

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



Redcar and Cleveland Council

June 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)
	Coatham Sands to Saltburn Sands
HAT	3.25
MHWS	2.65
MHWN	1.45
MLWN	-0.85
MLWS	-1.95

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.

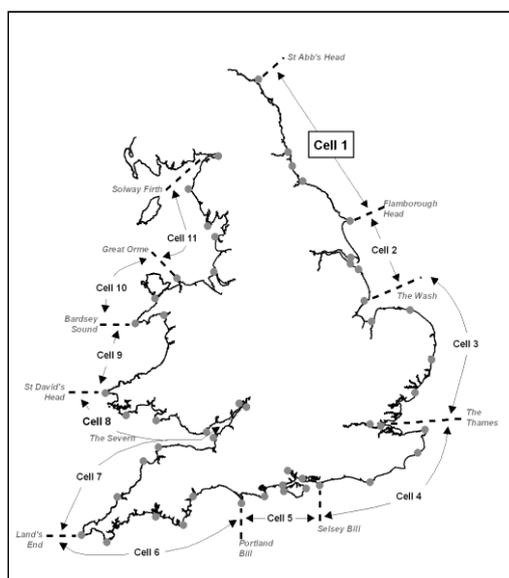


Figure 1 Sediment Cells in England and Wales

The programme commenced in its present guise in September 2008¹ and is managed by 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 sea bed characterisation surveys
- aerial photography
- LiDAR Surveys
- walk-over cliff and coastal defence asset surveys

The beach profile surveys, topographic surveys and cliff top recession surveys are undertaken as a 'Full Measures' survey in autumn/early winter every year. Some of these surveys are then repeated the following spring as part of a 'Partial Measures' survey.

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

At the end of each phase of the programme, a Cell 1 Overview Report is also produced. This provides a region-wide summary of the main findings relating to trends and interactions along the entire Cell 1 frontage. To date the following reports have been produced:

To date the following reports have been produced:

Table 1 Analytical, Update and Overview Reports Produced to Date

Year		Full Measures		Partial Measures		Cell 1 Overview Report
		Survey	Analytical Report	Survey	Update Report	
1	2008/09	Sep-Dec 08	May 09	Mar-May 09		
2	2009/10	Sep-Dec 09	Mar 10	Feb-Mar 10	Jul 10	
3	2010/11	Aug-Nov 10	Feb 11	Feb-Apr 11	Aug 11	Sep 11
4	2011/12	Sep-Oct 11	Oct 12	Mar-May 12	Feb 13	
5	2012/13	Sep 2012	Mar 13	Feb- Mar 13	May 13	
6	2013/14	Oct-Nov 13	Feb 14	Mar-Apr 14	Jul 14	
7	2014/15	Sep-Oct 14	Feb 15	Mar-Apr	Jul 15	
8	2015/16	Sep-Oct 15	Feb 16	Mar 16	Jul 16	Jun 16
9	2016/17	Sep-Nov 16	Feb 17	Mar 17	Jul 17	
10	2017/18	Oct 17	Mar 18	Mar-May 18	Jun 18	
11	2018/19	Sep 18	Mar 19	Mar-Apr 19	May 19	
12	2019/20	Sep-Nov 19	Jan 20	Mar-May 20	Aug 20	
13	2020/21	Oct-Dec 20	Feb 21	Mar 21	May 21	Aug 21
14	2021/22	Sep-Oct 21	Dec 21	Apr 22	Jul 22	
15	2022/23	Oct 22	Jan 23	Mar-Apr 23	Jun 23	
16	2023/24	Sep-Nov 23	Jan 24	Apr 24	Jun 24	

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

1. Introduction

1.1 Study Area

South Gare Breakwater at the mouth of the River Tees estuary to Cowbar Nab at Staithes. For the purposes of this report, it has been sub-divided into six areas, namely:

- Coatham Sands
- Redcar Sands
- Marske Sands
- Saltburn Sands
- Cattersty Sands (Skinningrove)
- Staithes²

1.2 Methodology

Along Redcar & Cleveland Borough Council's frontage, the following surveying is undertaken:

- Full Measures survey annually each autumn/early winter comprising:
 - Beach profile surveys along nine transect lines
 - Topographic survey along Coatham Sands
 - Topographic survey along Redcar Sands
 - Topographic survey along Marske Sands
 - Topographic survey along Saltburn Sands
 - Topographic survey at Skinningrove along Cattersty Sands
- Partial Measures survey annually each spring comprising:
 - Beach profile surveys along nine transect lines
 - Topographic survey along Redcar Sands
 - Topographic survey along Saltburn Sands
 - Topographic survey at Skinningrove along Cattersty Sands
- Cliff top survey (biannually) at:
 - Staithes

The location of these surveys is shown in Figure 2 and 3. The Partial Measures surveys was undertaken on the following dates;

- Redcar (Coatham Sands, Redcar Sands, Marske Sands and Saltburn Sands): 24th – 26th April 2024
- Skinningrove: 27th March 2024
- Staithes: 6th March 2024

During the surveys the weather was varied with varying sea states. Specific weather conditions are detailed in the survey reports. Processed data from the present survey are presented in the Appendices.

² The Staithes frontage straddles the boundary of jurisdiction of Redcar & Cleveland Borough Council and Scarborough Borough Council



SURVEY LOCATIONS

Topographic Profile

- Annual
- Bi-Annual

Topographic Area

- 6 monthly
- yearly
- 5 yearly

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

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

Title: **Figure 2 - Map 1**
COATHAM SANDS TO SALT BURN SANDS
Redcar and Cleveland Borough Council Frontage

Report: **Survey Report**

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	n/a	TC	NJC	A4	1:65,000

Co-ordinate system: British National Grid

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SURVEY LOCATIONS

Topographic Profile

- Annual
- Bi-Annual

Topographic Area

- 6 monthly
- yearly
- 5 yearly

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

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

Title:

Figure 2 - Map 2

CATTERSTY SANDS (SKINNINGROVE)

Redcar and Cleveland Borough Council Frontage

Report:

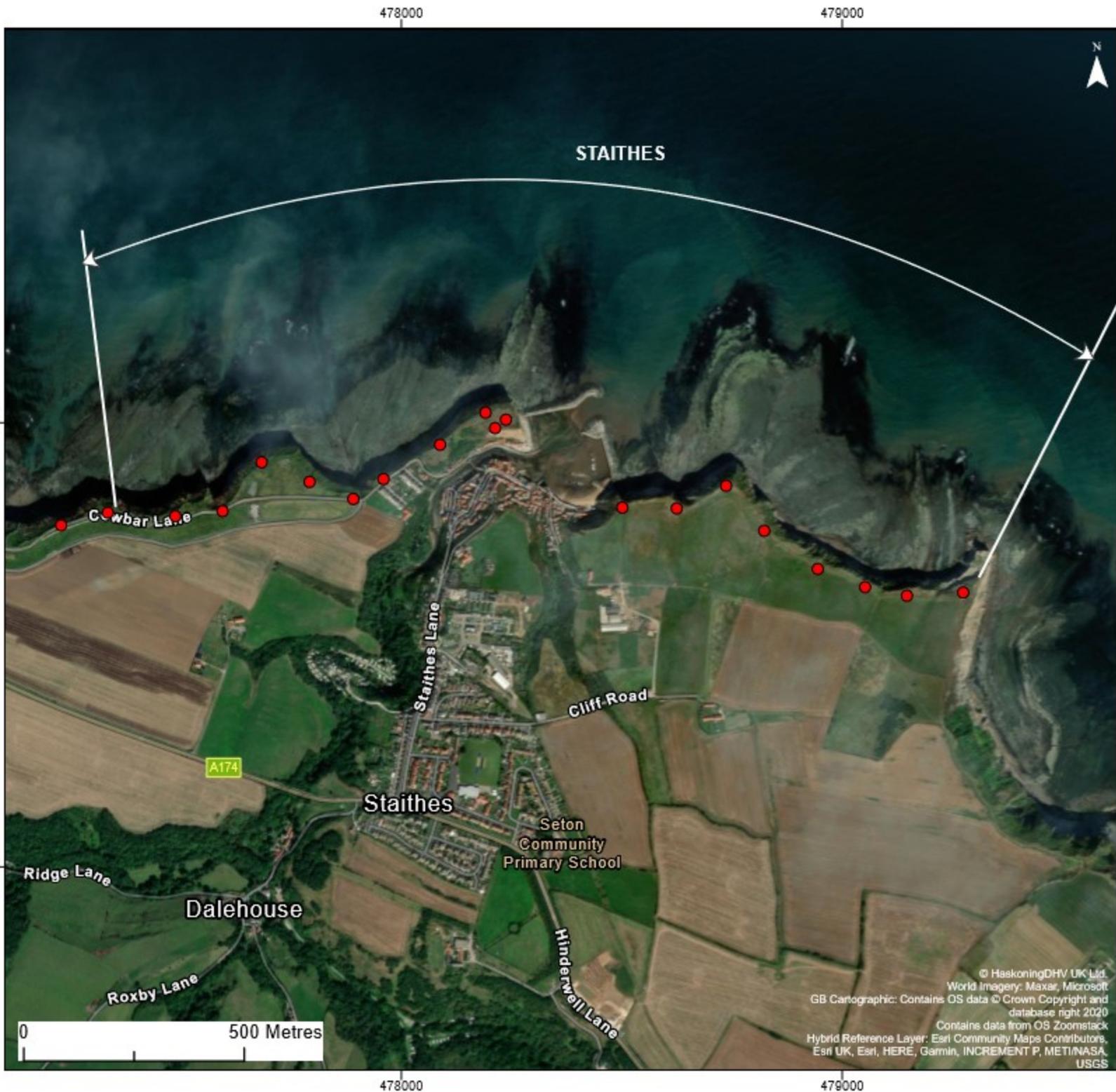
Survey Report

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

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SURVEY LOCATIONS

Topographic Profile

- Annual
- Bi-Annual

Topographic Area

- 6 monthly
- yearly
- 5 yearly

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

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

Title:

Figure 2 - Map 3

STAITHES

Redcar and Cleveland Borough Council Frontage

Report:

Survey Report

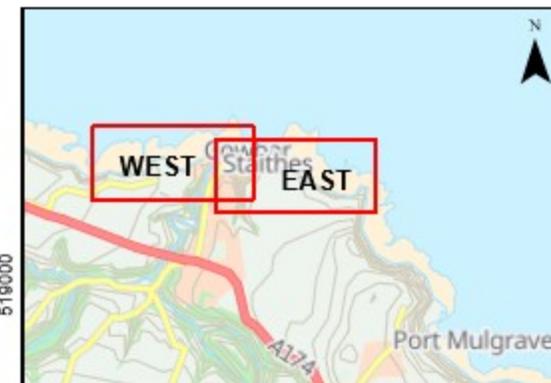
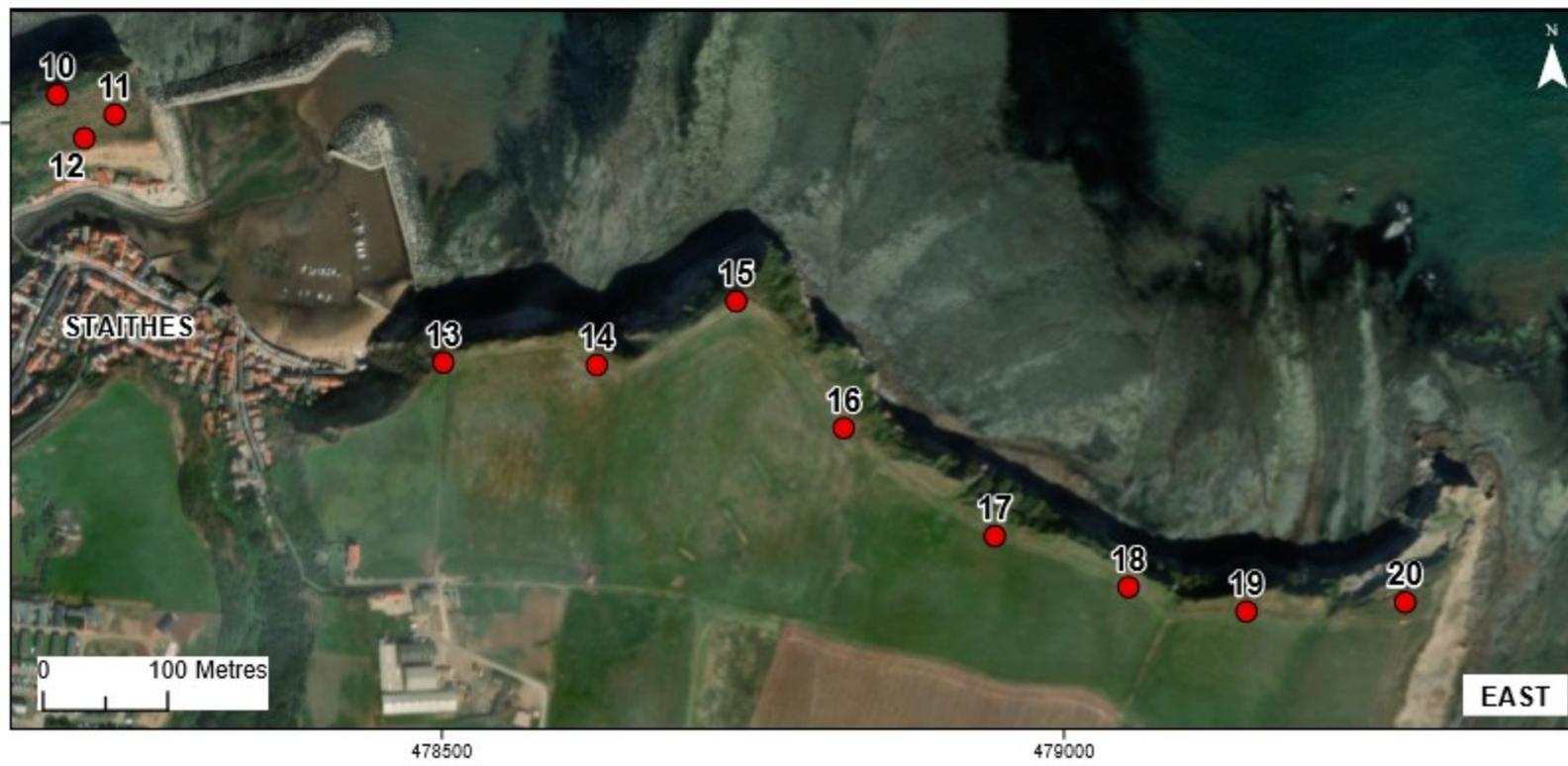
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate system: British National Grid

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SURVEY LOCATIONS

- Cliff Top Survey Points

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 Hybrid Reference Layer: Esri Community Maps Contributors, Esri UK, Esri, HERE, Garmin, INCREMENT P, METI/NASA, USGS

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

Title:
Figure 3 - Map 1
STAITHES
Redcar and Cleveland Borough Council Frontage

Report:
Survey Report

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

Co-ordinate system: British National Grid



2. Analysis of Survey Data

2.1 Coatham Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
<p>24th – 26th April 2024</p>	<p>Beach Profiles:</p> <p>Coatham Sands is covered by four beach profiles during the Partial Measures survey (1cRC1 to 1cRC4; Appendix A) that were last surveyed in November 2023.</p> <p>Profile 1cRC1 is located 300m southeast of the South Gare Breakwater, in the lee of the German Charlies slag banks. The upper profile to chainage 107m is covered by dunes, over which change is limited to ± 0.1m. From the toe of the foredune, to chainage 210m, the upper beach has dropped in level by up to 0.5m. Seawards of chainage 210m, to the end of the profile at chainage 310m, the lower beach has accreted by a similar magnitude. Compared to the range of the previous surveys the upper beach is at a medium level, where as accretion on the lower beach has resulted in the profile, between chainage 225m and 306m, being at the highest level on record. The dunes remain at a high level.</p> <p>At profile 1cRC2, change across the dune system up until the foredune is limited to low level accretion up to 0.15m in level. At the foredune, at chainage 97m, erosion has steepened the seaward face creating a 1.3m high cliff. This erosion reduces in magnitude to 0.2m in level by chainage 100m before gradually tapering to no change by chainage 170m. Seawards of chainage 170m, the beach has accreted, initially limited to +0.2m but increasing to 0.4m between 270m and 340m. The profile remains within the range envelope of the previous surveys. The dunes remain at a high level.</p> <p>At Profile 1cRC3, the largest change over the dune system has occurred on the seaward face of the foredune where accretion of up to +0.5m is observed. The rest of the dune system has remained stable. At the toe of the foredune, to chainage 190m, the upper beach has dropped in level by up to 0.2m. Seawards of chainage 190m the beach has accreted in level, initially limited to +0.1m up to chainage 268m, before increasing to +0.4m at chainage 320m. The profile is generally at medium level, with the lower beach at a high level and even the highest on record between 302m and 346m as a result of the accretion.</p>	<p>The profiles, particularly the three northern profiles, show a clear pattern of drawdown of material from the upper beach to the lower beach, a typical seasonal response. While the upper beach remains at medium level the accretion on the lower beach has resulted in sections being at highest level on record (compared to the range of previous surveys), indicating the strength of storms over winter 2023 / 2024.</p> <p>Other than moderate cliffing of the foredune in profile 1cRC2, the dunes appear to have been resilient to the storms with the surveyors' photos even suggesting embryonic dune growth across some of the foredune.</p> <p>Longer term trends:</p> <p>All beach profiles at Coatham show the dunes are stable or accreting on their seaward extent. The beaches to the west show a typical longer-term trend of progressive accretion. The beaches in the centre and to the east have a more fluctuating long-term pattern.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>Profile 1cRC4 is located at the beginning of the defended section at Coatham and Redcar. Beach levels at the toe of the wall have dropped in level by 0.5m, exposing a greater length of the sloping apron. Bar a small section of accretion on the upper beach, erosion dominates the rest of the profile. This erosion is modest (-0.2m) for the majority of the profile but does increase (-0.5m) on the lower beach between chainage 260m and 320m. The profile is at a very low when compared to the range of the previous surveys, with not insignificant lengths at the lowest level on record.</p>	

2.2 Redcar Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
<p>24th – 26th April 2024</p>	<p>Beach Profiles:</p> <p>Redcar Sands is covered by three beach profiles (1cRC5 to 1cRC7; Appendix A), with 1cRC7 being approximately on the boundary with the Marske Sands area. They were last surveyed in November 2023.</p> <p>At profile 1cRC5 the sea defences constructed in 2012 remain unchanged. At the toe of the stepped revetment, beach levels have locally accreted by 0.9m in level concealing the lower section of the structure. This accretion has created a steep upper beach, with the profile tapering to no change by chainage 28m. This is followed by a short length of erosion, it is likely it is this same material that has been driven against the seawall. Seawards of chainage 60m there has been no change with the rocky foreshore still exposed. Due to the lack of sediment present, the profile remains at a very low level when compared to the range of the previous surveys.</p> <p>Profile 1cRC6 is defended up until chainage 52m and has remained unchanged over this length. At the toe of the sloping concrete apron, beach levels have accreted, continuing across the upper beach, tapering to no change by chainage 73m. This accretion is limited to +0.3m in level, the material appears to be larger cobbly material likely driven up during storms. A short length of minor erosion (-0.15m) is then again proceeded by accretion which has occurred between chainage 94m and 218m (limited to +0.3m) and again seawards of change 231m. The accretion across the lower beach is up to +0.7m in magnitude. Overall, the beach is at a medium level when compared to the range of the previous surveys.</p> <p>Profile 1cRC7 is undefended. At the toe of the cliff, beach levels have dropped by up to 1.4m in level. It is clear this drop in level has accelerated the erosion of the toe of the cliff. This initial erosion tapers to no change by chainage 71m. A short length of minor accretion (+0.15m) is then followed by widescale erosion, peaking in magnitude at chainage 221m with -0.5m. Accretion is observed at the very lower reaches of the profile, seawards of chainage 270m. This widescale erosion has resulted in the profile being at the lowest level on record for approximately 100m over the upper central sections.</p>	<p>Change across Redcar Sands is varied. It is thought this varied change can partially be explained due to the timing of the Full Measures Survey which was undertaken in November, later in the year than usual. This meant that Full Measure Survey was after some of the more severe winter storms that significantly eroded the frontage (particularly Storm Babet).</p> <p>As a result, rather than erosion dominating the partial measures report, as is the seasonal pattern, the 2024 partial measures survey has possibly recorded some post storm recovery, particularly at The Stray. This said, levels have not returned to those pre-storm, and further erosion in some areas (notably 1cRC7) reflects further storms later in season.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <div data-bbox="488 272 667 328" style="border: 1px solid black; padding: 2px;">Apr 2024</div>  </div> <div style="text-align: center;"> <div data-bbox="887 272 1066 328" style="border: 1px solid black; padding: 2px;">Nov 2023</div>  </div> </div>	
	<p>Topographic Survey:</p> <p>Redcar Sands is covered by a 6-monthly topographic survey. Data have been used to create a DGM (Appendix B – Map 1) using a GIS. The DGM shows that the beach topography is broadly parallel to the shore other than between Coatham Rocks and Redcar Rocks where the lack of sediment is reflected with distorted contours. The GIS has also been used to calculate the differences between the current topographic survey (April 2024) and the previous topographic survey (November 2023), as shown in Appendix B – Map 4, to identify areas of erosion and accretion.</p> <p>The difference plot shows that the change around Redcar since the previous survey is varied. To the west, at the interface with Coatham Sands, the profile has been dominated by low level erosion (-0.5m). The pattern of change at Coatham and Redcar Rocks reflects the exposed rocky foreshore with patches of both accretion and erosion observed. From Redcar Rocks south, the dominant process of change appears to have been accretion, albeit again at a low magnitude (+0.5m) and not exclusive.</p>	

2.3 Marske Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
<p>24th – 26th April 2024</p>	<p>Beach Profiles:</p> <p>Marske Sands is covered by two beach profiles during the Partial Measures survey (1cRC7 to 1cRC8; Appendix A). 1cRC7 is on the boundary with the Redcar Sands area.</p> <p>Profile 1cRC7 is located along The Stray and has been discussed in Section 2.2.</p> <p>Profile 1cRC8 is located to the south of Church Howle at Marske by the Sea. The first 57m of the profile are covered by dunes over which all change is limited to ± 0.1m. However, erosion of the foredune has created cliffing at the toe. This erosion continues across the upper beach tapering to no change by chainage 70m. Between chainage 70m and 228m, the beach has accreted by up to 0.5m in level. Erosion is observed across the lower beach up to -0.3m in level. The profile remains within the range envelope of the previous surveys.</p>	<p>At Marske Sands, both profiles have experienced a notable drop in level at the dunes / cliffs leading to visible erosion of the undefended toe. The toe of the cliff at profile 1cRC7 is at the lowest on record indicating the severity of the storms over winter 2023/2024. Where Profile 1cRC8 has then accreted across the beach, possibly indicating some post storm recovery (noting the timing of the Full Measures survey discussed above), Profile 1cRC7 has eroded further likely as a result of further storms later in the season.</p>

2.4 Saltburn Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
24 th – 26 th April 2024	<p>Beach Profiles:</p> <p>Saltburn Sands is covered by one beach profile (1cRC9; Appendix A).</p> <p>Profile 1cRC9 is covered by a sea defence as far as chainage 20m and has experienced no change over this defended length. The toe of defence is fronted by a cobble berm that has accreted in level by 0.4m at the toe of the wall. Accretion continues across the upper beach tapering to no change by chainage 38m. Seawards of chainage 38m, the beach has been dominated by erosion, lowering in level by up to 0.6m in level. Consequently, at the toe of the seawall beach levels are at the highest on record where across the centre and lower beach there are at the lowest level on record.</p>	<p>The storm driven shingle berm against the seawall has further accreted. It is thought this, combined with a drop in level of the rest of beach, will only exacerbate overtopping concerns associated with waves 'ramping' up the berm.</p> <p>It is understood the council has attempted to redistribute the berm in the past. A beach management plan is ongoing, amongst other things, address concerns here.</p>
	<p>Topographic Survey:</p> <p>Saltburn Sands is covered by a 6-monthly topographic survey. The data has been used to create a DGM (Appendix B – Map 2). The DGM highlights the beach topography consists of shore parallel contours that begin to become distorted on the lower beach suggesting a plateau. The contours are also distorted at the interface with Skelton Beck.</p> <p>The DGM has been compared against the previous survey (November 2023) in Appendix B – Map 5 to observe patterns of erosion and accretion. The difference plot shows that over winter 2023 / 2024, Saltburn Sands has been dominated by erosion (up to -0.75m) across the vast majority of the beach. A very narrow band of accretion is observed up against the seawall and again at the mouth of the Skelton Beck.</p>	

2.5 Cattersty Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
<p>27th March 2024</p>	<p>Topographic Survey:</p> <p>Cattersty Sands is covered by a 6-monthly topographic survey. Data has been used to create a DGM (Appendix B – Map 3). The beach is steeper to the west of the breakwater than the east, but in both areas the gradient is relatively smooth. East of the breakwater, the beach is punctuated by Kilton Beck and the harbour. Immediately east of the former fishtail groyne (which has since been modified to a rock breakwater arm), the stream has cut a channel, which is most deeply incised at its landward extent.</p> <p>The March 2024 DGM has been compared against the previous survey (November 2023) in Appendix B – Map 8. To the west of the breakwater a significant, shoreline parallel band of erosion is observed at the toe of the cliffs and across the upper beach. This erosion is up to -2m in level and was reported by the surveyor to be ‘noticeable around the pillbox’. Two swathes of much lower magnitude accretion across the lower beach suggests that at least some of the material has been drawn down onto the lower beach (rather than transported offshore),</p> <p>The frontage east of the breakwater has also been dominated by erosion, albeit at much lower magnitude. Erosion is observed in the lee of the breakwater up against the structure and to the east of the modified fish tail groyne. The erosion on the east side of the breakwater is limited to -1.0m. Very minor accretion is observed in the mouth of the beck.</p>	<p>As is the seasonal pattern, Cattersty Sands has been dominated by erosion over the winter. The most notable change has occurred to the west of the breakwater, where the upper beach has experienced a significantly drop in level.</p> <p>Whilst this does raise some concerns regarding the exposure of the cliffs to increased erosion, it is expected that this will only be temporary, and that the area will recover in the coming months.</p> <p>This area was subject to notable accretion over the previous summer and so, to an extent, may be balancing itself out.</p> <p>Longer term trends:</p> <p>At Cattersty Sands, the winter erosion dominates the overall behaviour of the beach but the calmer weather in the summer months should lead to some accretion. If the erosion of the upper beach continues it is likely to drive cliff failures which would add material to the upper beach for redistribution.</p>

2.6 Staithes

Survey Date	Description of Changes Since Last Survey	Interpretation
<p>6th March 2024</p>	<p>Cliff-top Survey:</p> <p>Twenty ground control points have been established at Staithes for the purposes of cliff top monitoring. The separation between any two points is a nominal 100m. The cliff top surveys at Staithes are undertaken bi-annually. Data collection involves a distance offset measurement from the ground control point to the cliff edge along a fixed bearing.</p> <p>Appendix C provides results from the March 2024 survey, showing the distance from the ground control point to the edge of the cliff top along the defined bearing and changes in position since the November 2008 baseline survey and the previous September 2023.</p> <p>The results show that zero of the 23 control points experienced erosion greater than the survey error ($\pm 0.2\text{m}$) since the previous survey. This indicates a period of stability along this frontage. It has also resulted in a decrease in the long term recession rates. The two points with the greatest rates are now Point 1 (with 0.48m/yr.) and Point 13 (with 0.20m/yr.).</p>	<p>The cliff top along the Staithes frontage have remained stable since the previous survey.</p> <p>Longer term trends: Only Point 1 (0.48m/yr.) and Point 13 (0.20m/yr.) have experienced long term recession rates greater than (or equal to) 0.2m/yr. Point 4 also previously had a recession greater than the margin of error however, a period of stability means it is now only averaging 0.15m/yr.</p>

3. Problems Encountered and Uncertainty in Analysis

- The cliff top surveys at Staithes are assumed to have an accuracy of ± 0.2 m due to the methodology.

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

No further recommendations are made at this stage for the fine-tuning of the monitoring programme.

5. Conclusions and Areas of Concern

- At Coatham Sands, the profiles, particularly the three northern profiles, show a clear pattern of drawdown of material from the upper beach to the lower beach, a typical seasonal response. While the upper beach remains at medium level the accretion on the lower beach has resulted in sections being at highest level on record (compared to the range of previous surveys), indicating the strength of storms over winter 2023/24. Other than moderate cliffing of the foredune in profile **1cRC2**, the dunes appear to have been resilient to the storms with the surveyors' photos even suggesting embryonic dune growth across some of the foredune.
- Change across Redcar Sands is varied. It is thought this varied change can partially be explained due to the timing of the Full Measures Survey, which was undertaken in November 2023, later in the year than usual. This meant that Full Measure Survey was after some of the more severe winter storms that significantly eroded the frontage (particularly Storm Babet). As a result, rather than erosion dominating the partial measures report, as is the seasonal pattern, the 2024 partial measures has recorded some post storm recovery, particularly around The Stray. This said, levels have not returned to those pre-storm, and further erosion in some areas (notably 1cRC7) reflects further storms later in the season.
- At Marske Sands, both profiles have experienced a notable drop in level at the dunes / cliffs leading to visible erosion of the undefended toe. The toe of the cliff at profile 1cRC7 is at the lowest on record indicating the severity of the storms over winter 2023/24. Whereas Profile 1cRC8 has then accreted across the beach, possibly indicating some post storm recovery (noting the timing of the Full Measures survey discussed above), Profile 1cRC7 has eroded further likely as a result of further storms later in the season.
- At Saltburn Sands, the storm driven shingle berm against the seawall has further accreted. It is thought this, combined with a drop in level of the rest of beach, will only exacerbate overtopping concerns associated with waves 'ramping' up the berm. It is understood the council has attempted to redistribute the berm in the past. A beach management plan is ongoing to, amongst other things, address concerns here.
- As is the seasonal pattern, Cattersty Sands has been dominated by erosion over the winter of 2023/24. The most notable change has occurred to the west of the breakwater, where the upper beach has experienced a significant drop in level. Whilst this does raise some concerns regarding the exposure of the cliffs to increased erosion, it is expected that this will only be temporary and that the area will recover in the coming months. This area was subject to notable accretion over the previous summer and so, to an extent, may be balancing itself out.
- The cliff top along the Staithes frontage have remained relatively stable since the previous survey.

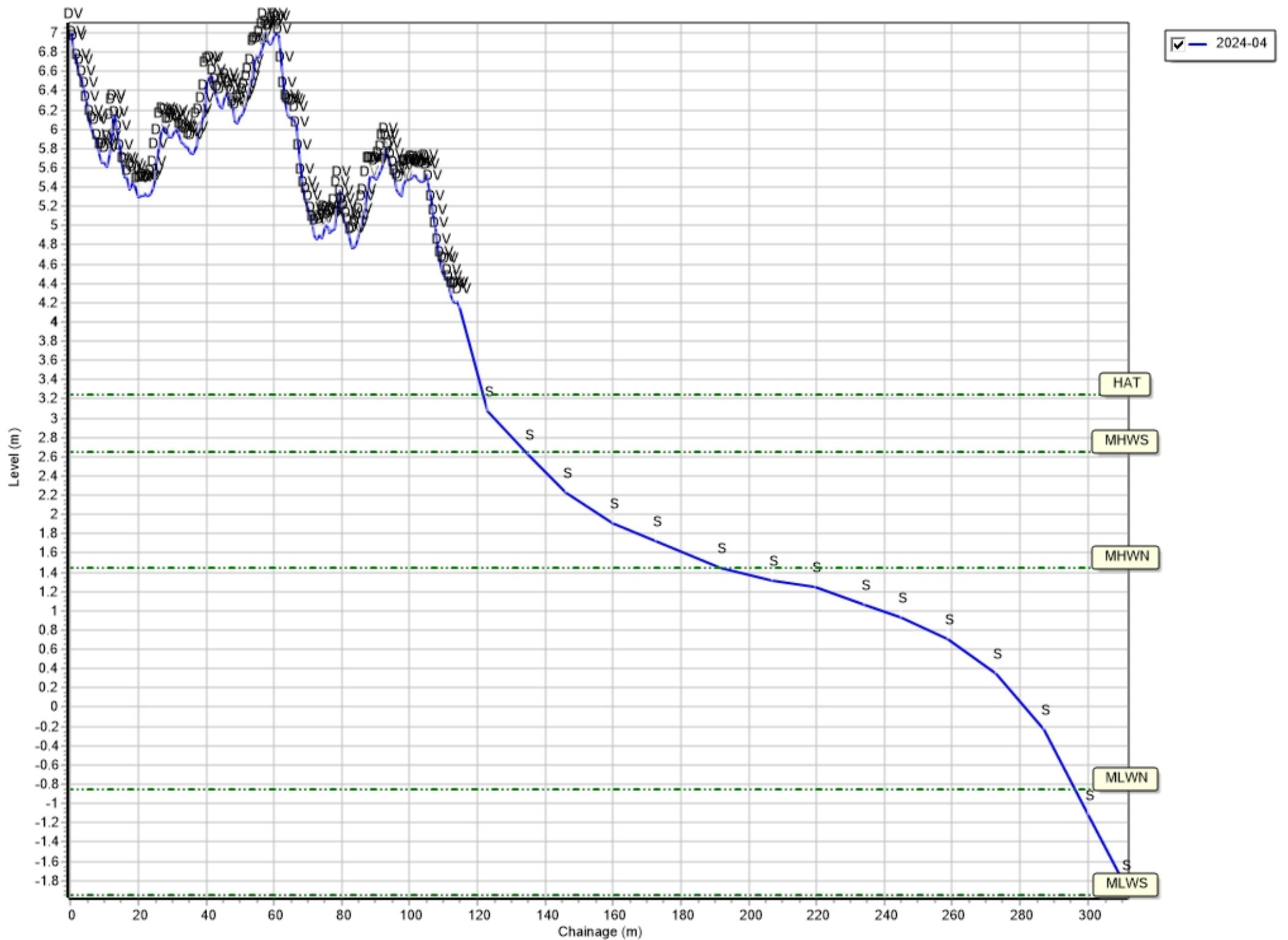
Appendices

Appendix A
Beach Profiles

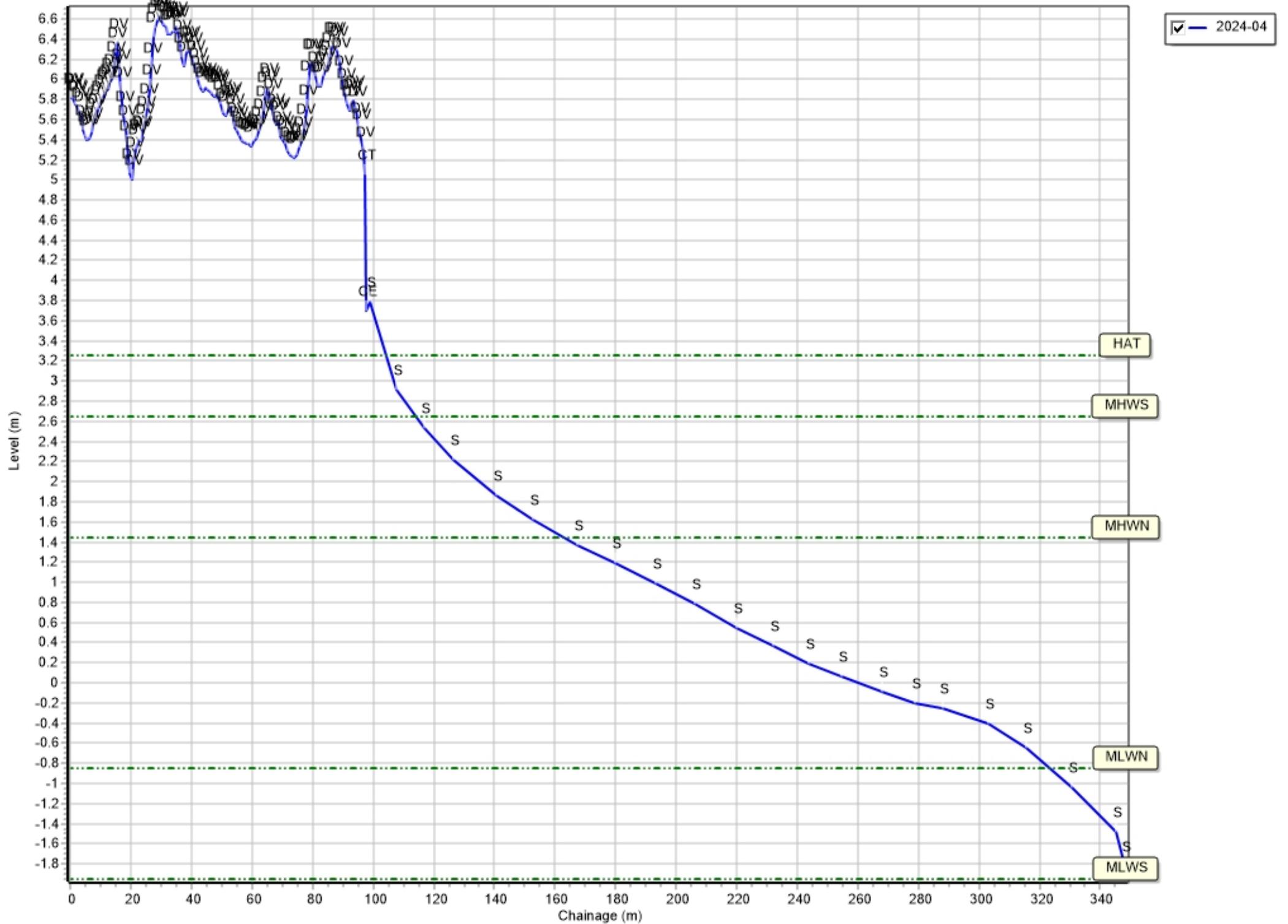
The following sediment feature codes are used on some profile plots:

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

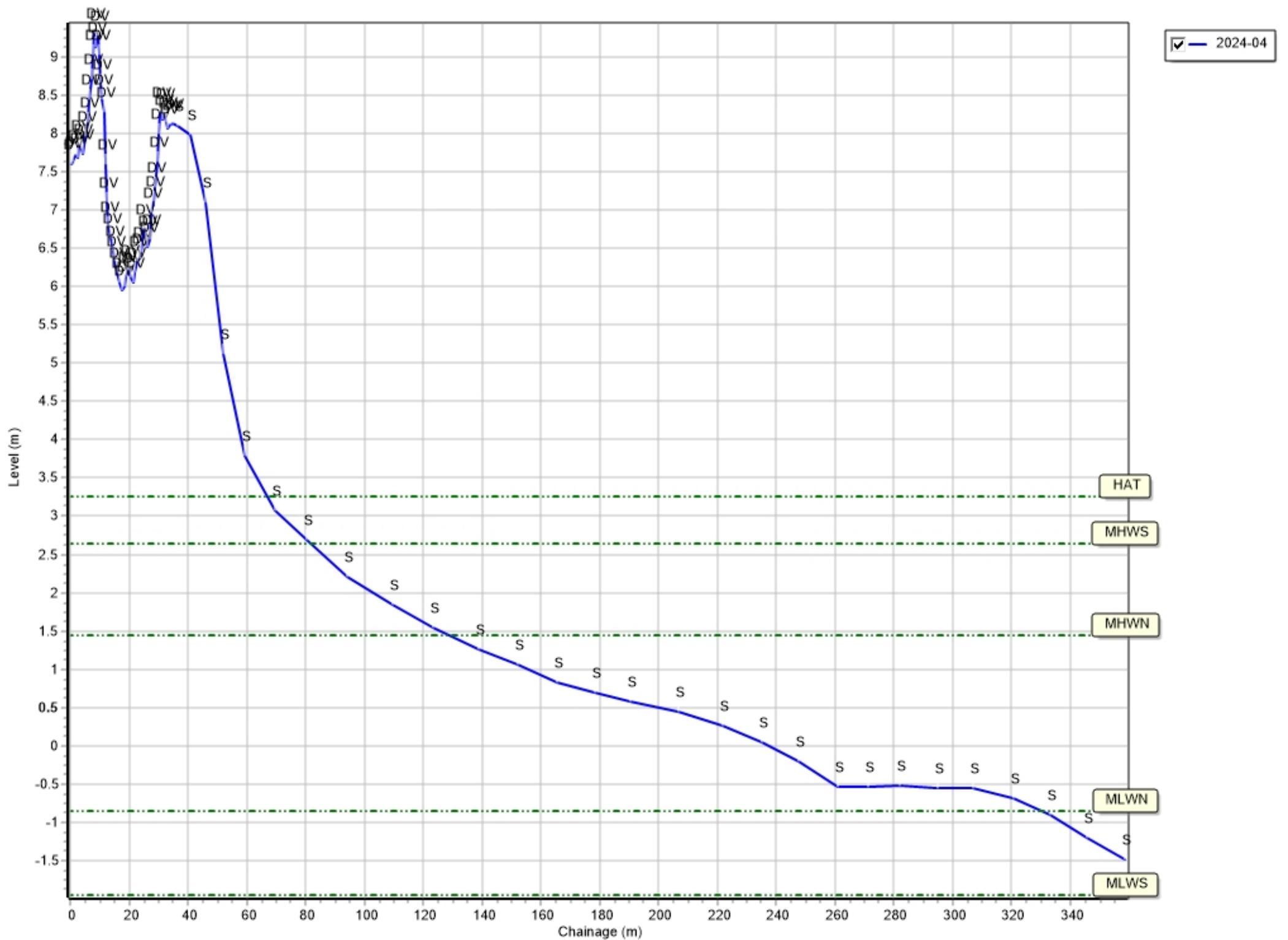
Profiles: 1cRC1



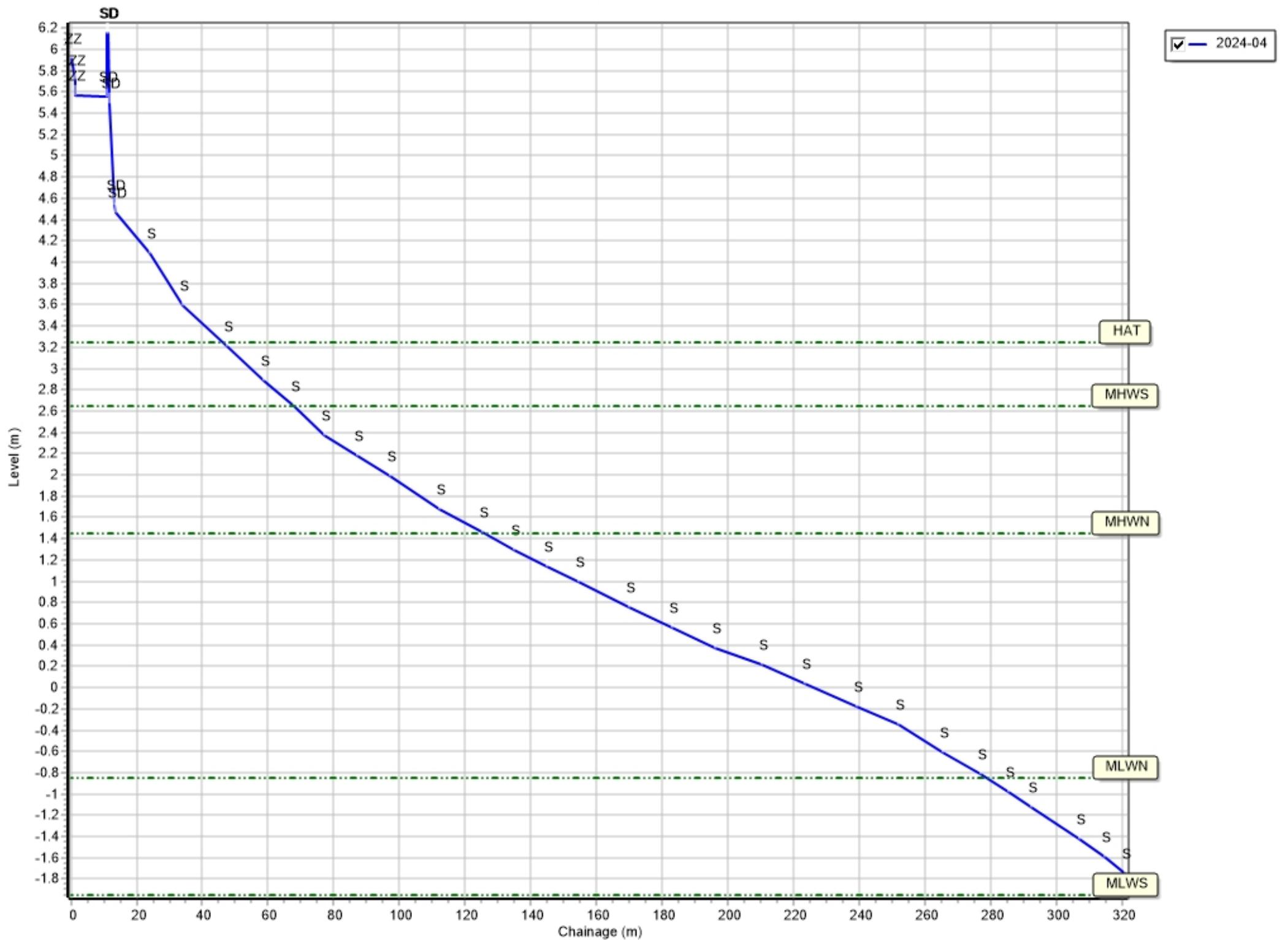
Profiles: 1cRC2



Profiles: 1cRC3



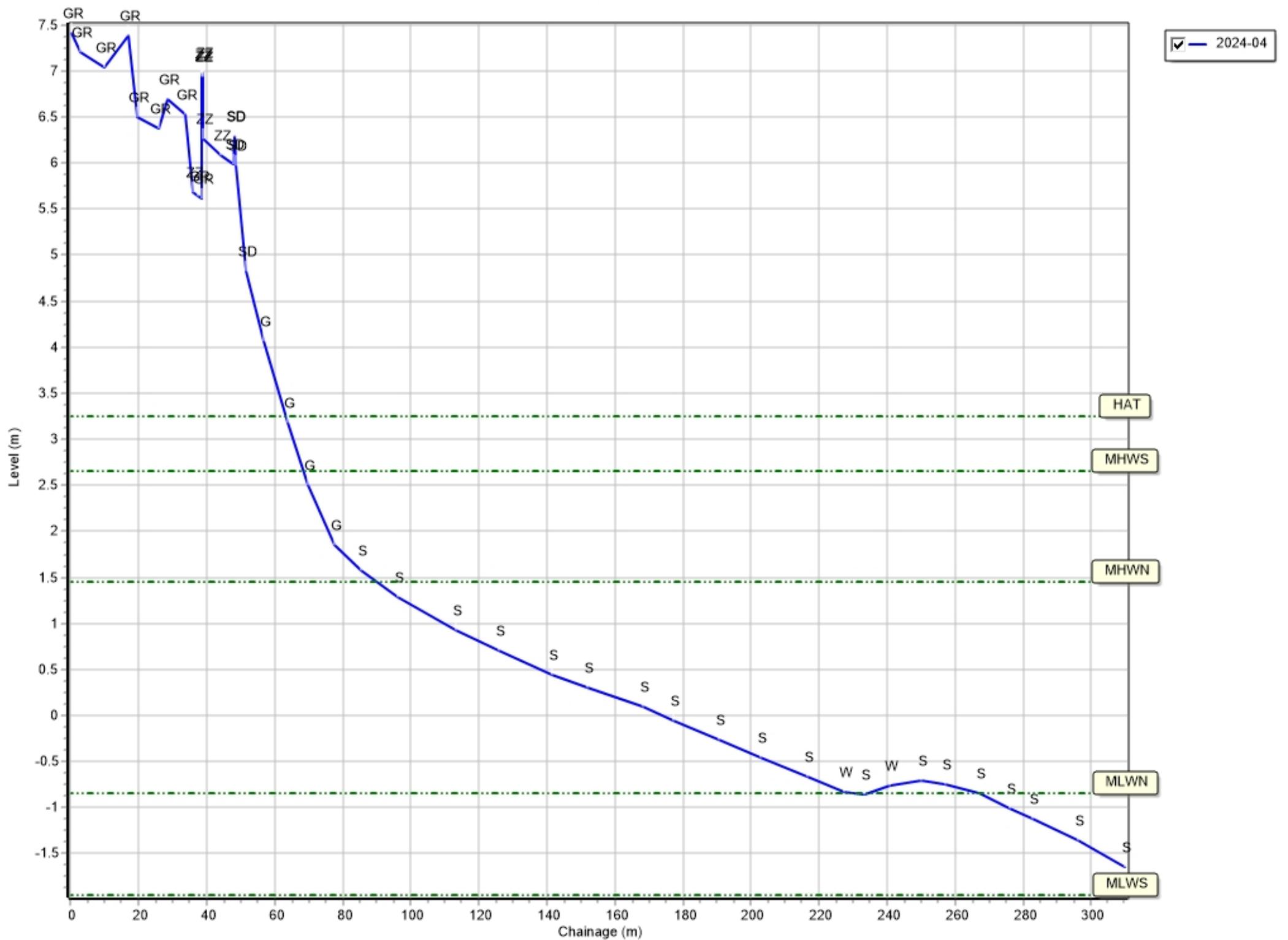
Profiles: 1cRC4



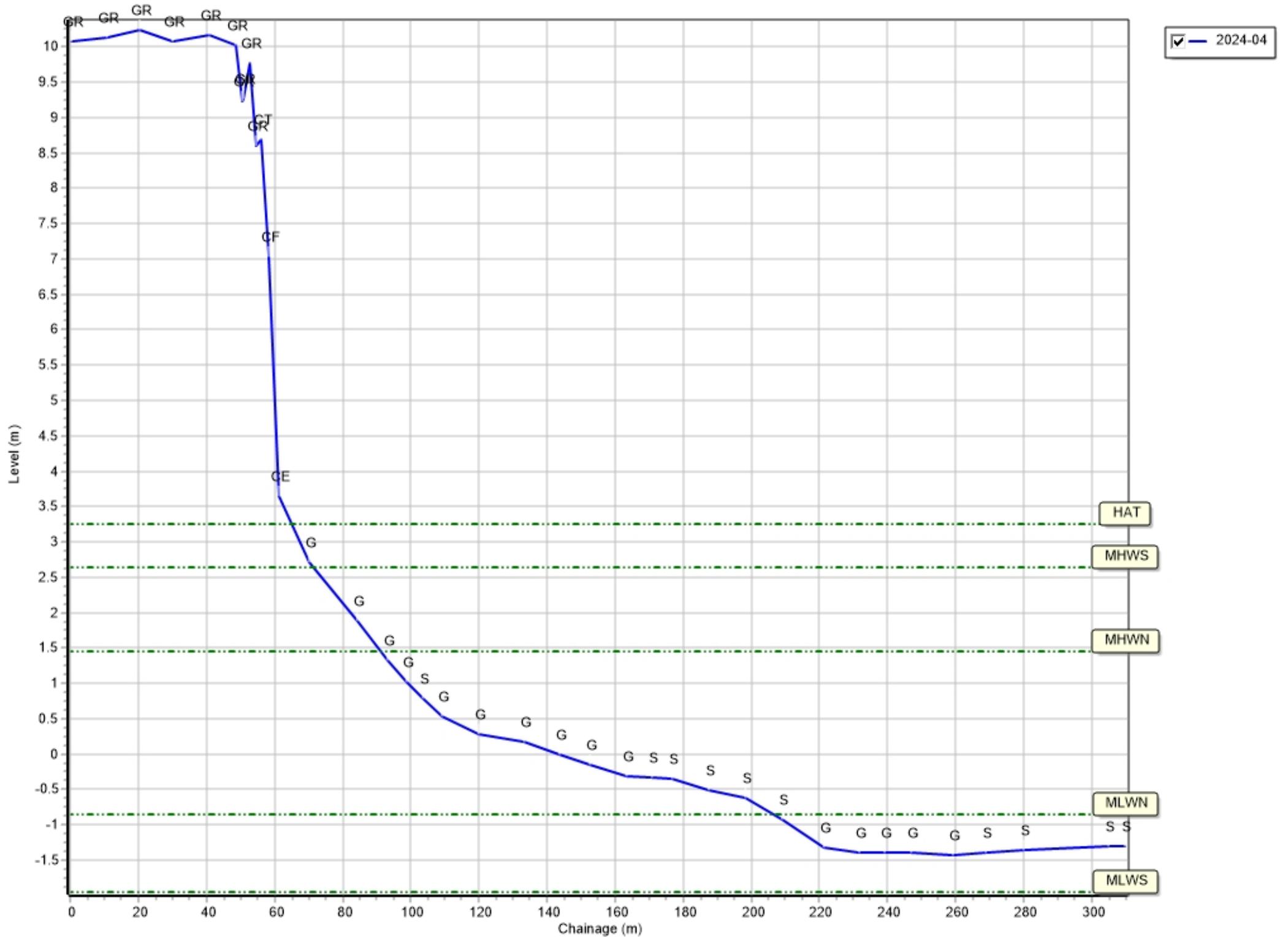
Profiles: 1cRC5



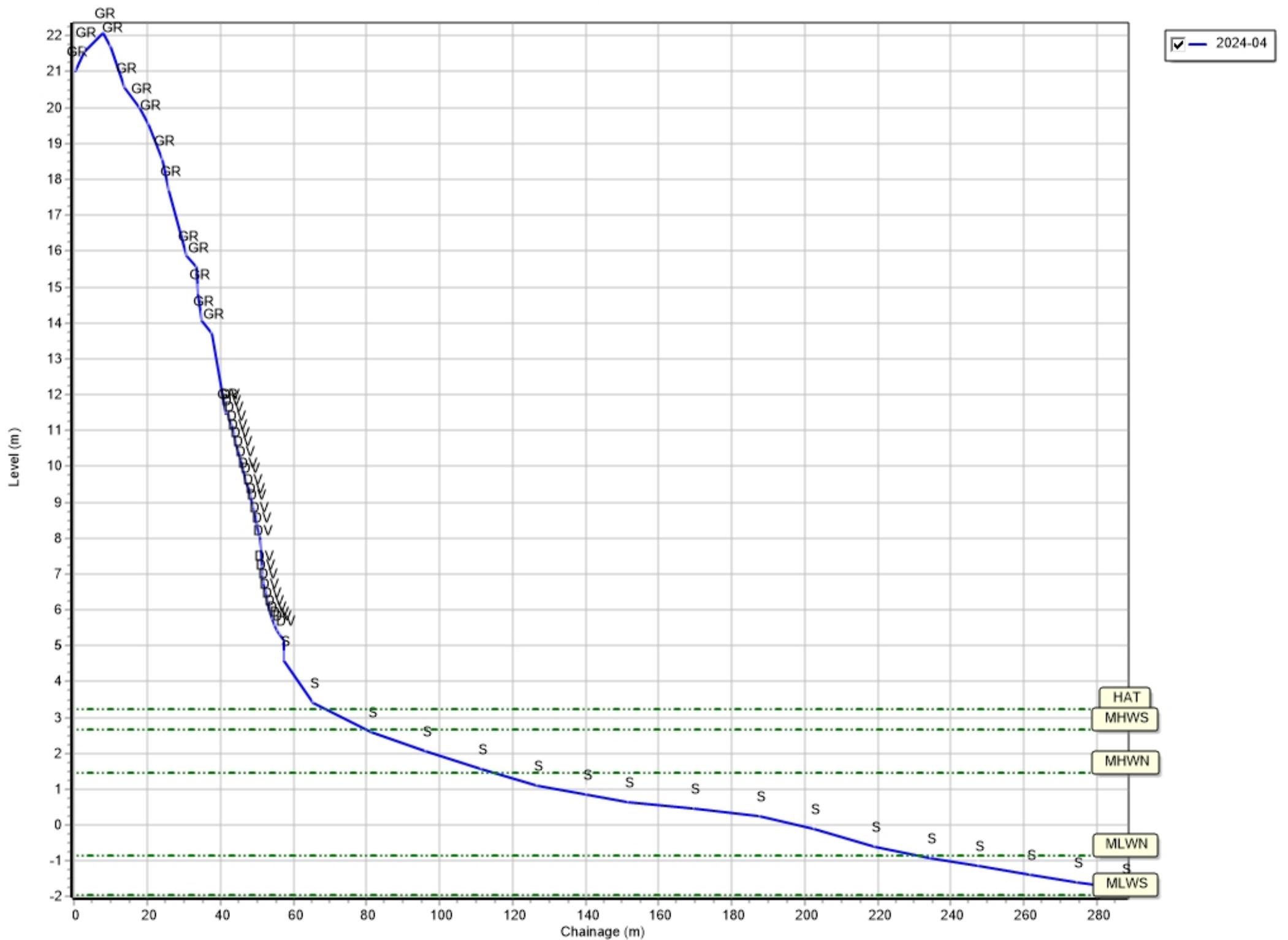
Profiles: 1cRC6



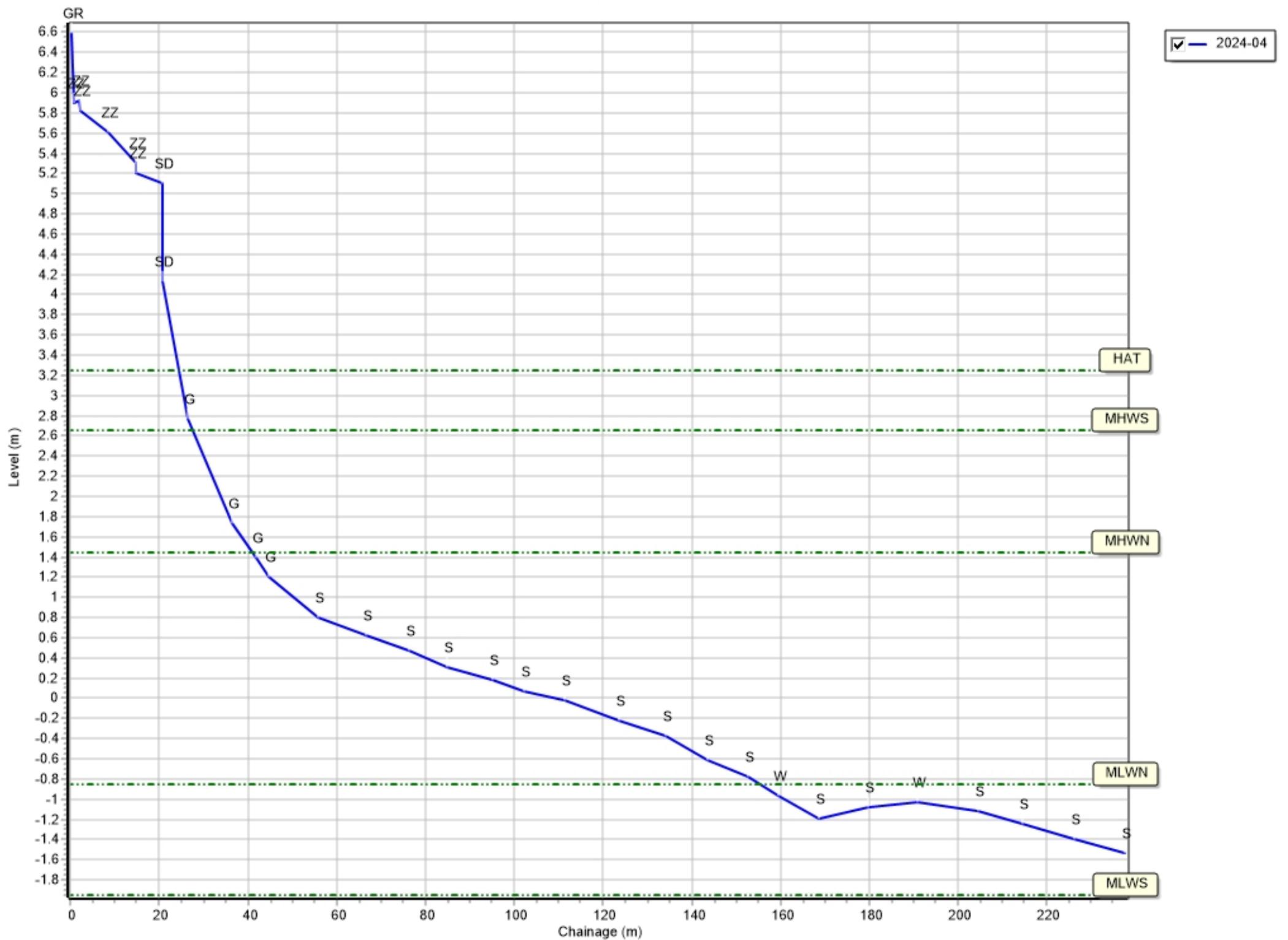
Profiles: 1cRC7



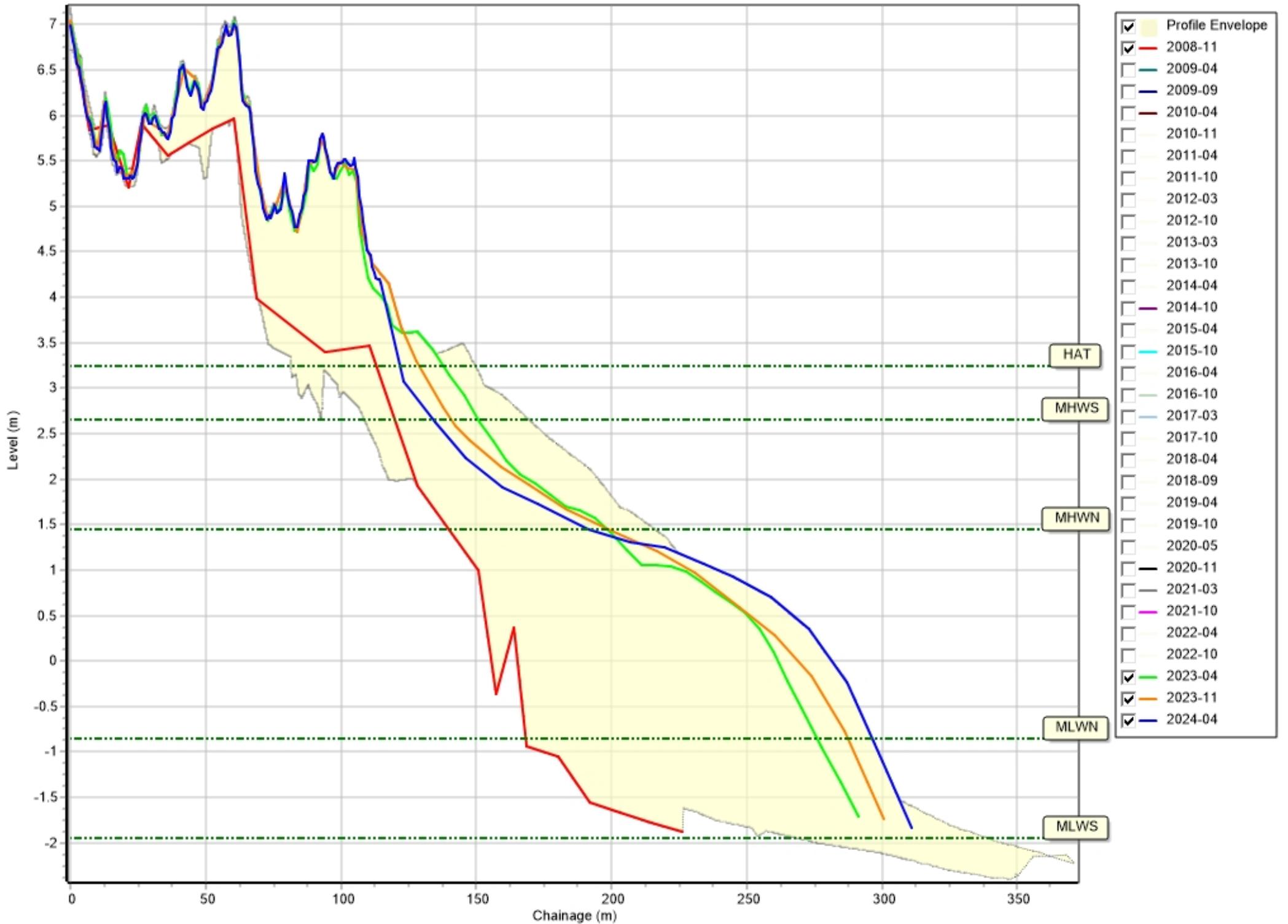
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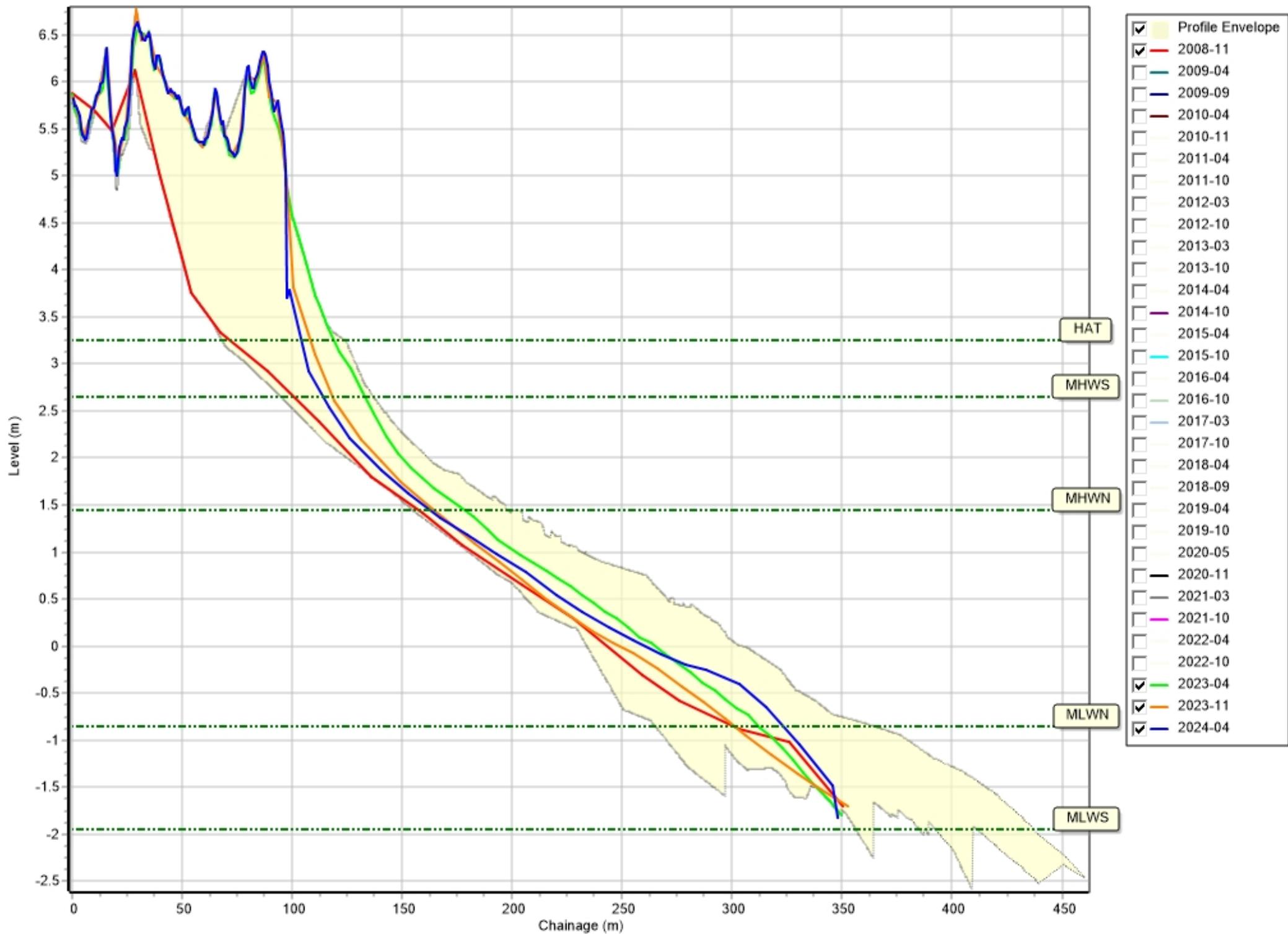
Profiles: 1cRC9



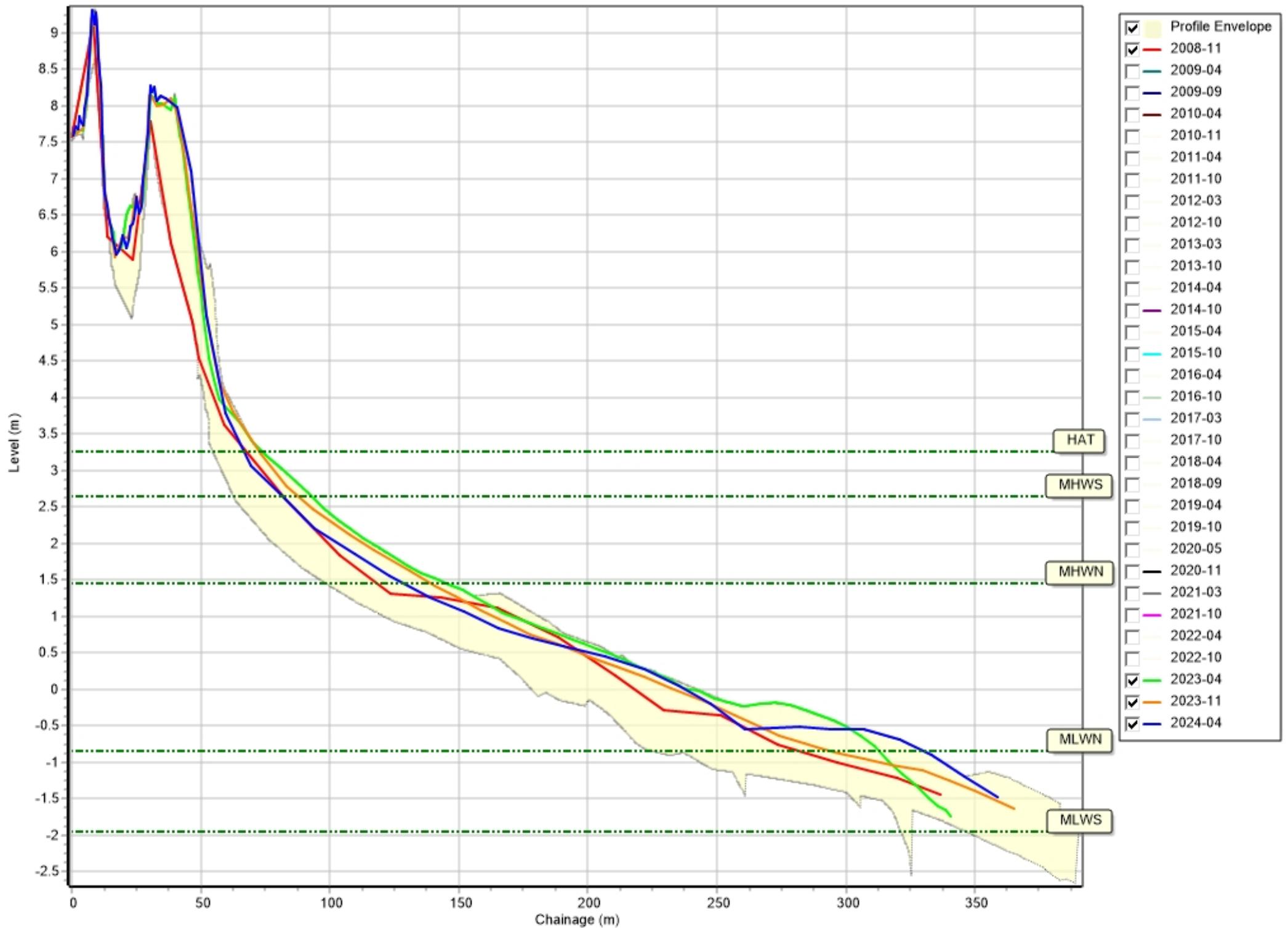
Profiles: 1cRC1



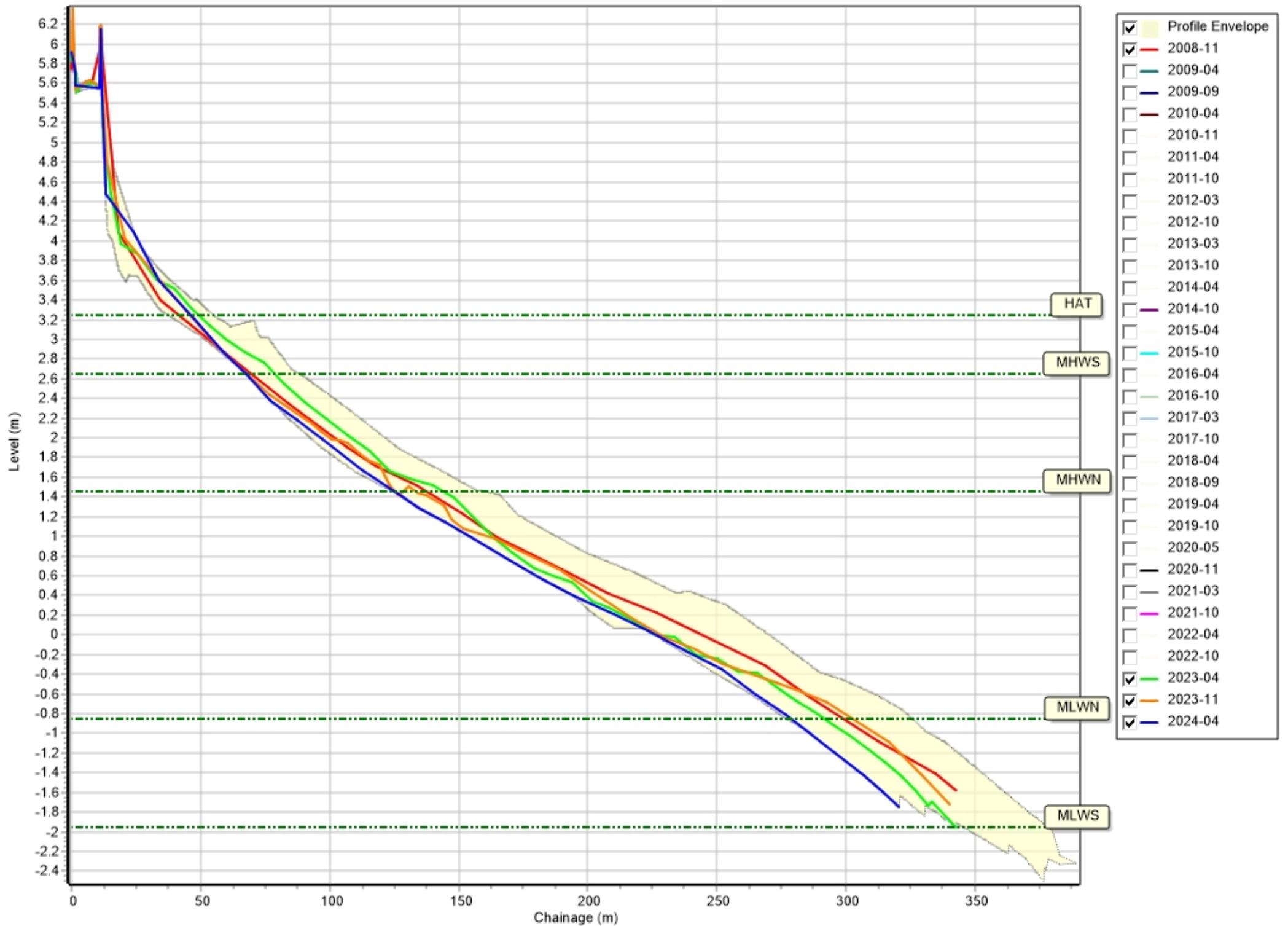
Profiles: 1cRC2



Profiles: 1cRC3



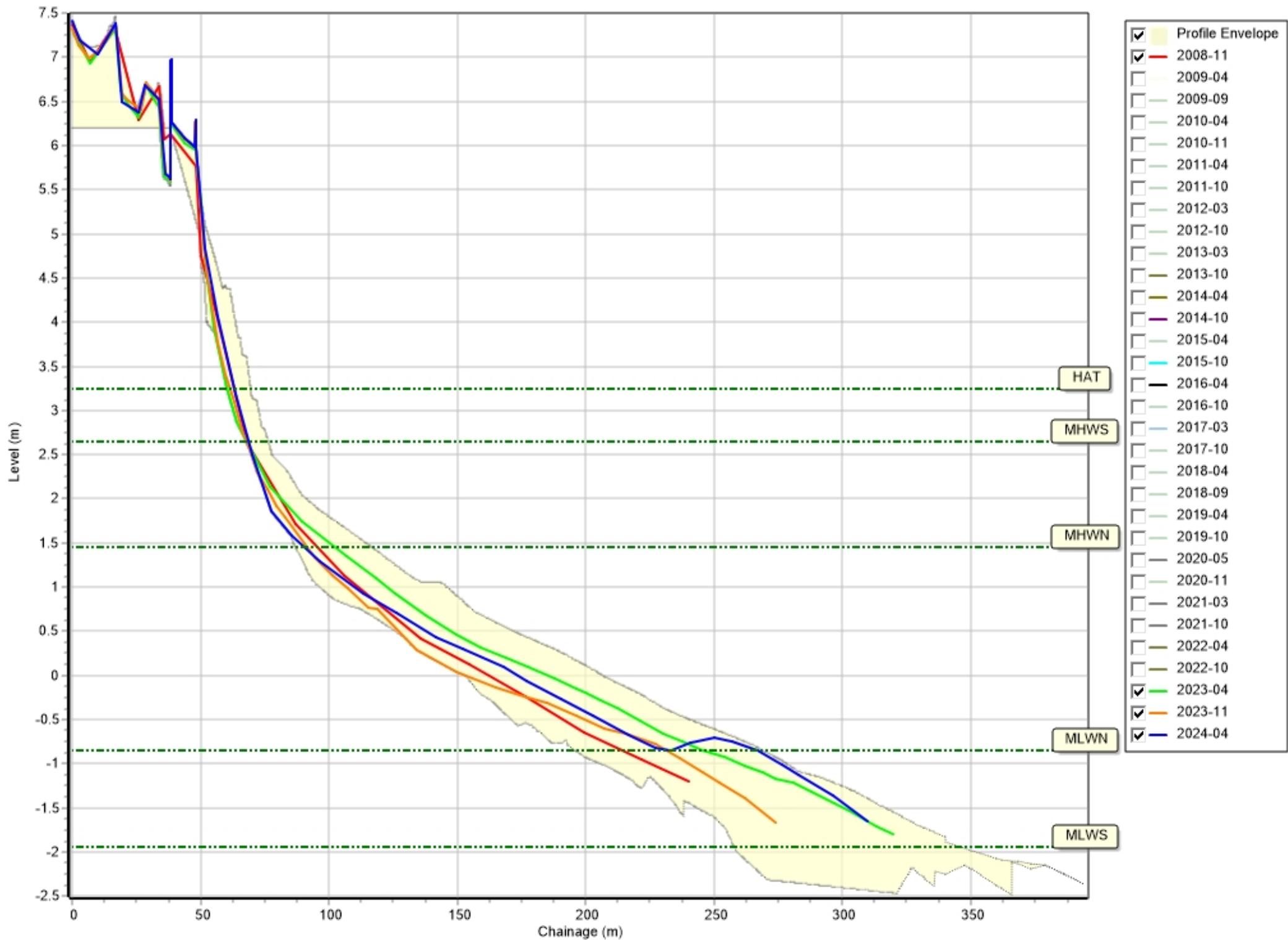
Profiles: 1cRC4



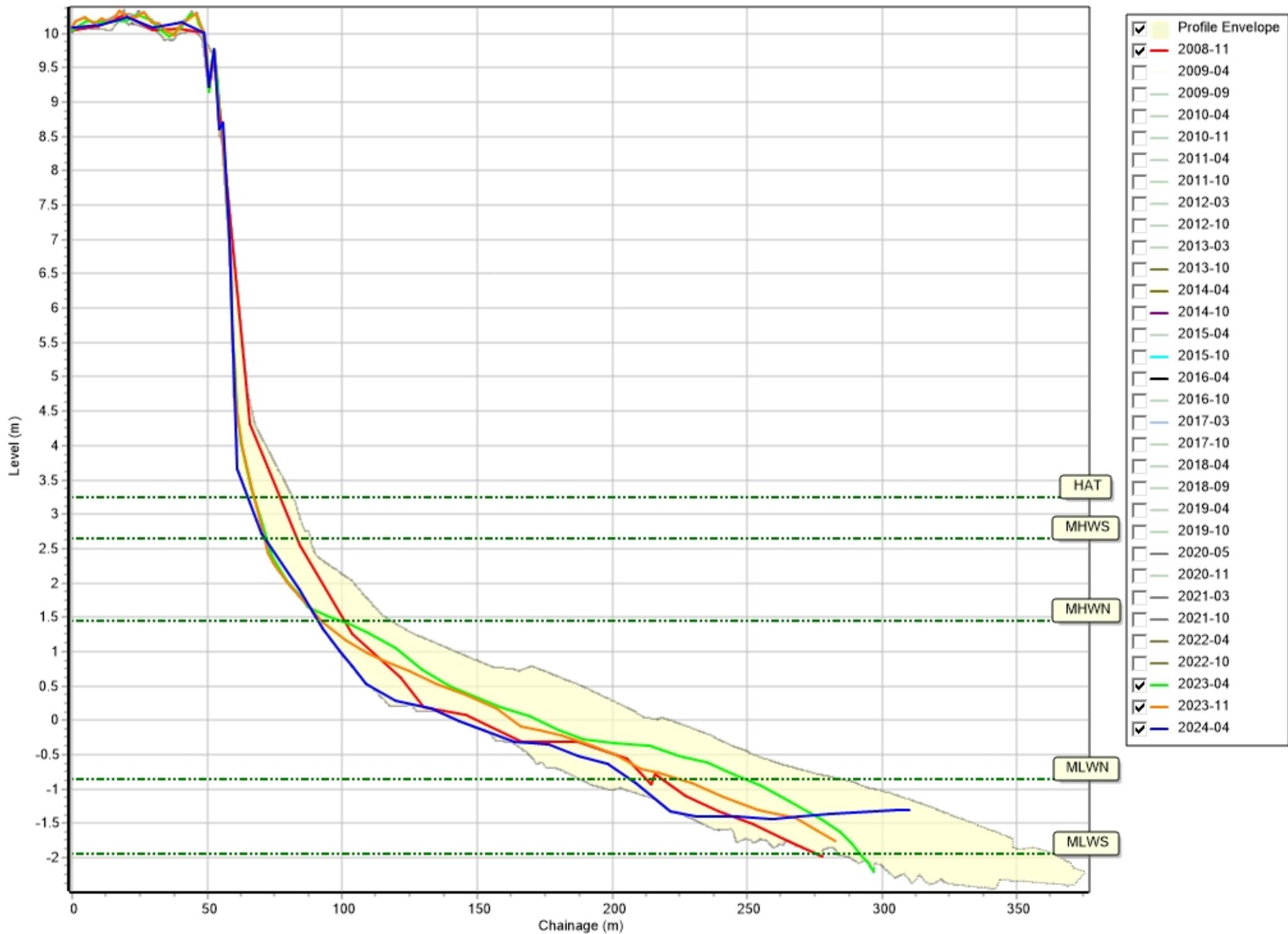
Profiles: 1cRC5



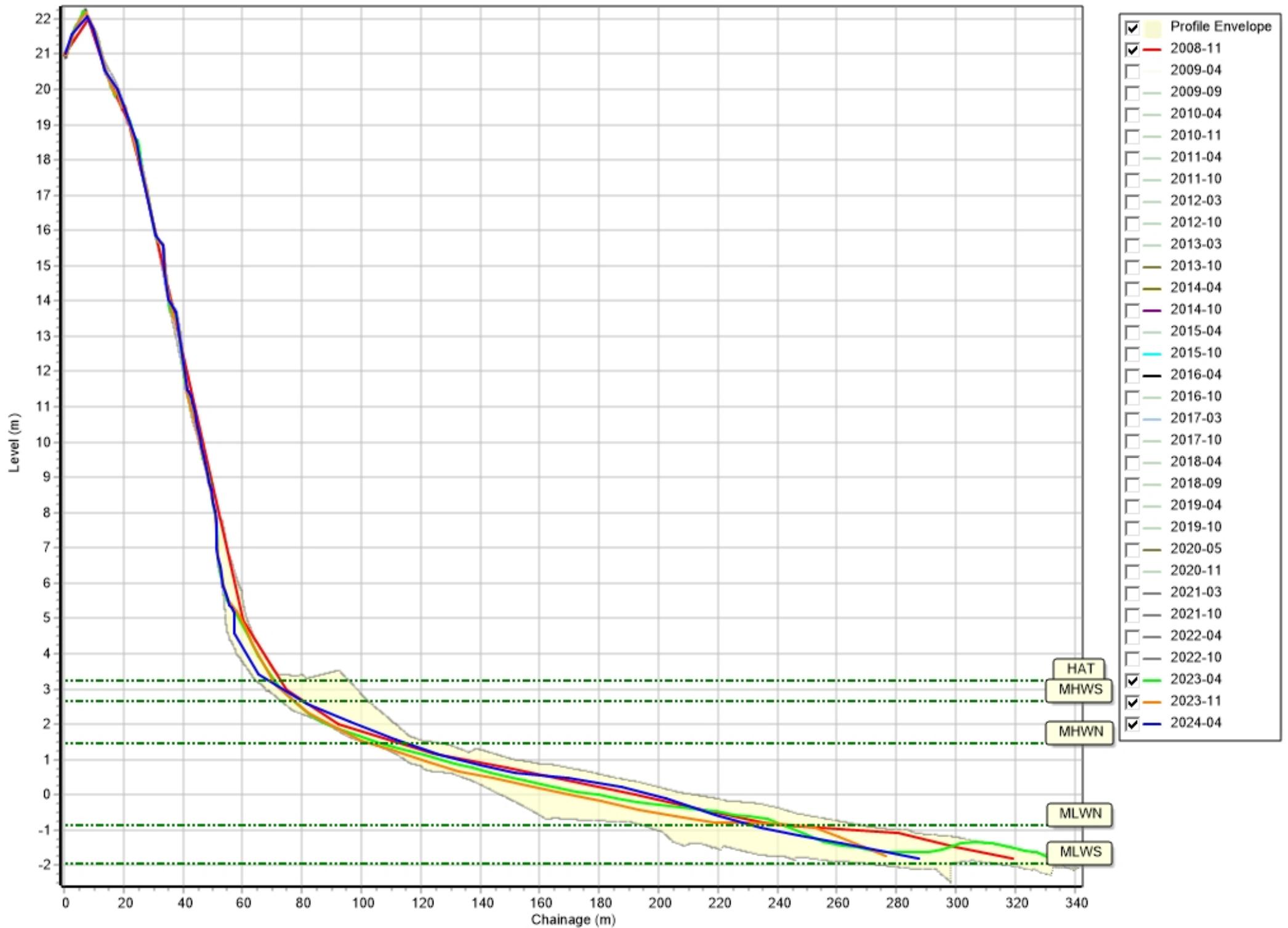
Profiles: 1cRC6



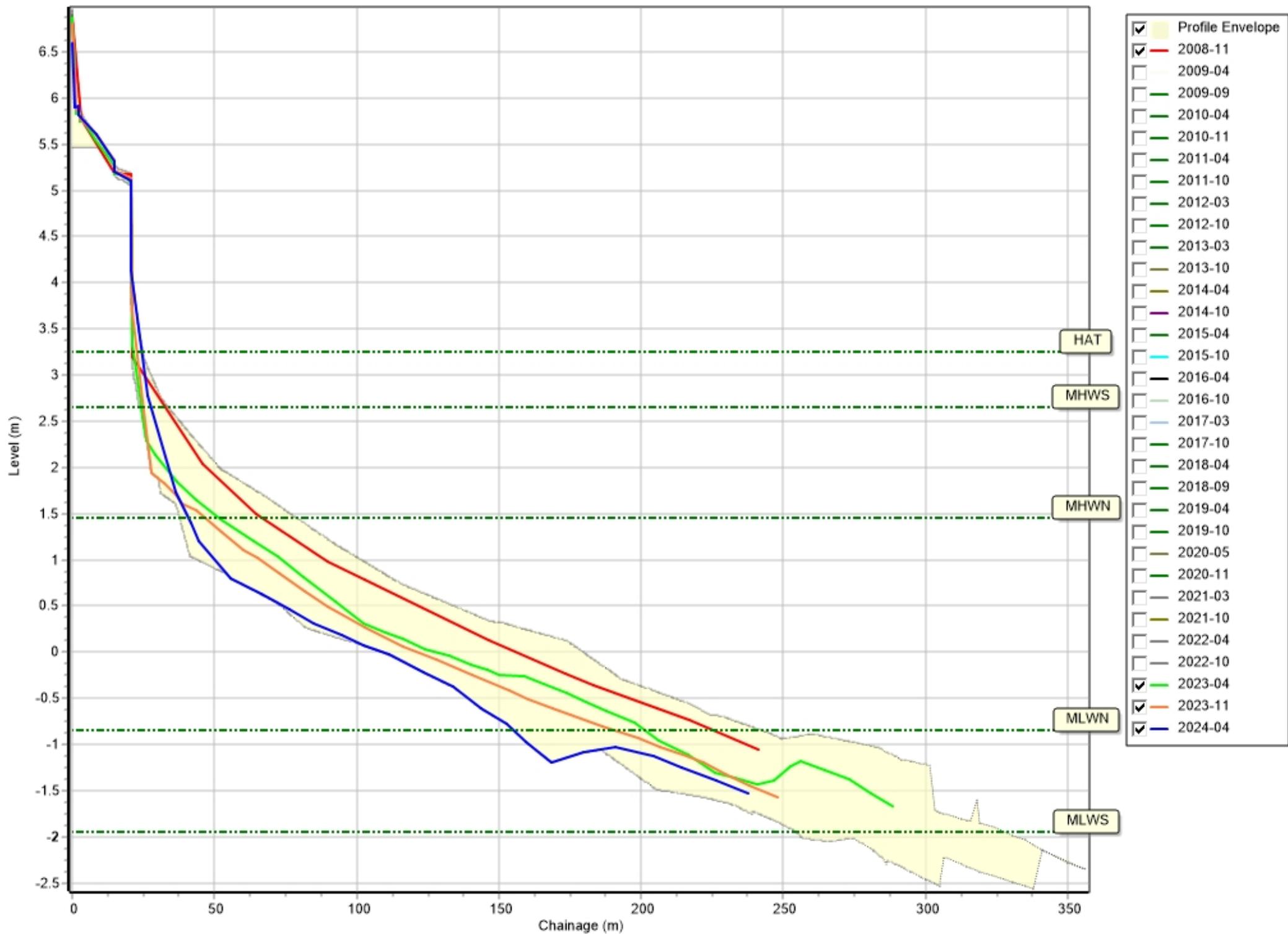
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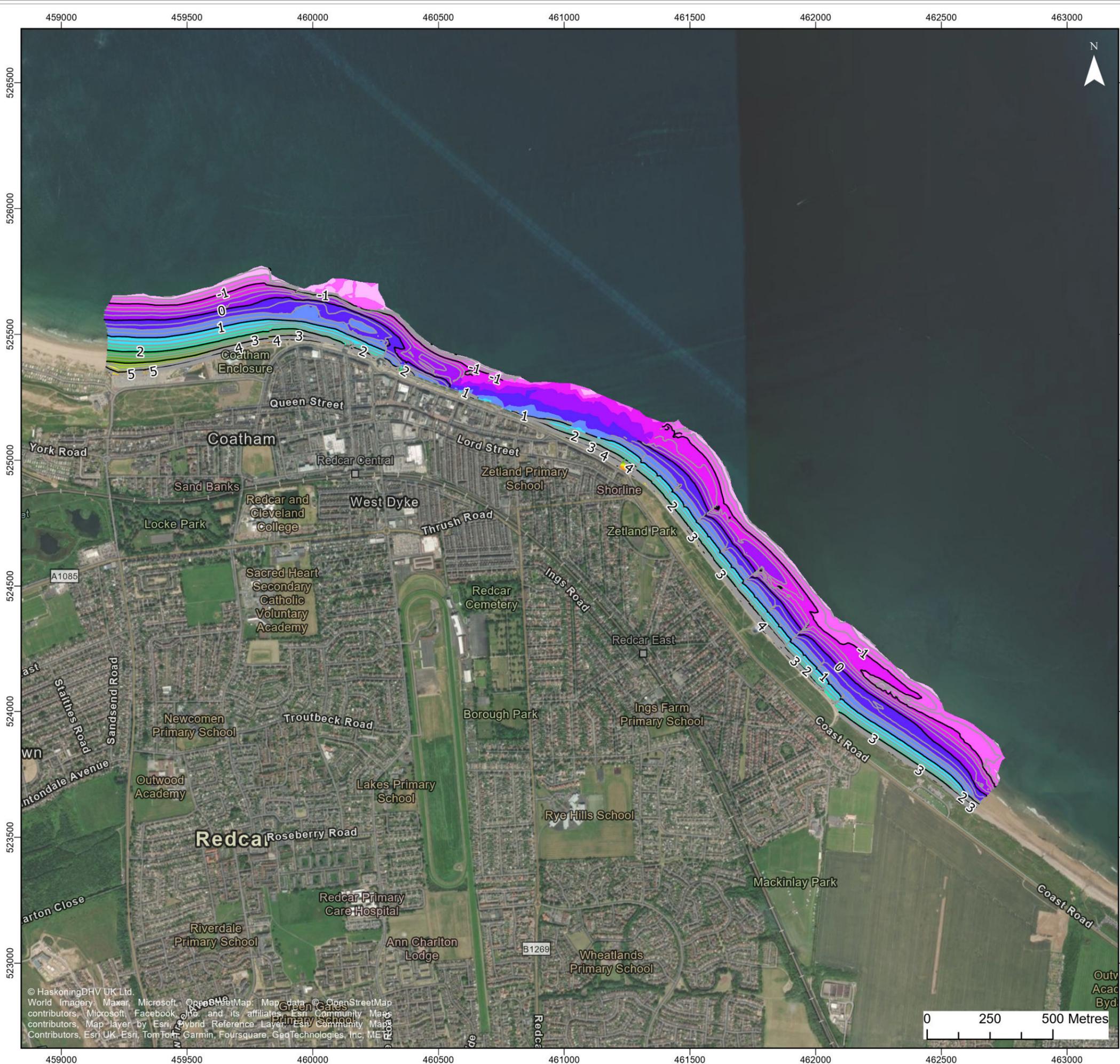
Profiles: 1cRC8



Profiles: 1cRC9



Appendix B
Topographic Survey



TOPOGRAPHIC SURVEY (April 2024)

Elevation (mOD)	Contours (mOD)*
-1.9 - -2	— 1.0m interval
-1.9 - -1.5	— 0.25m interval
-1.4 - -1	
-0.9 - -0.5	* Contours only cover sandy beach areas.
-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	

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

Title:

Appendix B - Map 1

REDCAR SANDS

Redcar and Cleveland Borough Council Frontage

Report:

Update Report
'Partial Measures' Survey 2024

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	08/05/2024	TC	NJC	A3	1:15,000

Co-ordinate system: British National Grid

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TOPOGRAPHIC SURVEY (April 2024)

Elevation (mOD)	Contours (mOD)*
-2.1 - -2	— 1.0m interval
-1.9 - -1.5	— 0.25m interval
-1.4 - -1	
-0.9 - -0.5	* Contours only cover sandy beach areas.
-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	

Client: North East Coastal Group	Project: Cell 1 Regional Coastal Monitoring Programme
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Title:
Appendix B - Map 2
SALTBURN SANDS
Redcar and Cleveland Borough Council Frontage

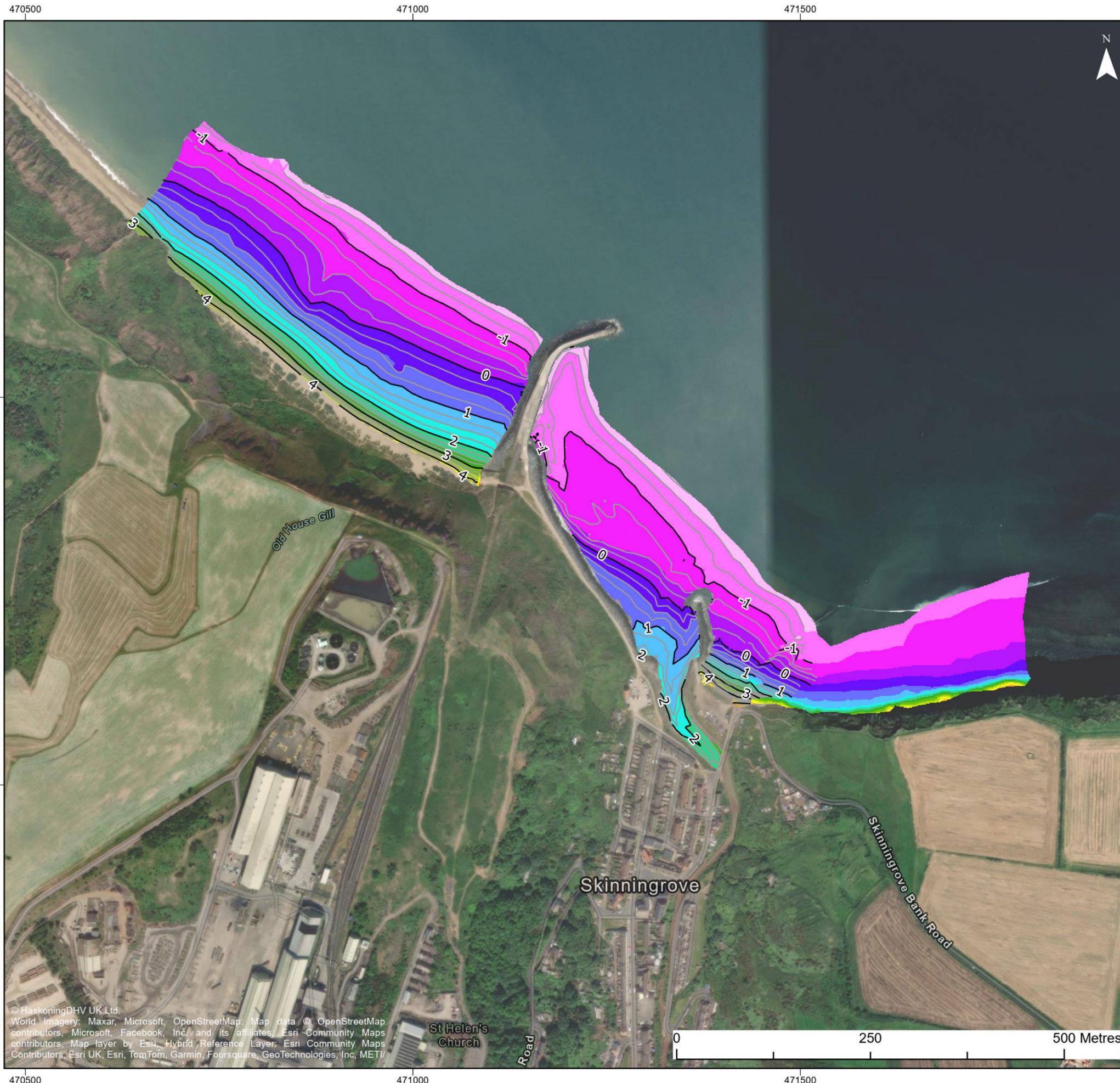
Report:
Update Report
'Partial Measures' Survey 2024

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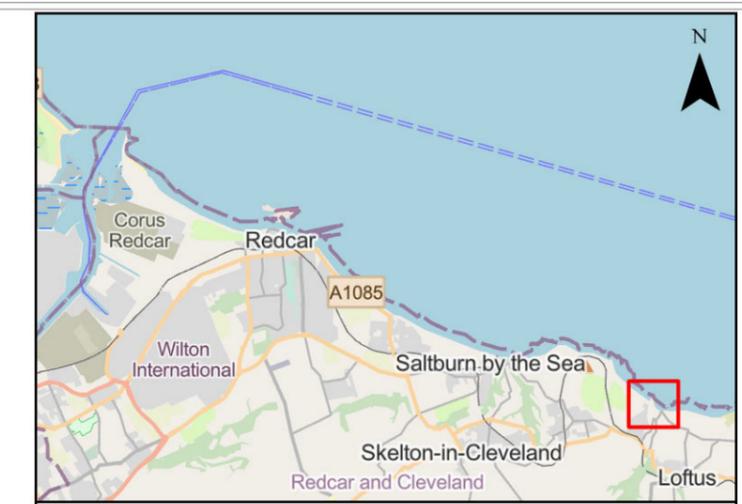
Co-ordinate system: British National Grid



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TOPOGRAPHIC SURVEY (April 2024)

Elevation (mOD)	Contours (mOD)*
<ul style="list-style-type: none"> -2.1 - -2 -1.9 - -1.5 -1.4 - -1 -0.9 - -0.5 -0.4 - 0 0.1 - 0.5 0.6 - 1 1.1 - 1.5 1.6 - 2 2.1 - 2.5 2.6 - 3 3.1 - 3.5 3.6 - 4 4.1 - 4.5 4.6 - 5 5.1 - 5.5 5.6 - 6 	<ul style="list-style-type: none"> 1.0m interval 0.25m interval <p>* Contours only cover sandy beach areas.</p>

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

Title:

Appendix B - Map 3

CATTERSTY SANDS (SKINNINGROVE)

Redcar and Cleveland Borough Council Frontage

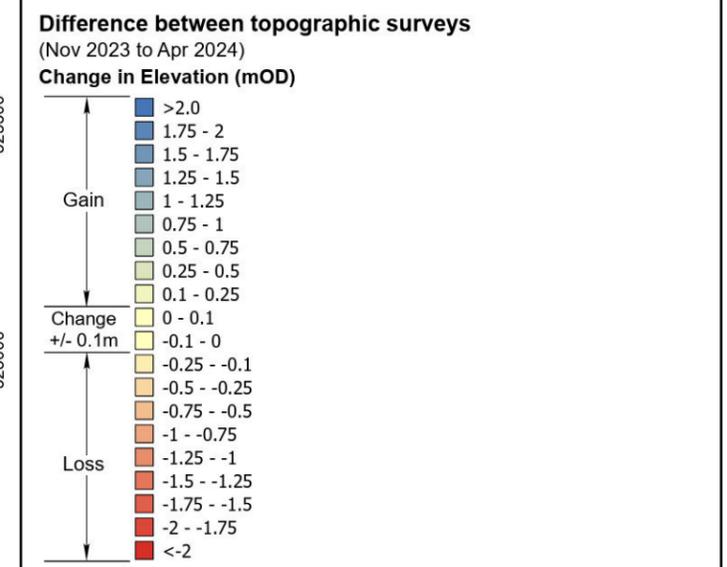
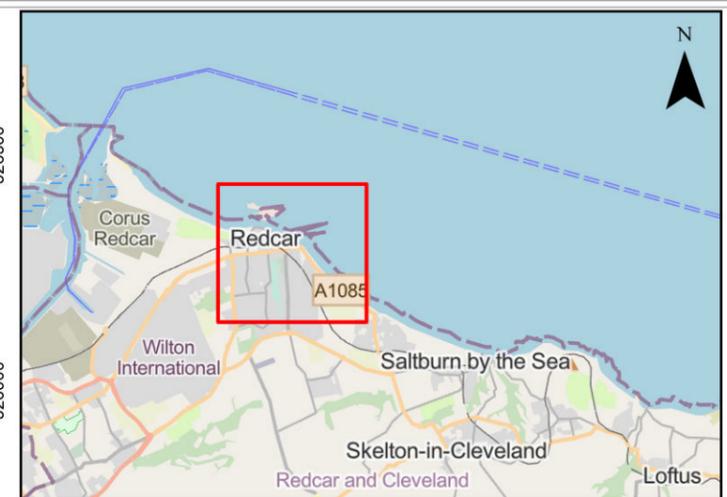
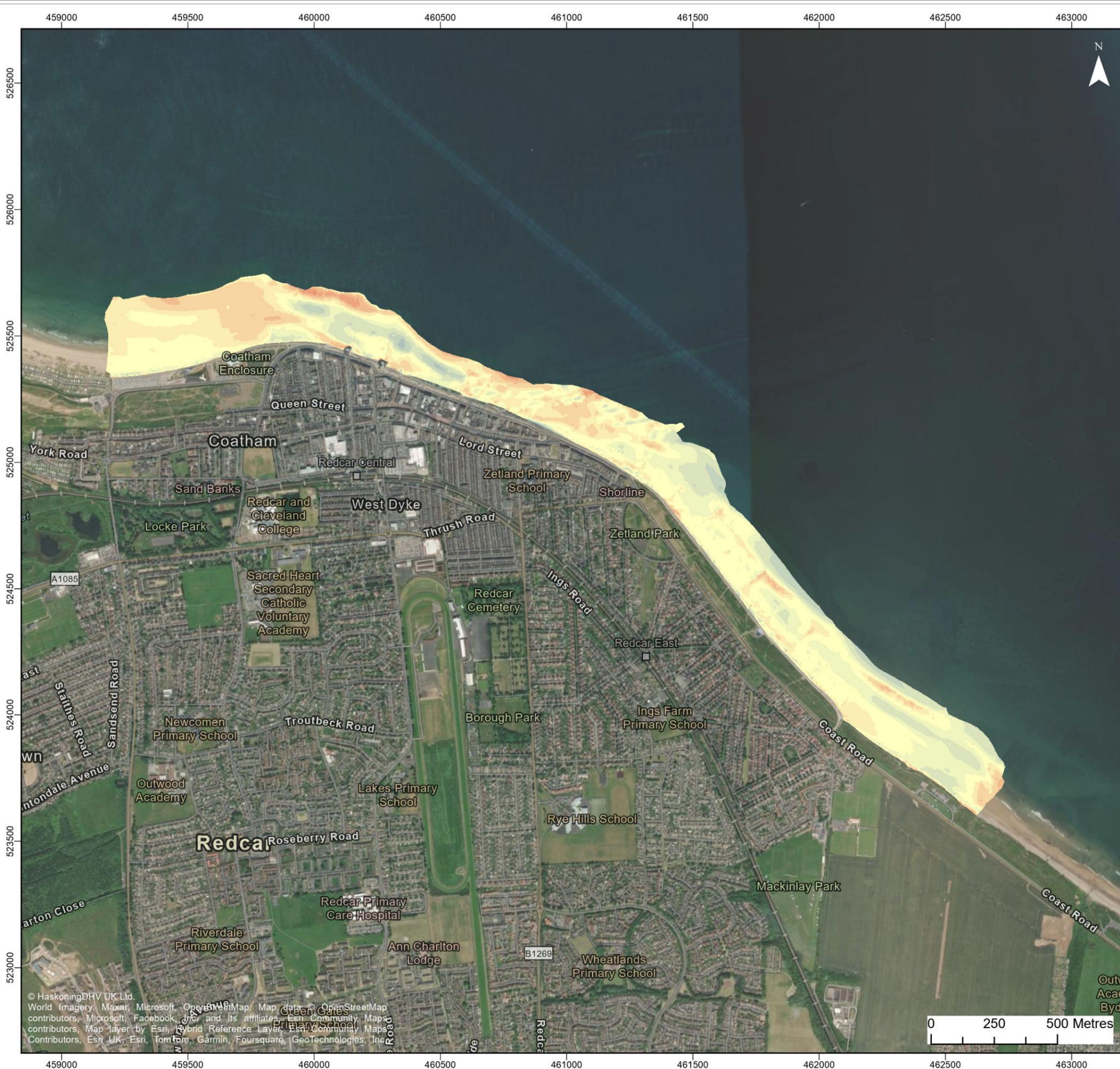
Report:

Update Report
 'Partial Measures' Survey 2024

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

Co-ordinate system: British National Grid





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

Title:

Appendix B - Map 4

REDCAR SANDS

Redcar and Cleveland Borough Council Frontage

Report:

Update Report
'Partial Measures' Survey 2024

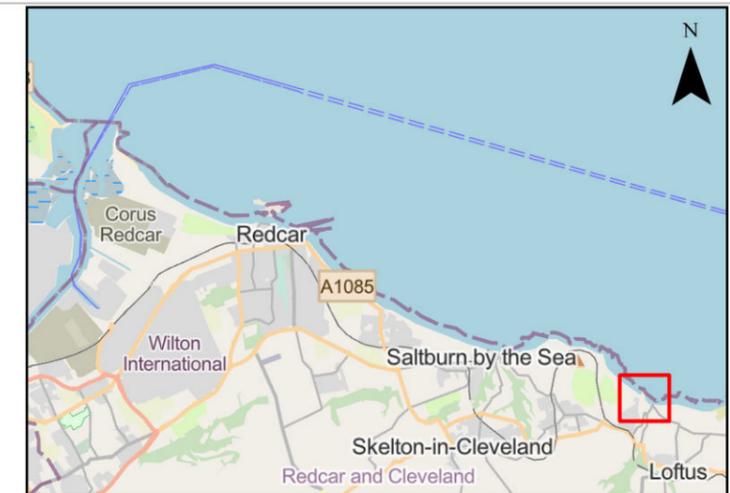
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate system: British National Grid

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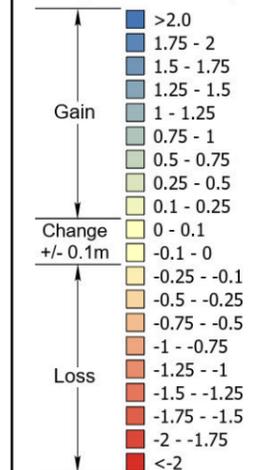
North East Coastal Observatory

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Difference between topographic surveys
(Nov 2023 to Apr 2024)

Change in Elevation (mOD)



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

Title:

Appendix B - Map 6

CATTERSTY SANDS (SKINNINGROVE)

Redcar and Cleveland Borough Council Frontage

Report:

Update Report
'Partial Measures' Survey 2024

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

Co-ordinate system: British National Grid



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Appendix C
Cliff Top Survey

Cliff Top Survey

Twenty ground control points have been established at Staithes (Figure 3 – Map 1). The maximum separation between any two points varies along the coast, reflecting the degree of risk from the erosion. The cliff top surveys at Staithes are undertaken bi-annually. Measurements are taken from a fixed ground control point along a fixed bearing to the edge of the cliff top.

Table C1 provides baseline information about these ground control points and results from the November 2008 (baseline) survey showing the position from the ground control point to the edge of the cliff top along the defined bearing. Future reports will show results from subsequent surveys and provide a means of assessing erosion since the baseline survey.

Table C1 – Cliff Top Surveys at Staithes

Ground Control Points				Distance to Cliff Top (m)			Total Erosion (m)		Erosion Rate (m/year)
Ref	Easting	Northing	Bearing (°)	Baseline Survey	Previous Survey	Present Survey	Baseline to Present	Previous to Present	Baseline to Present
STAITHES				Nov 2008	Sep 2023	Mar 2024	Nov 2008 - Mar 2024	Sep 2023 - Mar 2024	Nov 2008 - Mar 2024
1	477228	518769	320	1.90	-5.70	-5.80	7.70	0.10	0.48
2	477334	518798	0	10.90	10.66	10.66	0.24	0.00	0.02
3	477487	518789	350	7.10	8.03	8.01	-0.91	0.02	0.00
4	477594	518801	340	5.90	3.62	3.47	2.43	0.15	0.15
5	477683	518911	350	8.40	8.52	8.53	-0.13	-0.01	0.00
6	477792	518867	30	8.60	8.63	8.54	0.06	0.09	0.00
7	477891	518828	60	7.70	7.23	7.20	0.50	0.03	0.03
8	477959	518873	350	8.70	8.39	8.42	0.28	-0.03	0.02
9	478088	518950	350	7.60	8.05	8.03	-0.43	0.02	0.00
10	478191	519023	340	8.40	8.66	8.62	-0.22	0.04	0.00
11	478237	519007	60	6.90	6.56	6.56	0.34	0.00	0.02
12	478213	518988	150	6.10	6.17	6.16	-0.06	0.01	0.00
13	478501	518809	15	11.40	8.24	8.22	3.18	0.02	0.20
14	478624	518807	20	7.50	7.30	7.28	0.22	0.02	0.01
15	478737	518858	60	6.10	6.12	6.13	-0.03	-0.01	0.00
16	478823	518757	60	8.00	8.41	8.41	-0.41	0.00	0.00
17	478944	518671	30	9.30	8.55	8.56	0.74	-0.01	0.05
18	479052	518630	20	9.20	9.05	9.03	0.17	0.02	0.01
19	479147	518610	0	14.20	13.67	13.66	0.54	0.01	0.03
20	479274	518618	20	11.40	10.95	10.96	0.44	-0.01	0.03