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Cell 1 Regional Coastal Monitoring Programme Update Report 4: 'Partial Measures' Survey 2012

Northumberland County Council
Final Report

NORTHUMBERLAND
Northumberland County Council

February 2013

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Authors	
Emma Allan	Halcrow
Dr Paul Fish – Review of Draft	Halcrow
Dr Andy Parsons – Approval of Draft Final / Final	Halcrow

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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)		
	Berwick upon Tweed	Holy Island	North Sunderland
HAT	2.8	2.8	2.8
MHWS	2.2	2.4	2.4
MLWS	-1.9	-1.8	-1.7
Water Level Parameter	**Water Level (m AOD)**		
	Amble	**Blyth**	**River Tyne**
HAT	3.1	3.1	3.1
MHWS	2.4	2.4	2.4
MLWS	-1.9	-1.8	-1.9

Source: *Scottish Border to River Tyne Shoreline Management Plan 2.* Royal Haskoning, May 2009.

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).

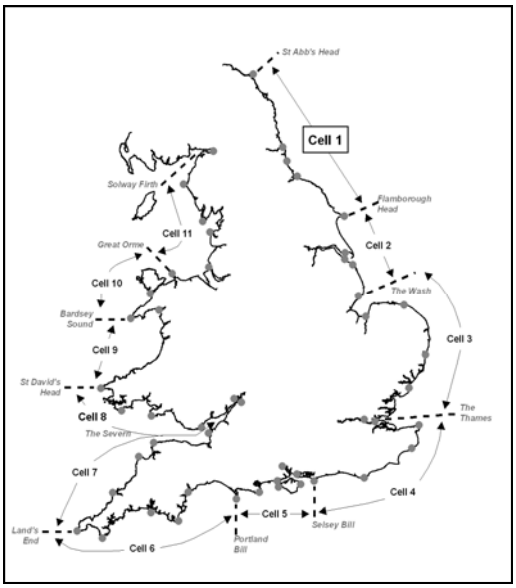


Figure 1 Sediment Cells in England and Wales

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	Aug 11	Sept 11
4	2011/12	Oct-Nov 11	Oct 12	Mar-May 12	Feb13 (*)	

(*) The present report is **Update Report 4** and provides an analysis of the 2012 Partial Measures survey for Northumberland Council's frontage.

1. Introduction

1.1 Study Area

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

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

1.2 Methodology

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

Full Measures survey annually each autumn/early winter comprising:

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

Partial Measures survey annually each spring comprising:

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

Cliff top survey (bi-annually) at:

- Cliff top survey at Lynemouth Bay (commenced 2008)
- Cliff top survey at Cambois Bay (Sandy Bay) (commenced 2008)
- Cliff top survey at Cambois Bay (Cambois) (commenced 2009)

Sand extent survey (bi-annually) at:

- Edge of sand survey at Newbiggin Bay, Spital Carrs, (commenced 2011)

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

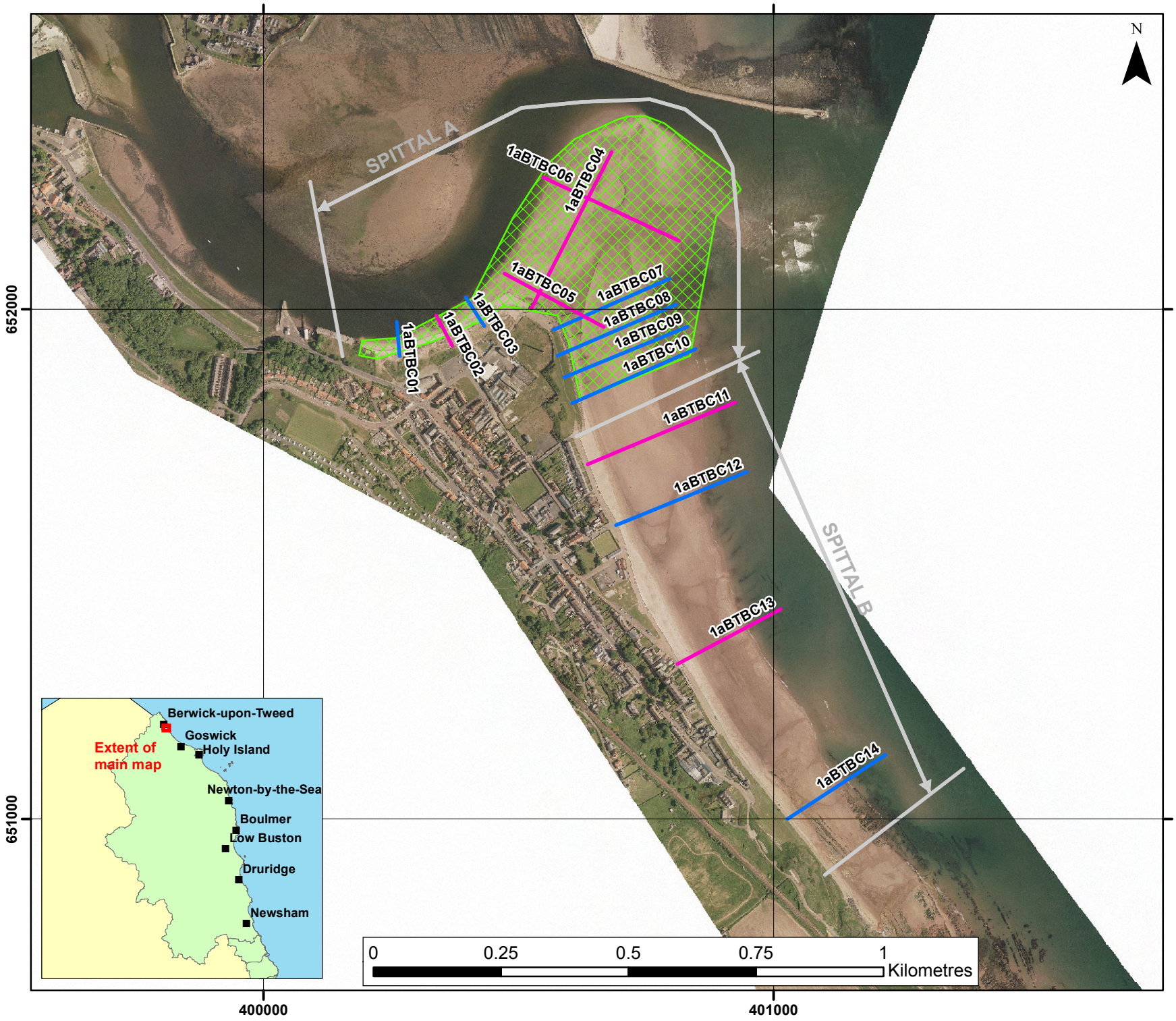
The location of these surveys is shown in Figure 2. The Partial Measures survey was undertaken along this frontage between 10th March 2012 (Sandstell Point (Spittal A) and Spittal (Spittal B topographic survey), 20th March 2012 to 23rd March 2012, 5th April October 2012 (Newbiggin topographic survey), 10th April 2012 to 13th April 2012, 23rd April 2012 to 24th April 2012 and 23rd to 24th April 2012 (Alnmouth topographic survey) and 26th and 27th April (Cambois cliff top survey).

During this time weather conditions varied considerably; refer to the survey reports for details of the weather conditions over this survey period.

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
- 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
Sandstell Point (Spittal A)
Northumberland County Council

Update Report 4
Partial Measures Survey
Spring 2012

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Tel: +44 (0)121 456 2345
Fax: +44(0)121 456 1569
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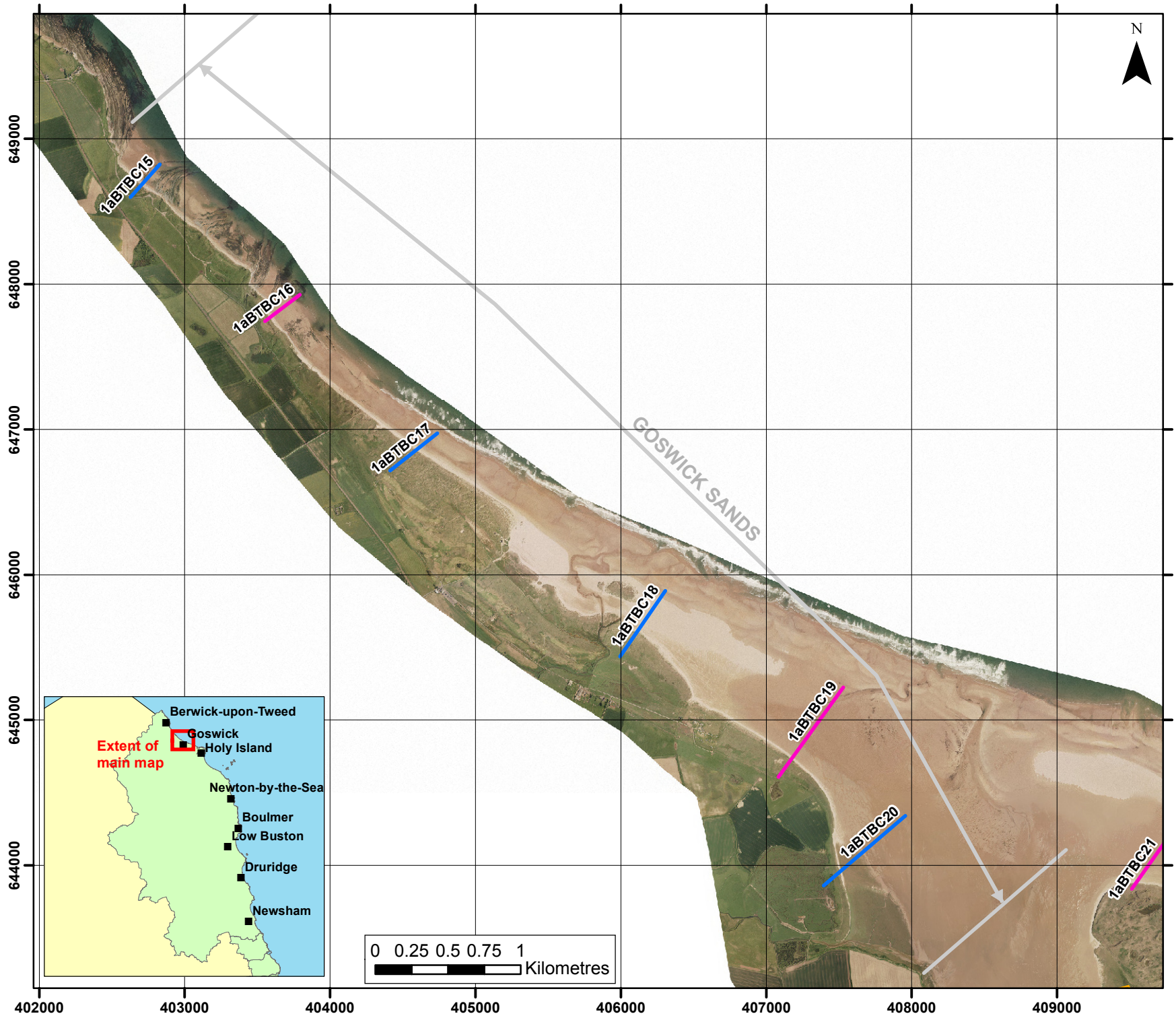

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Topographic Surveys

- 6 monthly
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Cliff Top Monitoring Pegs

- 50m centres
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- 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
Goswick Sands
Northumberland
County Council

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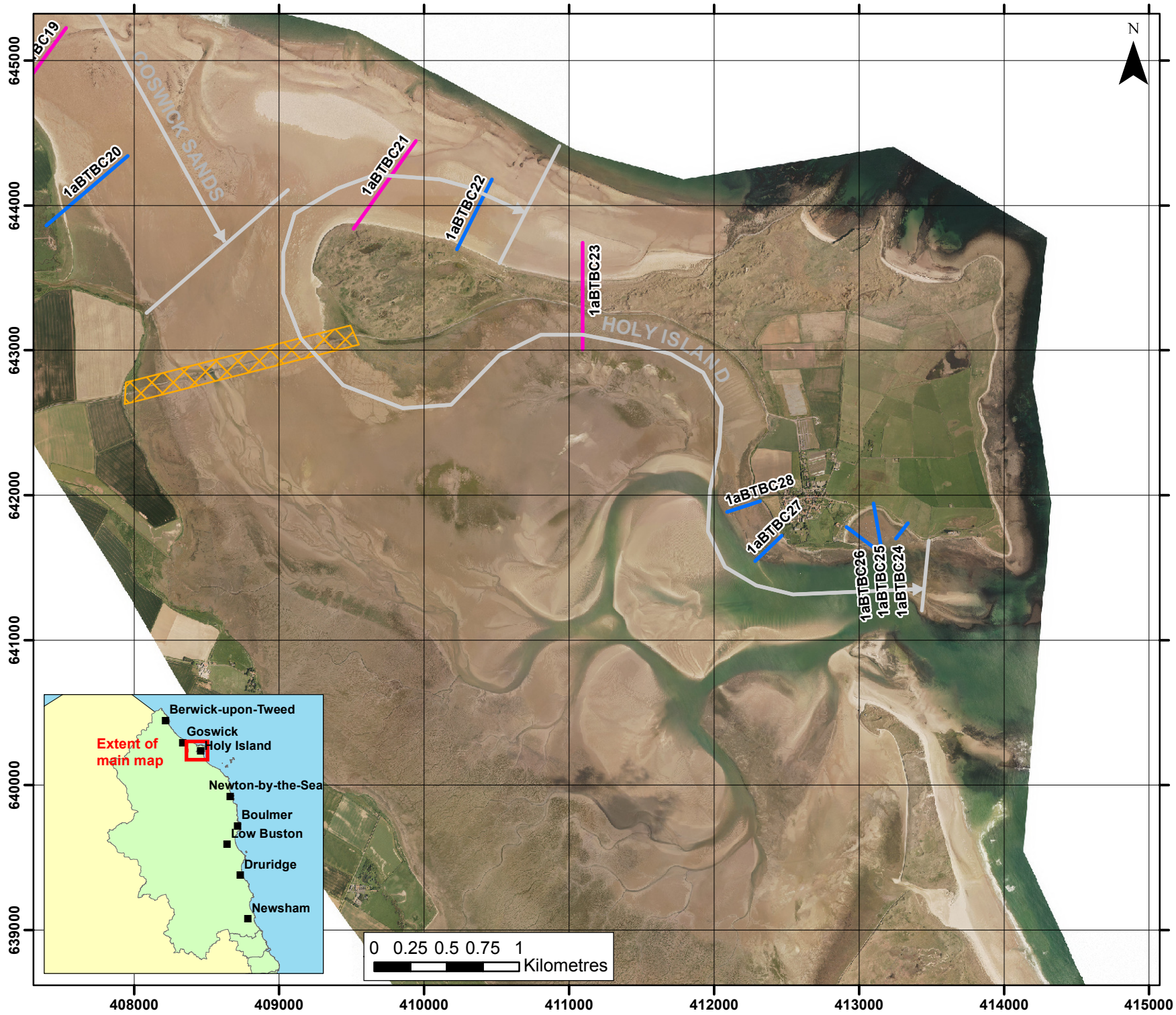

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Topographic Surveys
- 6 monthly
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- 5 yearly

Cliff Top Monitoring Pegs
- 50m centres
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- 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
Holy Island
Northumberland
County Council

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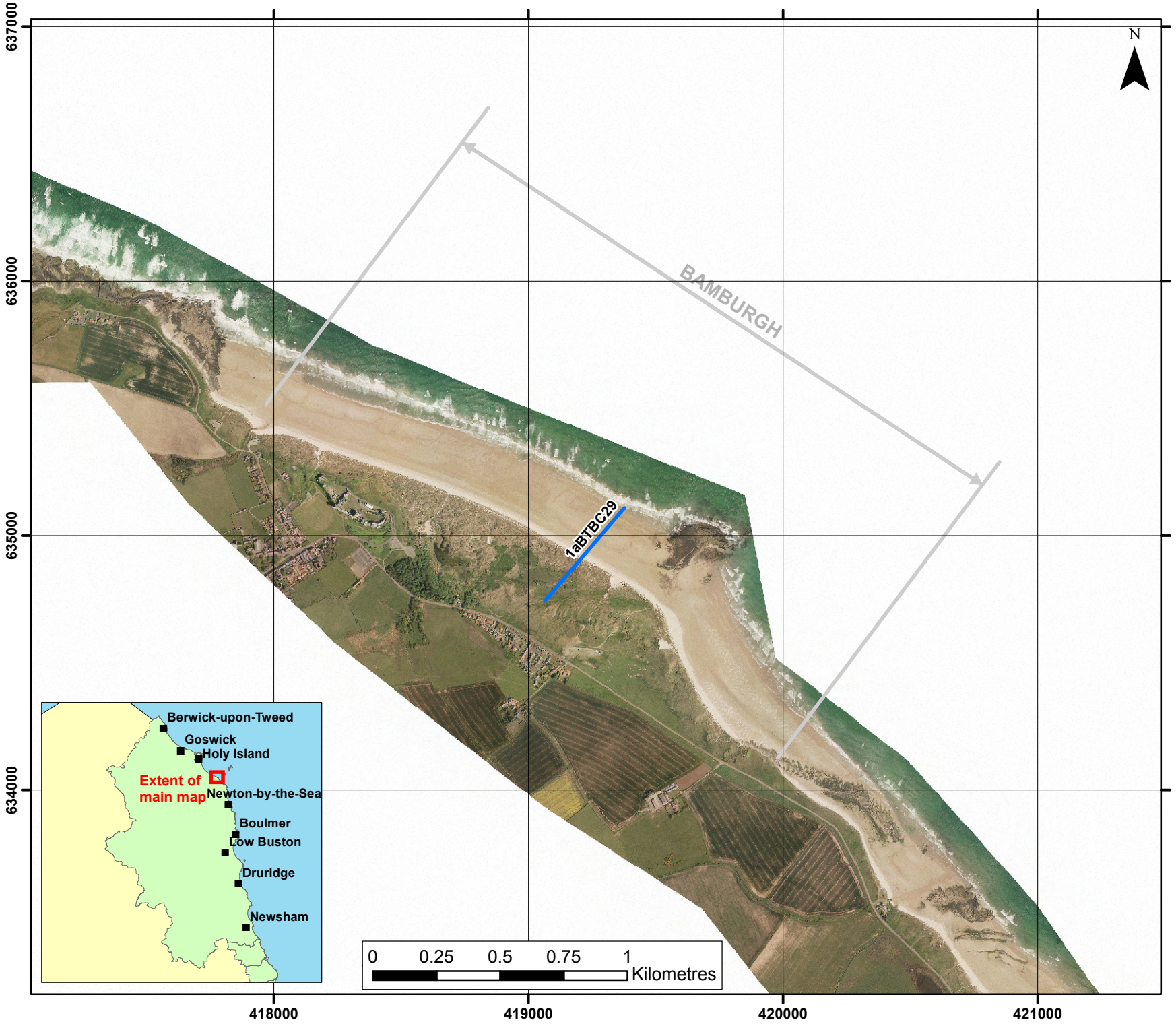

KEY

Topographic Profiles

- Annual
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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 4
Survey Locations
Bamburgh
Northumberland
County Council

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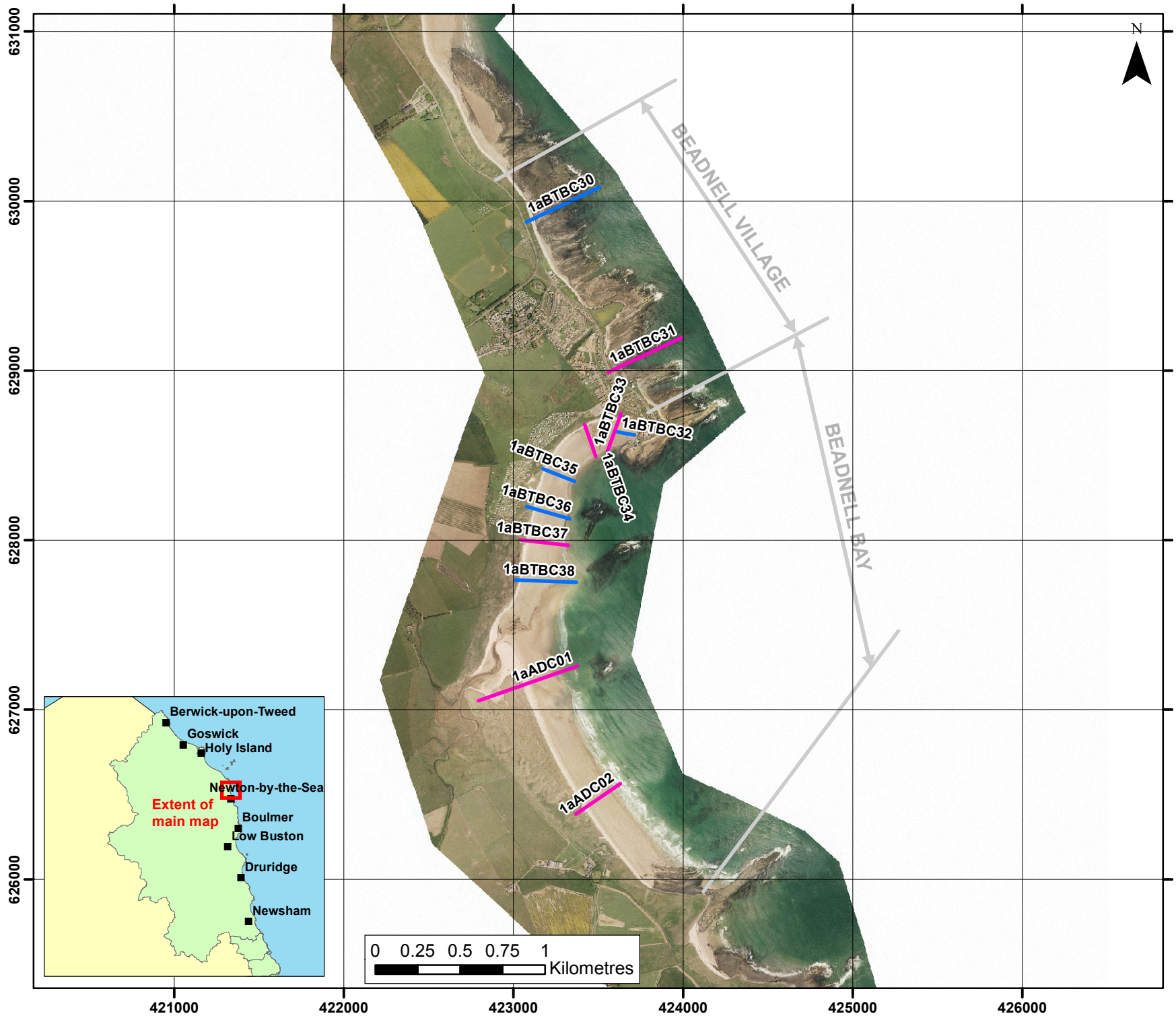

KEY

Topographic Profiles

- Annual
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Topographic Surveys

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Cliff Top Monitoring Pegs

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

(Indicative Survey Extents shown)

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Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Figure 2 - Map 5
Survey Locations
Beadnell Villange and Bay
Northumberland County Council

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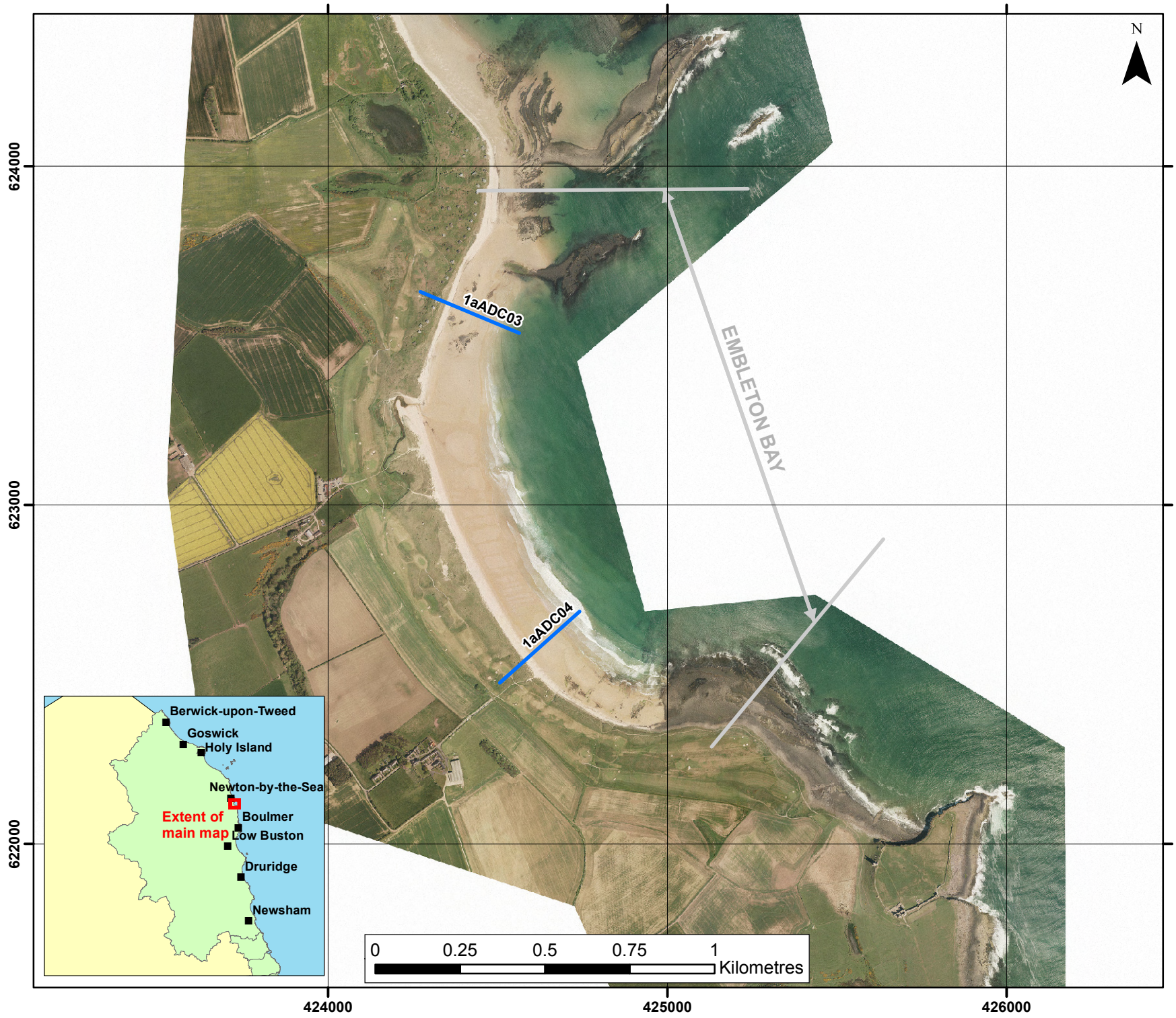

KEY

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)

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Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Figure 2 - Map 6
Survey Locations
Embleton Bay
Northumberland County Council

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Partial Measures Survey
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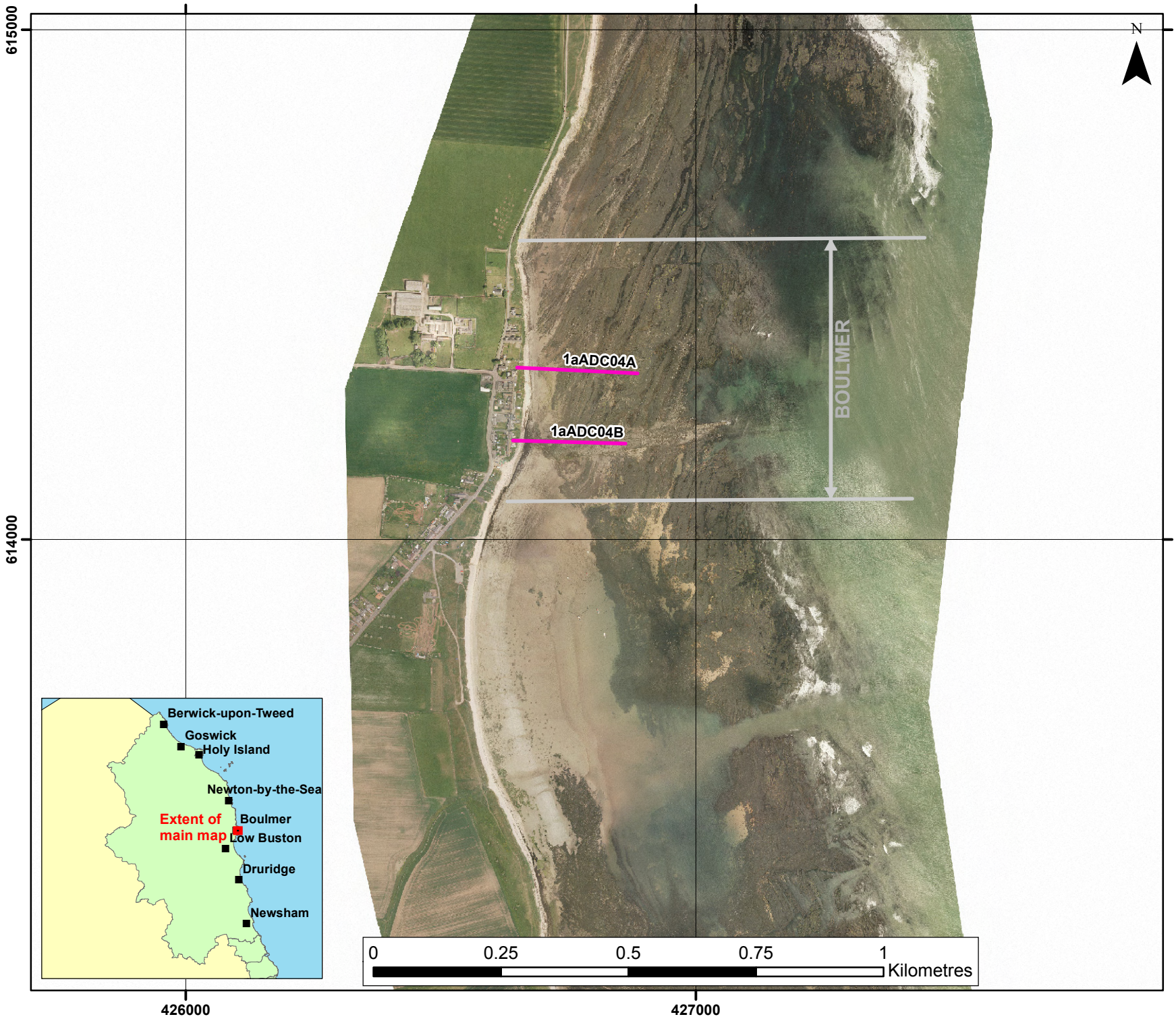

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Cliff Top Monitoring Pegs

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

(Indicative Survey Extents shown)

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Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Figure 2- Map 7
Survey Locations
Boulmer
Northumberland
County Council

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Partial Measures Survey
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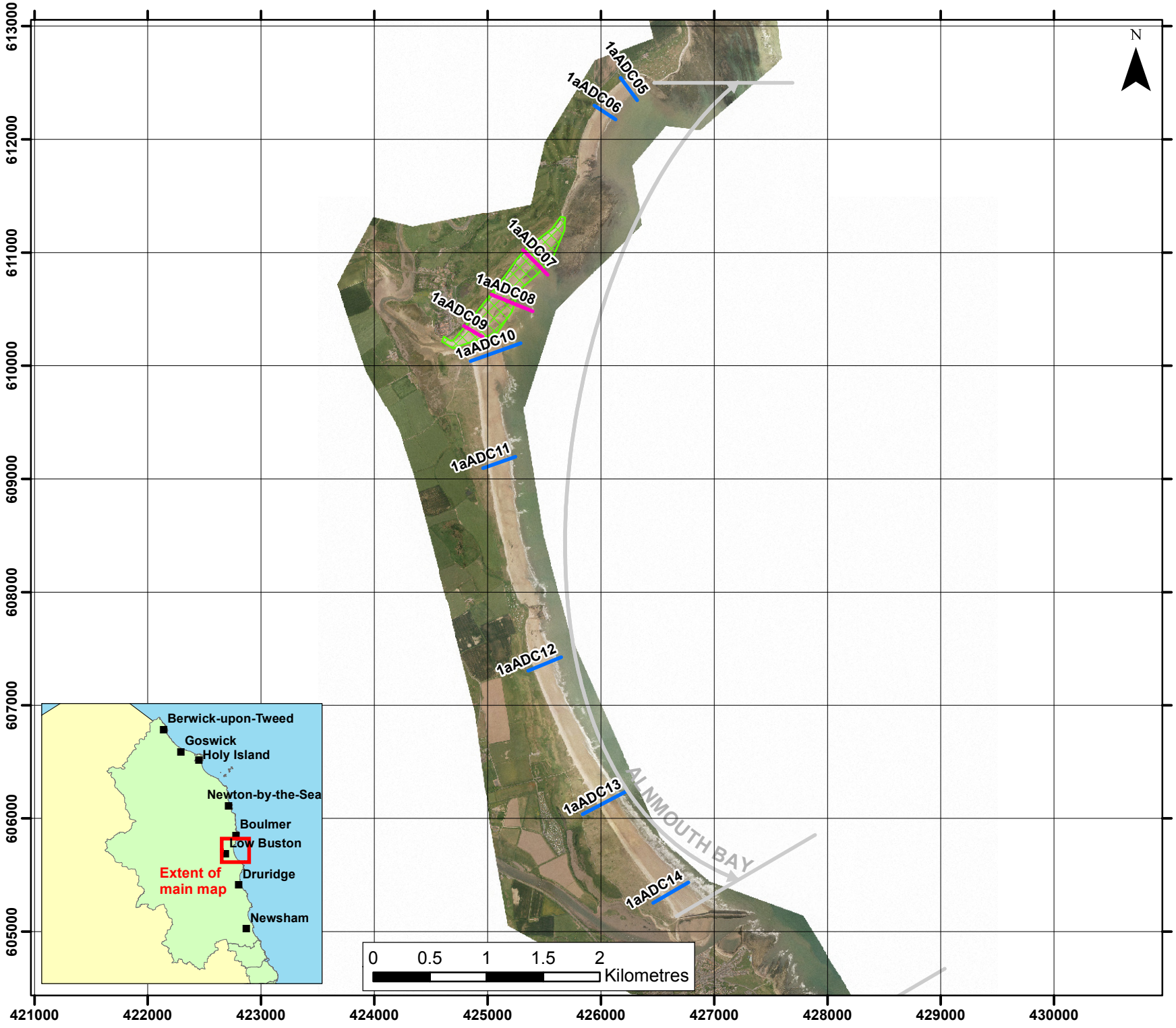

KEY

Topographic Profiles
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Cliff Top Monitoring Pegs
- 50m centres
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- 300m centres

(Indicative Survey Extents shown)

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Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Figure 2- Map 8
Survey Locations
Alnmouth Bay
Northumberland County Council

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Partial Measures Survey
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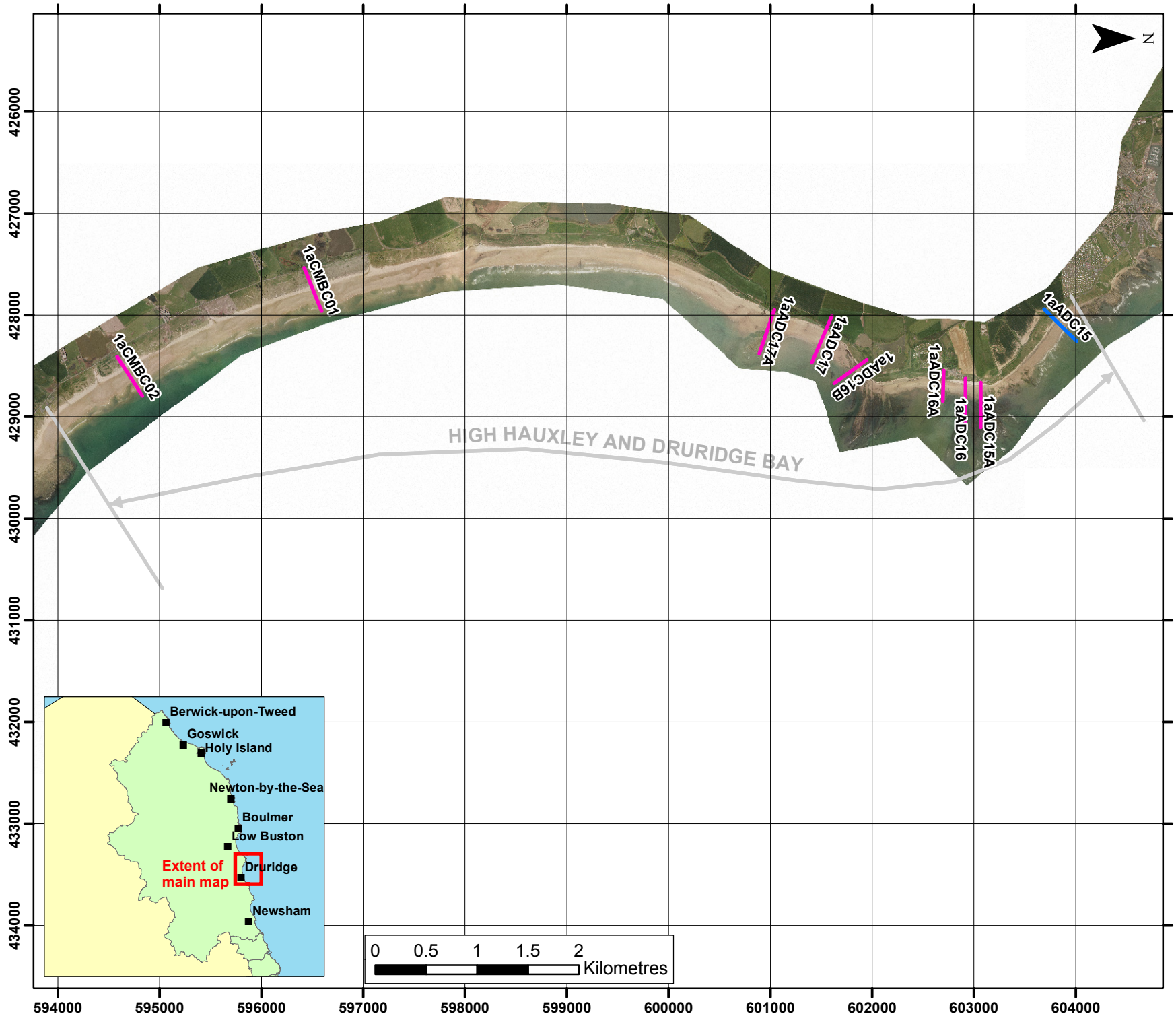

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Cliff Top Monitoring Pegs
- 50m centres
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- 300m centres

(Indicative Survey Extents shown)

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Figure 2 - Map 9
Survey Locations
High Hauxley & Druridge Bay
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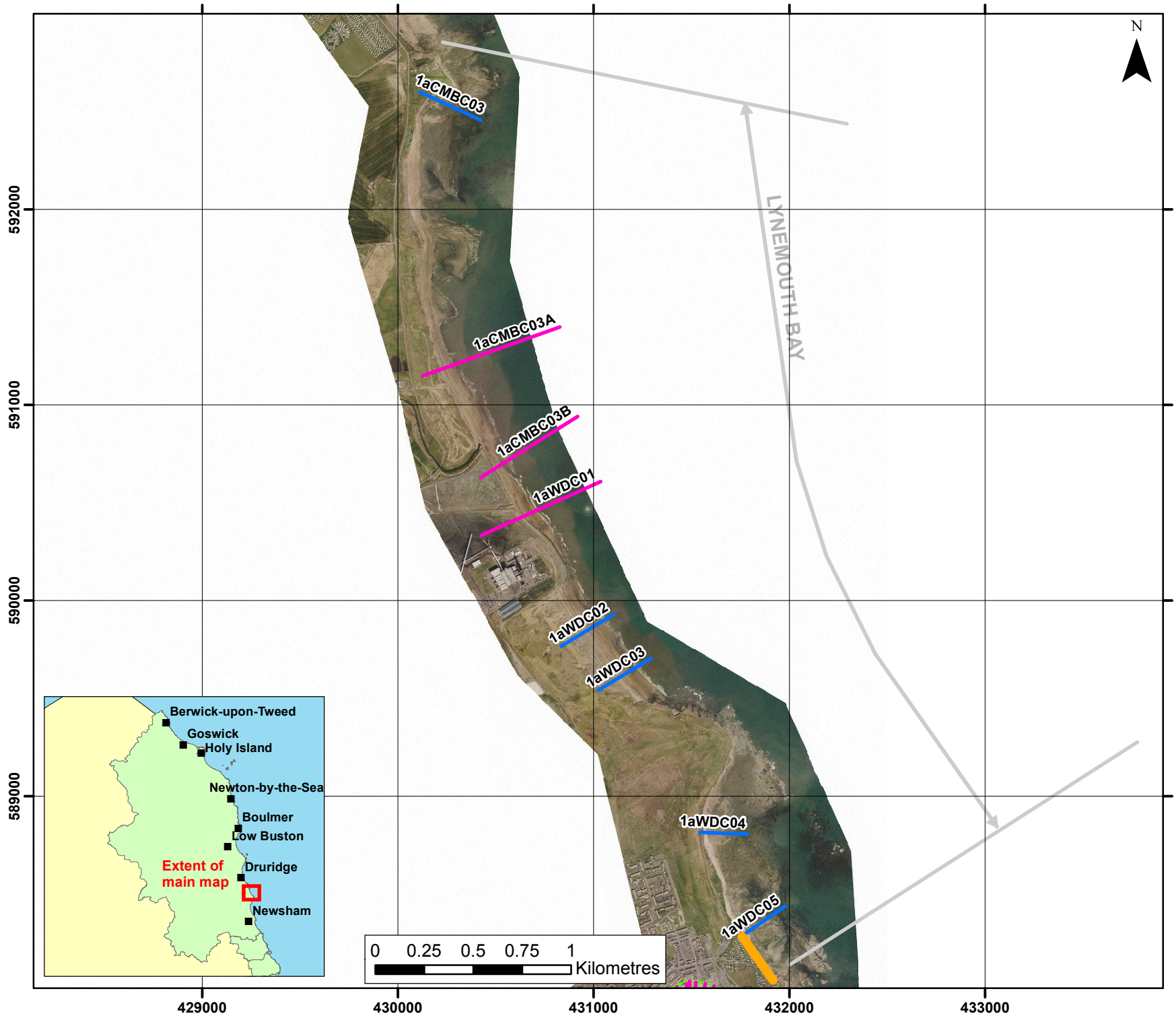

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- Cliff Top Edge Survey

(Indicative Survey Extents shown)

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Figure 2 - Map 10
Survey Locations
Lynemouth Bay
Northumberland County Council

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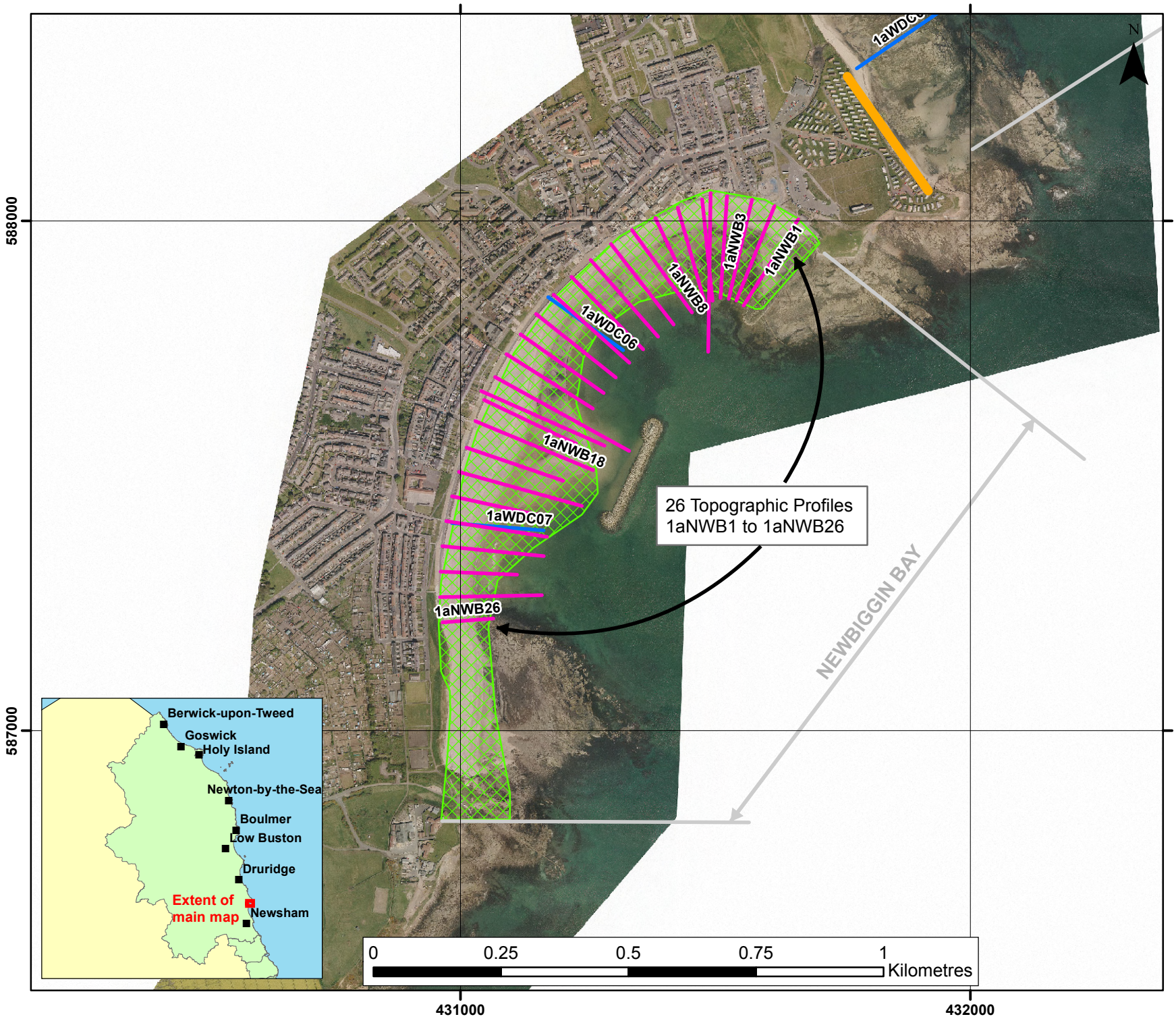

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(Indicative Survey Extents shown)

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Figure 2 - Map 11
Survey Locations
Newbiggin Bay
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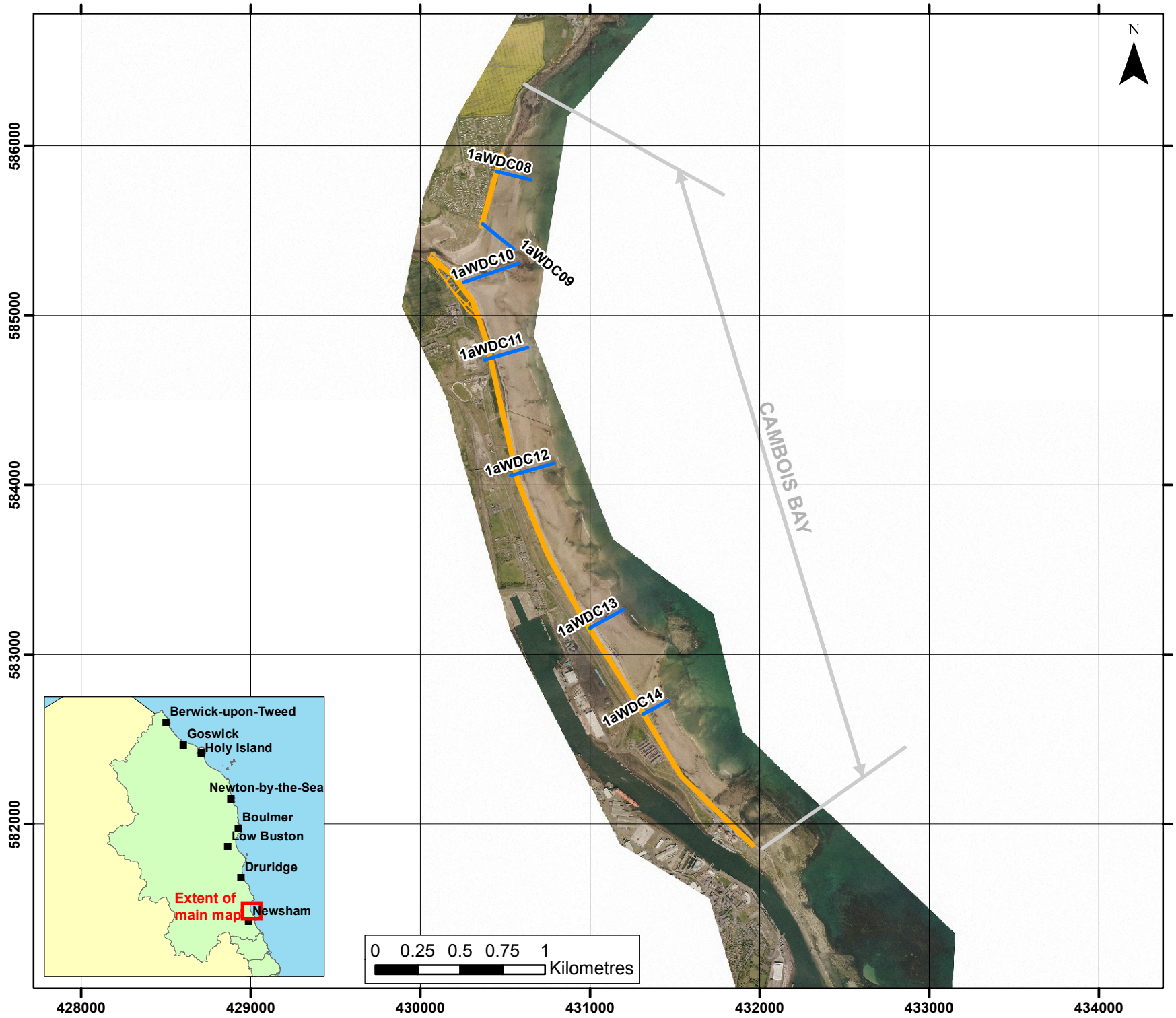

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Figure 2 - Map 12
Survey Locations
Cambois Bay
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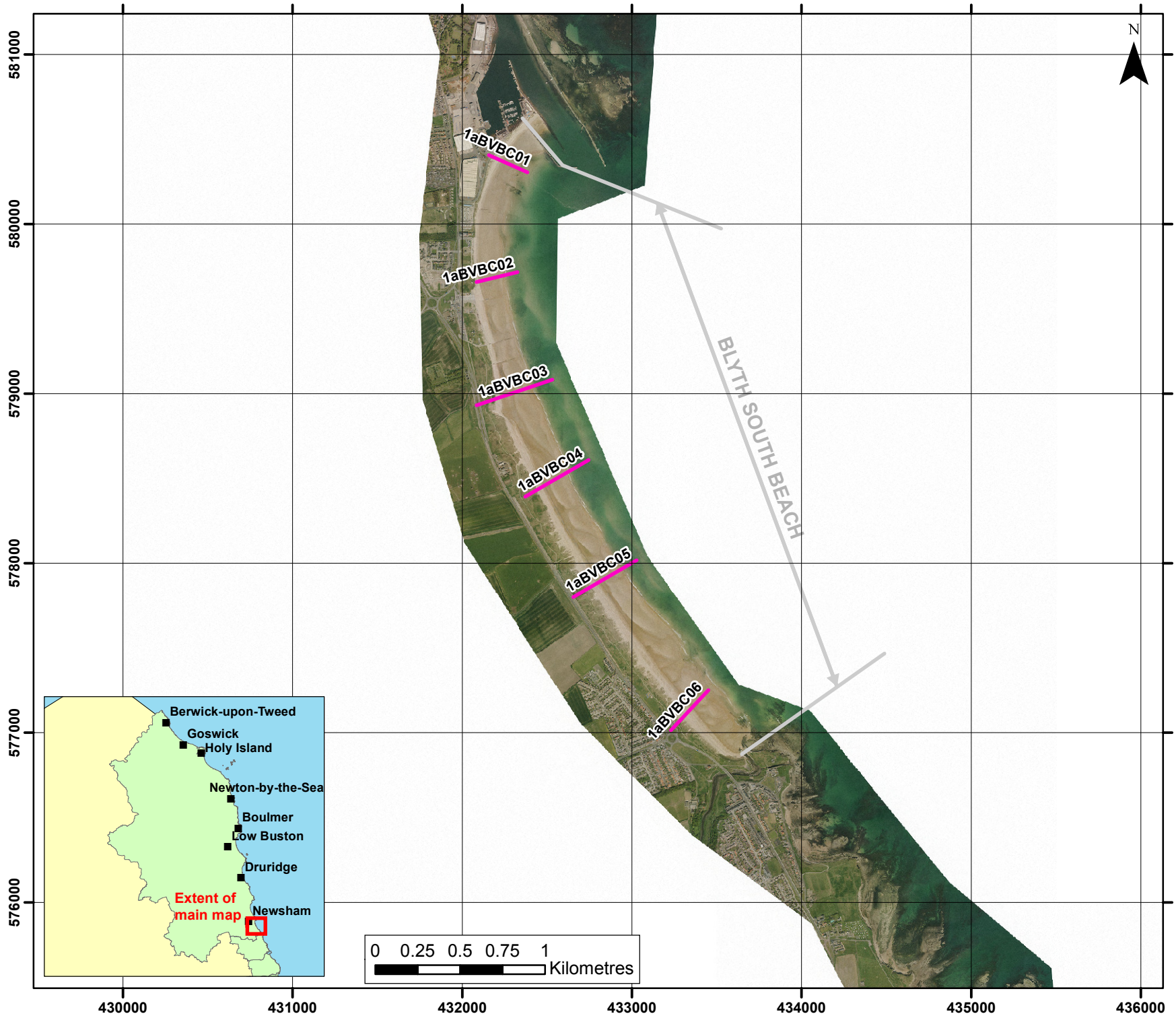

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(Indicative Survey Extents shown)

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Figure 2 - Map 13
Survey Locations
Blyth South Beach
Northumberland County Council

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Tel: +44 (0)121 456 2345
Fax: +44(0)121 456 1569
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2. Analysis of Survey Data

2.1 Sandstell Point (Spittal A)

Survey Date	Description of Changes Since Last Survey	Interpretation
Apr 2012	**Beach Profiles:** Sandstell Point is covered by four beach profile lines for the Partial Measures survey (Appendix A). The previous survey was undertaken for the full measures survey in winter 2011. Profile **1aBTBC02** is located on the southern bank of the inner estuary. The dunes have accreted by approximately 0.1m from the profile origin to just above HAT. From HAT to a level of -0.2 (chainage 70m), beach levels have reduced by up to 0.4m. Similar beach levels were last observed in the previous survey in September 2010. It is likely that material has been eroded from the beach by wind-blown transport and deposited over the dunes. Profiles **1aBTBC04** (longitudinal section) and **1aBTBC05** and **1aBTBC06** (both cross-sections) cover the spit at Sandstell Point. At profile 1aBTBC04, the beach profile has a similar form when compared to the previous survey, however, the profile appears to have translated seawards so that beach levels at the toe of the rock revetment are lower, but higher across the middle beach. Profiles **1aBTBC05** and **1aBTBC06** are transects across the spit, drawn looking towards the south, with the river channel on the right-hand side of the plot and the open sea on the left-hand side of the plot. As observed in 1aBTBC04, the beach profiles have retained a similar form to the previous survey but translated along the profile (i.e. to the west). When these three profiles are compared to previous surveys, it is clear that the beach material is subject to seasonal movement with no clear long-term trend.	Since the last survey, the dunes on the southern bank of the inner estuary have accreted by a small amount. Beach levels have fallen and it is likely that material has been eroded from the beach by wind-blown transport and deposited over the dunes. On the Sandstell Point, the beach material has shifted evident by the movement of the berm seaward. **Longer term trends:** The dunes on the southern bank of the inner estuary are accreting. The changes observed on the beach of the southern bank of the inner estuary are within those changes observed since 2008. Full measures report 3, from 2010, links changes on the Sandstell Point to the movement of the main channel of the River Tweed towards the southern bank as it adopts a more sinuous flow route around Sandstell Point spit. This could explain the ongoing movement of the berm away from the river and towards the sea. However, it is likely that the changes observed since the last survey relate to winter seasonal changes in tides, storms and freshwater flows.

Survey Date	Description of Changes Since Last Survey	Interpretation
Mar 2012	**Topographic Survey:** Due to the significant changes that have been observed from the beach profiles along the spit at Sandstell Point, and the three dimensional nature of these changes, a topographic survey was introduced to the monitoring programme in November 2009. The previous survey was undertaken for the full measures survey in winter 2011. Data from the most recent topographic survey (partial measures, spring 2012) have been used to create a digital ground model (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 and the present survey. In particular, the difference plot shows: (i) an increase in beach elevation seaward of the dunes around the u-bend of the River Tweed (the survey report for Berwick notes '*band of small dunes forming along top of river beach'*); (ii) a band of reduced beach elevation orientated north to south that runs parallel to Sandstell Point and abuts the headland; (iii) a band of increased beach elevation orientated north to south that runs parallel to Sandstell Point; (iv) on the seaward side of the berm beach elevation has reduced. The latter repeats the findings of the beach profile analysis above, which suggests the development of a berm to the east.	The topographic survey shows a band of reduced elevation (i.e. erosion) that abuts and extends passed the headland. Adjacent to this, to the east, is a parallel band of increased elevation. It is likely that the material eroded from the zone of reduced elevation is deposited in the zone of increased elevation to form a bank and represents the eastwards movement of the berm. This change is reflected in the beach profiles for the same areas is this accretion reflects the bank that is likely to have formed under winter storm conditions **Longer term trends:** There is a clear lateral movement of the berm across Sandstell Point. Around this berm material erodes and accretes, sometimes leading to the growth of the dunes on the inner estuary. In the previous survey report, it was suggested that between the winter and summer months the spit is likely to be subject to storms where the resultant waves and currents act to move the material around. Over the summer calmer conditions lead to the formation of berms and troughs. Over the winter between 2011 and 2012, the berm has shifted. The areas of beach elevation increase and decrease are less well defined that in the full measures (winter, 2011) survey, supporting the idea that storm waves and currents act to move the material around.

2.2 Spittal (Spittal B)

Survey Date	Description of Changes Since Last Survey	Interpretation
Apr 2012	**Beach Profiles:** Spittal B is covered by two beach profile lines for the Partial Measures survey (Appendix A). The previous survey was undertaken for the full measures survey in winter 2011. Profile **1aBTBC11** is located to the north of Spittal Beach. Beach levels at the toe of the seawall have increased by up to 0.4m. Seaward of a chainage of 30m, through HAT and MHWS to 65m, beach levels have reduced across the profile by up to 0.4m. Here, the profile has retained the same form. Between a chainage of 65m and 155m, beach levels have increased by over 1m. The beach profile is convex indicating the formation of a wide berm. Profile **1aBTBC13** is located to the centre of Spittal Beach. With the exception of a small length of beach between a chainage of 55m and 80m, beach levels have increased across the profile by up to 0.4m.	Since the last survey, the beach profiles on Spittal Beach have shown signs of upper beach accretion, erosion across the middle beach, and accretion on the lower beach. This behaviour is expected over the winter months as material is moved up the beach to form a berm and other material is drawn down the beach by storms. **Longer term trends:** The general form and position of the beach is similar to previous surveys. Present beach levels are amongst the highest recorded since 2008 (full measures, winter 2008).

2.3 Goswick Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
Apr 2012	**Beach Profiles:** Goswick Sands are covered by two beach profile lines for the Partial Measures survey (Appendix A). The previous survey was undertaken for the full measures survey in winter 2011. Profile **1aBTBC16** is located to the north of Goswick Sands, between Far Skerr and Cheswick Black Rocks. The dunes have not changed in form or position since the last survey. Beach levels at the dune toe have increased by approximately 0.1m. The survey report for the North East Coast notes that '*sand accumulation at foot of dune*'. Seaward of MHWS, with the exception of a small section of the profile between 130m and 150m chainage, beach levels have fallen across the profile. This is a continuation of the trends observed over the previous two surveys. Profile **1aBTBC19** is located to the south of Goswick Sands. The dunes have not changed in form or position since the last survey. Beach levels have also remained the same since the last survey.	To the north of Goswick Sands, beach levels at the dune toe have increased, however beach levels have fallen across the profile. To the south of Goswick Sands, the dunes and the beach have remained stable with no discernable change. **Longer term trends:** The dunes at Goswick Sands are stable. To the north of this section of coastline, the dune toe is accreting. Although beach levels to the north are falling, they are still higher than those observed in October 2010 (full measures, winter 2011) and in previous surveys. The beach to the south is stable and the profile compares well to previous surveys.

2.4 Holy Island

Survey Date	Description of Changes Since Last Survey	Interpretation
Apr 2012	**Beach Profiles:** Holy Island is covered by two beach profile lines for the Partial Measures surveys (Appendix A). The previous survey was undertaken for the full measures survey in winter 2011. **1aBTBC21** and **1aBTBC23** are located on the north-west side of the island, along The Snook. Profile **1aBTBC21** shows little change since the last survey, with no discernible change in from or position of the dunes or beach. Profile **1aBTBC23** shows little change since the last survey, with no discernible change in from or position of the dunes or beach. However, the present survey is shorter than previous profiles and only extends to a chainage of 550m while previous profiles have extended to a chainage of 1050m. Therefore it is not possible to make a comparison with previous profiles for the missing length of profile.	At Holy Island, on the north-west side of the island, along The Snook, the profiles have shown little change since the last survey (full measures, winter 2011), with no discernable change in from or position of the dunes or beach. The previous full measures report (winter 2011) indicated profile 1aBTBC23 was a prograding beach, suggesting that this coastline is a net receiver of sediment. In the absence of survey data for this section of coastline, it was not possible to verify if this trend has continued since the last survey. **Longer term trends:** The trends observed from the present survey are a continuation of trends observed in the past, whereby the dunes and beach have retained the same form and position.

2.5 Beadnell Village

Survey Date	Description of Changes Since Last Survey	Interpretation
Apr 2012	**Beach Profiles:** Beadnell Village is covered by one beach profile line for the Partial Measures survey (Appendix A). The previous survey was undertaken for the full measures survey in winter 2011. **1aBTBC31** is in Nacker Hole and extends across the promenade and seawall. The profile has not changed from or position. Since the last survey, beach levels at the toe of the seawall to HAT have increased by up to 0.2m. Across the profile, beach levels have varied by approximately 0.1m.	At Nacker Hole, the profile has remained stable. There has been a small increase in beach levels at the coastal defence toe and across the beach. **Longer term trends:** The profile form and position is within the bounds of previous surveys.

2.6 Beadnell Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
Apr 2012	**Beach Profiles:** Beadnell Bay is covered by five beach profile lines for the Partial Measures survey (Appendix A). The previous survey was undertaken for the full measures survey in winter 2011. Profiles **1aBTBC33** and **1aBTBC34** are located to the north of Beadnell Bay, in Beadnell Harbour. Profile **1aBTBC37** is located further south towards the outfall of Brunton Burn/Long Nanny. At **1aBTBC33**, the profile suggests erosion of the dune face, by up to approximately 0.4m. However, the survey report for the North East Coast notes '*gap in data due to bushes on top of dunes*'. Beach levels have increased by a small amount (0.1m) between HAT and MHWS. With the exception of a small length of profile between a chainage of 110m and 140m, beach levels have fallen in the region of 0.1m. The dunes at profile **1aBTBC34** have not changed from or position. Beach levels have generally increased across the beach profile, particularly at the dune toe. Along relatively short lengths of the profile, between a chainage of 30m and 45m and 100m and 150m, beach levels have reduced by up to 0.2m. At **1aBTBC37**, the toe of the dune has accreted, with a translation seawards of approximately 3m. This is also acknowledged in the survey report that notes '*sand accumulation at foot of dune*'. Beach levels have fluctuated across the profile in the order of 0.2m, but generally the beach has retained a similar form and position to the last survey. Profiles **1aADC01** and **1aADC02** are located along the frontage to the south of the outfall of Brunton Burn/Long Nanny. Since the last survey, the dunes have remained stable. Beach levels have increased across both profiles by up 0.3m. The profile form and position is within the bounds of previous surveys.	Near Beadnell harbour the dunes are mostly stable. For profile 1aBTBC33, the survey report notes that '*gap in data due to bushes on top of dunes*'. This could impact on the accuracy of survey comparisons for this profile. Beach levels have generally increased across the profile, particularly at the dune toe. Towards the outfall of Brunton Burn/Long Nanny, the beach at profile 1aBTBC37 has remained relatively stable with small changes and retaining a similar form and position to the previous survey. To the south, the dunes have remained stable and the beaches have accreted. **Longer term trends:** To the north of Beadnell Bay, the dune face and beach levels are marginally more dynamic than to the south. The dune and beach form are similar to those observed in the past, however, beach levels at the dune toe are higher than recorded previously, indicating sediment accretion and dune growth. To the centre and south of the bay, dune and profile form and position is within the bounds of previous surveys.

2.7 Boulmer

Survey Date	Description of Changes Since Last Survey	Interpretation
Apr 2012	**Beach Profiles:** Boulmer is covered by two beach profile lines for the Partial Measures survey (Appendix A). These were added to the programme in October 2007. The previous survey was undertaken for the full measures survey in winter 2011. At profile **1aADC04A** the dune cliff backshore has eroded. This is seen clearly in the survey photograph (see Plate 1). The upper beach around HAT/MHWS has remained largely stable. From MHWS to a chainage of 45m, which marks the sand portion of the beach located between the upper cobble beach and the rocky foreshore, beach levels have reduced by 0.1m to 0.2m. The survey photograph (see Plate 2) shows a large amount of seaweed on the upper beach, which may have been deposited by storms over the winter months. Beach levels over the rocky foreshore have not changed. At profiles **1aADC04B**, since the last survey, the dune and dune face has remained stable with no change in form or position. Beach levels at the toe of the dune/rock/cobble toe (MHWS) to a chainage of 45m have increased by 0.1m to 0.2m. Beach levels over the rocky foreshore have not changed. It is possible that material eroded from the beach at profile 1ADC04A has been transported and deposited at profile 1aADC04B.	The backshore at profile 1aADC04A has cut back since the last survey (full measures, winter 2011). Beach levels at have also reduced. To the south at profile 1aADC04B, the dune has remained stable and the beach has accreted. It is possible that this accretion could be linked to erosion at adjacent profile 1aADC04A. **Longer term trends:** Cutback of the backshore at profile 1aADC04A is part of an ongoing trend. Beach levels fluctuate throughout the seasons, and the levels observed in the present survey are within the bounds of previous surveys. To the south, the dunes are stable. Beach levels are the highest observed to date.

Plate 1 – Survey photograph 1aADC04A_20120411_S2.JPG

Plate 2 – Survey photograph 1aADC04A_20120411_S3.JPG

2.8 Alnmouth Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
Apr 2012	**Beach Profiles:** Alnmouth Bay is covered by three beach profile lines during the Partial Measures survey (Appendix A). These are located to the north of Alnmouth Bay between Marden Rocks and the mouth of the River Aln Estuary. The previous survey was undertaken for the full measures survey in winter 2011. At profile **1aADC07** the front face of the dunes has remained stable since the last survey (full measures, winter 2011). There has been a very small increase in beach levels at the toe of the dune and above HAT by approximately 0.1m. Beach levels across the profile have generally fallen and the beach has been re-worked. The profile indicates a bar at about 120m, with erosion of up to 1m to landwards to form a channel. At profile **1aADC08** the front face of the dunes has remained stable since the last survey. Beach levels have increased across the profile from HAT to a chainage of 170m. The profile shows a small berm of material that has formed around HAT and MHWS. The survey photograph (see Plate 3) indicates this is likely to correspond to the accumulation of beach material around the concrete blocks (former WW2 anti-tank defences).that were previously much more exposed. At profile **1aADC09** the front face of the dunes has remained stable since the last survey. Beach levels have increased across the profile from HAT to a chainage of 145m to form a more gently sloping beach profile. Between a chainage of 150m and 185m, the berm that existed in the previous survey has been eroded to form a concave profile.	Between Marden Rocks and the mouth of the River Aln Estuary, the dunes have remained stable. The upper and middle beaches have accreted. The profile here has also changed to form bars and troughs rather than the more concave beach observed from the previous survey. There had been accretion around the concrete tank trap blocks at profile 1aADC08. Towards MLWS, beach levels have fallen. In some cases this is where a former berm has been flattened out to form a trough. As the survey photograph for profile 1aADC09 shows (see Plate 4), there is a collection of water towards MLWS, which represents this trough. **Longer term trends:** The dunes have remained stable since 2008. The beaches are dynamic and the changes observed in the present survey are within the bounds of previous surveys. As noted in the previous full measures report (winter 2011), the beaches here are likely to be affected by channel movements in the Aln Estuary and flow into and from the channel.
Apr 2012	**Topographic Survey:** The northern part of Alnmouth Bay (to the north of the River Aln estuary) is covered by bi-annual topographic survey, which commenced in April 2005. Data from the most recent topographic survey (full measures, winter 2011) have been used to create a DGM (Appendix B – Map 2a) using a Geographical Information System (GIS). A difference plot has also been produced using the DGM (Appendix B – Map 2b) produced from the last produced topographic survey (partial measures, spring 2011) and the	The findings of the topographic survey support the findings of the beach profile analysis, which indicate that the beach has accreted along the upper and middle beach and the lower beach, close to MLWS, has eroded. This compares well to the location of a water-filled trough observed from the survey photograph (see Plate 4).

Survey Date	Description of Changes Since Last Survey	Interpretation
	present survey. The difference plot shows a reduction in beach elevation on the northern bank of the estuary, on the upper beach in the lee of Marsden Rocks and on the lower shore. Along the central section of this beach length, there is a linear band where beach elevation has increased. Also, the upper beach has accreted over about a 300m length centred on the access road to the car park. These findings reflect the findings of the beach profile, where there has been accretion along the upper and middle beach and erosion of the lower beach, close to MLWS.	**Longer term trends:** Comparison of the present topographic survey with the previous full measures (winter 2011) shows that the linear band of beach elevation reduction on the upper/middle beach has been replaced with a band of beach elevation increase. A second band of beach elevation reduction that is located on the lower beach in 2011 has also moved landward. In addition two former zones of predominantly beach elevation gain to the north (in the lee of Marsden Rocks) and at the channel entrance have switched to beach elevation reduction. Similar to Sandstall Point (Spittal A), the beach form is continually changing as a result of the interaction between waves and tidal currents and the influence of the headland/rock outcrop to the north and the River Aln to the south. As in the previous full measures (winter, 2011) report, between the winter and summer months the beach is likely to be subject to storms where the resultant waves and currents act to move the material, predominantly in an offshore direction.

Plate 3 – Survey photograph 1aADC08_20120423_N2.JPG

Plate 4 – Survey photograph 1aADC09_20120423_N11.JPG

2.9 High Hauxley & Druridge Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
Apr 2012	**Beach Profiles:** High Hauxley to Druridge Bay is covered by eight beach profile lines during the Partial Measures survey (Appendix A). Four of these (with 'A' or 'B' suffices) were added to the programme in October 2007). The previous survey was undertaken for the full measures survey in winter 2011. **1aADC15A**, **1aADC16** and **1aADC16A** are located around Hauxley Haven. The dunes at all three profiles have remained largely unchanged since the last survey. At profile **1aADC15A**, beach levels at the toe of the dune to MHWS have increased up to 0.3m to form a berm. From MHWS to a chainage of 150m beach levels have reduced by 0.1m. From chainage 150m to the rocky foreshore beach levels increased by 0.1m to 0.2m. At profile **1aADC16**, beach levels at the toe of the dune to a chainage of 120m have increased by 0.1m, again with the formation of a small berm at HAT. Seaward of 120m beach levels have reduced by 0.1m. This profile form is typical of a winter profile with the formation of a storm berm at the back of the beach and draw down of material on the face of the beach. At profile **1aADC16A**, there has been no discernable change to the dunes or beach levels. **1aADC16B**, **1aADC17** and **1aADC17A** are located to the north of Druridge Bay, between Bondi Carrs and Hadston Carrs and extend seawards from Togston Links. The dunes at all three profiles have remained largely unchanged since the last survey. At profile **1aADC16B**, beach levels at the toe of the dune have fallen by 0.1m and increased at a chainage of 180m, seaward of the rock foreshore. No change to the beach is observed across the rocky outcrop, where the survey report notes '*section is all rock on beach*'. At profile **1aADC17**, beach levels at the toe of the dune have increased by 0.2m. Generally beach levels have not changed, with limited accretion of 0.1m to a chainage of 100m and accretion of 0.2m seaward of chainage 100m. At profile **1aADC17A**, beach levels at the toe of the dune, just below MHWS, have increased by 0.2m. From a chainage of 50m across the profile, beach levels have fallen by up to 0.3m. **1aCMBC01** and **1aCMBC02** are located in the southern section of Druridge Bay. Since the last survey, the dunes have remained stable. At both profiles, beach levels have increased across the profile to a level of about 0m. Seaward of there, they have fallen. Around HAT/MHWS a berm has formed at the dune two, this is particularly apparent at profile 1aCMBC01 where two berms have formed. This material could be the seaward movement of the material that made-up the berm that in the previous survey was	At Hauxley Haven, the dunes have remained stable. With the exception of 1aADC16, the beach is showing evidence of cross-shore movement, with the redistribution of material from the middle beach to the upper beach to form a berm, and to the lower beach. This is typical of a winter profile and beach response to storms. Between Bondi Carrs and Hadston Carrs, the dunes have remained stable and the beaches levels have changed only marginally (0.1m to 0.2m). The southern central part of Druridge Bay is accreting, evident by a prograding shoreline. **Longer term trends:** At Hauxley Haven, the changes are just within the bounds of previous surveys. However at profiles 1aADC16 and 1aADC16A, beach levels at the location of the berm are the highest observed and the lowest observed around a height of -1m. Between Bondi Carrs and Hadston Carrs, the dunes have remained stable. When compared to the present survey to previous surveys, beach levels at 1aADC16B remain low and have not returned to levels first seen 2008. Beach levels at profile 1aADC17 are some of the highest observed to date. Changes at 1aADC17A levels at the dune toe are the highest observed and the lowest observed around a height of -

Survey Date	Description of Changes Since Last Survey	Interpretation
	located further down the profile.	-1m. In the southern central part of Druridge Bay, beach levels at the dune toe are the highest recorded since 2008. beach level change in the lower portion of the profile are within the bounds of previous surveys.

2.10 Lynemouth Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
Apr 2012	**Beach Profiles:** Lynemouth is covered by two beach profile lines during the Partial Measures survey (Appendix A), Profiles 1aCMBC03A and 1aCMBC03B were added to the programme in October 2007. Profile 1aWDC01 was added to the programme in March 2010. The previous survey was undertaken for the full measures survey in winter 2011. **1aCMBC03A** is located opposite Lynemouth and extends across the extensive slag banks before reaching the foreshore. The slag bank has not experienced any change since the last survey. Around HAT/MHWS the gravel berm that was present in the previous survey has been flattened so that the beach now slopes consistently from the toe of the slag bank to MLWS. **1aCMBC03B** is located to the north of Lynemouth Power Station and extends across the extensive slag banks before reaching the foreshore. The slag bank has eroded considerably since the previous survey. The bank has receded by approximately 10m on the top and 1m on the face (see survey photograph, Plate 5). Beach levels have fallen across the profile by 0.4m. The survey report for the North East Coast notes '*section top has lowered due to grading*'. **1aWDC01** extends from seaward of the rock revetment down to low water across the extensive slag banks. Beach levels seaward of the rock revetment have increased by up to 0.4m since the last survey.	The behaviour of the shoreline from Lynemouth to the Power Station is variable. To the north, the slag bank at the rear of the foreshore has remained stable, whilst the foreshore has shown some minor variation. This behaviour was observed in the previous partial measures report (spring, 2011). Opposite the Power Station, the slag bank has eroded significantly. The previous partial measures report (spring, 2011) notes '*erosion - appears to have prompted management intervention... The combined effect of regarding of the slope to a shallower angle together with the foreshore accretion should slow or arrest the rate of recession. This will be confirmed through analysis on ongoing surveys in future reports'*. The survey report also notes '*section top has lowered due to grading*'. It is therefore possible that further re-grading of the slag tip has occurred between the present and previous partial measures survey and could explain the observed erosion. Beach levels at 1aWDC01 have increased. **Longer term trends:** Beach level changes observed to the north are within the bounds of those observed in the past. The slag tip and beach have reduced in size and width/level considerably since 2008. Beach levels at 1aEDC01 have returned to those recorded in the previous partial measures survey (spring, 2011).

Survey Date	Description of Changes Since Last Survey	Interpretation
Apr 2012	**Cliff-top Survey:** This is the first year that the cliff top survey data has been plotted with change measured along pre-defined, fixed transect lines. Therefore, this is the first time that a comparison with previous data has been completed. This analysis will be completed on a bi-annual basis in future reports. Three transect lines (numbered 1-3) were established along the cliff top in Lynemouth Bay in October 2008. Measurements are from the landward end of the transect (the fixed datum) to the surveyed cliff top. Measured distances to cliff top can then be compared to calculate erosion rates. The cliff top surveys are intended to inform on erosion rates of the sea cliffs to the south of Lynemouth Bay on the north side of Newbiggin Point. 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 - Map 1 for the location of the transects ground control points. The results from the cliff top monitoring are anticipated to have an accuracy of ±0.2m due to the technique used. Appendix C – Table C1 provides results from the October 2008 cliff top survey, showing the position from the datum to the edge of the cliff top along each transect. Also shown is the calculated rate of change since the October 2008 baseline survey the previous (November 2011) and survey. Results show that erosion or an amount of movement greater than the survey error has occurred at 2 ground control points (1 and 3) since surveys began in October 2008. At ground control point 2, movement is within the error band. Since the last survey in November 2011, cliff movement at all three locations is zero or within the error band.	This is the first year that the cliff top survey data has been calculated along transects, so it is the first time that a comparison with previous data has been completed. Since the last survey in November 2011, cliff movement at all three locations is zero or within the error band. **Longer term trends:** Since surveys began in October 2008, results show that erosion or an amount of movement greater than the survey error has occurred at 2 ground control points (1 and 3). At ground control survey point 1 this is erosion of 0.6m. The equates to an erosion rate of 0.2m/year. At ground control surely point 3, the cliff is recorded to have accreted by 0.3m. Cliffs are unlikely to accrete and this accretionary trend highlights the problems in identification of the cliff top due to growth of vegetation that make the short term change data unreliable. An additional assessment of cliff recession will be derived from analysis of time-series remote sensing data. A high quality baseline survey, comprising LiDAR and aerial photography, was collected in 2010, a repeat survey was completed in Sept/Oct 2012 and a second repeat survey is planned for 2014. These data will be analysed to give more accurate information on the behaviour of the cliffs in a separate report.

Plate 5 – Survey photograph 1aCMBC03A_20120412_N3.JPG

2.11 Newbiggin-by-the-Sea

Survey Date	Description of Changes Since Last Survey	Interpretation
Mar 2012	**Beach Profiles:** Newbiggin-by-the-Sea is covered by four beach profile lines during the Partial Measures survey (Appendix A). Two of these (with 'A' suffices) were added to the programme in October 2007 specifically to help assess the performance of the capital scheme involving beach replenishment and construction of an offshore breakwater. It should be noted that an extended series of profiles and a topographic survey are also recorded via the Cell 1 Regional Coastal Monitoring Programme for purposes of post-project evaluation of this capital scheme. These profiles are not analysed here, however, the findings of the topographic survey are presented below. The previous survey was the full measures assessment undertaken in winter 2011. **1aWDC05A** is in the north of Newbiggin Bay. Between the toe of the seawall and a chainage of 55m, beach levels have increased by up to 1m. This increase is greatest between HAT and MHWS. The survey photograph shows accretion of beach material against the seawall toe and slipway (see Plate 5). Beach levels between a chainage of 55m and 80m have fallen by up to 0.4m, but increased between there and the rocky foreshore. **1aWDC06** is located in the centre of the northern part of Newbiggin Bay, between the two breakwaters. Since the last survey, beach levels have increased across the profile from the toe of the seawall to a chainage of 40m so that the stepped revetment is now covered by sand again. Between about 40m and 80m beach levels have fallen. The survey photograph shows the accumulation of sand in the lee of the seawall (see Plate 7). It is likely that material eroded from the middle/lower beach has been transported to the middle/upper beach by wind-blown transport. **1aWDC06A** is located in the centre of Newbiggin Bay, behind the offshore breakwater. Beach levels have increased by 0.2m at the seawall. The berm at HAT has extended upwards and outwards, a trend that follows on from the previous partial measures survey (spring, 2011). Between a chainage of 100m and 170m beach levels have fallen by up to 0.6m, but increased seaward of there. **1aWDC07** is located in towards the south of Newbiggin Bay. Beach levels above MHWS have increased by up to 0.5m. Between HAT and a chainage of 56m they have fallen by up to 0.2m, but increased seaward of there.	Since the last survey, along the length of the Newbiggin Bay, beach levels on the upper beach have increased. The nature of the accretion (i.e. beach material in the lee of the seawall, trapped in amongst the rock revetment), suggests that this material has been deposited by wind blown transport after being entrained from the middle beach. The lower beach at all locations has accreted. This material could have been drawn-down from the beach by winter storms. **Longer term trends:** As noted in the full measures report (winter, 2011), Northumberland County Council undertook beach re-profiling during the last 3 weeks of September in 2011 and the survey from 31st October 2011 is likely to reflect the redistribution of material on the beach due to the re-profiling undertaken as part of the beach management measures. Along the profiles to the north of the bay (1aWDC05A and 1aWDC06), beach levels between HAT and MHWS appear to be returning to the levels observed prior to October 2011. As in the previous partial measures report (spring 2011), it is anticipated that ongoing maintenance aspect associated with the capital recharge scheme will again be required. The changes observed at profiles to the south of the bay are within the bounds of previous surveys and here too the beach above HAT appears to be returning towards profiles measured before the September 2011 beach management.

Survey Date	Description of Changes Since Last Survey	Interpretation
Apr 2012	**Topographic Survey:** Newbiggin-by-the-Sea is covered by bi-annual topographic survey, which commenced in September 2010 specifically to help assess the performance of the capital scheme that was constructed in 2007, which involved beach replenishment and an offshore breakwater. The topographic survey comprises a series of 26 beach profiles plus additional intervening spot heights. Prior to incorporation in the programme, these surveys were undertaken on occasions between 2007 and 2010 as part of the scheme development. The previous survey was the full measures assessment undertaken in winter 2011. Data from the most recent topographic survey (partial measures, spring 2012) have been used to create a digital ground model (DGM) (Appendix B – Map 3a) using a Geographical Information System (GIS). A difference plot has also been produced using the DGM (Appendix B – Map 3b) produced from the previous and present surveys. The topographic survey shows areas of both gain and loss across the beach. With the exception of a band of beach elevation reduction that is located on the middle beach and follows the beach contour to the north of the offshore breakwater, there does appear to be a greater spread of beach elevation gain. The survey report for Newbiggin notes that '*tractor was clearing patches of sea coal gravel from beach*'. This process results in the removal of sea coal sediment that accumulates on the beach.	The findings of the topographic survey support the findings of the beach profile analysis, which indicate beach accretion at the toe of the seawall to the north and reduction along the middle beach. **Longer term trends:** Comparison with the topographic survey for the previous full measures survey (winter 2011) shows that the band of elevation increase that followed the beach contour in the north of the bay has been replaced by a band of beach elevation reduction. However, areas previously defined by beach elevation reduction are now showing increase (e.g. the north, in the lee of Down Over Rocks and to the south, in the lee of Spital cars, and along the backshore). These changes are likely to represent the natural distribution of the recharge material across the beach following beach re-profiling that occurred in late September (described above).
Apr 2012	**Sand Extent Survey:** Spital Carrs is located to the south of Newbiggin Bay and is covered by a bi-annual sand extent survey, which commenced in 2012. The survey was designed to address concern that the beach recharge scheme undertaken in the Newbiggin Bay may have impacts on the Spital Carrs SSSI and SPA if sand from the recharge scheme moves to the south. The sand extent survey therefore identifies the boundary of the sand beach on the rock platform. This is the first year that the sand extent survey data has been plotted as a line on an aerial map, so it is the first time that a comparison with previous data has been completed. This will be completed on a bi-annual basis thereafter. Data from the most recent sand extent survey (partial measures, spring 2012) has been plotted onto	This is the first comparison with previous data and will be completed on a bi-annual basis thereafter. There is some movement to the south, where the sand extent has moved slightly seaward, however, further north of that it has moved landwards. Otherwise, there are no discernable trends suggesting the seawards extension of sand.

Survey Date	Description of Changes Since Last Survey	Interpretation
	aerial imagery (refer to Appendix D – Map 1). The plot shows that there is some variation of the extent of sand about the winter 2011 survey extent. There is some movement to the south, where the sand extent has moved slightly seaward, however, further north of that it has moved landwards. Otherwise, there are no discernable trends suggesting the seawards extension of sand.	

Plate 6 – Survey photograph 1aWDC05A_20120320_E2.JPG

Plate 7 – Survey photograph 1aWDC06_20120320_N2.JPG

12.12 Cambois Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
Apr 2012	**Cliff-top Survey:** This is the first year that the cliff top survey data has been plotted as transects, so it is the first time that a comparison with previous data has been completed. This will be completed on a bi-annual basis thereafter. Five ground control points (numbered 1-5) were established along the cliff top to the north of Cambois Bay in October 2008. Measurements are taken along a fixed transect line from the landward datum to the edge of the cliff top. The cliff top surveys are intended to inform on erosion rates of the sea cliffs to the north of Cambois Bay, opposite North Seaton Colliery. 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 - Map 2 for the location of the transects ground control points. The results from the cliff top monitoring are anticipated to have an accuracy of ±0.2m due to the technique used. Appendix C – Table C2 provides results from the October 2008 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 (October 2008), the previous (November 2011) and the present (April 2012) cliff top surveys. Results show that change greater than the survey accuracy has occurred at two ground control points (3 and 5) since surveys began in October 2008. Other locations have not changed, or erosion is within the error band. Since the last survey in November 2011, the cliffs are eroding at all but one ground control point (3), which is recorded to be accreting. Erosion that is greater than the survey error occurred at ground control survey points 4 and 5 (located on the north side of the River Wansbeck), by 0.9m and 0.6m respectively.	This is the first year that the cliff top survey data has been plotted as transects, so it is the first comparison with previous data. Since the last survey in November 2011, cliff movement at ground control survey points at locations 1 and 2 is within the error band. At point 3, the cliffs are recorded to be accreting. At points 4 and 5, the cliffs have eroded by 0.9m and 0.6m respectively. **Longer term trends:** Since surveys began in October 2008, results show that erosion or an amount of movement greater than the survey error has occurred at two ground control points (3 and 5). At ground control survey point 3 this is accretion of 0.5m Cliffs are unlikely to accrete and this accretionary trend highlights the problems in identification of the cliff top due to growth of vegetation that make the short term change data unreliable tend to diminish over the long-term. At ground control survey point 5, this is -1.8m. This equates to an erosion rate of 0.5m/year. An additional assessment of cliff recession will be derived from analysis of time-series remote sensing data. A high quality baseline survey, comprising LiDAR and aerial photography, was collected in 2010, a repeat survey was completed in Sept/Oct 2012 and a second repeat survey is planned for 2014. These

Survey Date	Description of Changes Since Last Survey	Interpretation
		data will be analysed to give more accurate information on the behaviour of the cliffs in a separate report.
Apr 2012	**Cliff/Dune-top Survey:** A further 36 ground control points (numbered 6-41) were established along the cliff/dune top to the south of Cambois Bay in May 2009. The cliff/dune top surveys are intended to inform on erosion rates of the sea cliffs and dunes from Cambois to Blyth. 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 - Map 2 for the location of the transects ground control points. The results from the cliff/dune top monitoring are anticipated to have an accuracy of ±0.2m due to the technique used. Appendix C – Table C3 provides results from the May 2009 cliff/dune top survey, showing the position from the ground control point to the edge of the cliff/dune top along a defined bearing. A distinction is made in the table between whether the coastline is cliff/dune at the survey location. Also shown is the change in measurement since the original (May 2009), the previous (November 2011) and the present (April 2012) cliff top surveys. Results show that erosion or an amount of movement greater than the survey error has occurred at 20 ground control points since surveys began in May 2009. Other locations have not changed, or erosion is within the error band. Since the last survey in October 2011, erosion that is greater than the survey error occurred at points 21, 27 and 35. Accretion that is greater than the survey error is recorded to have occurred at 10 to 15, 17, 19, 25, 30 to 31, 38,and 41.	This is the first year that the cliff/dune top survey data has been plotted as transects, so it is the first time that a comparison with previous data has been completed. Since the last survey in October 2011, erosion that is greater than the survey error occurred at points 21, 27 and 35. Accretion that is greater than the survey error is recorded to have occurred at 10 to 15, 17, 19, 25, 30 to 31, 38 and 41. Cliffs are unlikely to accrete and this accretionary trend highlights the problems in identification of the cliff top due to growth of vegetation that make the short term change data unreliable tend to diminish over the long-term. **Longer term trends:** Since surveys began in May 2009, results show that erosion or an amount of movement greater than the survey error has occurred at 20 ground control points. Erosion greater than the survey error is recorded to have taken place at: - ground control survey point 8 (to the north of Cambois, close to the mouth of the River Wansbeck); - ground control survey points 16 to 18 and 20 to 24 (the centre of the frontage, opposite Cambois). Erosion is greatest at points 23 to 24, with up to 5m of erosion recorded since May

Survey Date	Description of Changes Since Last Survey	Interpretation
		2008; - ground control survey points 28 to 29 (opposite the tidal basin); - 32 and 33 (opposite The Rockers); and - ground control survey point 35 (opposite Blythe). An additional assessment of cliff recession will be derived from analysis of time-series remote sensing data. A high quality baseline survey, comprising LiDAR and aerial photography, was collected in 2010, a repeat survey was completed in Sept/Oct 2012 and a second repeat survey is planned for 2014. These data will be analysed to give more accurate information on the behaviour of the cliffs in a separate report.

2.13 Blyth South Beach

Survey Date	Description of Changes Since Last Survey	Interpretation
Mar 2012	**Beach Profiles:** Blyth South Beach is covered by six beach profile lines for the Partial Measures survey (Appendix A). The previous survey was the full measures assessment undertaken in winter 2011. **1aBVBC01** is located towards the north of South Beach, in front of the area of land owned by Port of Blyth. **1aBVBC06** is located at the southern end of the beach, towards Seaton Sluice. With the exception of profile **1aBVBC02**, which is protected by a seawall, at **all profiles** the dunes have remained stable, retaining the same form and position since the last survey. At profile **1aBVBC01**, beach levels at the dune toe have increased, however, seaward to a chainage of 100m beach levels have fallen by up to 0.8m. Seaward of a chainage of 100m beach levels have increased by up to 0.8m.This is likely to represent the cross-shore movement of material, and the beach is drawn-down during storms. This pattern of change is repeated at profiles **1aBVBC02** through to **1aBVBC06**, with an increase in beach levels at the dune/seawall toe and around HAT/MHWS. Seaward of that is a zone of beach level reduction and seaward again, there is a zone of beach level increase. The extent of the fall and increase becomes more prominent to the south of the beach. At profiles **1aBVBC04** and **1aBVBC05** in particular, a berm has formed in the zone of beach level increase and is also acknowledged in the survey report for the North East Coast, which notes '*large sand bar formed*'. This is shown in the survey photograph (see Plate 8).	Since the last survey, the beach has been subject to cross-shore change. The beach at the toe of the dune/seawall has accreted. This could be related to beach management activities over the winter. As reported in the previous full measures report (winter 2011)' *there have been ongoing beach management and dune repairs since 2002, including using recycled Christmas trees to create sand traps, within the damaged areas of the dunes system. Restoration areas are then usually planted up with Marram Grass the following January if enough sand has accreted. In some years there has also been occasional recycling of sand to the toe of damaged areas of dunes from both the Blyth Harbour and Seaton Sluice end of the beach.*' On the middle beach, levels have fallen but seaward of this towards MLWS, they have increased. The cross-shore movement of material and the resultant profile is typical of a winter profile formed by storms. Towards the south of the beach, this increase is quite prominent such that a berm has formed. The survey photographs show (see Plate 8 and Plate 9), the berm and trough is very prominent and is similar to a ridge/runnel feature. The beach here is likely to be influenced by tidal flows, which are themselves affected by flows in and out of the Blyth River. Similar observations have been made at Alnmouth, where the

Survey Date	Description of Changes Since Last Survey	Interpretation
		beach can be affected by the influence of the Aln Estuary. At profile 1aVBVC06, nearest to Seaton Sluice, the change is dominated by accretion. **Longer term trends:** The changes observed from the present survey are within the bounds of the previous surveys. Beach levels do fluctuate across the length of the profile and the movement of berms and troughs occurs across the seasons. The upper beaches and dunes here are likely to be affected by a combination of natural accretion processes and beach management activity.

Plate 8 – Survey photograph 1aBVBC04_20120321_N10.JPG

Plate 8 – Survey photograph 1aBVBC04_20120321_N9.JPG

3. Problems Encountered and Uncertainty in Analysis

Individual Profiles – problems with survey data collection:

At profile 1aBTBC23, the survey is shorter than previous profiles extending to a chainage of 550m. Previous profiles have extended to a chainage of 1050m. Therefore it is not possible to make a comparison with previous profiles for the full length of profile.

At profile 1aBTBC19, it was observed that there was quicksand at the seaward end of the section, however, this di not hinder data collection.

At profile 1aBTBC21, it was observed that there was soft sand at the end of the section, however, this did not hinder data collection.

Profile 1aBTBC23 ends at the drain.

At profile 1aBTBC33 there is a gap in the data due to bushes on top of dunes (as first noted in full measures, winter 2011). Care is needed interpolating the data as this would incorrectly imply erosion.

At profile 1aBTBC34, there is a new start point as the fence has now gone. The section is now taken over the dune.

Profile 1aADC08 ends at the river.

Profile 1aADC09 ends at the river.

At profile 1aCMBC03B, the top of the section has been lowered due to grading.

Profile 1aWDC01 was measured from the fence to include the revetment (as first noted in full measures, winter 2011).

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 problems in interpretation of the cliff edge on successive surveys, especially where thick vegetation is present.

For these reasons, it has been assumed that any changes of ±0.2m may be considered as being within the accuracy of the surveying technique. The widespread reporting of cliffs advancing by over 0.2m indicates vegetation growth on the cliff top and/or slumping of superficial sediments, has made precise identification of the cliff top extremely difficult.

Surveying the cliff top along Cambois Bay is more difficult than the similar surveys at Newbiggin Caravan Park and Sandy Bay Caravan Park because the cliff/dune edge is less distinct and hard to precisely define due to vegetation coverage and its smooth, degraded form. At Cambois Bay, the surveyors noted that undergrowth at north end of cliff top hindered surveying. This was also noted in the full measures report (winter 2011).

Consequently a long-term record is required before results from this surveying technique become truly meaningful. In addition to the analysis of beach profiles, assessments of cliff recession will be derived from analysis of time-series remote sensing data. A high quality baseline survey, comprising LiDAR and aerial photography, was collected in 2010, a repeat survey was completed in autumn/winter 2012 and a second repeat survey is planned for 2014. This data will be analysed to give more accurate information on the behaviour of the cliffs in a separate report.

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

No changes are recommended at the present time.

5. Conclusions and Areas of Concern

- At Sandstell Point (Spittal A), the recorded profiles and topographic survey present no causes for concern.
- At Spittal (Spittal B), the recorded profiles present no causes for concern.
- At Goswick Sands, the recorded profiles present no causes for concern.
- At Holy Island, the recorded profiles present no causes for concern.
- At Beadnell Village, the recorded profiles present no causes for concern.
- At Beadnell Bay, the survey report notes that for profile 1aBTBC33 '*gap in data due to bushes on top of dunes*'. This could impact on the accuracy of subsequent survey interpretation or volume calculations for this profile
- Elsewhere along Beadnell Bay, the recorded profiles present no causes for concern.
- At Boulmer, cutback of the dune/backshore at profile 1aADC04A is part of an ongoing trend. The low dunes here form part of private gardens. The previous partial measures report (spring 2011) noted that the changes were not of significant concern for management. This also applies to the present survey, but should be re-assessed in the next full measures report (winter 2012).
- Elsewhere along Boulmer, the recorded profiles present no causes for concern.
- At Alnmouth Bay, accretion is apparent around the concrete blocks at the toe of the dune.
- Elsewhere along Alnmouth Bay, the recorded profiles and topographic survey present no causes for concern.
- At High Hauxley & Druridge Bay, the recorded profiles present no causes for concern.
- At Lynemouth Bay, opposite the Power Station (profile 1aCMBC03B), the slag bank has eroded significantly. It is possible that further mechanical re-grading of the slag tip profile has occurred between the present and previous partial measures survey and could explain the observed erosion.
- Elsewhere along Lynemouth Bay, the recorded profiles and cliff top survey present no causes for concern.
- At Newbiggin-by-the-Sea, along the profiles to the north of the bay (1aWDC05A and 1aWDC06), beach levels between HAT and MHWS appear to be returning towards the levels observed prior to October 2011. This follows beach management re-profiling during the last 3 weeks of September in 2011 undertaken by Northumberland County Council. As in the previous partial measures report (spring 2011), it is anticipated that ongoing maintenance associated with the capital recharge scheme will again be required.
- Also, at Newbiggin-by-the-Sea, the surveyors noted that at the time of survey there was a tractor was clearing patches of sea coal gravel from beach. As raised in the previous full measures report (full measures, winter 2011), this process could result in the permanent removal of sediment from the beach.
- Elsewhere along Newbiggin Bay, the recorded profiles and the sand extent survey present no causes for concern.
- At Cambois, the cliff top survey shows that there is a short-length of frontage, 10m long to the south-west of East View House, where the cliffs have receded by 1.5m. However the magnitude of this change does not presently cause concern.
- At Blyth South Beach, a combination of beach management activities may have contributed towards accretion seen, however, it is not known how much of the accretion seen is natural or the result of beach management / recycling works to move beach sand from the ends of the beach back to low spots at the toe of the dunes.

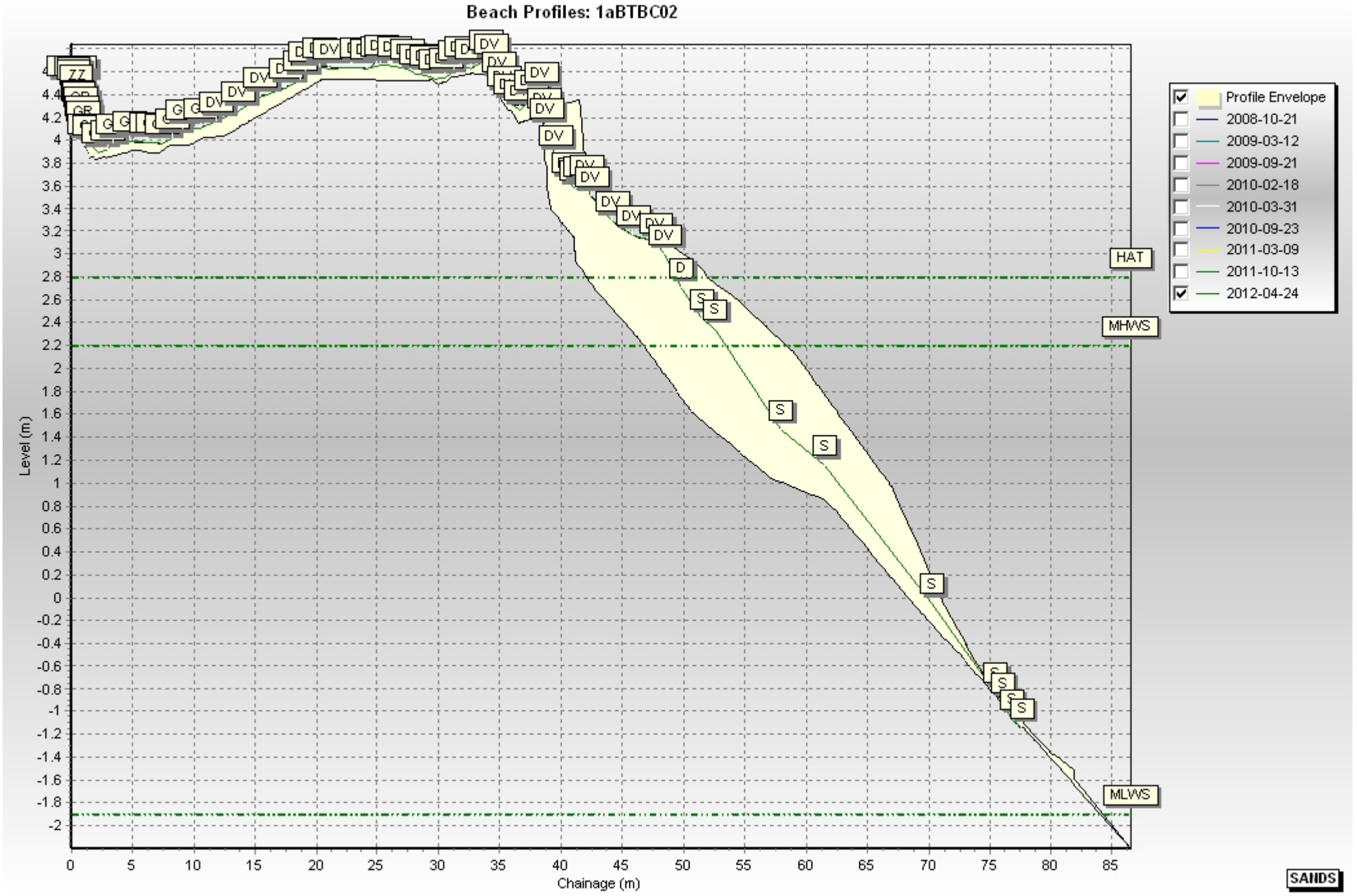
Appendices

Appendix A

Beach Profiles

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

Code	Description
S	Sand
M	Mud
G	Gravel
GS	Gravel & Sand
MS	Mud & Sand
B	Boulders
R	Rock
SD	Sea Defence
SM	Saltmarsh
W	Water Body
GM	Gravel & Mud
GR	Grass
D	Dune (non-vegetated)
DV	Dune (vegetated)
F	Forested
X	Mixture
FB	Obstruction
CT	Cliff Top
CE	Cliff Edge
CF	Cliff Face
SH	Shell
ZZ	Unknown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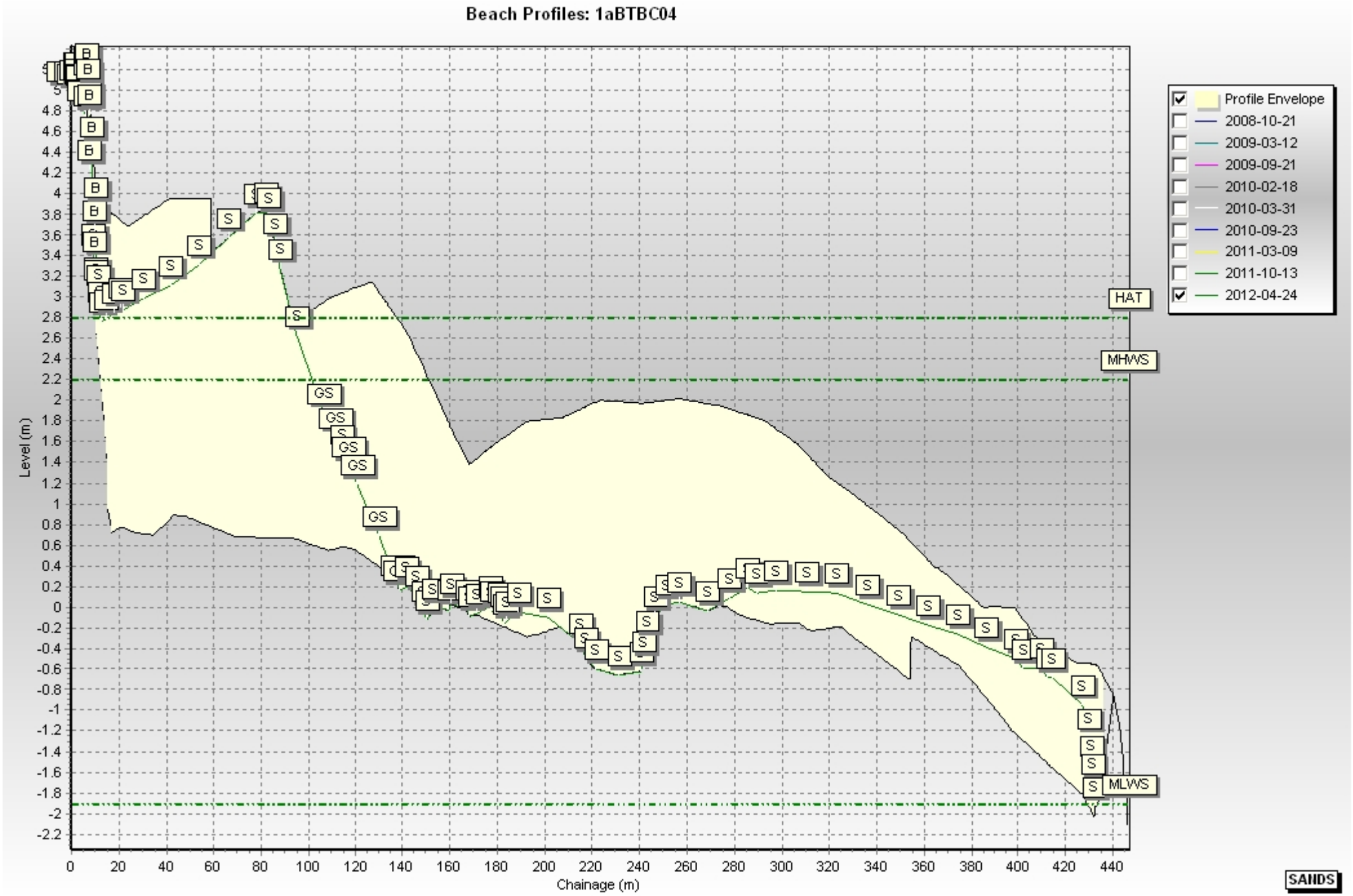
2012-04-24
HAT
MHWS
MLWS
Level (m)
Chainage (m)
SANDS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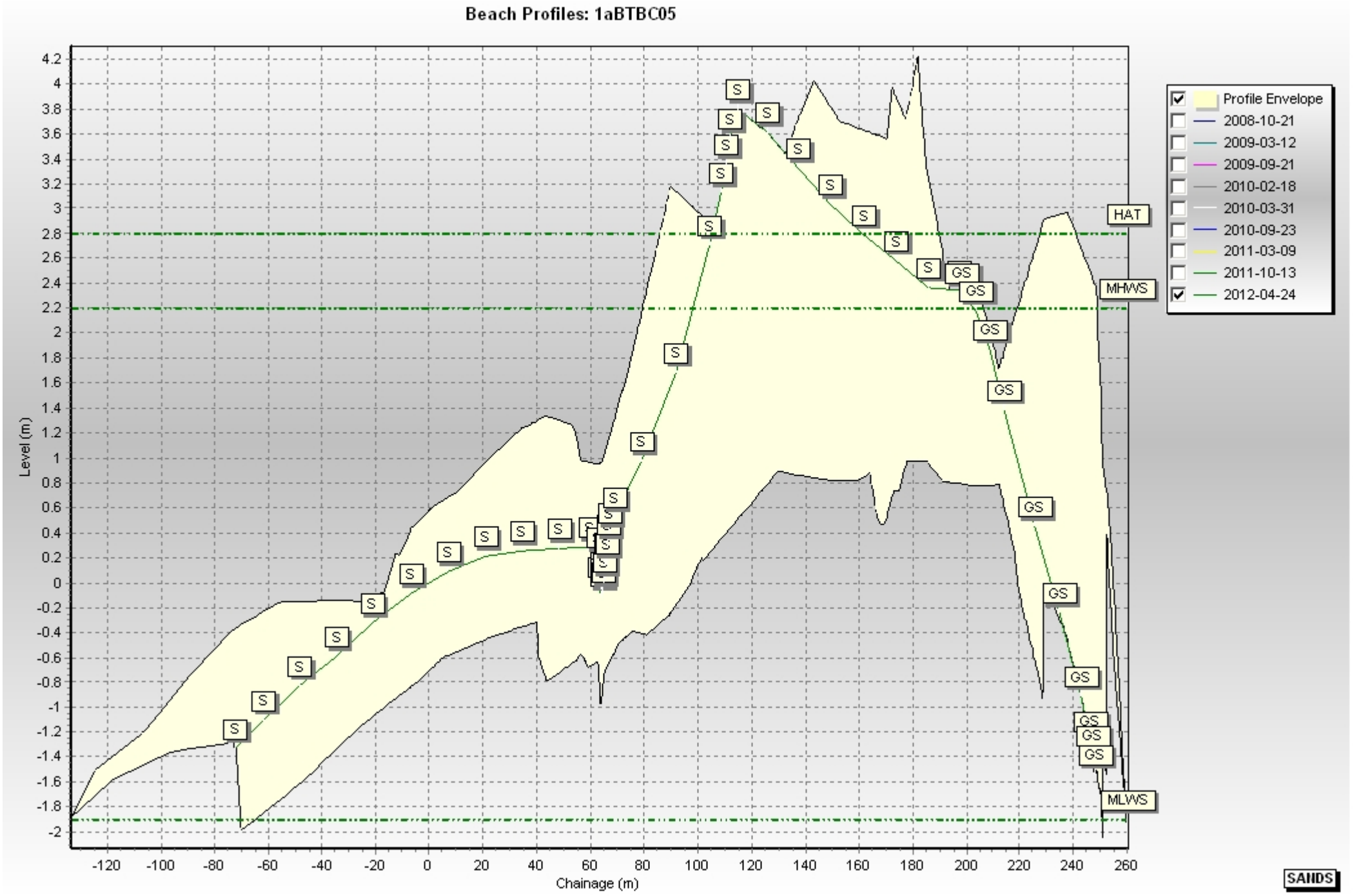
HAT
MHWS
MLWS
Level (m)
Chainage (m)
SANDS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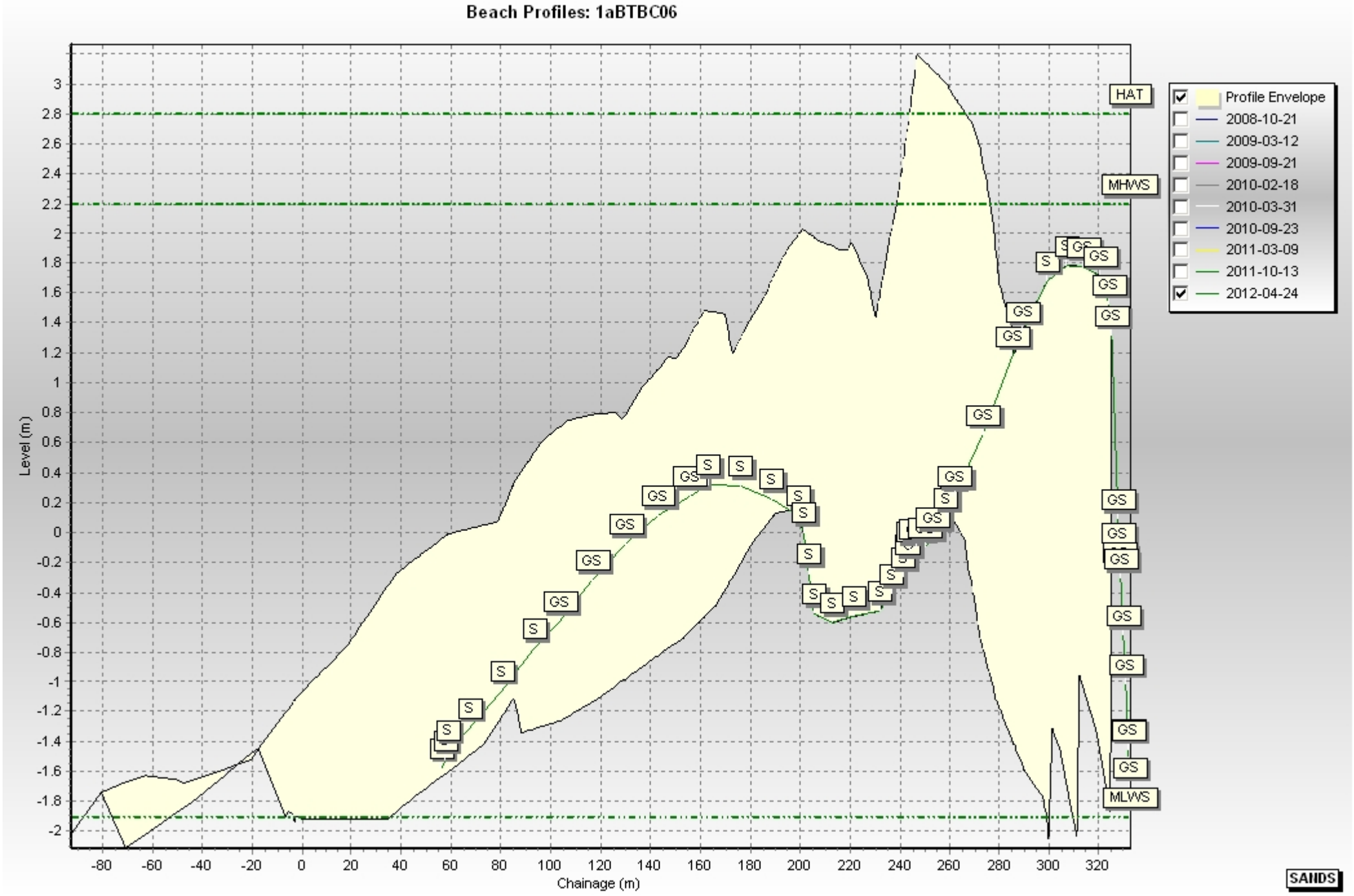
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MLWS
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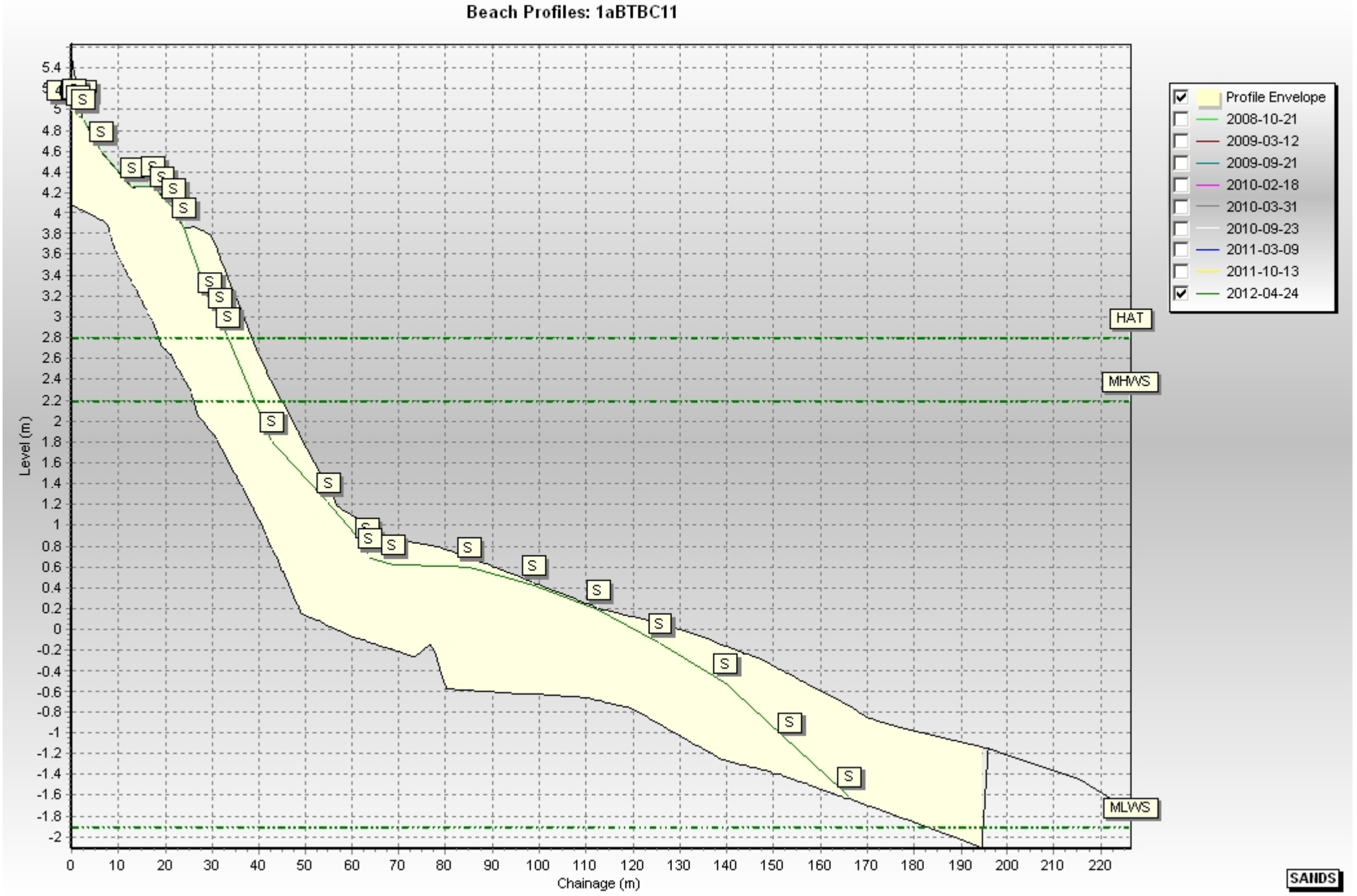
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MLWS
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Chainage (m)
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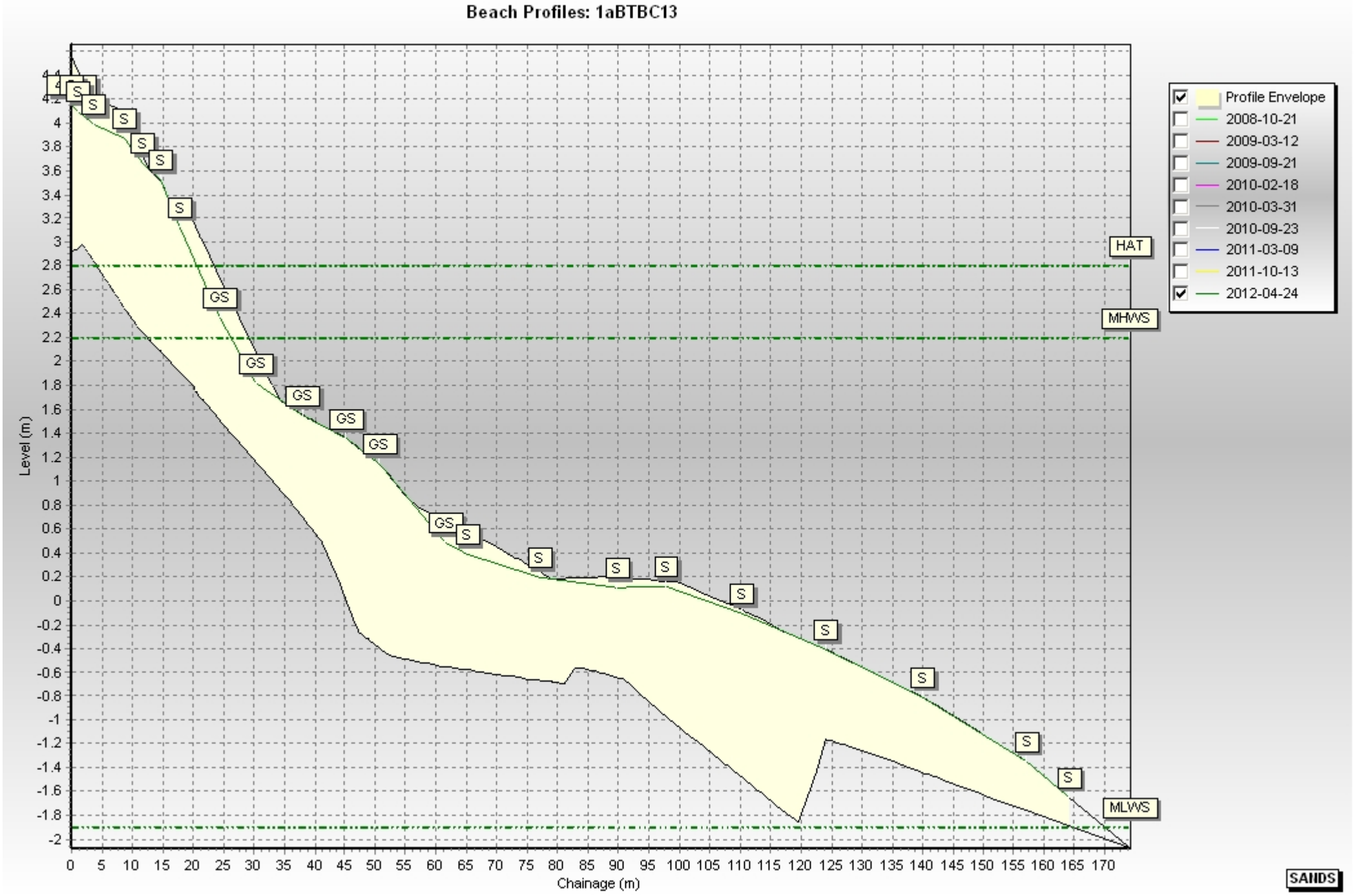
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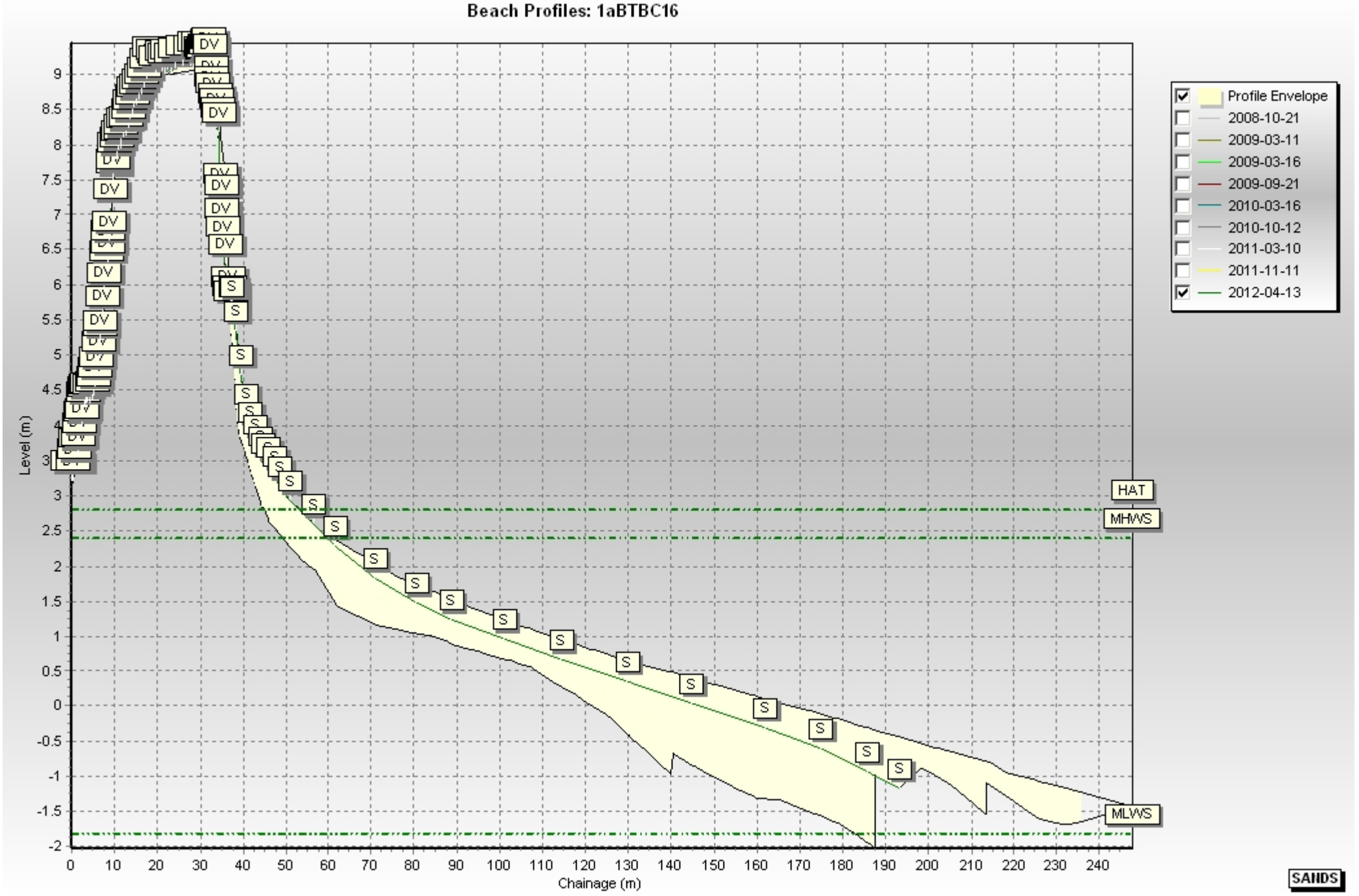
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DV
S
Level (m)
Chainage (m)
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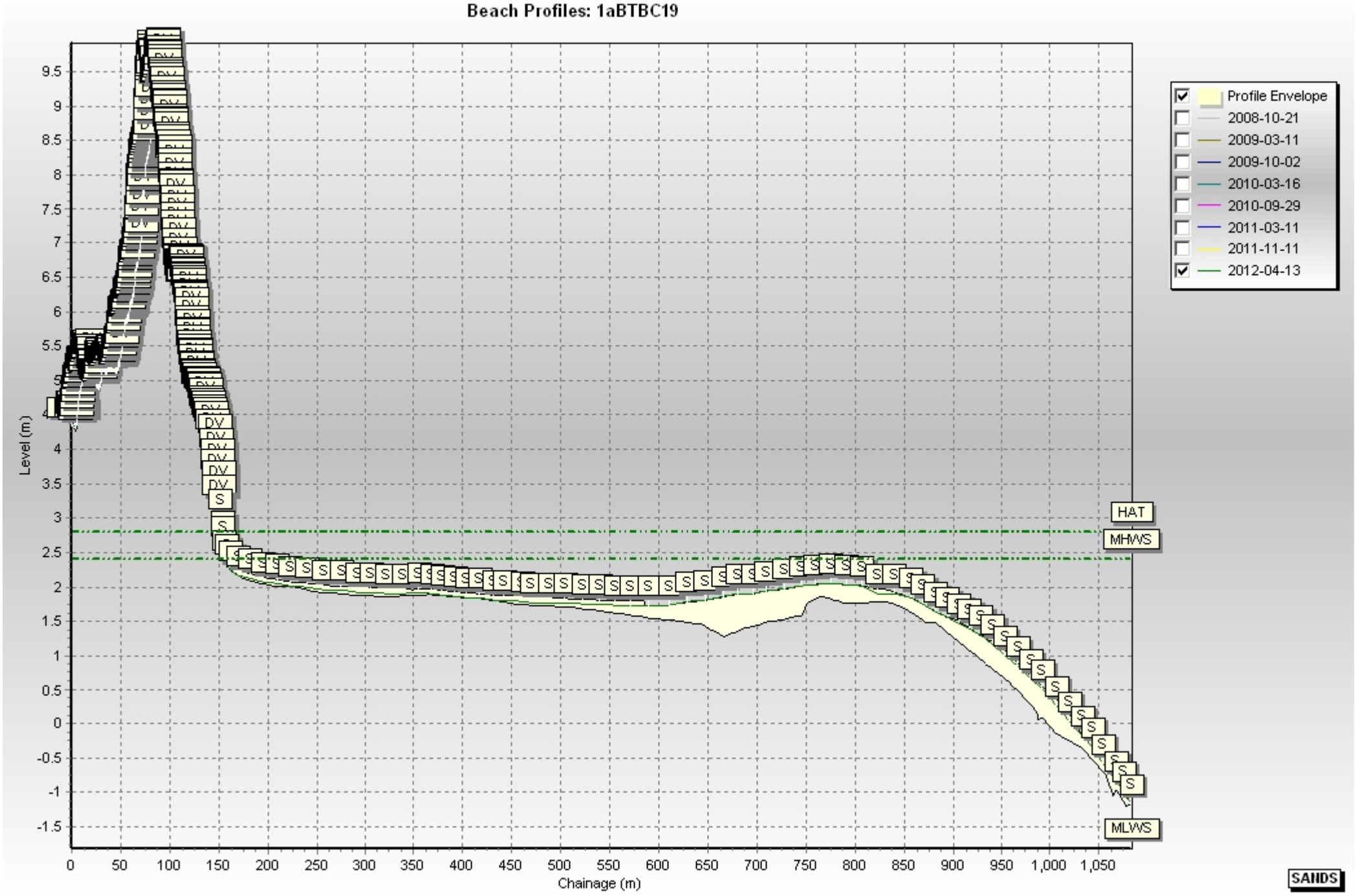
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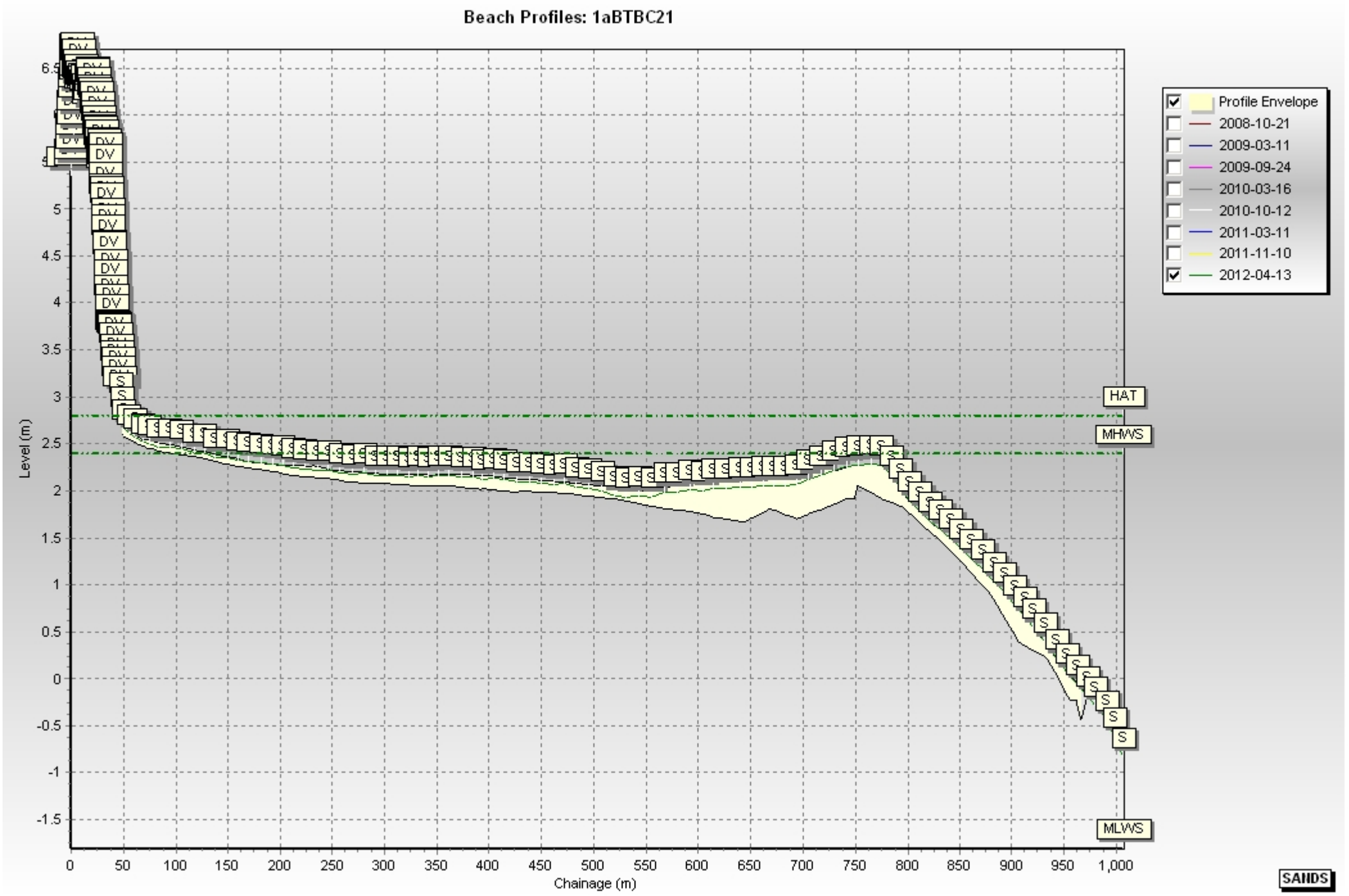
HAT
MHWS
MLWS
SANDS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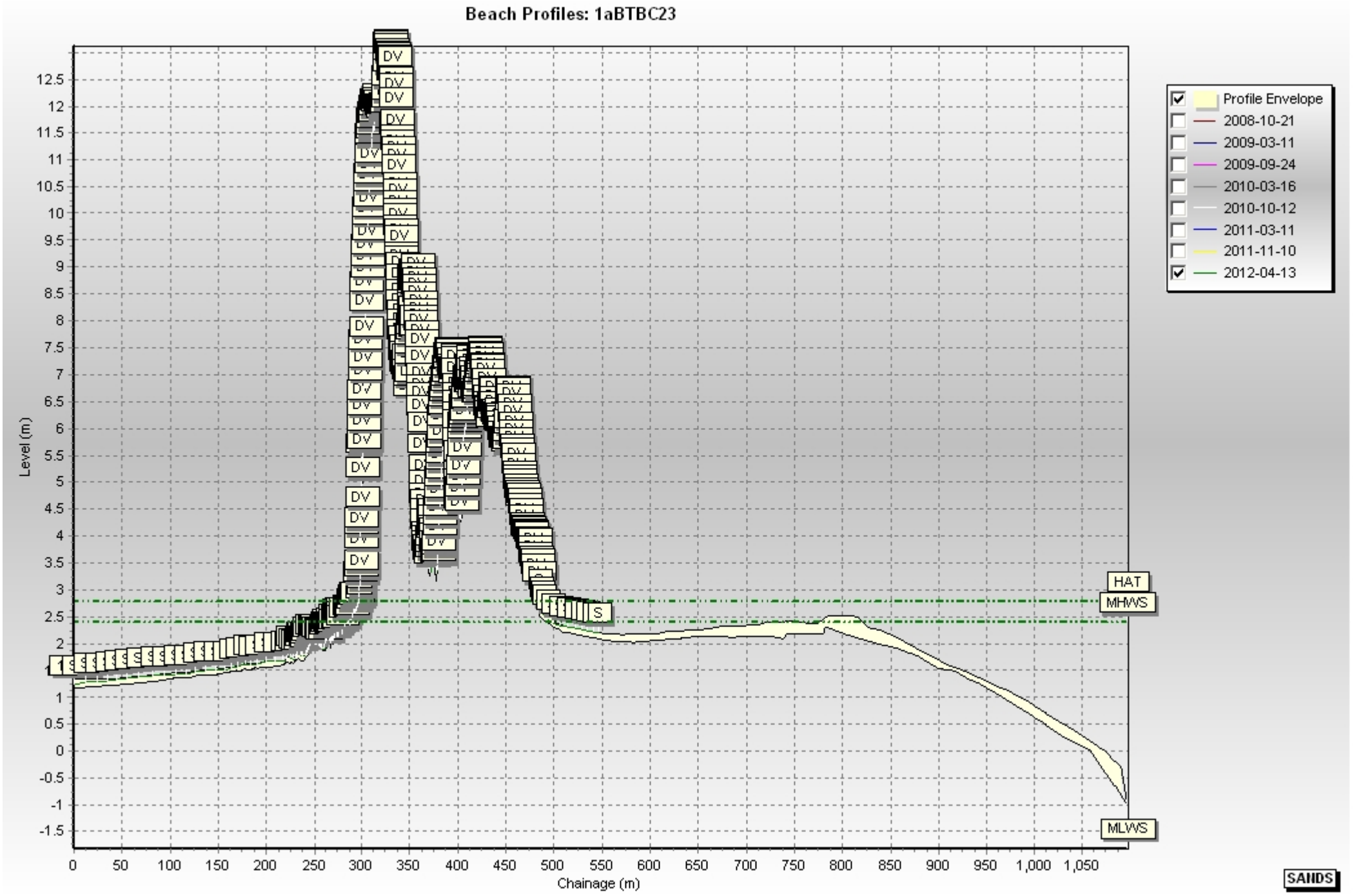
MHWS
MLWS
Level (m)
Chainage (m)
SANDS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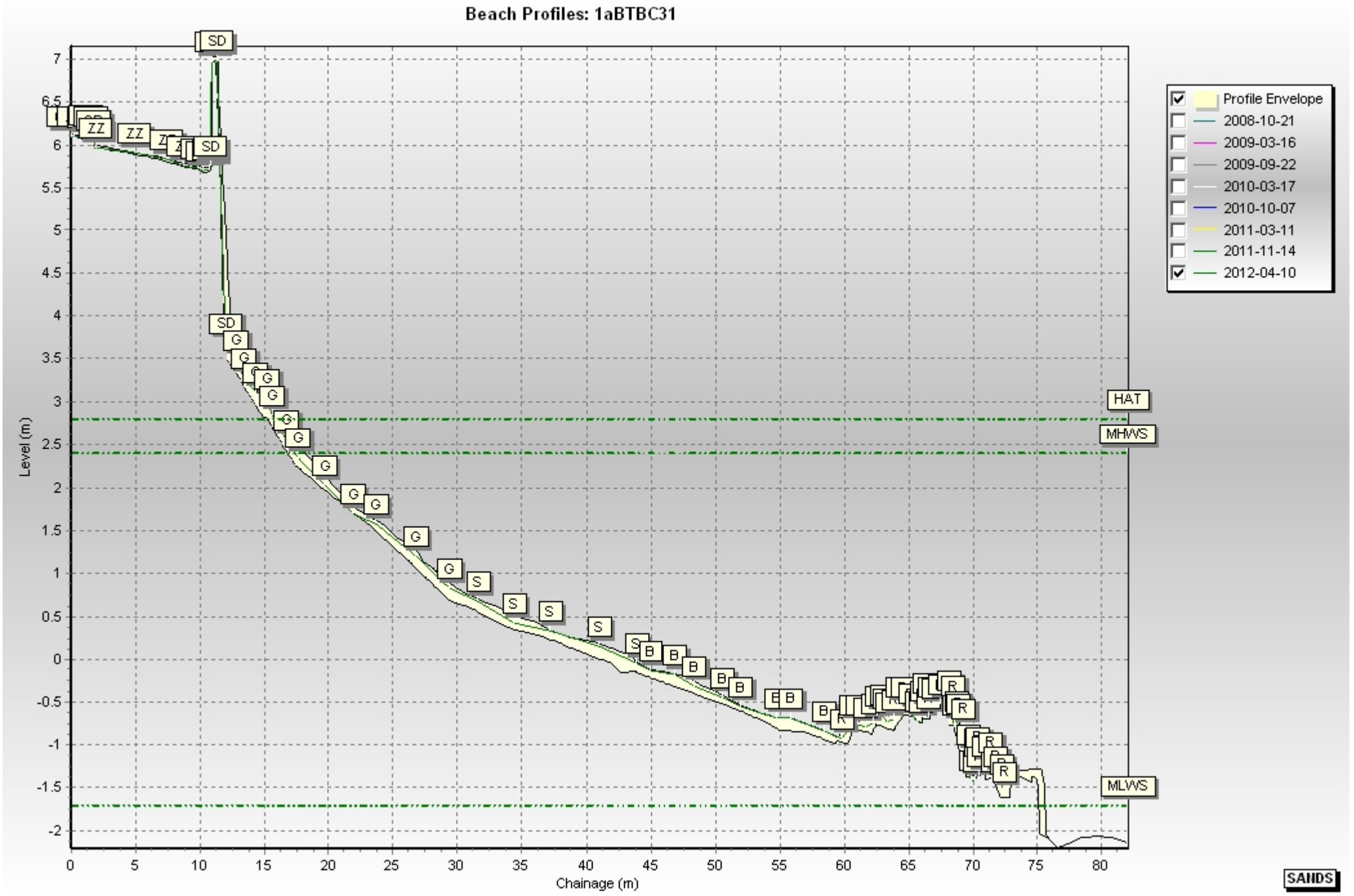
Level (m)
Chainage (m)
HAT
MHWS
MLWS
DV
S
SANDS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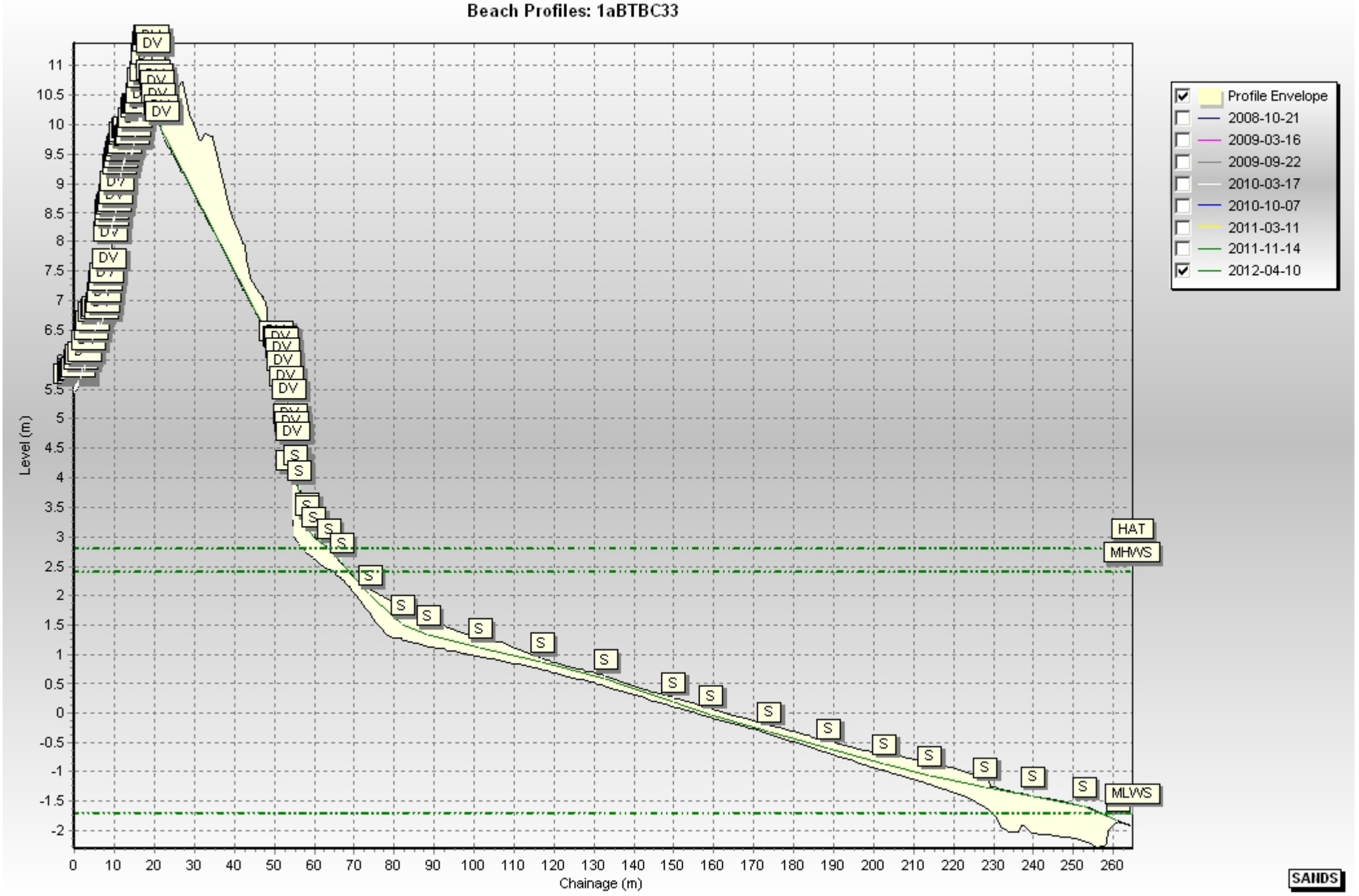
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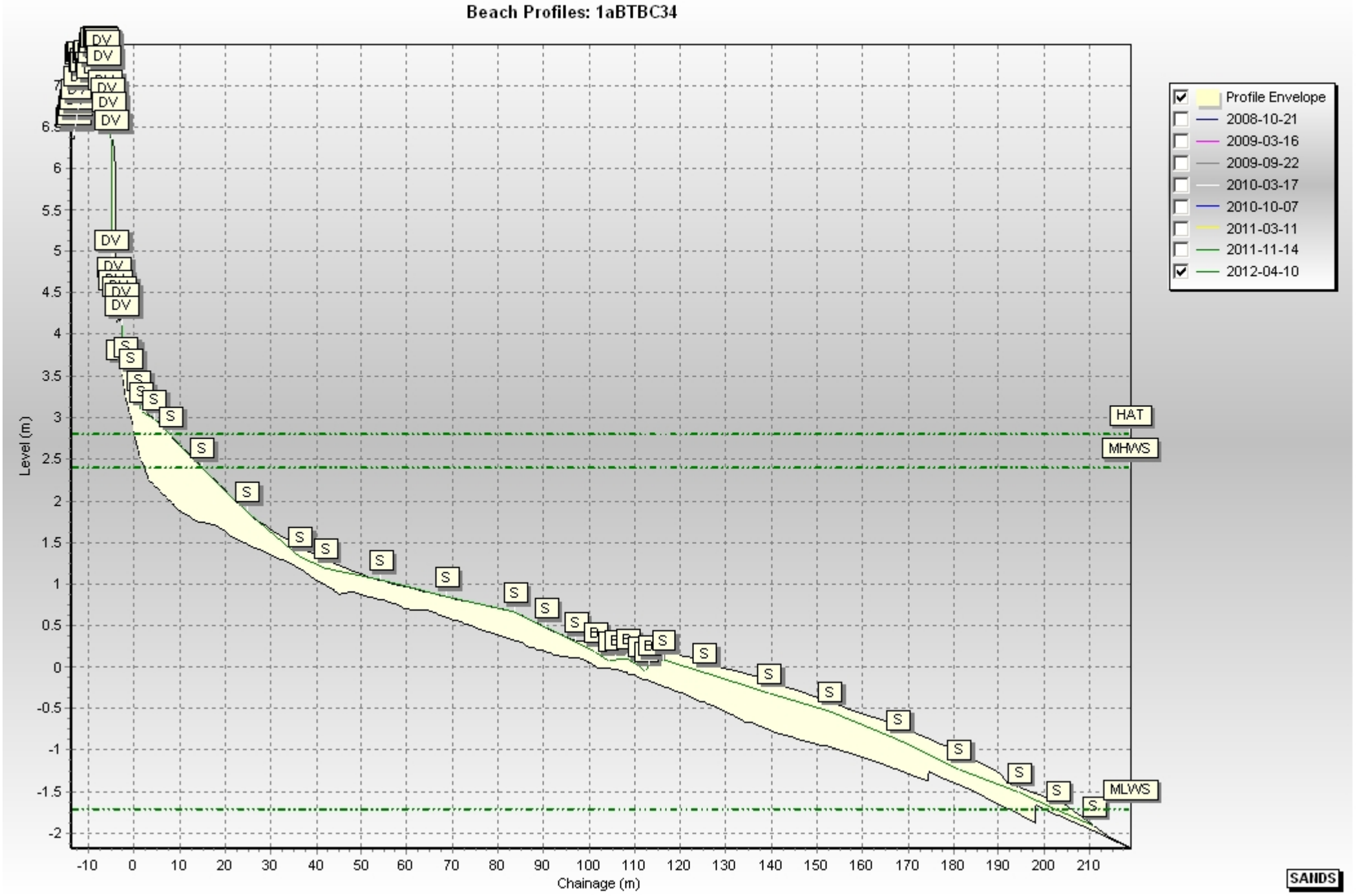
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Chainage (m)
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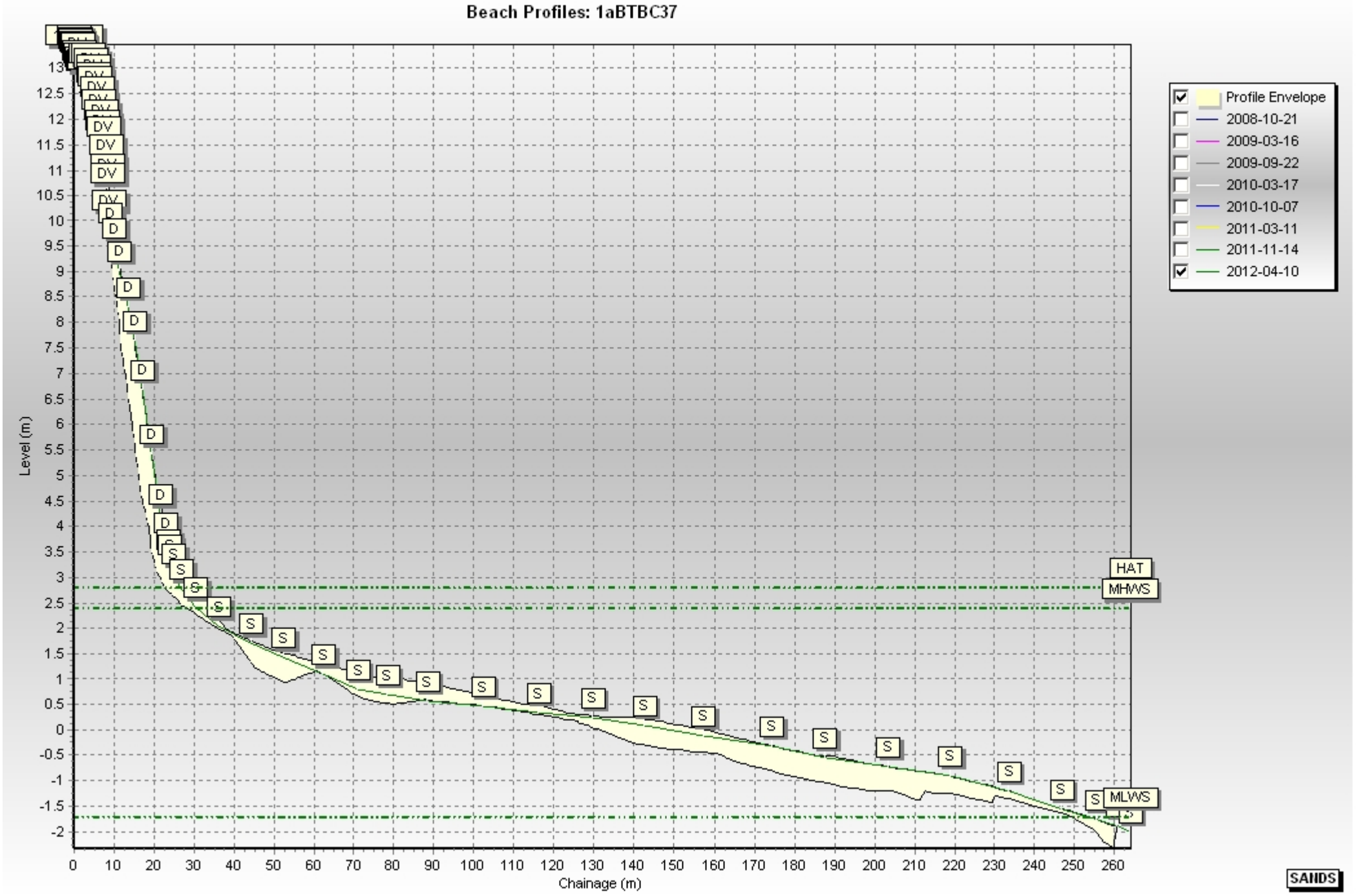
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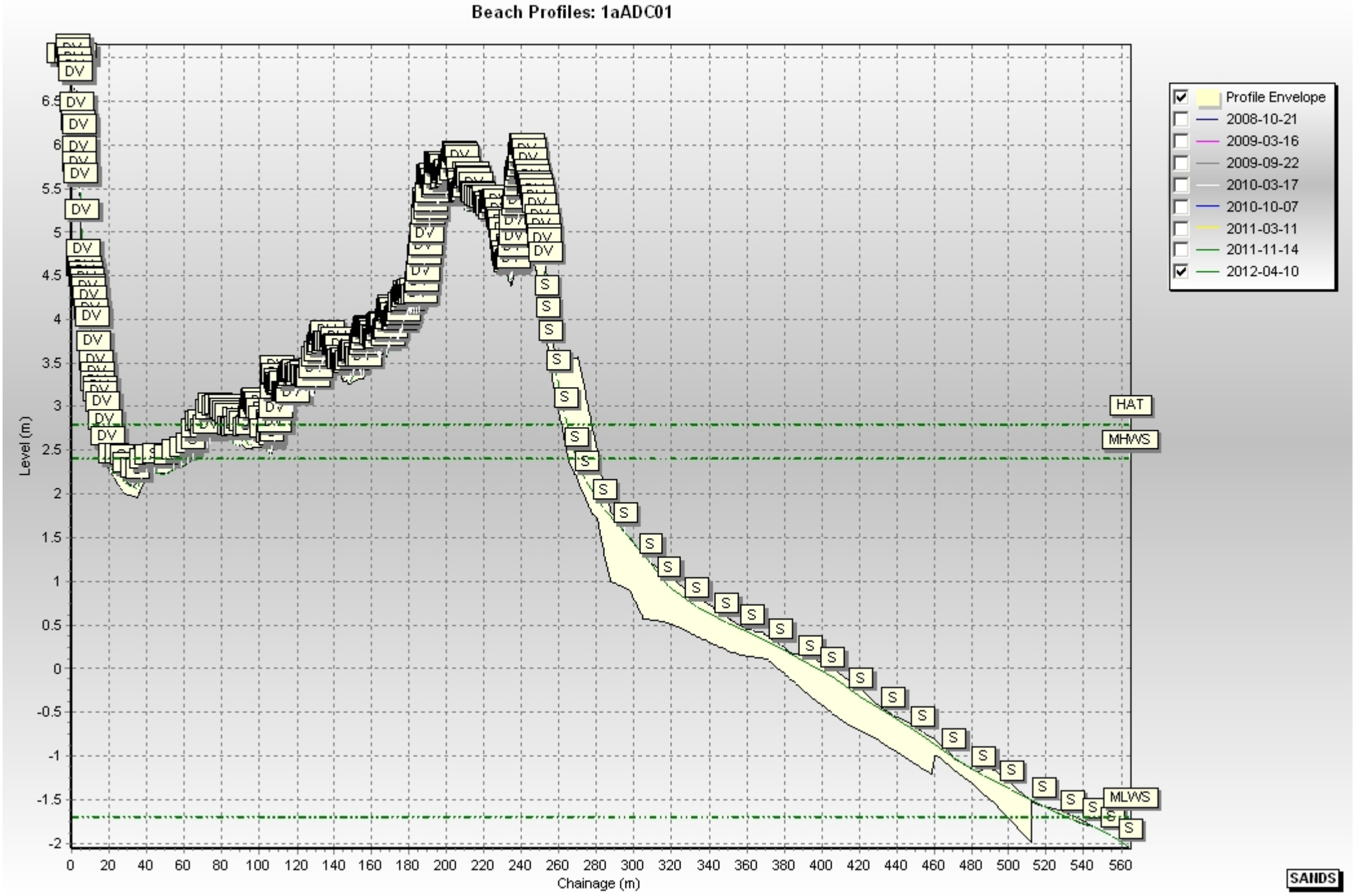
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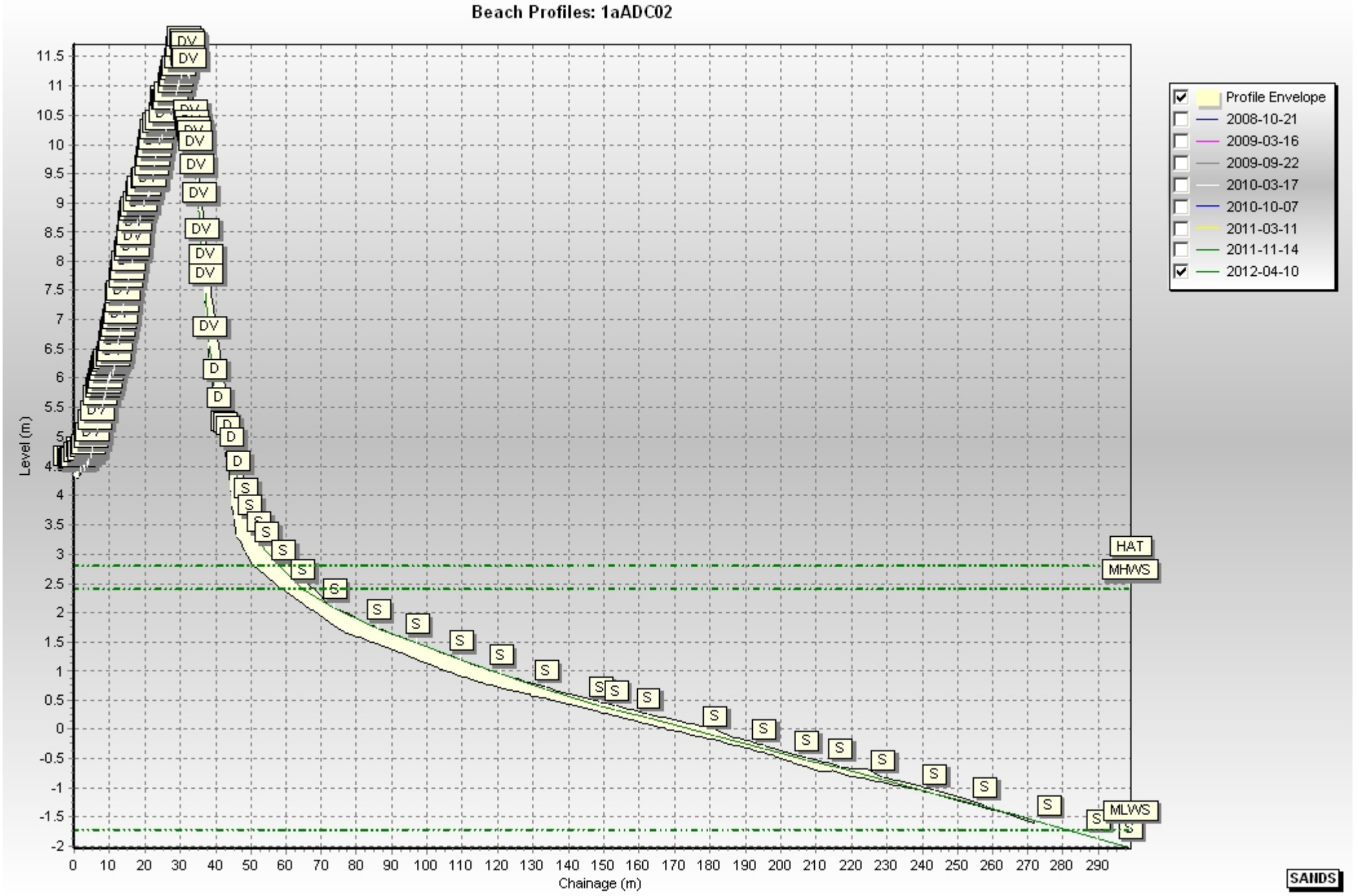
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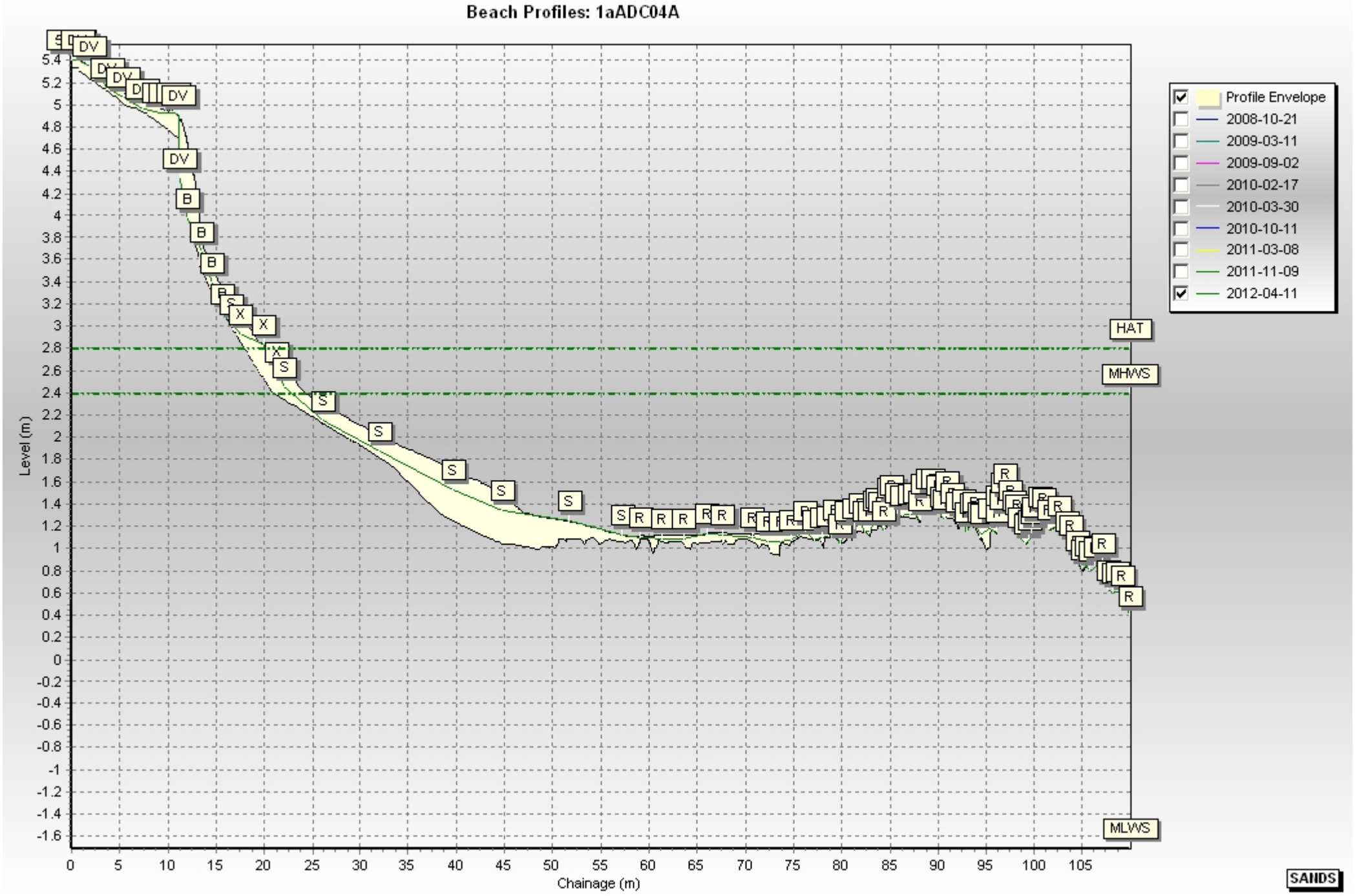
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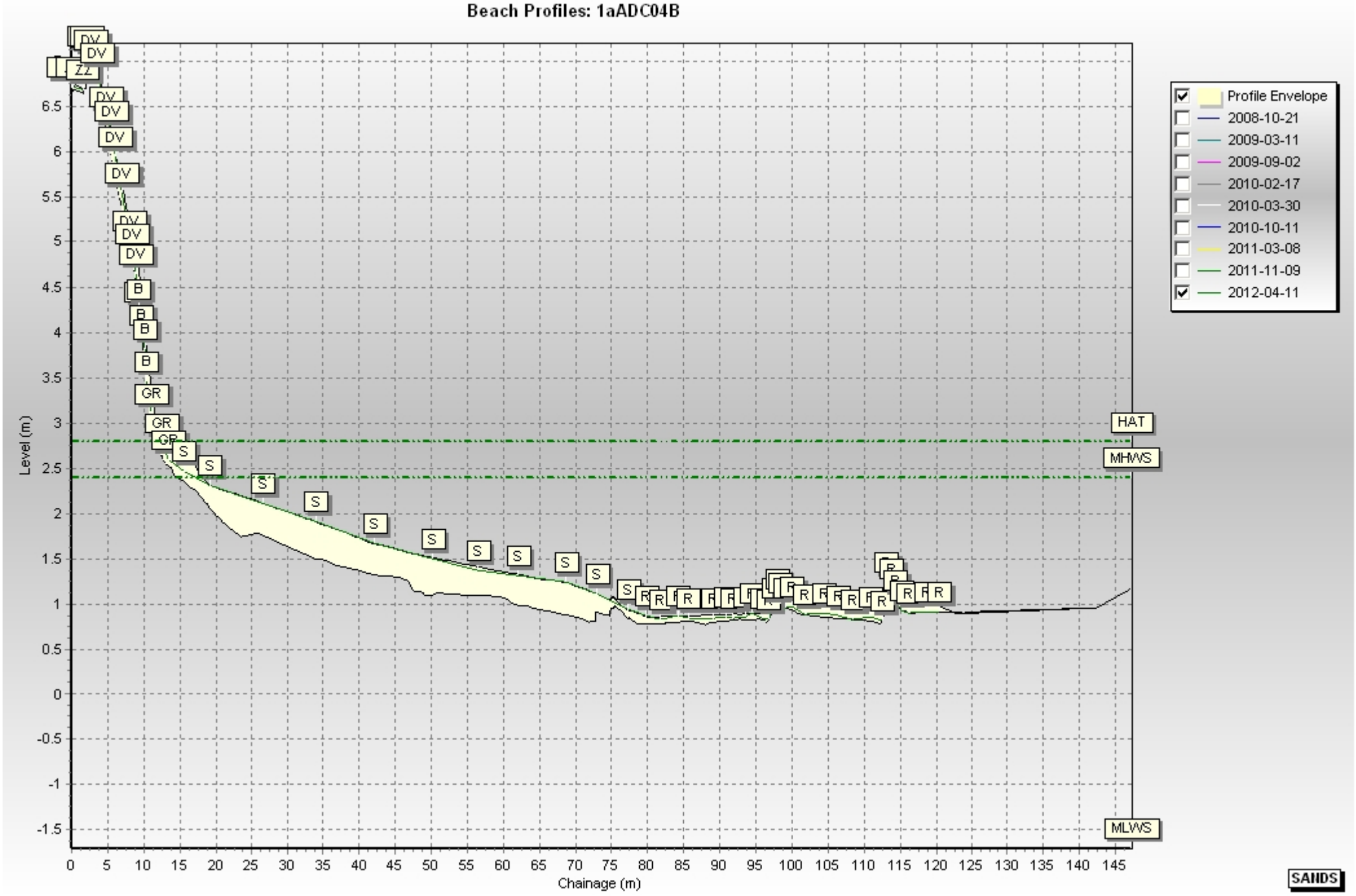
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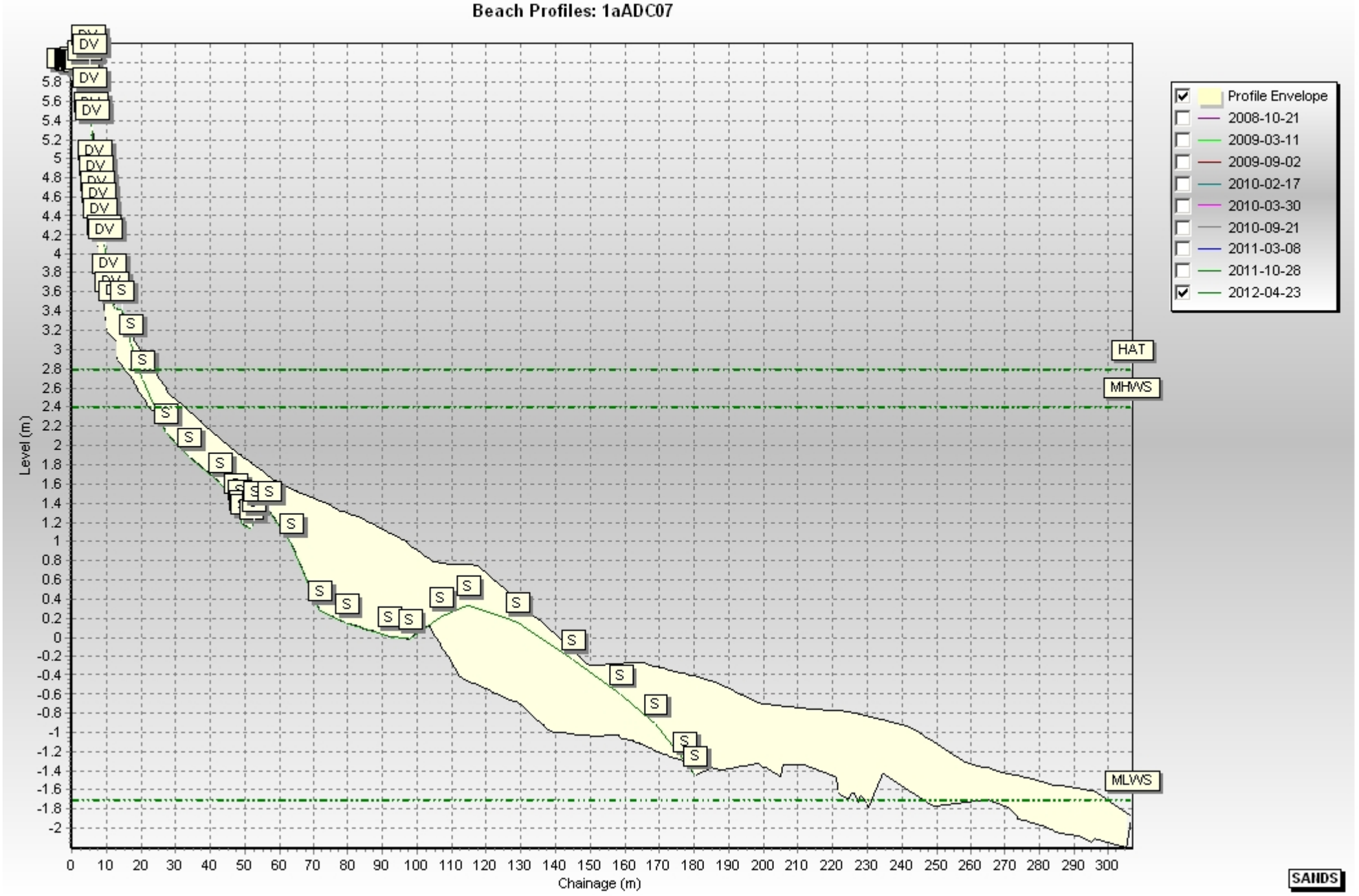
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Chainage (m)
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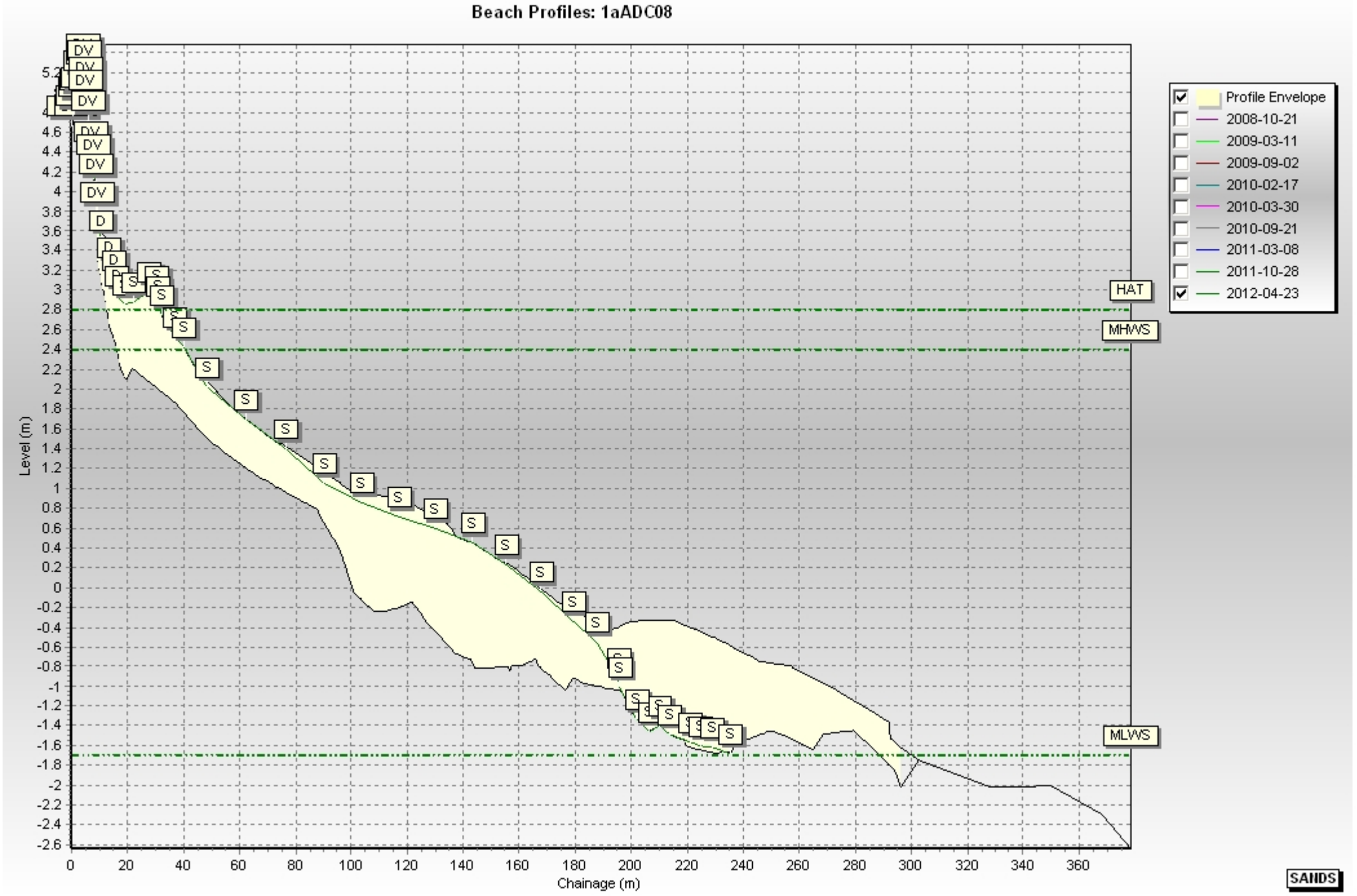
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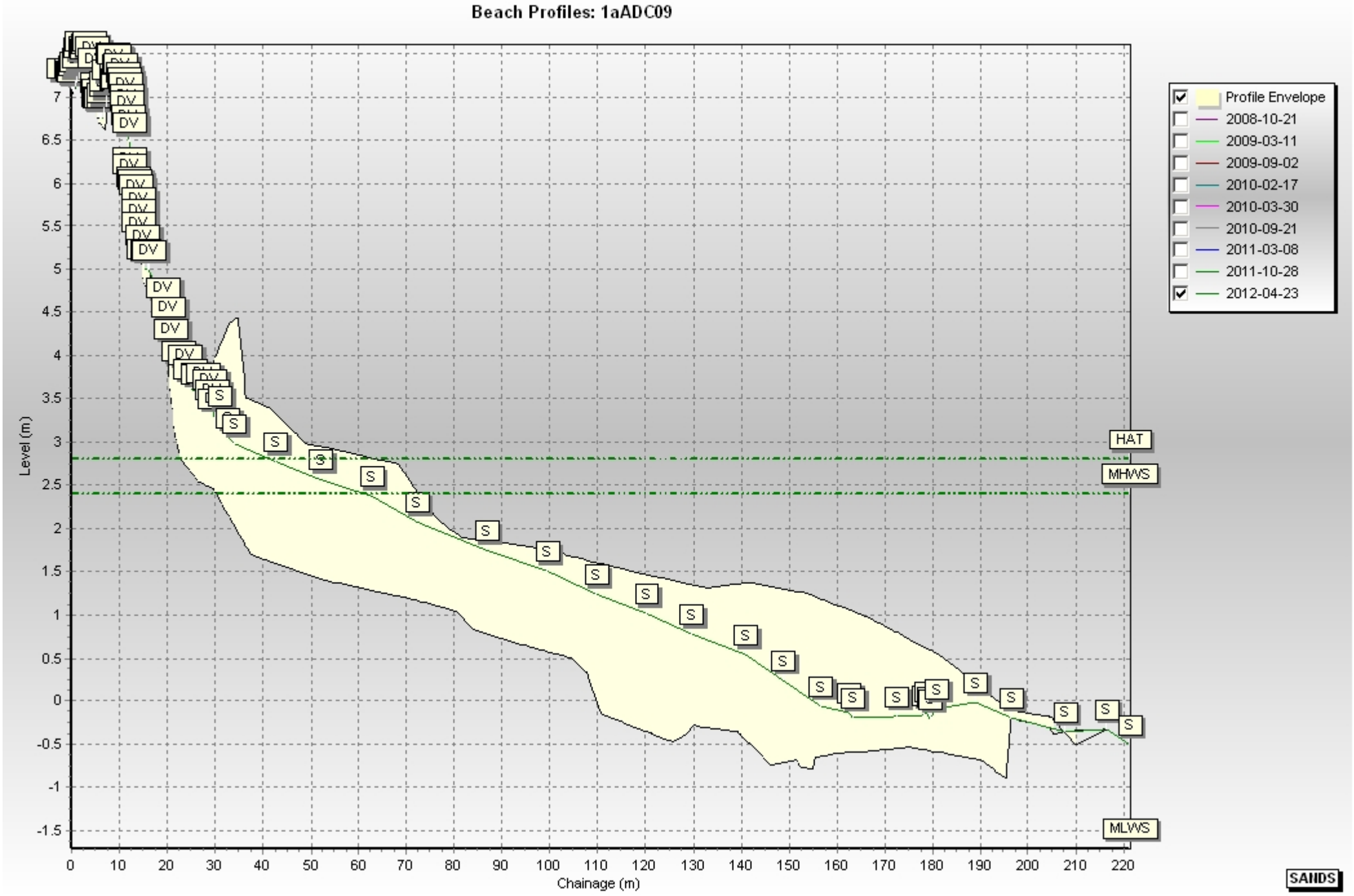
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MLWS
Level (m)
Chainage (m)
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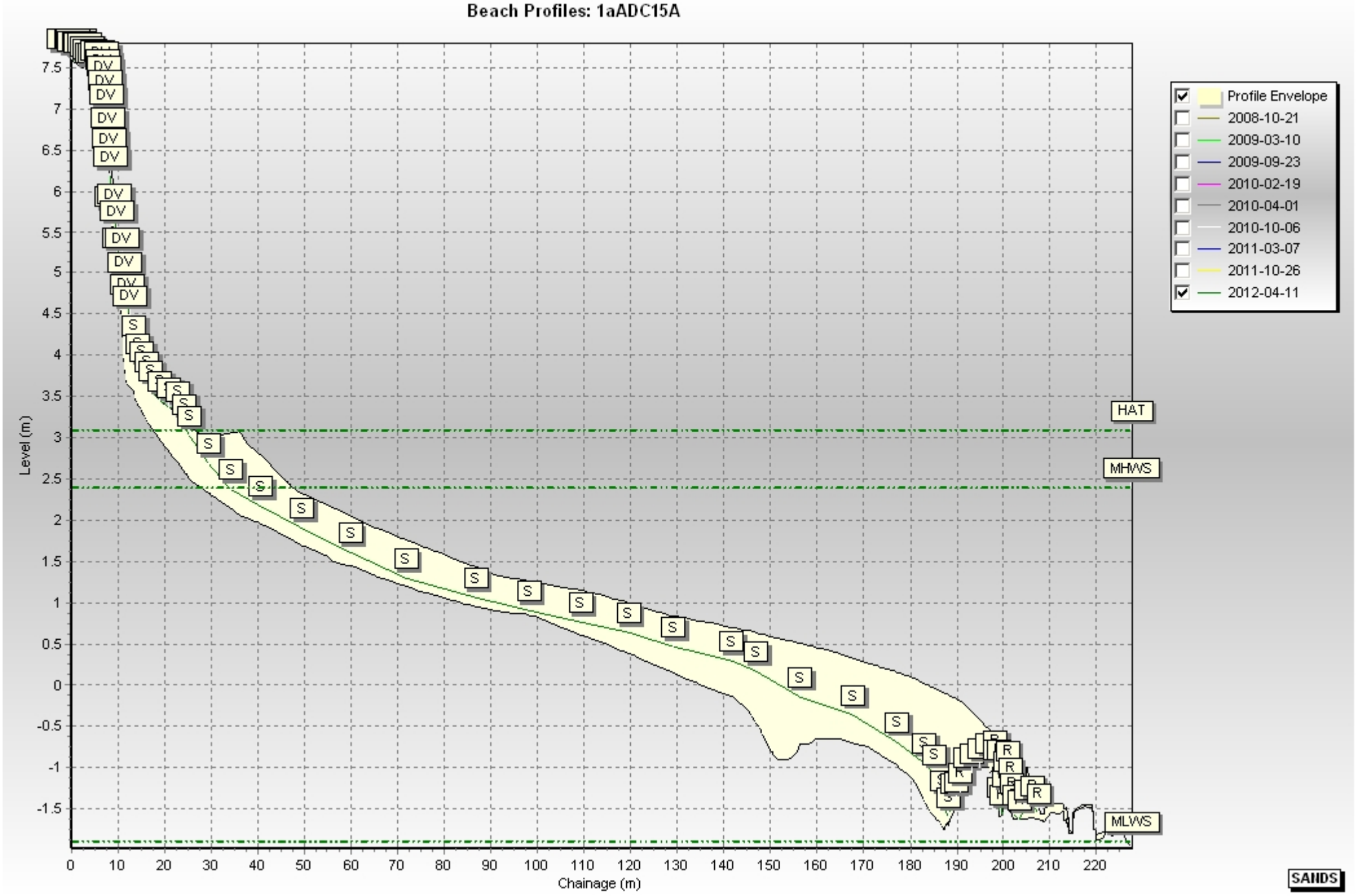
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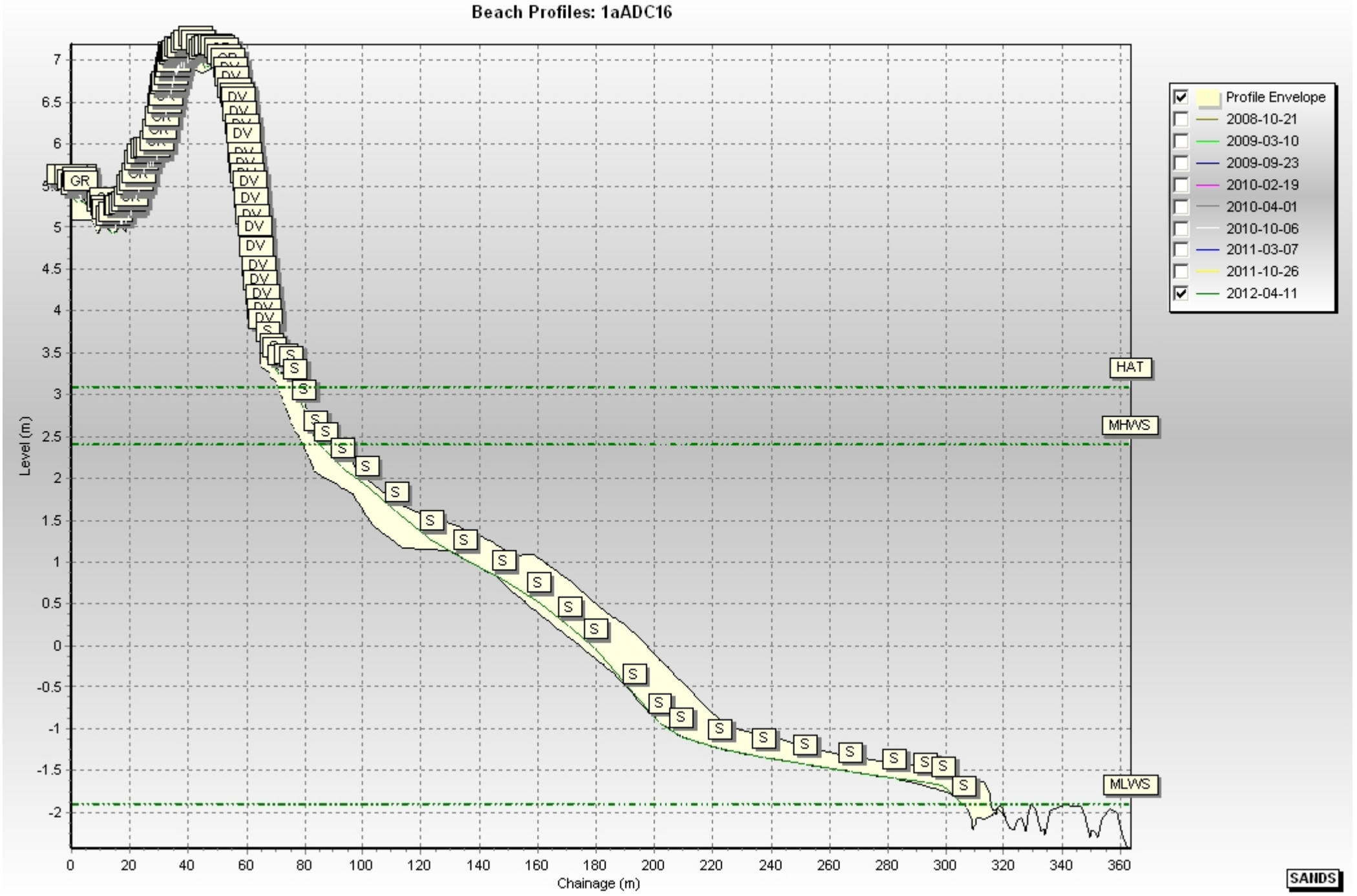
MLWS
Level (m)
Chainage (m)
SANDS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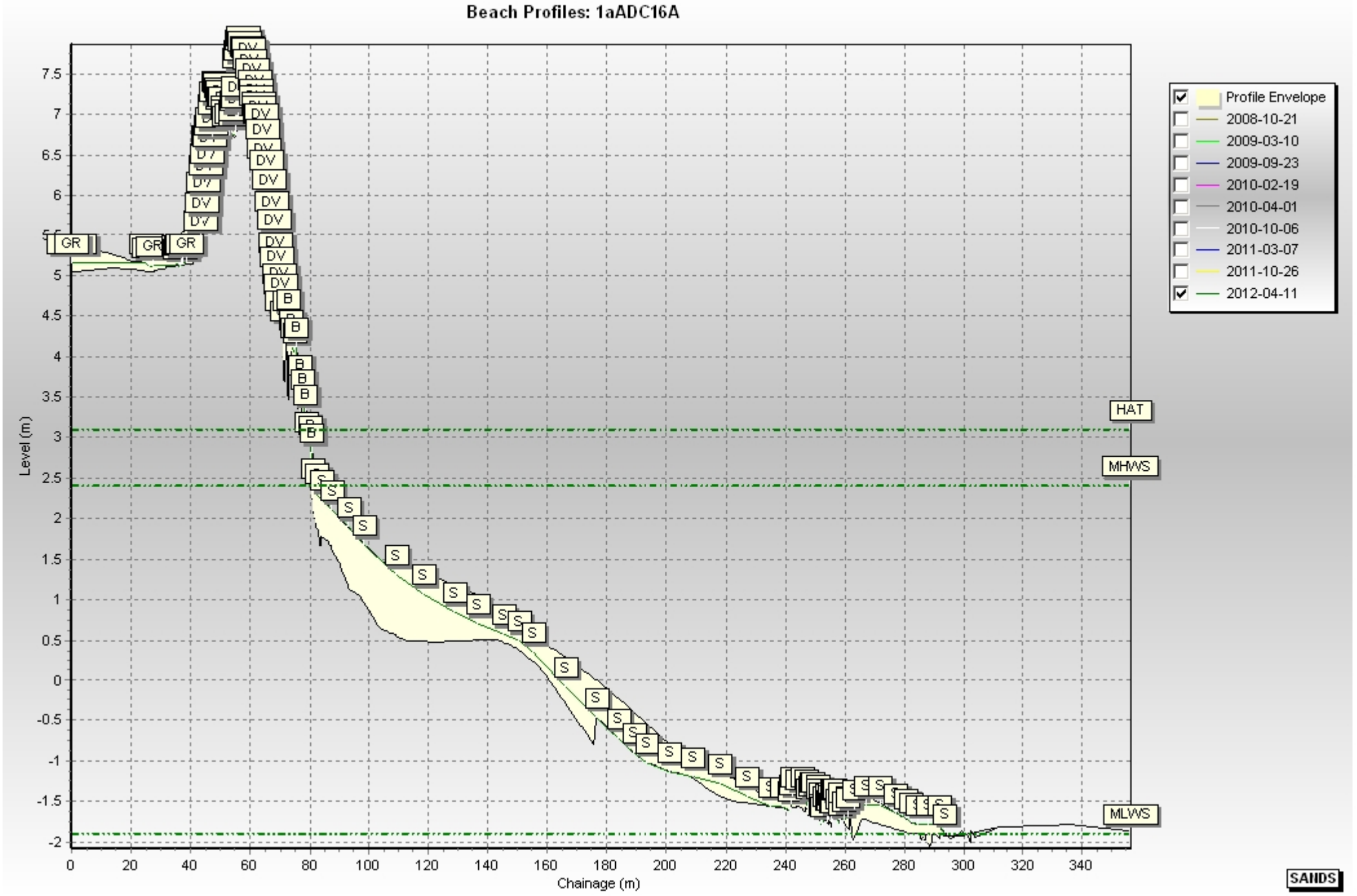
MLWS
GR
DV
S
Level (m)
Chainage (m)
SANDS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MLWS
Level (m)
Chainage (m)
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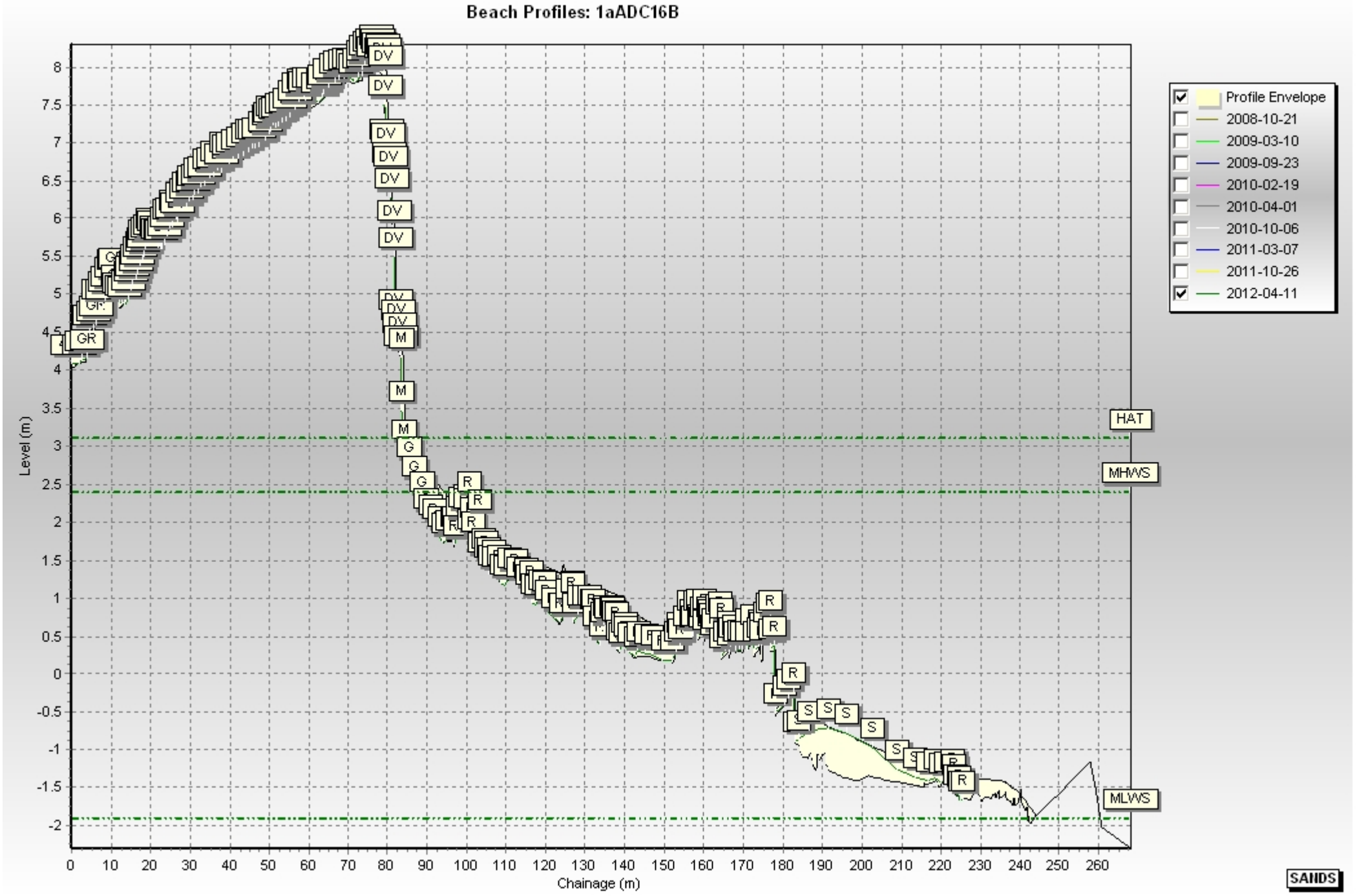
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MLWS
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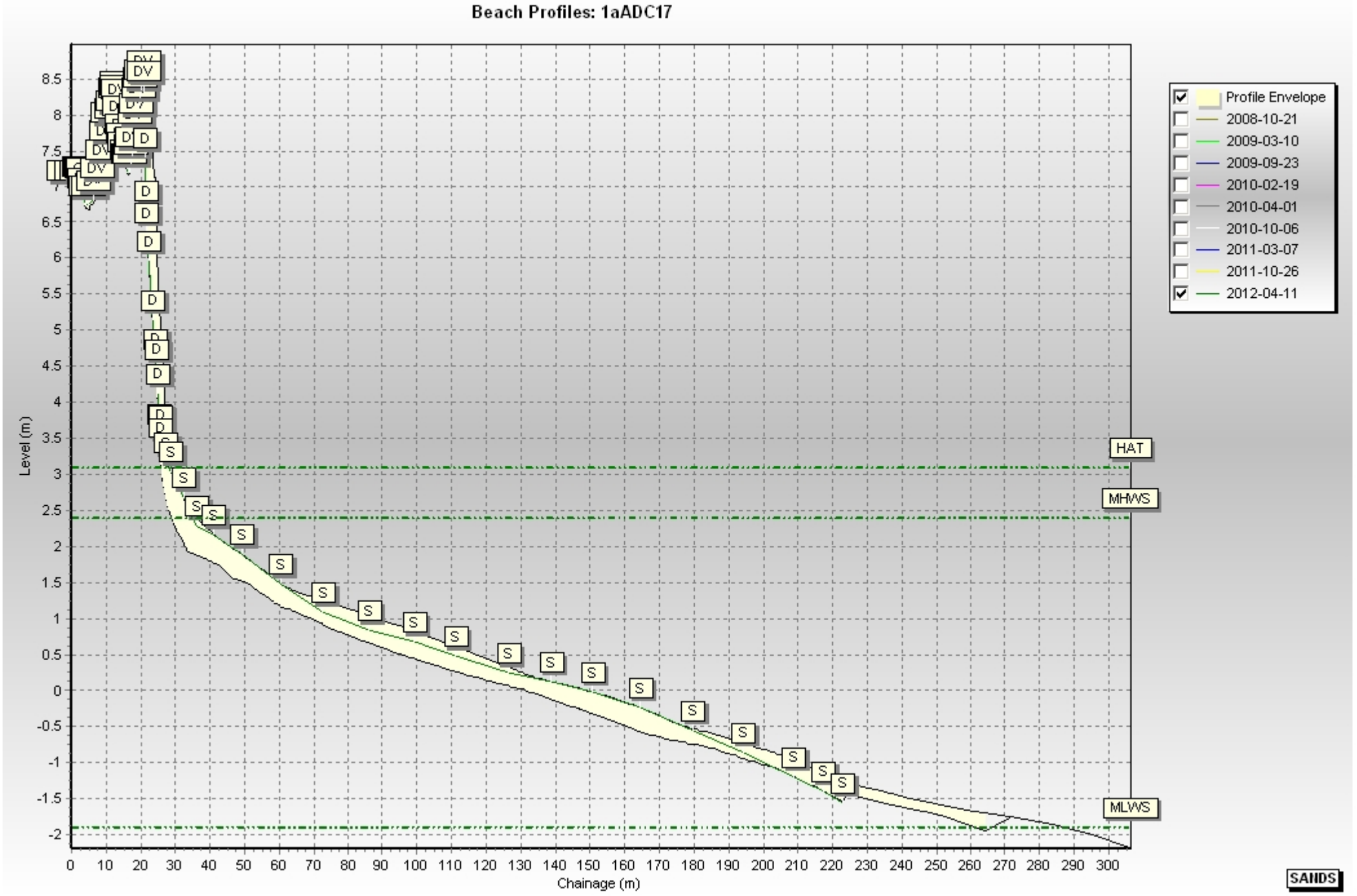
Chainage (m)
SANDS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MLWS
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Chainage (m)
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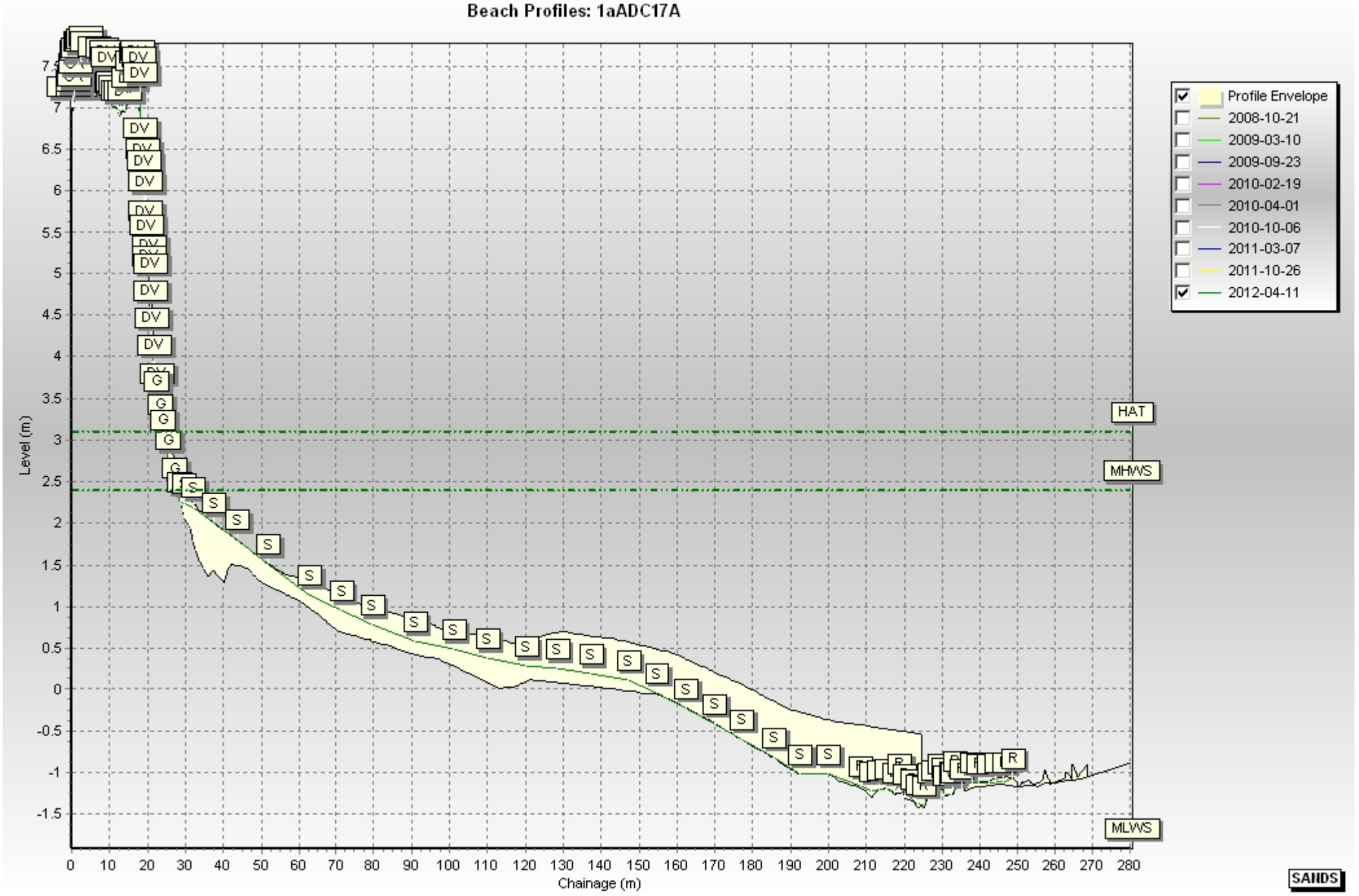
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Chainage (m)
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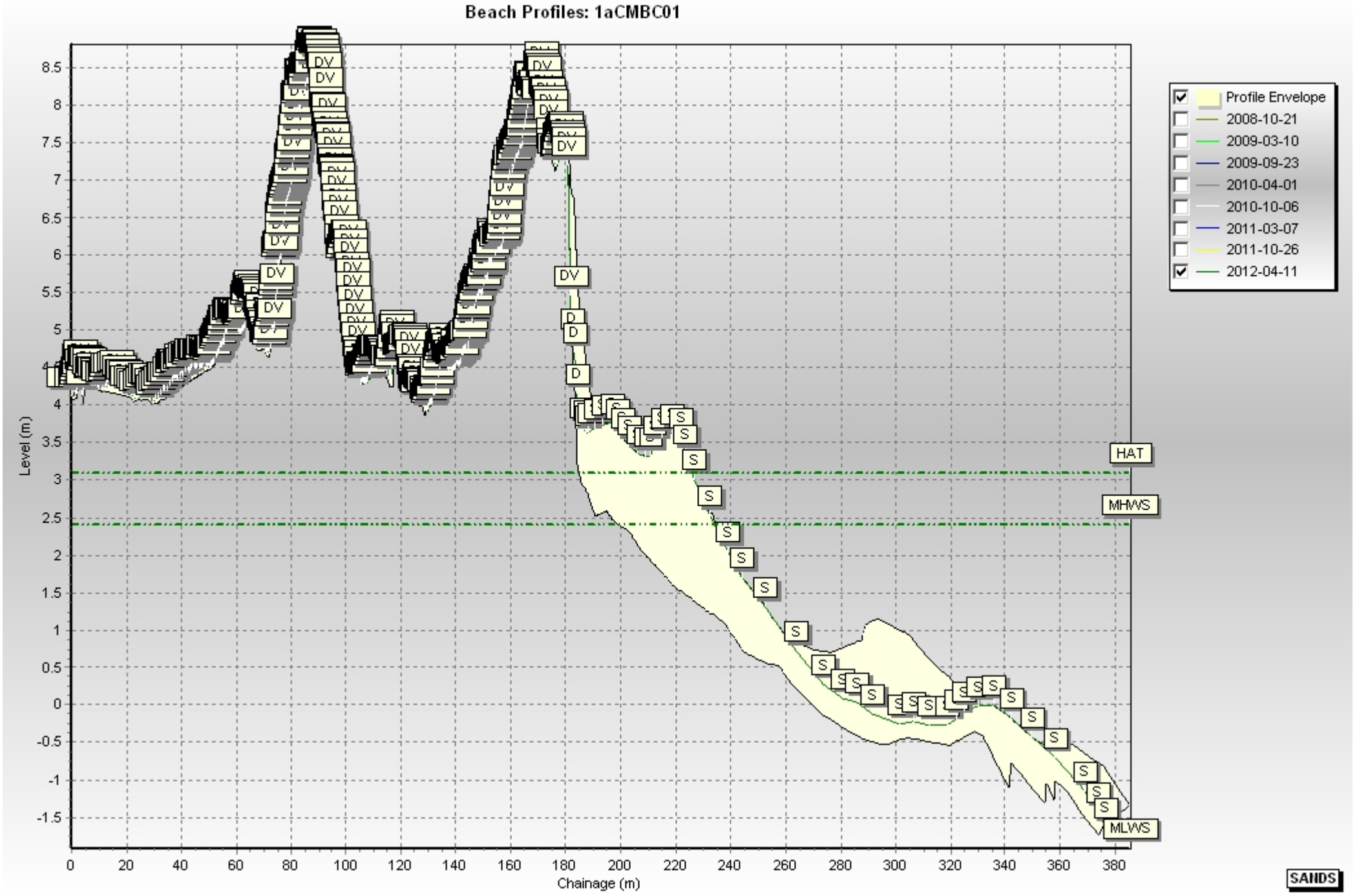
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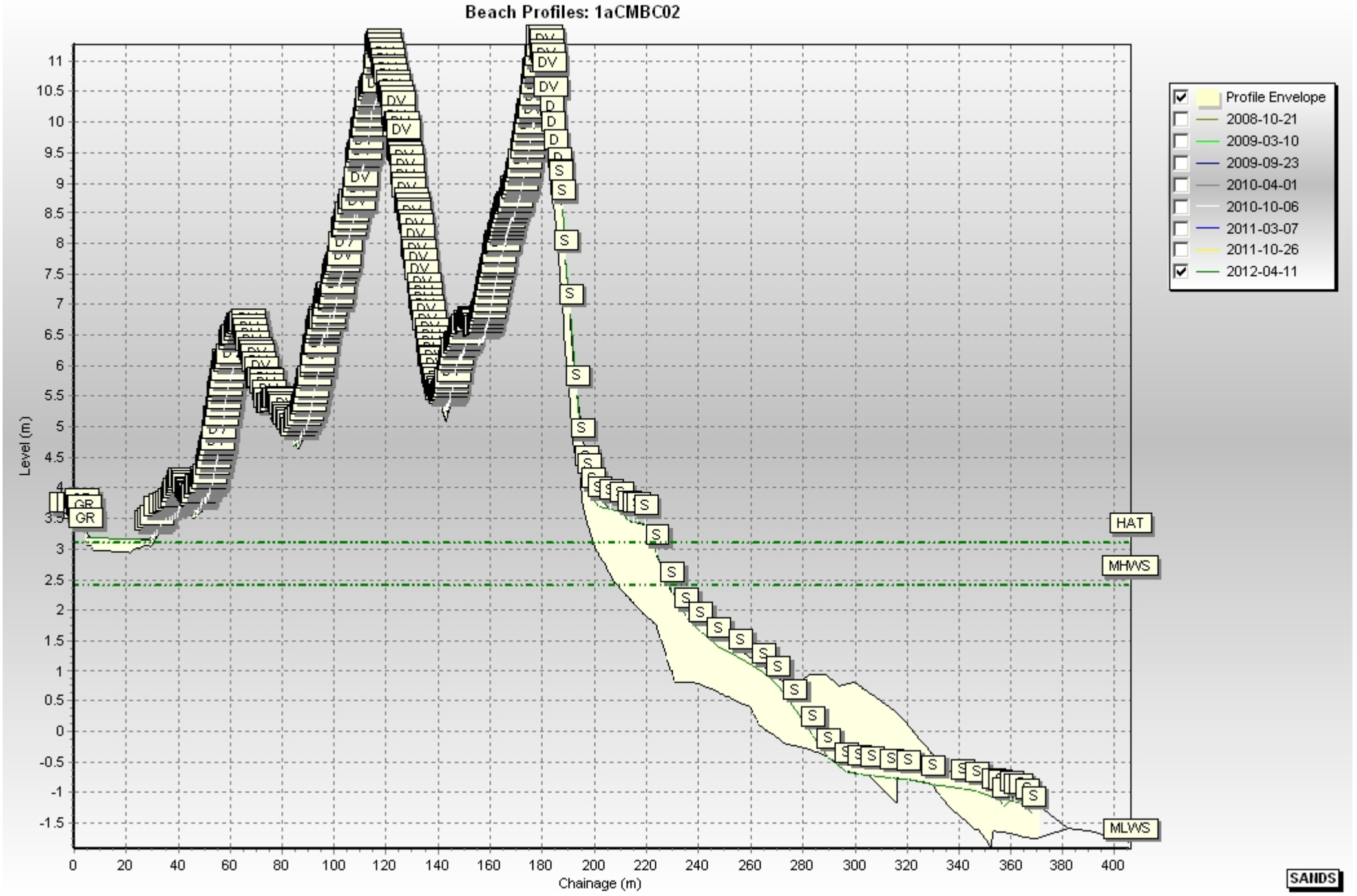
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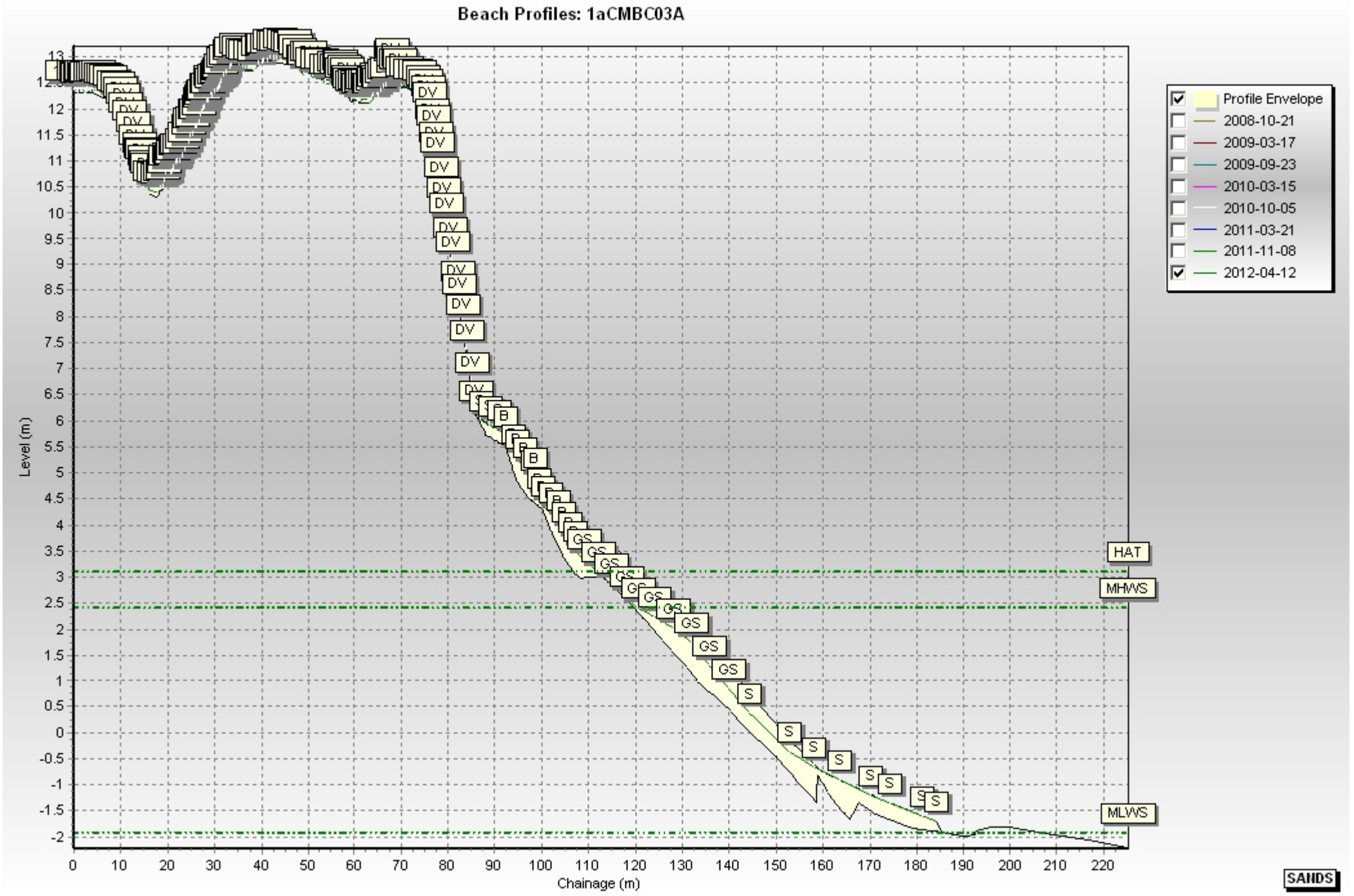
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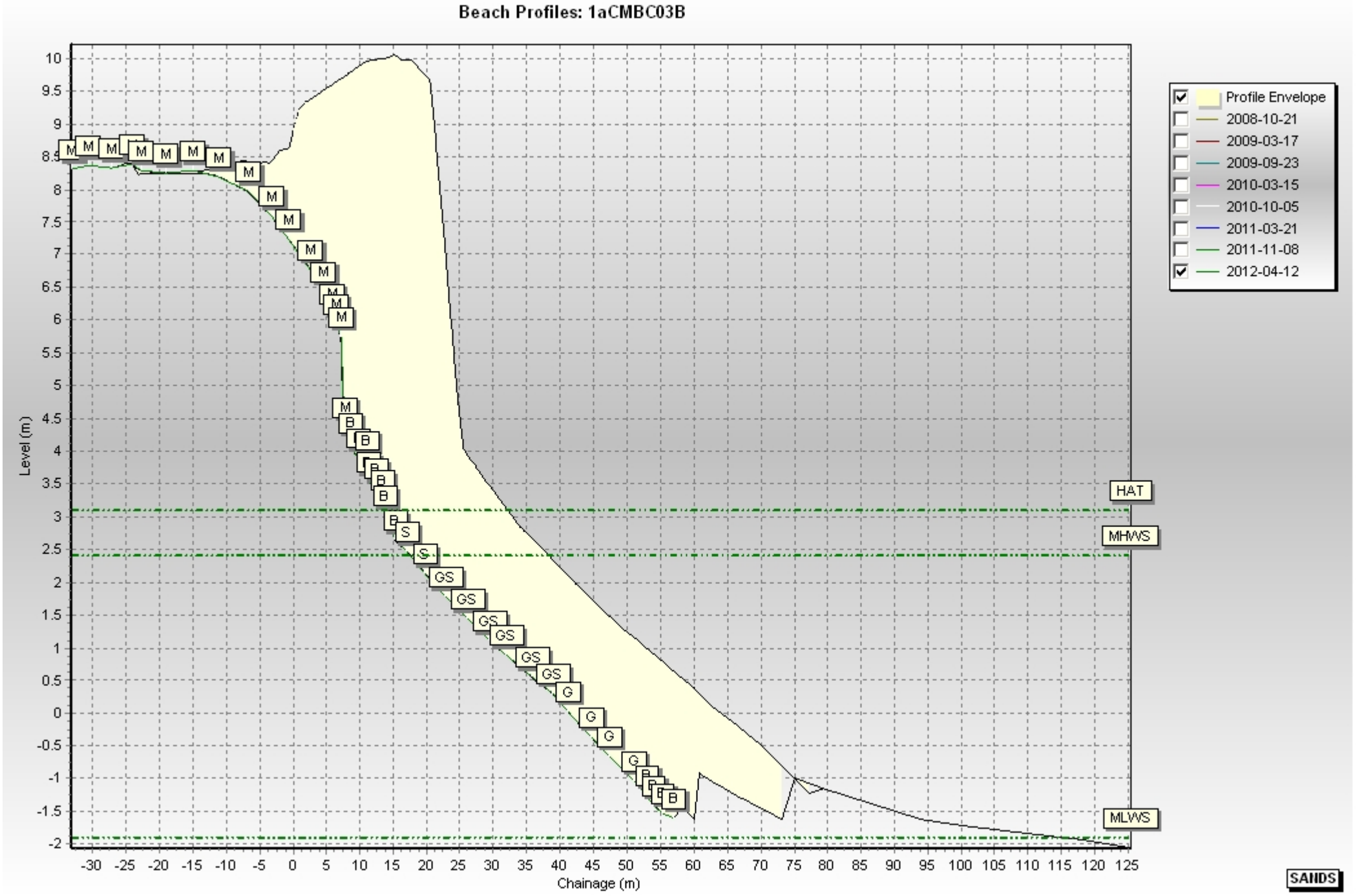
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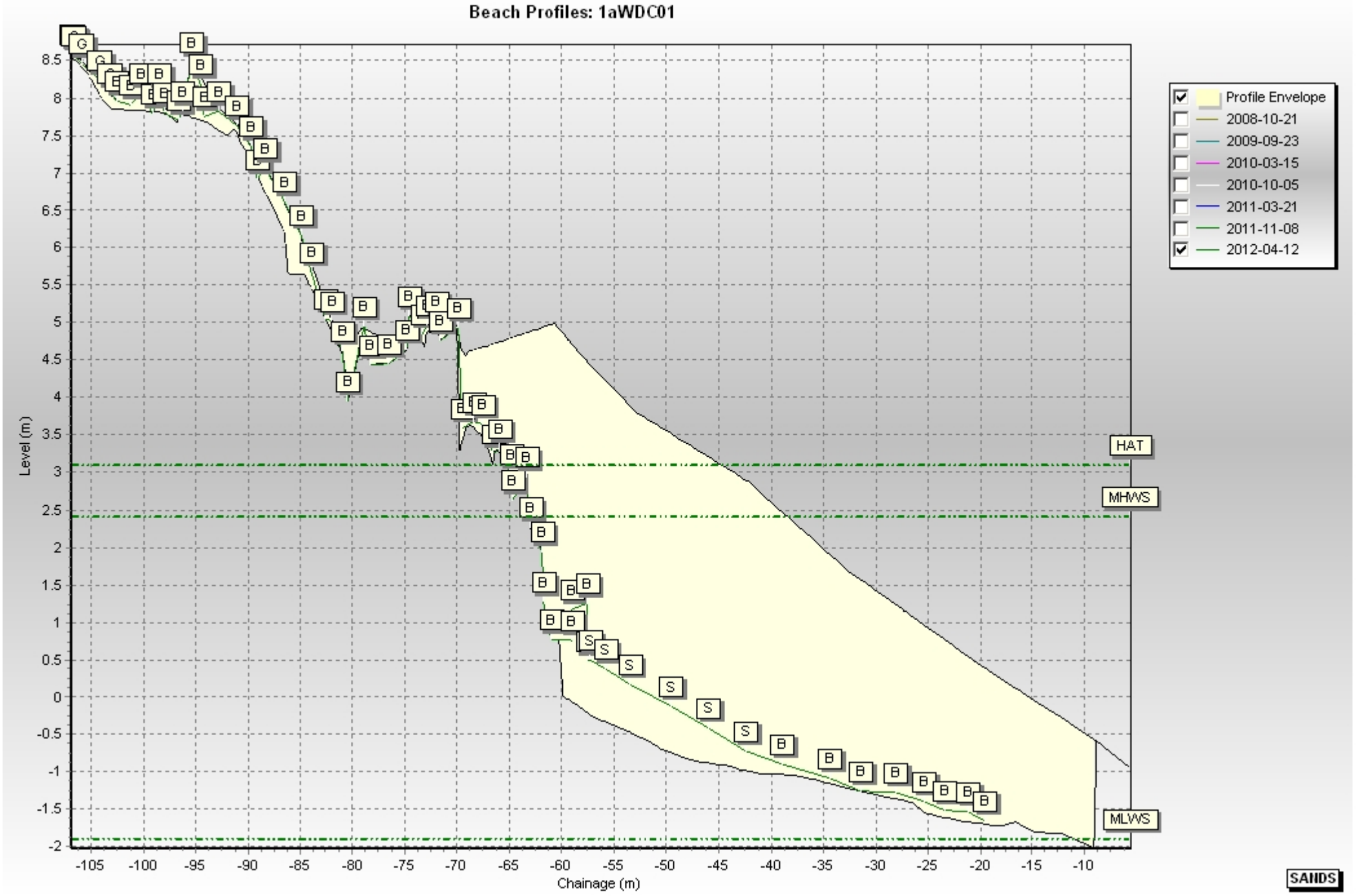
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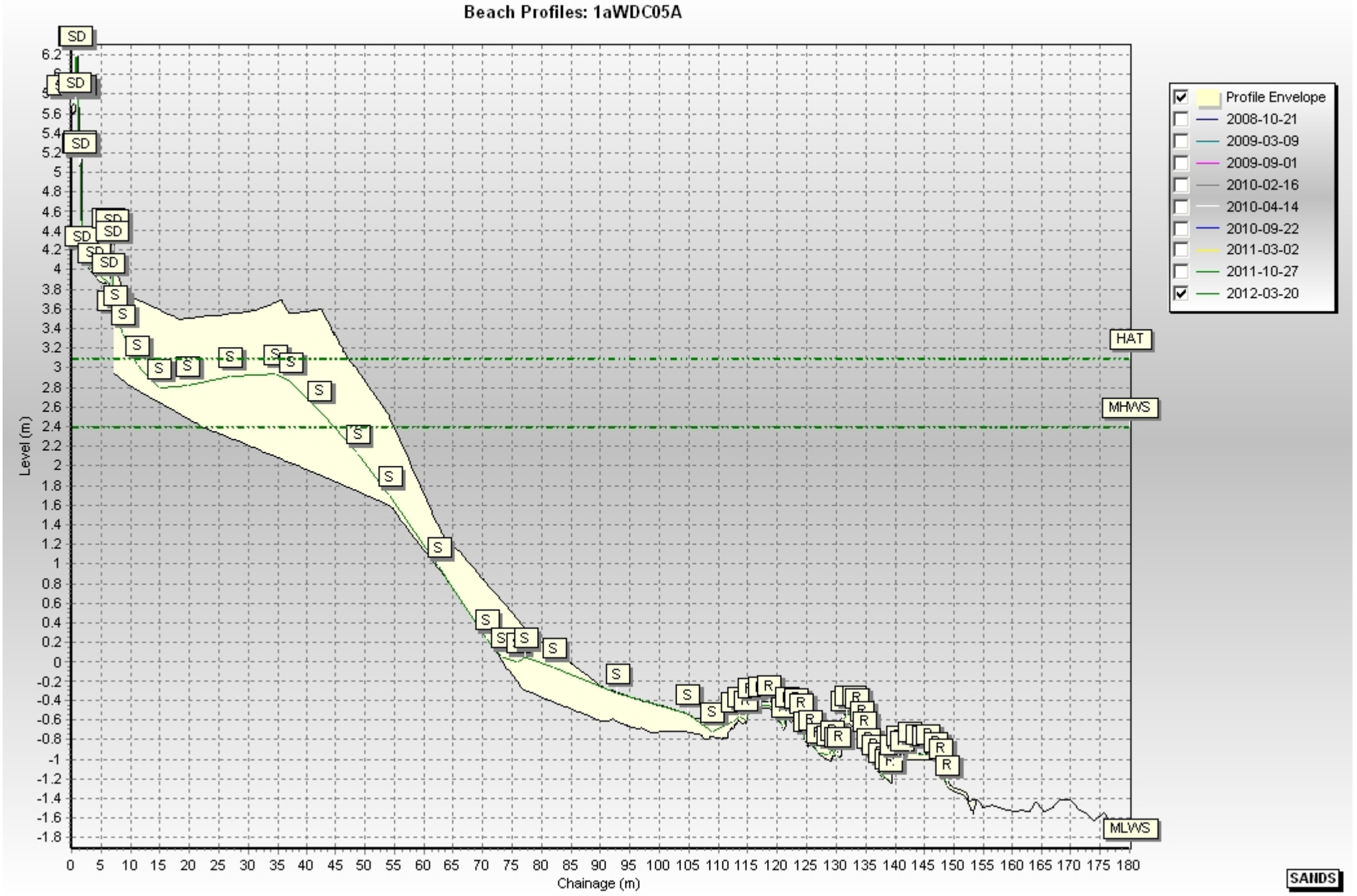
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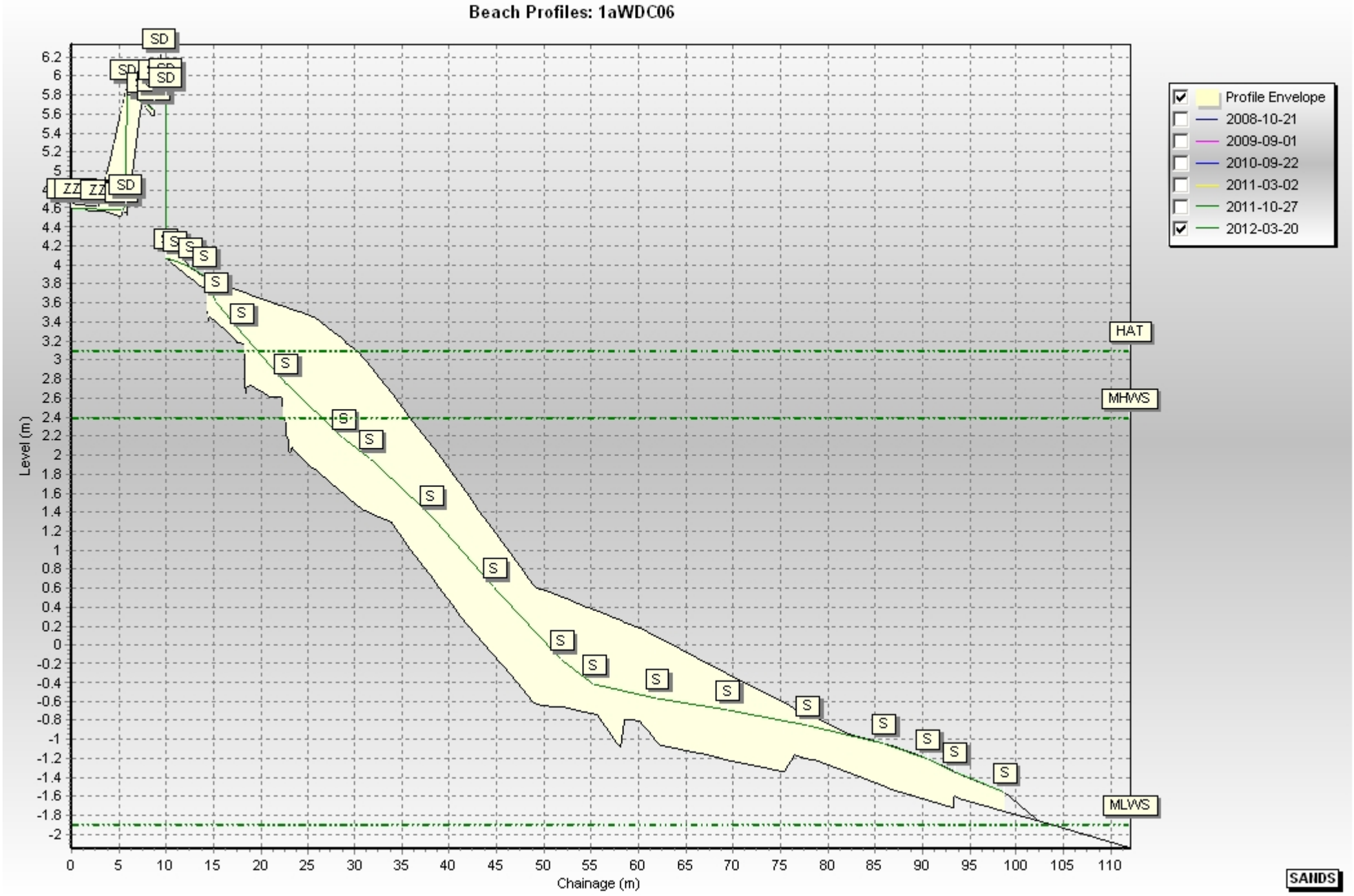
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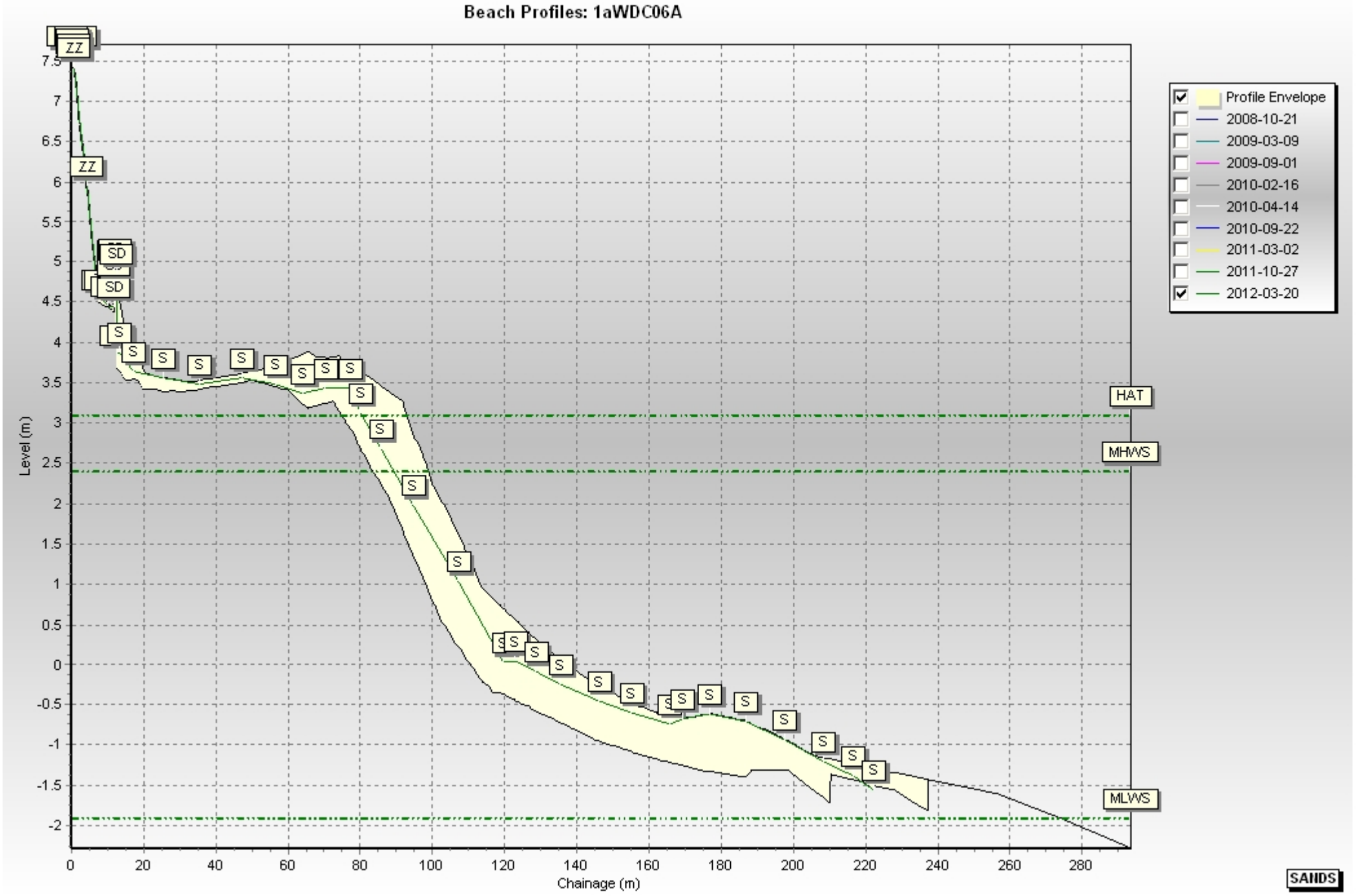
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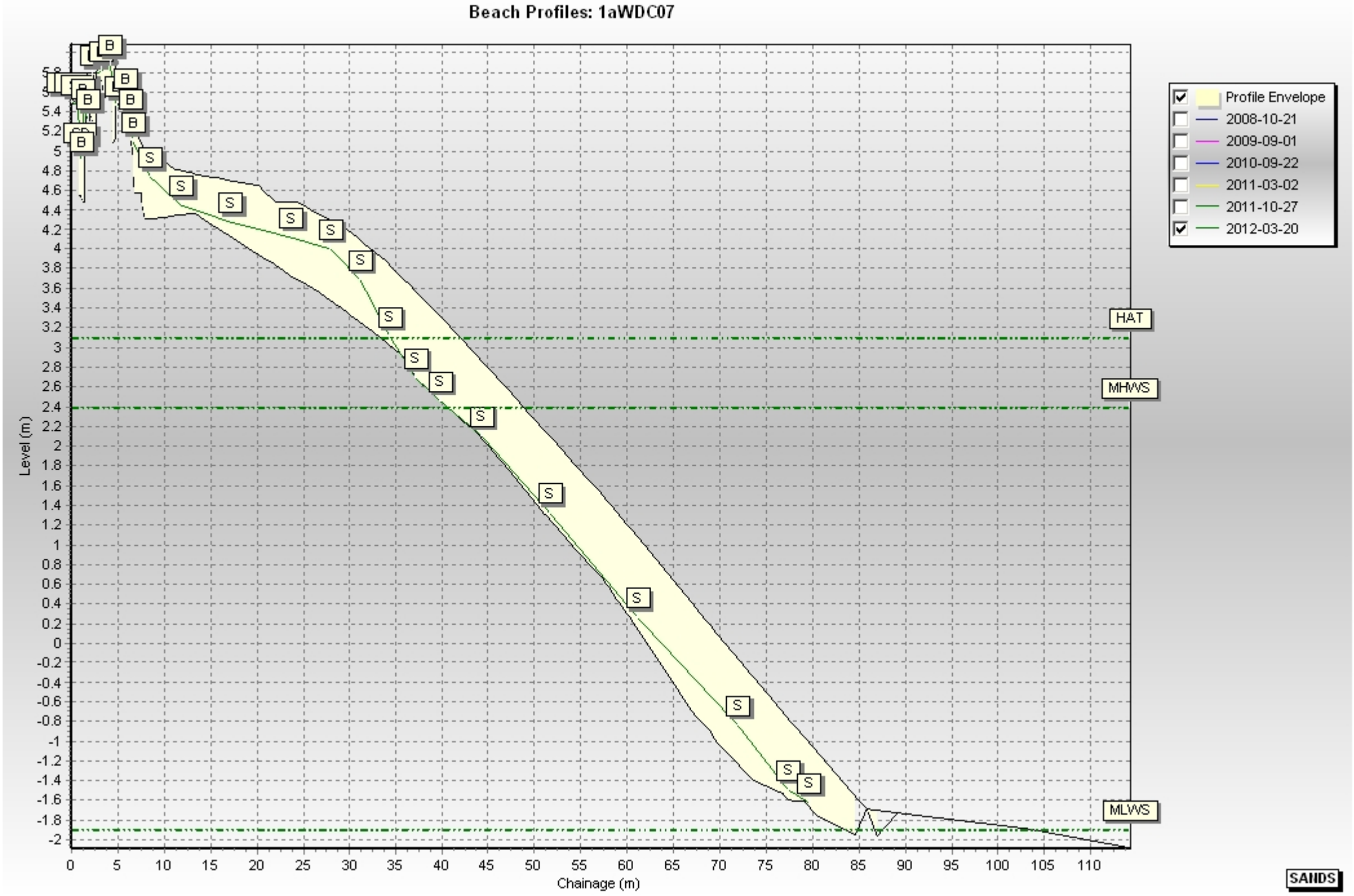
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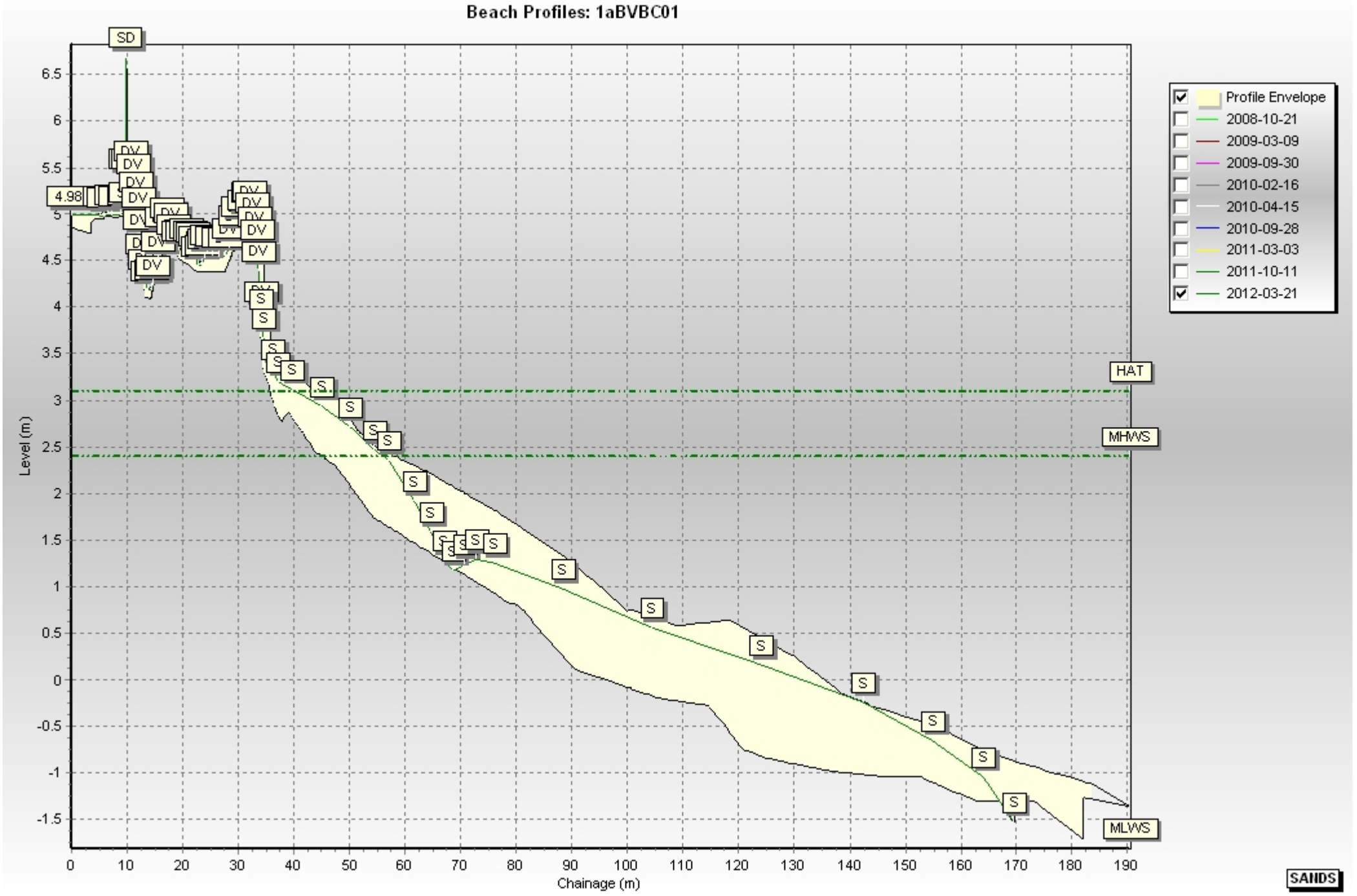
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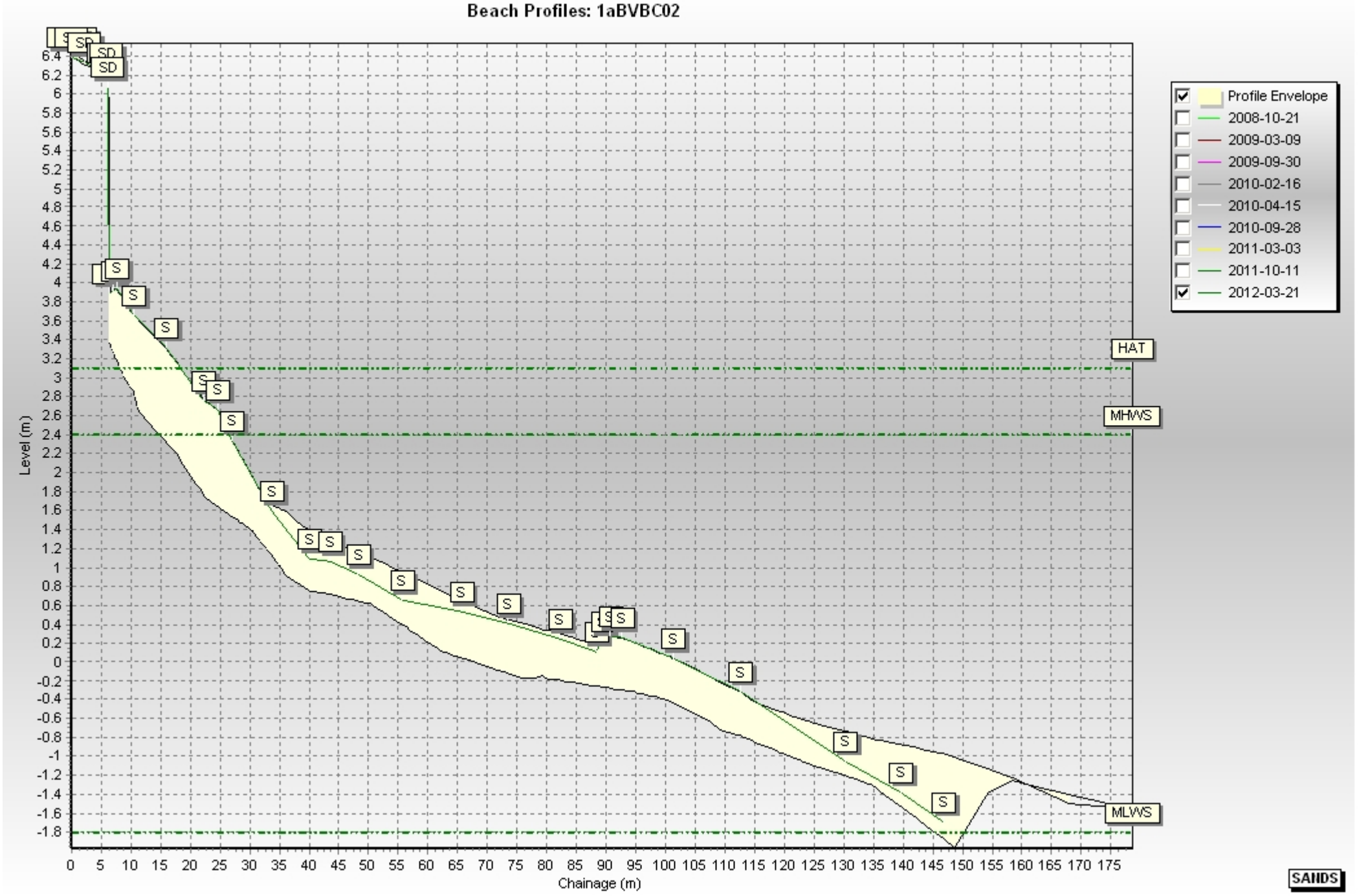
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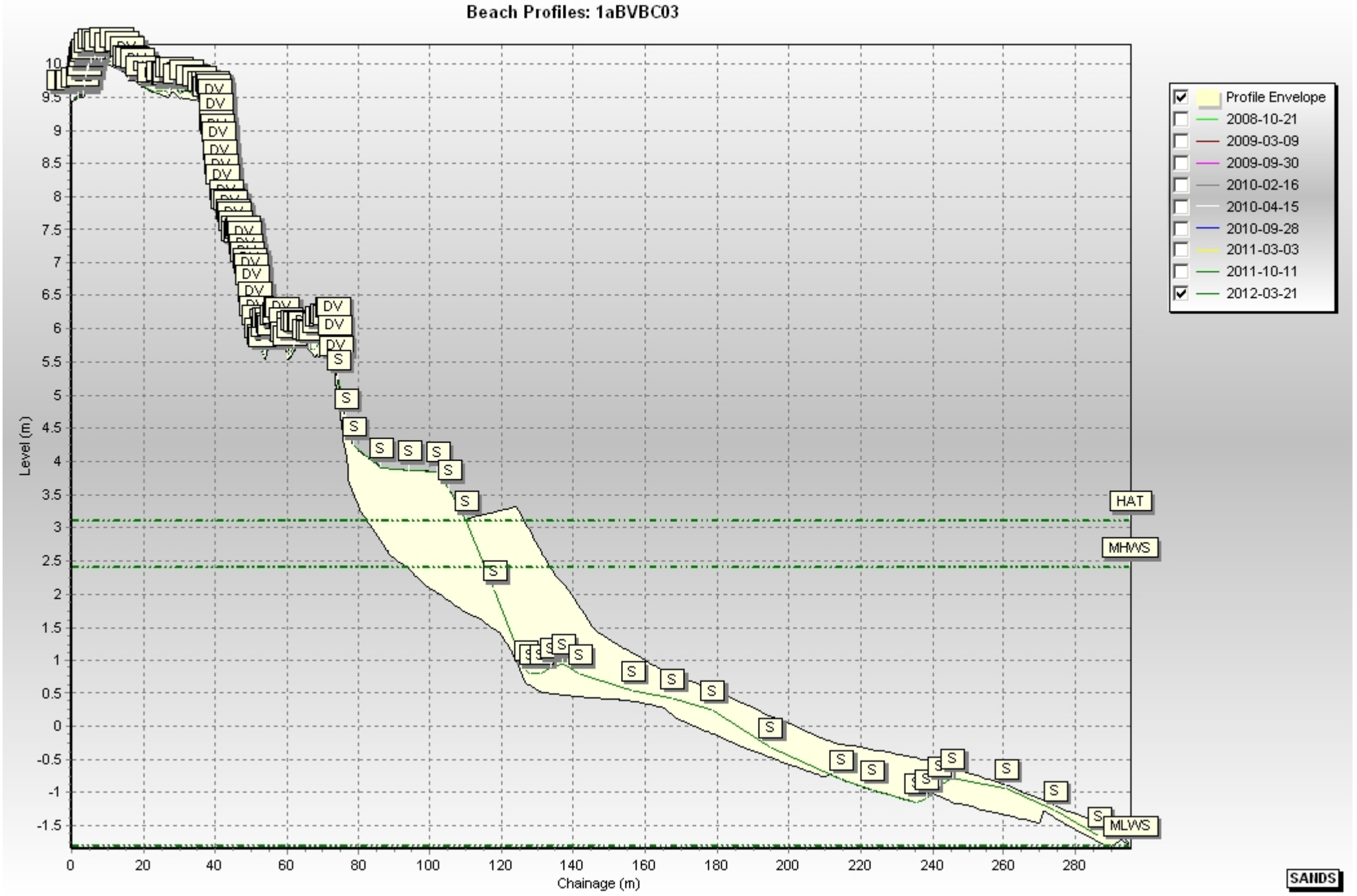
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Chainage (m)
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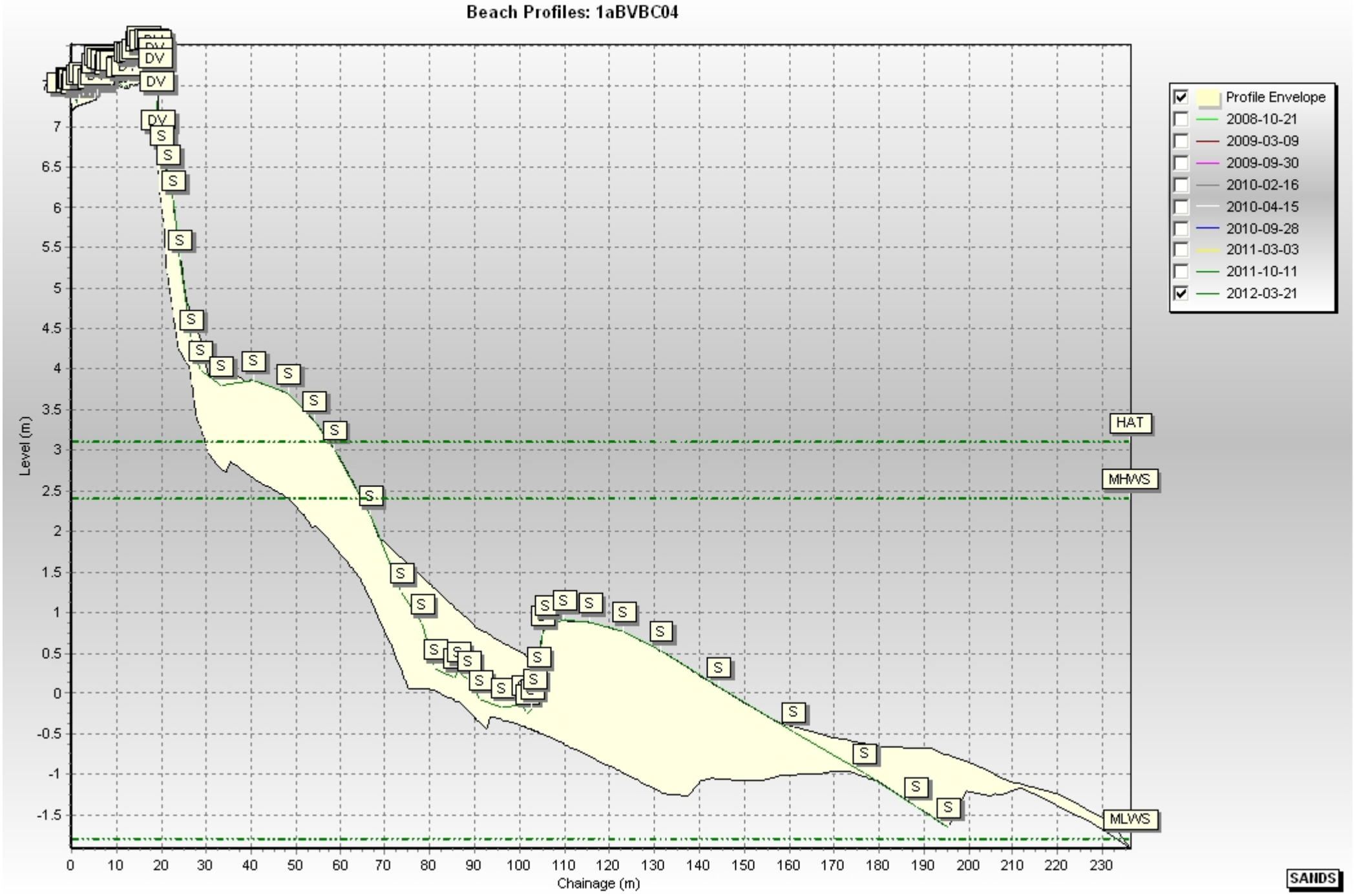
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Chainage (m)
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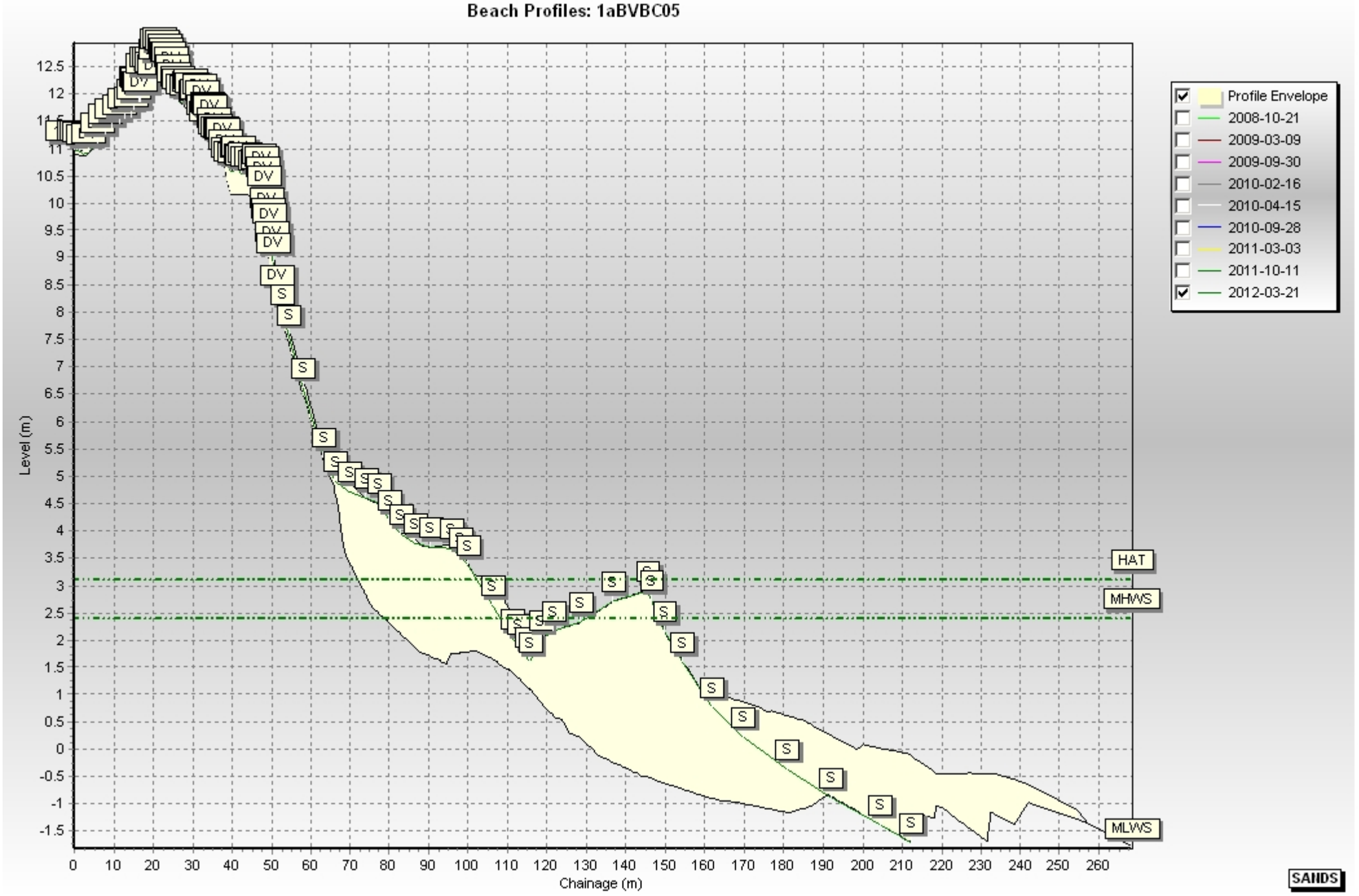
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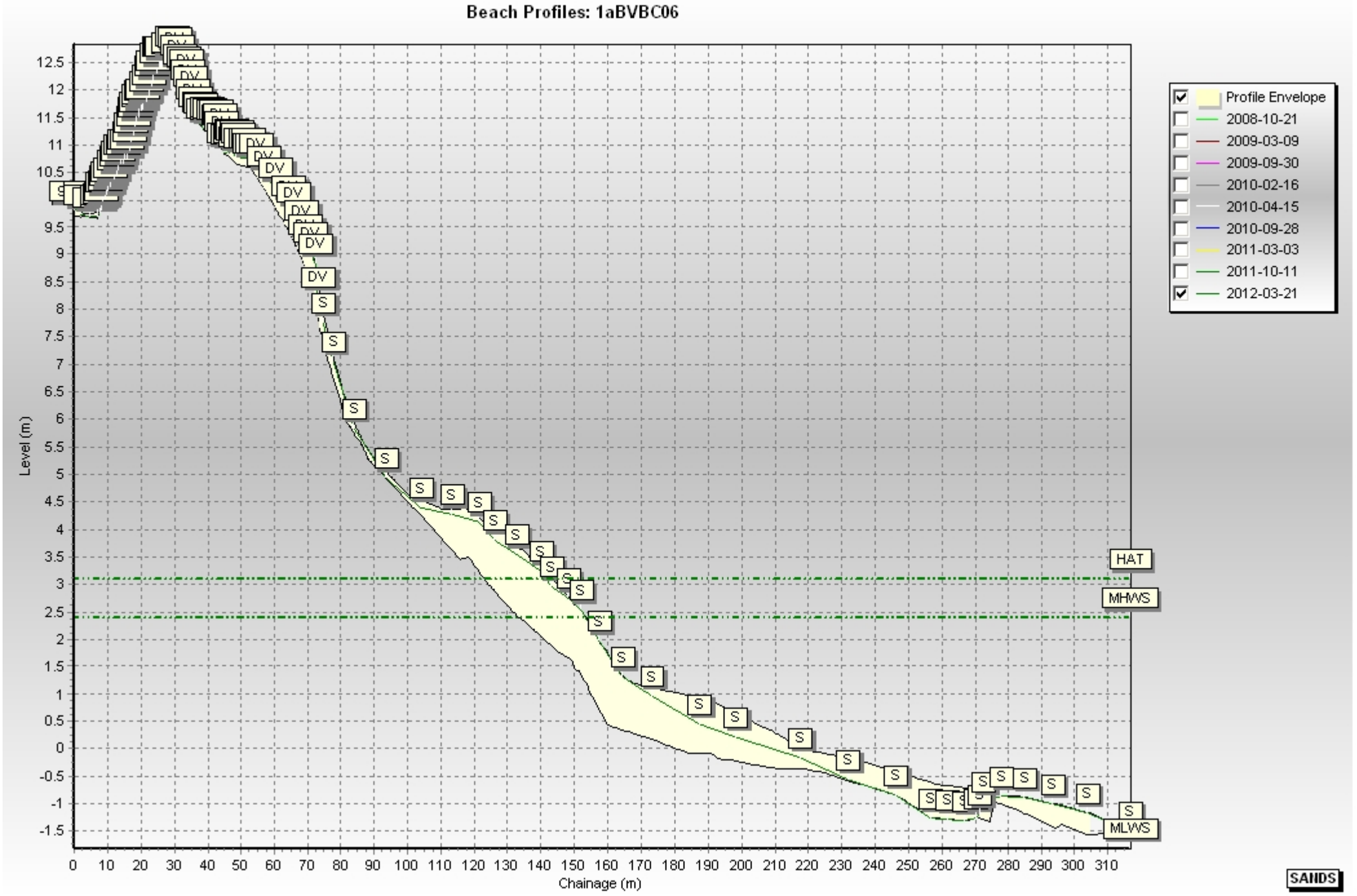
SANDS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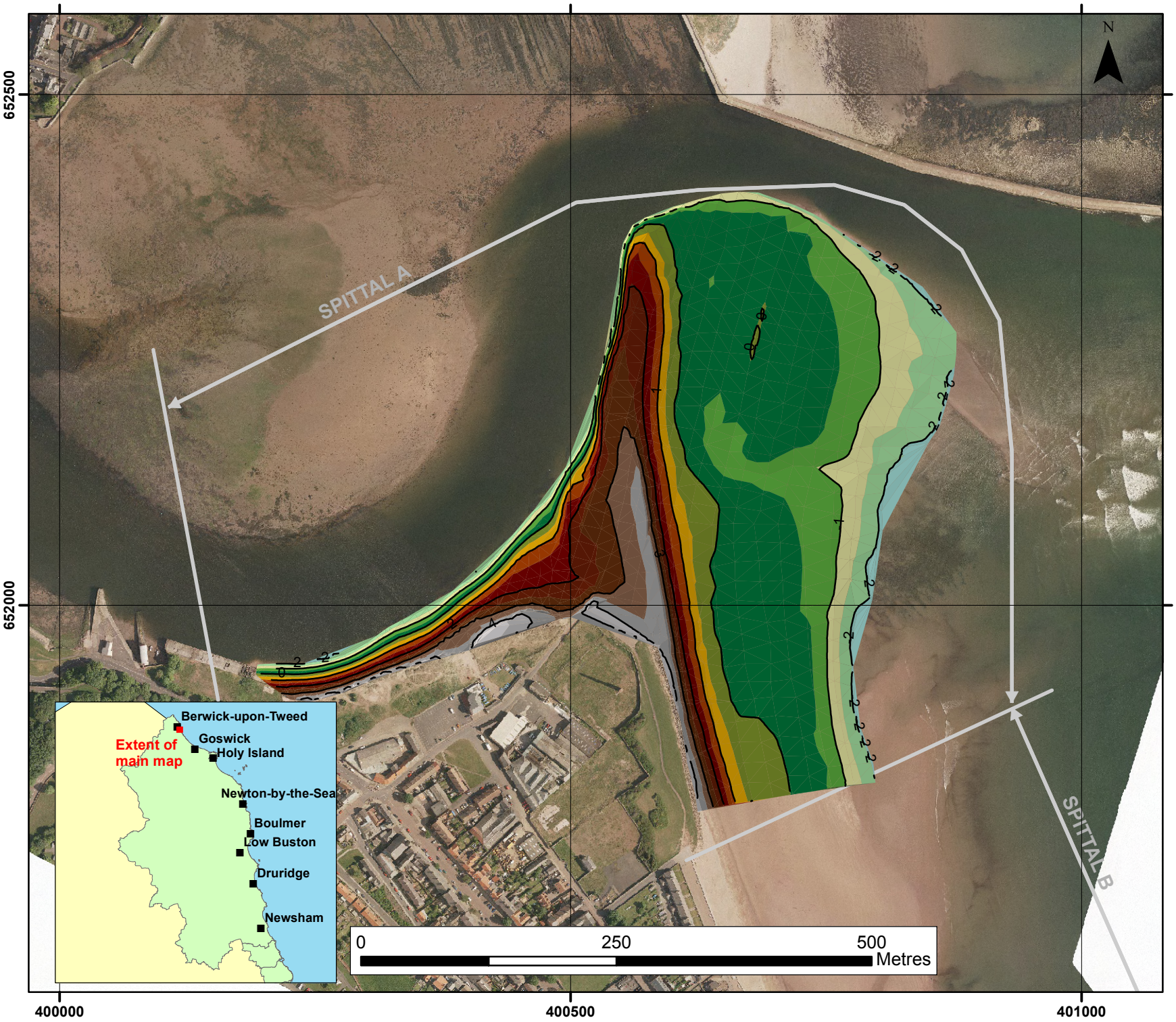
HAT
MHWS
MLWS
Level (m)
Chainage (m)
SANDS

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
- Contour (1m)

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

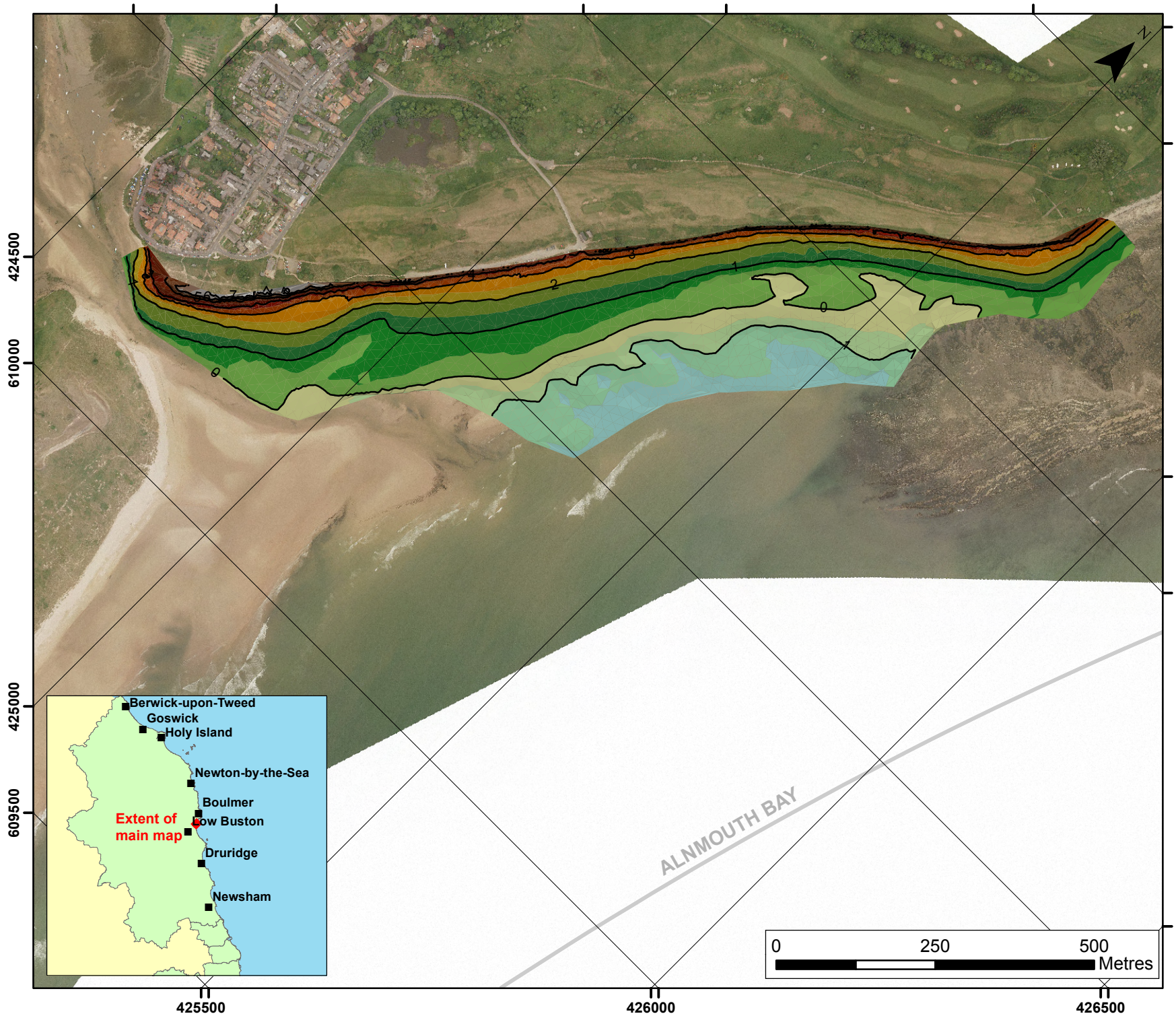
Appendix B- Map 1a Topographic Survey Sandstell Point (Spittal A) Northumberland County Council

Update Report 4
Partial Measures Survey
Spring 2012

Halcrow
A CH2M HILL COMPANY

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



KEY

Elevation (m OD)	
8 - 8.5	3 - 3.5
7.5 - 8	2.5 - 3
7 - 7.5	2 - 2.5
6.5 - 7	1.5 - 2
6 - 6.5	1 - 1.5
5.5 - 6	0.5 - 1
5 - 5.5	0 - 0.5
4.5 - 5	-0.5 - 0
4 - 4.5	-1 - -0.5
3.5 - 4	-1.5 - -1
	-2 - -1.5
	Contour (1m)

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

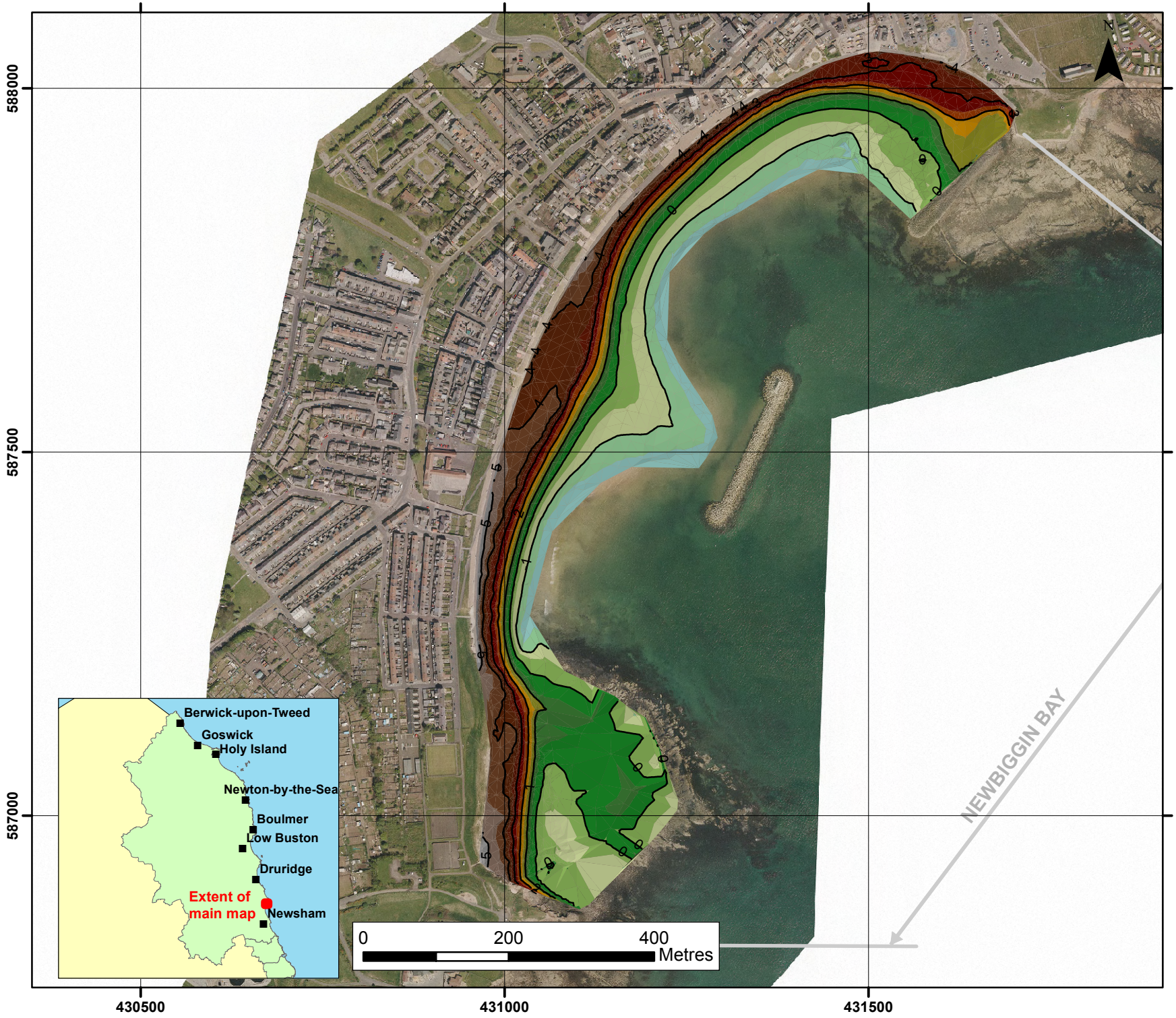
Appendix B- Map 2a
Topographic Survey
Alnmouth Bay
Northumberland County Council

Update Report 4
Partial Measures Survey
Spring 2012

Halcrow
A CH2M HILL COMPANY

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



KEY

Elevation

- 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
- -1.998 - -1.5
- contour

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Appendix B- Map 3a
Topographic Survey
Newbiggin Bay
Northumberland County Council

Update Report 4
Partial Measures Survey
Spring 2012

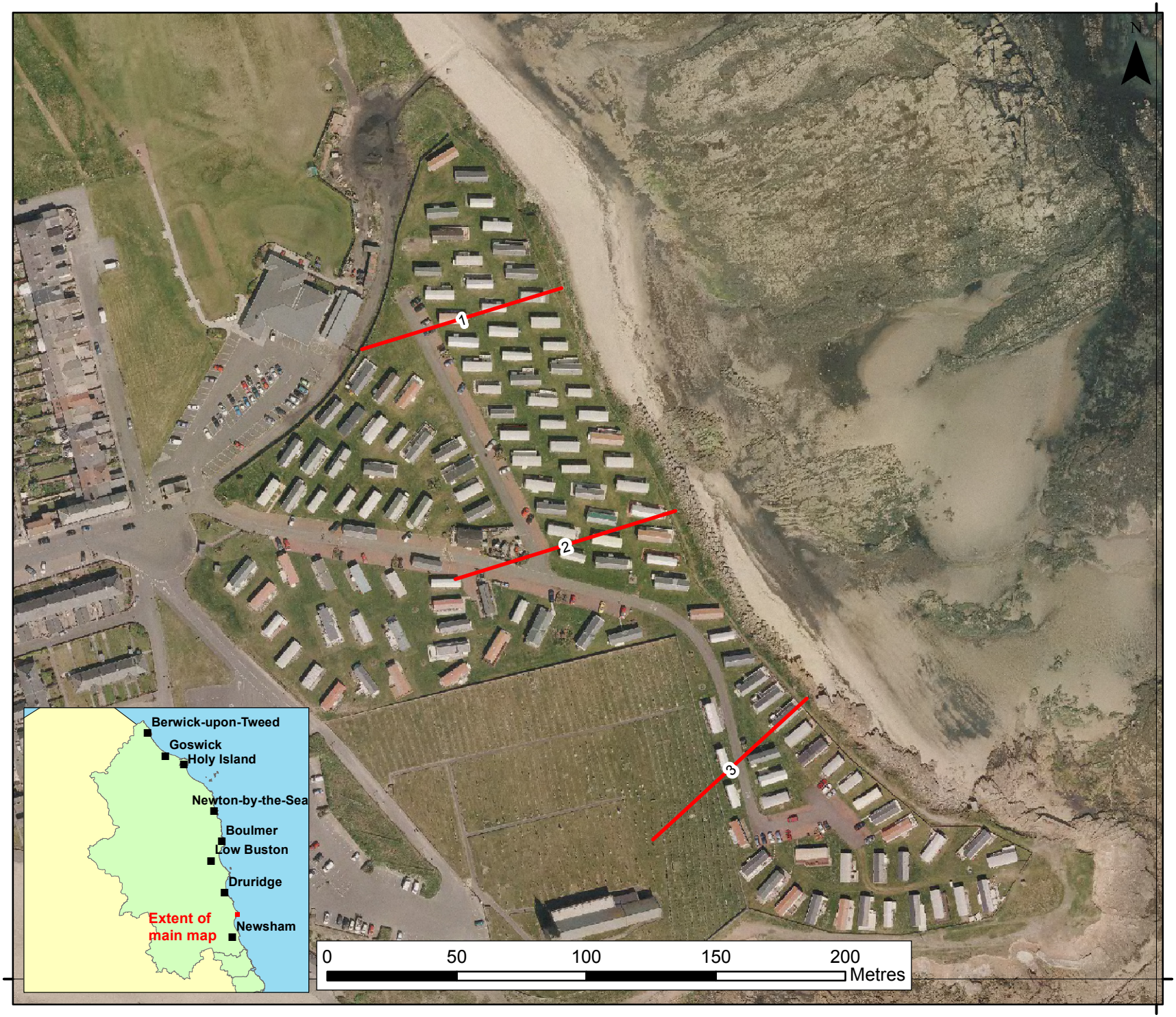
Halcrow
A CH2M HILL COMPANY

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

Appendix C

Cliff Top Survey



KEY

Transects

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Appendix C- Map 1
Cliff Top Survey
Lynemouth Bay
Northumberland CountyCouncil

Update Report 4
Partial Measures Survey
Spring 2012

Halcrow
A CH2M HILL COMPANY

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

Cliff Top Survey

Lynemouth Bay

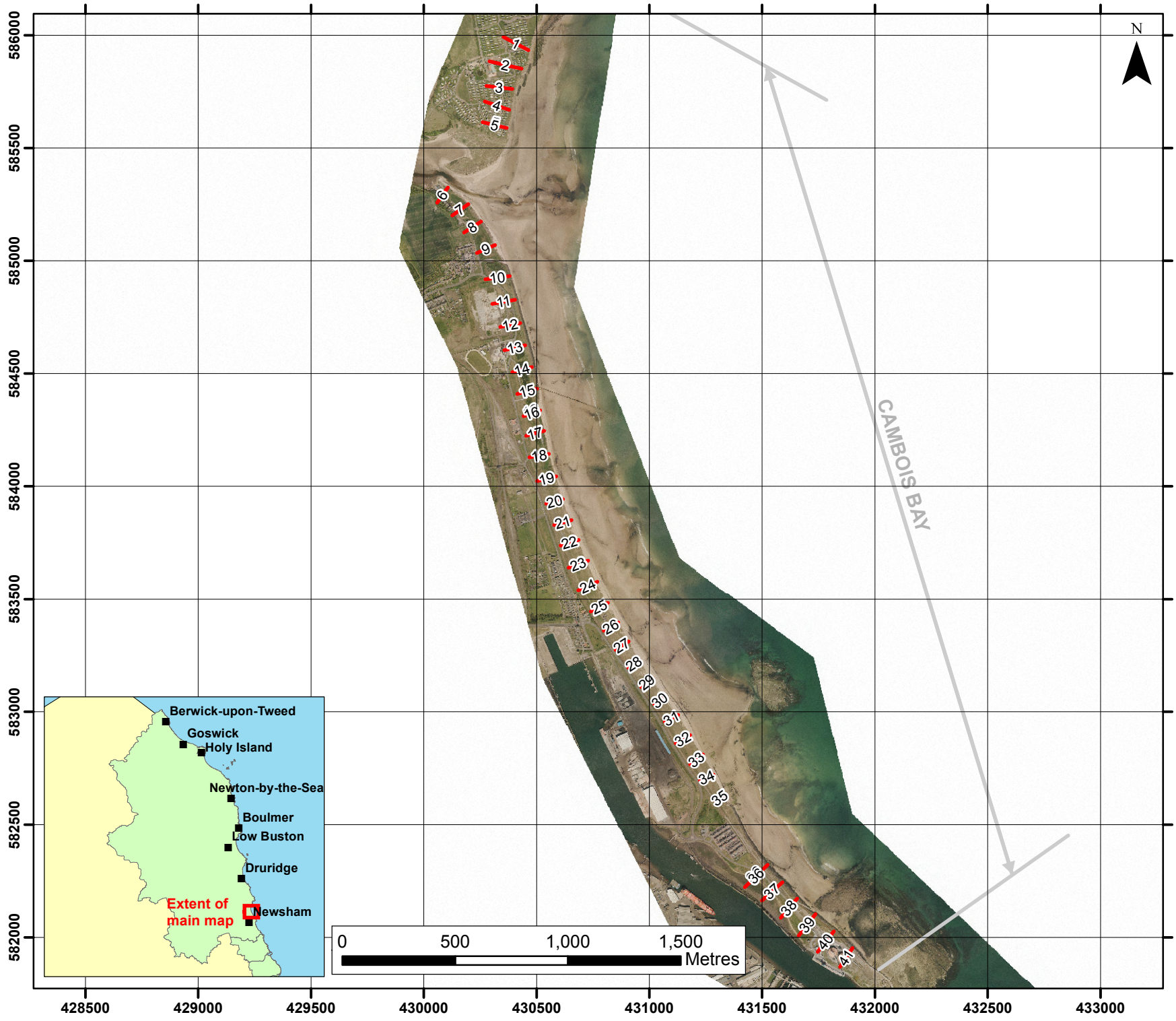
Three ground control points have been established at Lynemouth Bay (Map 1). The maximum separation between any two points varies along the coast, reflecting the erosion risk.

The cliff top surveys at Lynemouth Bay are undertaken bi-annually. Measurements are taken along a fixed transect from the landward datum to the surveyed cliff top position.

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

Table C1 – Cliff Top Surveys at Lynemouth Bay

Ground Control Point Details		Distance to Cliff Top (m)			Total Erosion (m)		Erosion Rate (m/year)
Ref	Type	Baseline Survey (Oct 2008))	Previous Survey (Nov 2011))	Present Survey (Apr 2012)	Baseline (Oct2008) to Present (Apr 2012)	Previous (Nov 2011) to Present (Apr 2012)	Baseline (Oct 2008) to Present (Apr 2012)
1	Cliff	80.62	80.0	80.0	-0.6	0.0	-0.2
2	Defended	88.88	88.9	88.8	-0.1	-0.1	0.0
3	Cliff	80.23	80.6	80.5	0.3	-0.1	0.1



KEY

Transects

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Appendix C- Map 2
Cliff Top Survey
Cambois Bay
Northumberland CountyCouncil

Update Report 4
Partial Measures Survey
Spring 2012

Halcrow
A CH2M HILL COMPANY

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

Cliff Top Survey

Cambois Bay (north)

Five ground control points have been established at Cambois Bay (north) (Map 2). The maximum separation between any two points varies along the coast, reflecting erosion risk.

The cliff top surveys at Cambois Bay (north) 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 C2 provides baseline information about these ground control points and results from the 2008 (baseline) survey showing the position from the ground control point to the edge of the cliff top along the defined bearing. Future reports will show results from subsequent surveys and provide a means of assessing erosion since the baseline survey.

Table C2 – Cliff Top Surveys at Cambois Bay (north)

Ground Control Point Details		Distance to Cliff Top (m)			Total Erosion (m)		Erosion Rate (m/year)
Ref	Type	Baseline Survey (Oct 2008))	Previous Survey (Nov 2011))	Present Survey (Apr 2012)	Baseline (Oct2008) to Present (Apr 2012)	Previous (Nov 2011) to Present (Apr 2012)	Baseline (Oct 2008) to Present (Apr 2012)
1	Cliff	125.47	125.4	125.3	-0.2	-0.1	-0.1
2	Defended	146.01	146.0	145.9	-0.1	-0.1	0.0
3	Defended	116.4	116.7	116.9	0.5	0.3	0.2
4	Cliff	114.44	115.3	114.4	0.0	-0.9	0.0
5	Cliff	110.04	108.9	108.3	-1.8	-0.6	-0.5

Cliff Top Survey

Cambois Bay (south)

36 ground control points have been established at Cambois Bay (south) (Map 2). The maximum separation between any two points varies along the coast, reflecting the degree of risk from the erosion.

The cliff top surveys at Cambois Bay (south) 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 C3 provides baseline information about these ground control points and results from the 2008 (baseline) survey showing the position from the ground control point to the edge of the cliff top along the defined bearing. Future reports will show results from subsequent surveys and provide a means of assessing erosion since the baseline survey.

Table C3 – Cliff Top Surveys at Cambois Bay (north)

Ground Control Point Details		Distance to Cliff Top (m)			Total Erosion (m)		Erosion Rate (m/year)
Ref	Type	Baseline Survey (Oct 2008))	Previous Survey (Nov 2011))	Present Survey (Apr 2012)	Baseline (Oct2008) to Present (Apr 2012)	Previous (Nov 2011) to Present (Apr 2012)	Baseline (Oct 2008) to Present (Apr 2012)
6	Dune	74.5	No Data	74.9	0.4	No Data	0.1
7	Cliff	80	79.9	80.0	0.0	0.1	0.0
8	Cliff	82.62	80.8	80.7	-1.9	-0.1	-0.6
9	Cliff	76.91	76.9	76.9	0.0	0.0	0.0
10	Defended	94.47	93.0	94.6	0.1	1.6	0.0
11	Defended	90.65	89.6	90.8	0.1	1.2	0.0
12	Defended	83.25	80.7	83.3	0.1	2.6	0.0
13	Defended	87.72	86.8	87.6	-0.1	0.9	0.0
14	Defended	80.09	79.2	81.2	1.1	2.1	0.4
15	Defended	81.24	77.5	81.1	-0.2	3.5	-0.1
16	Cliff	71.65	70.8	71.0	-0.6	0.2	-0.2
17	Cliff	81.5	78.8	79.9	-1.7	1.1	-0.5
18	Cliff	85.72	84.8	84.7	-1.0	-0.1	-0.3
19	Cliff	81.48	81.4	81.9	0.4	0.5	0.1

Ground Control Point Details		Distance to Cliff Top (m)			Total Erosion (m)		Erosion Rate (m/year)
Ref	Type	Baseline Survey (Oct 2008))	Previous Survey (Nov 2011))	Present Survey (Apr 2012)	Baseline (Oct2008) to Present (Apr 2012)	Previous (Nov 2011) to Present (Apr 2012)	Baseline (Oct 2008) to Present (Apr 2012)
20	Dune	71.04	70.0	69.8	-1.2	-0.2	-0.4
21	Dune	75.11	73.1	72.7	-2.4	-0.4	-0.8
22	Dune	78.69	75.8	75.8	-2.9	-0.1	-1.0
23	Dune	86.59	81.7	81.6	-5.0	-0.1	-1.6
24	Dune	87.99	84.6	84.5	-3.5	0.0	-1.1
25	Dune	78.24	77.5	83.3	5.0	5.7	1.6
26	Dune	67.08	66.9	66.9	-0.2	0.0	-0.1
27	Dune	61.31	67.9	66.8	5.5	-1.1	1.8
28	Dune	55.83	55.5	55.5	-0.4	0.0	-0.1
29	Dune	57.66	57.0	56.9	-0.8	-0.1	-0.2
30	Dune	56.66	56.3	56.8	0.1	0.5	0.0
31	Dune	63.03	63.2	63.9	0.8	0.7	0.3
32	Dune	68.35	68.1	68.1	-0.3	-0.1	-0.1
33	Dune	65.17	64.8	64.8	-0.4	0.0	-0.1
34	Dune	60.34	60.0	60.2	-0.1	0.3	0.0
35	Cliff	42.21	41.4	41.1	-1.1	-0.3	-0.4
38	Defended	No Data	101.4	101.8	No Data	0.3	No Data
39	Defended	111.71	111.8	111.8	0.1	0.0	0.0
40	Defended	109.02	109.1	109.2	0.2	0.1	0.1
41	Defended	94.35	93.6	94.1	-0.2	0.5	-0.1

Appendix D

Sand Extent Survey

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Appendix D- Map 1
Sand Extent Survey
Newbiggin Bay
Northumberland County Council

Update Report 4
Partial Measures Survey
Spring 2012

Halcrow
A CH2M HILL COMPANY

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