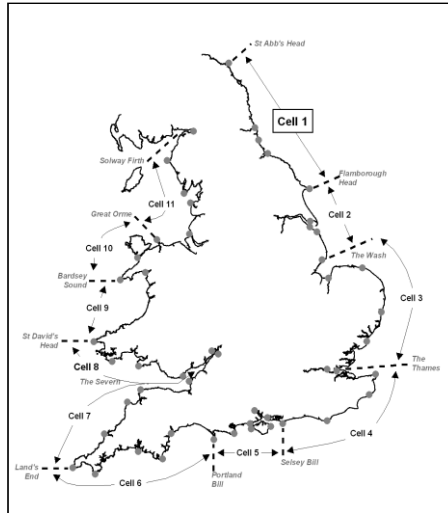


Figure 1 Sediment Cells in England and Wales

The programme commenced in its present guise in September 2008¹ and is managed by Scarborough Borough 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.

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 (Table 1). 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. The report presents the analysis of the post-storm surveys undertaken at Lynemouth.

Name	Date named	Date of impact on UK and/or Ireland and/or Netherlands
Agnes	25 September 2023	27 - 28 September 2023
Babet	16 October 2023	18 - 21 October 2023
Ciarán	29 October 2023	1 - 2 November 2023
Debi	12 November 2023	

Table 1 UK Named storms 2023 ([UK Storm Centre - Met Office](#))

Table 2 Analytical, Update and Overview Reports Produced to Date

Year		Full Measures		Partial Measures		Post Storm		Cell 1 Overview Report
		Survey	Analytical Report	Survey	Update Report	Survey	Post Storm 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 23	In Progress	-	-	Nov 23	Dec 23	-

(*) The present report provides an analysis of the 2023 Post Storm survey for the Lynemouth frontage.

1. Introduction

1.1 Study Area

This report presents the Post Storm Walkover Inspection for Lynemouth.

1.2 Methodology

Along the Lynemouth frontage, the following post-storm surveys were undertaken:

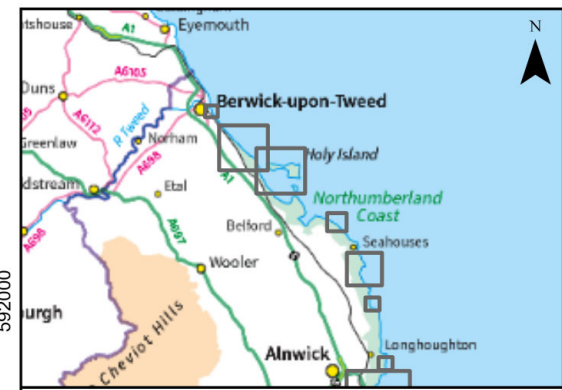
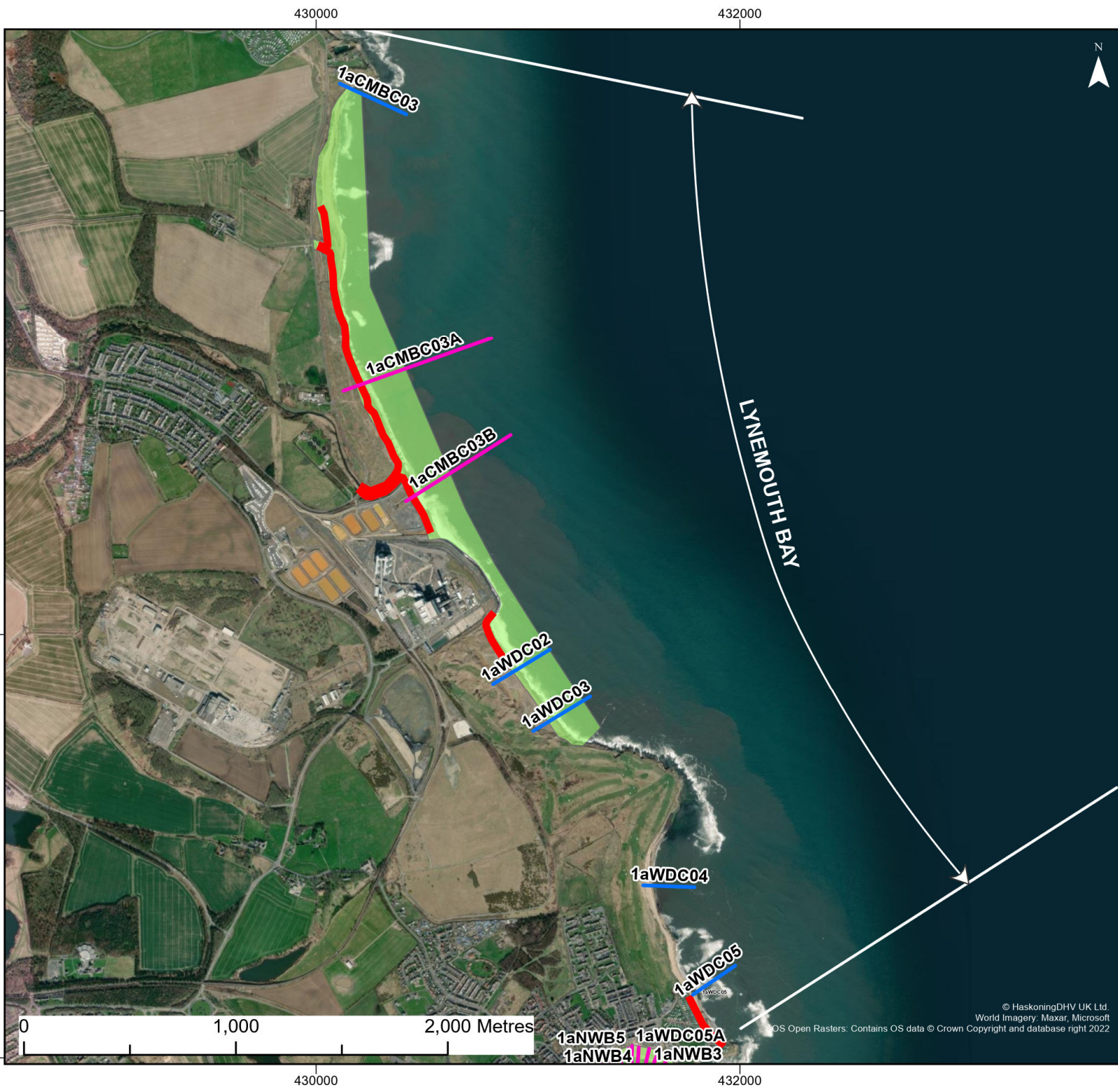
- Beach profile surveys along 5 transect lines (commenced 2002)
- Topographic survey along Lynemouth (commenced 2020)
- Colliery spoil edge survey (commenced 2020)

The location of these surveys is shown in **Figure 2**. The Post-Storm survey was undertaken along this frontage between 14 – 16th November 2023. During this time, the weather was overcast and raining heavily. The wind was force 4 from the south west. The sea state was rough.

The Analytical Report produced follows a standard structure, involving;

- 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 fill)
- yearly (Orange fill)
- 5 yearly (Light Purple fill)

- 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

LYNEMOUTH 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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North East Coastal Observatory

2. Analysis of Survey Data

2.1 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. Profiles 1aWDC04 and 1aWDC05 are located between Beacon Point and Newbiggin Point and were not covered as part of this post-storm survey.</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 crest of the colliery spoil cliff has receded landward by approximately 2.0m since the previous survey. This is corroborated by the survey report which notes 'cliff receding up to 2.0m as a result of the storm'. The upper beach profile has risen slightly between chainage 81-110m by up to 0.2m. Seaward of this point, the lower beach has lowered by up to 1.0m. Overall, the profile is at a low level compared to the range recorded from previous surveys, particularly the crest and face of the cliff which is at its most landward position recorded.</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 crest of the colliery spoil cliff has not changed significantly, however, the toe of the cliff has lowered by up to 1.4m to chainage -6m. The middle beach between chainages -6m and 47m has risen by up to 1.0m, switching to erosion on the lower beach by up to 0.25m. Overall, the profile is at a low level compared to the</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 post-survey in November 2023 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 post-storm survey in November 2023 of 37.0m overall. The rate of erosion has reduced slightly from 2.5m/yr to 2.3m/yr since the last survey. The crest of the colliery spoil cliff has been slowly retreating since 2007 by up to 2.0m.</p> <p>To the north of the power station, total recession between the first survey in autumn 2007 and the most recent survey in November 2023 is 65.0m. The average annual rate of erosion has increased from 3.7m/yr to 4.0m/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 November 2023 by up to 55m. The average annual rate of erosion has decreased from 3.2m/yr to</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>range recorded from previous surveys, particularly the toe of the colliery spoil cliff which is at its lowest level recorded. The colliery spoil berm has progressively retreated since surveys began, however has slowed somewhat compared to previous years.</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 50m remain largely unchanged. Some material has accumulated on the landward facing colliery spoil berm by up to 0.3m, whilst the crest of the colliery spoil berm has lowered by up to 0.3m. The colliery spoil cliff face between chainage 122-176m has accumulated up to 0.8m of sediment and is back to a similar position as in 2021. The lower beach seaward of chainage 176m has lowered by up to 0.8m. The area of colliery tipped spoil remains at its most landward position recorded and the beach profile is at one of its most landward positions recorded,</p> <p>1aWDC03 is located to the south of the Power Station and to the north of Beacon Point. Material has accumulated on the leeward side of the colliery spoil berm by up to 0.8m. The crest of the colliery spoil berm has lowered by up to 0.4m and the face of the colliery spoil berm has lowered by between 0.2m and 1.4m. The colliery spoil berm is now at its most landward position recorded (however the leeward side of the colliery spoil berm between chainages 35-85m is at its highest level recorded).</p>	<p>2.5m/yr at 1aWDC02 and increased from 1.8m/yr to 3.2m/yr at 1aWDC03.</p>
<p>Aug 2023 to Nov 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). This additional survey was undertaken in November 2023 to assess the impacts of three named storms that occurred in late September and early November 2023.</p> <p>A difference plot has also been produced using the DGM (Appendix B – Map 9) produced from the last topographic survey (Autumn 2023) and the present survey (Post Storm, November 2023).</p> <p>The plot shows the most significant change in the north of the bay is the high magnitude erosion at the toe of the colliery spoil berm (>2m) and in the lee of the rock outcrops at Headagee (up to 1.75m).</p>	<p>The beach topographic survey plot shows a landward retreat of the beach survey extent across the majority of the survey area. High magnitude erosion is concentrated in the lee of Headagee, at the mouth of the River Lyne and the south of the survey extent south of the Power Station.</p> <p>There is a remediation scheme to the north of the Power Station planned to commence in January 2024.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>The survey report notes that 'a lot of sand has been removed from the beach compared to the recent full measures survey exposing areas of rubble'. The rest of the beach in the north of the bay is dominated by patches of little change/low level erosion, with some isolated patches of accretion (up to 1.0m). Some of the accretion occurs on top of the colliery spoil berm which could reflect material that has been transported by storm waves / fallen from the cliffs behind. The survey report notes that a 'lot of debris has been washed ashore'. Erosion has occurred at the mouth of the River Lyne (up to 1.75m), and the survey report notes that 'the River Lyne was too deep to survey bed levels'.</p> <p>The plot for the south of the bay is similar to the north, in that it is dominated by erosion and minor change ($\pm 0.1\text{m}$) with isolated patches of accretion just south of the River Lyne and south of Lynemouth Power Station (1.5m). The most significant change in the south of the bay is at the southernmost end of the survey where high levels of erosion occur across the beach profile, reaching up to 1.75-2.0m.</p> <p>The beach extent in August 2023 (mapped as a dotted line) shows a much wider beach front compared to the present post-storm survey, except in the lee of the rock outcrops at Headagee which remains in a similar position.</p>	

Survey Date	Description of Changes Since Last Survey	Interpretation
November 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 up until autumn 2023, followed by the current post-storm survey in November 2023 (Figure 3).</p> <p>The results from the November 2023 Post Storm survey have been analysed against the August 2023 Full Measures survey to ascertain the impact of the recently named storms. The surveys show the colliery spoil edge has not changed from the northernmost extent of the survey to the cliff in the lee of Headagee since the previous survey.</p> <p>From Headagee to the cliff edge adjacent to the traveller's site, the cliff edge has retreated by up to 7.50m in places, although usually between 2 – 4.5m.</p> <p>The cliff edge between the traveller's site and the River Lyne has remained stable in the northern half, whilst the southern half has retreated by up to 10.0m. The cliff edge between the River Lyne and the Power Station has undergone a lower amount of retreat by up to 5.0m.</p> <p>The cliff edge to the south of the Power Station has retreated by between 1m in the north, increasingly to 11.5m of retreat in the southernmost survey area.</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 18.0m retreat). The northern part of the survey area has shown less movement with smaller sections of retreat up to 3.0m.</p>

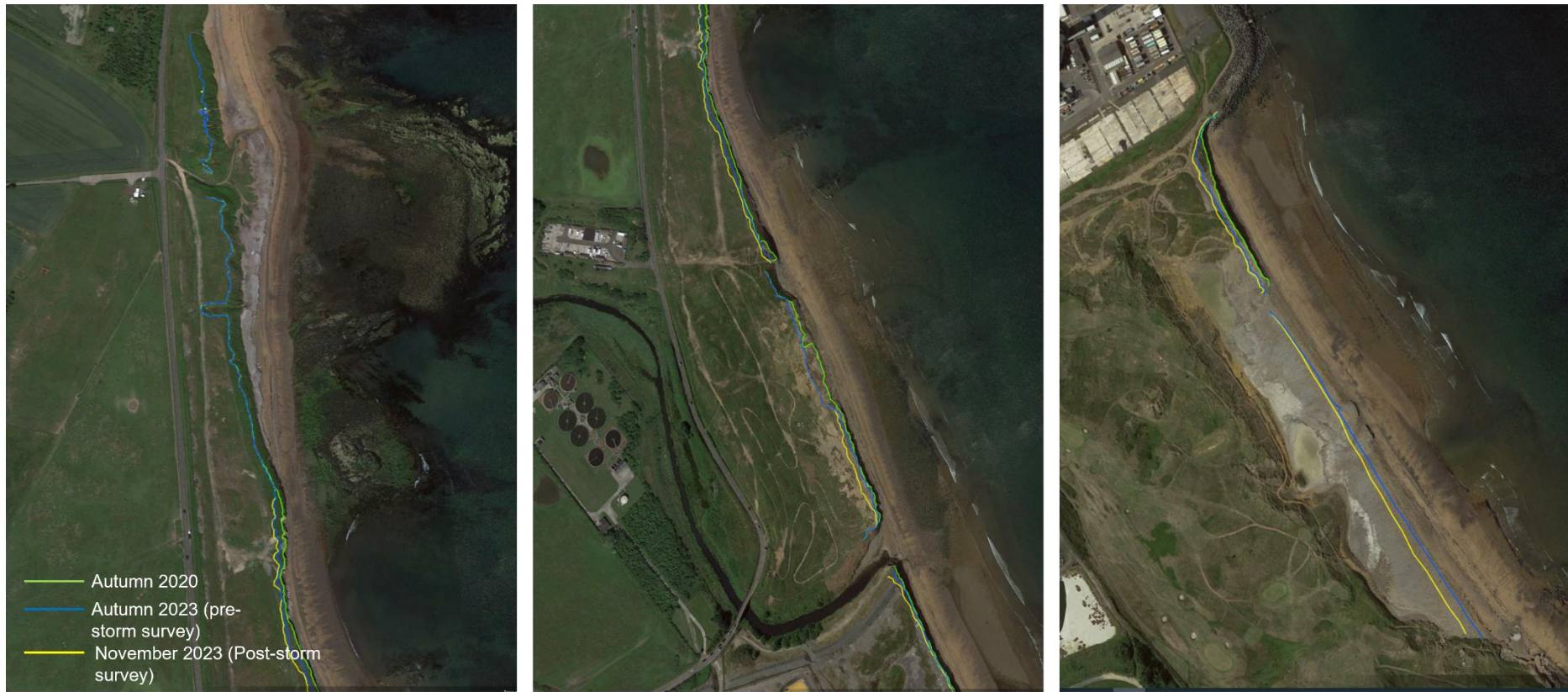


Figure 3 Lynemouth cliff top surveys in Autumn 2020, Autumn 2023 (pre-storm survey) and November 2023 (post-storm survey) (north: left, centre: middle, and south: right)

4. Problems Encountered and Uncertainty in Analysis

No major problems were encountered during the survey (as per the survey reports).

5. Conclusions and Areas of Concern

The beach profile surveys show a significant retreat of the cliff top has occurred at some profiles, particularly at profile 1aCMBC03A where the cliff has retreated by up to 2.0m. The profiles also show a large retreat of the toe of the colliery spoil berm, by up to 1.4m at profile 1aCMBC03B. This is also evident in Map 2 of Appendix B. The topographic survey plot shows a large landward retreat of the beach extent in general from the last survey.

The survey report notes that 'a lot of sand has been removed from the beach, exposing areas of rubble' and that there are 'noticeable changes to the cliff top line post-storm'. The storms have washed up a lot of debris which, from pictures, looks to contain plastic waste which could be progressively returned to the sea over the winter period unless cleared by the Council as part of their ongoing inspection and clear-up regime.

Until the profiles start to return to an equilibrium following a period of calm, it is unclear how much material was lost out of the system as a result of the storms. Regardless, it is likely that the colliery spoil berm will continue to retreat, accelerating following stormy periods and eventually reaching the backing cliffs. For example, the crest of the colliery spoil berm at Profile WDC02 is within 65m of these natural cliffs in 2023 compared to 120m in 2002.

Appendices

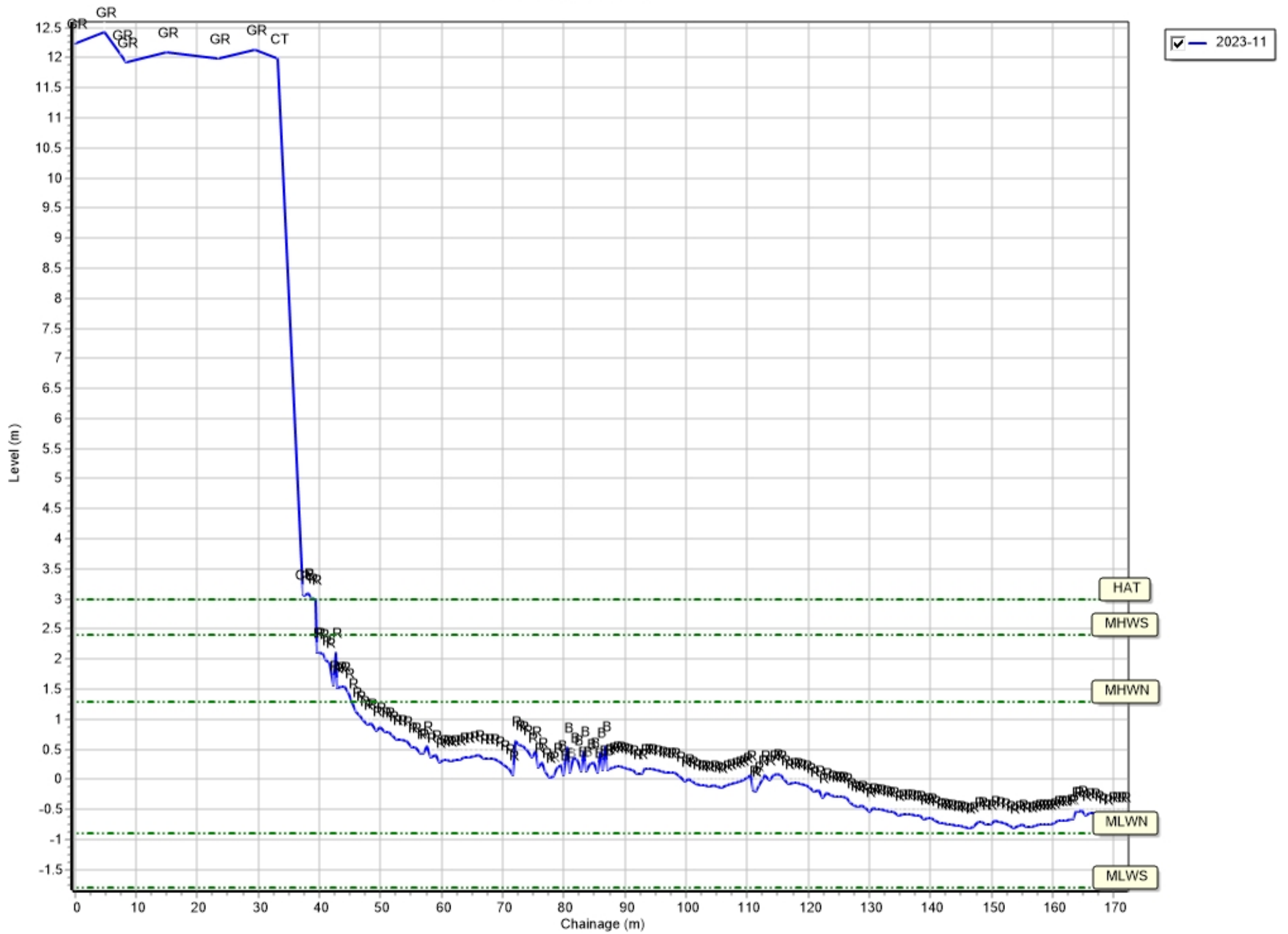
Appendix A

Beach Profiles

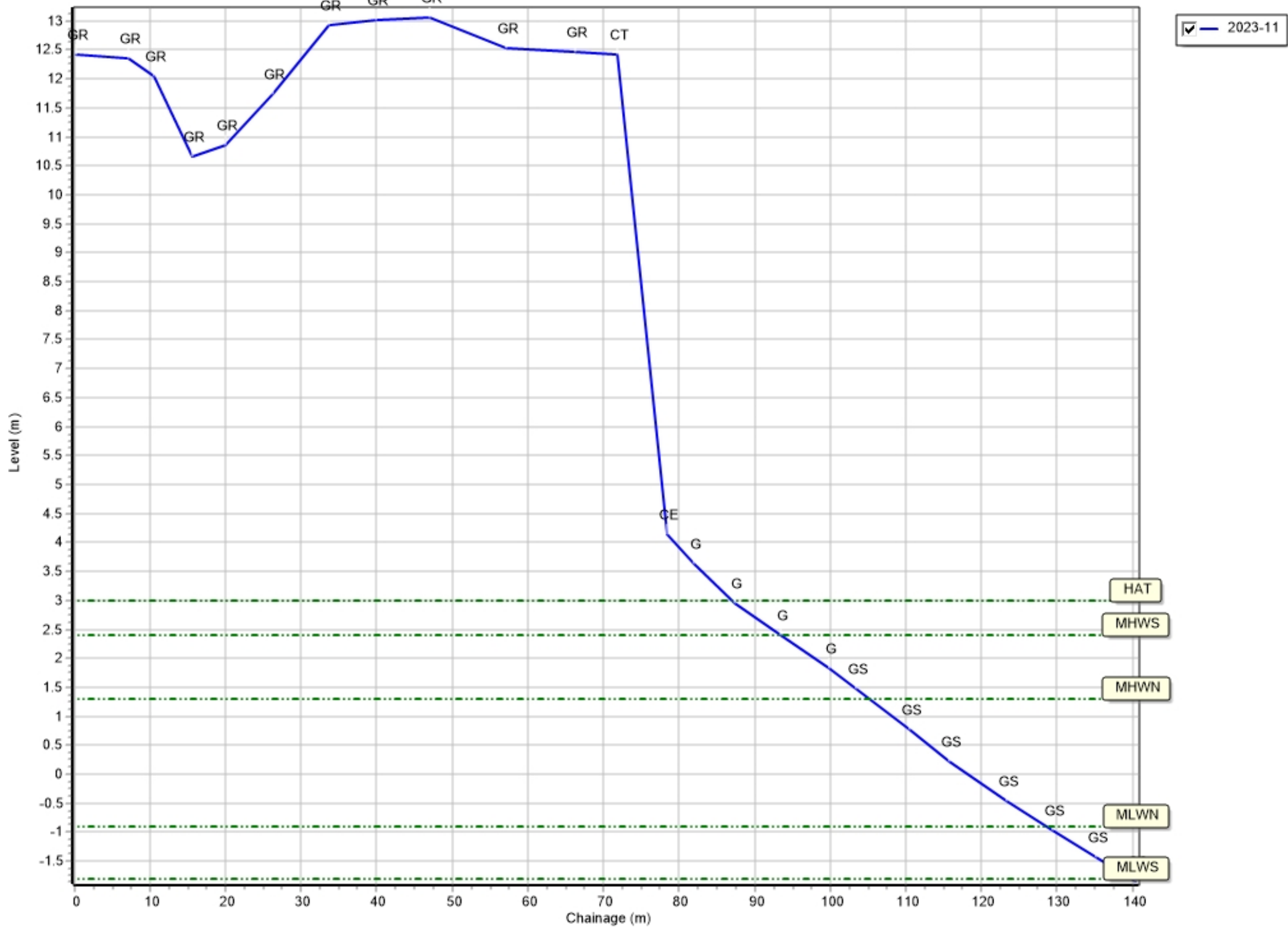
The following sediment feature codes are used on some profile plots:

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

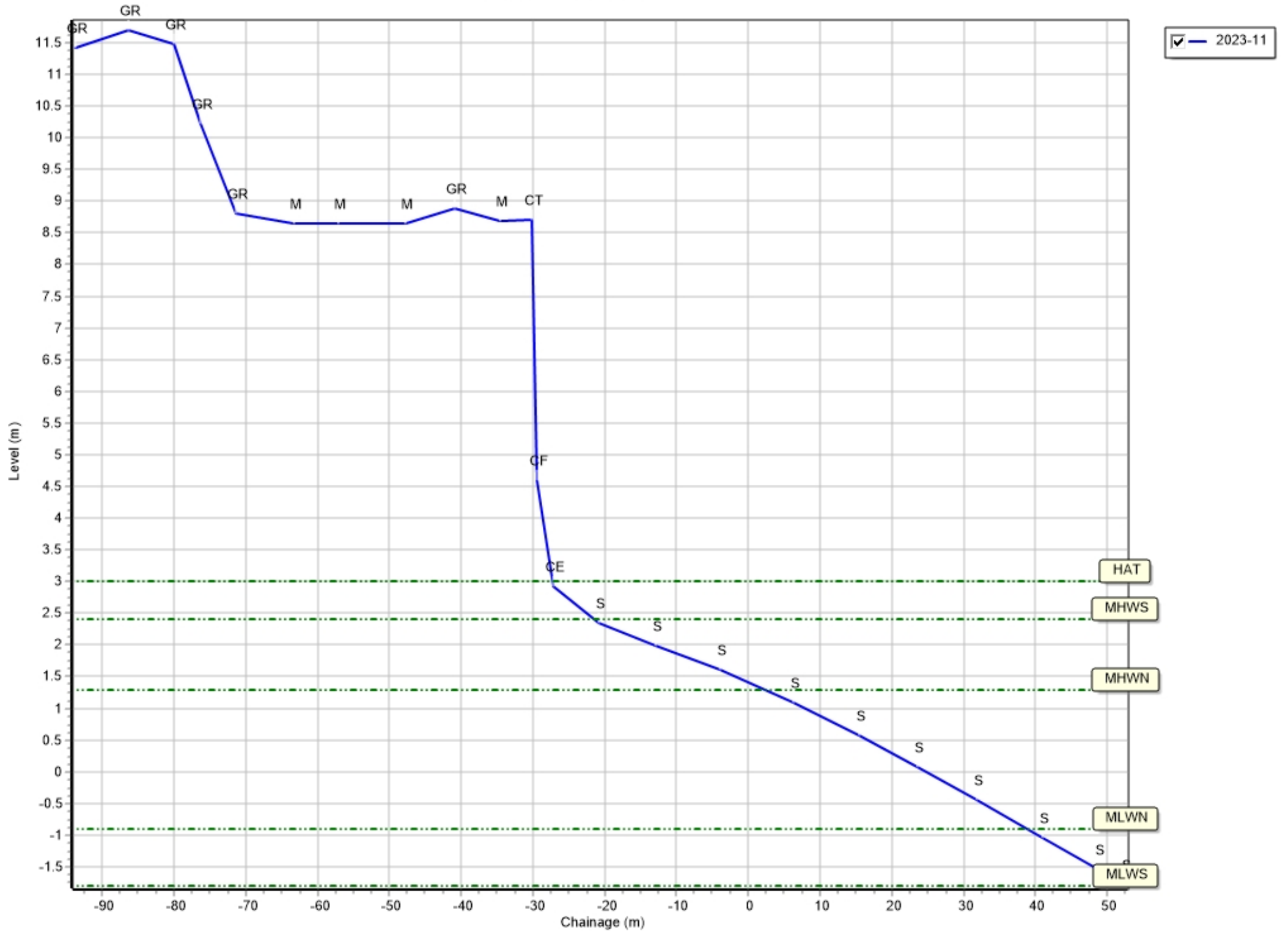
Profiles: 1aCMBC03



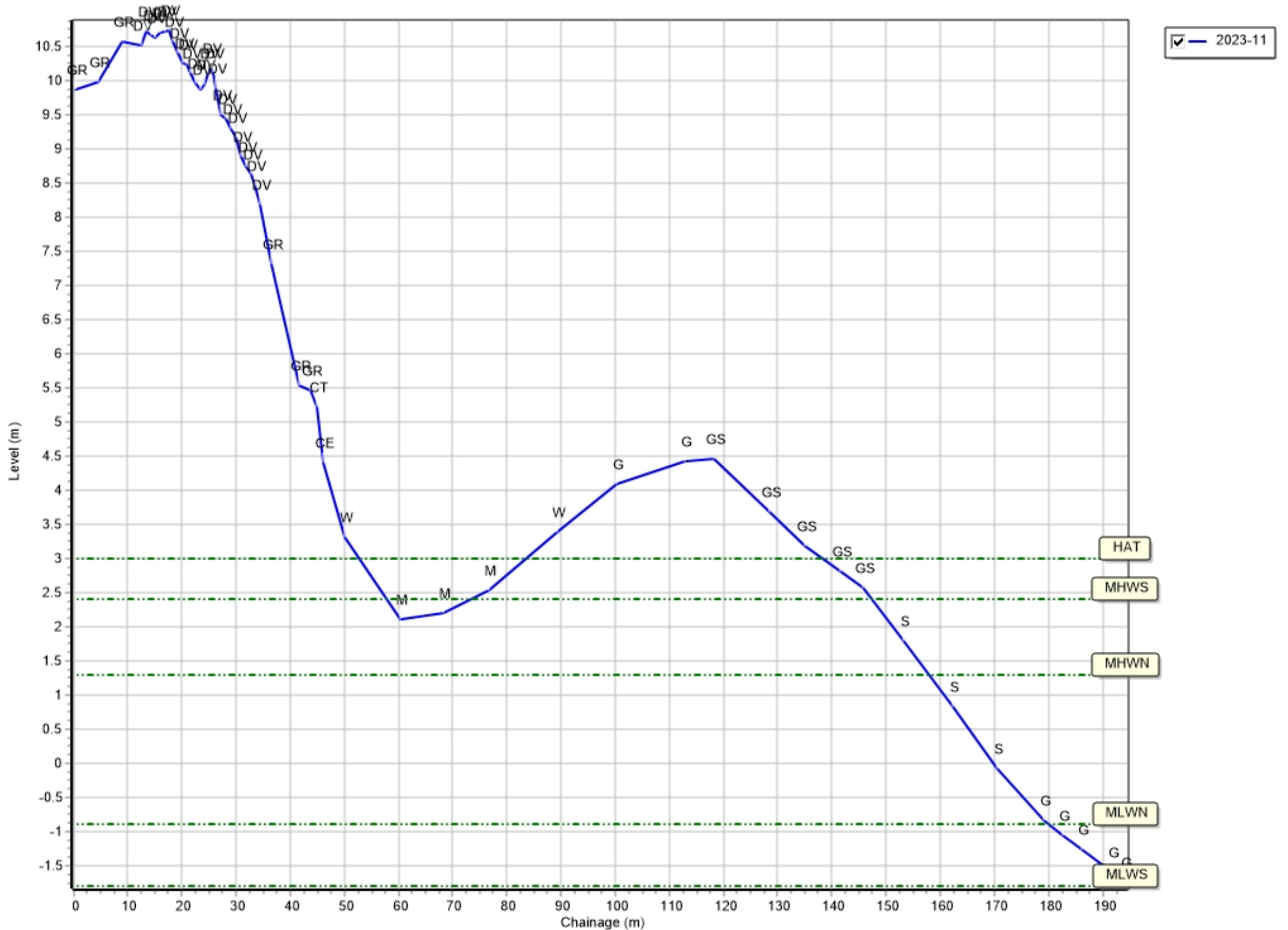
Profiles: 1aCMBC03A



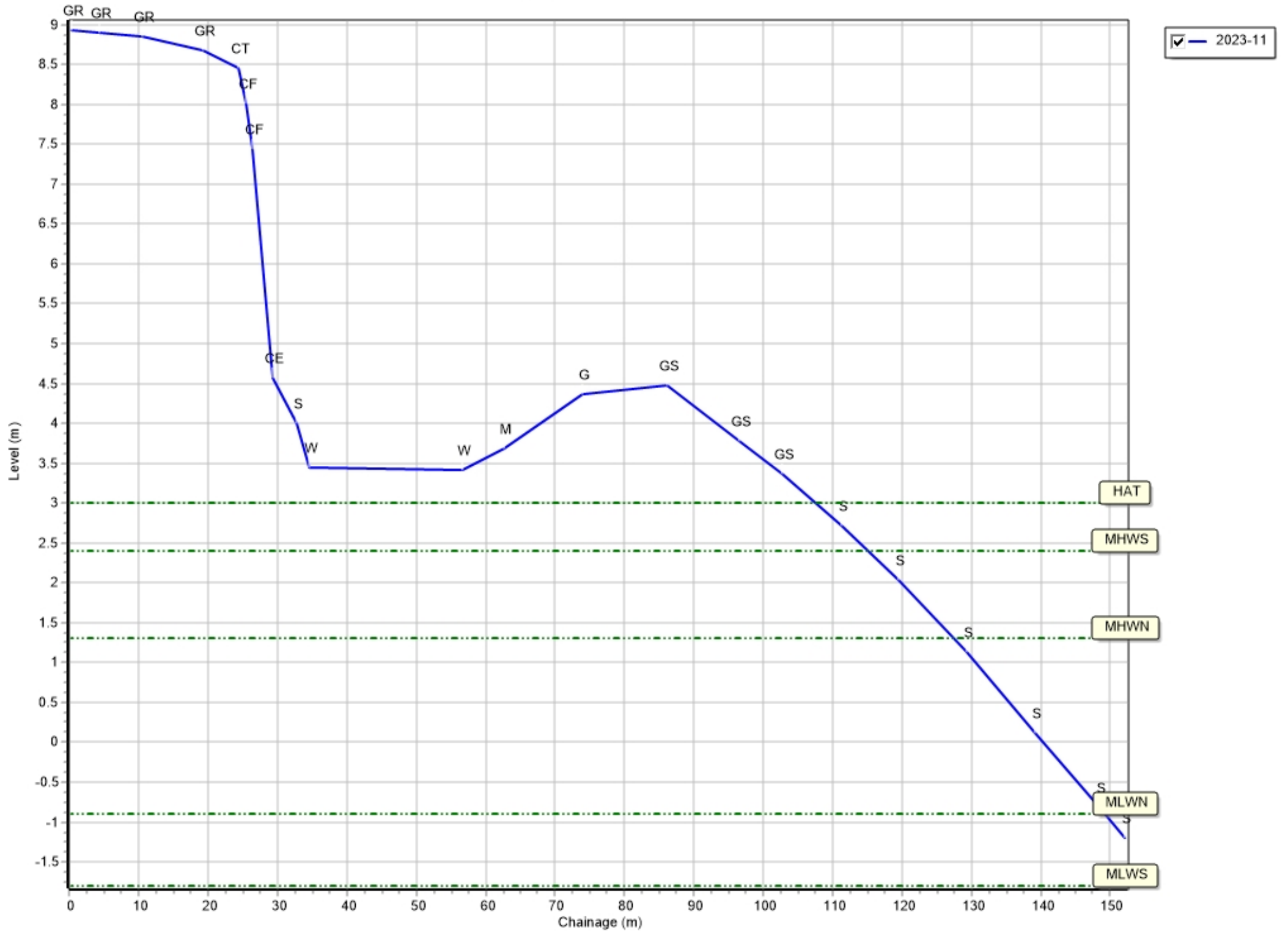
Profiles: 1aCMBC03B



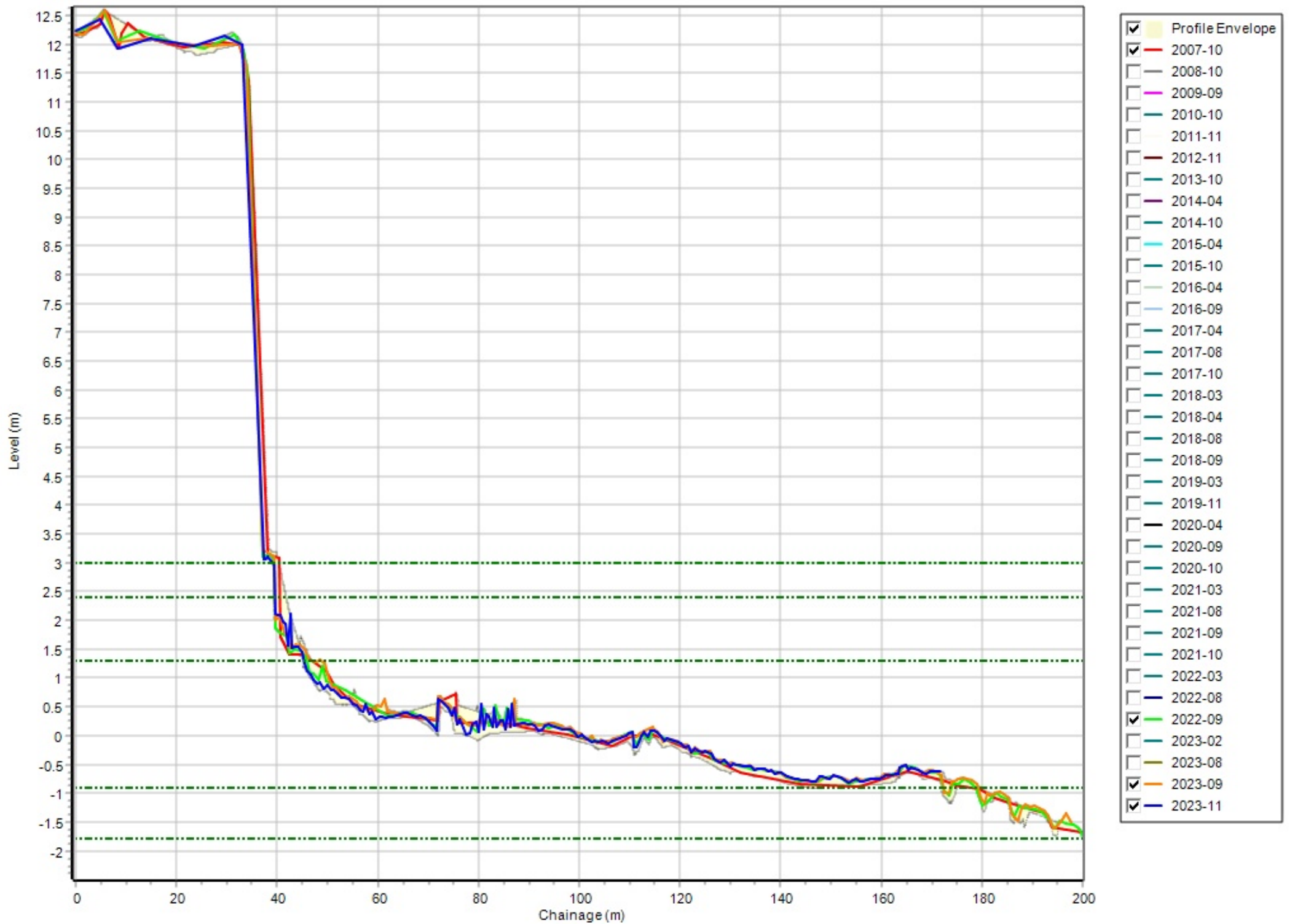
Profiles: 1aWDC02



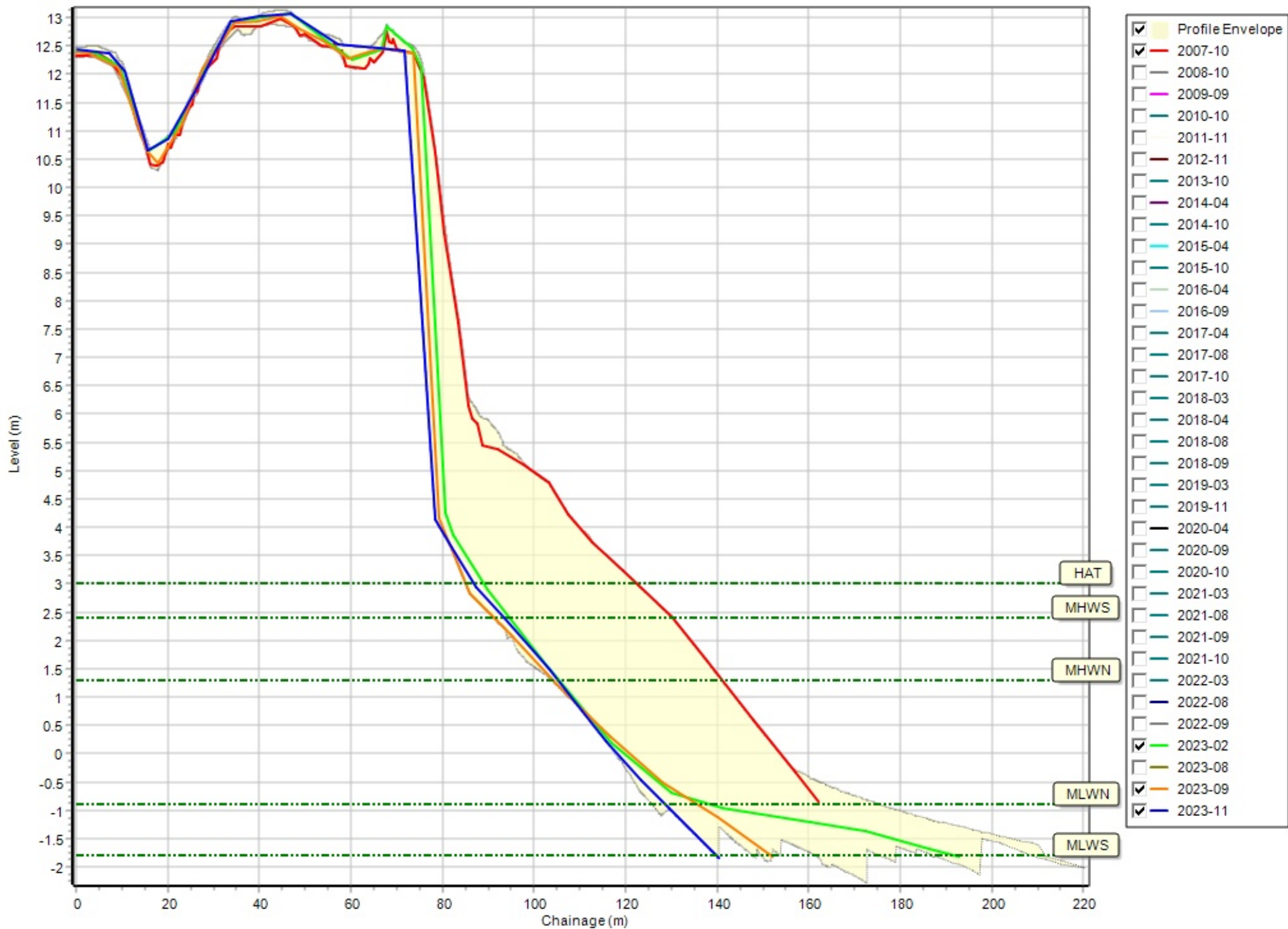
Profiles: 1aWDC03



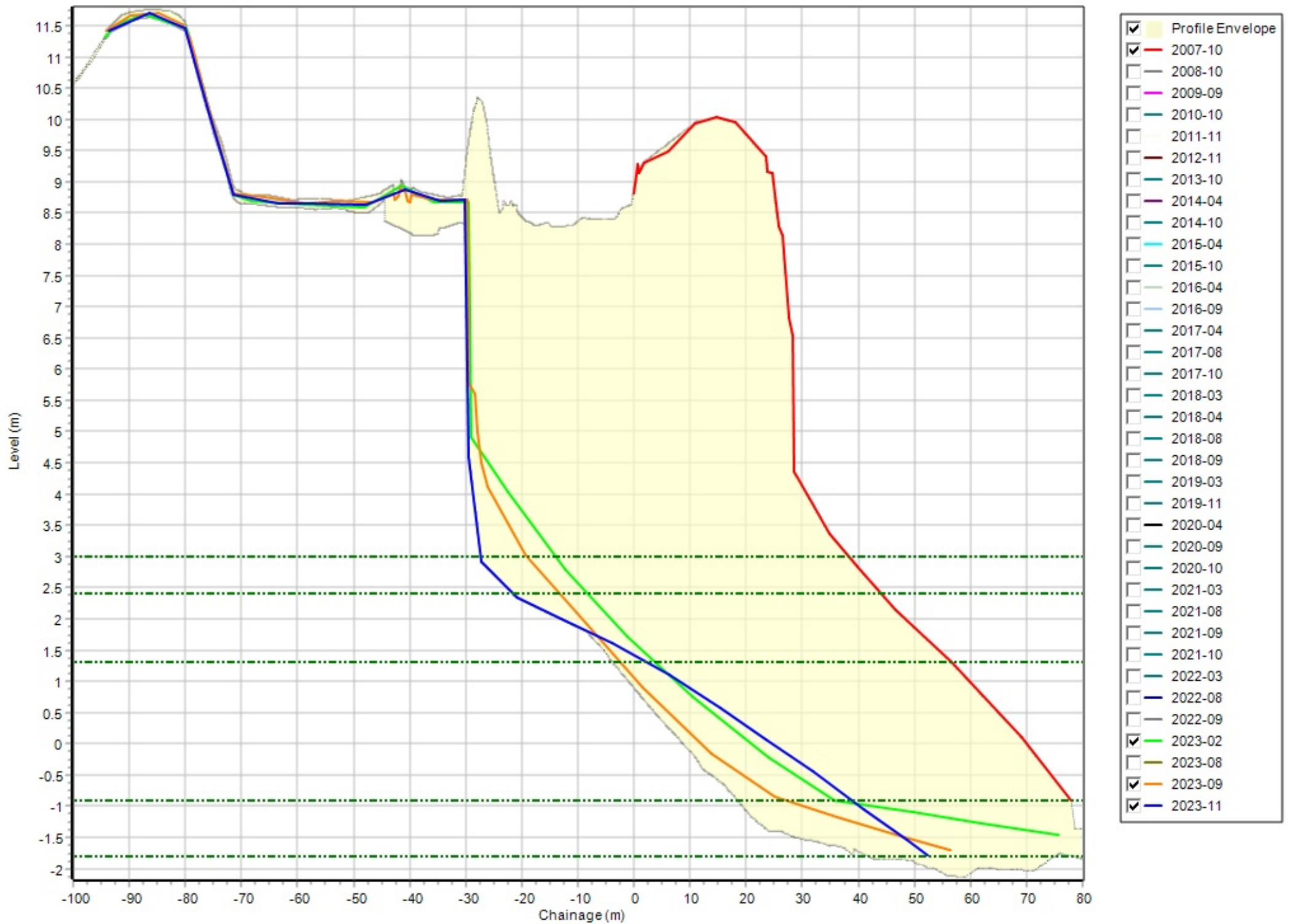
Profiles: 1aCMBC03



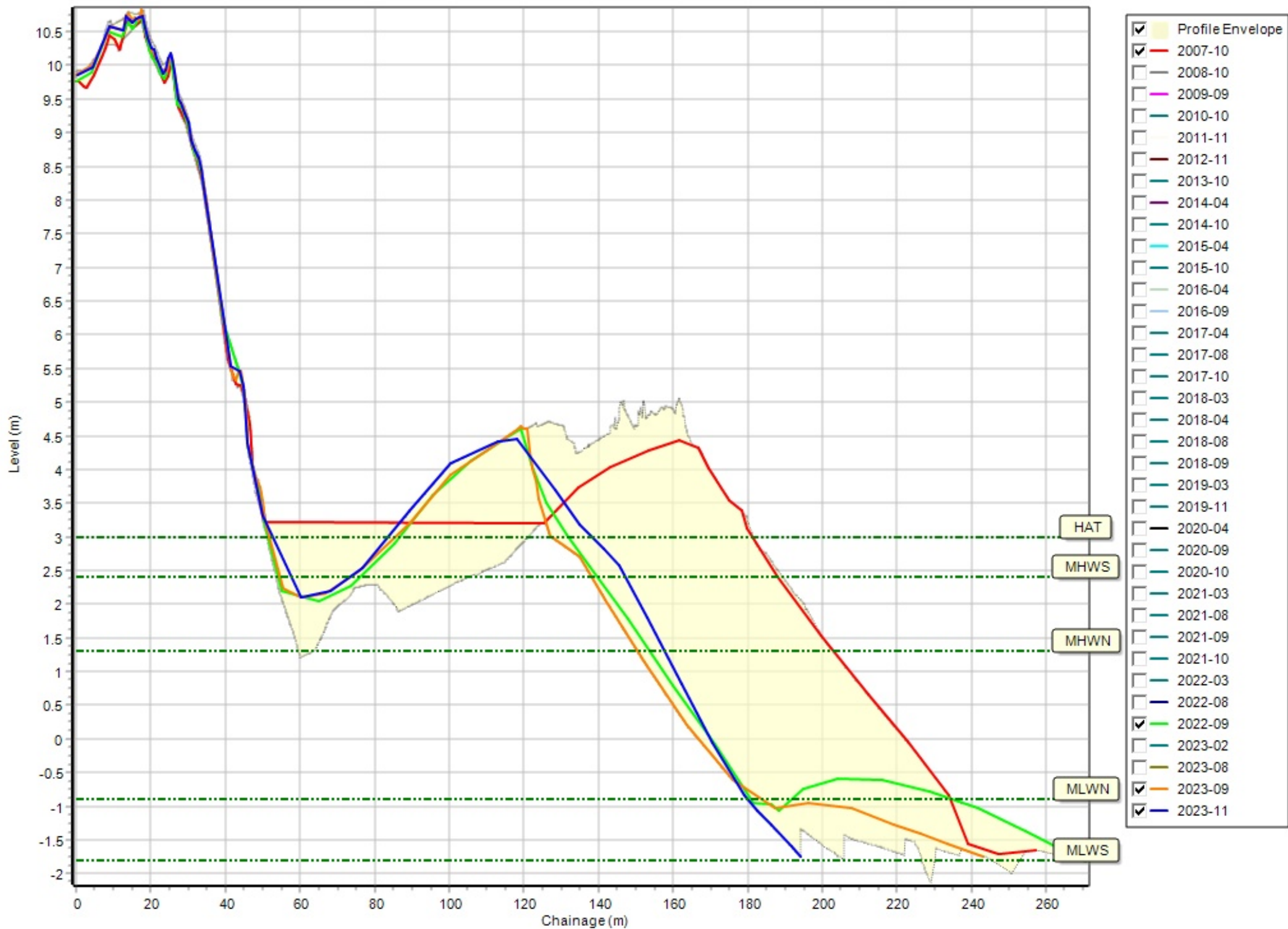
Profiles: 1aCMBC03A



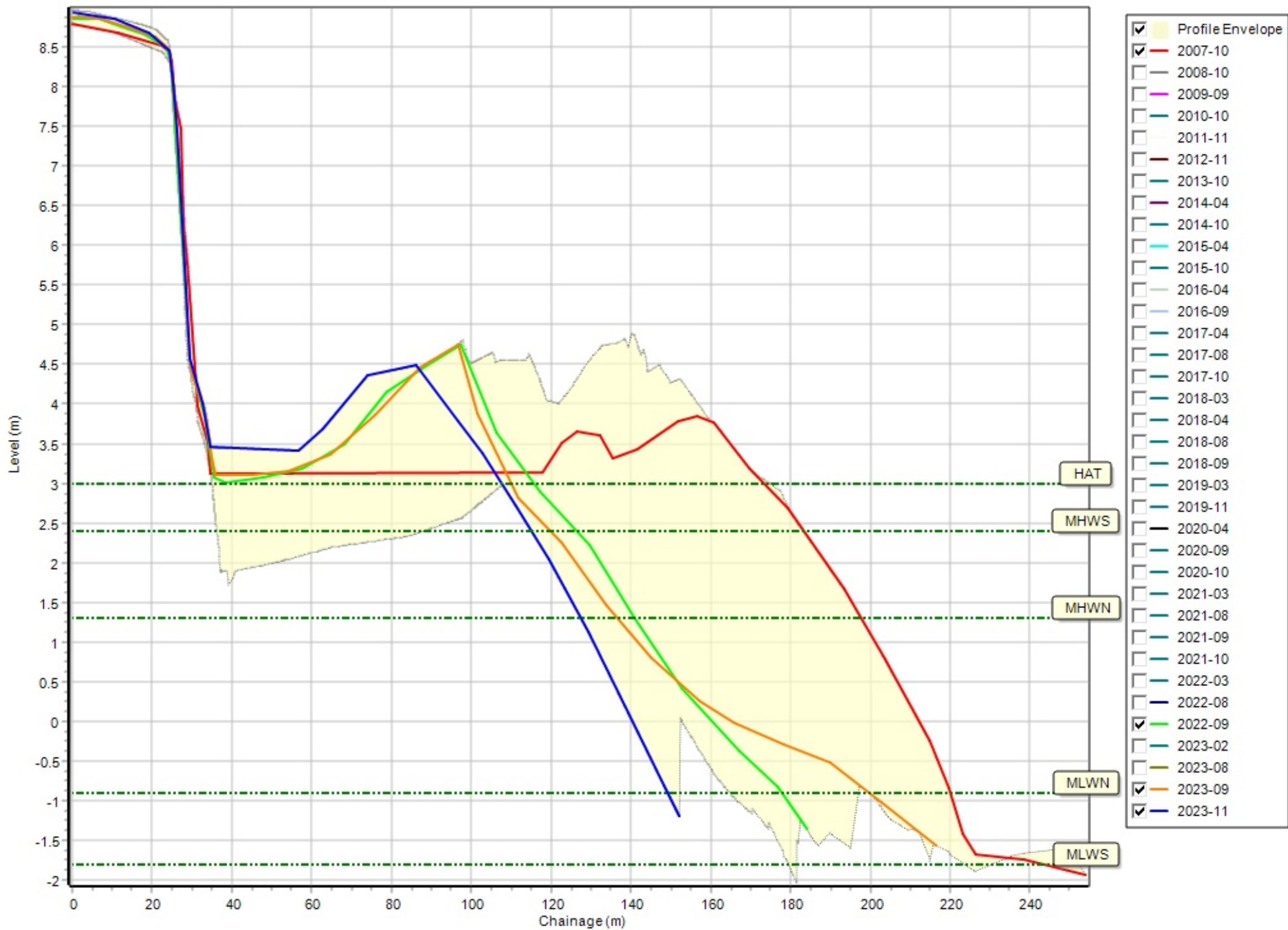
Profiles: 1aCMBC03B



Profiles: 1aWDC02

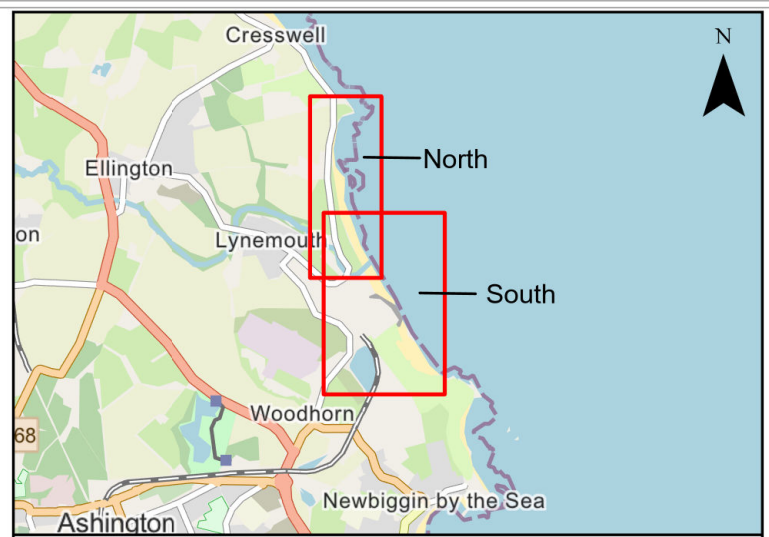
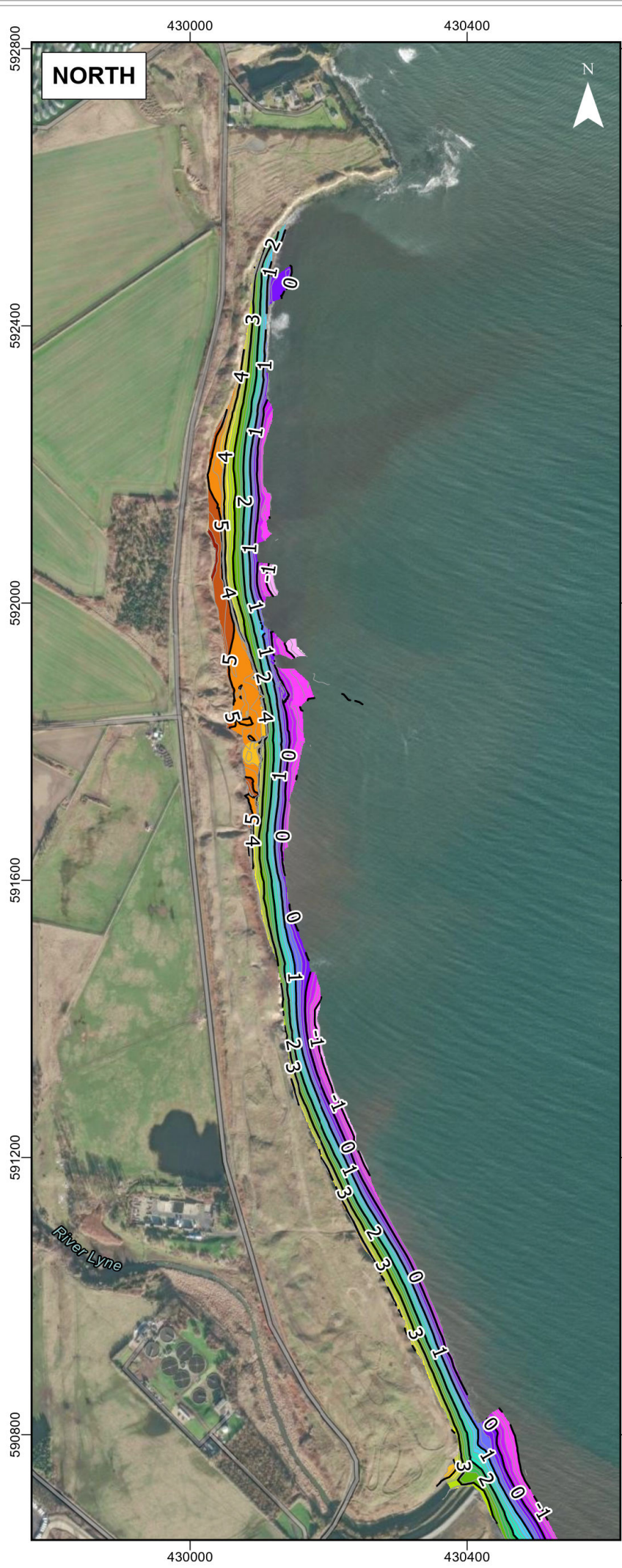


Profiles: 1aWDC03



Appendix B

Topographic Survey



TOPOGRAPHIC SURVEY (16th November 2023)

Elevation (mOD)	Contours (mOD)*
-1.4 - -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	

* Contours only cover sandy beach areas.

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

Title:

Appendix B - Map 1

LYNEMOUTH

Northumberland County Council Frontage

Report:

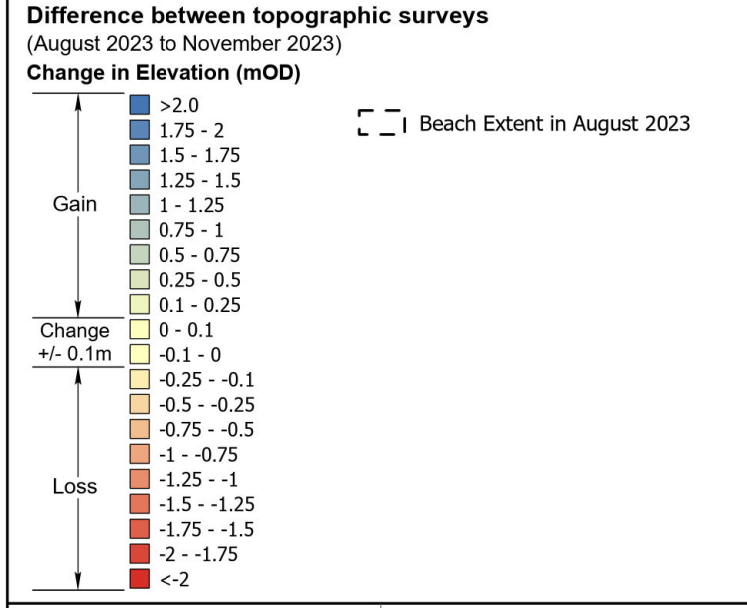
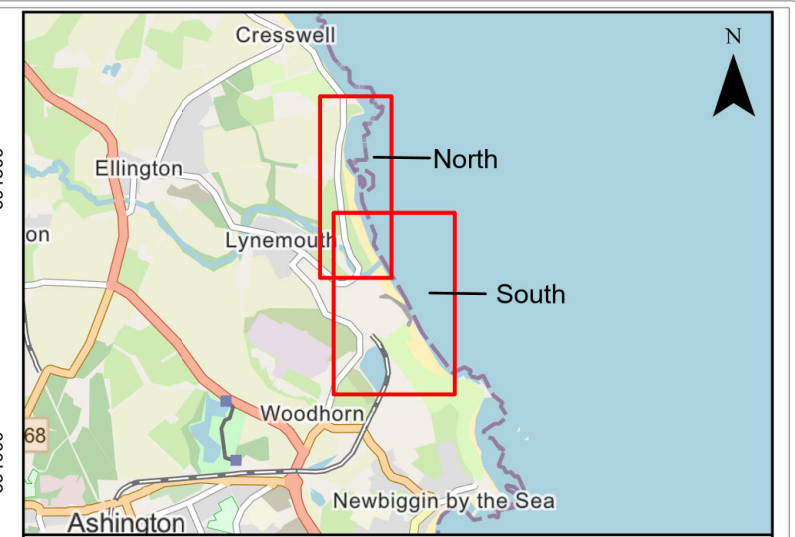
'Post Storm' Survey 2023

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	04/12/2023	TC	AS	A3	1:8,000

Co-ordinate system: British National Grid




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 World Imagery: Maxar, Microsoft
 Hybrid Reference Layer: Esri Community Maps Contributors, Esri UK, Esri, HERE, Garmin, Foursquare, GeoTechnologies, Inc, METI/NASA, USGS
 OpenStreetMap: Map data © OpenStreetMap contributors, Microsoft, Facebook, Inc. and its affiliates, Esri Community Maps contributors, Map layer by Esri



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

Title: **Appendix B - Map 2**
LYNEMOUTH
Northumberland County Council Frontage

Report: 'Post Storm' Survey 2023

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	04/12/2023	TC	AS	A3	1:8,000

Co-ordinate system: British National Grid



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Hybrid Reference Layer: Esri Community Maps Contributors, Esri UK, Esri, HERE, Garmin, Foursquare, GeoTechnologies, Inc, METI/NASA, USGS
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