



**Cell 1 Regional Coastal Monitoring Programme
Update Report 5: 'Partial Measures' Survey 2013**

**Hartlepool Council
Final Report**

June 2013

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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)			
	River Tyne to Frenchman's Bay	Frenchman's Bay to Souter Point	Souter Point to Chourdon Point	Chourdon Point to Hartlepool Headland
1 in 200 year	3.41	3.44	3.66	3.91
HAT	2.85	2.88	3.18	3.30
MHWS	2.15	2.18	2.48	2.70
MLWS	-2.15	-2.12	-1.92	-1.90

Water Level Parameter	Water Level (m AOD)			
	Hartlepool Headland to Saltburn Scar	Skinninggrove	Hummersea Scar to Sandsend Ness	Sandsend Ness to Saltwick Nab
1 in 200 year	3.87	3.86	4.1	3.88
HAT	3.25	3.18	3.15	3.10
MHWS	2.65	2.68	2.65	2.60
MLWS	-1.95	-2.13	-2.15	-2.20

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).

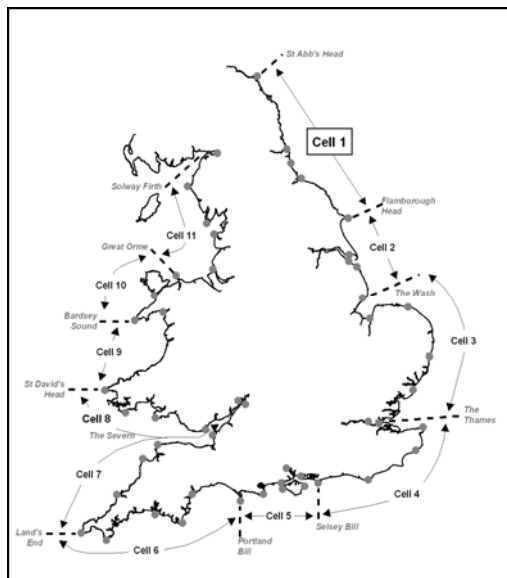


Figure 1 Sediment Cells in England and Wales

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. 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	July 10	-
3	2010/11	Aug-Nov 10	Feb 11	Feb-April 11	August 11	Sept 11
4	2011/12	Sep-Oct 11	Oct 12	Mar-May 12	Oct 12	-
5	2012/13	Sep 2012	Jan 13	April 13	May 13(*)	-

(*) The present report is **Update Report 5** and provides an analysis of the 2013 Partial Measures survey for Hartlepool Council's frontage.

1. Introduction

1.1 Study Area

Hartlepool Council's frontage extends from Crimdon Beck in the north to the North Gare Breakwater in the south. For the purposes of this report, it has been sub-divided into four areas, namely:

- North Sands
- Hartlepool Headland
- Middleton
- Hartlepool Bay

1.2 Methodology

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

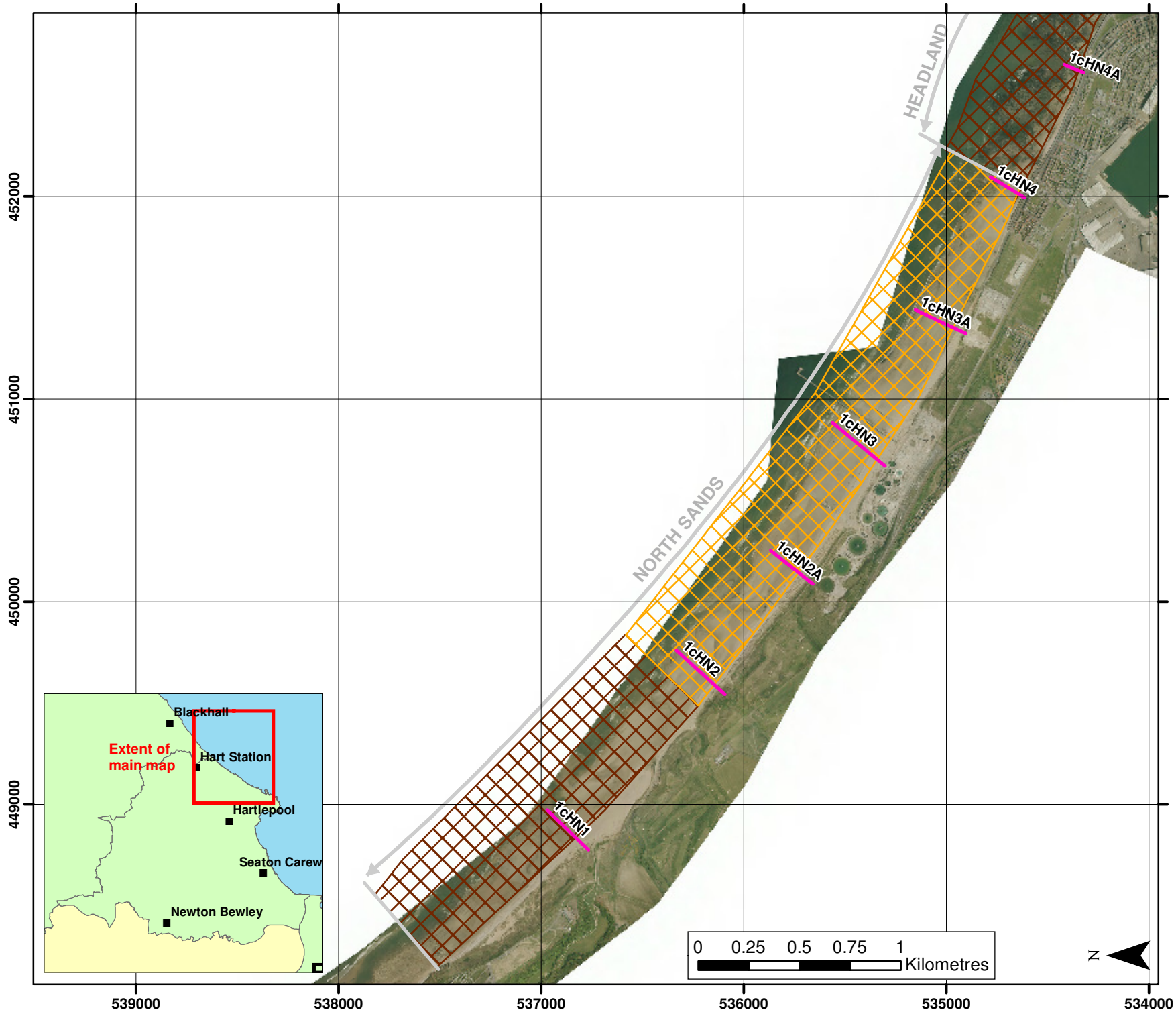
- Full Measures survey annually each autumn/early winter comprising:
 - Beach profile surveys along nine transect lines
 - Topographic survey along part of North Sands (referred to as Hartlepool North)
 - Topographic survey along Middleton (referred to as Hartlepool Central)
 - Topographic survey along Hartlepool Bay (referred to as Hartlepool South)
- Partial Measures survey annually each spring comprising:
 - Beach profile surveys along nine transect lines
- Additionally, every five years (starting with 2008 as the baseline year), the Full Measures survey at Hartlepool North is extended to fully cover the whole of North Sands and Hartlepool Headland with a topographic survey. This extends across the boundary of jurisdiction between Hartlepool Borough Council and Durham County Council.

The location of these surveys is shown in Figure 2. The Partial Measures survey was undertaken along this frontage between 9th and 19th April 2013. During this time weather conditions cloudy with sunny spells the sea state was rough for the central and southern surveys, and calm for the northern survey.

The Update Report presents the following:

- 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 (Blue line)
- 6 monthly (Magenta line)

Topographic Surveys

- 6 monthly (Green cross-hatch)
- yearly (Yellow cross-hatch)
- 5 yearly (Brown cross-hatch)

Cliff Top Monitoring Pegs

- 50m centres (Purple square)
- 100m centres (Green square)
- 300m centres (Red square)

(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
North Sands
Hartlepool Borough Council

Update Report 5
 Partial Measures Survey
 Spring 2013

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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 2
Survey Locations
Headland and Middleton
Hartlepool Borough
Council**

Update Report 5
Partial Measures Survey
Spring 2013



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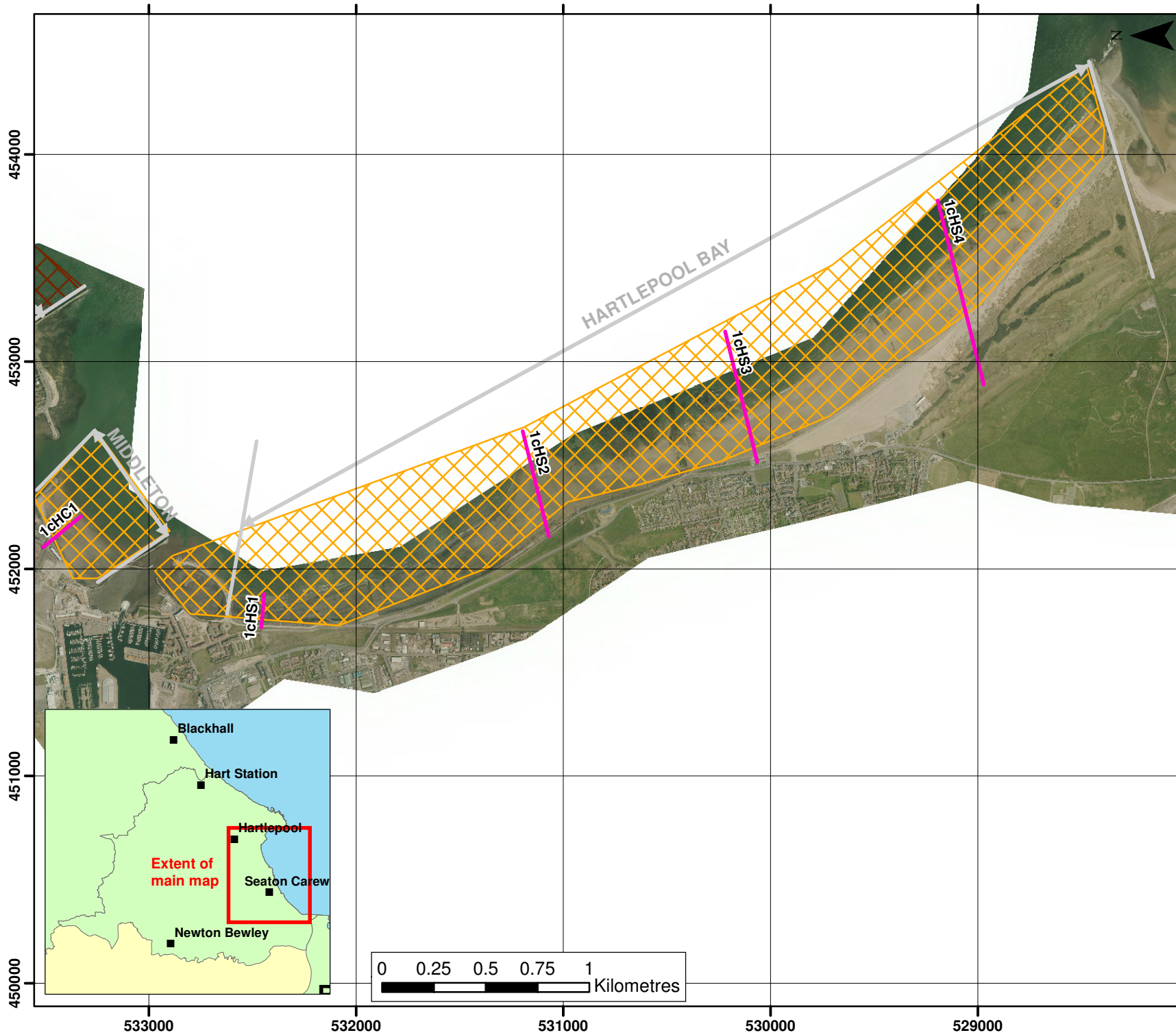
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KEY

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 3
Survey Locations
Hartlepool Bay
Hartlepool Borough
Council**

Update Report 5
Partial Measures Survey
Spring 2013



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2. Analysis of Survey Data

2.1 North Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
11 th April 2013	<p>Beach Profiles:</p> <p>North Sands is covered by four beach profile lines during the Partial Measures survey (Appendix A) that were last surveyed in September 2012.</p> <p>Profile HN1 is located within Durham County Council's jurisdiction, about 400m north of the outfall of Crimdon Beck, but has been reported here so changes can be interpreted in association with those observed elsewhere along North Sands at HN2, HN3 and HN4.</p> <p>The April 2013 profile for HN1 is very similar to the September 2012 profile to the HAT level. Below HAT (80m chainage) the September 2012 and April 2013 profiles are similar, but with some slight erosion around the level of MHWS. From 120m chainage to 175m chainage the beach level has dropped and is 0.5m below the level of the April 2013 profile. Between 175m to 230m the beach has accreted a sand bar and is 0.5m higher than the profile from September 2012. At the base of the profile close to MLWS the beach level in April 2013 was the lowest since 2010.</p> <p>Profile HN2 shows stability from 0m to 60m chainage. Between 60m and 110m chainage up to 1m has been eroded from the beach between September 2012 and April 2013. At 120m and 180m chainage the sand bars in the April 2013 profile mean that the beach level is similar to the level in September 2012. Between these two sand bars there is a depression where the profile is 0.5m lower than in September 2012. At its base the April 2013 profile records the lowest beach level seen since 2008.</p> <p>Profile HN2a was established in October 2011 and runs through the dunes close North Sands. The part of the survey over the dunes to 70m chainage has remained stable since October 2011. Between 70 and 80m chainage a small sand bar directly in front of the dune has grown by 0.5m. From 80m chainage to the end of the survey at 250m the beach level has dropped to its lowest level, which is 0.5m below the September 2012 level.</p> <p>At Profile HN3 the peak in the profile at 35m chainage, which has been progressively accreting since 2008, has grown in March 2013. From 65m to 145m chainage the beach has eroded and is 0.5m lower</p>	<p>The profiles are low for much of intertidal zone when compared to others surveyed following winter storms, which suggests the winter of 2012/13 was particularly severe. The profiles have developed sand bars on the lower beach, which are likely to be formed from material drawn down from the upper beach in storms. Many of the profiles are very low at the landward extent of the survey and HN4 was so low that the underlying rock shore platform was exposed.</p> <p>Longer term trends:</p> <p>All the profiles appear to be stable above the HAT line with variation of the beach below. At HN1 and HN2 the beach levels were reasonably similar to the range of beach levels observed since 2008.</p> <p>The beach levels at profiles HN2a HN3a and HN4a are the lowest since the surveys began in October 2011. At HN3 and HN4 the beaches are low compared to the profiles since 2008, to the point where the rocks are exposed on HN4. However, the peak at HN3 still continues to progressively accrete. Although the beach levels are low it is anticipated that they will recover over the summer months.</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>than in September 2012. Below 145m there is a mound in the profile followed by a rapid drop in level at the end of the profile.</p> <p>At Profile HN3a the part of the frontage above HAT has changed little since the profile was established in October 2011. From 25m chainage to the end of the survey at 250m the beach level has dropped by around 0.5m and a bar has formed in the mid-beach.</p> <p>Profile HN4 has not changed down to the HAT level. At the base of the sea wall near MHWS the beach has eroded. From the base of the seawall at 15m chainage to 40m chainage the beach and the level has dropped by 0.3m. Between 40m and 90m chainage the beach had accreted by 0.3m. From 90m chainage to the end of the survey at 210m the beach level has dropped by 0.5m. The uneven section of profile is interpreted as rocks on the lower beach that are usually covered by sediment.</p> <p>Profile HN4a was established in October 2011. The defended part of the profile to 10m chainage has not changed since October 2011. The shore platform is exposed for much of the survey, which is due to a 0.8m drop in beach level since September 2012.</p>	

2.2 Middleton

Survey Date	Description of Changes Since Last Survey	Interpretation
9 th April 2013	<p>Beach Profiles:</p> <p>Middleton is covered by one beach profile line during the Partial Measures survey (Appendix A). The profile was last surveyed in September 2012.</p> <p>Profile HC1 is a gentler slope than the September 2012 survey. The upper beach between the sea wall at 45m chainage and 130m chainage has eroded by up to 0.8m. From 130m chainage to the end of the survey near MLWS the beach has accreted by around 0.5m.</p>	<p>The beach was at a low level compared to the previous surveys, as can be expected following winter storms.</p> <p>Longer term trends: The beach level at this location tends to fluctuate through the year, with the most variable area being adjacent to the sea wall where wave energy is reflected. There a seasonality to the variability, with lower levels typically recorded in the spring, following winter storms.</p>

2.3 Hartlepool Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
9 th April 2013	<p>Beach Profiles:</p> <p>Hartlepool Bay is covered by four beach profile lines during the Partial Measures survey (Appendix A). The profiles were last surveyed in October 2012.</p> <p>Profile HS1 is located approximately 150m south of the root of the South Pier. The profile starts at the wall to the rear of the promenade and extends over the fronting concrete splash wall and down the sloping face of the rock armour revetment before reaching the beach. The majority of changes in the profile occur beyond 40m chainage. The April 2013 profile stops in the mid-beach at 75m chainage because sea defence construction works inhibited safe access.</p> <p>Profile HS2 shows very little difference between the April 2013 and October 2012 profiles above the MHWS level at 20m chainage. Between 30 and 190m chainage the April 2013 profile is 0.2-0.5m lower than the October 2012 profile. Below 190m chainage the beach is 0.2m higher than the October 2012 profile.</p> <p>At profile HS3 the April 2013 and October 2012 profiles are very similar to the MLWS level at 30m chainage. From 30m to 205m chainage the beach has eroded by up to 0.3m. From 203m chainage to the end of the survey a mound of material has been formed and the beach has accreted by 0.6m.</p> <p>Profile HS4 is located around 1km north of the North Gare Breakwater, within the area of undefended dunes at Seaton Carew. The main dune ridge has remained very stable over time. However, there was a fore dune developing on the seaward face in October 2010, which was reduced in crest height and moved seaward by October 2012 and April 2013. Between the MHWS level at 360m chainage and 400m chainage around 0.4m of material has been lost. From 400m to 460m change the beach has accreted by 0.5m and a mound has formed. From 460m onwards the beach level in the April 2013 profile drops quickly and is up to 1m lower than in October 2012.</p>	<p>The beach level at HS1 is low at the toe of the defence but then recovers and is in the middle of the previous recorded values down to the mid-beach and the end of the profile.</p> <p>HS2 and HS3 show that the upper beach levels have dropped since October 2012 and a sand bar has formed on the lower beach.</p> <p>The mounds of material on HS2 and HS3 are likely to be due to the sea defence construction works on beach. The surveyors noted “deep excavations with corresponding spoil heaps”. The mound and very low beach on HS4 are therefore likely to be related to construction works.</p> <p>Longer term trends: The April 2013 profiles cannot be put into the wider context of the previous beach profiles because they are incomplete or altered by beach management. Response of the beaches to this engineering can be monitored in coming years.</p>

3. Problems Encountered and Uncertainty in Analysis

Individual Profiles

Academy Geomatics note that the Hartlepool Bay profiles were affected by the sea defence construction works taking place on beach. There were deep excavations and corresponding spoil heaps. The new sea wall was finished at profile HS3.

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

No changes are recommended at the present time.

5. Conclusions and Areas of Concern

- At North Sands the beach profiles are some of the lowest recorded, which suggests the winter storms of 2012/13 were particularly severe. The beach levels may recover over the summer of 2013, so there is no cause for concern.
- At Middleton the beach was at a low level compared to the previous surveys. The previous seasonality of beach levels means that there is no cause for concern due to the Spring 2013 profile being comparatively low.
- Hartlepool Bay has been subject to coastal management over the winter of 2012/13 and the profiles show the effect of human intervention on the beach. As a result the April 2013 survey cannot be put in to the wider context of the previous behaviour of the coast. Future beach profiles will show how the beach recovers following the excavations on the shore.

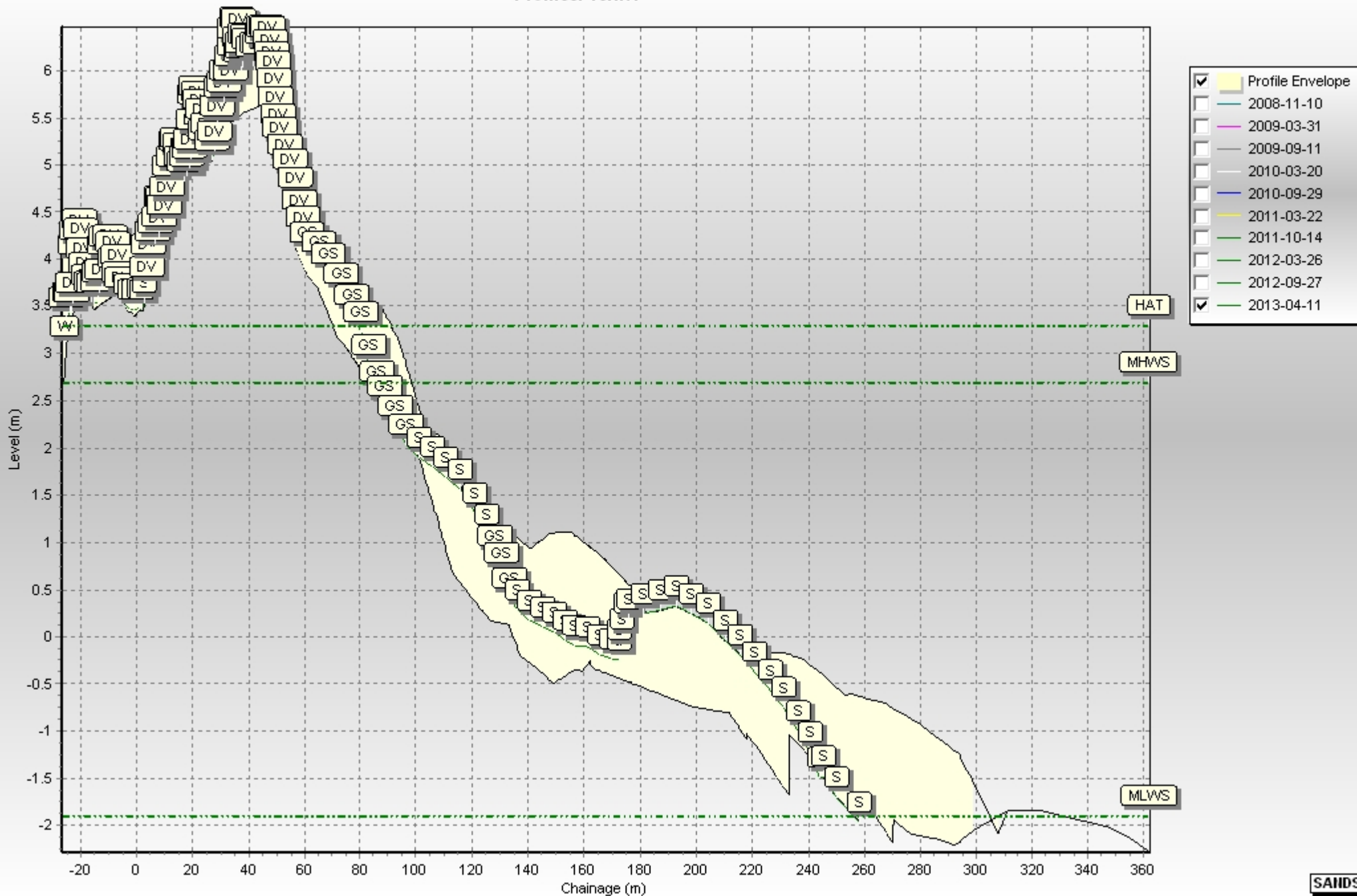
Appendices

Appendix A
Beach Profiles

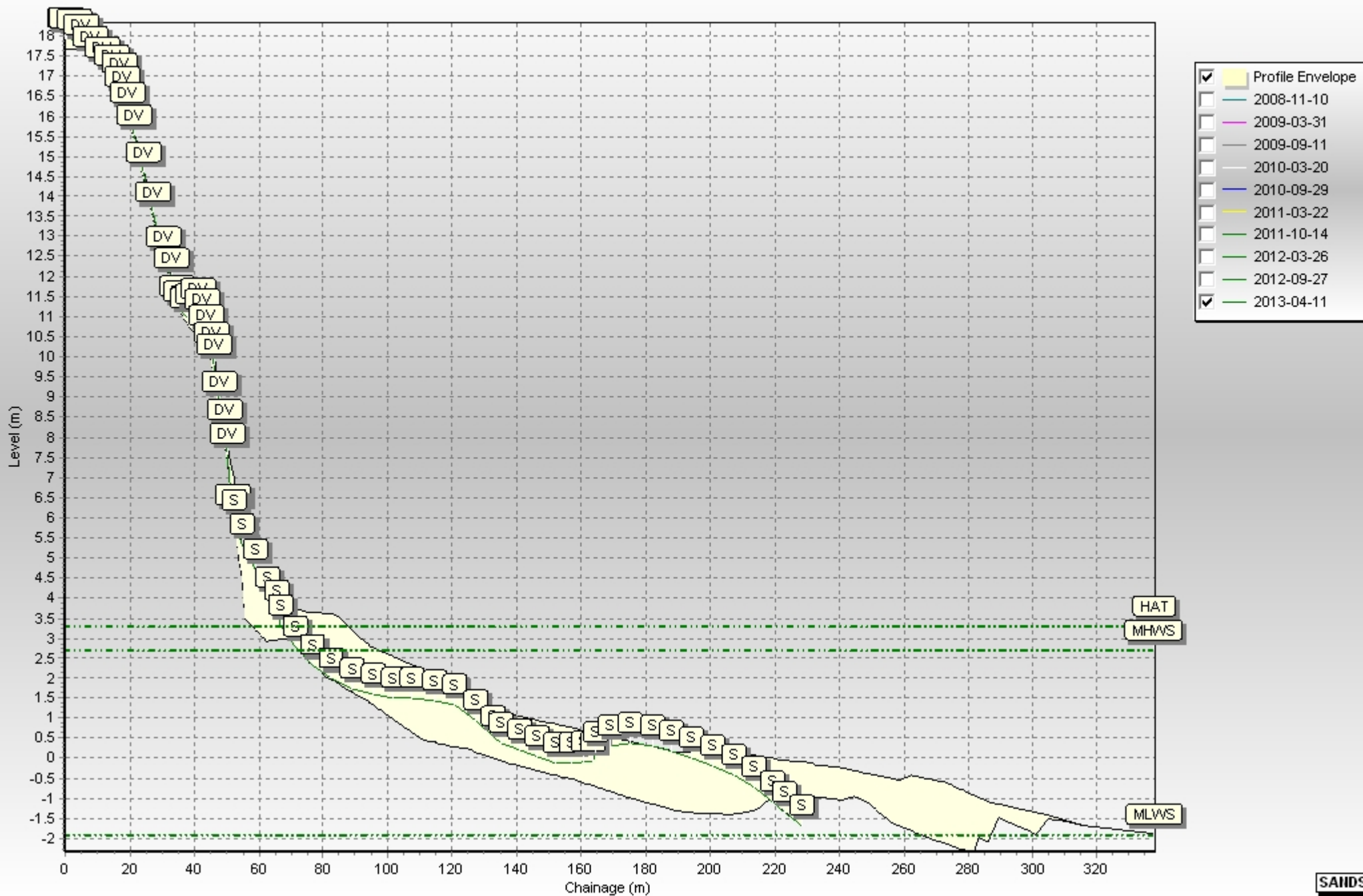
The following sediment feature codes are used on some profile plots:

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

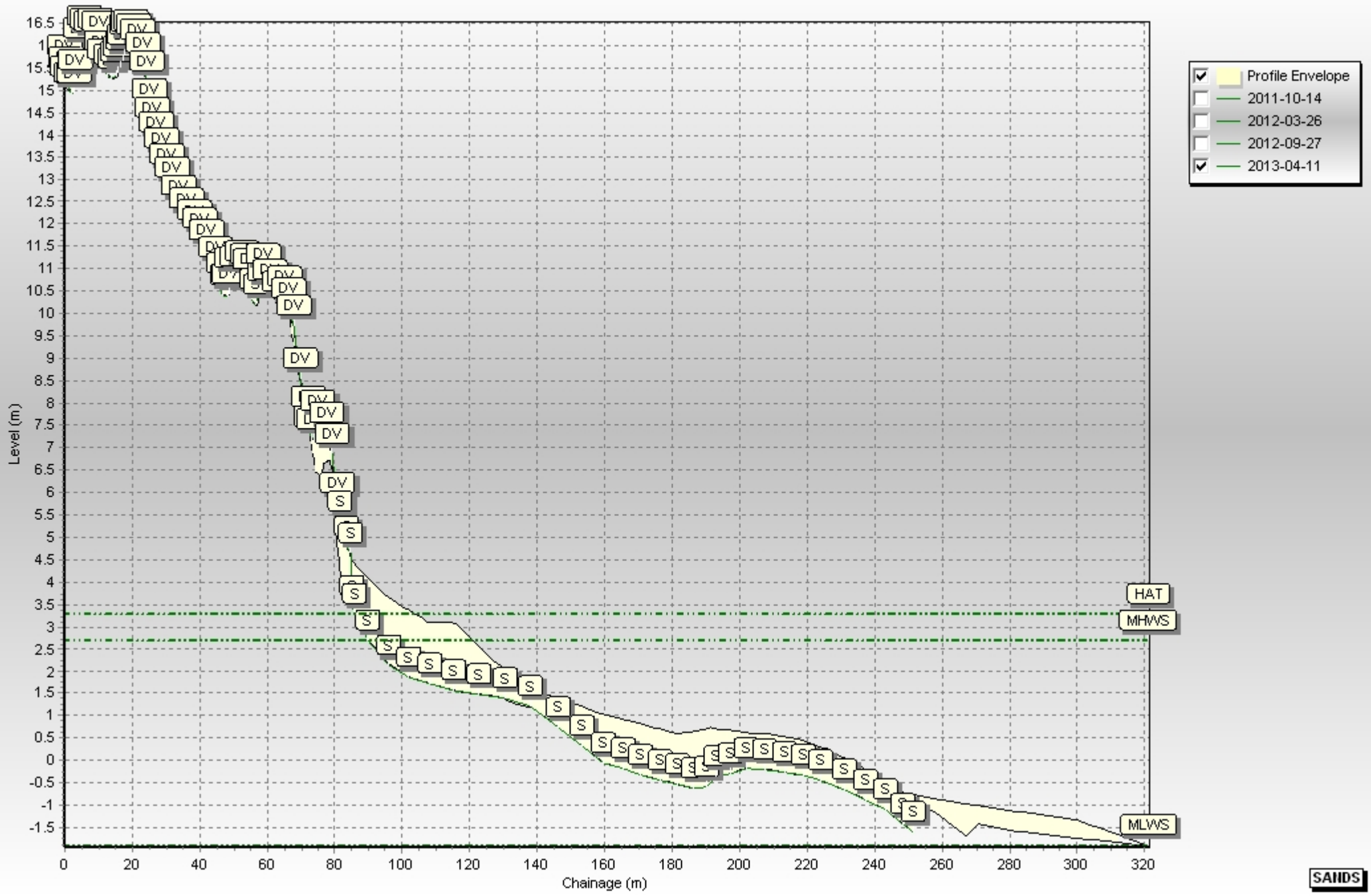
Profiles: 1cHN1



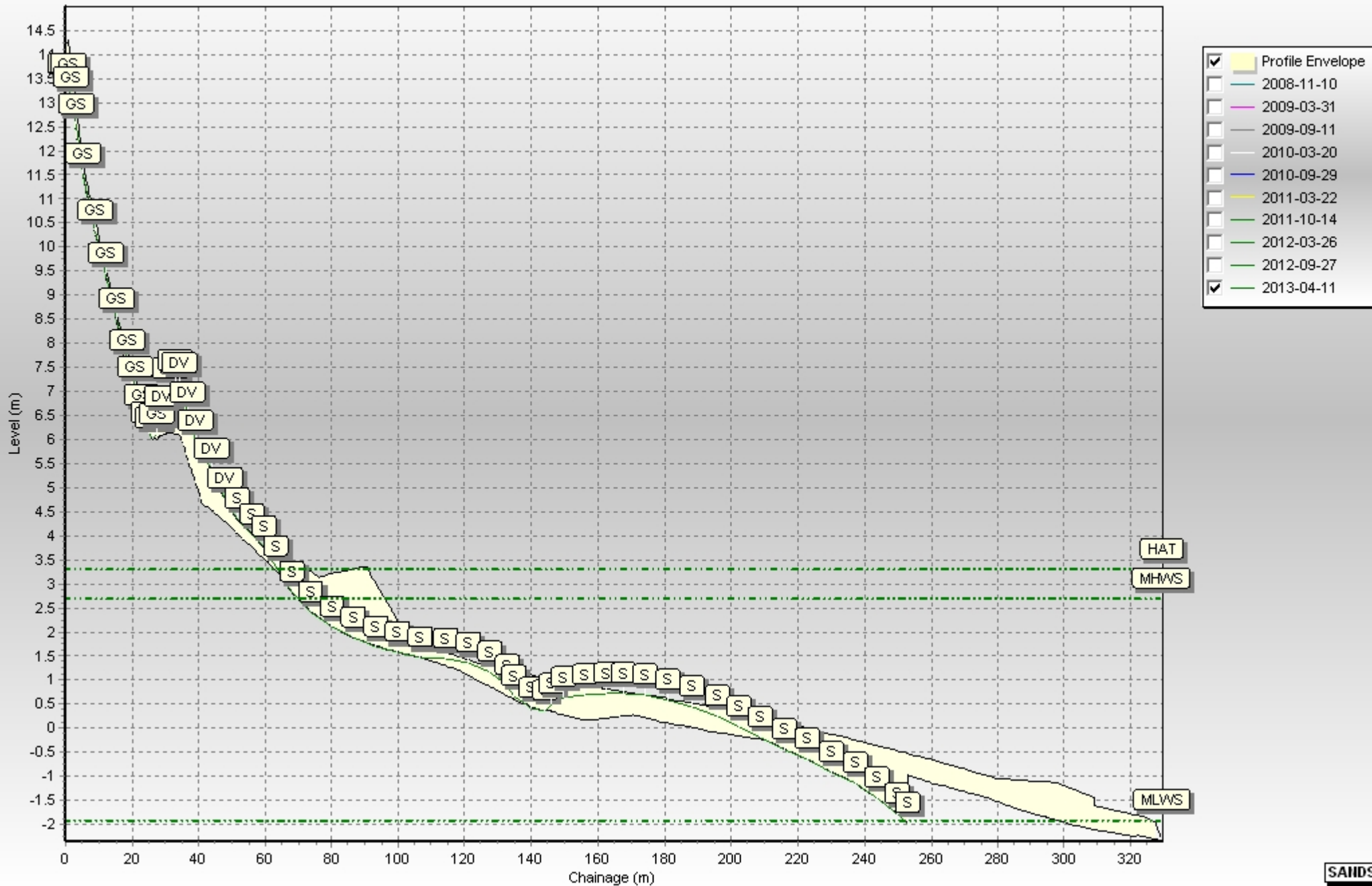
Profiles: 1cHN2



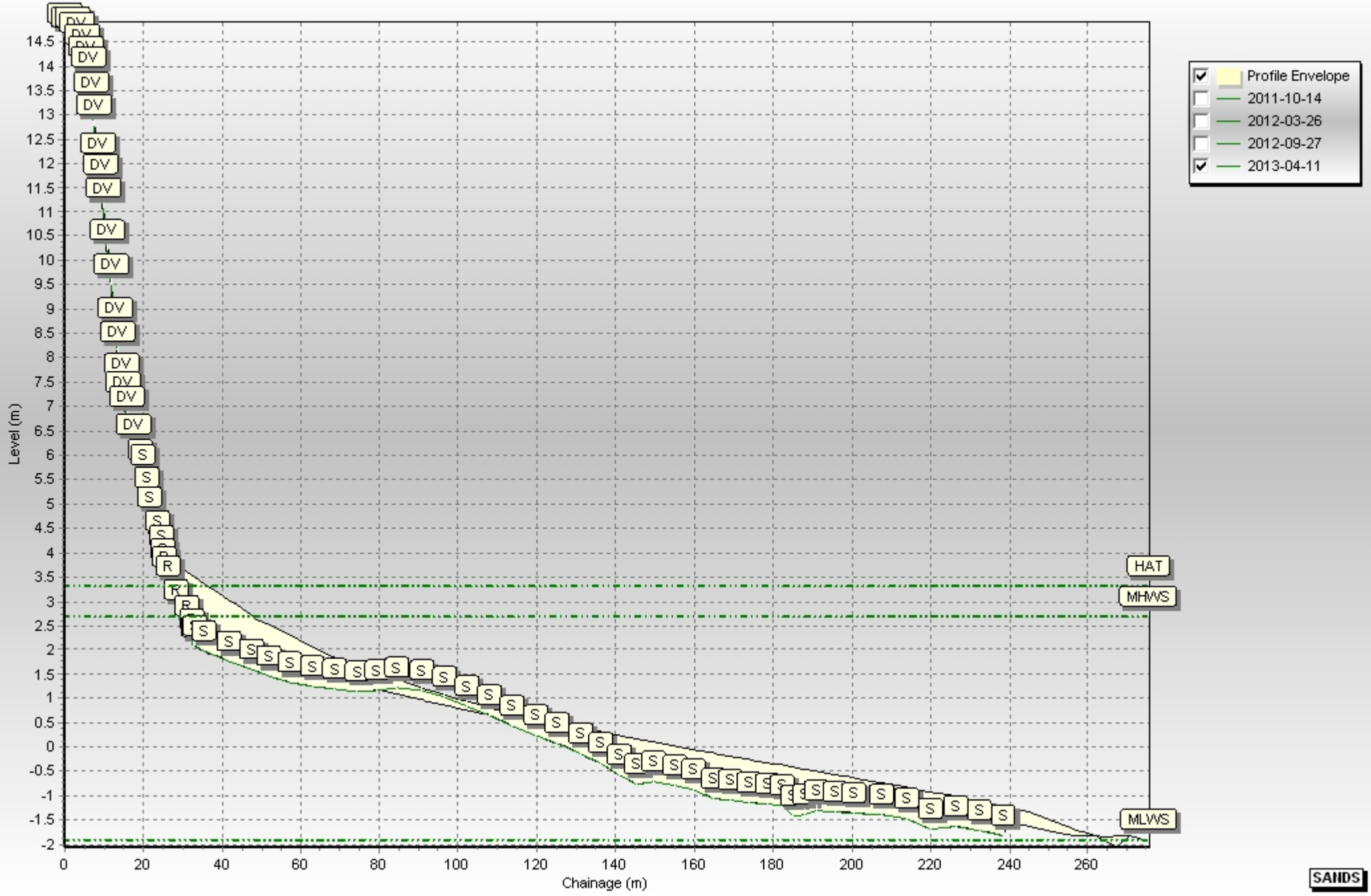
Profiles: 1cHN2A



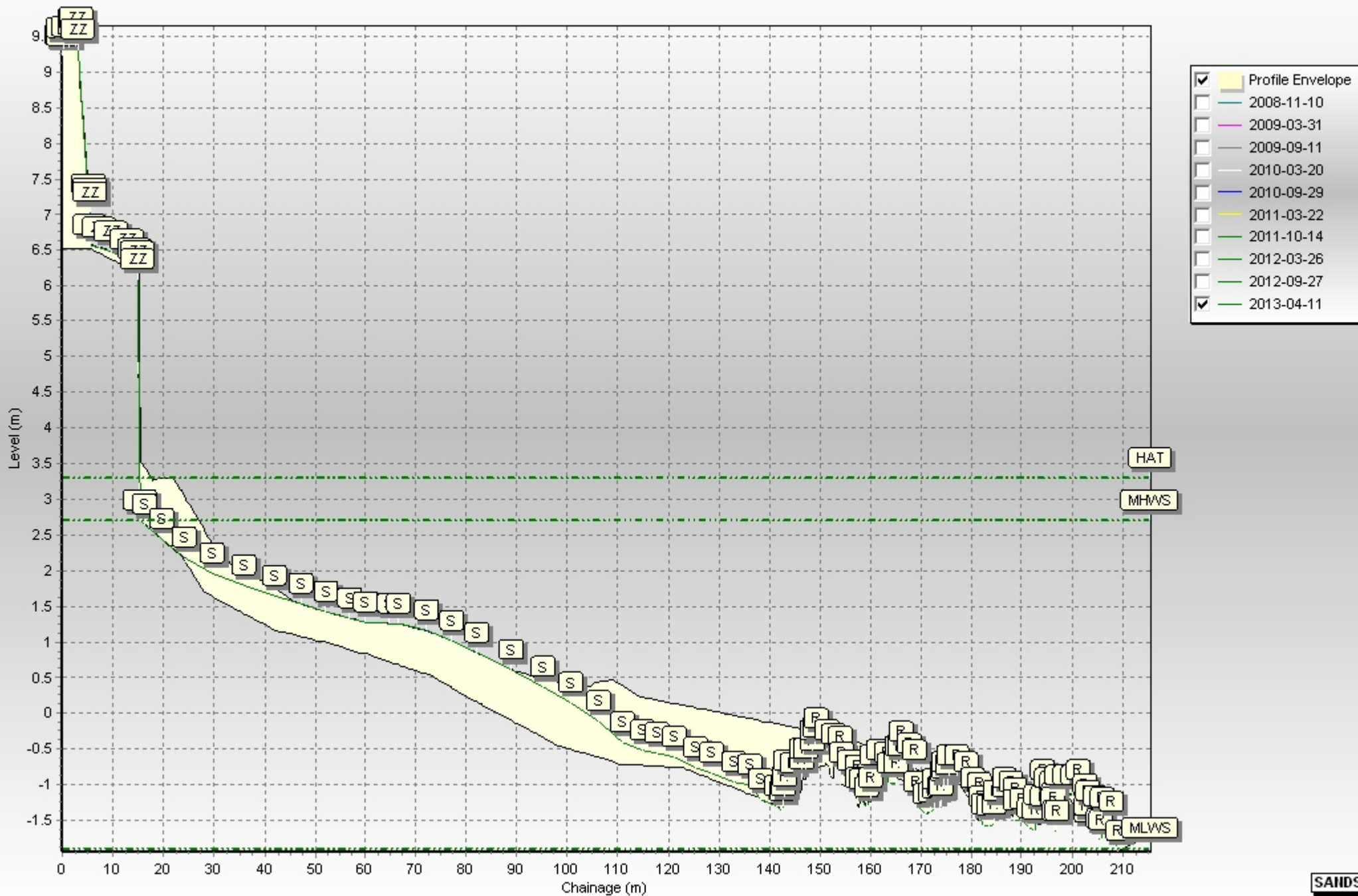
Profiles: 1cHN3



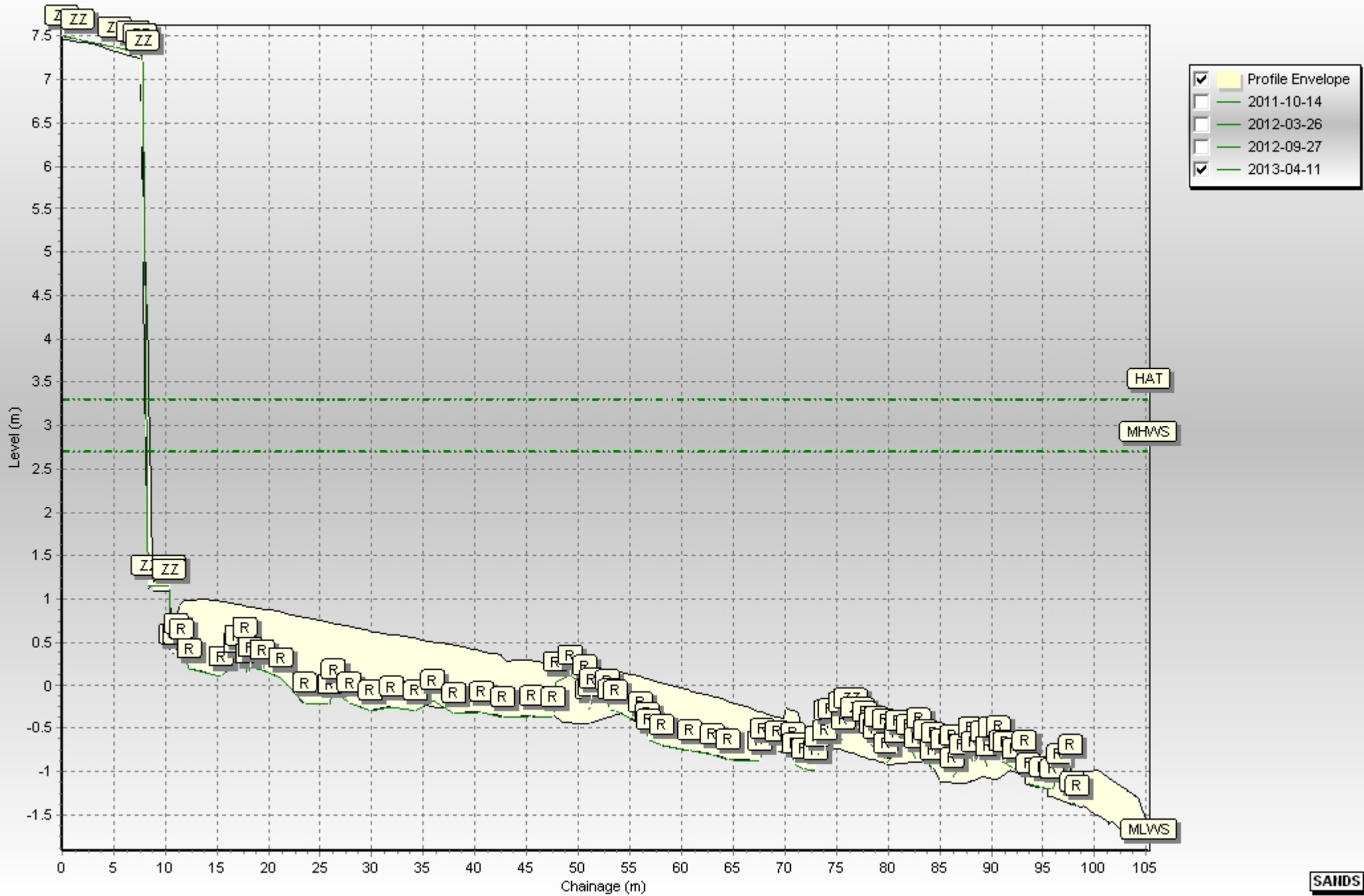
Profiles: 1cHN3A



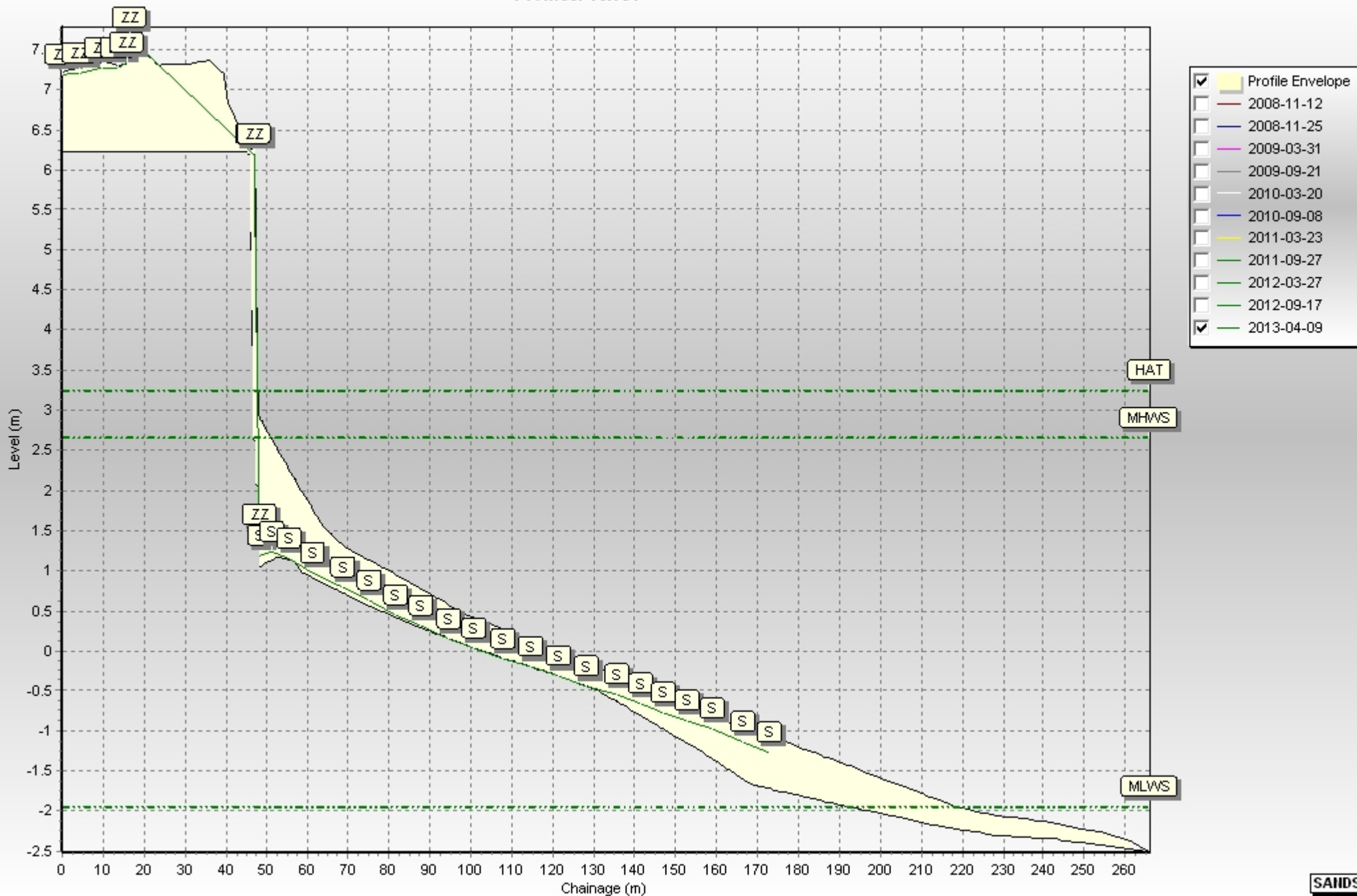
Profiles: 1cHN4



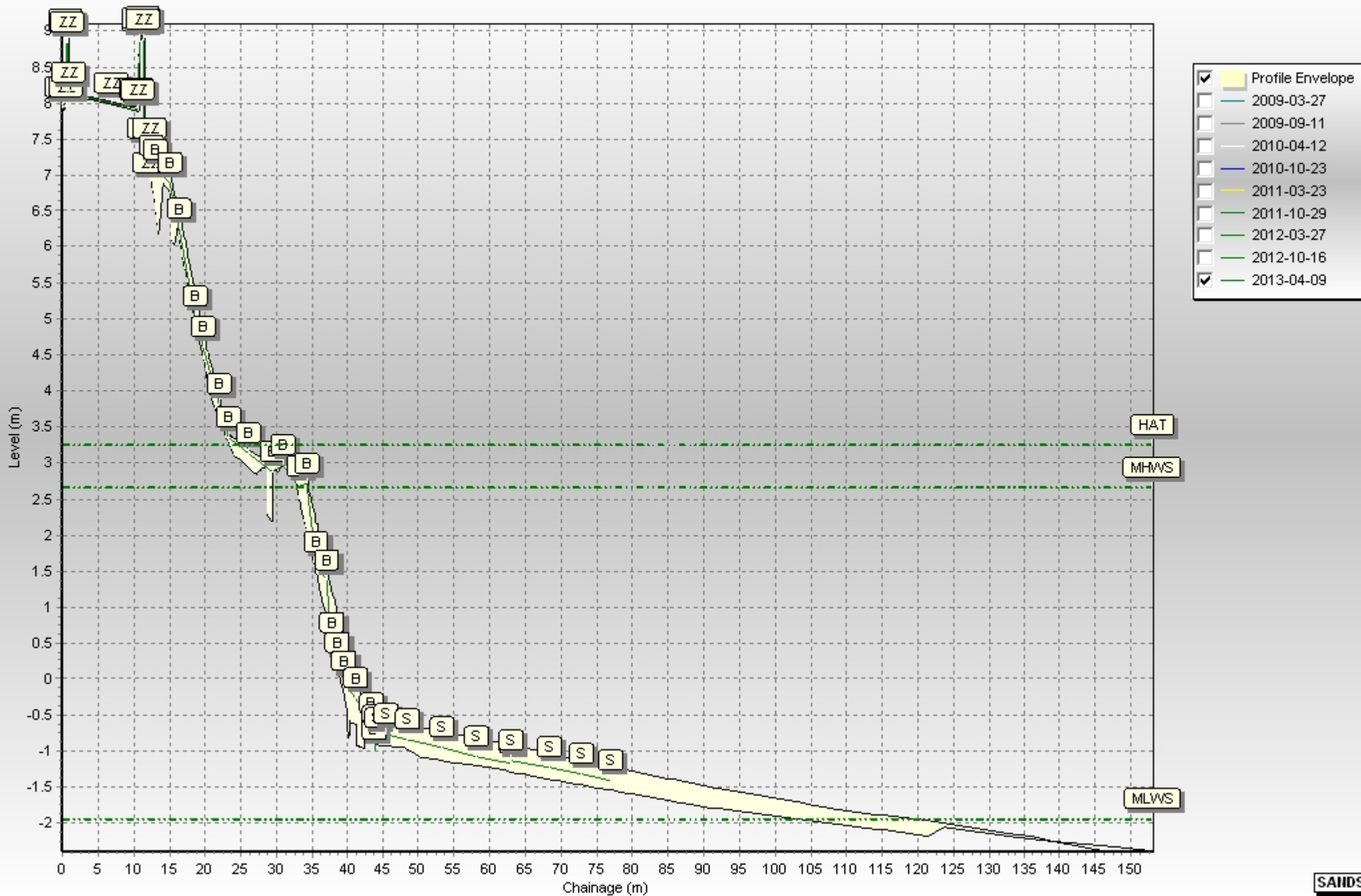
Profiles: 1cHN4A



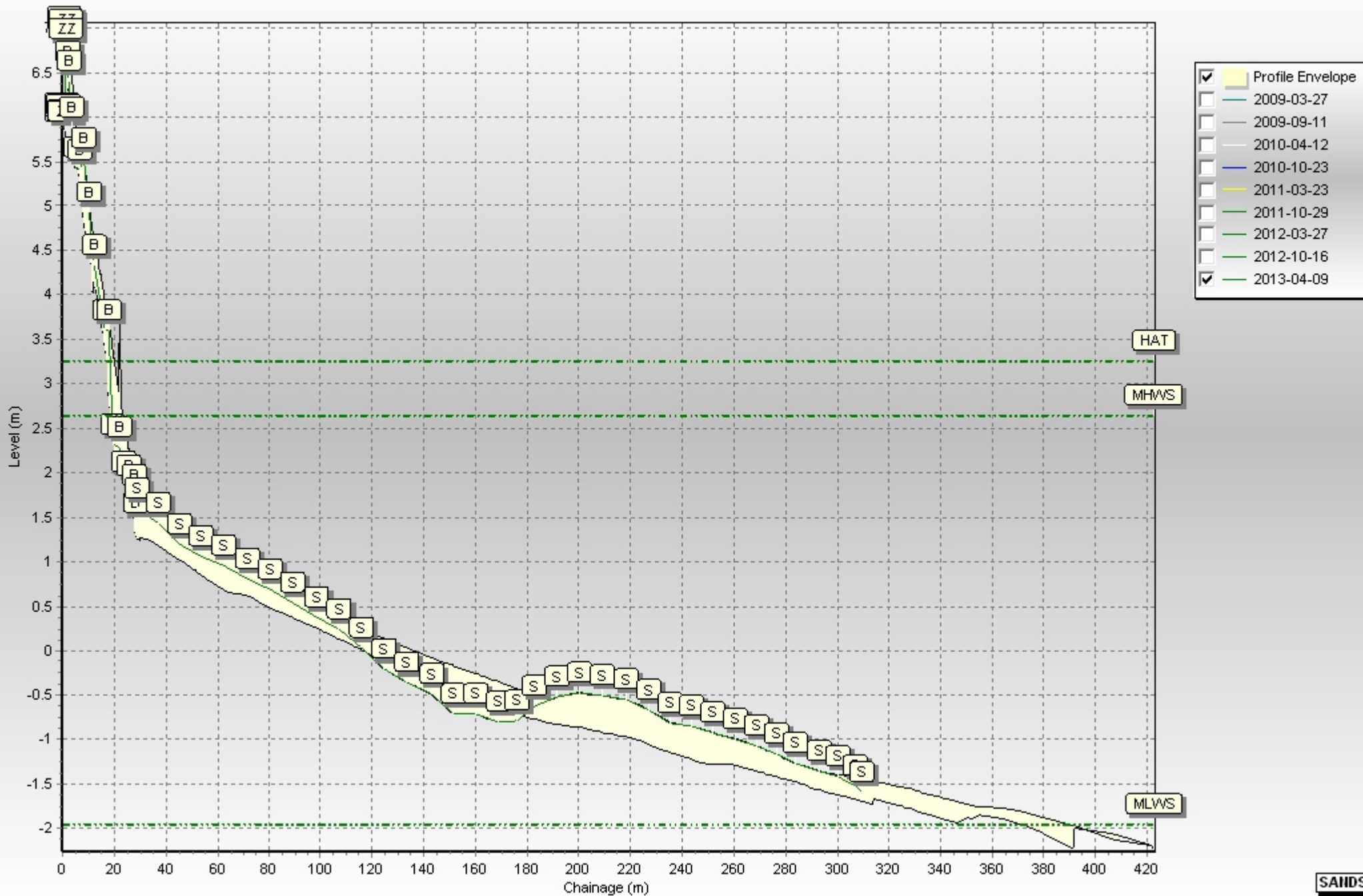
Profiles: 1cHC1



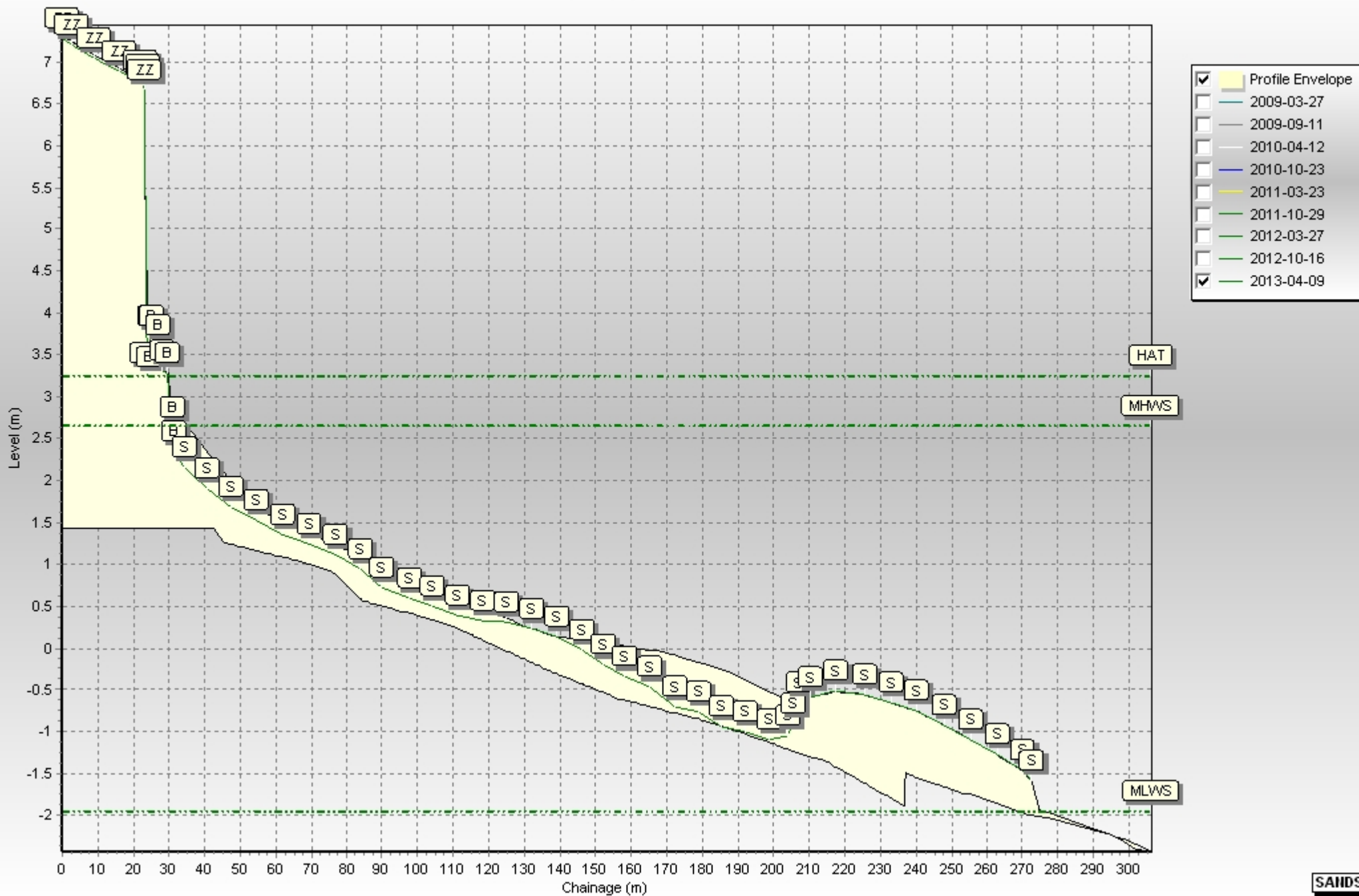
Profiles: 1cHS1



Profiles: 1cHS2



Profiles: 1cHS3



Profiles: 1cHS4

