



**Cell 1 Regional Coastal Monitoring Programme  
Analytical Report 3: 'Full Measures' Survey 2011**



**Sunderland City Council  
Final Report**

**October 2012**

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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)
	Souter Point to Chourdon Point
HAT	3.18
MHWS	2.48
MLWS	-1.92

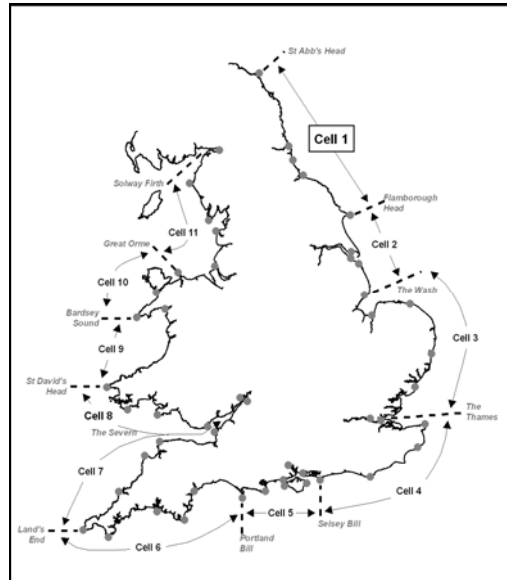
**Source:** *River Tyne to Flamborough Head Shoreline Management Plan 2.*  
Royal Haskoning, February 2007.

## 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 work commenced with a three-year monitoring programme in September 2008 that was managed by Scarborough Borough Council on behalf of the North East Coastal Group. This initial phase has been followed by a five-year programme of work, which started in October 2011. The work is funded by the Environment Agency, working in partnership with the following organisations:



The original three year programme of work was undertaken as a partnership between Royal Haskoning, Halcrow and Academy Geomatics. For the current five year programme of work the data collection associated with beach profiles, topographic surveys and cliff top surveys is being undertaken by Academy Geomatics. The analysis and reporting for the programme is being undertaken by Halcrow.



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
- walk-over 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	n/a	n/a	Mar-May 09	Jun 09	-
2	2009/10	Sept-Dec 09	Mar 10	Feb-Mar 10	Jul 10	-
3	2010/11	Aug-Nov 10	Feb 11	Feb-Apr 11	Aug 11	Sept 11
4	2011/12	Oct-Nov 11	Oct 12 (*)			

(\*) The present report is **Analytical Report 3** and provides an analysis of the 2011 Full Measures survey for Sunderland City Council's frontage. An Analytical Report was not produced in May 2009 for Sunderland City Council as part of the Cell 1 Regional Monitoring Programme because the survey data collection and reporting were coordinated under an existing agreement with the Council's framework consultants.

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

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

**Table 2 Sub-divisions of the Cell 1 Coastline**

<b>Authority</b>	<b>Zone</b>
Northumberland County Council	Sandstell Point (Spittal A)
	Spittal (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
	Sunderland Harbour and Docks
	Hendon to Ryhope (incl. Halliwell Banks)
Durham County Council	Featherbed Rocks
	Seaham
	Blast Beach
	Hawthorn Hive
	Blackhall Colliery
Hartlepool Borough Council	North Sands
	Headland
	Middleton
	Hartlepool Bay
Redcar & Cleveland Borough Council	Coatham Sands
	Redcar Sands
	Marske Sands
	Saltburn Sands
	Cattersty Sands (Skinningrove)
Scarborough Borough Council	Staithes
	Runswick Bay
	Sandsend Beach, Uppgang Beach and Whitby Sands
	Robin Hood's Bay
	Scarborough North Bay
	Scarborough South Bay
	Cayton Bay
	Filey Bay



## 1. Introduction

### 1.1 Study Area

Sunderland City Council's frontage extends from The Bents to Ryhope. For the purposes of this report and for consistency with previous reporting, it has been sub-divided into three areas, namely:

- Whitburn Bay
- Sunderland Harbour and Docks
- Hendon to Ryhope (including Halliwell Banks)

### 1.2 Methodology

Along Sunderland City Council's frontage, the following surveying is undertaken:

- Full Measures survey annually each autumn/early winter comprising:
  - Beach profile surveys along 58 transect lines (commenced 2009)
  - Topographic survey at Whitburn Bay (commenced 2010)
  - Topographic survey at Hendon to Ryhope (including Halliwell Banks) (commenced 2009)
- Partial Measures survey bi-annually each spring comprising:
  - Beach profile surveys along 16 transect lines (commenced 2009)
- Cliff top survey annually at:
  - Hendon to Ryhope (including Halliwell Banks) (commenced 2009)

The location of these surveys is shown in Figure 2. The Full Measures survey was undertaken along this frontage between 12<sup>th</sup> and 13<sup>th</sup> October 2011 (Whitburn Bay); 11<sup>th</sup> November 2011 (Sunderland Harbour and Docks); and 10<sup>th</sup> and 18<sup>th</sup> October 2011 Hendon to Ryhope (incl. Halliwell Banks). 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's website for storage and availability to others and also input to SANDS and GIS for subsequent analysis.

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

- description of the changes observed since the previous survey and an interpretation of the drivers of these changes (Section 2);
- documentation of any problems encountered during surveying or uncertainties inherent in the analysis (Section 3);
- recommendations for 'fine-tuning' the programme to enhance its outputs (Section 4); and
- providing key conclusions and highlighting any areas of concern (Section 5).

Data from the present survey are presented in a processed form in the Appendices.



**KEY**

**Topographic Profiles**

- Annual
- 6 monthly

**Topographic Surveys**

- 6 monthly
- yearly
- 5 yearly

**Cliff Top Monitoring Pegs**

- 50m centres
- 100m centres
- 300m centres

*(Indicative Survey Extents shown)*

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

**Figure 2- Map 1  
Survey Locations  
Whitburn Bay  
Sunderland City Council**

Analytical Report 4  
Full Measures Survey  
Winter 2011



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Photography courtesy of North East Coastal Observatory  
www.northeastcoastalobservatory.org.uk



**KEY**

**Topographic Profiles**  
 — Annual  
 — 6 monthly

**Topographic Surveys**  
 [Green cross-hatch] 6 monthly  
 [Yellow cross-hatch] yearly  
 [Brown cross-hatch] 5 yearly

**Cliff Top Monitoring Pegs**  
 [Purple bar] 50m centres  
 [Green bar] 100m centres  
 [Red bar] 300m centres  
*(Indicative Survey Extents shown)*

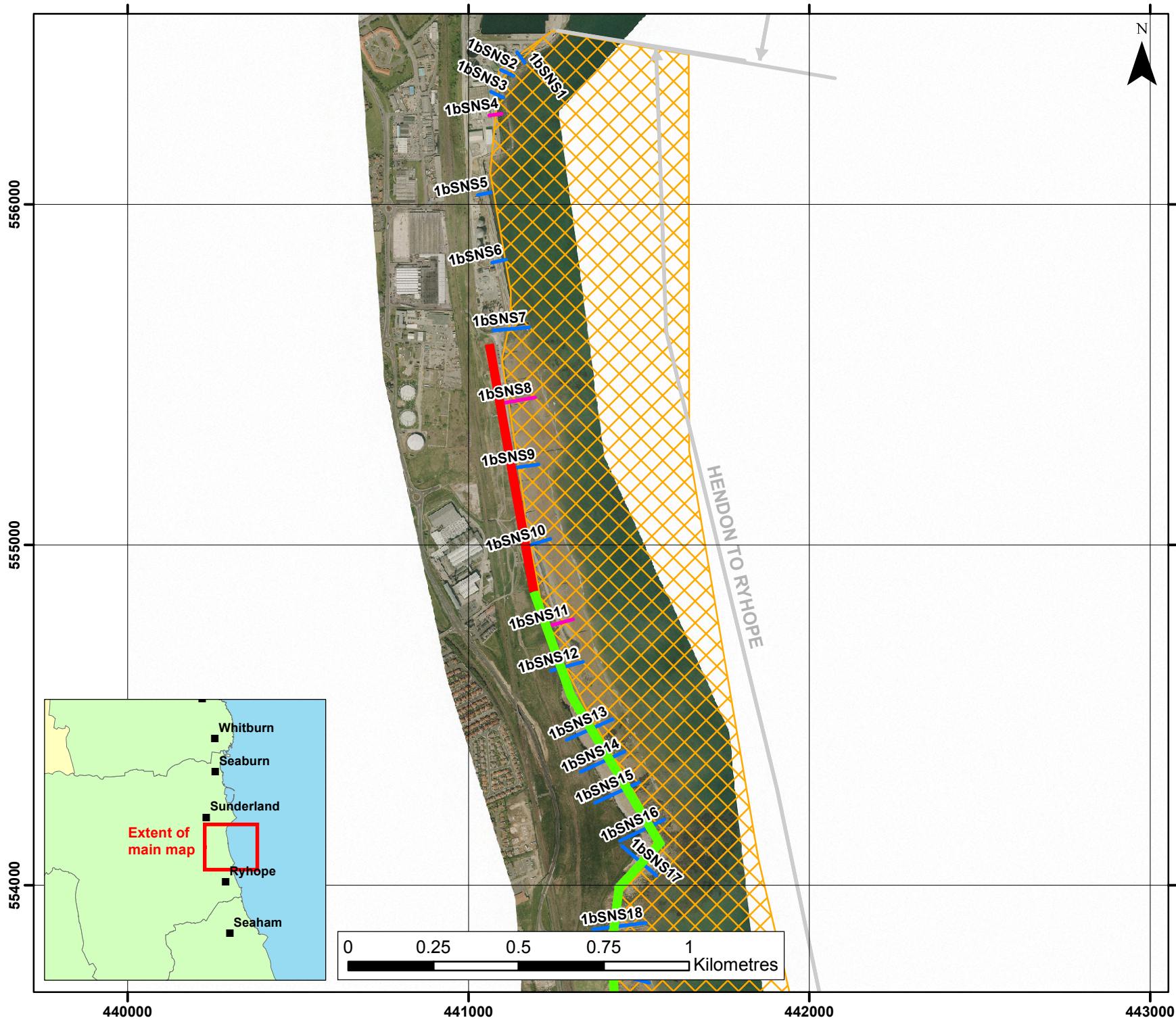
Client: North East Coastal Group  
 Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

**Figure 2- Map 2  
 Survey Locations  
 Sunderland Harbour  
 and Docks  
 Sunderland City Council**

Analytical Report 4  
 Full Measures Survey  
 Winter 2011

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**KEY**

**Topographic Profiles**

- Annual
- 6 monthly

**Topographic Surveys**

- 6 monthly
- yearly
- 5 yearly

**Cliff Top Monitoring Pegs**

- 50m centres
- 100m centres
- 300m centres

*(Indicative Survey Extents shown)*

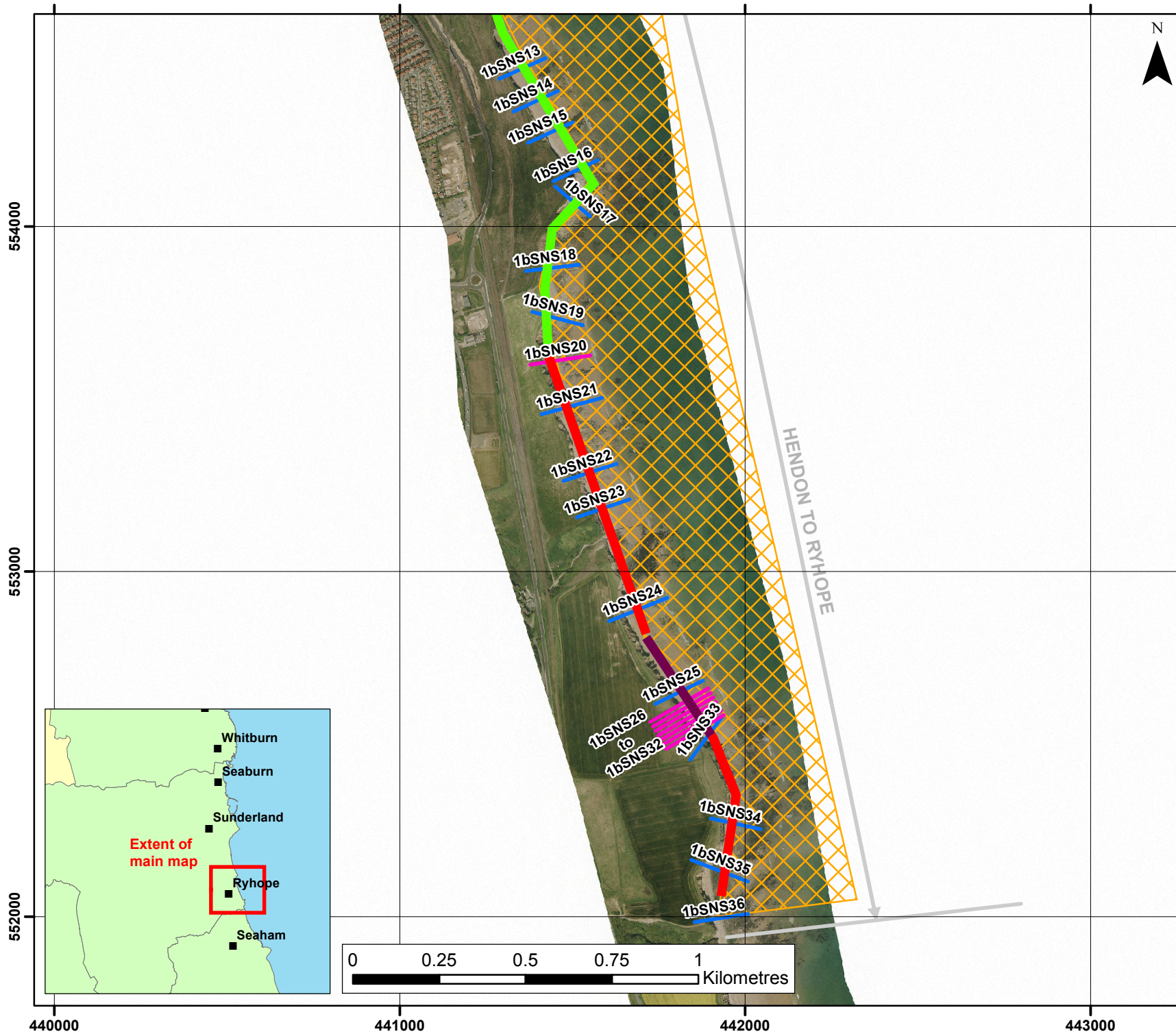
Client: North East Coastal Group  
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**Figure 2- Map 3  
 Survey Locations  
 Hendon to Ryhope a  
 Sunderland City Council**

Analytical Report 4  
 Full Measures Survey  
 Winter 2011

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**KEY**

**Topographic Profiles**

- Annual
- 6 monthly

**Topographic Surveys**

- 6 monthly
- yearly
- 5 yearly

**Cliff Top Monitoring Pegs**

- 50m centres
- 100m centres
- 300m centres

*(Indicative Survey Extents shown)*

Client: North East Coastal Group  
 Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

**Figure 2- Map 4  
 Survey Locations  
 Hendon to Ryhope b  
 Sunderland City Council**

Analytical Report 4  
 Full Measures Survey  
 Winter 2011

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## 2. Analysis of Survey Data

### 2.1 Whitburn Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
Oct 2011	<p><b>Beach Profiles:</b></p> <p>Whitburn Bay is covered by eleven beach profile lines for the Full Measures survey (Appendix A).</p> <p><b>1bSNN1</b> is just to the south of Sunderland City Council's northerly boundary of jurisdiction. Beach levels between HAT and a level of 1.2m increased by up to 1m to form a convex profile, with two small peaks at HAT and 2.8m. From a level of 1.2m to -1m, beach levels reduced by up to 0.6m. Beach levels increased by a small amount on top of the rocky outcrop around -1.2m. This change suggests that material has been redistributed from the lower/middle beach to the upper beach. The survey photographs (see Plate 1 and 2) show that pebbles on the upper beach have been buried by sand and vegetation growth is apparent. The survey photograph (see Plate 3 – S) also shows a large amount of seaweed on the beach.</p> <p>Profiles <b>1bSNN2</b> and <b>1bSNN3</b> are located towards the north of Whitburn Bay and extend across scrubland before reaching the upper gravel foreshore and then dropping across the lower sandy foreshore towards the rocky outcrop of Whitburn Steel. The changes observed at 1bSNN1 are repeated at 1bSNN2 and 1bSNN3 with an increase in beach levels around the MHWS mark and the presence of a domed profile indicating the formation of a beach berm. From a level of 1.5m and 1m for each profile respectively, beach levels have reduced to form a more concave profile. Again, this change suggests that material has been redistributed from the lower/middle beach to the upper beach. The survey photograph (Plate 4) also shows a large amount of seaweed on the beach.</p> <p>Profiles <b>1bSNN4</b> to <b>1bSNN6</b> are between the southern edge of South Bents housing estate and just north of Parsons Rock. Beach levels at <b>1bSNN4</b> have increased across the profile from HAT. This increase was greatest between a chainage of 30m and 130m to form a beach that is of a continuous slope to MLWS. At profile <b>1bSNN5</b>, this pattern of change is mostly repeated. Beach levels have increased at the same location but to a slightly lesser extent. At chainage 130m to seaward, beach levels have reduced by approximately 0.2m. At profile <b>1bSNN6</b>, beach levels have increased across the</p>	<p>At the north of Whitburn Bay (profiles 1bSNN1 to 1bSNN3), the beaches have been dynamic with the cross-shore movement of material from the lower/middle beach to the upper beach. The survey photographs (Plates 3 and 4) also show a large amount of seaweed on the beach. Together, this suggests that there has been significant recent wave activity, such as a storm, which has caused this change.</p> <p><b>Longer-term trends:</b> For profiles 1bSNN1 to 1bSNN3, these are the largest changes observed since partial measures, spring 2009. At 1bSNN1, the reduction in beach levels on the lower shore is a return to pre March 2011 (partial measures, spring 2011) levels.</p> <p>To the centre of Whitburn Bay (profiles 1bSNN4 to 1bSNN7), beach levels have increased overall and the beach profile has been levelled out to form a flatter profile since the last surveys (full measures, winter 2011 and for 1bSNN7, partial measures, spring 2007).</p> <p><b>Longer-term trends:</b> The beaches are generally at their highest levels since 7<sup>th</sup> September 2009 (full measures, winter 2009).</p> <p>To the south of Whitburn Bay (profiles 1bSNN9 to 1bSNN11), beach levels have increased in the upper</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>profile by approximately 0.3m. The beach gradient has remained the same.</p> <p><b>1bSNN7</b> is at Seaburn, just to the north of Parson's Rock. At 1bSNN7, beach levels have increased across the profile; by approximately 0.3m at the toe of the seawall, 0.1m across the profile, and greater than 0.2m beyond a chainage of 120m. The beach slope is continuous from the seawall out to sea.</p> <p>Profile <b>1bSNN8</b> extends across Parsons Rock. Beach levels at the toe of the seawall have increased to cover the rocks below. The survey report for Whitburn Bay (titled Sunderland North) notes that '<i>large sand patches of sand on Parson Rocks</i>'. This is a return to the beach levels observed in September 2009 (full measures, winter 2009). Seaward of there, there is little discernable change.</p> <p>Profile <b>1bSNN9</b> drops from the cliff top to the foreshore at Roker. The pattern of change observed at profile 1bSNN5 is repeated. Beach levels have increased from MHWS to a chainage of 130m by approximately 0.1m to 0.2m. At chainage 130m to seaward, beach levels have reduced very slightly by approximately 0.1m if at all.</p> <p><b>1bSNN10</b> is located approximately mid-way between Parson's Rock and Roker Pier. At 1bSNN10 beach levels out to a level of -0.4m have not changed since the last survey (full measures, winter 2010). From there to a chainage of 130m, beach levels have increased across the profile by up to 0.4m.</p> <p><b>1bSNN11</b> is located to the south of Whitburn. Beach levels have increased across the profile in the region of 0.6m from a level from the toe of the seawall. A berm has formed at HAT.</p>	<p>and middle reaches of the beach. Generally the beach profile has changed from a convex profile to gently sloping flatter beach. Towards the southern end of the beach, a berm has formed on the beach around HAT.</p> <p><b>Longer-term trends:</b> The beaches are showing a tendency to return to the levels they were in at the time of the 7<sup>th</sup> September 2009 survey (full measures, winter 2009).</p>
Oct 2011	<p><b>Topographic Survey:</b></p> <p>Whitburn Bay, between the Bents and Roker Pier, is covered by an annual topographic survey which commenced in September 2010.</p> <p>Data from the most recent topographic survey (full measures, winter 2011) have been used to create a DGM (Appendix B – Map 1a) using a Geographical Information System (GIS). A difference plot has also been produced using the DGM (Appendix B – Map 1b) produced from the last produced topographic survey (partial measures, spring 2011) and the present survey.</p> <p>The difference plot shows a general pattern of elevation increase across the beach. This increase is greatest along the backshore to the north of the Bay. Beach elevation has fallen on the middle and lower beach. This change is greatest to the north of the Bay in the lee of the rock platform, called</p>	<p>The topographic survey shows that beach elevation has generally increased across the beach at Whitburn Bay. Beach elevation has fallen on the middle and lower beach. This change is greatest to the north of the Bay in the lee of the rock platform, called Whitburn Steel where material is being drawn down from the beach and deposited on the rock shore platform.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>Whitburn Steel. The map in Figure 2 – Map 1 shows that beach material has been removed from the beach, exposing the rock below, however, the rock of Whitburn Steel has been covered with a layer of sand. Between these locations is a band of sand material, similar to a tombolo (i.e. an accretionary landform that links an island to the mainland). This suggests that material is being drawn down from the beach and deposited on the rock shore platform.</p>	





Plate 1 – Survey photograph 1bSNN1\_20111013\_N2.jpg



Plate 2 – Survey photograph 1bSNN1\_20111013\_N3.jpg



Plate 3 – Survey photograph 1bSNN1\_20111013\_N4.jpg



Plate 4 – Survey photograph 1bSNN2\_20111013\_N5.jpg

## 2.2 Sunderland Harbour and Docks

Survey Date	Description of Changes Since Last Survey	Interpretation
Nov 2011	<p><b>Beach Profiles:</b></p> <p>Sunderland Harbour and Docks is covered by eleven beach profile lines (Appendix A).</p> <p><b>1bSNN12</b> and <b>1bSNN13</b> are both located within the shelter of Roker Pier. At profile <b>1bSNN12</b>, beach levels between a chainage of 15m and 45m, beach levels have increased to from a wider berm at the back of the beach. The berm at HAT has not changed position or form. Seaward of HAT to a chainage of 115m, beach levels have increased across the profile. This increase (0.3m) is greatest between HAT and MHWS. The survey photographs (Plate 5 and Plate 6) show that the upper beach is comprised of shingle and sand, whereas the middle and lower beach is comprised of sand. This accretion could be attributed to the sorting of sediment as more coarse shingle and pebbles are moved to the upper beach to form a berm. At <b>1bSNN13</b> beach levels increased by approximately 0.1m from a height of 4.6m to 1m. Seaward of there, they increased out to -0.6m up to 0.6m to form a more gently sloping beach.</p> <p><b>1bSNC1</b> and <b>1bSNC2</b> are located within the shelter of New South Pier. Profile <b>1bSNC1</b> starts at the seaward edge of the dock building and extends across an earth mound before reaching the stepped landward face of the dock wall. The profile then drops from the wall crest directly into deep water. For this reason, profile 1bSNC1 has not been analysed. Profile <b>1bSNC2</b> starts at the crest of New South Pier and drops several metres to foreshore level. Beach levels at the toe of the pier have increased by up to 0.5m out to a chainage of 50m.</p> <p><b>1bSNC3</b> to <b>1bSNC7</b> are on the seaward face of the dock. Profile <b>1bSNC3</b> extends from the dock yard across a back flood wall, which has a crest level of around 7.2mODN, and promenade to the main seaward dock wall, which has a crest level of 7.55mODN. The profile then extends down the seaward face of the wall into deep water. For this reason, profile 1bSNC3 has not been analysed. Profiles <b>1bSNC4</b> and <b>1bSNC5</b> extend from the rock armoured revetment across the short width of foreshore down to low water. Profile 1bSNC4 suggests that beach levels have increased by over 1.5m and it is possible that this is due to survey error. No further analysis of this profile has been undertaken for this reason. At <b>1bSNC5</b> the position of the defences has changed which is likely to reflect the survey technique used rather than actual change. Seaward of a chainage of 7m, beach levels have increased across the profile by 0.2m between a chainage of 6m and 24m and up to 0.6m seaward of there. This</p>	<p>To the north of Sunderland Harbour and Docks (profiles 1bSNN12 to 1bSNS2), within the breakwaters (and to the north and south of the River Wear), beach levels have increased since the last survey (full measures inter 2011).</p> <p><b>Longer term trends:</b> The beaches are showing a tendency to return to the levels they were in at the time of the 7<sup>th</sup> September 2009 / 5<sup>th</sup> October 2009 survey (full measures, winter 2009).</p> <p>Within the centre of this frontage (1bSNC3 to 1bSNC7), there is only one profile which can be assed with confidence - Profile 1bSNC5. At this location, beach levels have increased since the last survey and are their highest since 5<sup>th</sup> October 2009 survey (full measures, winter 2009).</p> <p>To the south of Sunderland Harbour and Docks (profiles 1bSNC8 and 1bSNC9), is a beach located between the North East Pier and South West Breakwater. Levels on the northern side of the beach have fallen since the last survey, but increased on the southern side. For the southern side of the beach in particular, this is a trend that has continued since 5<sup>th</sup> October 2009 survey (full measures, winter 2009).</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>has resulted in a beach profile of a continuous slope. <b>1bSNC6</b> extends across the revetment and seawall. A small veneer of sand covers the rock at the toe of the coastal defences. Profile 1bSNC6 suggests that beach levels have fallen by almost 2m and it is possible that this is due to survey error. No further analysis of this profile has been undertaken for this reason.</p> <p><b>1bSNC7</b> to <b>1bSNC9</b> are within the shelter of North East Pier and South West Breakwater. <b>1bSNC7</b> is a section across North East Pier and shows the terraced nature of the landward face of the pier wall, extending across rock to the small sheltered bay between the two structures. For this reason, profile 1bSNC7 has not been analysed. Profile <b>1bSNC8</b> crosses the boulders and rubble, which reaches a level of around 6.2mODN, and then extends across the sandy but boulder strewn foreshore. Beach levels on the foreshore between a chainage of 30m and 70m have reduced by up to 0.6m. Profile <b>1bSNC9</b> extends from the dock facilities and crosses a short length of concrete wall before extending across the sand foreshore to reach and cross a large boulder mound that is towards the seaward end of the south west breakwater. Beach profiles have reduced at a chainage of 40m, to form a more concave profiled between the toe of the sheet piling and HAT. Seaward of HAT, beach levels have increased across the profile. A berm has formed seaward of the existing, just above HAT and at a chainage of 50m. Together this suggests that the profile has prograded and the beach is accreting.</p>	



**Plate 5 – Survey photograph 1bSNN12\_20111013\_N4.JPG**



**Plate 6 – Survey photograph 1bSNN12\_20111013\_N5.JPG**

## 2.3 Hendon to Ryhope (incl. Halliwell Banks)

Survey Date	Description of Changes Since Last Survey	Interpretation
Oct 2011	<p><b>Beach Profiles:</b></p> <p>Hendon to Ryhope is covered by thirty six beach profile lines (Appendix A).</p> <p><b>1bSNS1 to 1bSNS6</b> are located along the sea wall protecting the Hendon Sewage Treatment Works. The profiles typically include a section along the concrete deck, wall crest (which varies in elevation between around 7.0mODN in the north and 7.6mODN in the south after the dog-leg in the wall position), near-vertical seaward face of the wall, and sloping rock armour revetment. The foreshore across <b>1bSNS1, 1bSNS2, and 1bSNS3</b> were surveyed for the first time so they have not been analysed. Profile <b>1bSNS4</b> extends into water than previously and has not been analysed. Profiles <b>1bSNS5 and 1bSNS6</b> drop directly from the structure into deep water and have not been analysed.</p> <p><b>1bSNS7 to 1bSNS10</b> are located along the defended coastal slopes along south Hendon, which rise in elevation to higher defended cliffs at 1bSNS11.</p> <p>Profile <b>1bSNS7</b> extends across a seawall and concrete revetment, which is fronted by a foreshore comprised of large pebbles and coarse shingle. An additional data point is showing on the full measures profile at a 20m chainage, which is likely to be the handrail on top of the promenade rather than actual change. With the exception of a small length of profile between 24m and 36m chainage, beach levels have fallen from the toe of the revetment across the profile in the region of 0.2m.</p> <p>Profile <b>1bSNS8</b> extends across the seawall, rock revetment, a rocky upper beach and sandy middle and lower beach. An additional data point is showing on the full measures profile at a 25m chainage, which is likely to relate to survey technique rather than actual change. Beach levels have retreated around the HAT / MHWS mark by approximately 0.5m and between a chainage of 40m and 75m. Seaward of there beach levels have increased by approximately 0.5m.</p> <p>At profile <b>1bSNS9</b>, an additional data point is showing on the full measures profile between a chainage of 20m to 25m, which is likely to relate to survey technique rather than actual change. Beach levels have increased by approximately 0.2m across the profile from the toe of the seawall to MLWS. The berm located at 0m has been flattened and the profile is concave and slopes from the seawall continuously to sea.</p>	<p>To the north of the frontage, between Sunderland Docks and south Hendon, the profiles have been surveyed for the first time so they have not been analysed.</p> <p>The backshore along south Hendon (profiles 1bSN7 and 1bSNS11) are defended and the beach is stabilised with groynes. The cliffs (Points 1 to 8) have remained stable due to the presence of the coastal defences here. Beach levels along this stretch of coastline have increased since the last survey (full measures, winter 2010 and partial measures, spring 2011).</p> <p><b>Longer term trends:</b> Beach levels and the beach profile have returned to similar levels and form as observed on the 14th September 2010 (full measures, winter 2010).</p> <p>From between south Hendon and Ryhope, the cliffs are mostly eroding. The rate of erosion varies between 0.3m and 6m. The greatest rate is at point 25 (close to profile 1bSNS24), which is in the lee of Saltfern Rocks. The exceptions to this trend (because the change is zero or the rates of change are within the error of accuracy) are around points 13-16 and 22-23, which correspond with the headlands and the rock shore platforms at Saltfern Rocks and the start of Halliwell Bank respectively. This suggests that the rock platforms help to protect the cliffs from erosion.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>At profile <b>1bSNS10</b>, beach levels have increased up to 0.5m between a chainage of 35m and 90m to form a less concave and more gently sloping profile.</p> <p>At profile <b>1bSNS11</b> the cliffs have not been surveyed and the profile starts from a height of 7m. Beach levels have increased across the profile from the revetment toe to seaward. This increase is greatest at the toe of the revetment and reduces towards MLWS so that the beach profile tapers and slopes continuously.</p> <p><b>1bSNS12 to 1bSNS36</b> are located along the undefended cliffs between Grangetown and Ryhope Dene. Profiles SNS12 to SNS16 are between the end of the Hendon sea wall and Salterfen Rocks. Cliff top levels are typically between 20m and 22mOD. They are highest along the profiles further north, dropping in the centre and then increasing again to the south.</p> <p>Profile <b>1bSNS12</b> extends from the cliff across the foreshore which is comprised of boulders. The cliff face has retreated landward by up to 2.5m. The profile shows that beach levels have increased at the toe of the cliff and between a chainage of 60m and 90m.</p> <p>At profile <b>1bSNS13</b> the cliff face has retreated from the 2010 profile and the profile is now similar to the profile in 2009. The previous full measures report (winter 2010) reported on the 2010 profile and noted that the cliff eroded, which resulted in debris accreted at the toe. The movement of the latest 2011 profile to one similar in 2009 suggests that this material has now been removed from the cliff toe. Beach levels have also reduced by approximately 0.1 to 0.2m across the profile from the toe of the cliff to a chainage of 70m.</p> <p>At profile <b>1bSNS14</b>. Beach levels have increased by approximately 0.2m around HAT and MHWS, otherwise there has been very little change to the beach levels since the last survey (full measures, winter 2010).</p> <p>At profile <b>1bSNS15</b> there has been very little change to the beach levels since the last survey. Across the profile there are small variations in beach level so that the profile, which is likely to reflect the movement of pebbles and rocks across the foreshore rather than actual level changes.</p> <p>At profile <b>1bSNS16</b> there have been no discernable changes to the cliff or foreshore levels since the last survey (full measures, winter 2010).</p> <p>Profiles <b>1bSNS17 to 1bSNS36</b> extend between Salterfen Rock and Ryhope Dean/Pincushion Rocks</p>	<p>Adjacent to these headlands, the cliffs are cutting back as they erode at a faster rate.</p> <p>The beaches between south Hendon and Saltfern Rocks (profiles 1bSNS12 to 1bSNS16), beach levels have fluctuated but generally they have retained the same form and level.</p> <p><b>Longer term trends:</b> The extent of the change observed since the last survey is similar to that observed in the past with beach levels fluctuating by 0.5-1m.</p> <p>The beaches between Saltfern Rocks and Ryhope Dean / Pincushion (profiles 1bSNS17 to 1bSNS36) have fluctuated since the last survey. The upper beach is observed to have been the most dynamic and the topographic survey suggests that beach levels at the toe of the cliffs have reduced, but on the middle beach they have increased. The lower beach is to some extent stabilised by the presence of a rock platform.</p> <p>At the former landfill site the cliff points (28A, 28B and 28C) have eroded since the first survey by 0.3-1.2m and since the last survey by between 0.2 and 0.3m. Other profiles suggest advance of the cliffs sometimes on the cliff face and sometimes at the cliff toe. Advance of the cliff toe probably relates to the accumulation of cliff fall debris at the cliff toe. The survey report for Sunderland South notes that '<i>There are a number of cliff top and bottom slumps that are evident.</i>'</p> <p>In addition, as the previous report (full measures,</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>along Shirley Banks and Halliwell Banks. Profiles between SNS17 and SNS25 typically exhibit a characteristic cliff height of between 23m and 29mOD, with beaches at the toe typically at levels between 3.1m and 4.6mOD.</p> <p>At <b>1bSNS17</b>, the profile shows the cliff face and the cliff toe have accreted. This could be related to slumping of the toe of this cliff but may be caused by survey interpretation or the cliffs tendency to heave seawards prior to toppling failure. Across the foreshore there has been very little change to the beach levels since the last survey. Across the profile there are small variations in beach level so that the profile, which is likely to reflect the movement of pebbles and rocks across the foreshore rather than actual level changes.</p> <p>At <b>1bSNS18</b>, the profile shows the cliff face to have accreted. This could be related to slumping of the toe of this cliff but may be caused by survey interpretation or the cliffs tendency to heave seawards prior to toppling failure. Beach levels have reduced across the profile in the region of 0.1 to 0.2m.</p> <p>At <b>1bSNS19</b>, the profile shows the cliff face to have accreted. This could be related to slumping of the toe of this cliff but may be caused by survey interpretation or the cliffs tendency to heave seawards prior to toppling failure. Across the foreshore there has been very little change to the beach levels since the last survey. Across the profile there are small variations in beach level so that the profile, which is likely to reflect the movement of pebbles and rocks across the foreshore rather than actual level changes.</p> <p>At profile <b>1bSNS20</b>, the cliff face has retreated by approximately 1m. With the exception of a reduction in beach levels by up to 0.5m between a chainage of 110m and 121m, foreshore levels have not changed since the last survey (full measures, winter 2010).</p> <p>At <b>1bSNS21</b>, the profile shows the cliff face to have accreted. This could be related to slumping of the toe of this cliff but may be caused by survey interpretation or the cliffs tendency to heave seawards prior to toppling failure. Across the foreshore there has been very little change to the beach levels since the last survey. Between a chainage of 80m and 105m there is a small increase in beach levels and the slope is less bumpy indicating the deposition of a thin veneer of sand on top of the rock and pebbles beneath.</p> <p>At profile <b>1bSNS22</b>, the cliff face has retained the same form and position since the last survey (full measures, winter 2010). Beach (sand and pebbles) levels at the cliff toe (around MHWS) have reduced by up to 0.5m. They have not changed across the rocky platform in the centre of the profile, however</p>	<p>winter 2010), notes <i>'the cliffs along this frontage have a characteristic tendency to heave seawards prior to a toppling failure, leading to apparent discrepancies in the data where the cliff edge can appear to 'grow' seawards.'</i> This cliff behaviour may also result in health and safety issues for the survey team relating to the access under potentially unstable cliffs.</p> <p>The beach levels at this location have increased.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>seaward of there, from a chainage of 110m, beach levels (sandy) have increased by approximately 0.1m to 0.3m.</p> <p>At profile <b>1bSNS23</b>, the cliff face has retreated, this is by up to 5m at the toe. Beach levels between the cliff toe and a chainage of 80m have fallen by up to 0.5m. Seaward of chainage of 100m, beach levels have increased by 0.5m.</p> <p>At <b>1bSNS24</b>, the profile shows the cliff face to have accreted. This could be related to slumping of the toe of this cliff but may be caused by survey interpretation or the cliffs tendency to heave seawards prior to toppling failure. Beach levels seaward of the cliff have not changed since the last survey (full measures, winter 2010).</p> <p>At profile <b>1bSNS25</b>, the cliff face has retained the same form and position since the last survey (full measures, winter 2010). A small amount of beach re-profiling has occurred with the flattening of the beach berm at HAT and an increase in beach levels in the order of 0.1m across the profile.</p> <p>Profiles <b>1bSNS26</b> to <b>1bSNS32</b> are all located at close spacings at Halliwell Banks specifically to assess risks from erosion at a former land fill. Cliff height is characteristically around 26m and 27mODN, with beaches at the toe typically at levels between 3.3m and 3.9mODN.</p> <p>At profiles <b>1bSNS26</b> to <b>1bSNS32</b> the cliffs have largely retained the same form and position since the last survey (partial measures, 2011). The exceptions are at profiles <b>1bSNS27</b>, <b>1bSNS28</b> and <b>1bSNS29</b>, where the toe of the cliff appears to have accreted by 1m to 2m. This could be related to slumping of debris from retreat of the top of this cliff but may be caused by survey interpretation or the cliffs tendency to heave seawards prior to toppling failure. Beach levels have increased across the beach by approximately 0.2m at all profiles.</p> <p>At profile <b>1bSNS33</b> the cliff face has retreated, the greatest retreat rate being at the toe and in the order of 2m. Beach levels have reduced across the profile by up to 1m.</p> <p>At <b>1bSNS34</b>, the profile shows the cliff face to have accreted. This could be related to slumping at the toe of this cliff or debris from cliff slides but may be caused by survey interpretation or the cliffs tendency to heave seawards prior to toppling failure. Beach levels seaward of the cliff have not changed since the last survey (full measures, winter 2010). There are no discernable changes to the beach levels.</p> <p>At profile <b>1bSNS35</b> the cliff face has retreated by approximately 0.5m to 1m. No discernable change to</p>	



Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>beach levels from the toe of the cliff out to a chainage of 95m. Between a chainage of 95m and 175m, beach levels increased up to 0.5m.</p> <p>At profile <b>1bSNS36</b> the cliff face has retained the same form and position since the last survey (full measures, winter 2010). Across the profile there are small variations in beach level so that the profile, which is likely to reflect the movement of pebbles and rocks across the foreshore and the movement of the veneer of sand between them.</p>	
Oct 2011	<p><b>Topographic Survey:</b></p> <p>Hendon to Ryhope is covered by an annual topographic survey between the Hendon Sea Wall and Ryhope Dene, which commenced in winter 2009.</p> <p>Data from the most recent topographic survey (full measures, winter 2011) have been used to create a DGM (Appendix B – Map 2a and Map 3a) using a Geographical Information System (GIS). A difference plot has also been produced using the DGM (Appendix B – Map 2b and Map 2b) produced from the last produced topographic survey (partial measures, spring 2011) and the present survey.</p> <p>Between Hendon and Saltflern Rocks, beach elevation along the back of the beach at the toe of the defences has fallen. Across the remainder, beach elevation has generally increased. Around Saltflern Rocks the spread of areas where beach elevation has reduced is greater. Between Saltflern Rocks and Ryhope Dean/Pincushion, the backshore is defined by areas of beach elevation fall, whilst the middle and lower are defined predominantly by an increase in beach elevation. To the south of Ryhope Dean/Pincushion, the spread of beach elevation reduction and increase is more evenly spread.</p>	Between Hendon and Saltflern Rocks, beach elevation along the back of the beach at the toe of the defences has fallen. Across the remainder, beach elevation has generally increased.
Oct 2011	<p><b>Cliff-top Survey:</b></p> <p>32 ground control points (numbered 1-32) were established along the cliff top between Hendon and Ryhope in March 2009, with a further three (28A, 28B and 28C) added in September 2009. Note: the numbering of ground control points is not intended to correlate with that of the beach profile lines and reference should be made to Appendix C - Figure 1 and Appendix C – Figure 2 for the location of ground control points.</p> <p>Measurements are taken from each ground control point along a fixed bearing to the edge of the cliff top. These cliff top surveys are undertaken bi-annually and are intended to inform on erosion rates of</p>	The cliffs south of Saltflern have eroded by between c. 0.5 and c 6.0 m since 2009. Erosion is greatest between Points 24 and 32 where the cliffs have eroded up to 6.0m. In the previous survey report (partial measures, spring 2011) it was note that ' <i>At the most extreme (point 25), the cliff top has eroded 5.7m between March 2009 and March 2011, giving rise to concern about the integrity of the rock barrier which retains the waste within the land fill.</i> '. The ongoing erosion means concern about long-term sustainability

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>the sea cliffs extending from the defended industrial areas at Hendon southwards along the undefended cliffs to Ryhope Dene.</p> <p>The results from the cliff top monitoring are anticipated to have an accuracy of <math>\pm 0.2\text{m}</math> due to the technique used. These cliff top surveys are undertaken bi-annually and are intended to inform on erosion rates of the sea cliffs extending from the defended industrial areas at Hendon southwards along the undefended cliffs to Ryhope Dene. Appendix C provides results from the March 2009 cliff top survey, showing the position from the ground control point to the edge of the cliff top along a defined bearing. Also shown is the change in measurement since the original (March 2009) and previous (April 2011) cliff top surveys.</p> <p>Results show that erosion or an amount greater than the survey error has occurred 22 ground control points since surveys began in March 2009 (or September 2009 for 28A, 28B and 28C). Other locations have not changed, or erosion is within the error band.</p> <p>Points 9 to 12, which are located to the south of Saltfern have eroded by up to 4.3m. This is supported by the findings of the beach profile analysis and has been attributed to cutback occurring in the lee of the headland.</p> <p>At Points 17 to 21, the cliffs have eroded up to 4.2m since 2009. The cliff at Point 17 has experienced the most erosion since the last survey, with 0.5m lost.</p> <p>Points 24 to 32 have eroded by up to 6.0m since 2009.</p>	<p>of the landfill site remains.</p>

### 3. Problems Encountered and Uncertainty in Analysis

#### **Individual Profiles – problems with survey data collection:**

At profile 1bSNC1, the profile drops from the wall crest directly into deep water and has therefore not been analysed.

Profile 1bSNC3 extends down the seaward face of the wall into deep water and has therefore not been analysed.

Profile 1bSNC4 suggests that beach levels have increased by over 1.5m, which is unlikely and it is possible that this is due to survey error. No further analysis of this profile has therefore been undertaken.

At 1bSNC5 the position of the defences is indicated to have changed, which is likely to reflect the survey technique used rather than actual change.

Profile 1bSNC6 suggests that beach levels have fallen by almost 2m, which is unlikely and it is possible that this is due to survey error. No further analysis of this profile has been undertaken for this reason.

Profile 1bSNC7 is a section across North East Pier and shows the terraced nature of the landward face of the pier wall, extending across rock to the small sheltered bay between the two structures. No further analysis of this profile has been undertaken for this reason.

The foreshore across 1bSNS1, 1bSNS2 and 1bSNS3 were surveyed for the first time so they have not been analysed. The foreshore across 1bSNS1, 1bSNS2 and 1bSNS3 was not surveyed previously because of difficult access conditions and dangerous conditions at the time of the survey.

Profile 1bSNS4 extends into water and has therefore not been analysed.

Profiles 1bSNS5 and 1bSNS6 drops directly from the structure into deep water and have therefore not been analysed.

On profile 1bSNS7 an additional data point is showing on the full measures profile at a 20m chainage, which is likely to relate to survey technique rather than actual change.

On profile 1bSNS8 an additional data point is showing on the full measures profile at a 25m chainage, which is likely to relate to survey technique rather than actual change.

On profile 1bSNS9 an additional data point is showing on the full measures profile between a chainage of 20m to 25m, which is likely to relate to survey technique rather than actual change.

At profile 1bSNS11 the cliffs have not been surveyed and the profile starts from a height of 7m.

At profiles 1bSNS17, 1bSNS18, 1bSNS19, 1bSNS21, 1bSNS24, 1bSNS27, 1bSNS28, 1bSNS29, and 1bSNS34 the profile shows the cliff face to have accreted. This could be related to slumping of the toe of this cliff, debris from cliff falls at the toe, or it could be due to the cliffs tendency to heave seawards prior to toppling or survey interpretation (as described below). Such cliff behaviour could bring about health and safety issues relating to the surveying of the cliff toe where the cliffs are unstable or overhanging, resulting in different interpretation of the survey locations.

#### **Cliff Top Surveys:**

Surveying any cliff top is difficult due to: (i) the Health and Safety risks posed to surveyors, especially during adverse weather; and (ii) the 'apparent' changes that can arise due to surveyors interpreting different points as the cliff edge on successive surveys.

For these reasons, it has been assumed that any changes of  $\pm 0.2\text{m}$  may be considered as being within the accuracy of the surveying technique.

However, in addition to surveyor interpretation, the cliffs along this frontage have a characteristic tendency to heave seawards prior to a toppling failure, leading to apparent discrepancies in the data where the cliff edge can appear to 'grow' seawards.

Points 1 to 8 have either experienced zero change, a change within the assumed accuracy of the survey technique or an increase. This increase is attributed to the survey technique described above.

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

No changes are recommended at the present time.

#### **5. Conclusions and Areas of Concern**

- At Whitburn Bay, the recorded profiles and topographic present no causes for concern.
- At Sunderland Harbour and Docks, the recorded profiles present no causes for concern.
- At Hendon to Ryhope (incl. Halliwell Banks), the cliffs continue to erode between south Hendon and Ryhope at a rapid rate. The greatest erosion since the last survey in April 2011 was observed at Point 17 just to the south of Maiden's Flat (opposite Shirley Banks). The cliffs in the lee of the Saltfleet and Pincuhston are eroding at a faster rate than those adjacent cliffs, which are afforded some protection by the cliff platforms. At the former landfill site the cliff points (28A, 28B and 28C) have eroded since the first survey by 0.3-1.2m and since the last survey by between 0.2 and 0.3m. Beach levels fronting the cliffs are generally stable.

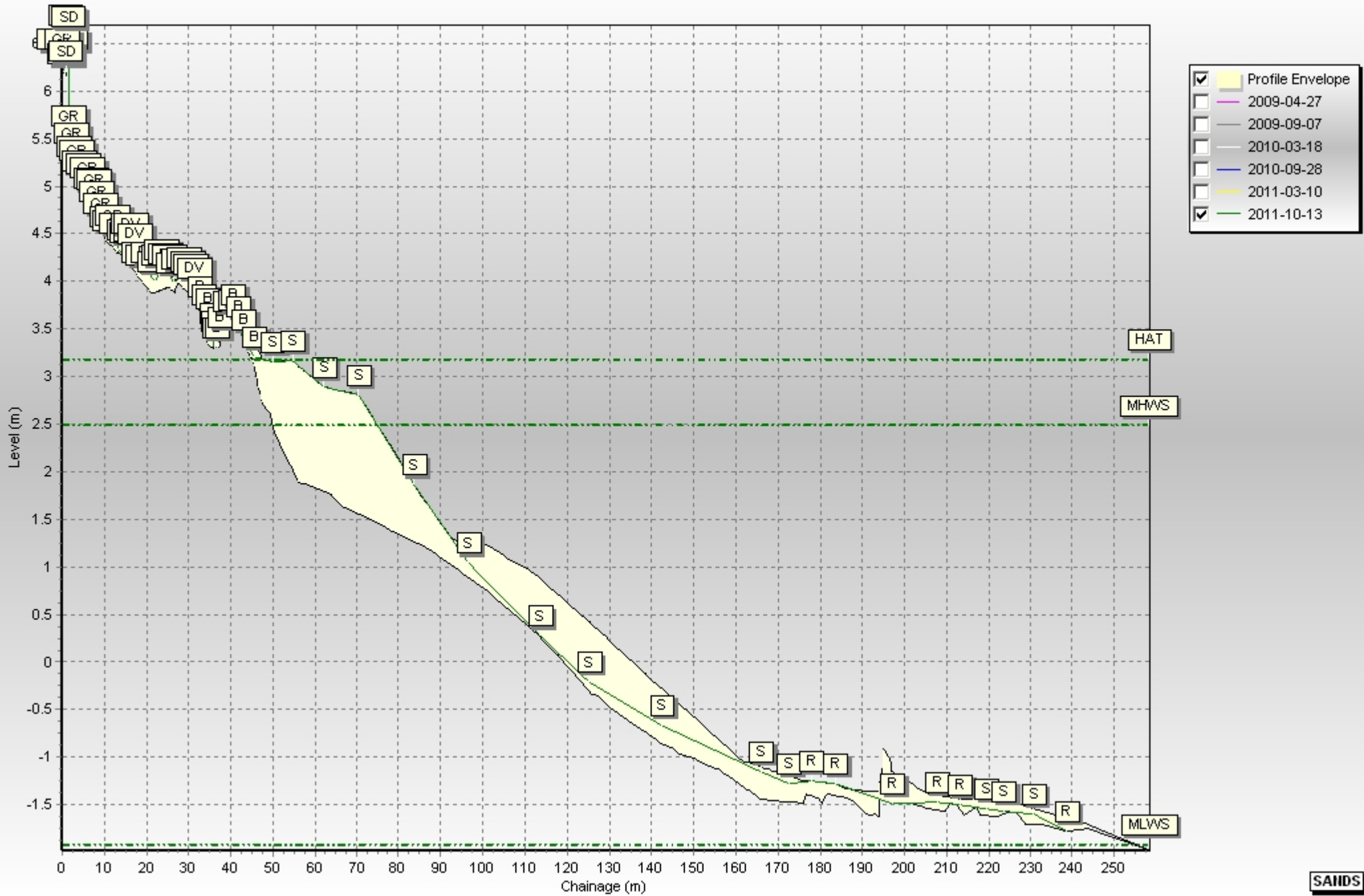
## **Appendices**

**Appendix A**  
**Beach Profiles**

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

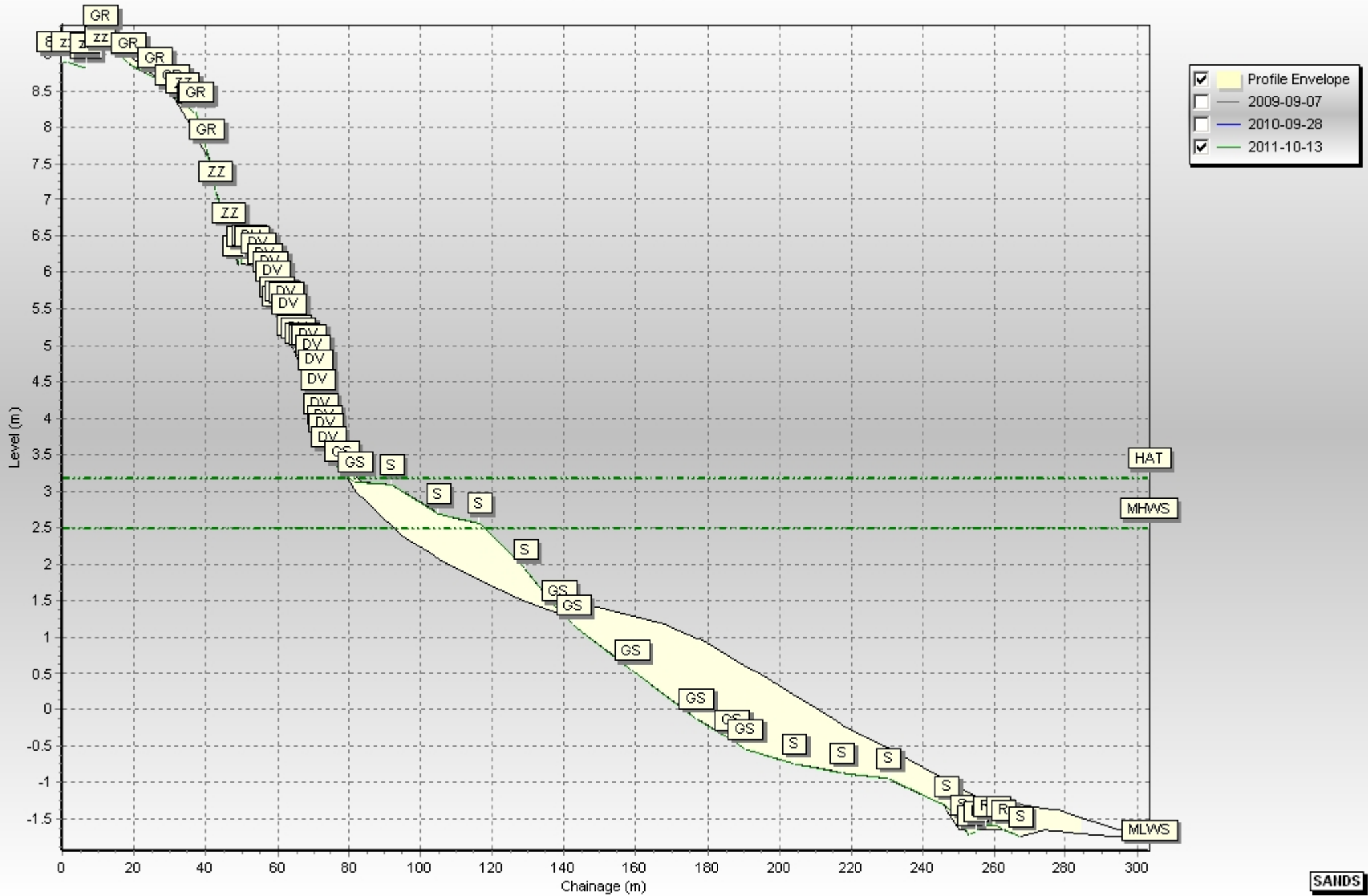
<b>Code</b>	<b>Description</b>
S	Sand
M	Mud
G	Gravel
GS	Gravel & Sand
MS	Mud & Sand
B	Boulders
R	Rock
SD	Sea Defence
SM	Saltmarsh
W	Water Body
GM	Gravel & Mud
GR	Grass
D	Dune (non-vegetated)
DV	Dune (vegetated)
F	Forested
X	Mixture
FB	Obstruction
CT	Cliff Top
CE	Cliff Edge
CF	Cliff Face
SH	Shell
ZZ	Unknown

### Beach Profiles: 1bSNN1

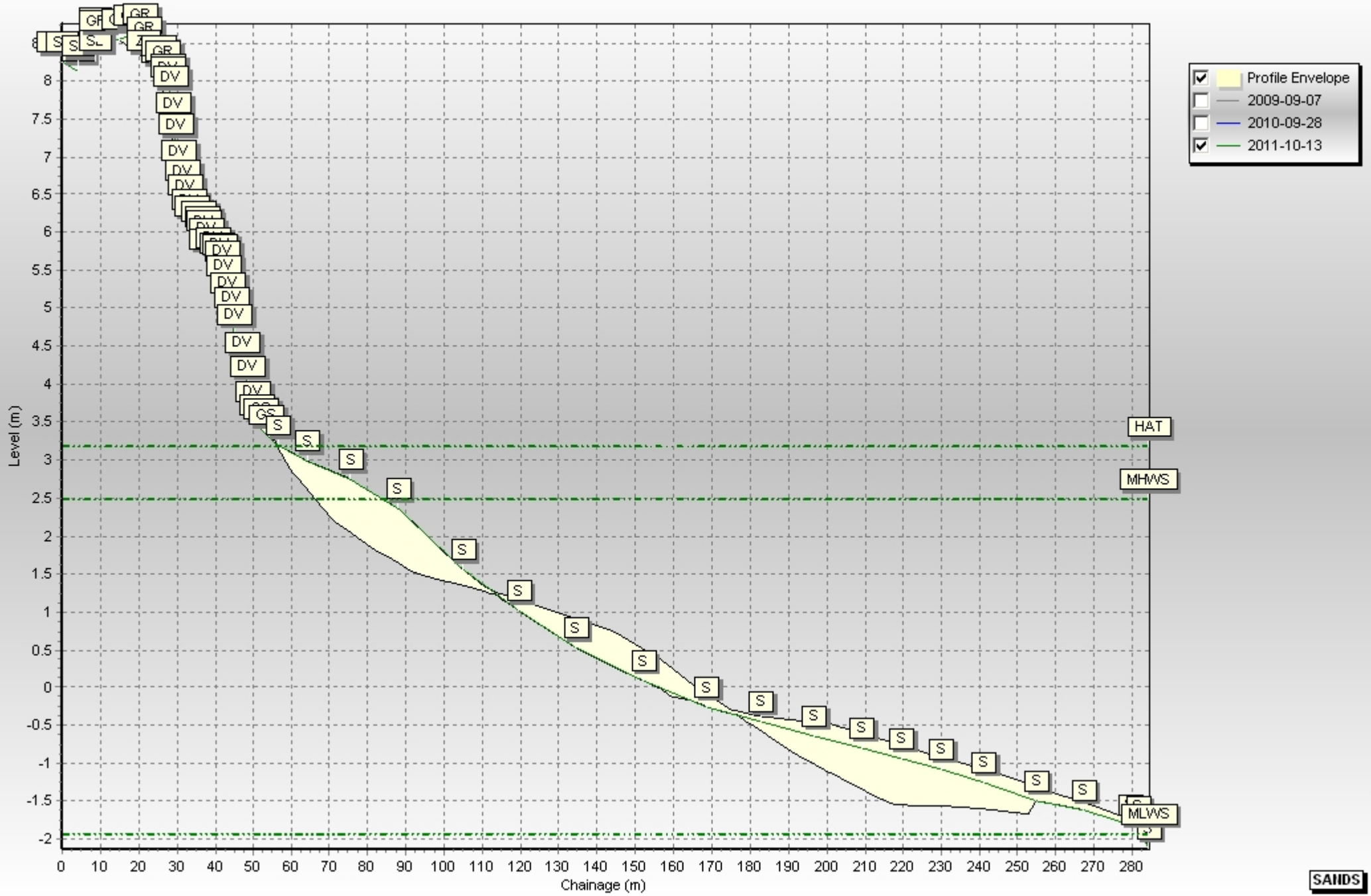




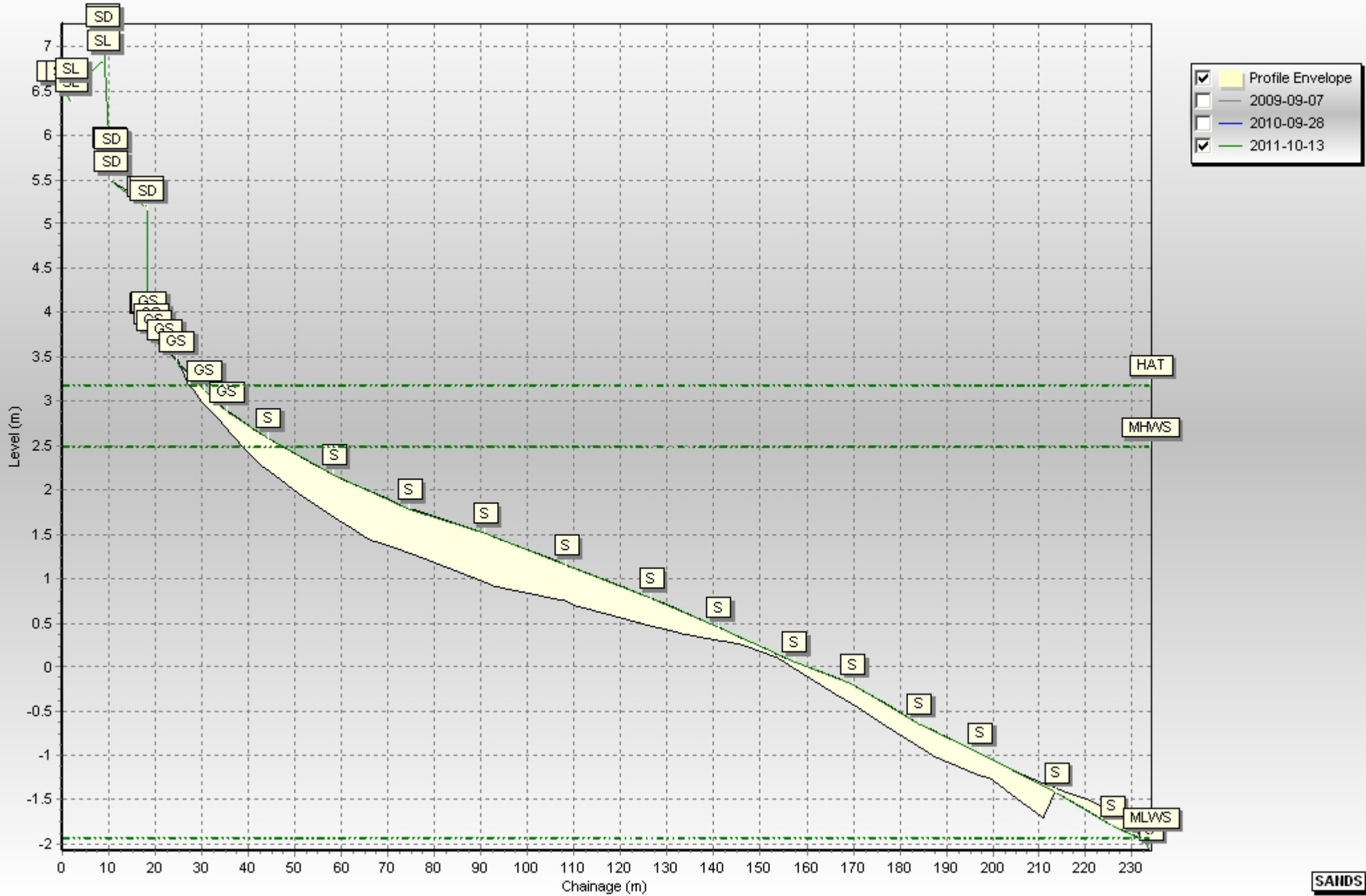
### Beach Profiles: 1bSNN2



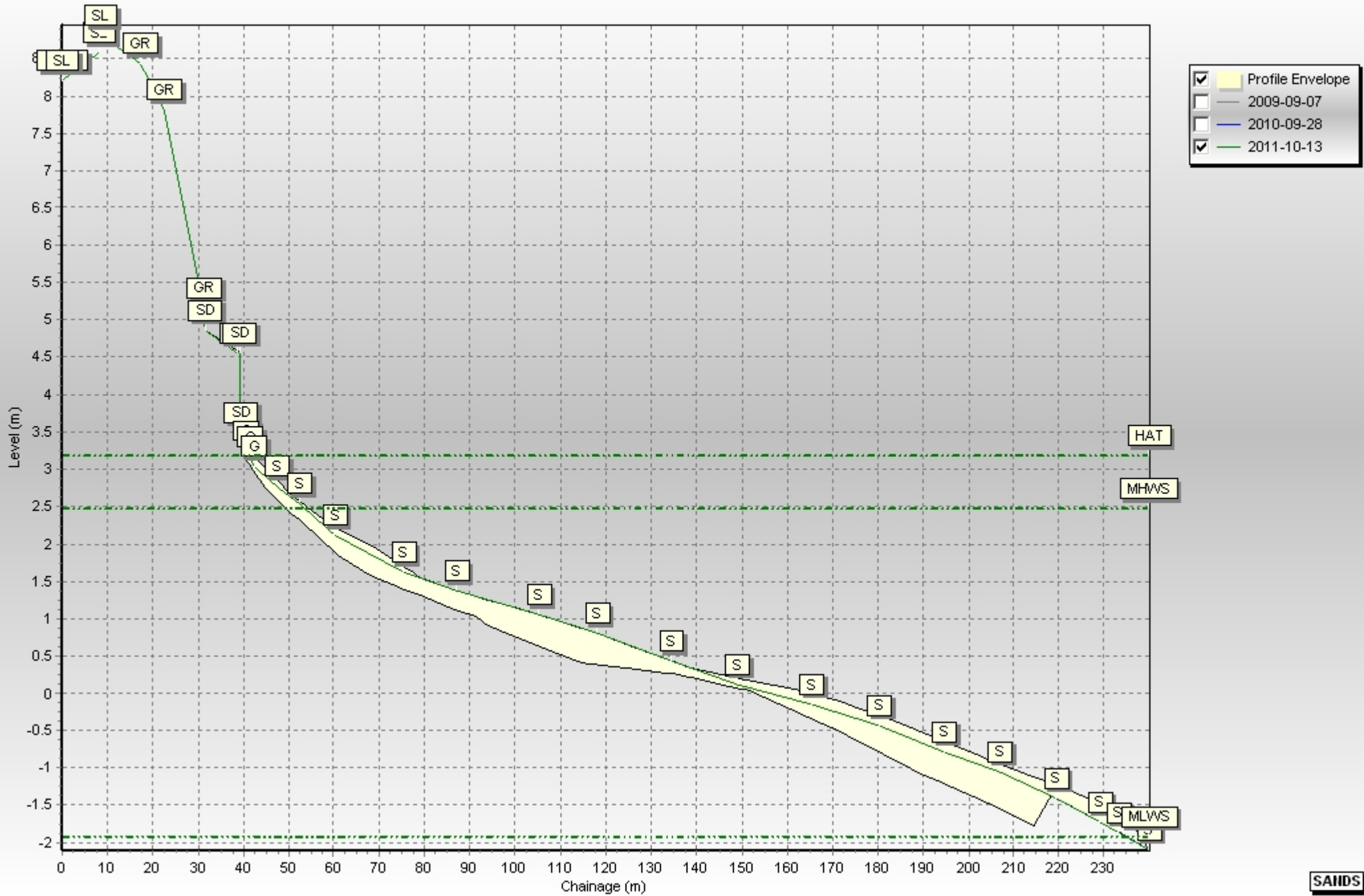
### Beach Profiles: 1bSNN3



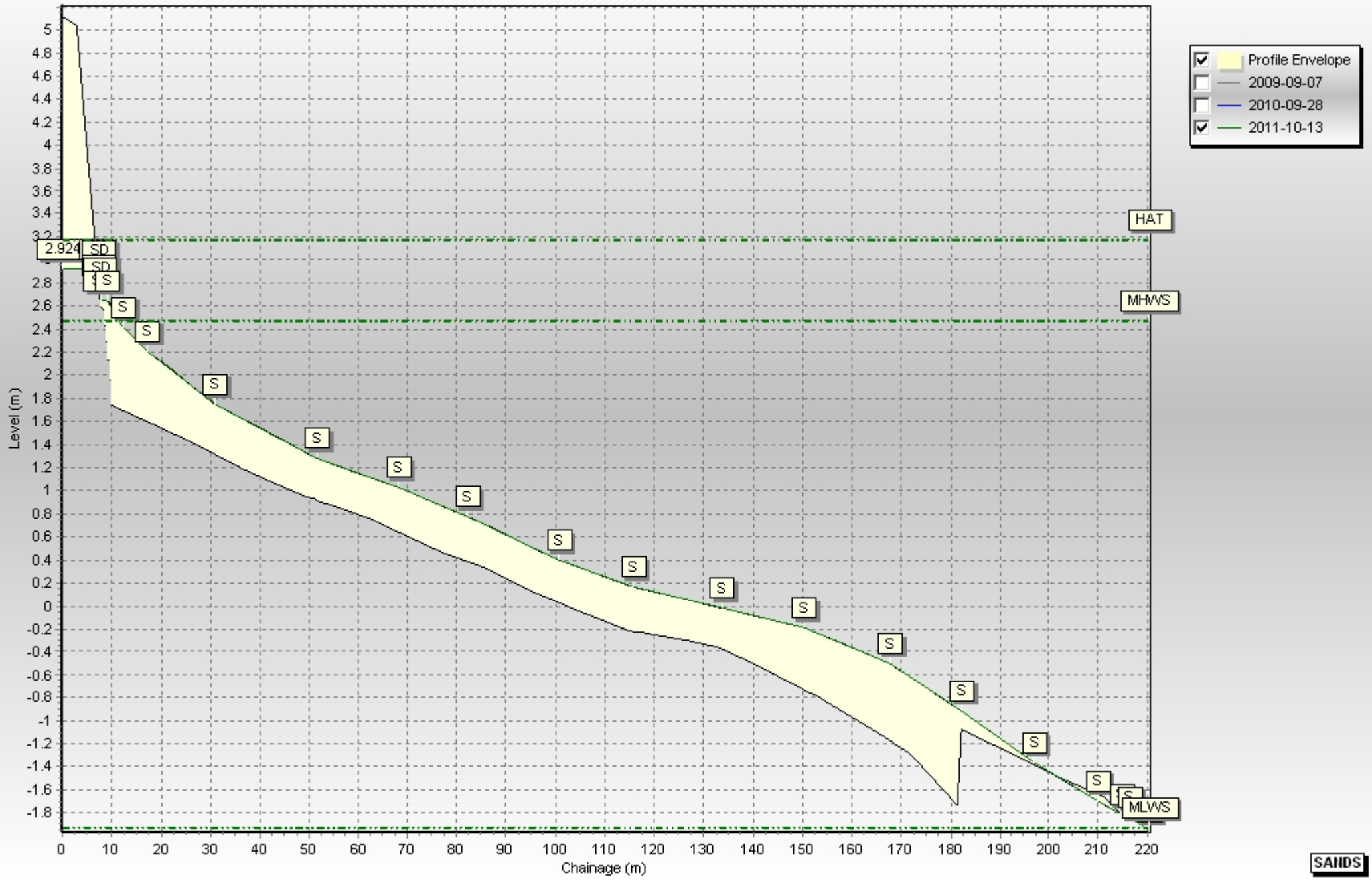
### Beach Profiles: 1bSNN4



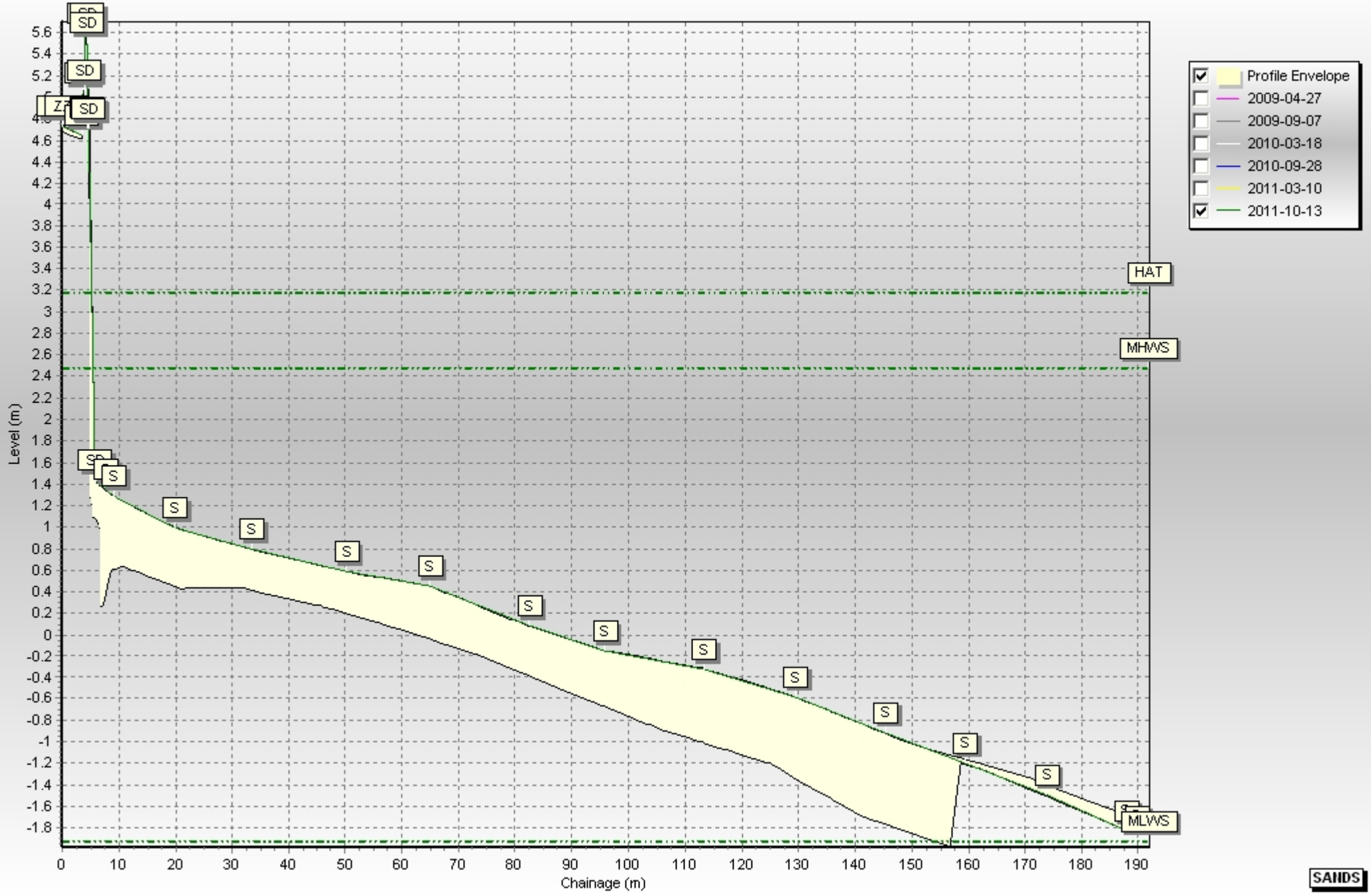
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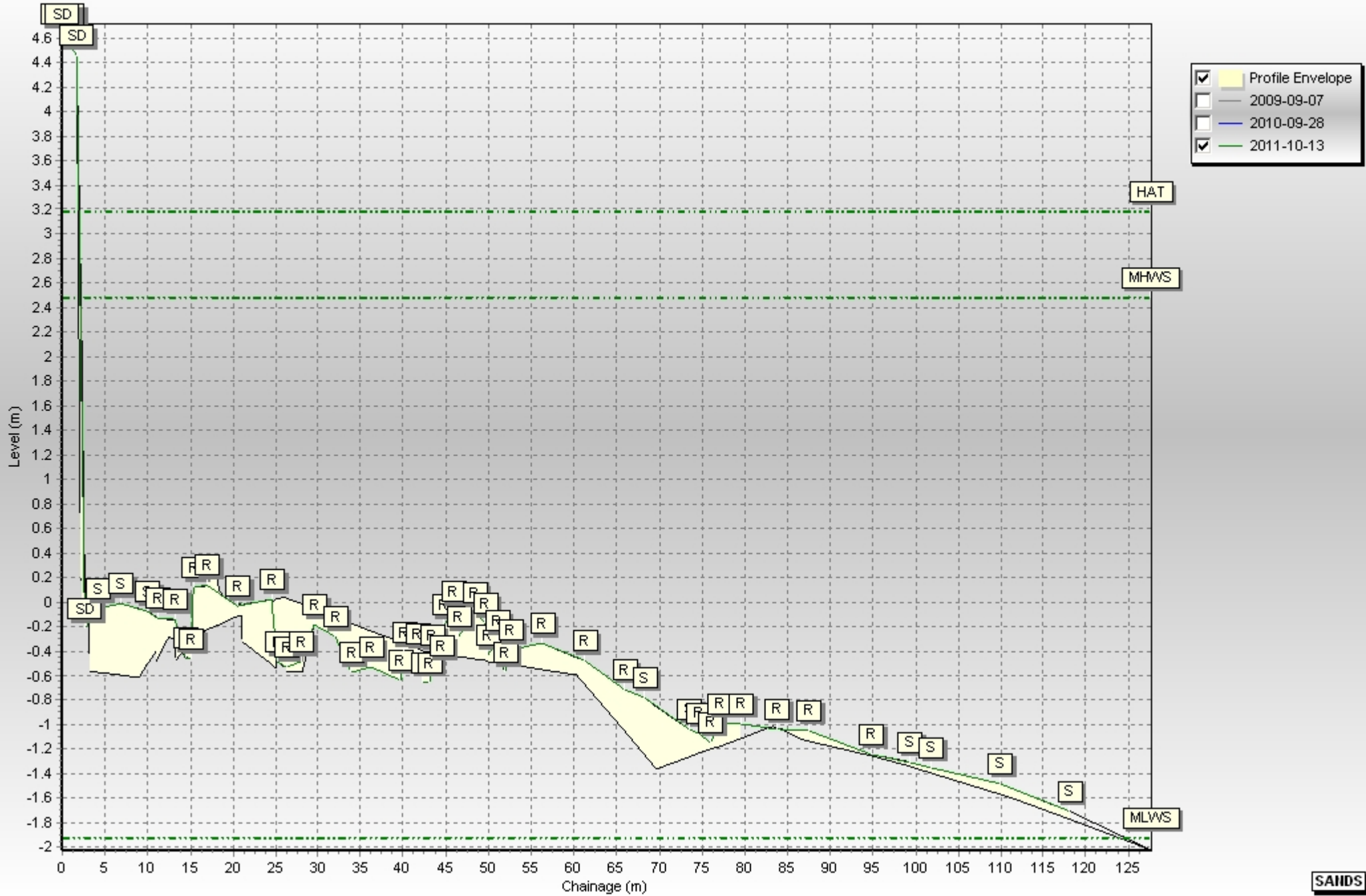
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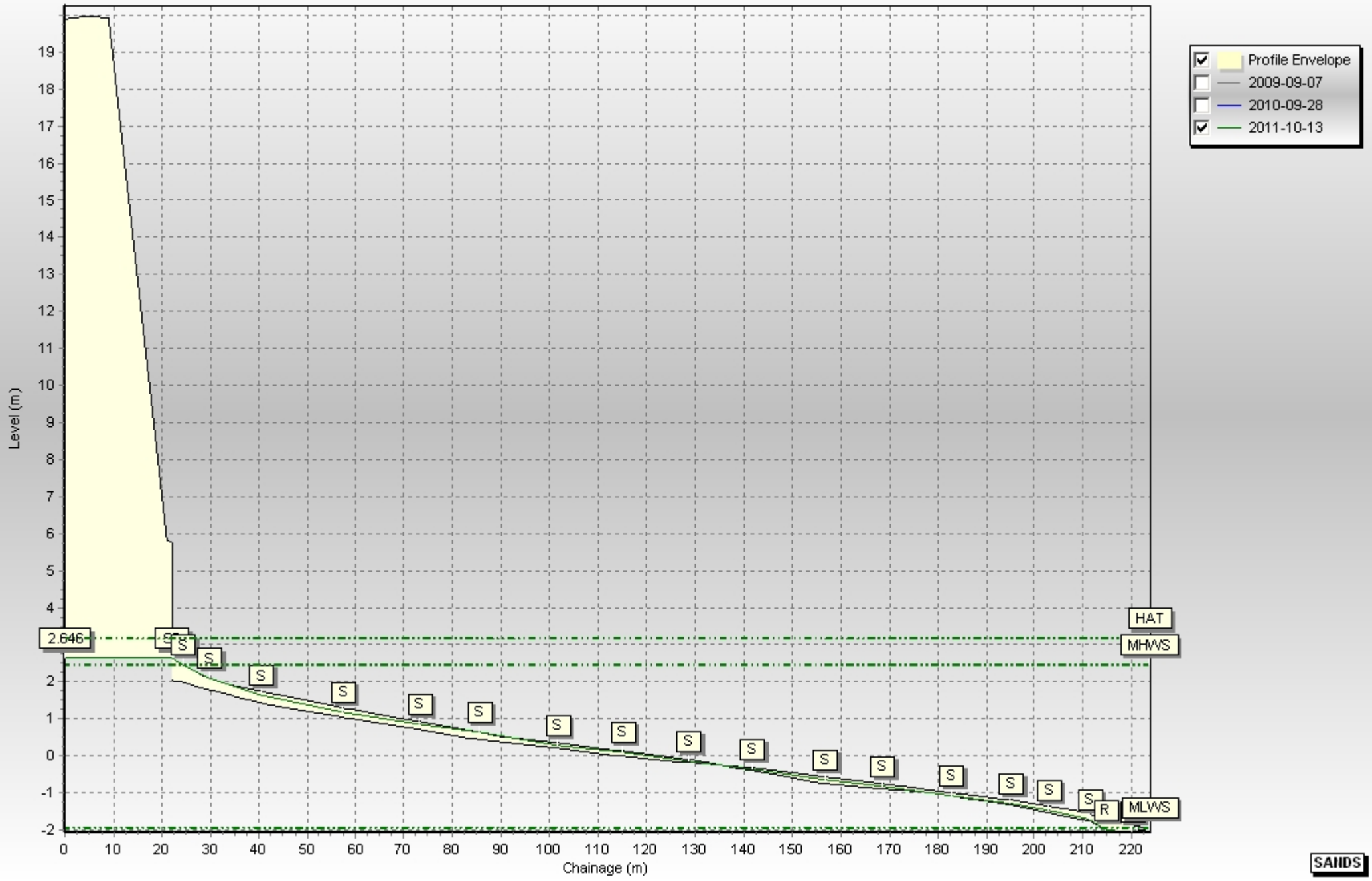
### Beach Profiles: 1bSNN7



### Beach Profiles: 1bSNN8

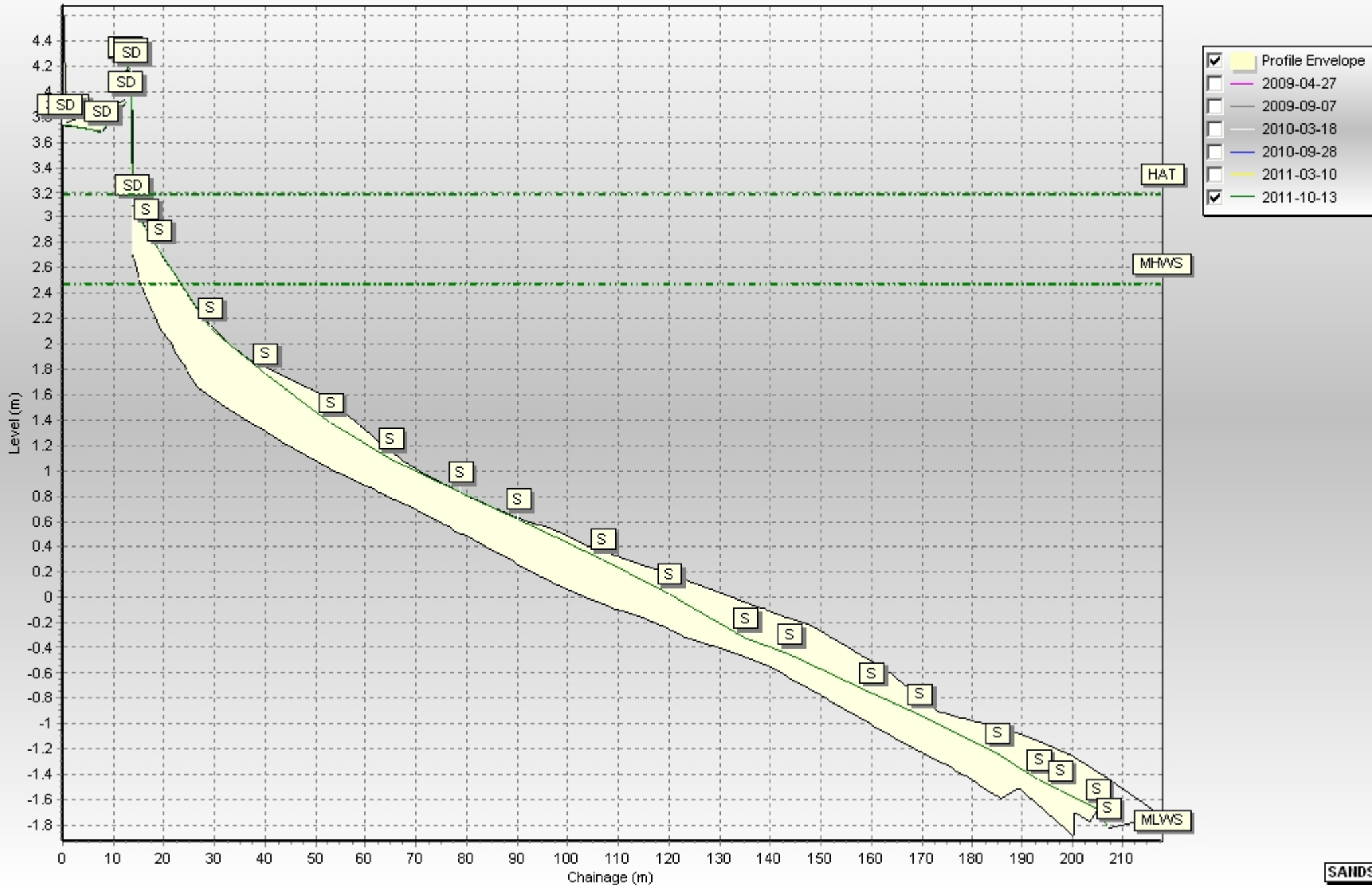


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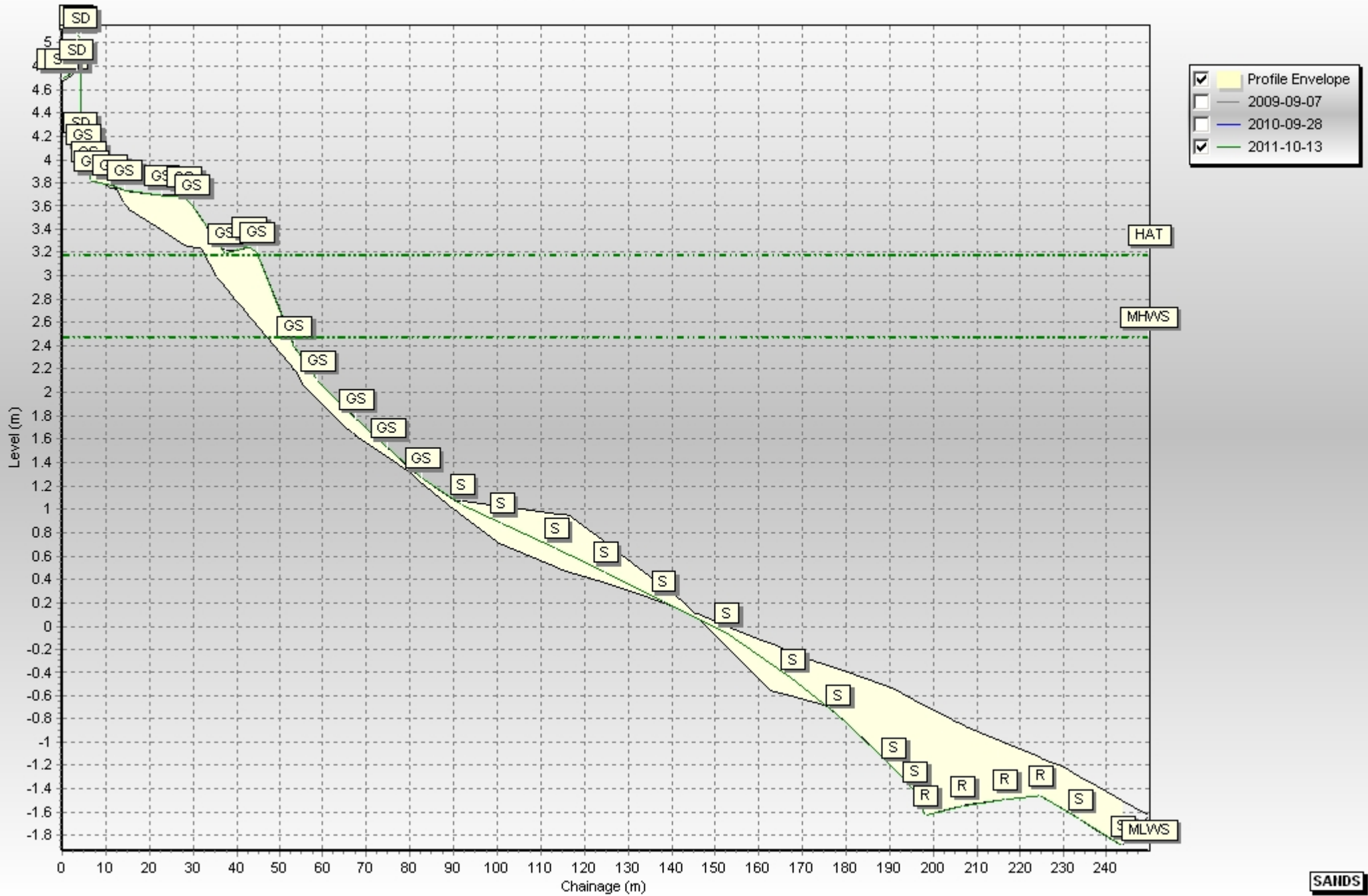




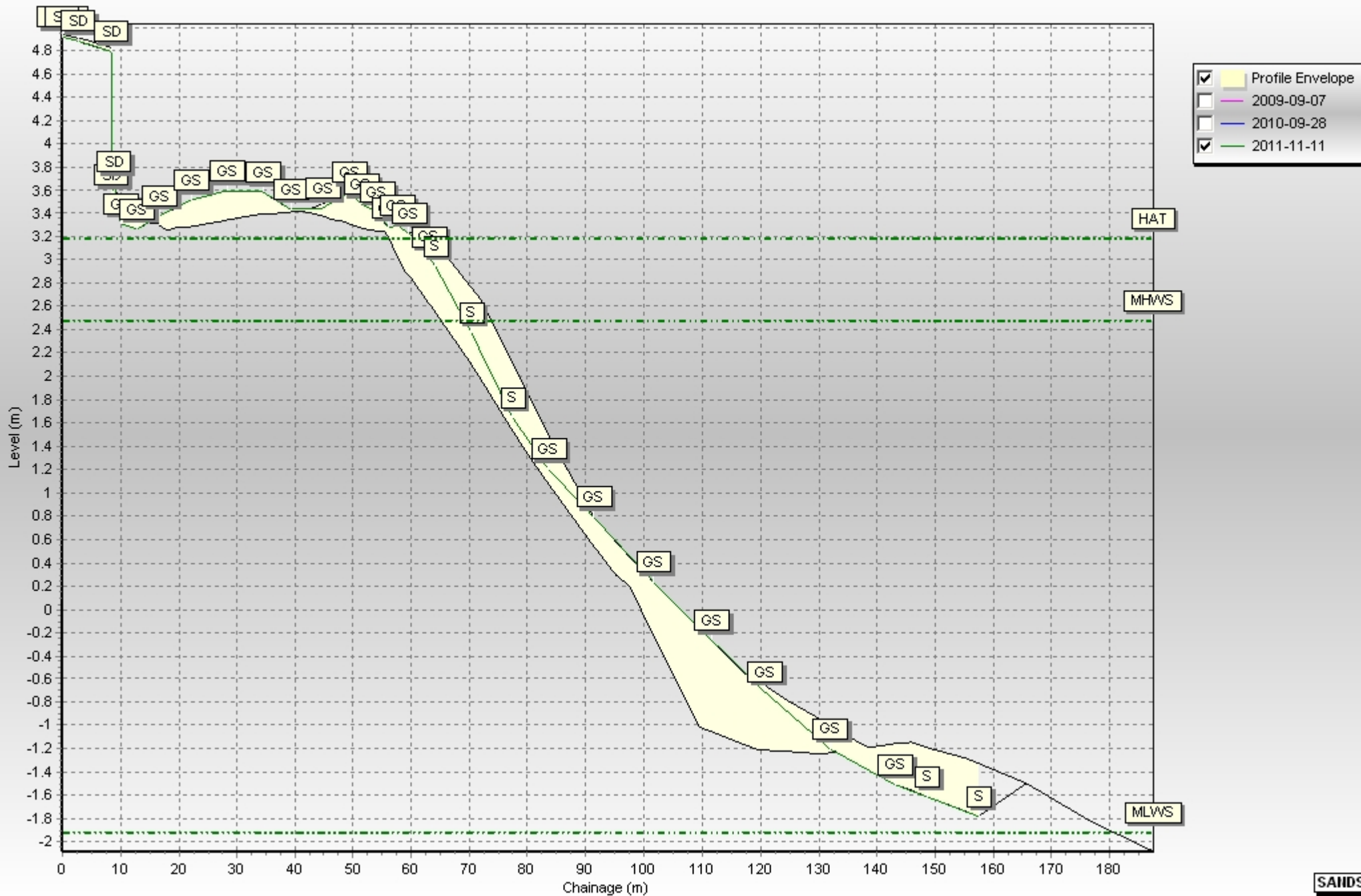
### Beach Profiles: 1bSNN10



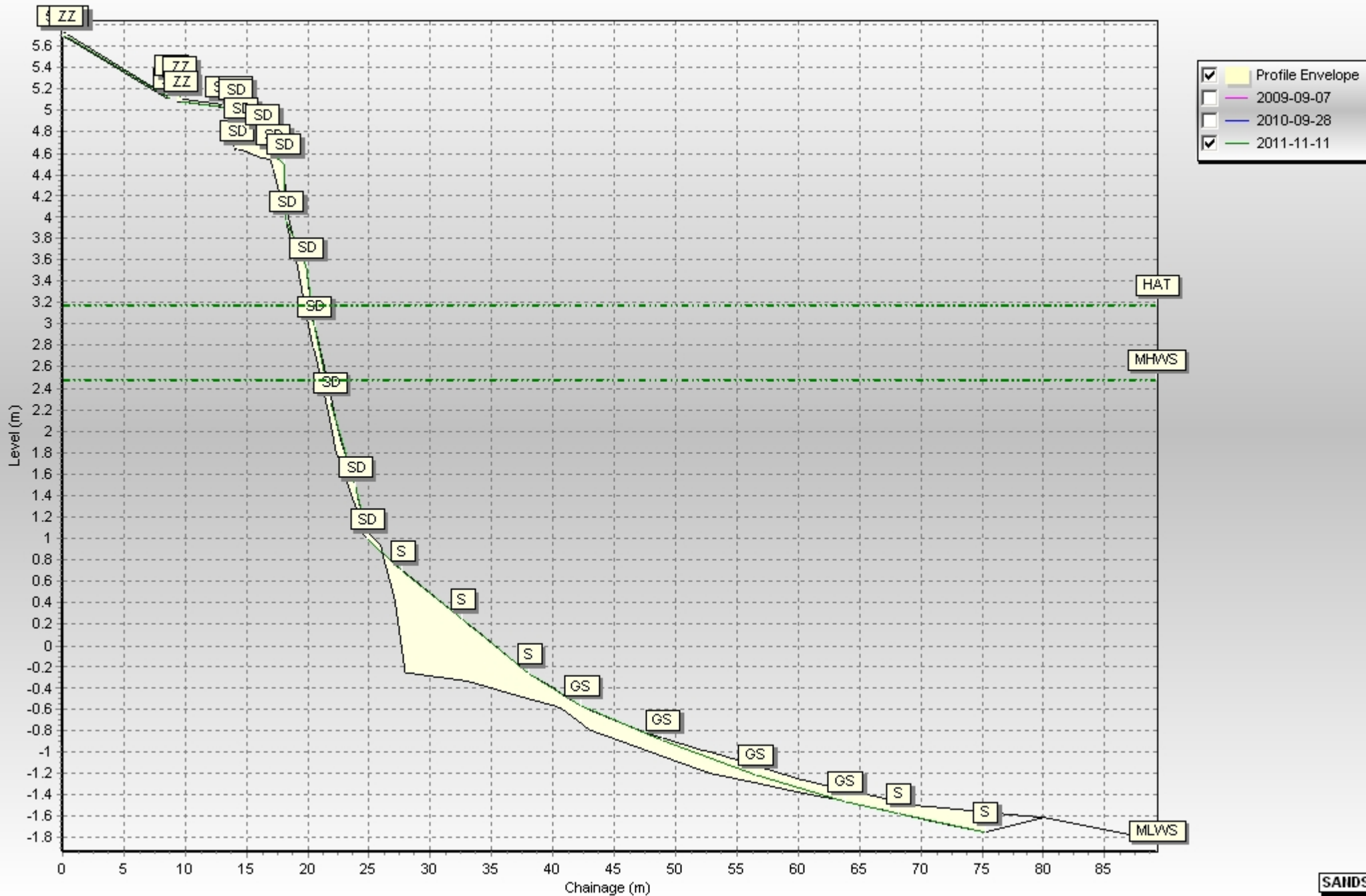
### Beach Profiles: 1bSNN11



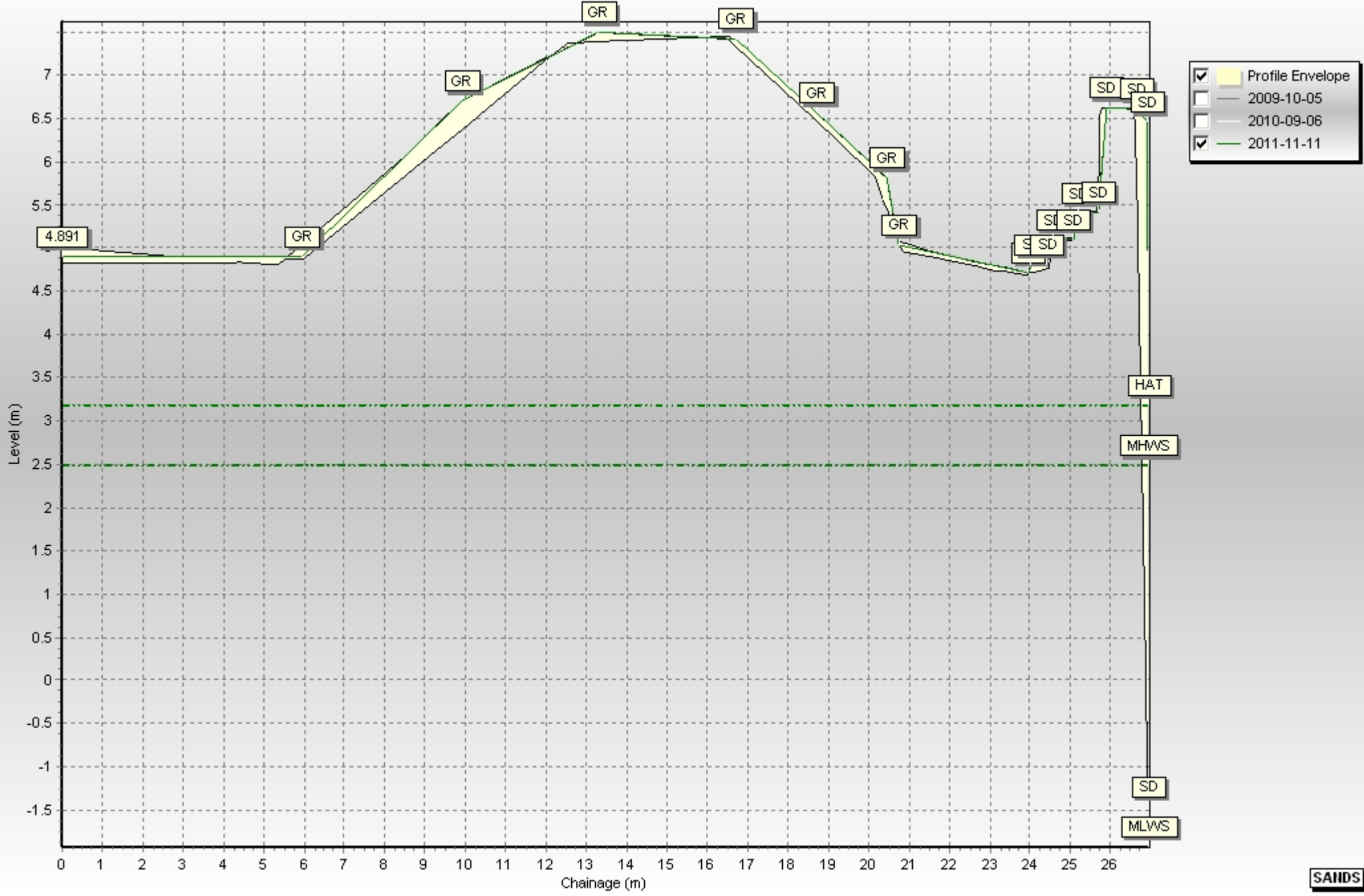
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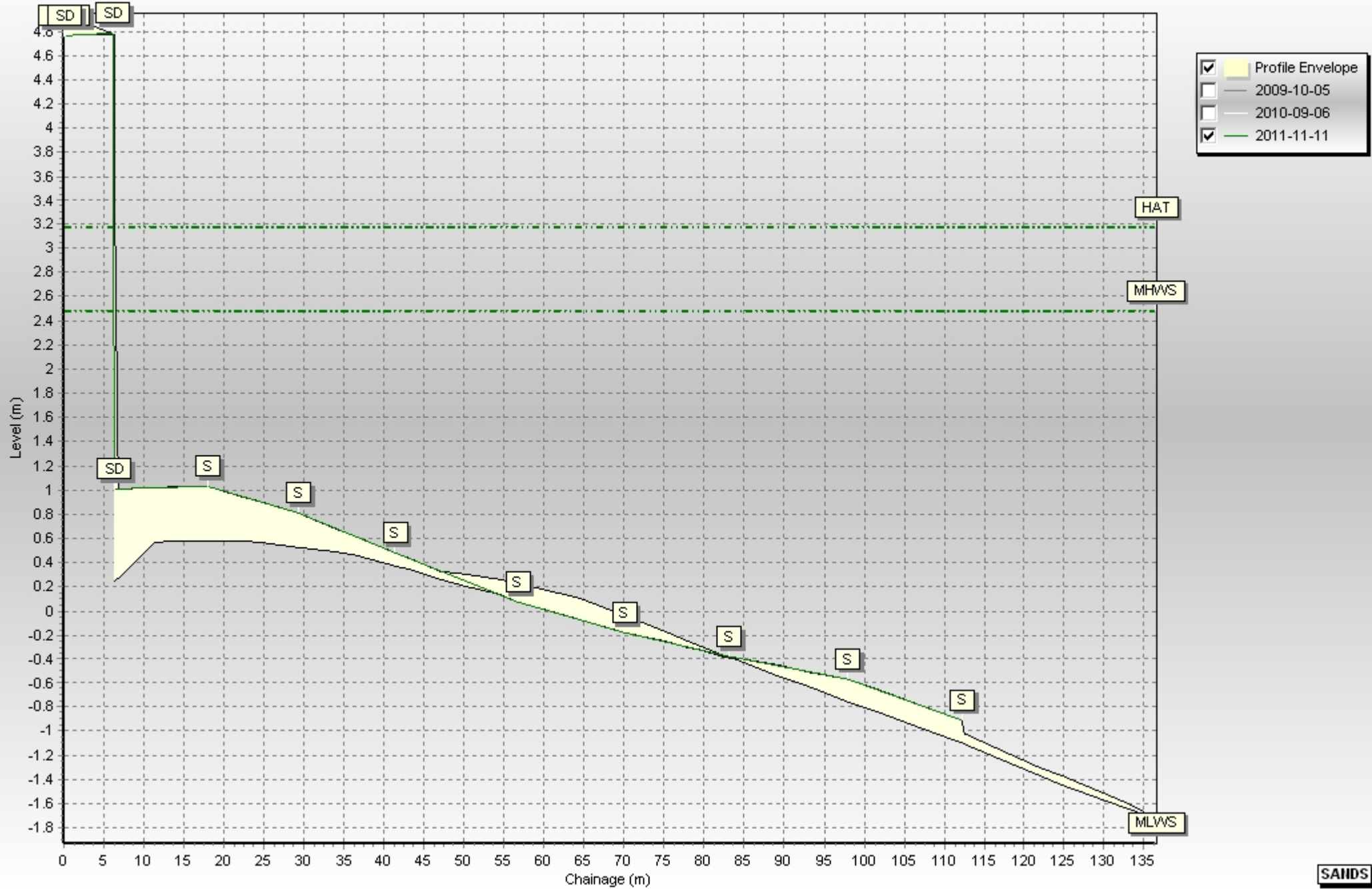
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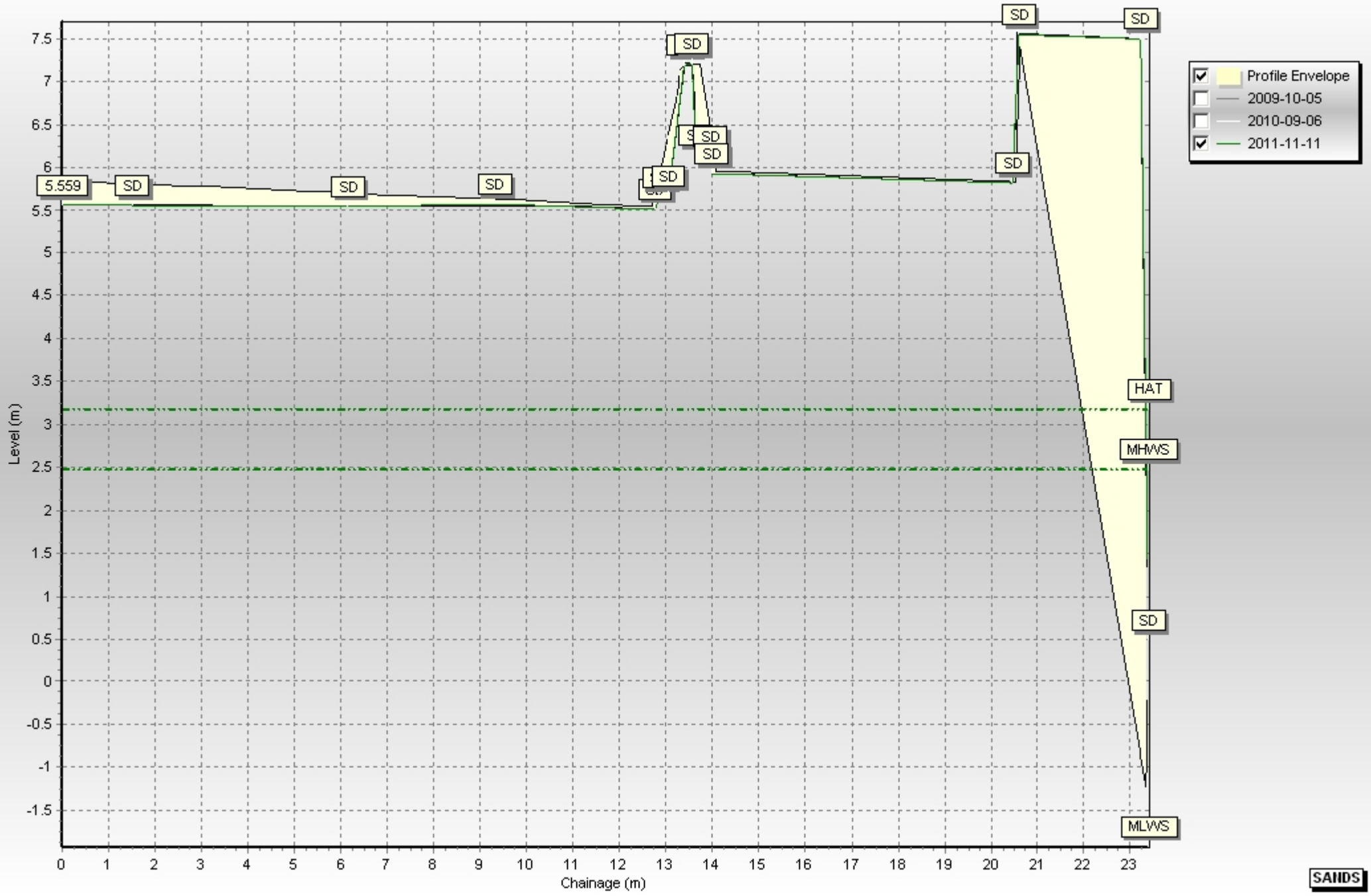
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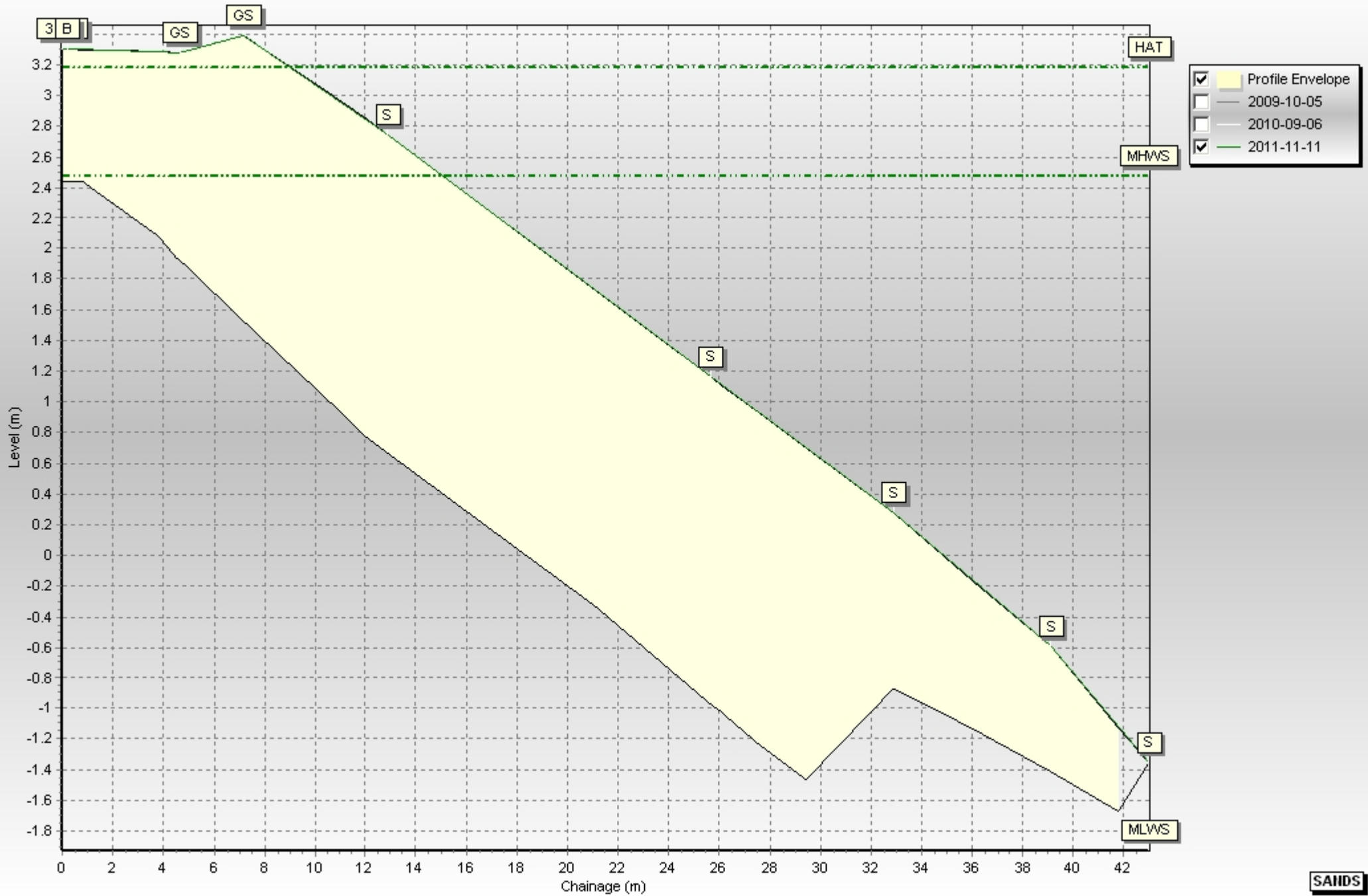
### Beach Profiles: 1bSNC2



### Beach Profiles: 1bSNC3

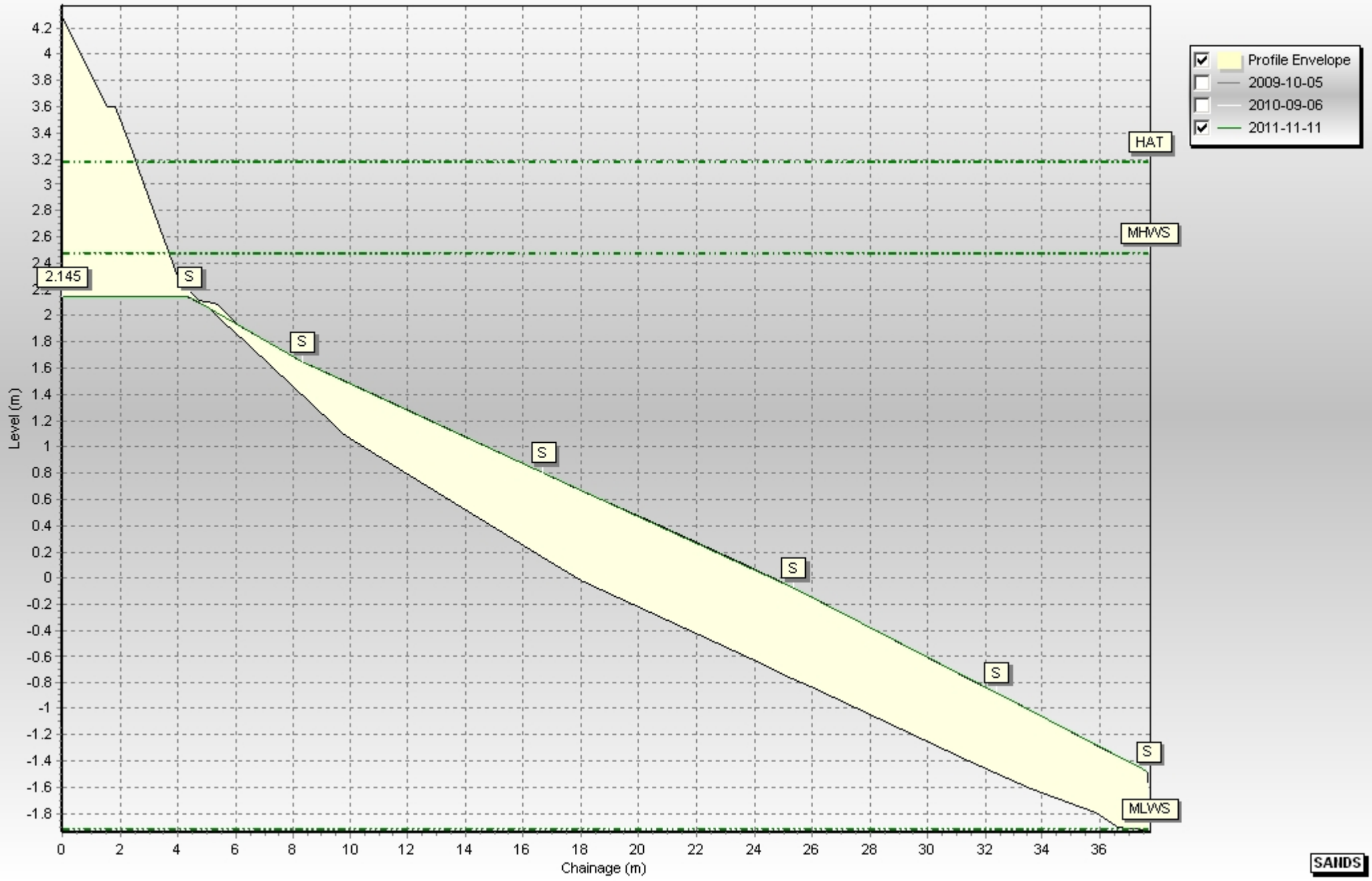


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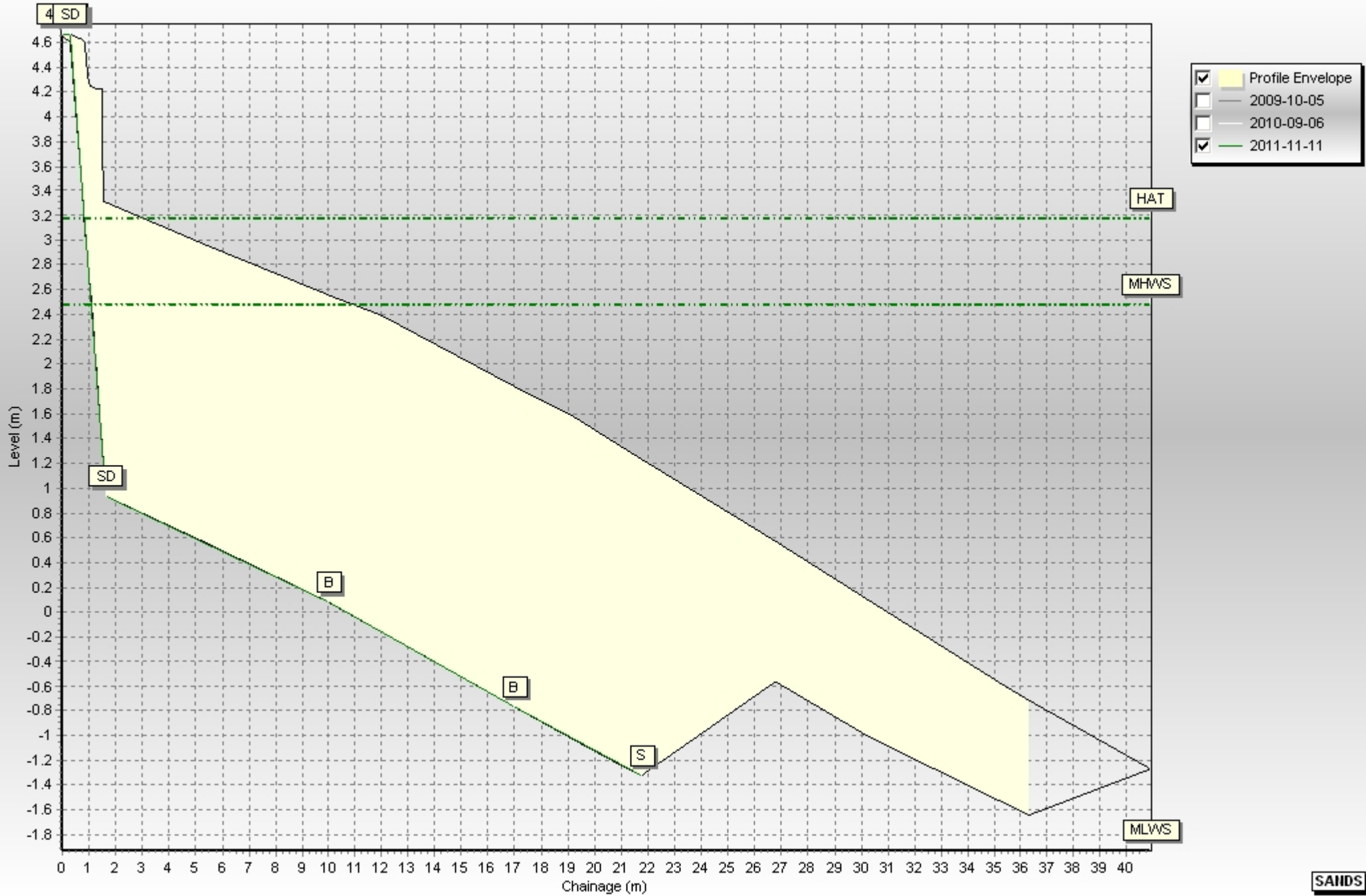




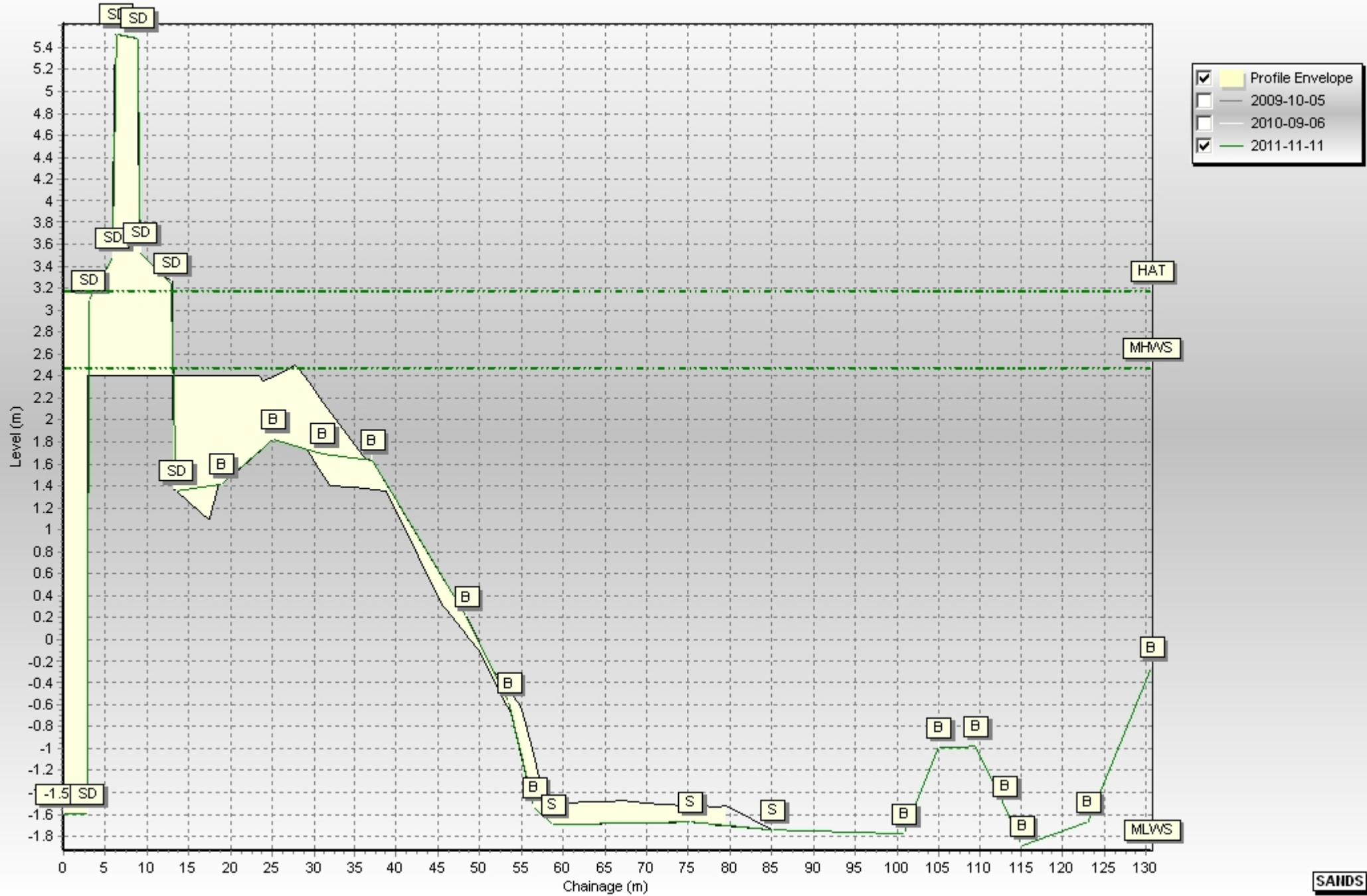
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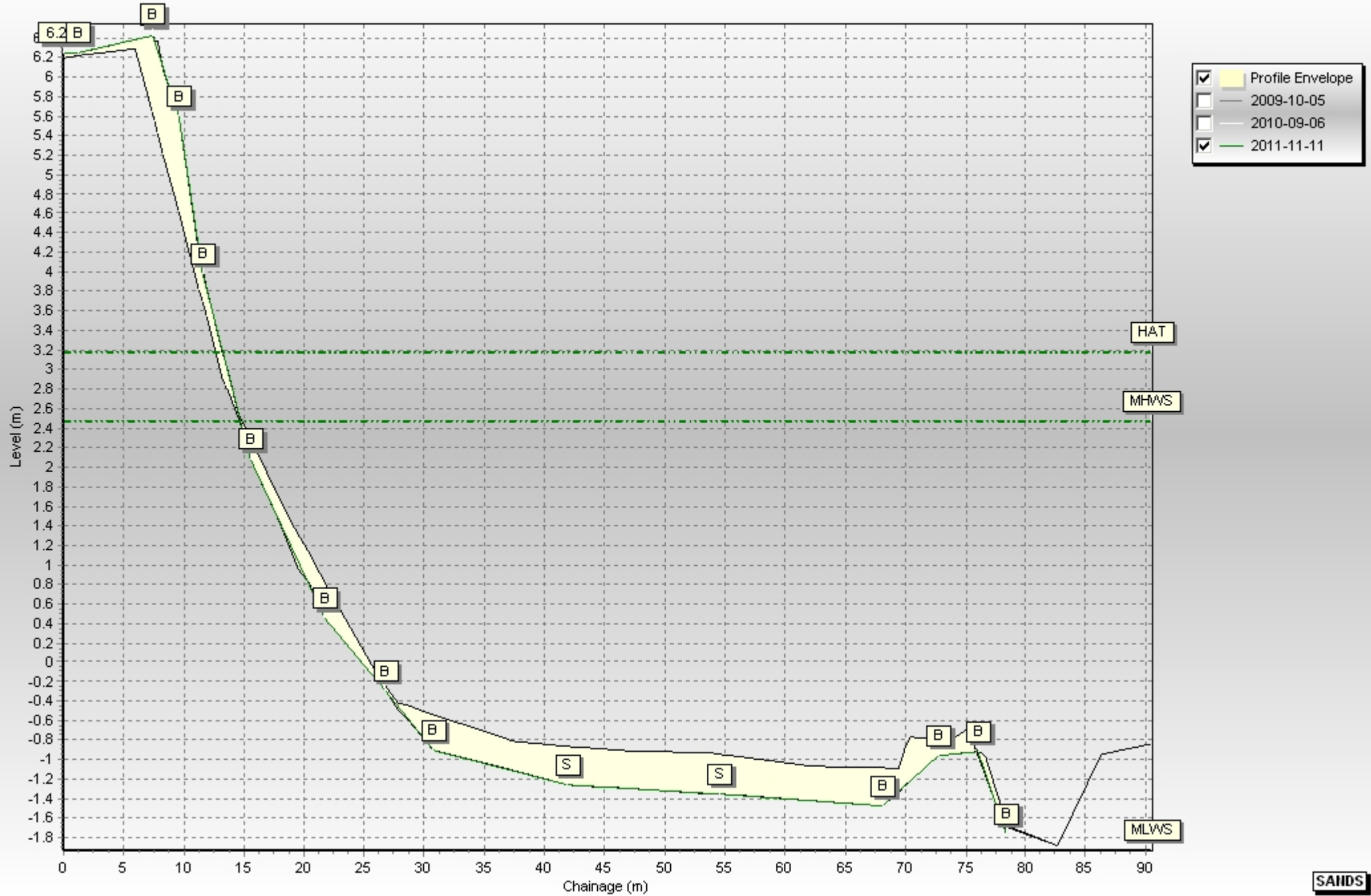
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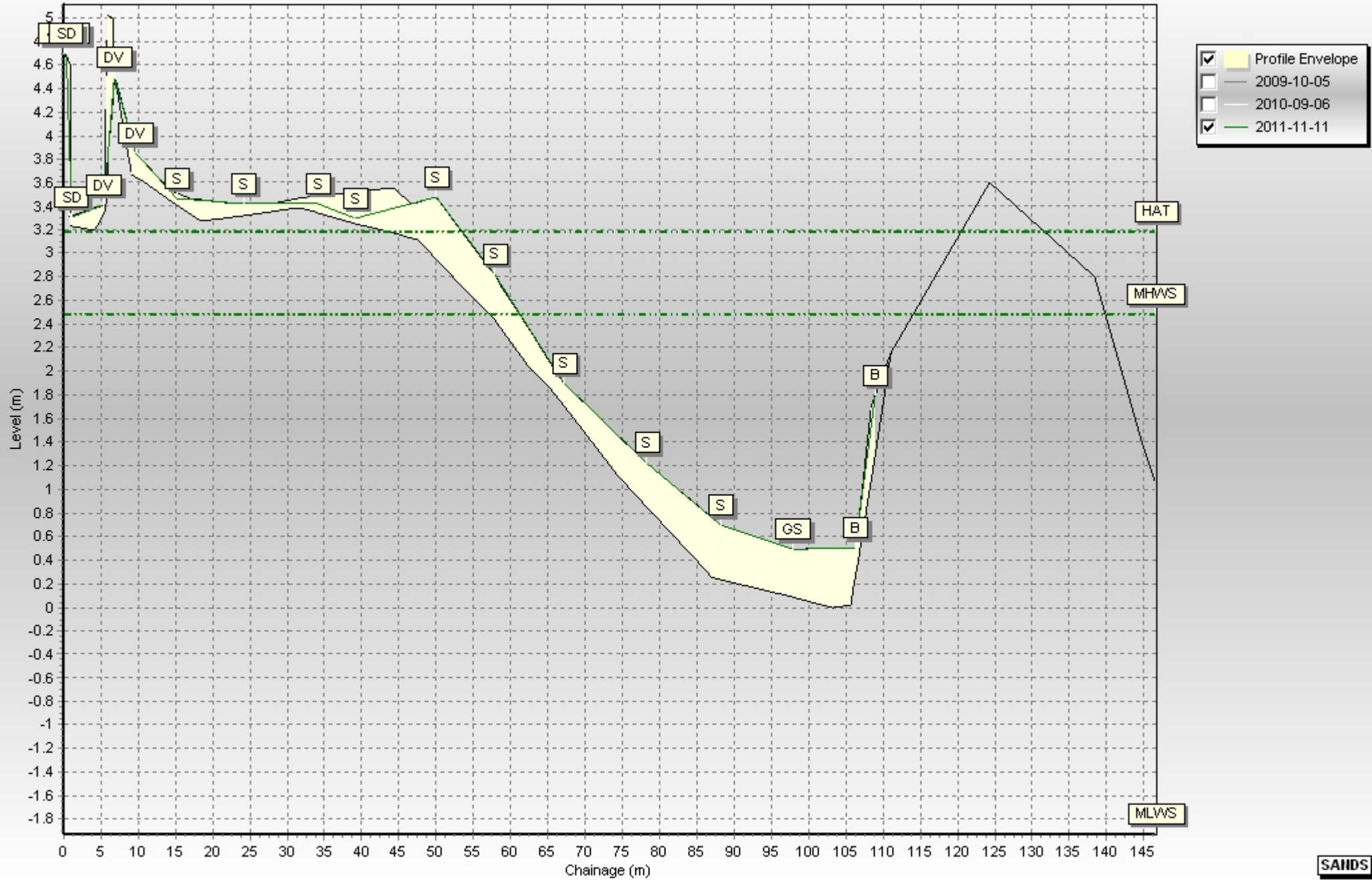
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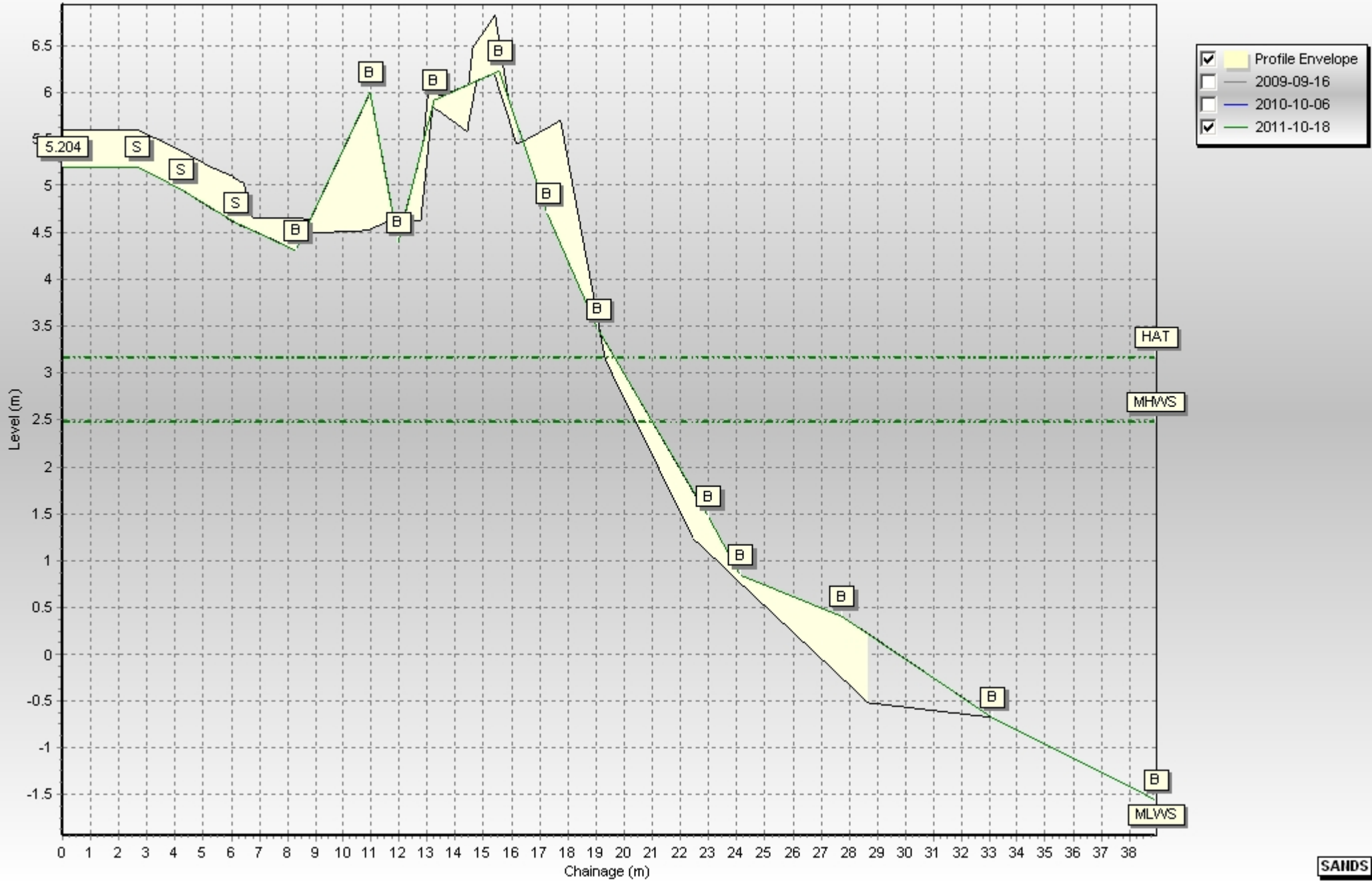
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### Beach Profiles: 1bSNC9



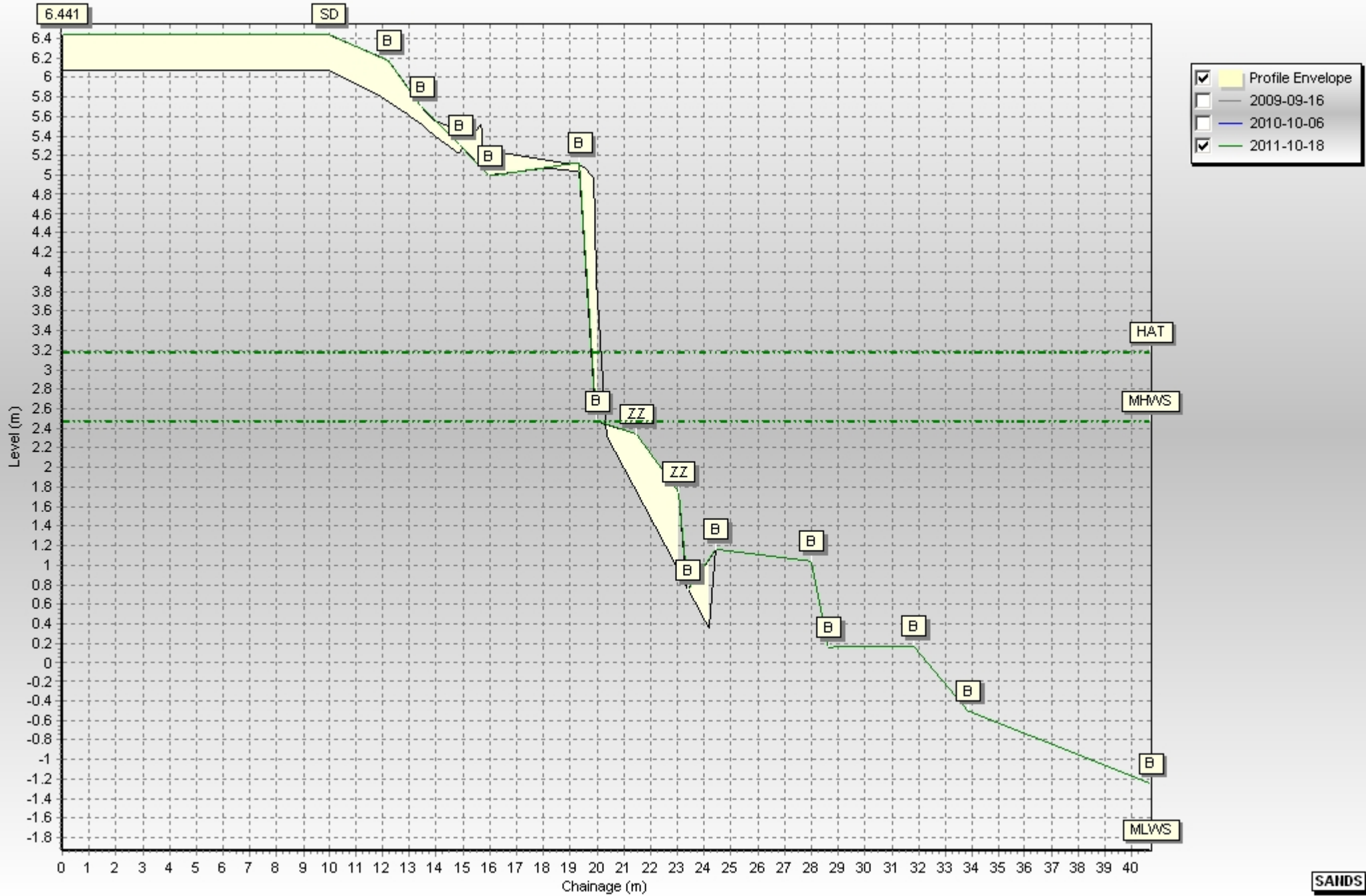
### Beach Profiles: 1bSNS1



### Beach Profiles: 1bSNS2

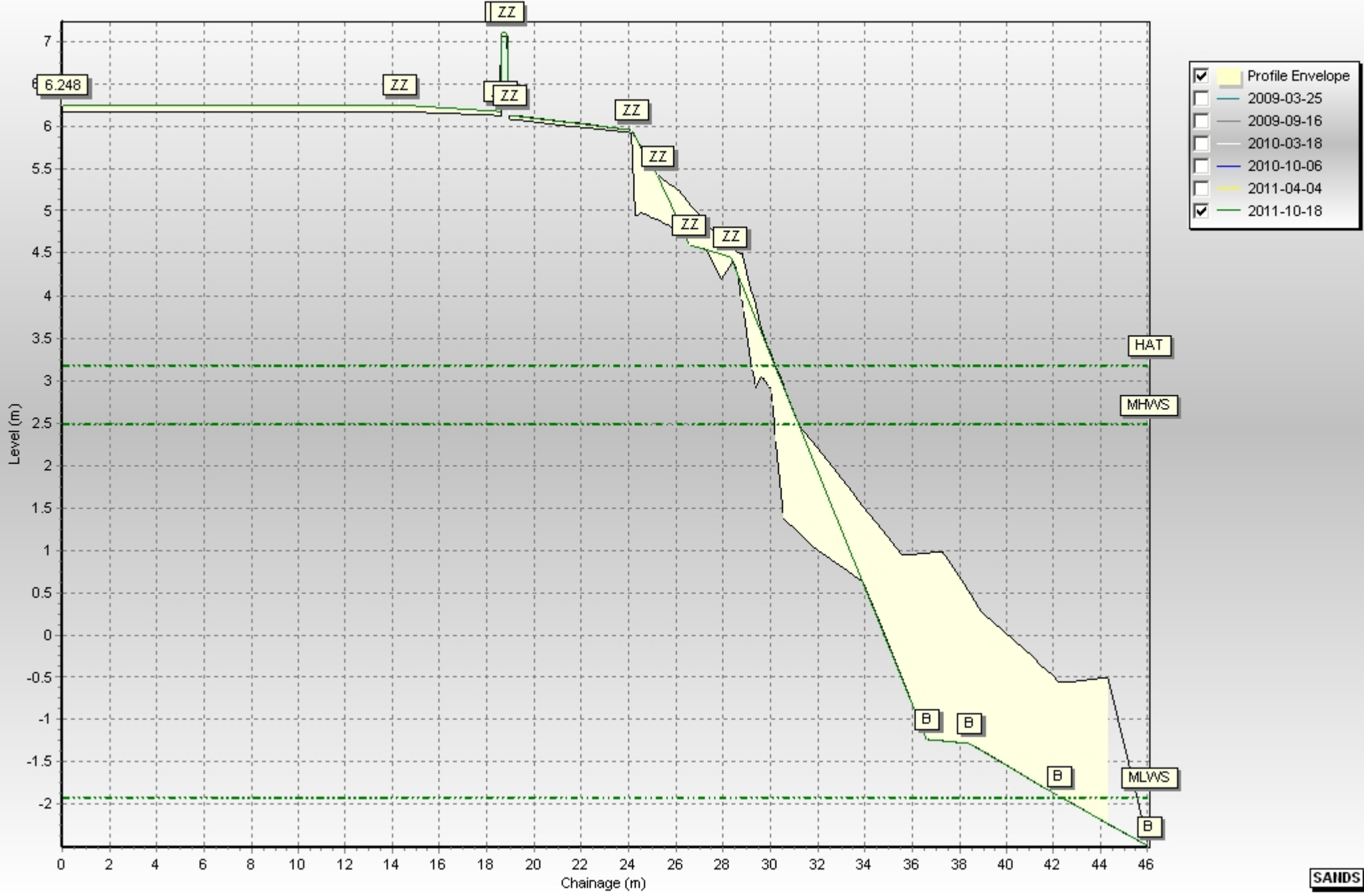


### Beach Profiles: 1bSNS3

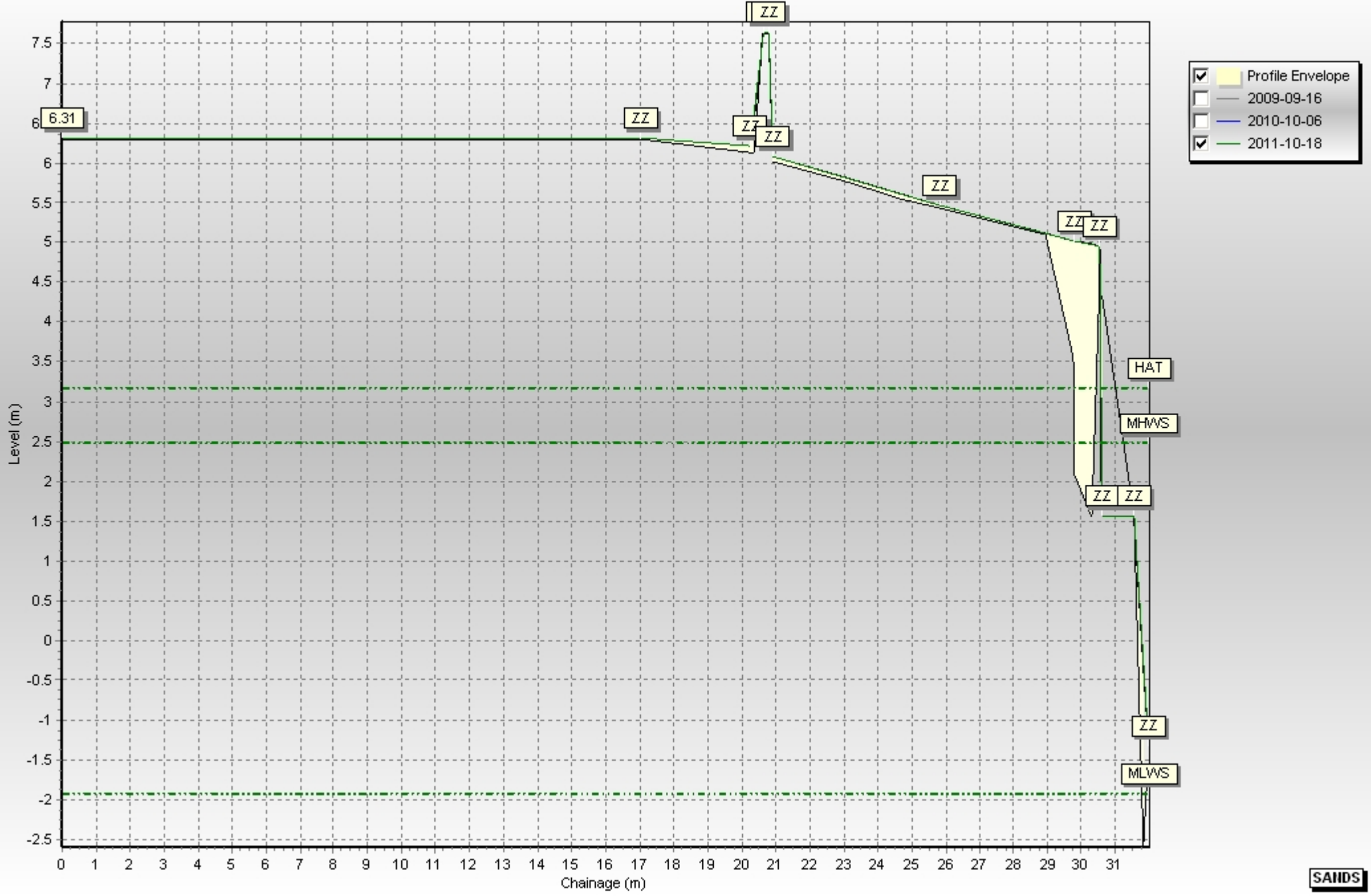




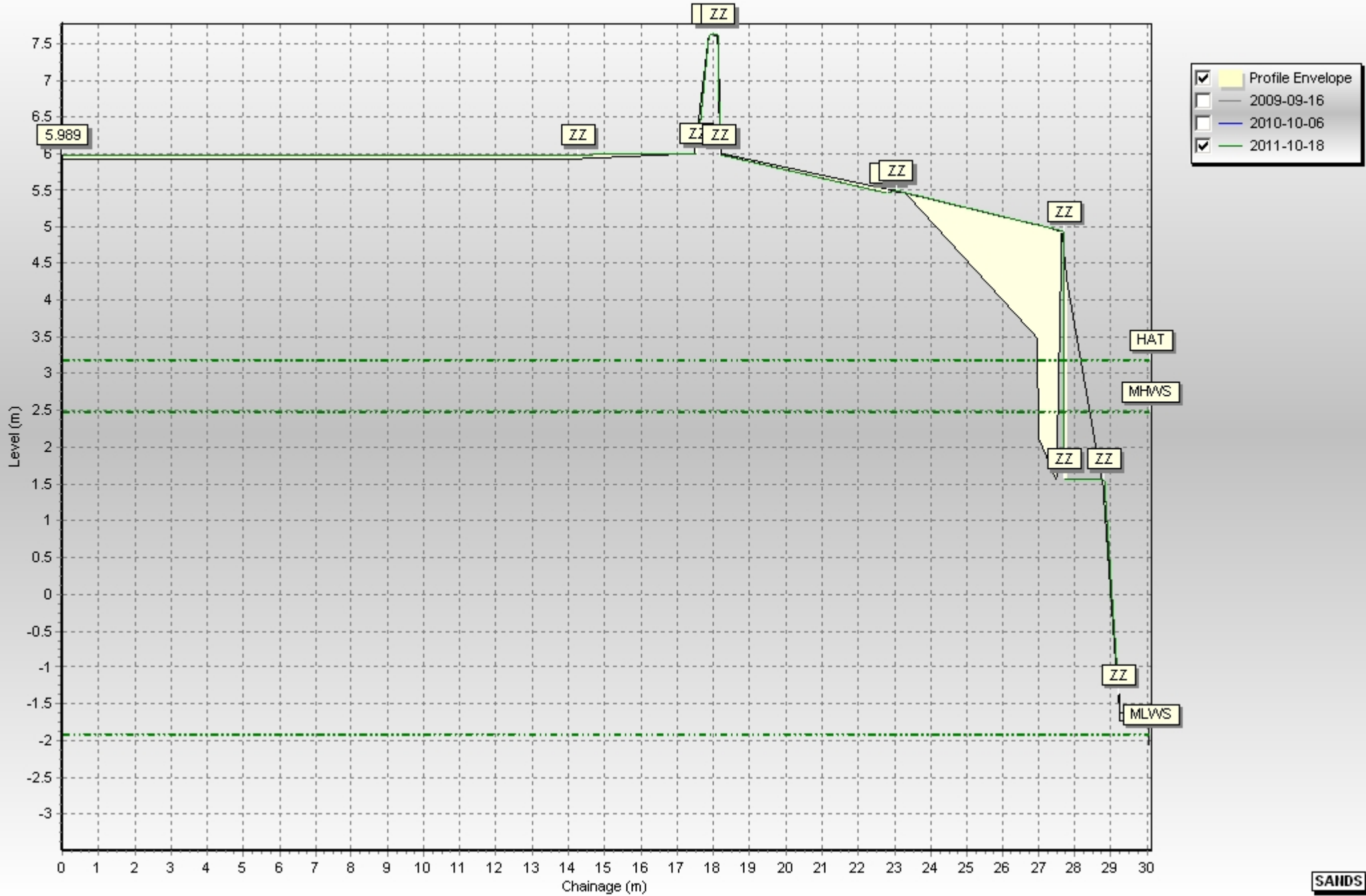
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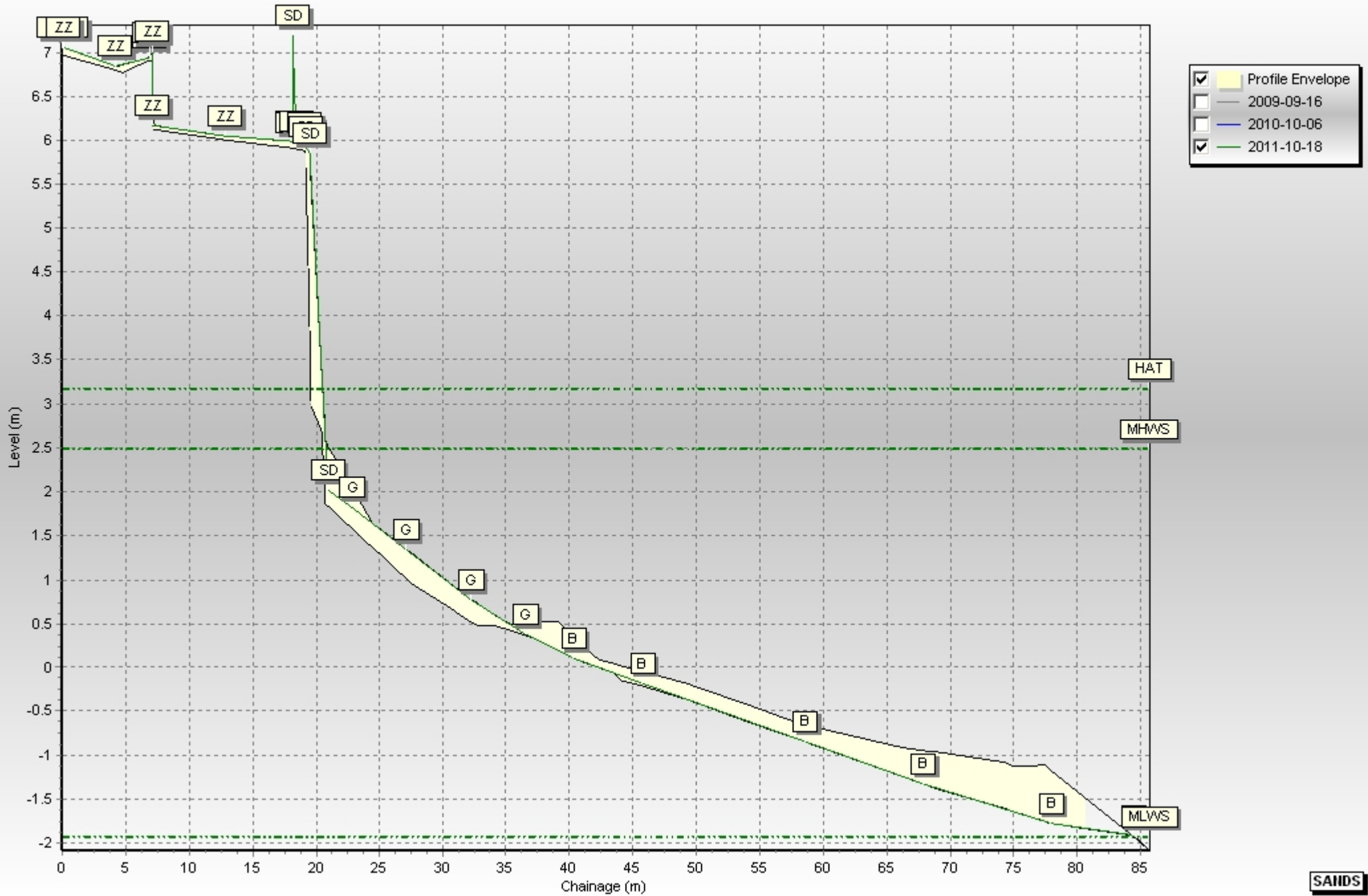
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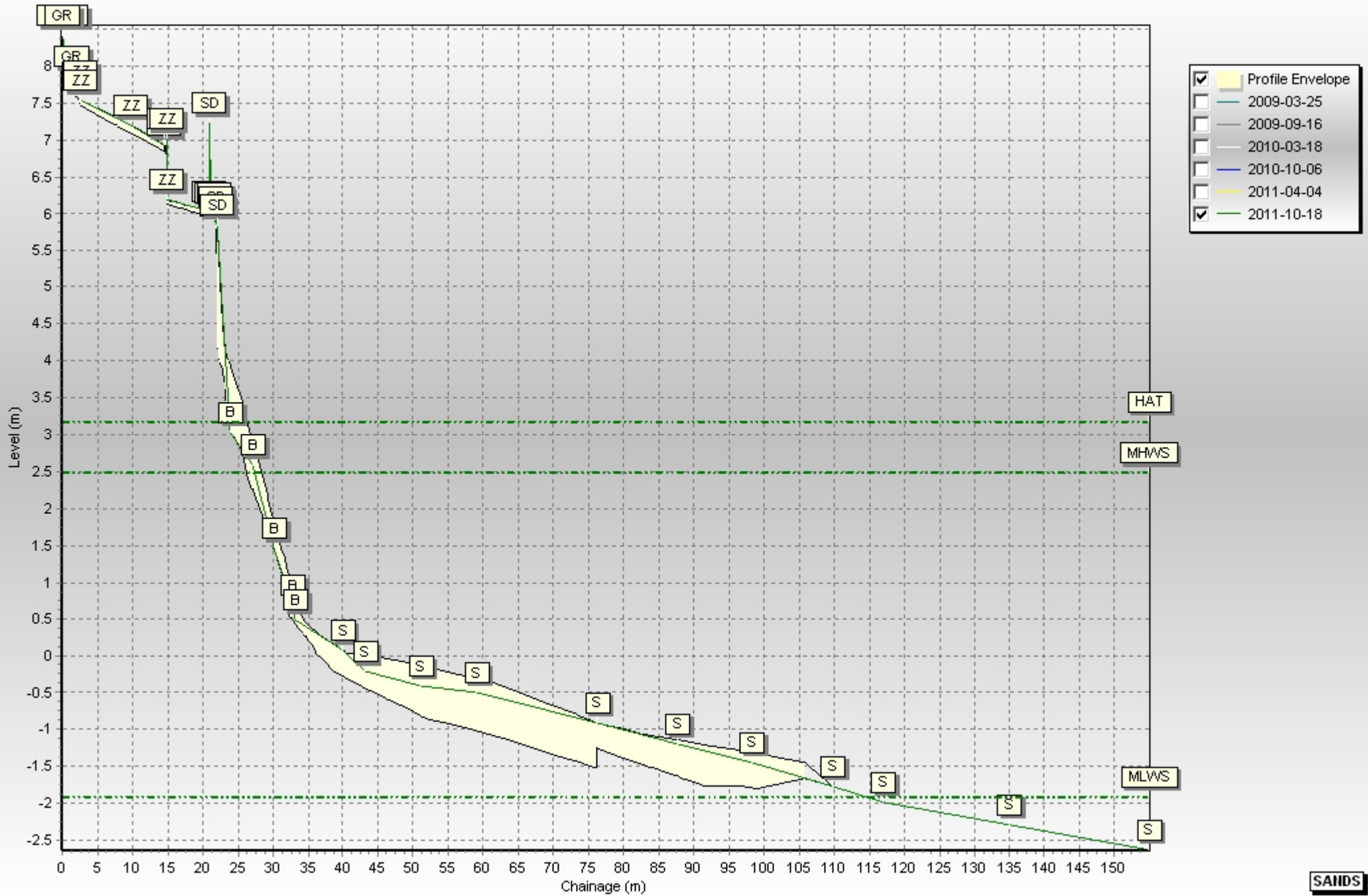
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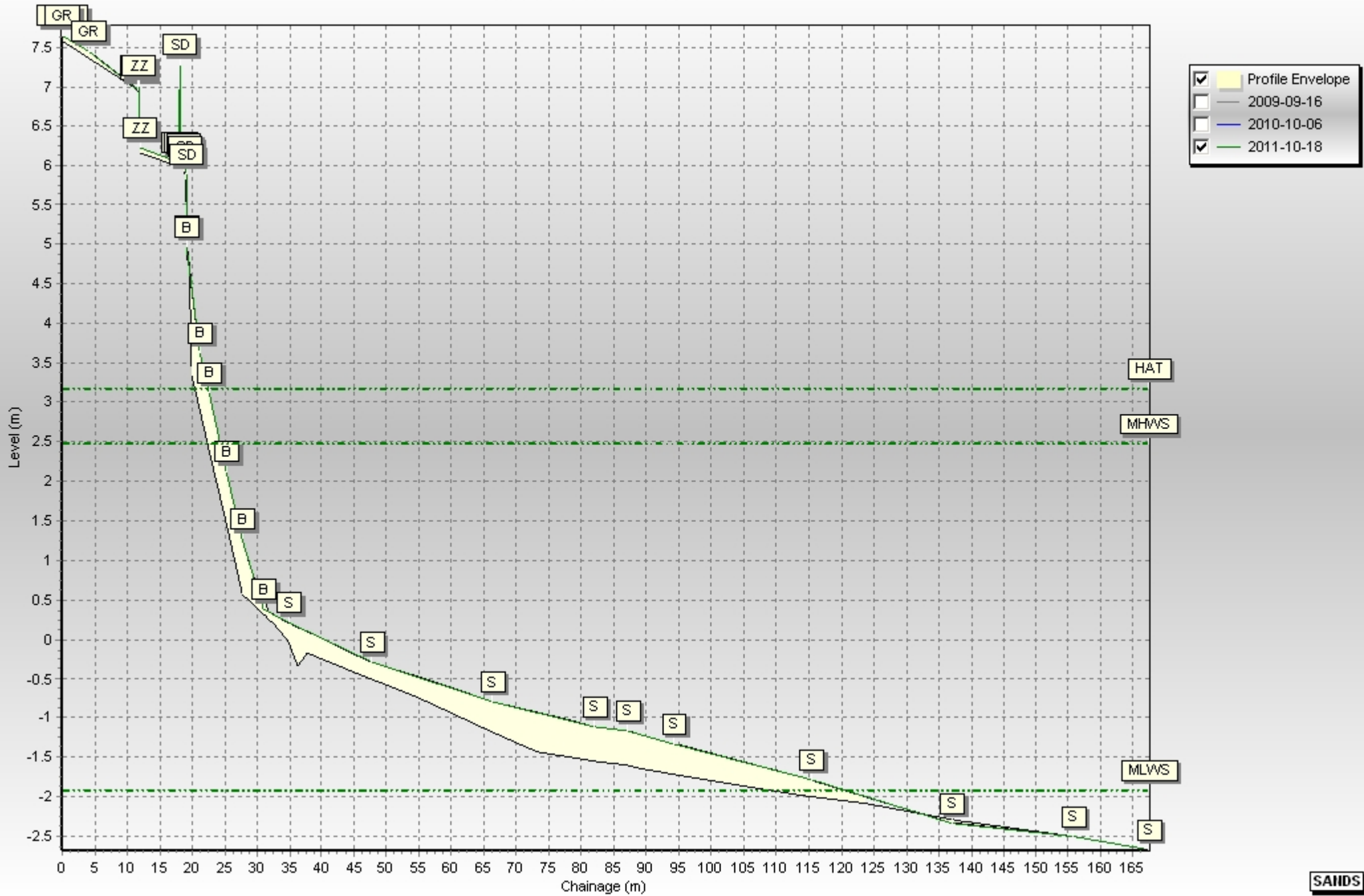
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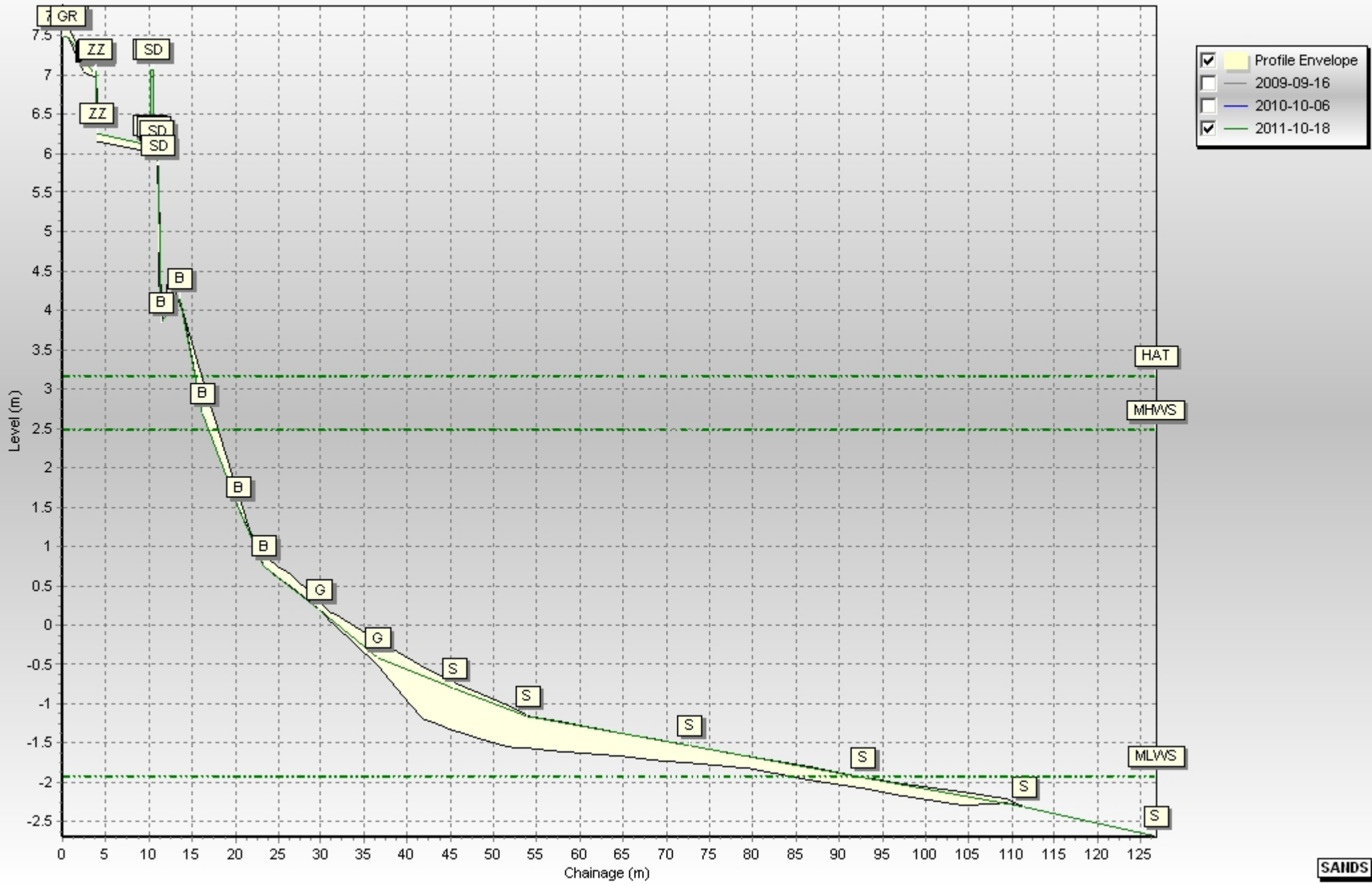
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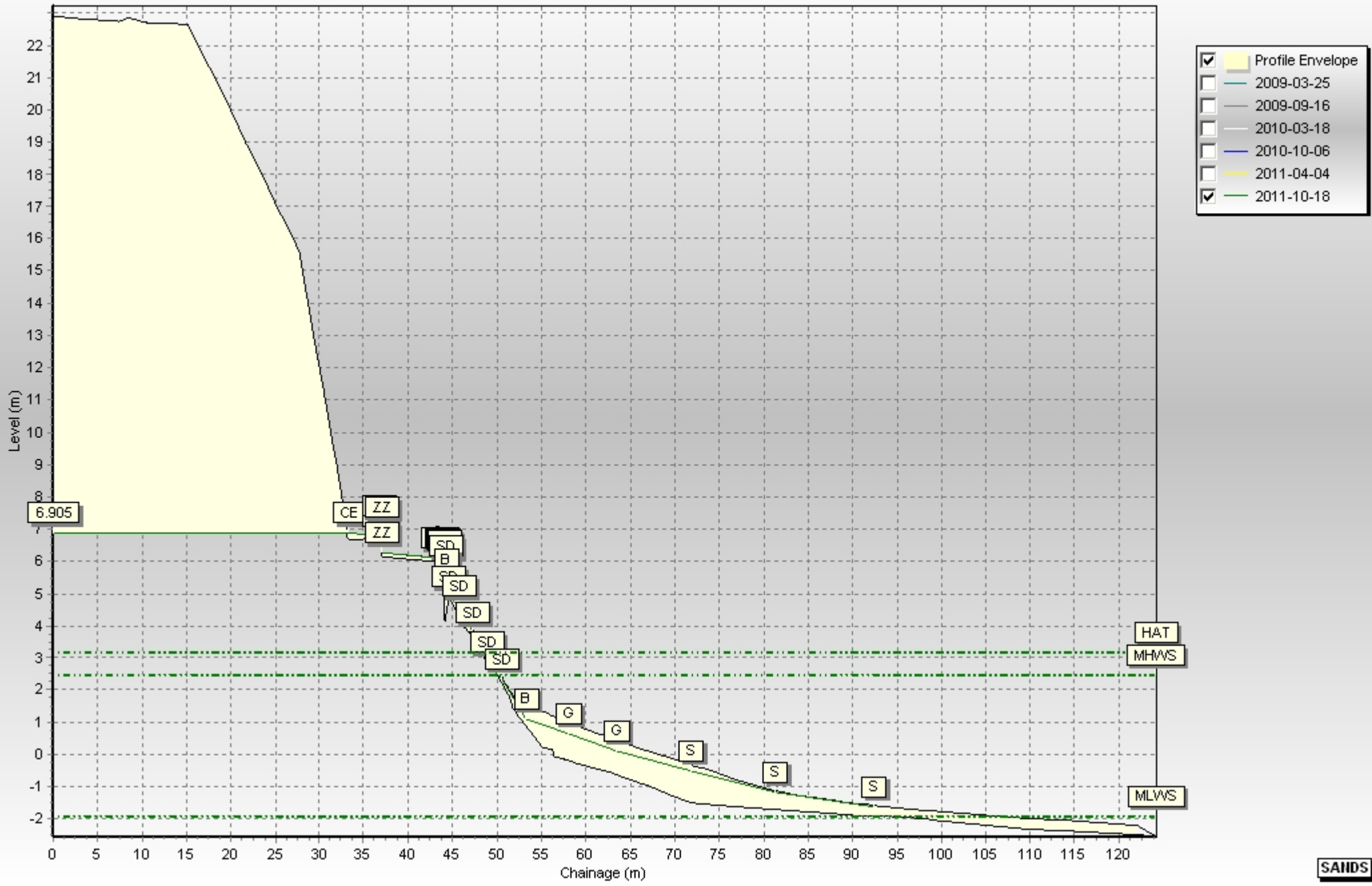
### Beach Profiles: 1bSNS9



### Beach Profiles: 1bSNS10

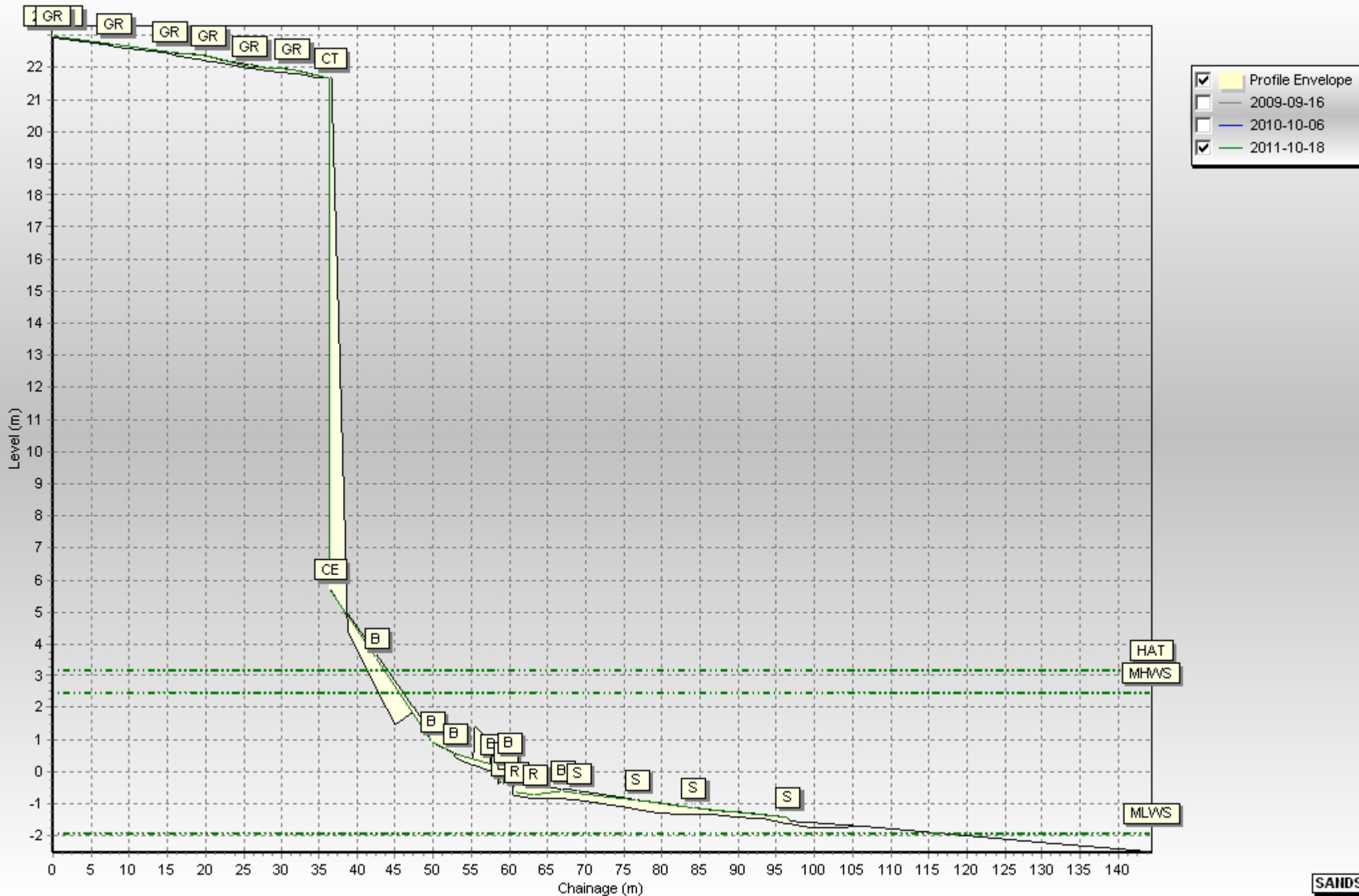


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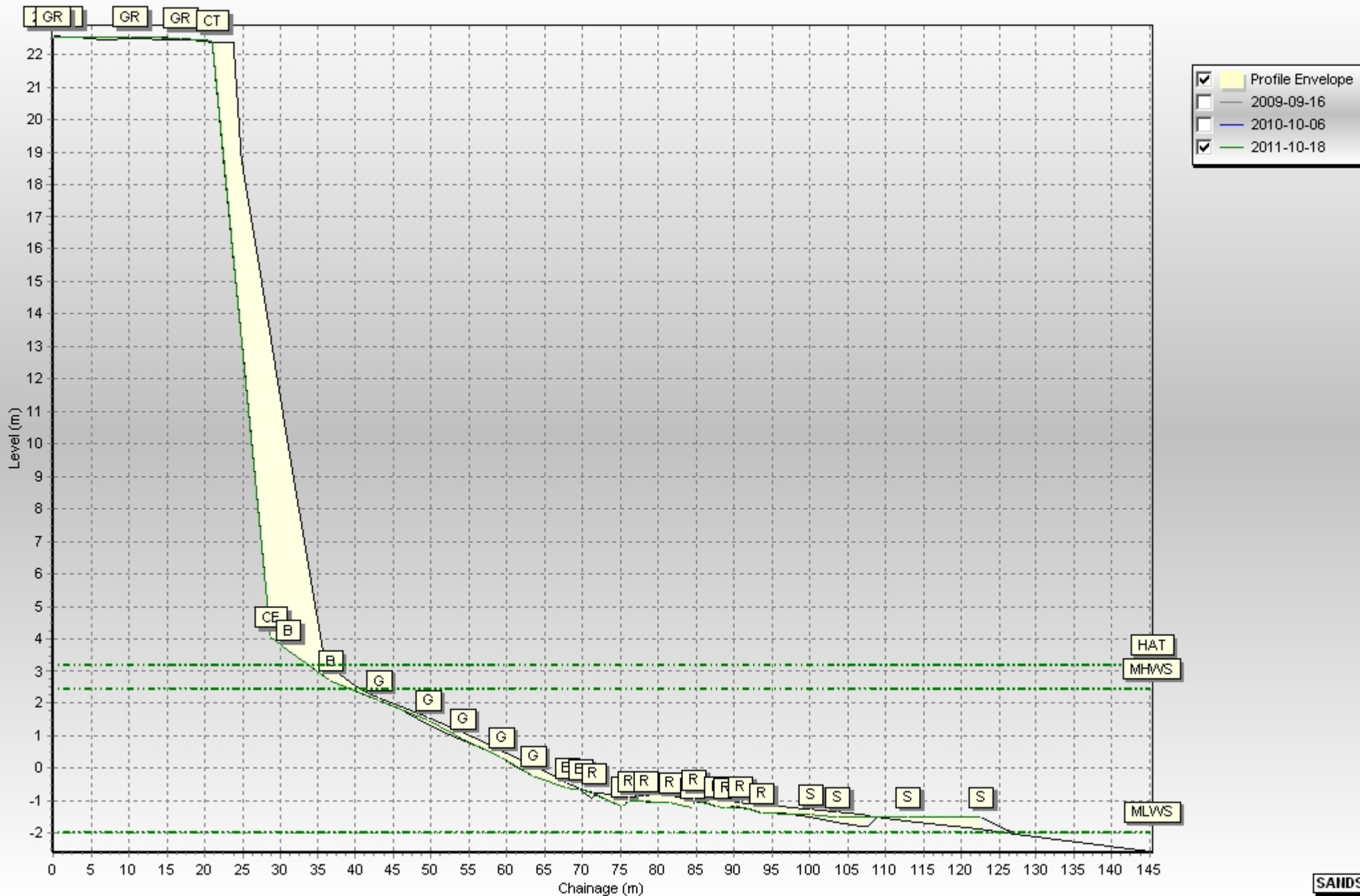




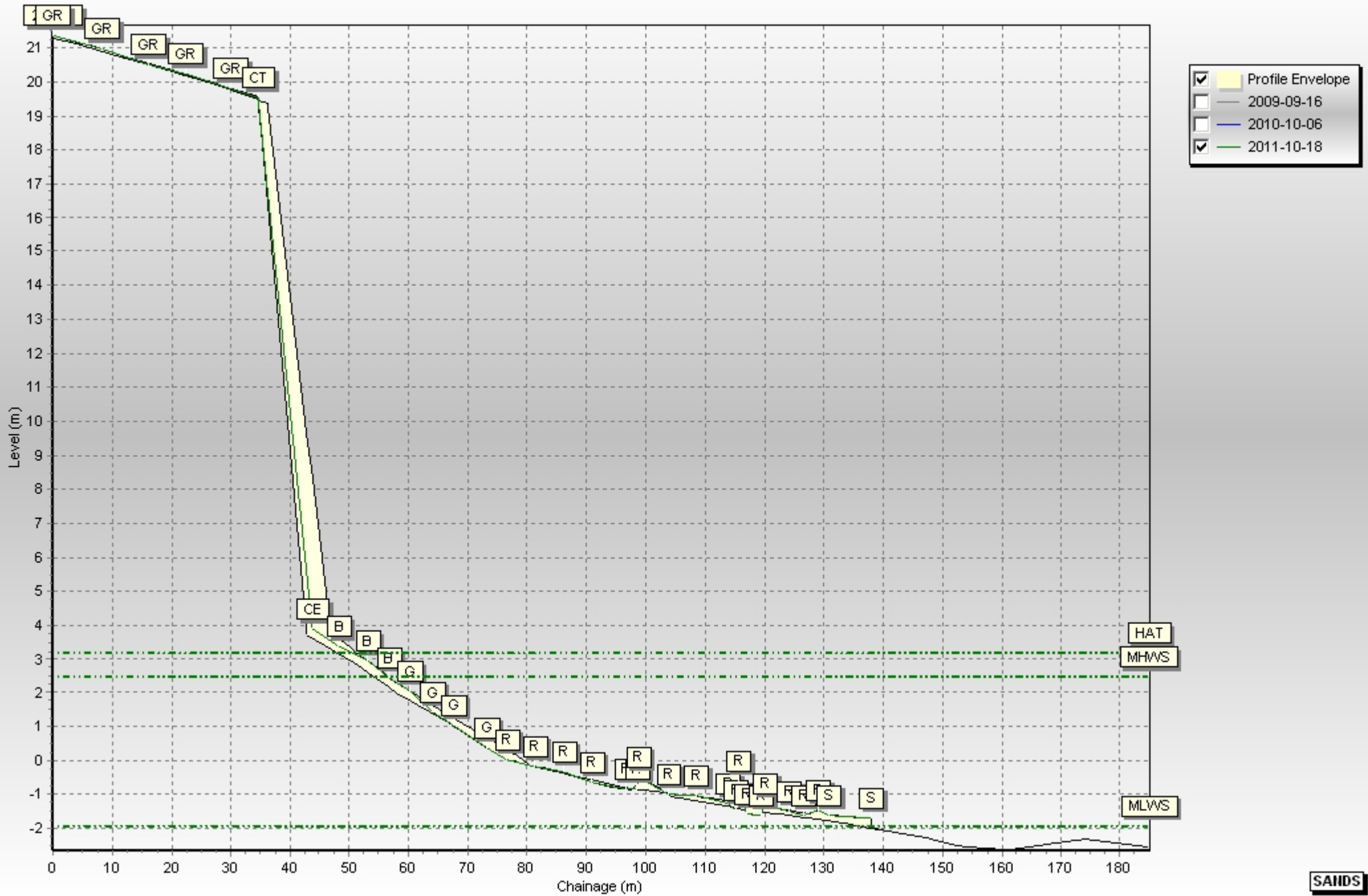
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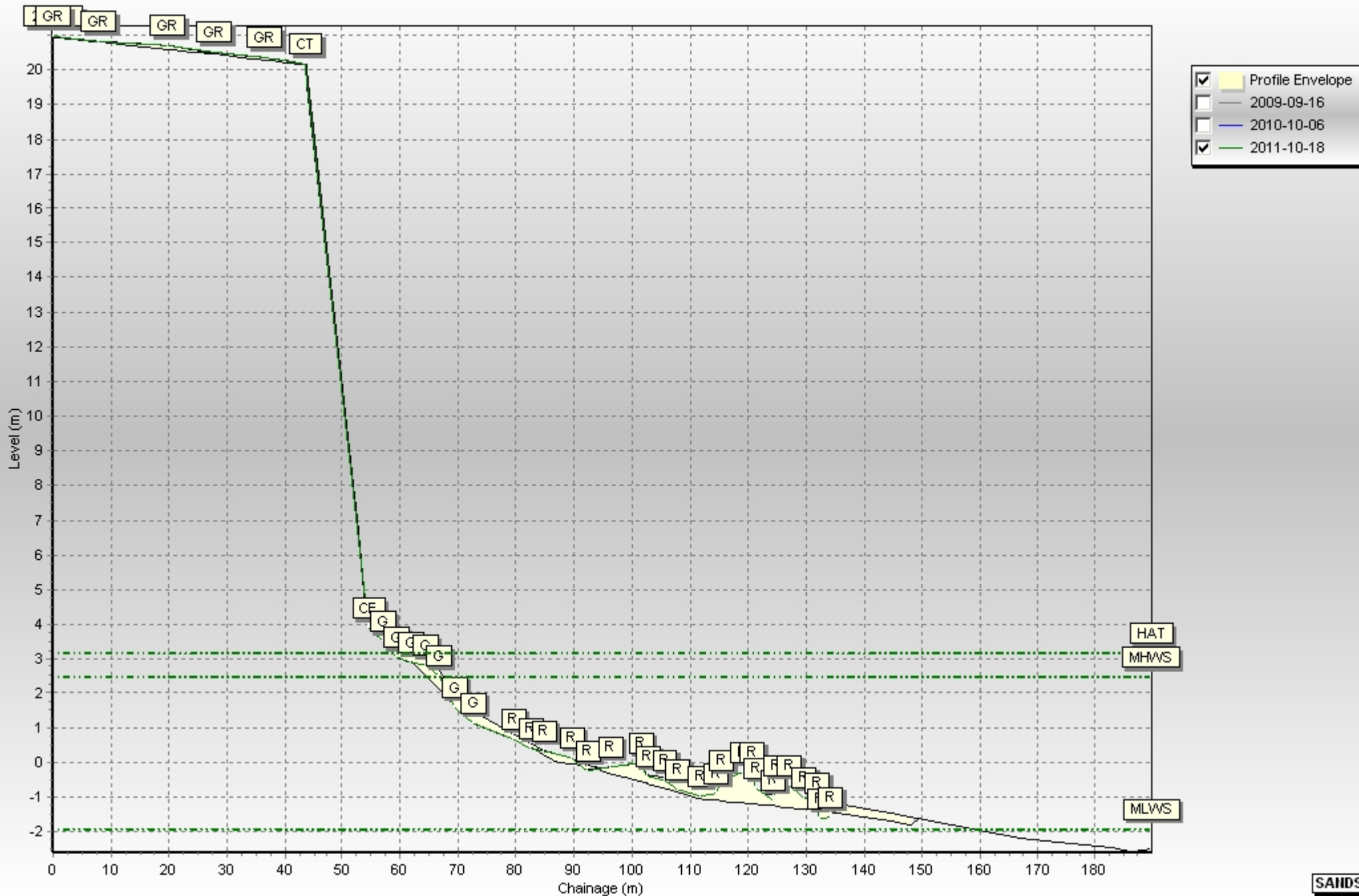
### Beach Profiles: 1bSNS13



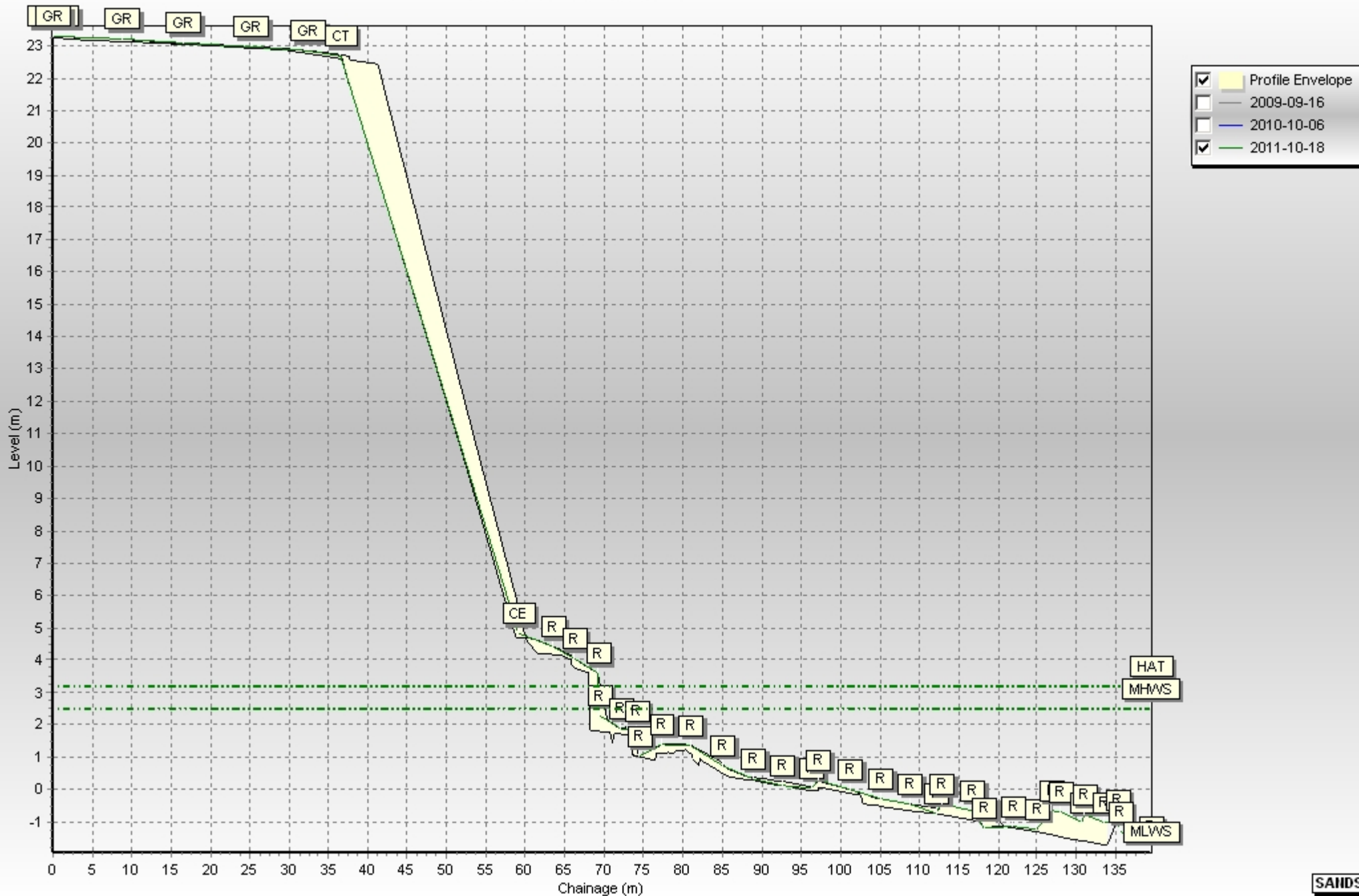
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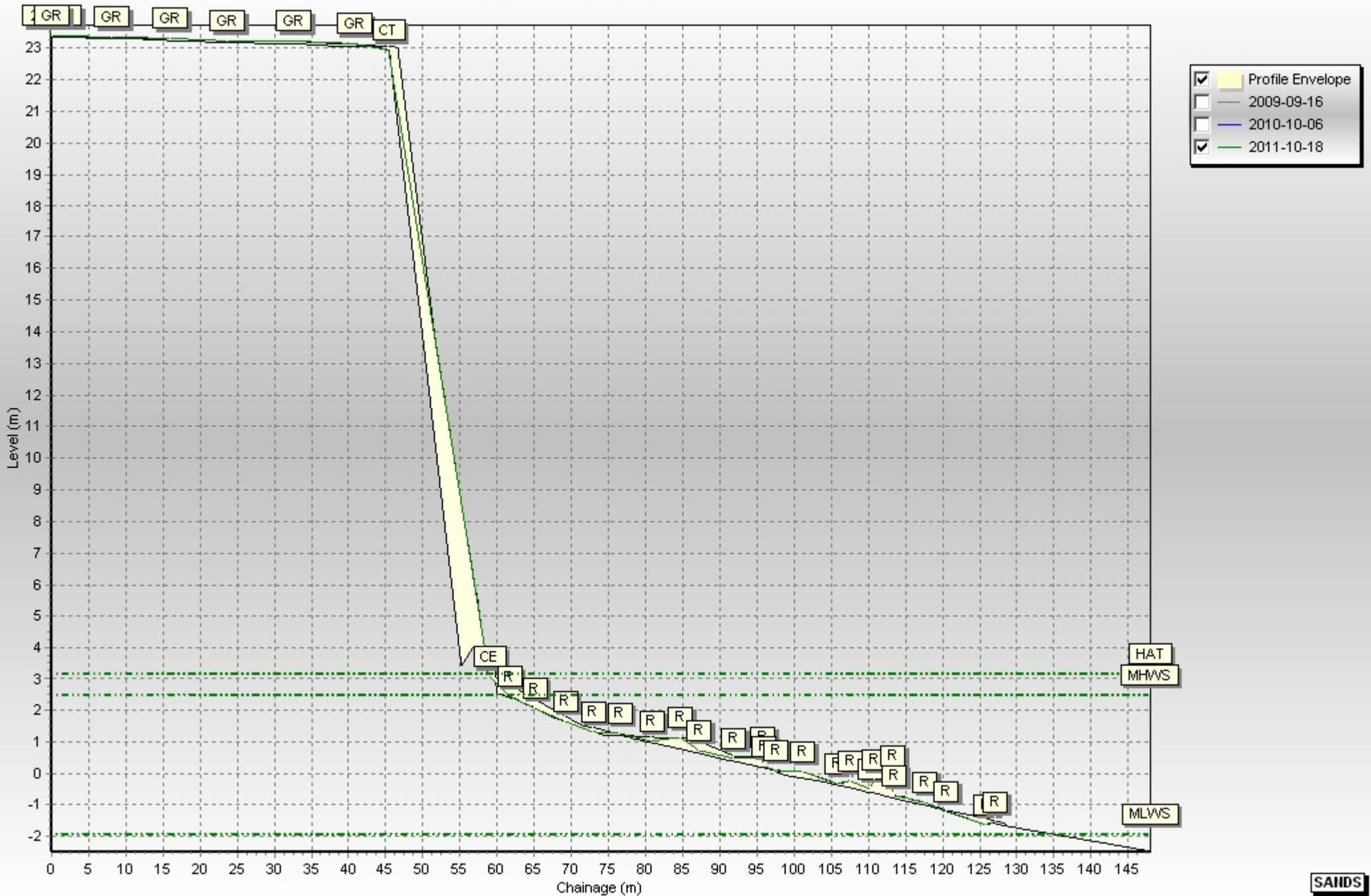
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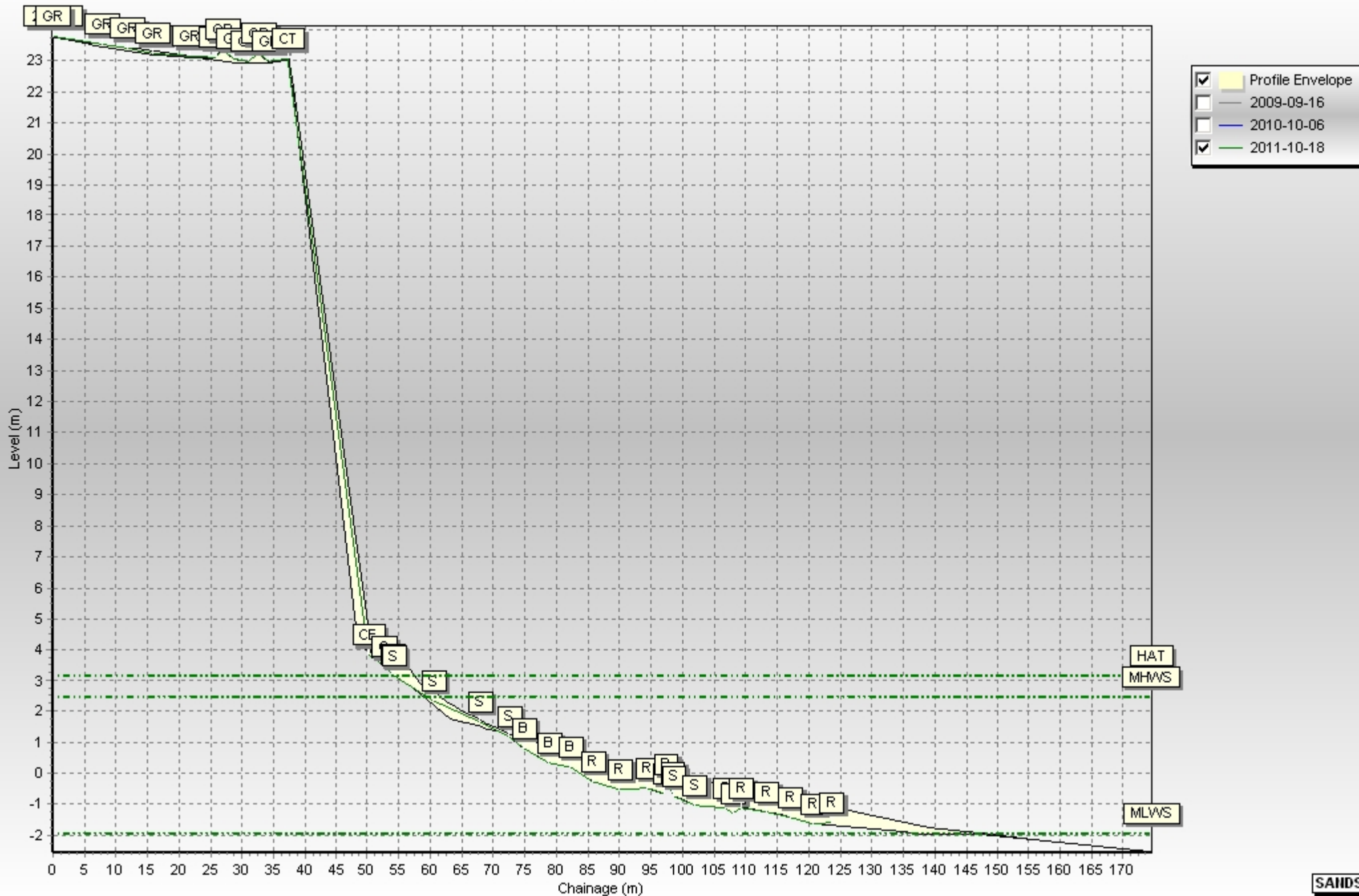
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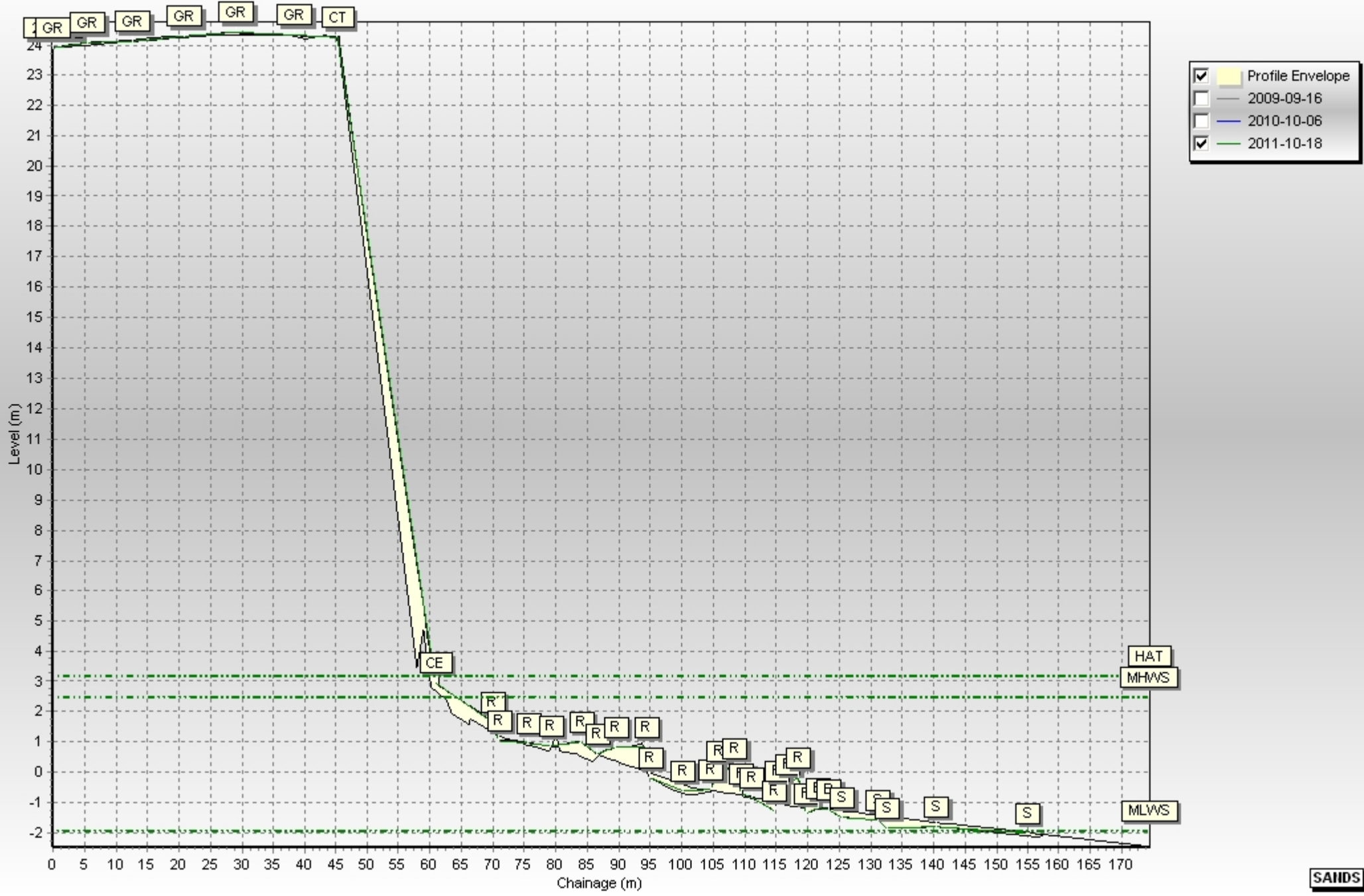
Beach Profiles: 1bSNS17



### Beach Profiles: 1bSNS18

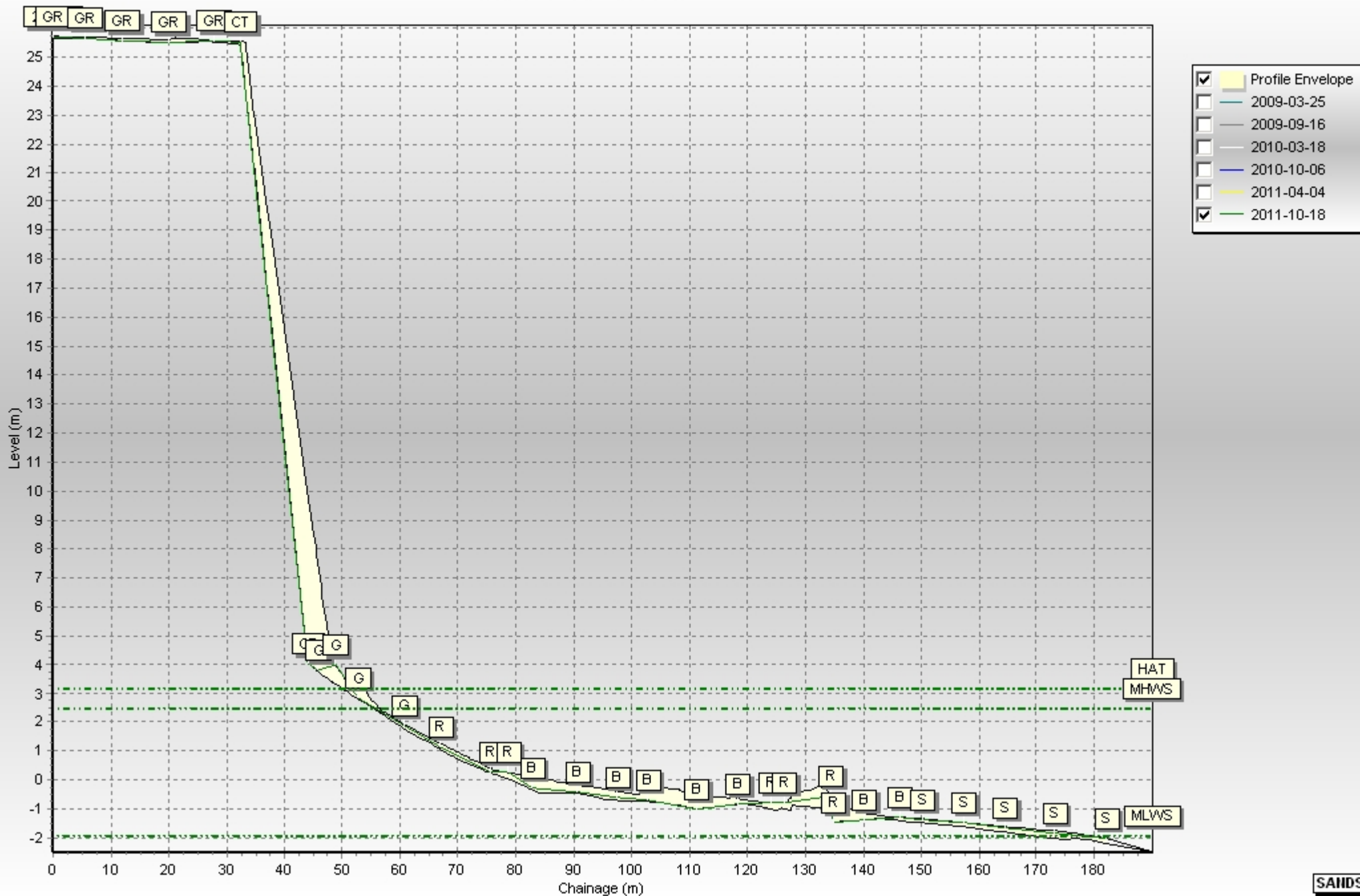


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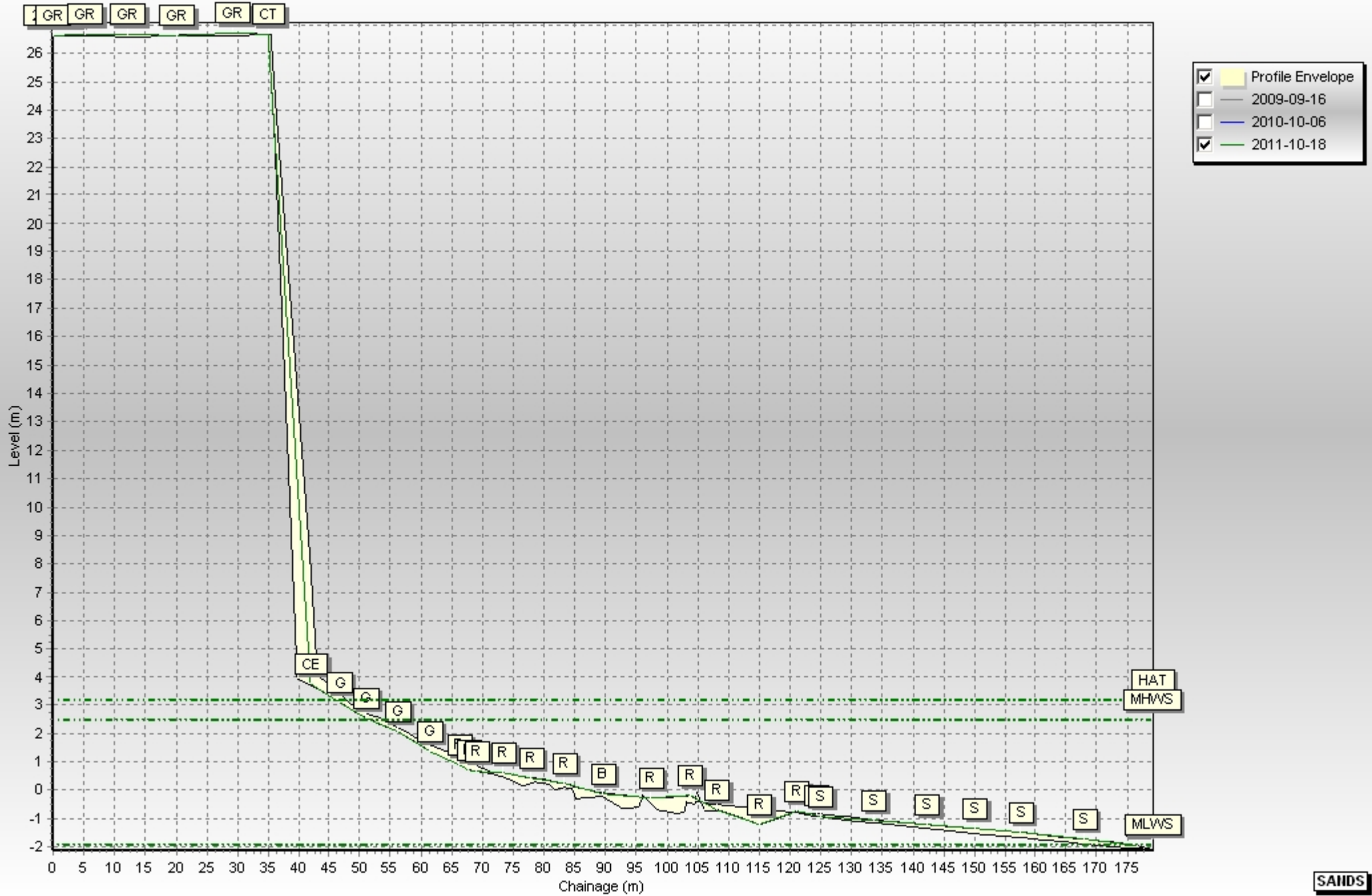




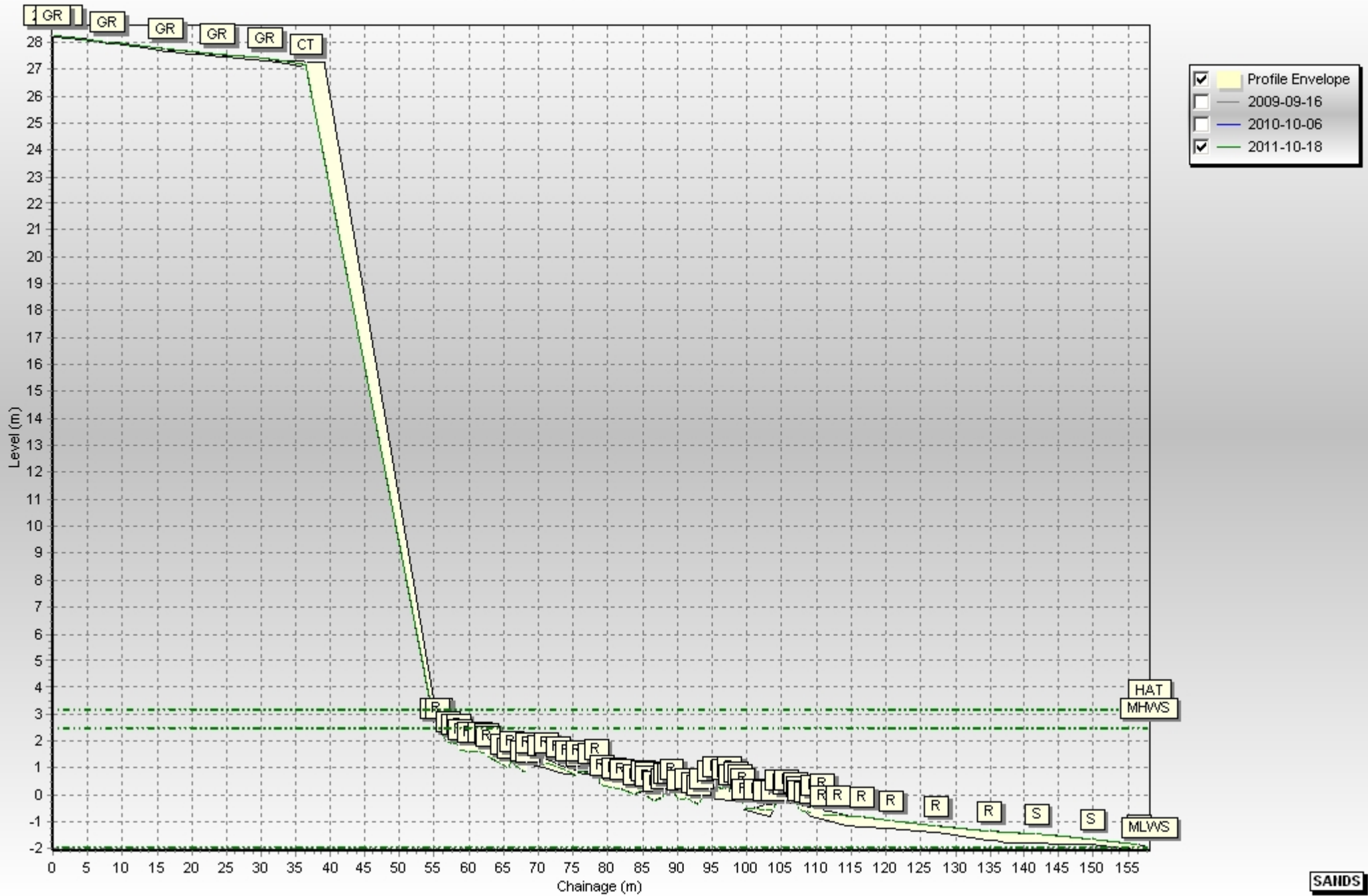
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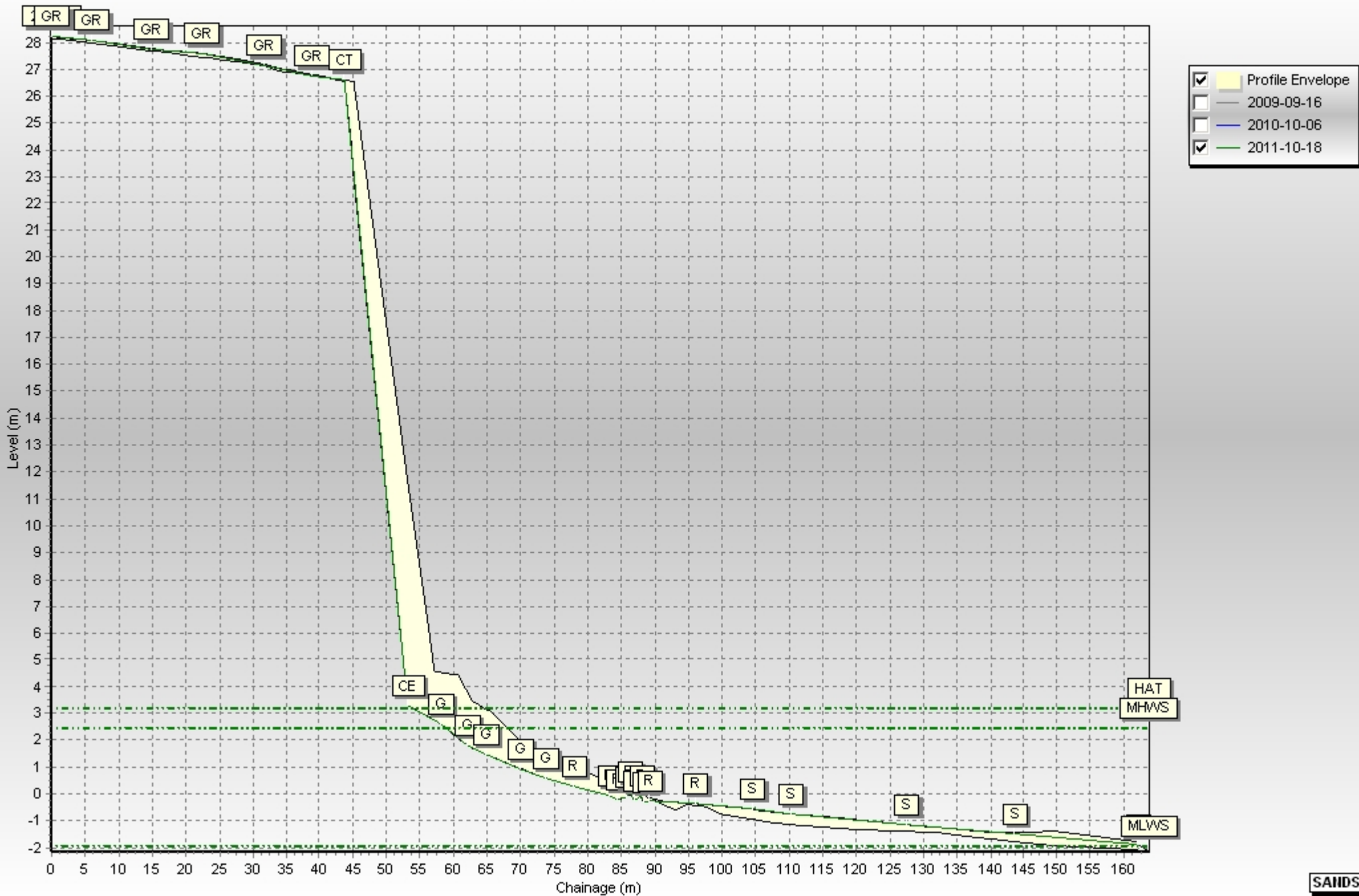
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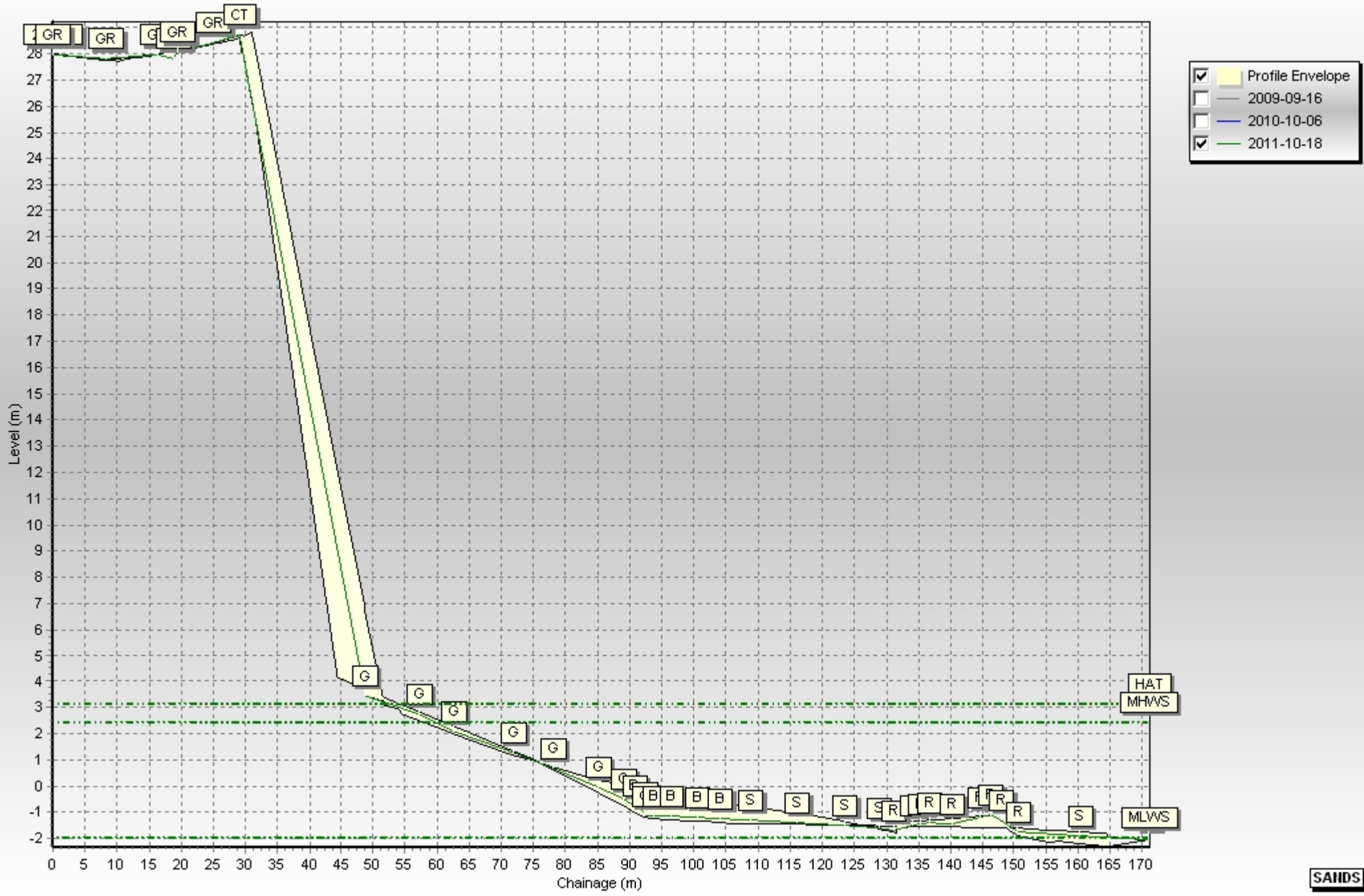
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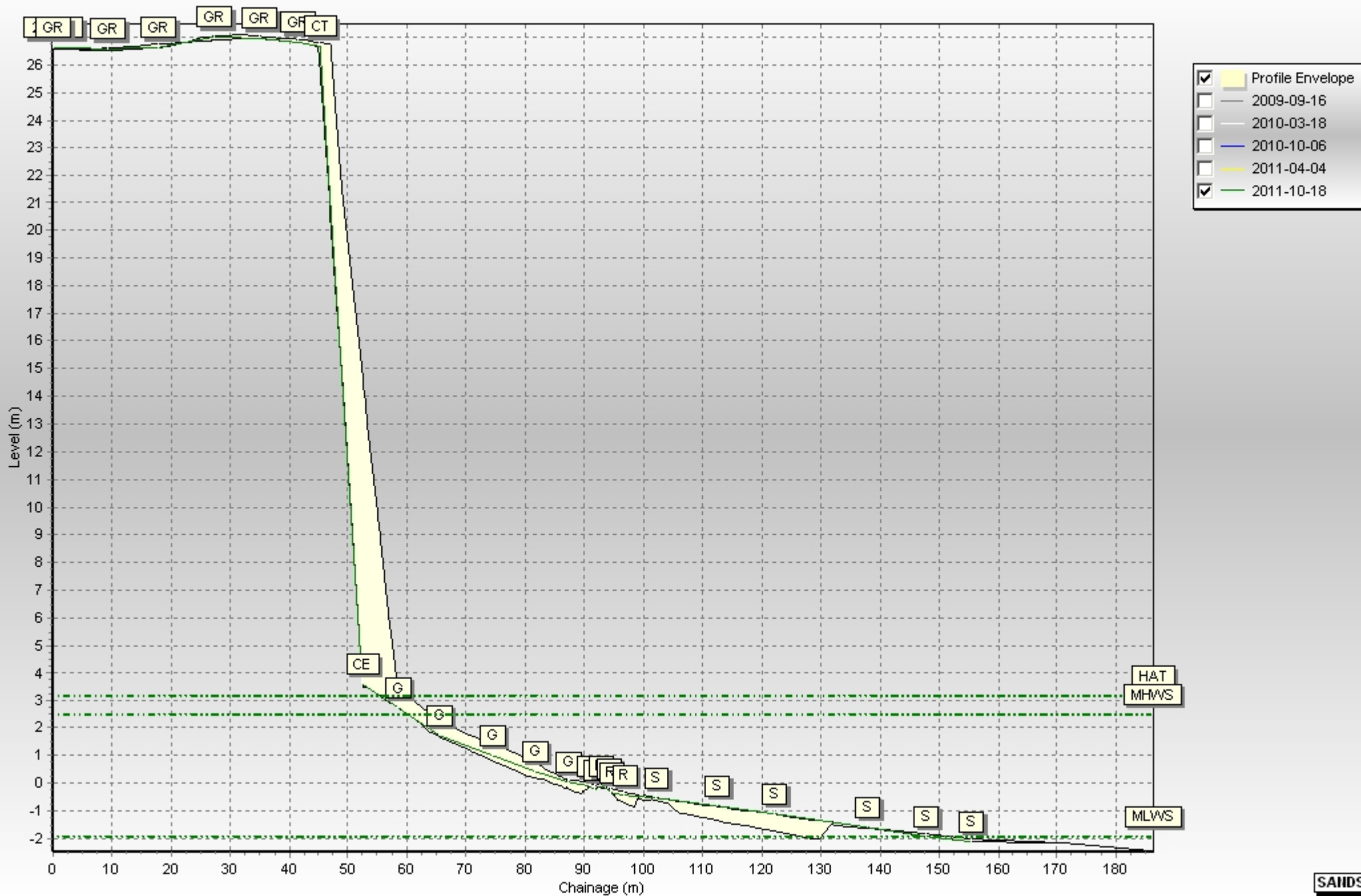
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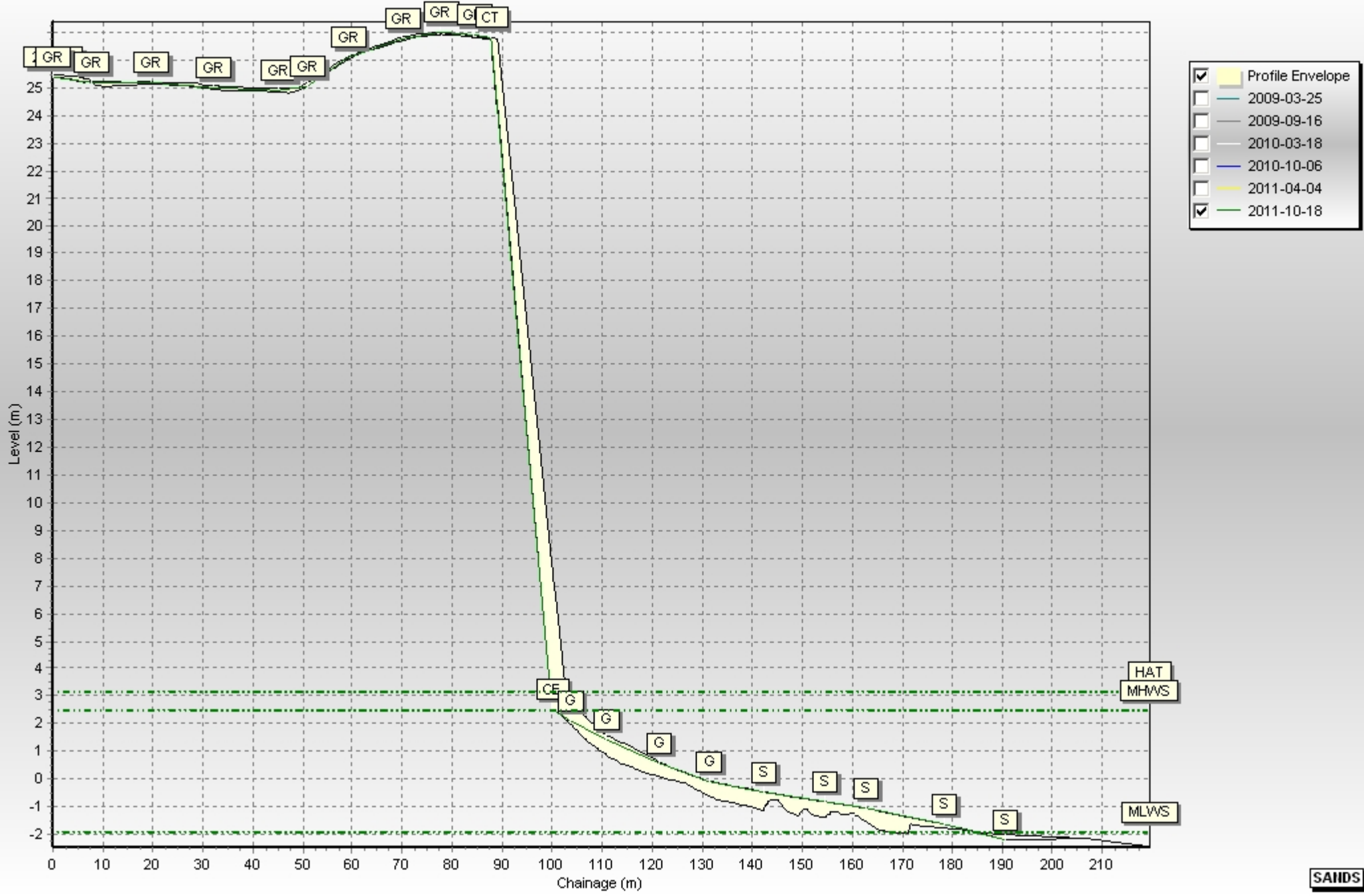
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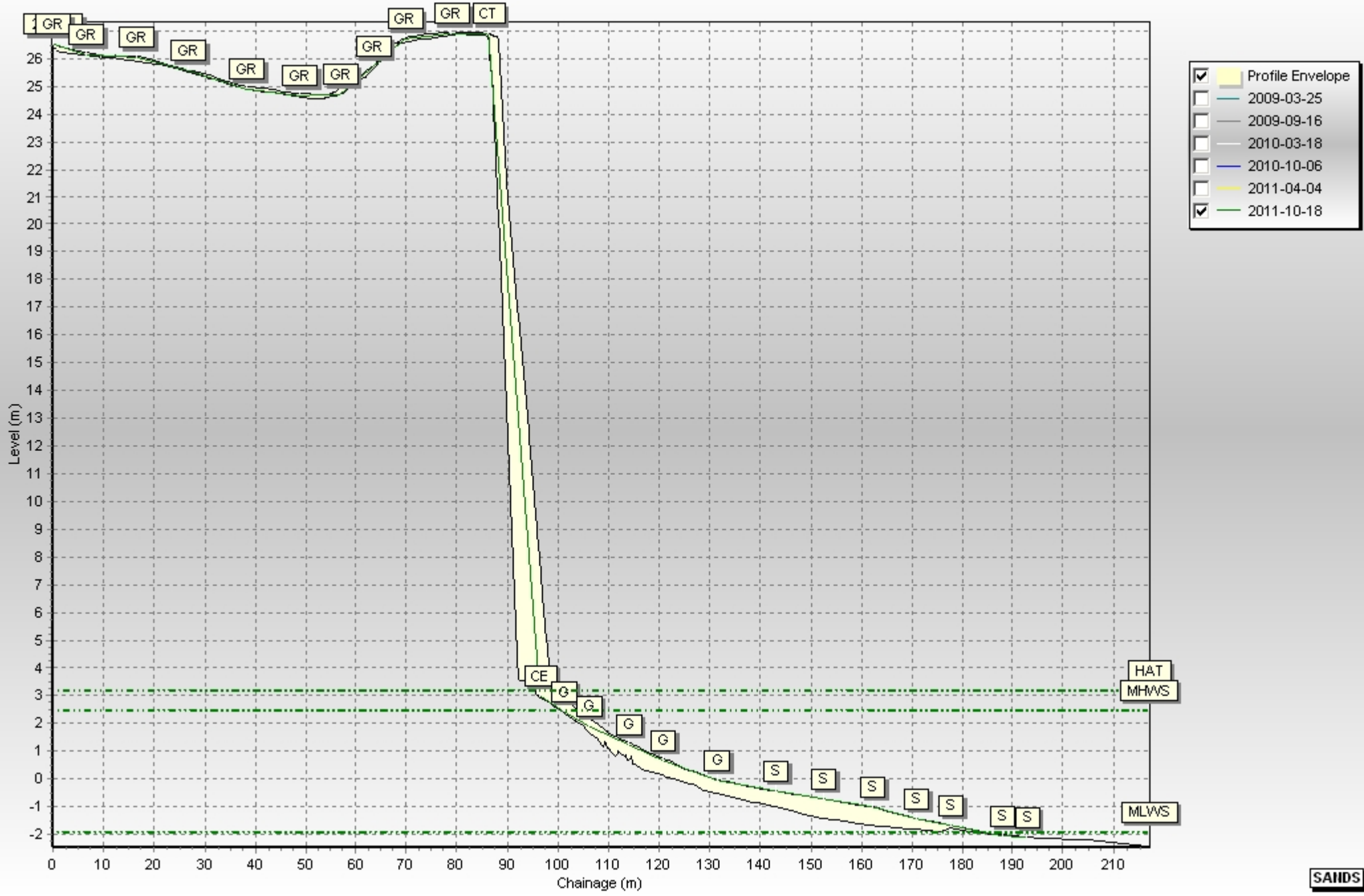
### Beach Profiles: 1bSNS25



### Beach Profiles: 1bSNS26

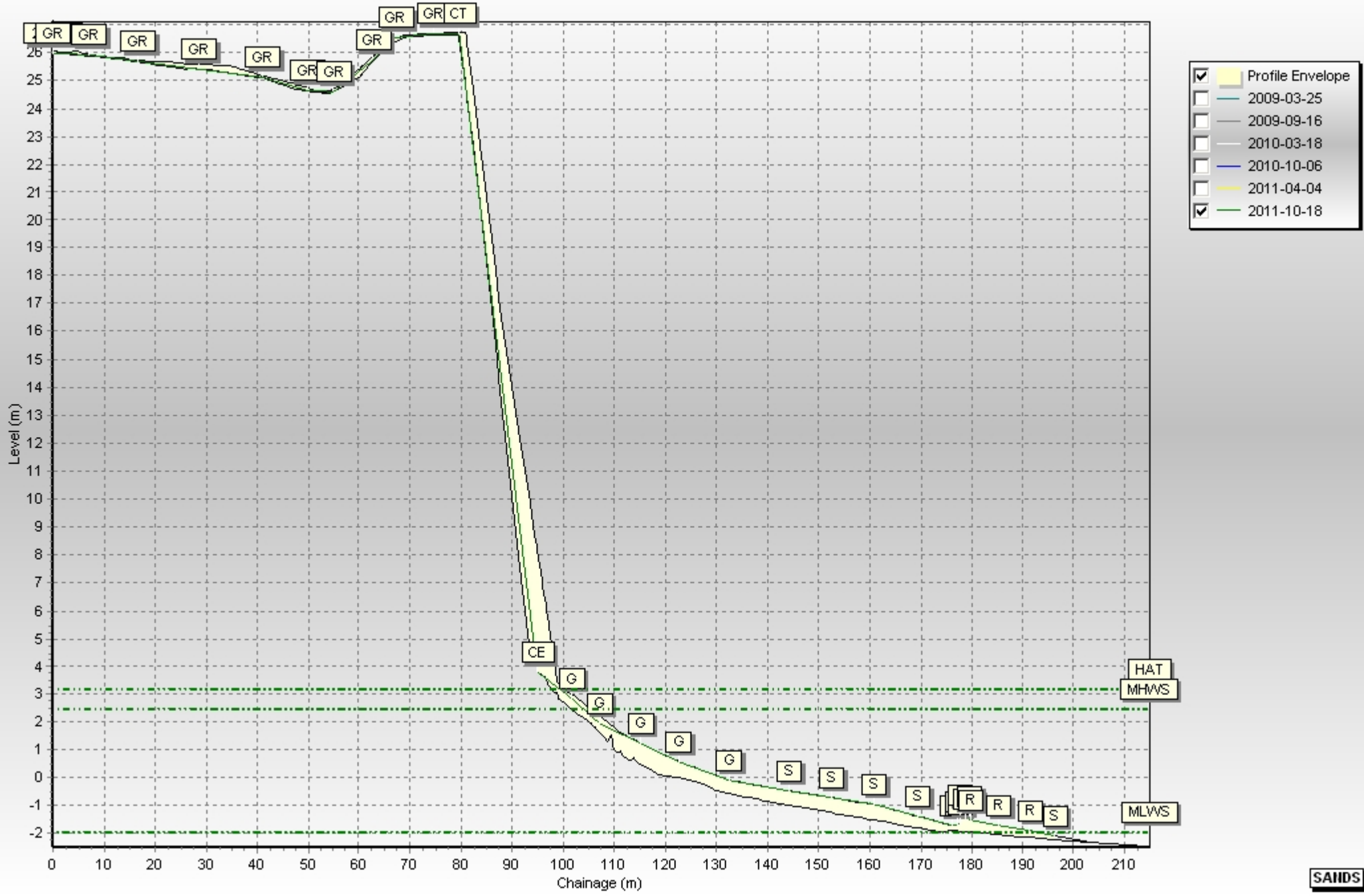


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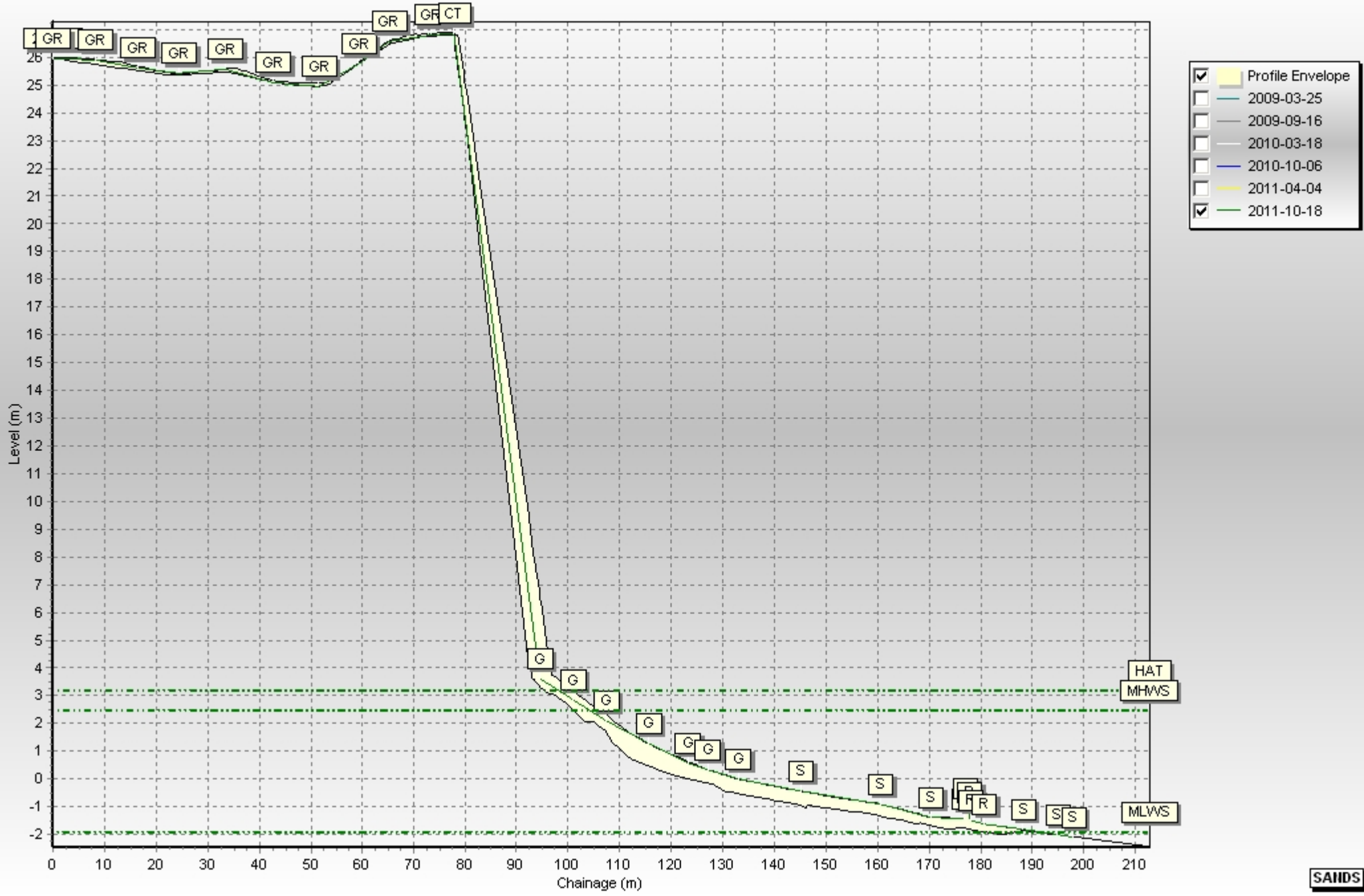




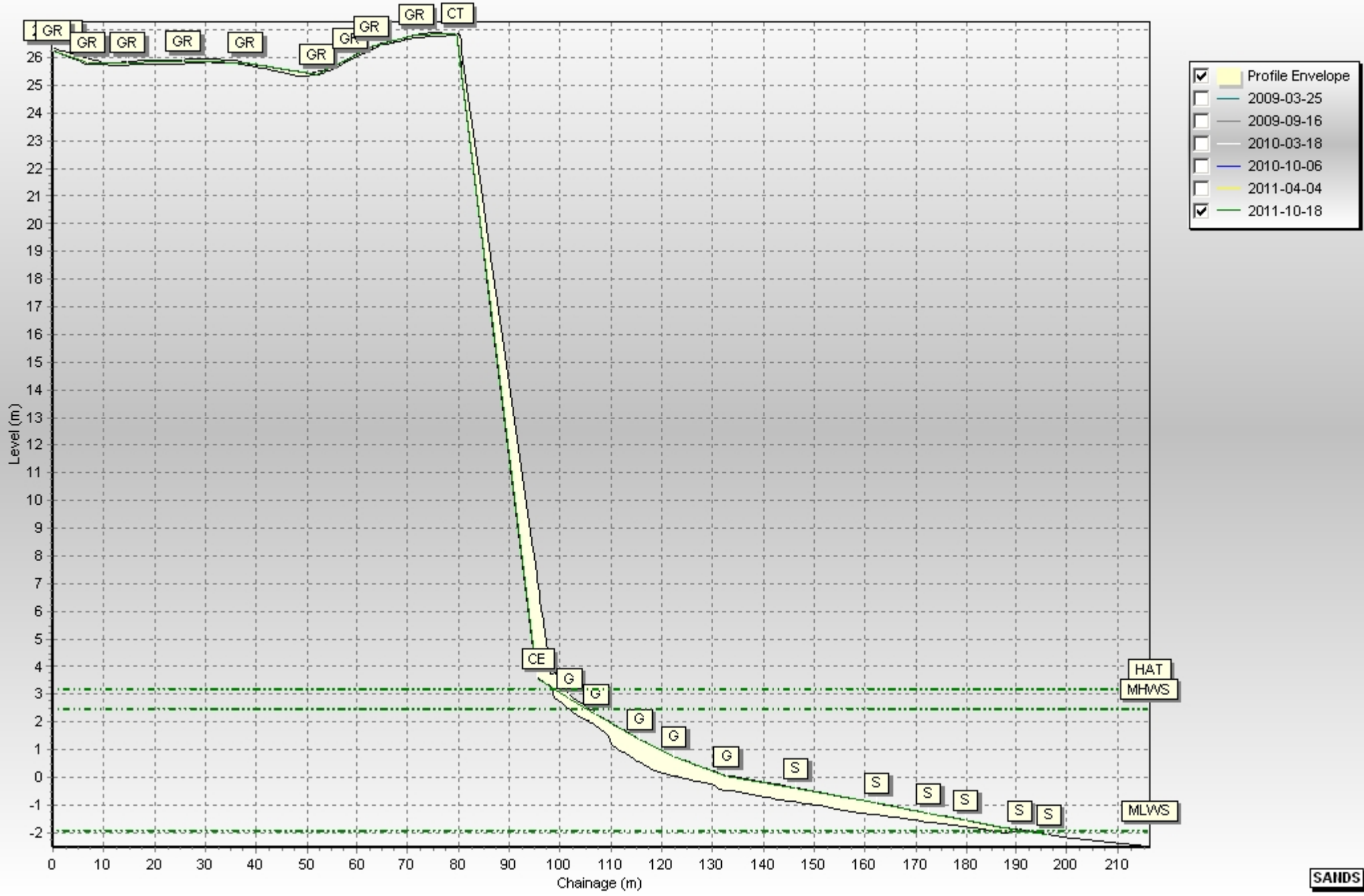
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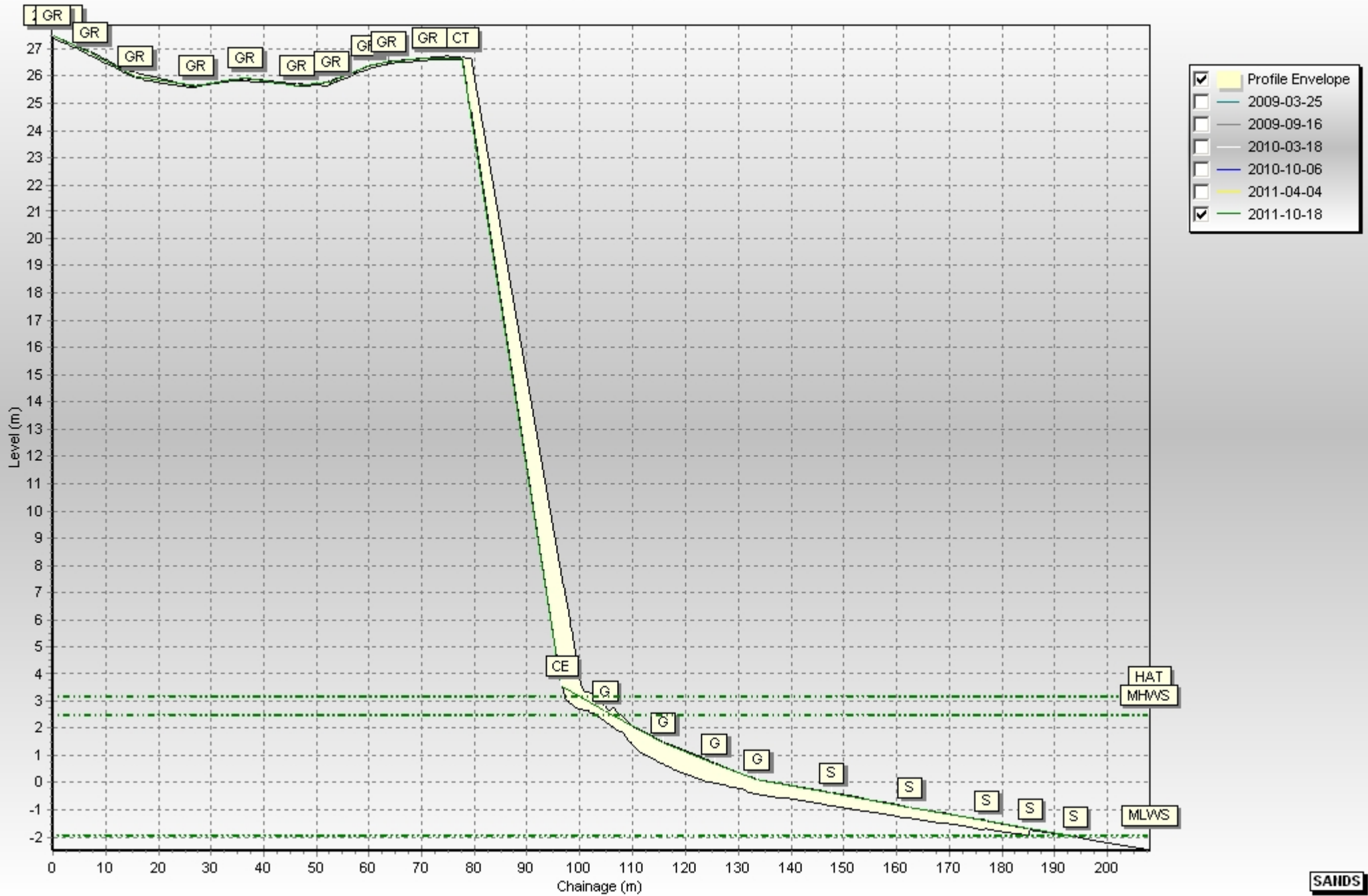
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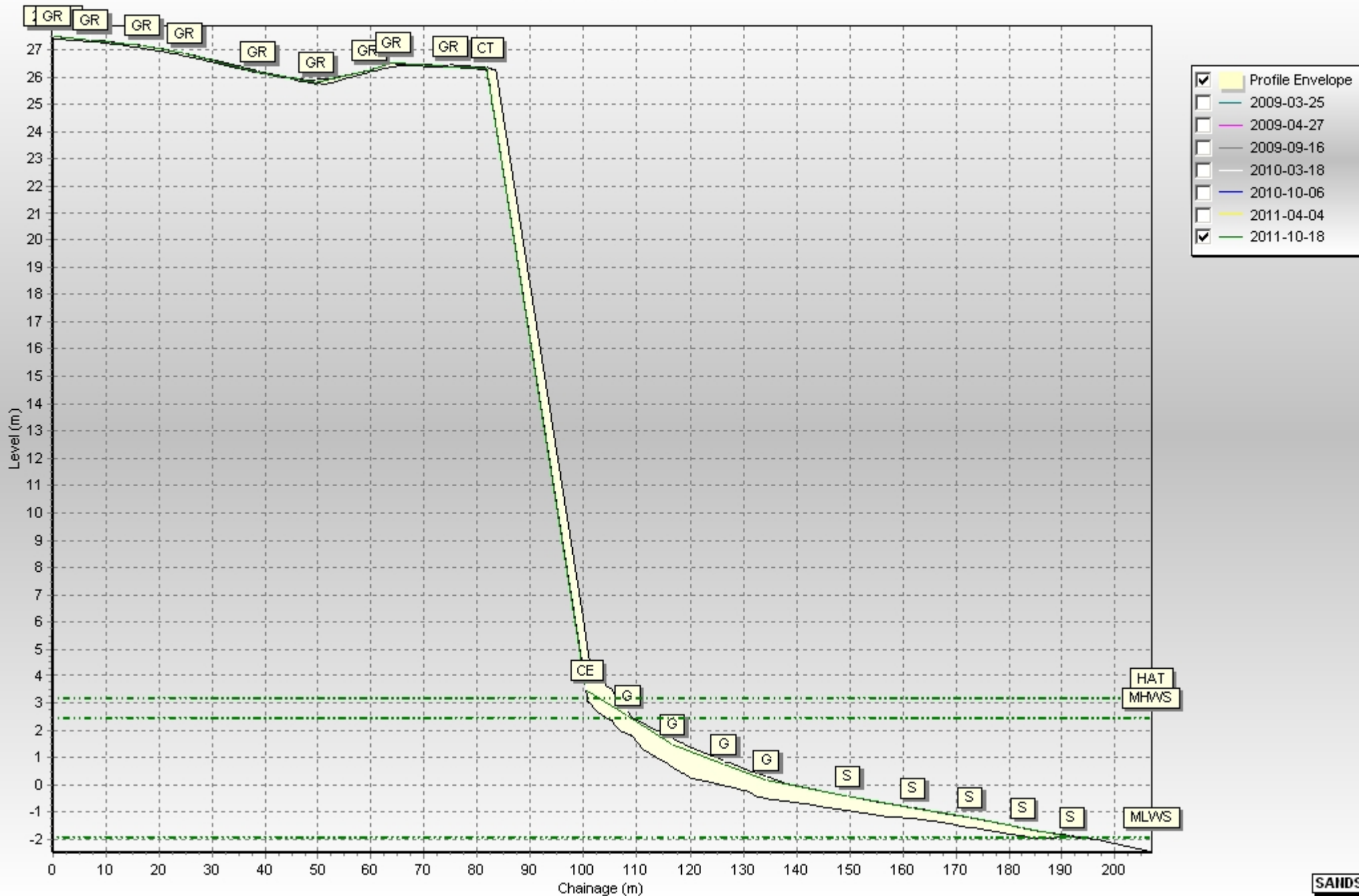
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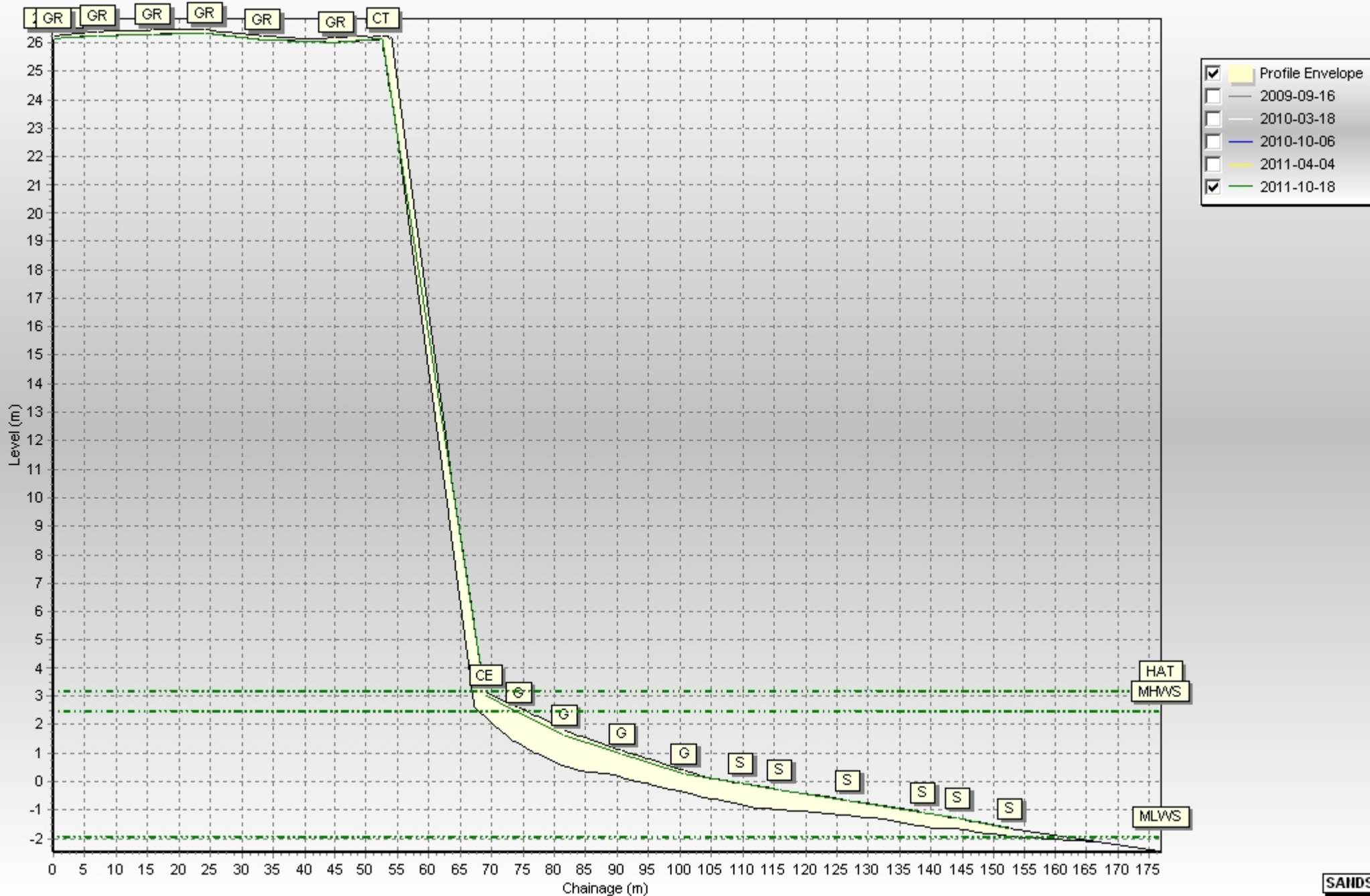
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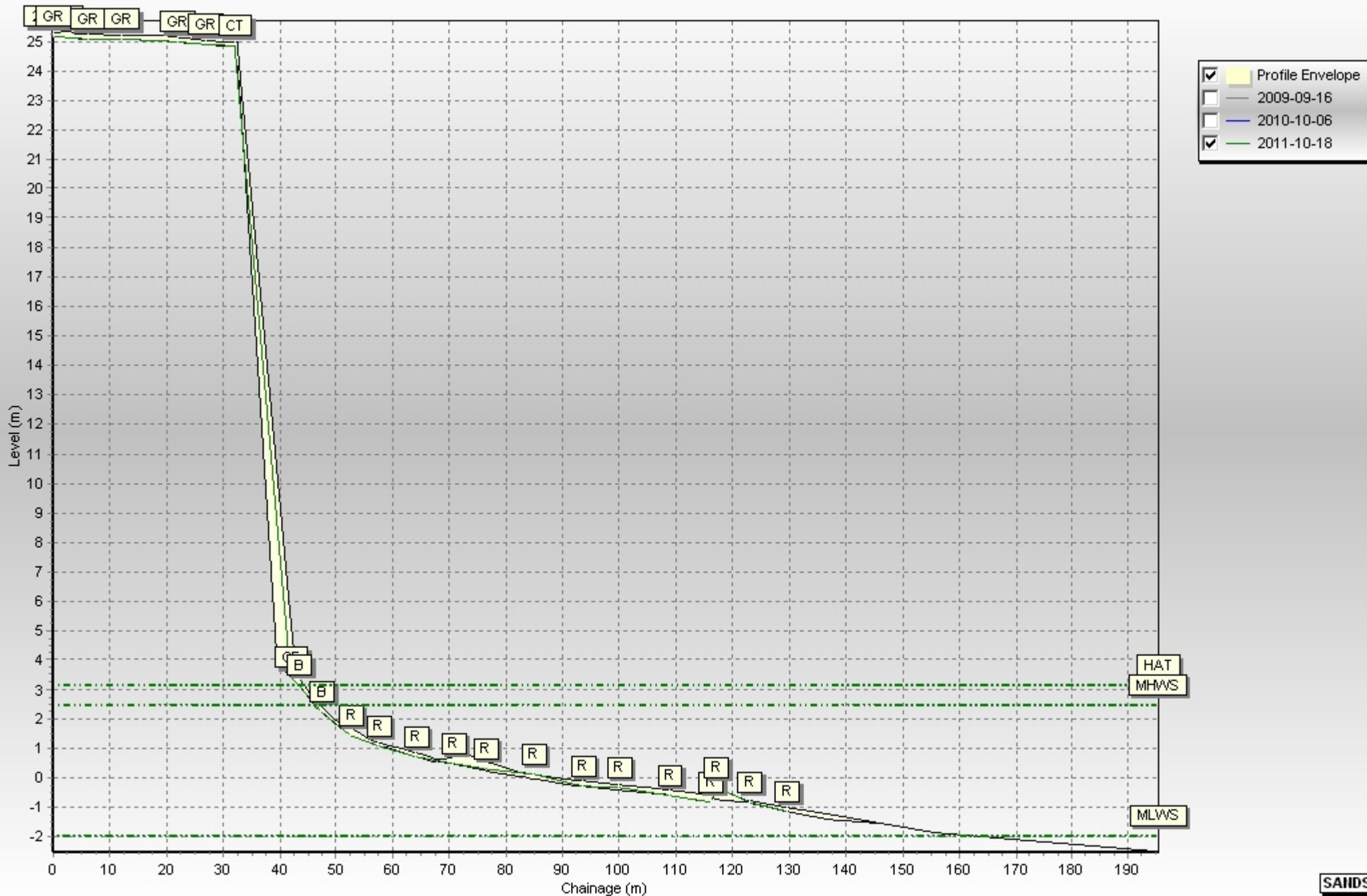
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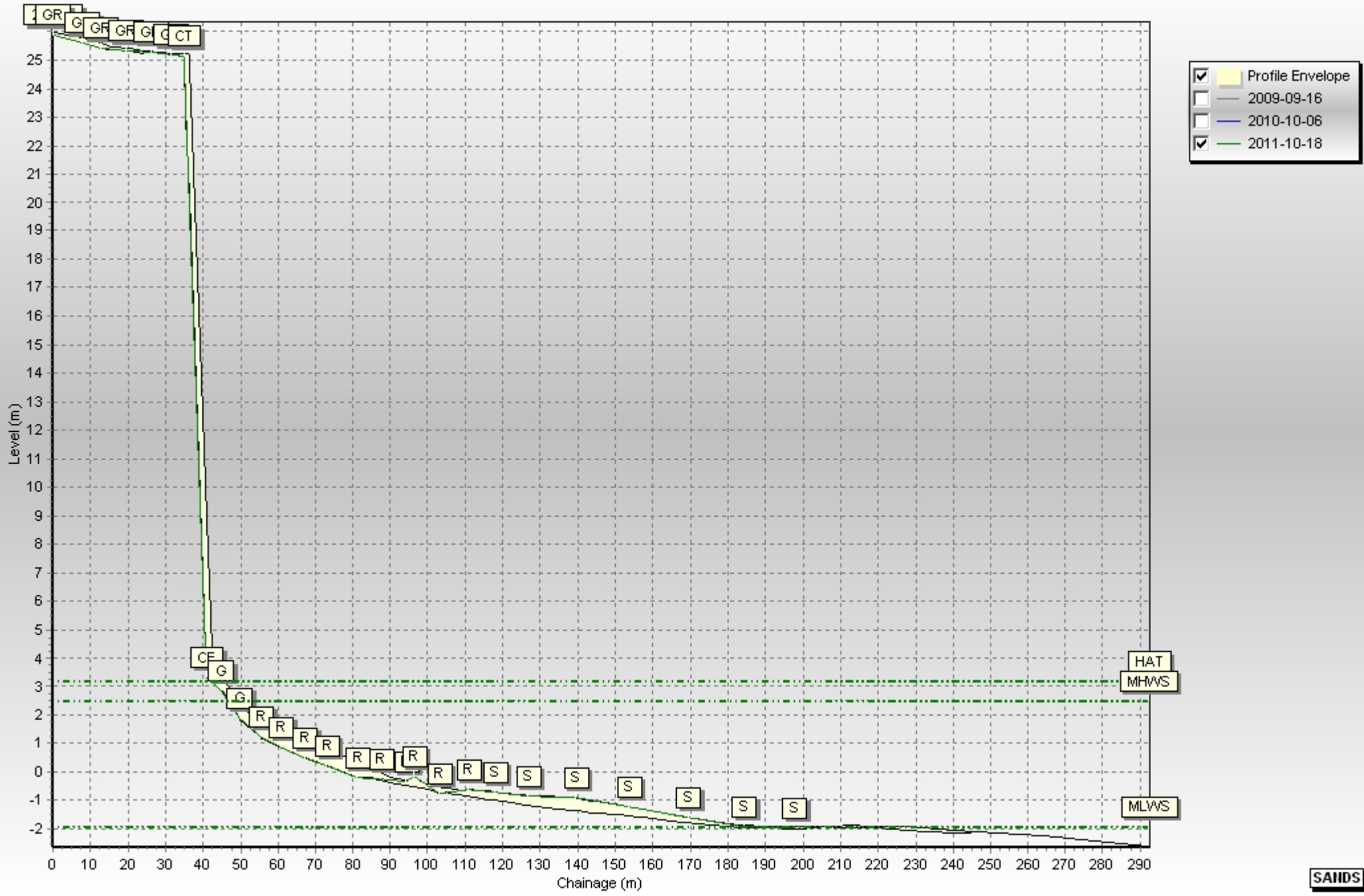
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### Beach Profiles: 1bSNS34

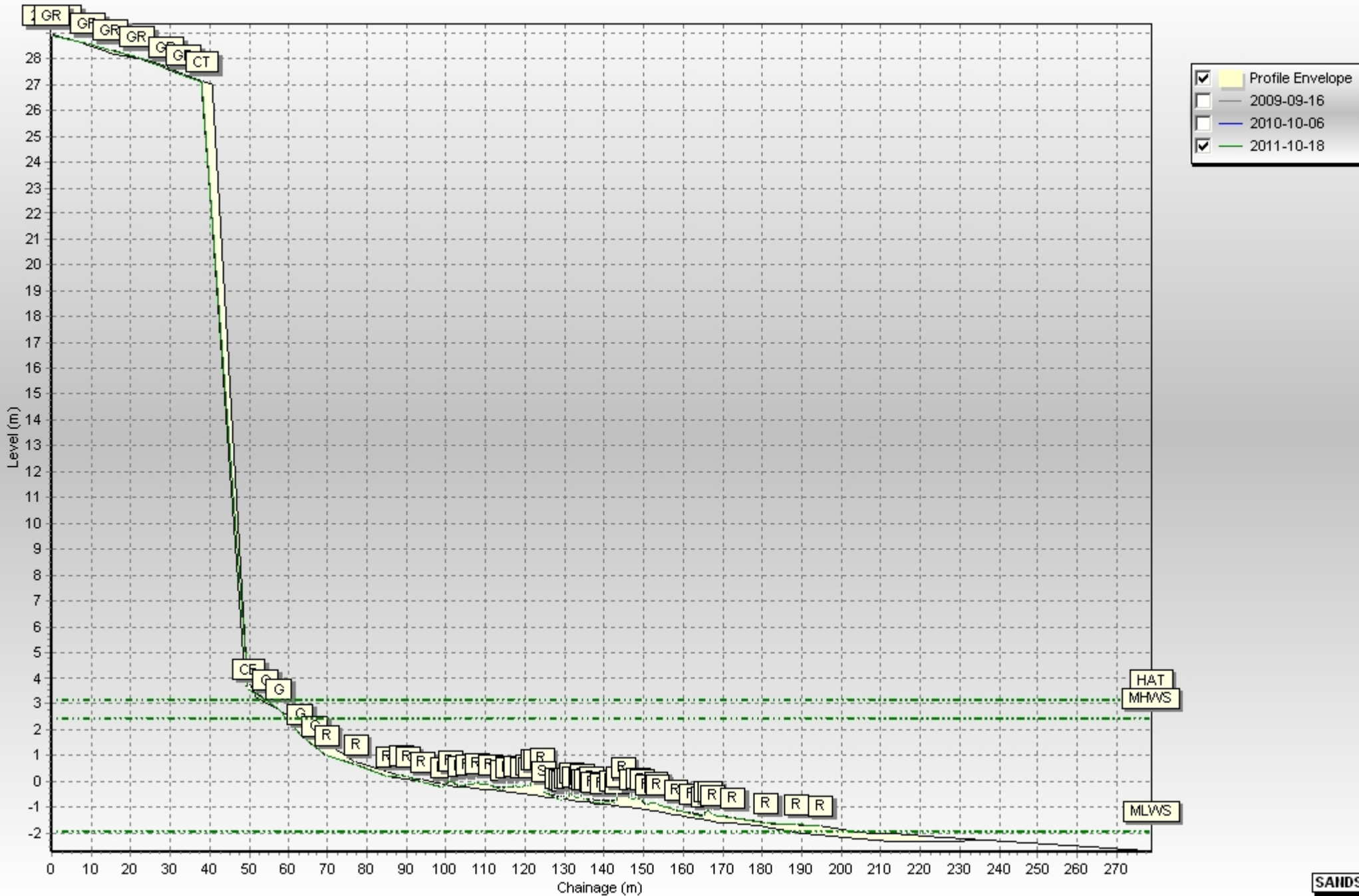


### Beach Profiles: 1bSNS35





### Beach Profiles: 1bSNS36



**Appendix B**  
**Topographic Survey**



**KEY**

Elevation (m OD)

4.5 - 5
4 - 4.5
3.5 - 4
3 - 3.5
2.5 - 3
2 - 2.5
1.5 - 2
1 - 1.5
0.5 - 1
0 - 0.5
-0.5 - 0
-1 - -0.5
-1.5 - -1
-2 - -1.5
-2.5 - -2

— 1m Contour

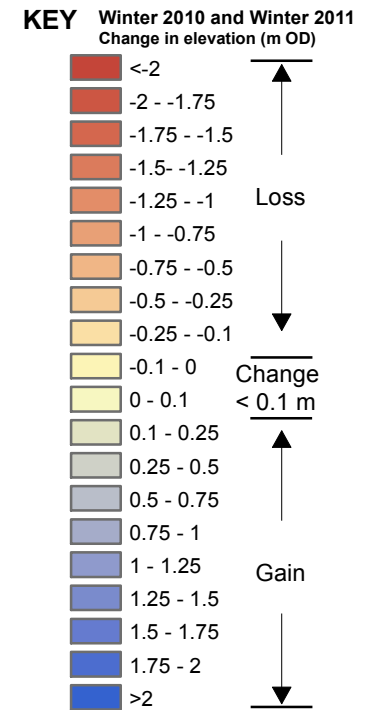
Client: North East Coastal Group  
 Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

**Appendix B- Map 1a**  
**Topographic Survey**  
**Whitburn Bay**  
**Sunderland City Council**

Analytical Report 4  
 Full Measures Survey  
 Winter 2011

**Halcrow**  
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 Halcrow Group Ltd, Lyndon House, 62 Hagley Road, Edgbaston, Birmingham, B16 8PE  
 Tel: +44 (0)121 456 2345  
 Fax: +44(0)121 456 1569  
 www.halcrow.com

Photography courtesy of North East Coastal Observatory  
 www.northeastcoastalobservatory.org.uk



Client: North East Coastal Group

Project: Cell 1 Regional Coastal  
Monitoring Programme 2011 to 2016

**Appendix B- Map 1b**  
**Topographic Difference**  
**Whitburn Bay**  
**Sunderland City Council**

Analytical Report 4  
Full Measures Survey  
Winter 2011

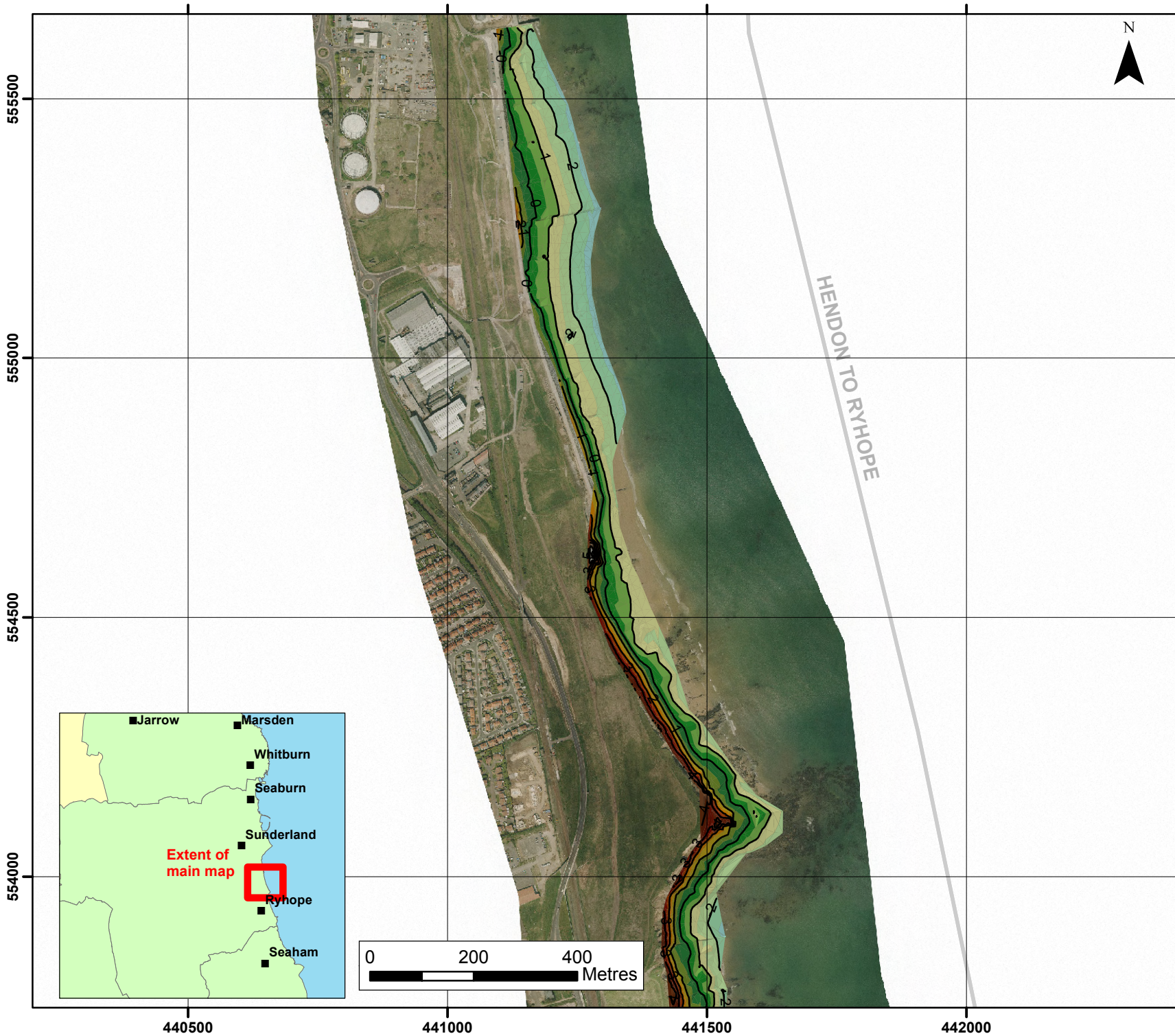
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www.halcrow.com

Photography courtesy of North East Coastal Observatory  
www.northeastcoastalobservatory.org.uk



**KEY**

**Elevation (m OD)**

7 - 7.5
6.5 - 7
6 - 6.5
5.5 - 6
5 - 5.5
4.5 - 5
4 - 4.5
3.5 - 4
3 - 3.5
2.5 - 3
2 - 2.5
1.5 - 2
1 - 1.5
0.5 - 1
0 - 0.5
-0.5 - 0
-1 - -0.5
-1.5 - -1
-2 - -1.5
-2.5 - -2
-3 - -2.5
— 1m Contour

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

**Appendix B - Map 2a**  
**Topographic Survey**  
**Hendon to Ryhope a**  
**Sunderland City Council**

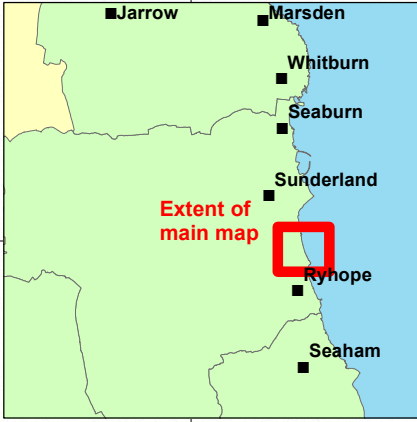
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 Full Measures Survey  
 Winter 2011

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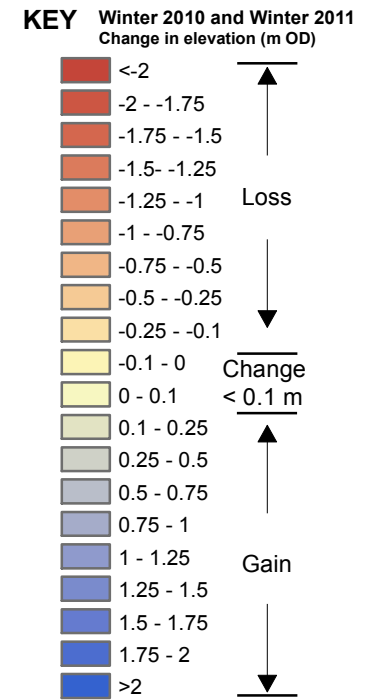
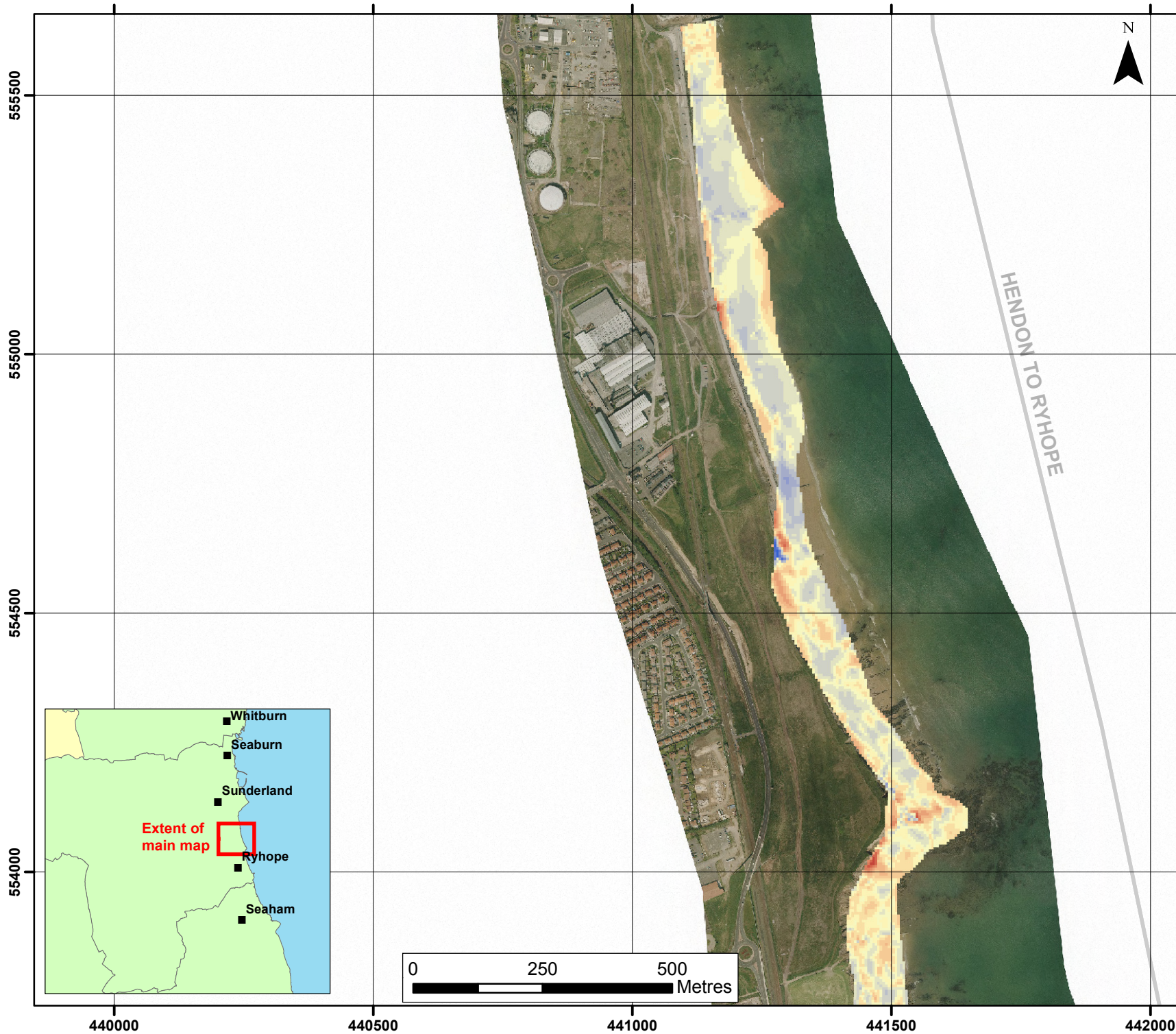
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555500  
555000  
554500  
554000

440500 441000 441500 442000



Client: North East Coastal Group

Project: Cell 1 Regional Coastal  
Monitoring Programme 2011 to 2016

**Appendix B - Map 2b**  
**Topographic Difference**  
**Hendon to Ryhope a**  
**Sunderland City Council**

Analytical Report 4  
Full Measures Survey  
Winter 2011

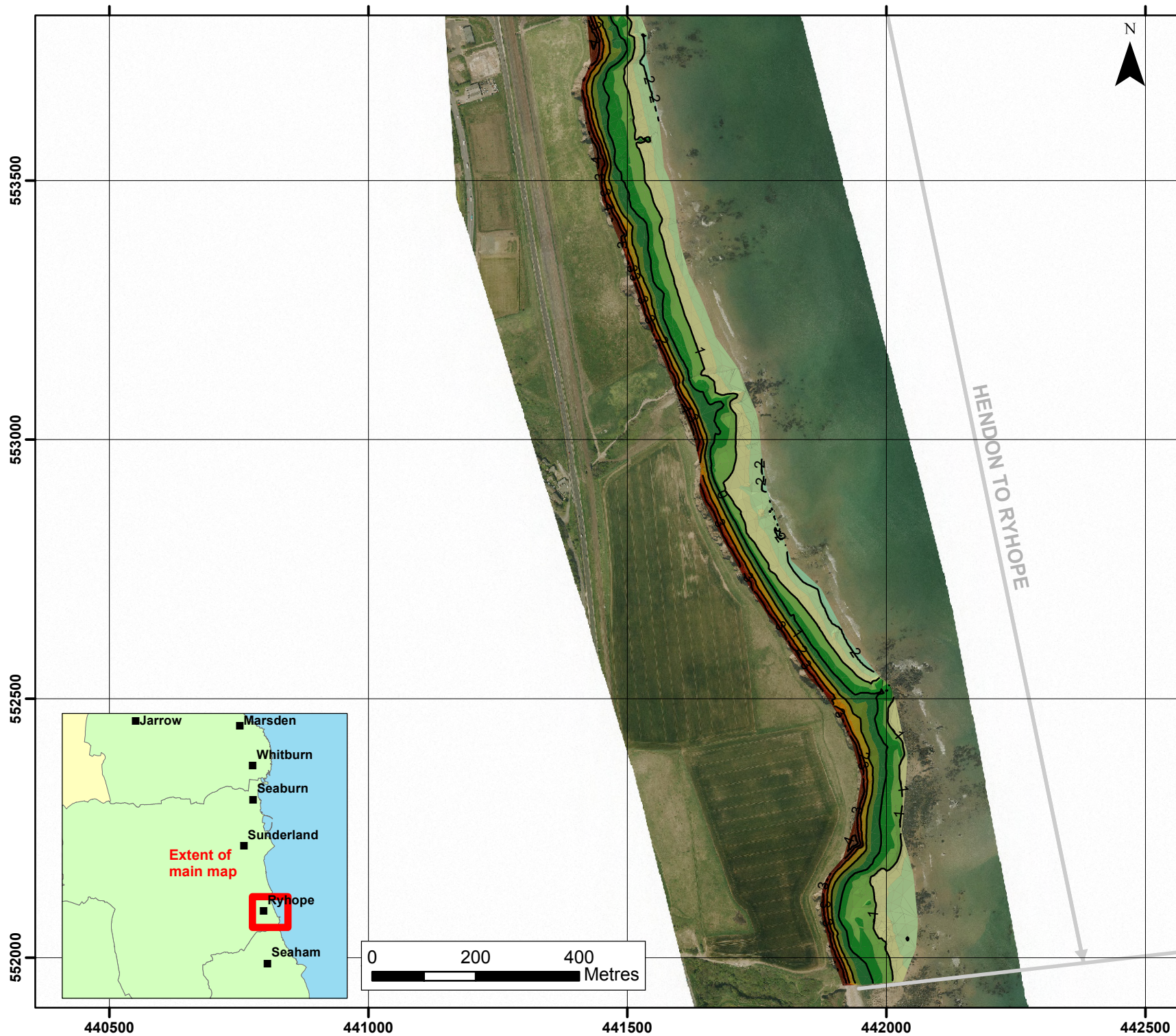
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**KEY**

**Elevation (m OD)**

7 - 7.5
6.5 - 7
6 - 6.5
5.5 - 6
5 - 5.5
4.5 - 5
4 - 4.5
3.5 - 4
3 - 3.5
2.5 - 3
2 - 2.5
1.5 - 2
1 - 1.5
0.5 - 1
0 - 0.5
-0.5 - 0
-1 - -0.5
-1.5 - -1
-2 - -1.5
-2.5 - -2
-3 - -2.5
— 1m Contour

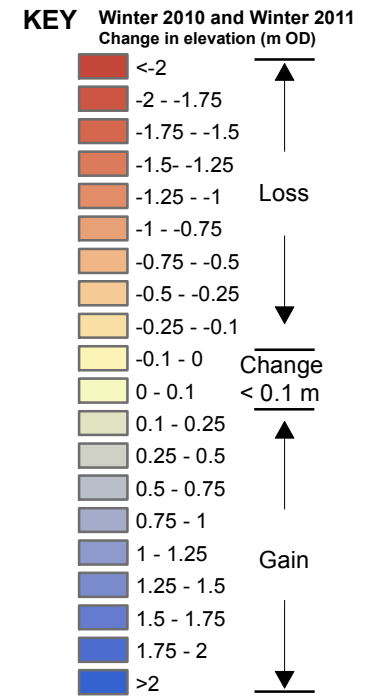
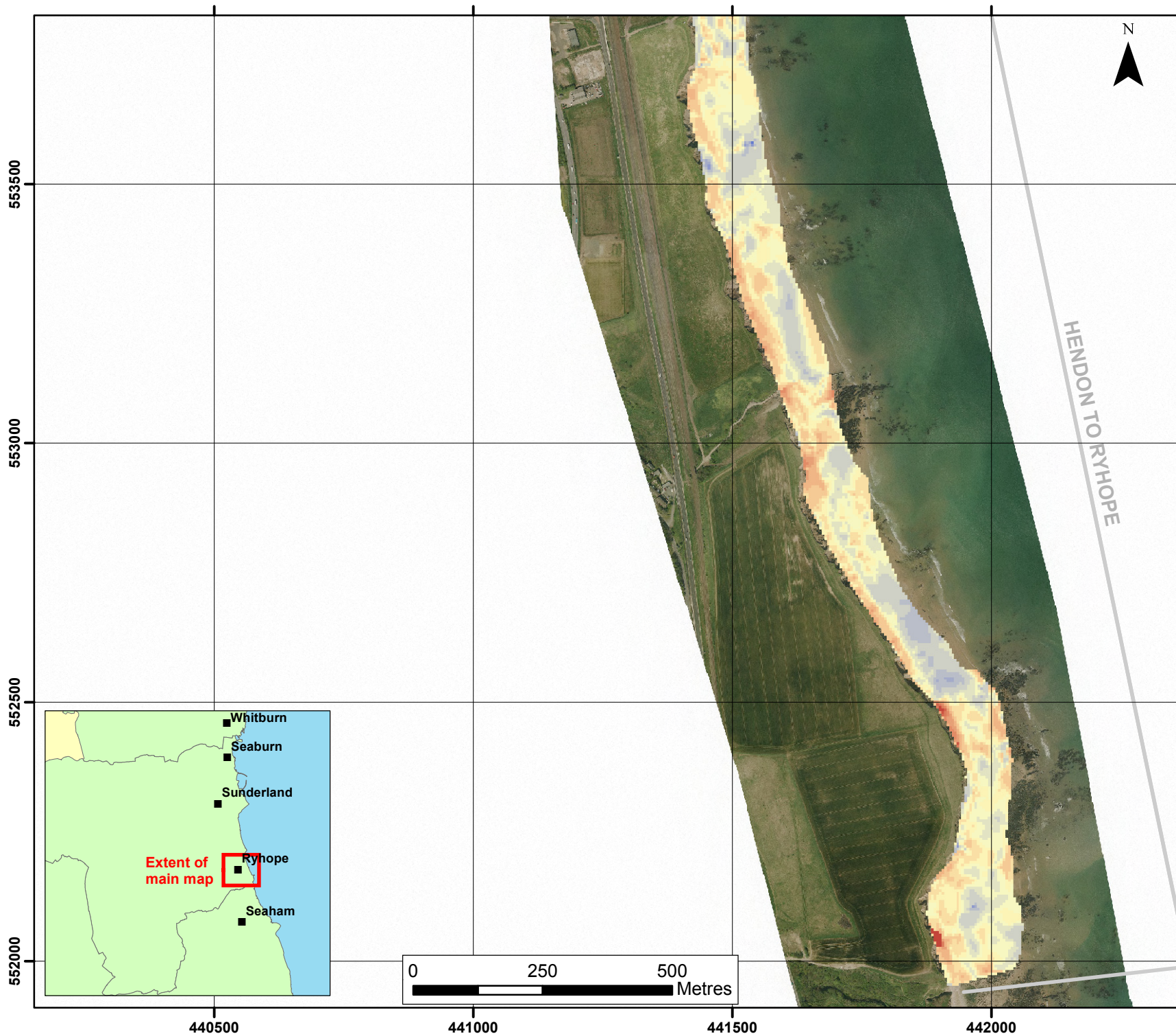
Client: North East Coastal Group  
 Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

**Appendix B - Map 3a**  
**Topographic Survey**  
**Hendon to Ryhope b**  
**Sunderland City Council**

Analytical Report 4  
 Full Measures Survey  
 Winter 2011

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Client: North East Coastal Group

Project: Cell 1 Regional Coastal  
Monitoring Programme 2011 to 2016

**Appendix B - Map 3b**  
**Topographic Difference**  
**Hendon to Ryhope b**  
**Sunderland City Council**

Analytical Report 4  
Full Measures Survey  
Winter 2011

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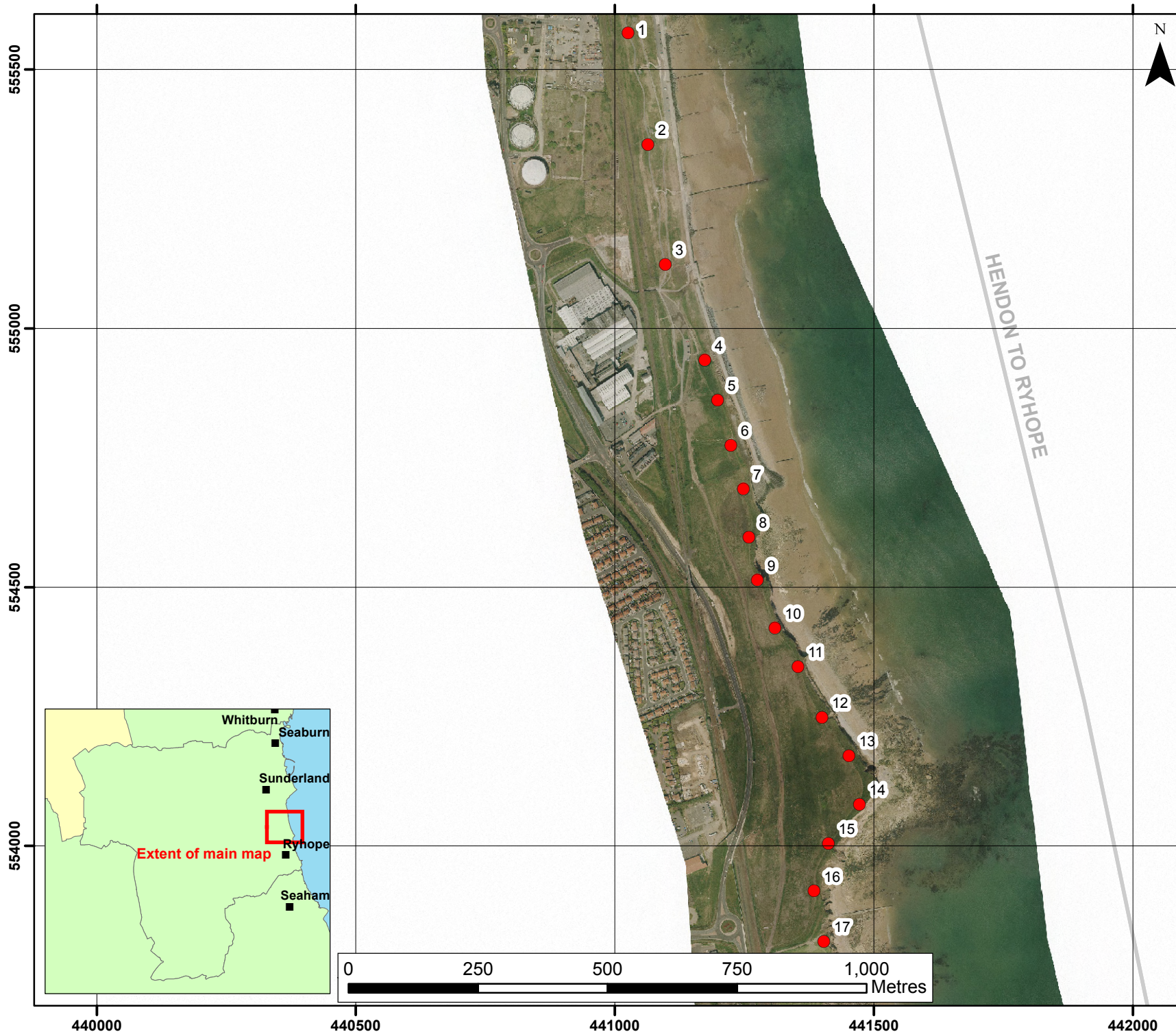
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**Appendix C**  
**Cliff Top Survey**



**KEY**

● Ground Control Points

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

**Appendix C - Map 1  
Ground Control Points  
Hendon to Ryhope a  
Sunderland City Council**

Analytical Report 4  
Full Measures Survey  
Winter 2011

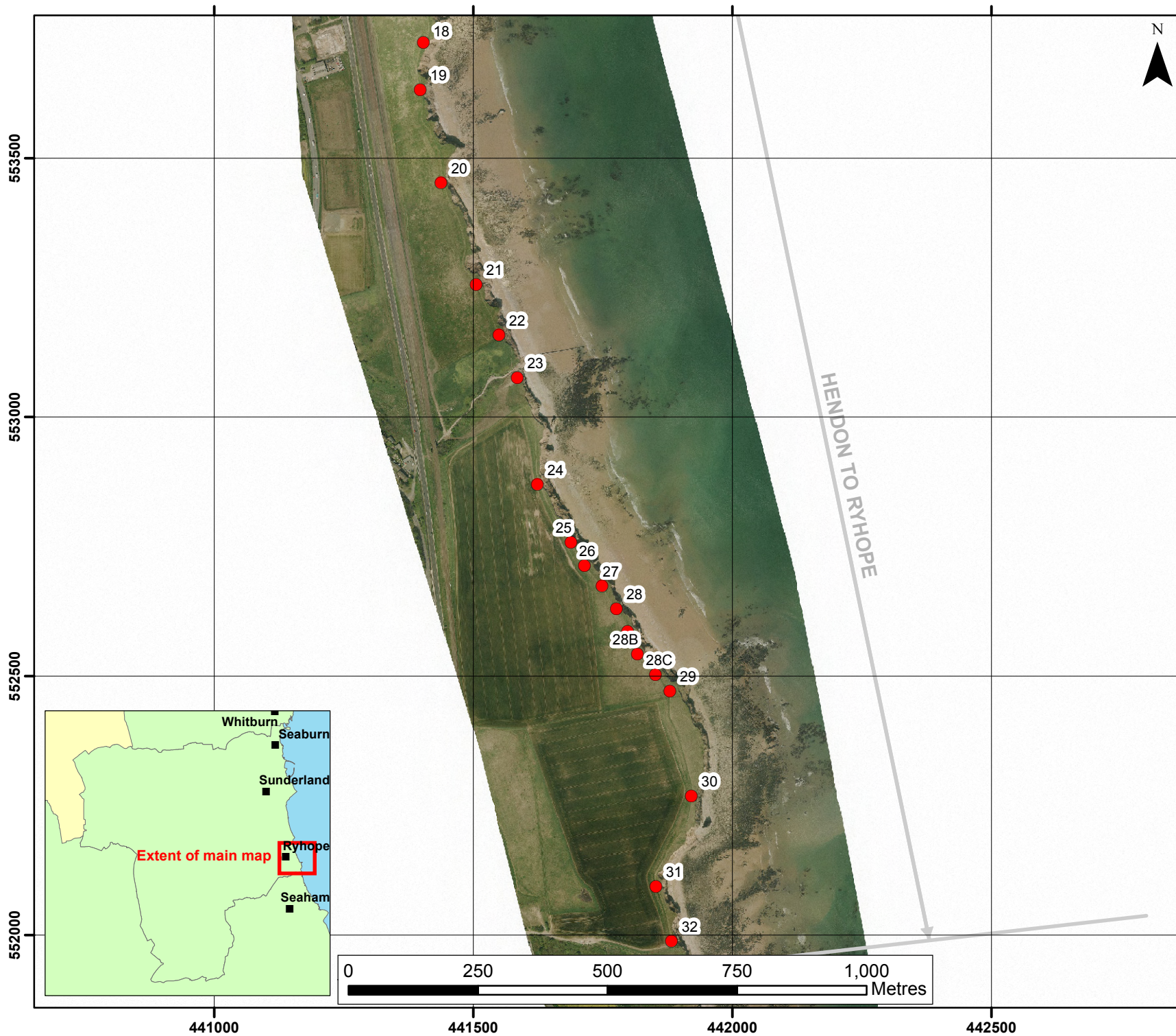


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**KEY**

- Ground Control Points

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

**Appendix C - Map 2  
Ground Control Points  
Hendon to Ryhope b  
Sunderland City Council**

Analytical Report 4  
Full Measures Survey  
Winter 2011



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## Cliff Top Survey

### Hendon and Ryhope

Thirty-two ground control points have been established between Hendon and Ryhope (Figure C1). The maximum separation between any two points varies along the coast, reflecting the degree of risk from the erosion.

The cliff top surveys between Hendon and Ryhope 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 2009 (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 between Hendon and Ryhope**

Ground Control Point Details				Distance to Cliff Top (m)			Total Erosion (m)		Erosion Rate (m/year)
Ref	Easting	Northing	Bearing (°)	Baseline Survey (March 09)	Previous Survey (April 2011)	Present Survey (Oct 2011)	Baseline (March 2009) to Present (Oct 2011)	Previous (April 2011) to Present (Oct 2011)	Baseline (March 2009) to Present (Oct 2011)
1	441025.7	555571.1	75	8.16	8.5	8.7	0.5	0.1	0.2
2	441064.4	555355.1	85	7.09	6.0	7.2	0.1	1.2	0.0
3	441098	555124	82	10.01	10.5	10.4	0.4	-0.1	0.1
4	441174	554938.7	65	10.3	10.6	10.7	0.4	0.1	0.2
5	441199.1	554861.1	65	7.71	7.7	7.8	0.1	0.0	0.0
6	441224.5	554774.2	71	10.83	10.9	11.2	0.3	0.3	0.1
7	441248.4	554690.3	74	10.18	10.4	10.2	0.0	-0.2	0.0
8	441259.3	554596.6	101	10.08	10.4	10.2	0.1	-0.2	0.0
9	441275.8	554513.4	66	10.52	6.7	6.3	-4.3	-0.4	-1.7
10	441309.4	554421.3	58	8.77	6.5	6.2	-2.6	-0.3	-1.0
11	441354	554346.5	68	8.2	6.8	6.6	-1.6	-0.2	-0.6

Ground Control Point Details				Distance to Cliff Top (m)			Total Erosion (m)		Erosion Rate (m/year)
Ref	Easting	Northing	Bearing (°)	Baseline Survey (March 09)	Previous Survey (April 2011)	Present Survey (Oct 2011)	Baseline (March 2009) to Present (Oct 2011)	Previous (April 2011) to Present (Oct 2011)	Baseline (March 2009) to Present (Oct 2011)
12	441400.2	554248.2	56	6.17	6.2	5.9	-0.3	-0.3	-0.1
13	441452.3	554174.7	63	11.61	12.0	11.5	-0.1	-0.4	0.0
14	441472.3	554080.5	127	7.33	7.6	7.2	-0.1	-0.4	0.0
15	441413	554005.1	122	7.84	8.0	7.7	-0.2	-0.3	-0.1
16	441384.8	553913.3	90	9.89	10.0	9.8	-0.1	-0.2	0.0
17	441404.1	553815.5	93	6.32	6.5	6.1	-0.3	-0.5	-0.1
18	441404.1	553723.6	119	8.1	8.2	7.8	-0.3	-0.4	-0.1
19	441398.5	553632.8	78	8.23	6.2	5.9	-2.4	-0.4	-0.9
20	441438.3	553452.9	71	10.09	6.9	6.7	-3.4	-0.2	-1.3
21	441506.1	553256.1	62	8.57	4.7	4.4	-4.2	-0.3	-1.6
22	441550.1	553158.7	103	6.57	6.8	6.4	-0.2	-0.4	-0.1
23	441585.2	553076.5	64	8.11	8.1	7.9	-0.2	-0.1	-0.1
24	441624.4	552870.7	69	7.53	5.3	5.0	-2.5	-0.2	-1.0
25	441689.1	552758	70	14.58	8.9	8.6	-6.0	-0.4	-2.3
26	441715	552713.3	54	12.87	12.9	12.5	-0.4	-0.4	-0.2
27	441749.2	552674.4	62	14.56	10.8	10.4	-4.1	-0.3	-1.6
28	441776.6	552629.9	57	8.62	4.8	4.5	-4.1	-0.2	-1.6
28A	441798.6	552586.3	56	No Data	12.8	12.5	-1.1	-0.2	-0.4
28B	441817.4	552542.4	64	No Data	11.4	11.1	-1.2	-0.3	-0.5
28C	441852.2	552502.6	52	No Data	13.1	12.8	-0.3	-0.3	-0.1
29	441880.1	552471.6	83	15.46	15.4	15.0	-0.4	-0.3	-0.2
30	441921.4	552269	97	8.55	8.1	7.8	-0.8	-0.4	-0.3
31	441853.1	552094	75	11.2	8.0	7.9	-3.3	-0.1	-1.3
32	441883.3	551988.5	96	9.82	7.5	7.4	-2.4	-0.1	-0.9