Cell 1 Regional Coastal Monitoring Programme Update Report 6: 'Partial Measures' Survey 2014

Northumberland County Council
Final Report

July 2014

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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	**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).

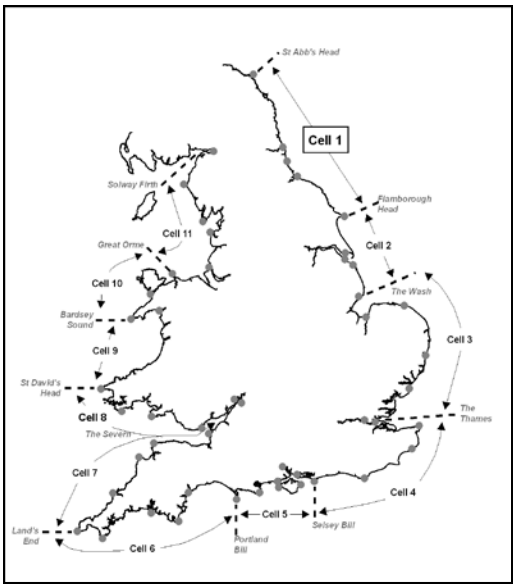


Figure 1 Sediment Cells in England and Wales

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 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	Sept-Dec 08	May 09	Mar-May 09		-
2	2009/10	Sept-Dec 09	Mar 10	Feb-Mar 10	Jul 10	-
3	2010/11	Aug-Nov 10	Feb 11	Feb-Apr 11	Aug 11	Sept 11
4	2011/12	Oct-Nov 11	Oct 12	Mar-May 12	Oct 12	
5	2012/13	Sept-Nov 12	Mar 13	Mar-Apr 13	Jul 13	
6	2013/14	Sept-Oct 13	Feb 14	Mar-Apr 14	Jul 14 (*)	

(*) The present report is **Update Report 6** and provides an analysis of the 2014 Partial Measures survey for Northumberland County Council's frontage.

1. Introduction

1.1 Study Area

Northumberland County 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 the Northumberland frontage, the following surveying is undertaken:

Full Measures survey annually each autumn 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 and future surveys, the data will be plotted in GIS and change will qualified along a series of pre-defined 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 on 21st March 2014, 31st March 2014 to 4th April 2014 and 13th to 17h April 2014. During this time weather conditions varied considerably; refer to the survey reports for details of the weather conditions over this survey period.

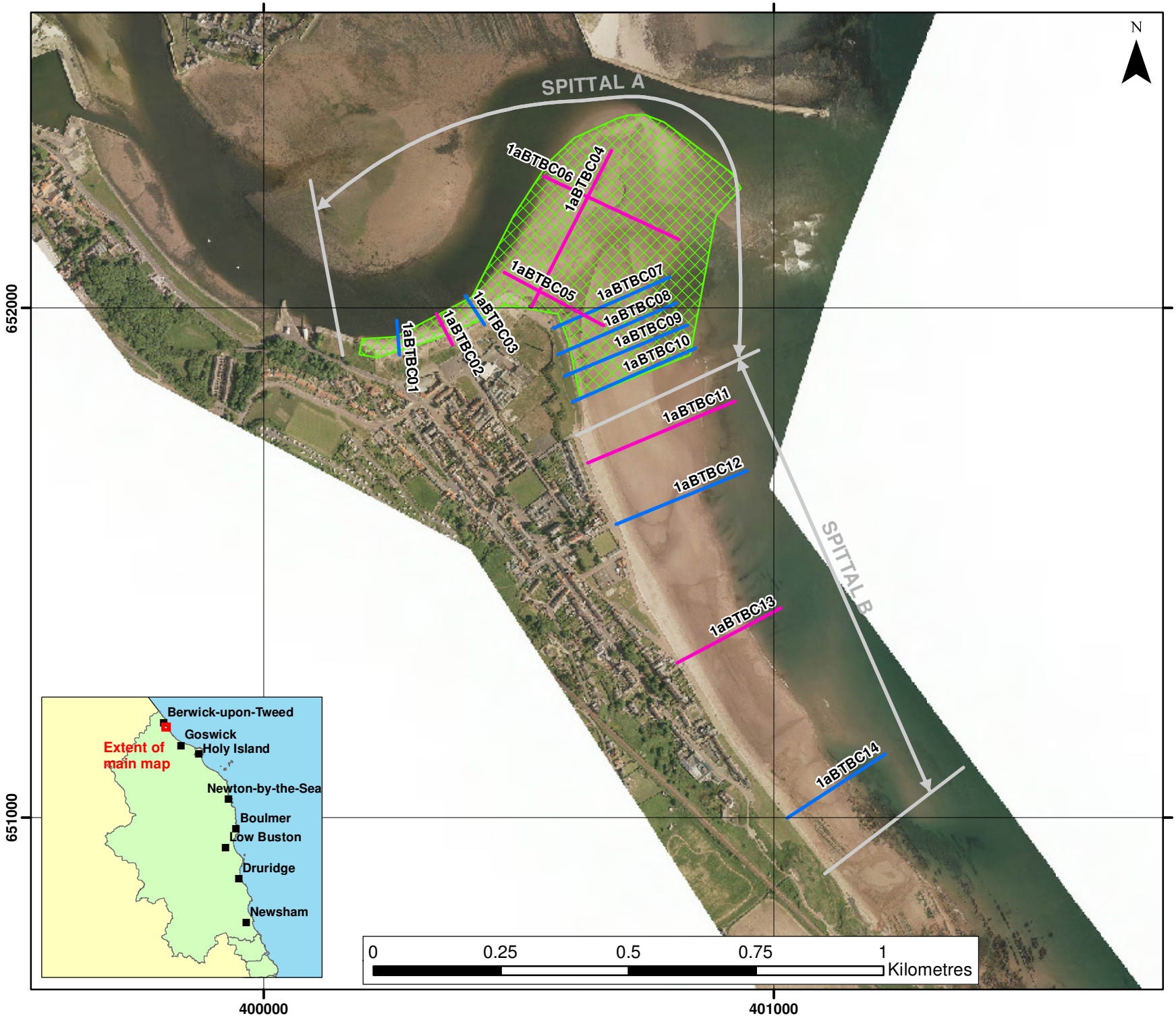
On 5th December 2013 a significant storm surge, driven by strong northerly winds, coincided with one of the highest astronomical tides of the year. A comparison of the recorded water level data for the December 2013 storm surge at North Shields, Whitby and Scarborough is provided in the second wave data analysis report covering the period 2013 to 2014. Recorded surge residuals from that report show a similar signature at the three sites, with the maximum surge height occurring before high water and the surge increasing in height as it progressed down the coast, from around 1.3m above predicted water level at North Shields to around 1.8m at Whitby and Scarborough. Based on the EA (2011) Coastal Flood Boundary Condition extreme water level data the surge had the follow chance of occurrence each year:

- North Shields: between 1 in 200 and 1 in 500
- Whitby: between 1 in 100 and 1 in 500
- Scarborough between 1 in 150 and 1 in 500

The Update Report presents the following:

- description of the changes observed since the previous survey and an interpretation of the drivers of these changes Particular attention is paid to determining any residual impacts of the storm surge that occurred in December 2013 (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
- key conclusions and highlighting of 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 6
Partial Measures Survey
Spring 2014

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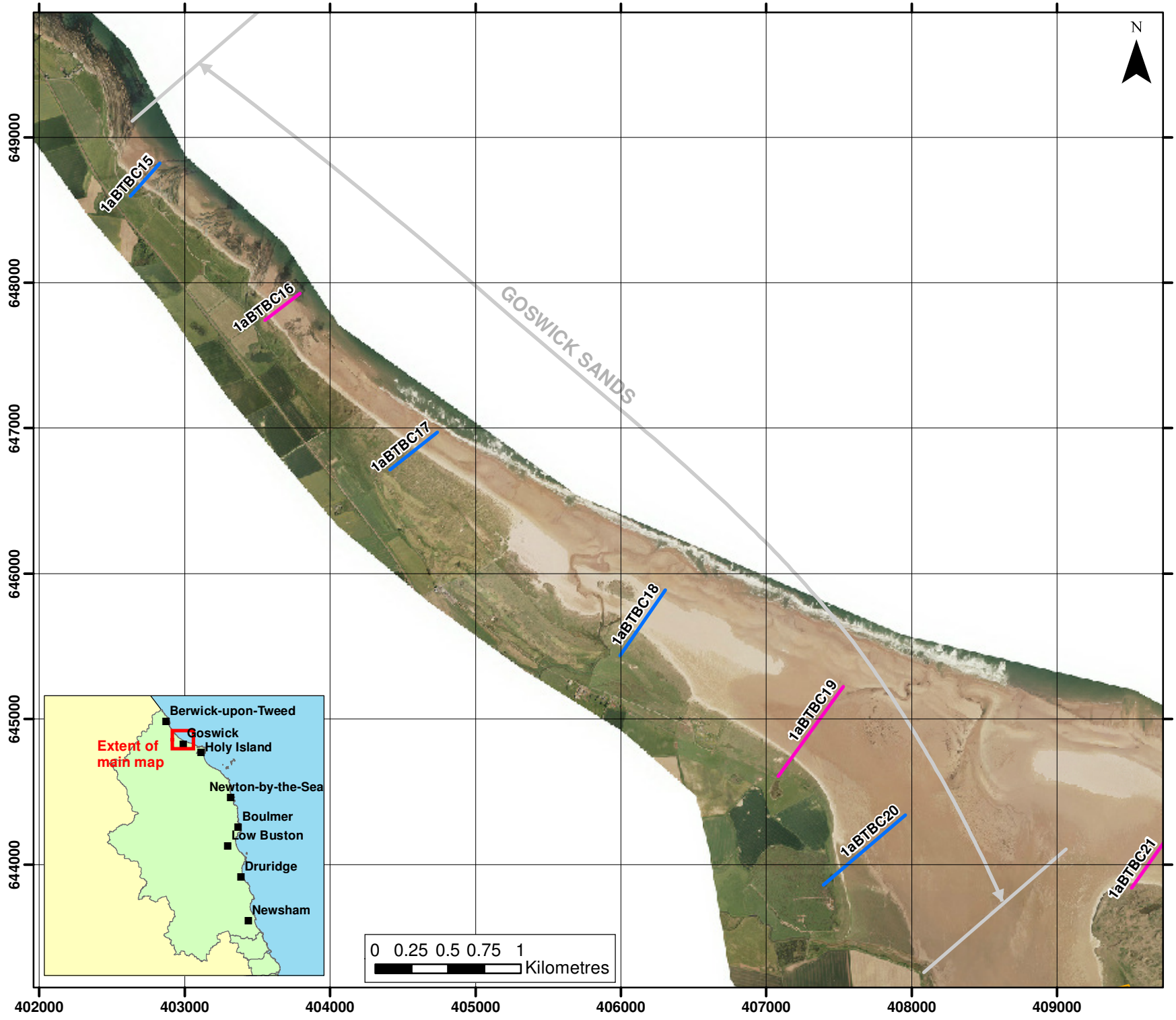

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Topographic Surveys
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Cliff Top Monitoring Pegs
- 50m centres
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- 300m centres

(Indicative survey extents shown)

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Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Figure 2- Map 2
Survey Locations
Goswick Sands
Northumberland County Council

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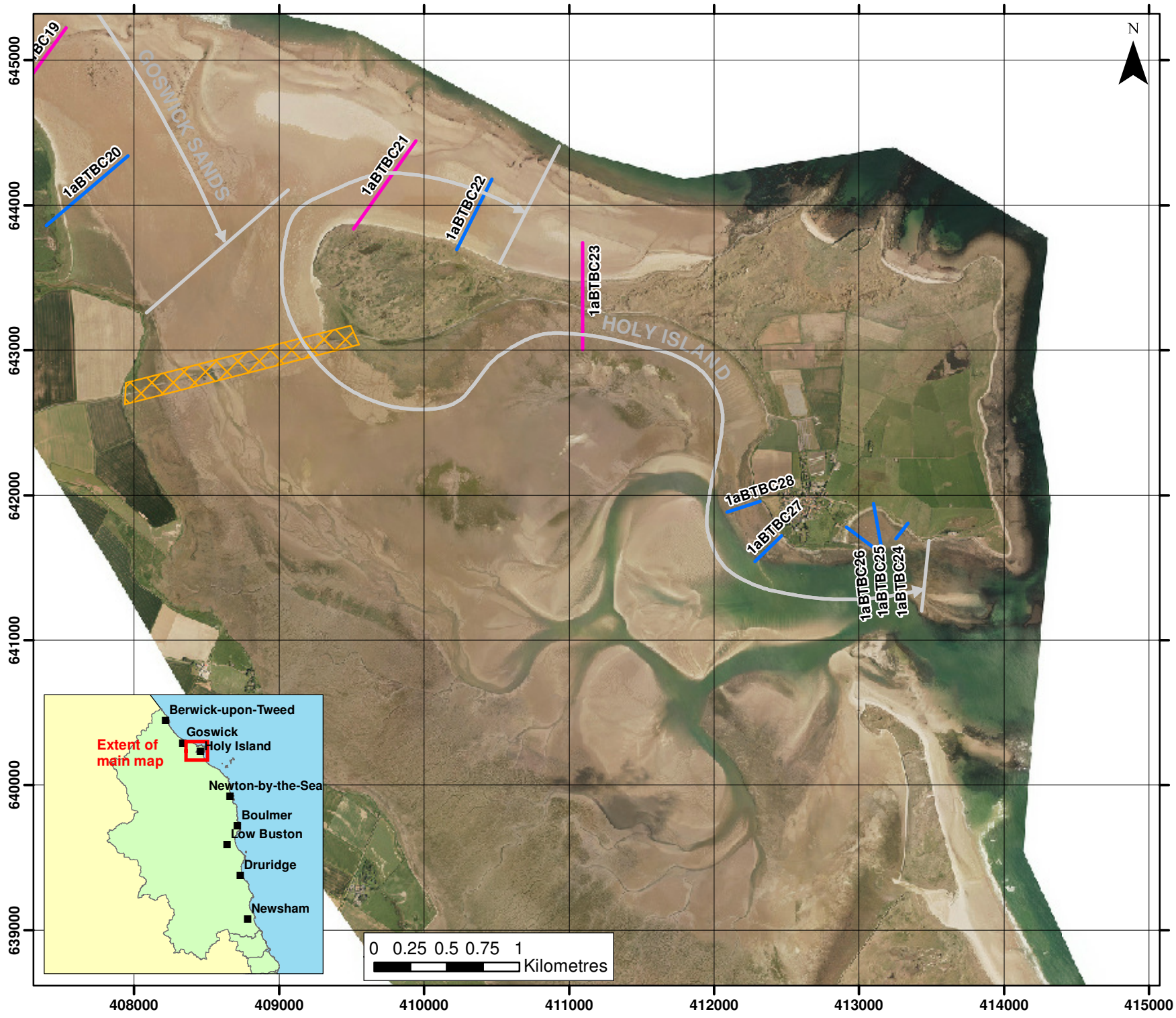

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Topographic Surveys
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- 5 yearly

Cliff Top Monitoring Pegs
- 50m centres
- 100m centres
- 300m centres

(Indicative survey extents shown)

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Figure 2 - Map 3
Survey Locations
Holy Island
Northumberland
County Council

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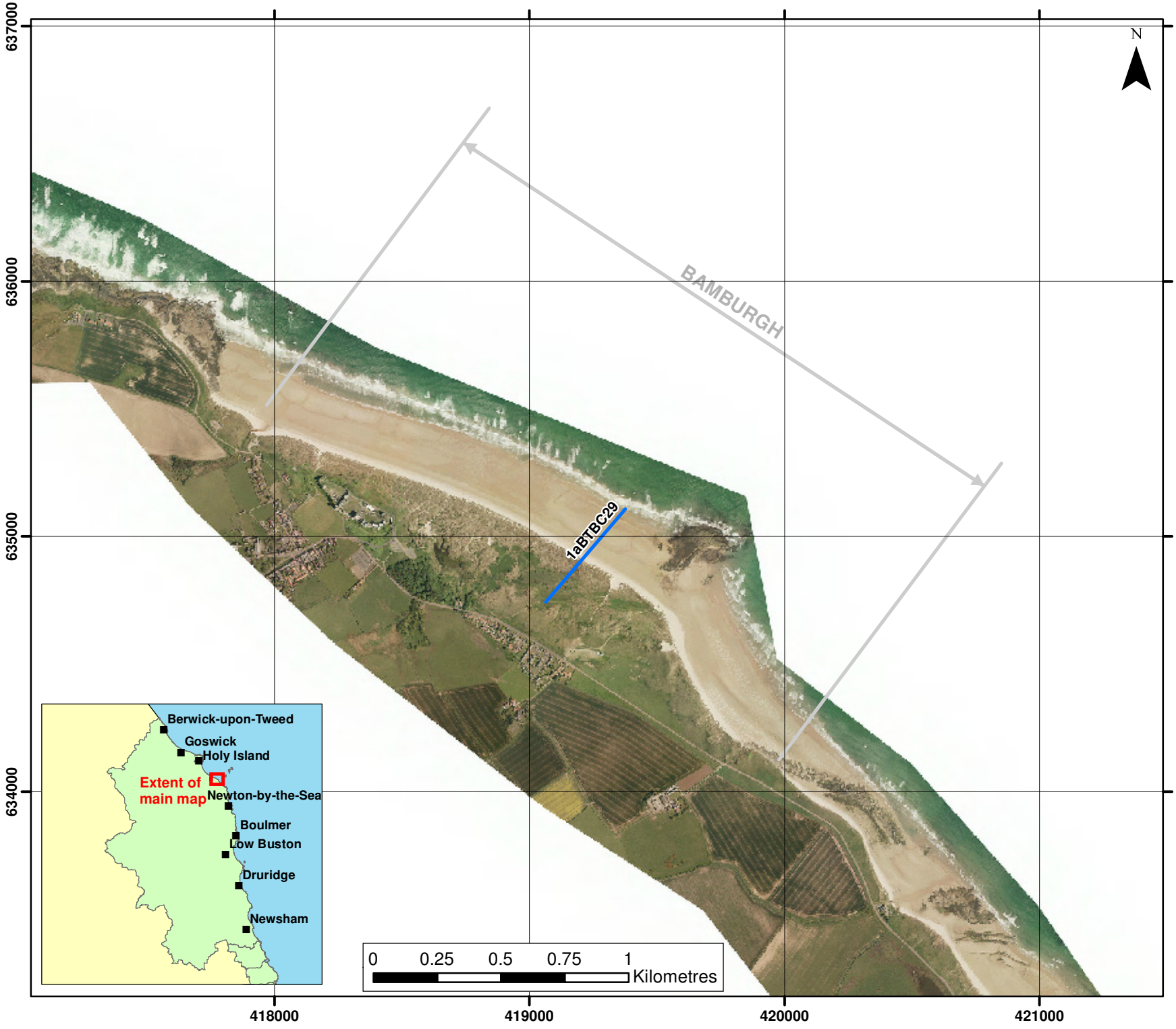

KEY

Topographic Profiles

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Topographic Surveys

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- 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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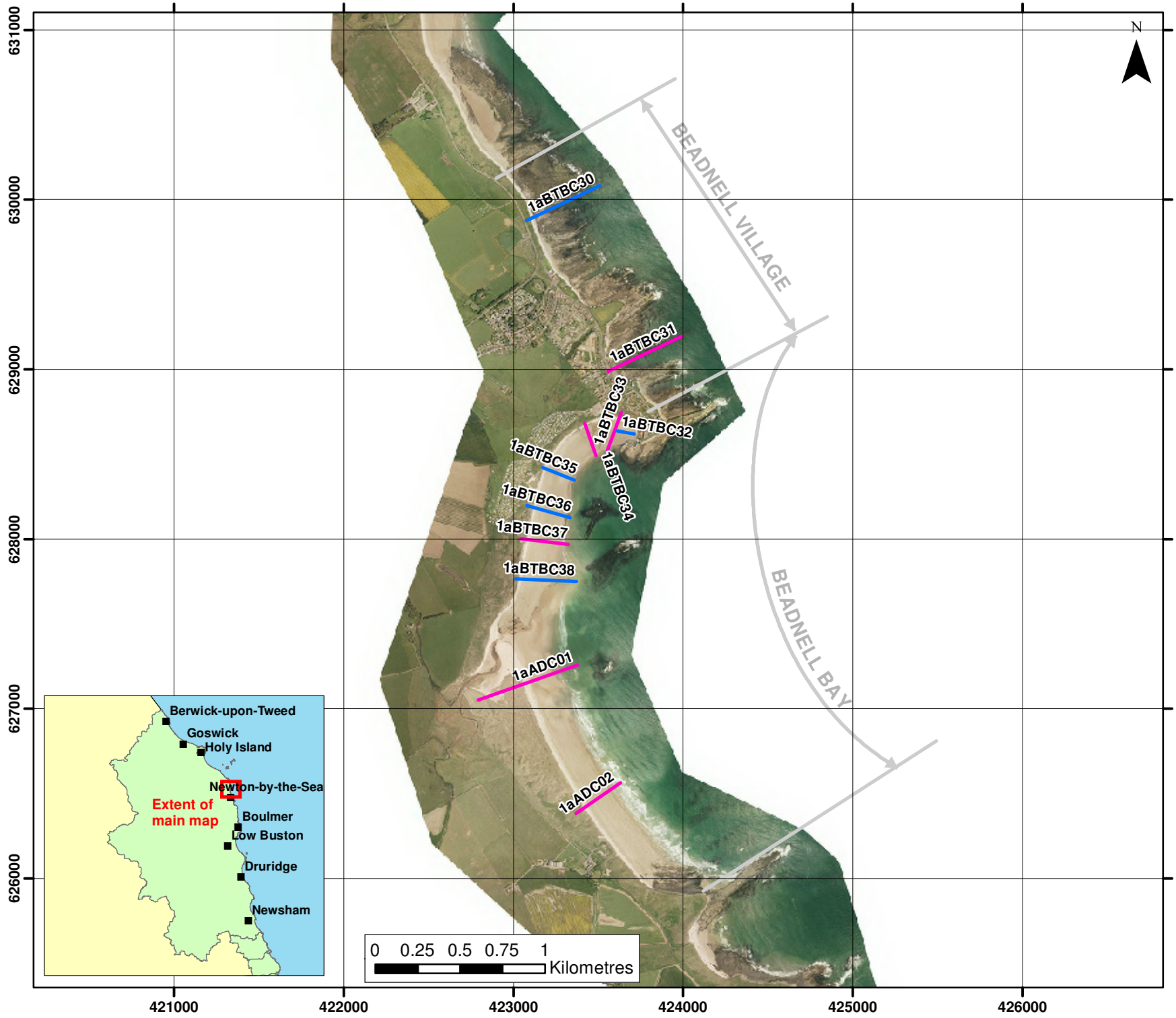

KEY

Topographic Profiles
- Annual
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Topographic Surveys
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- 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 5
Survey Locations
Beadnell Village and Bay
Northumberland County Council

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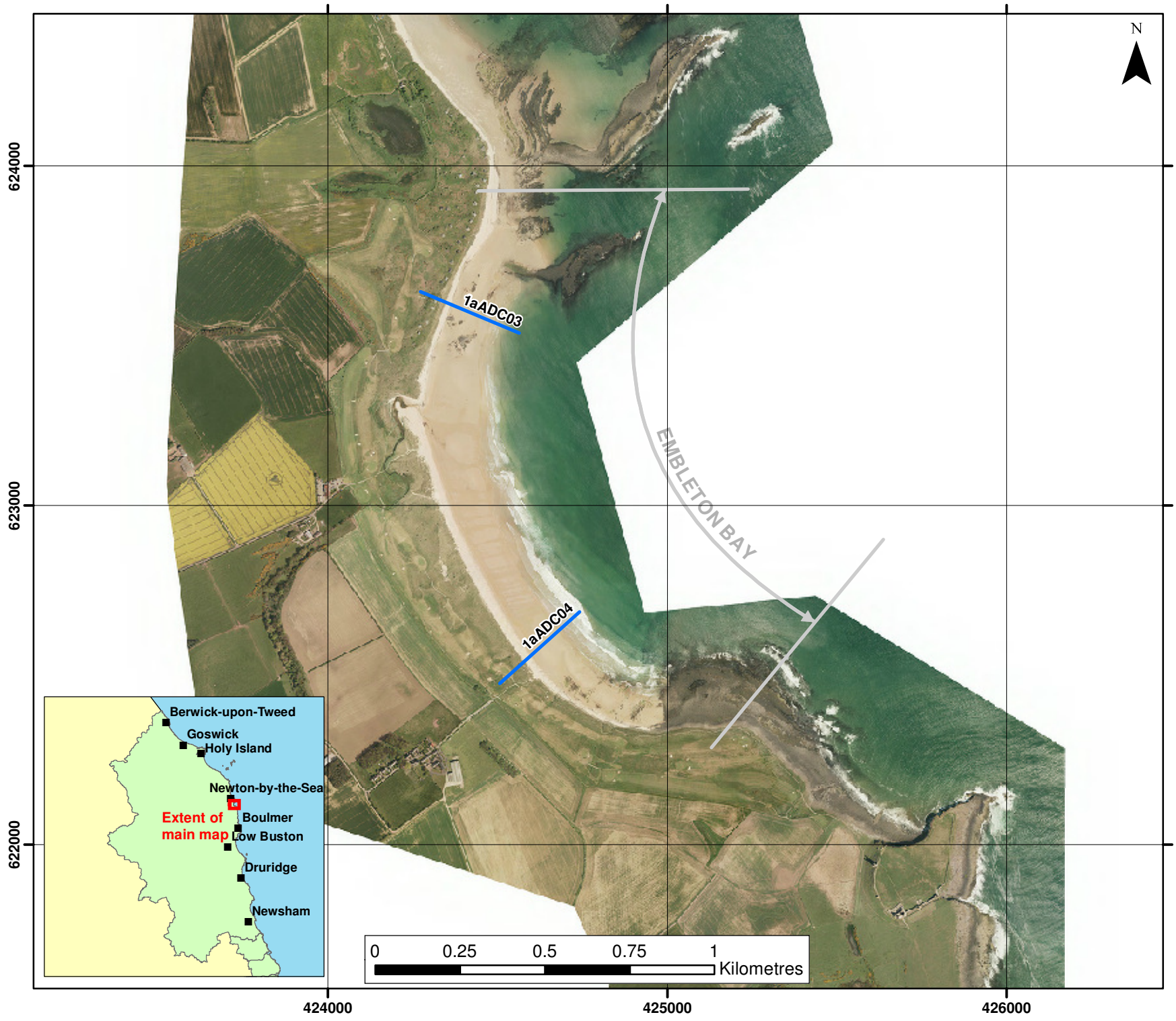

KEY

Topographic Profiles
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- 6 monthly

Topographic Surveys
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- 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 6
Survey Locations
Embleton Bay
Northumberland
County Council

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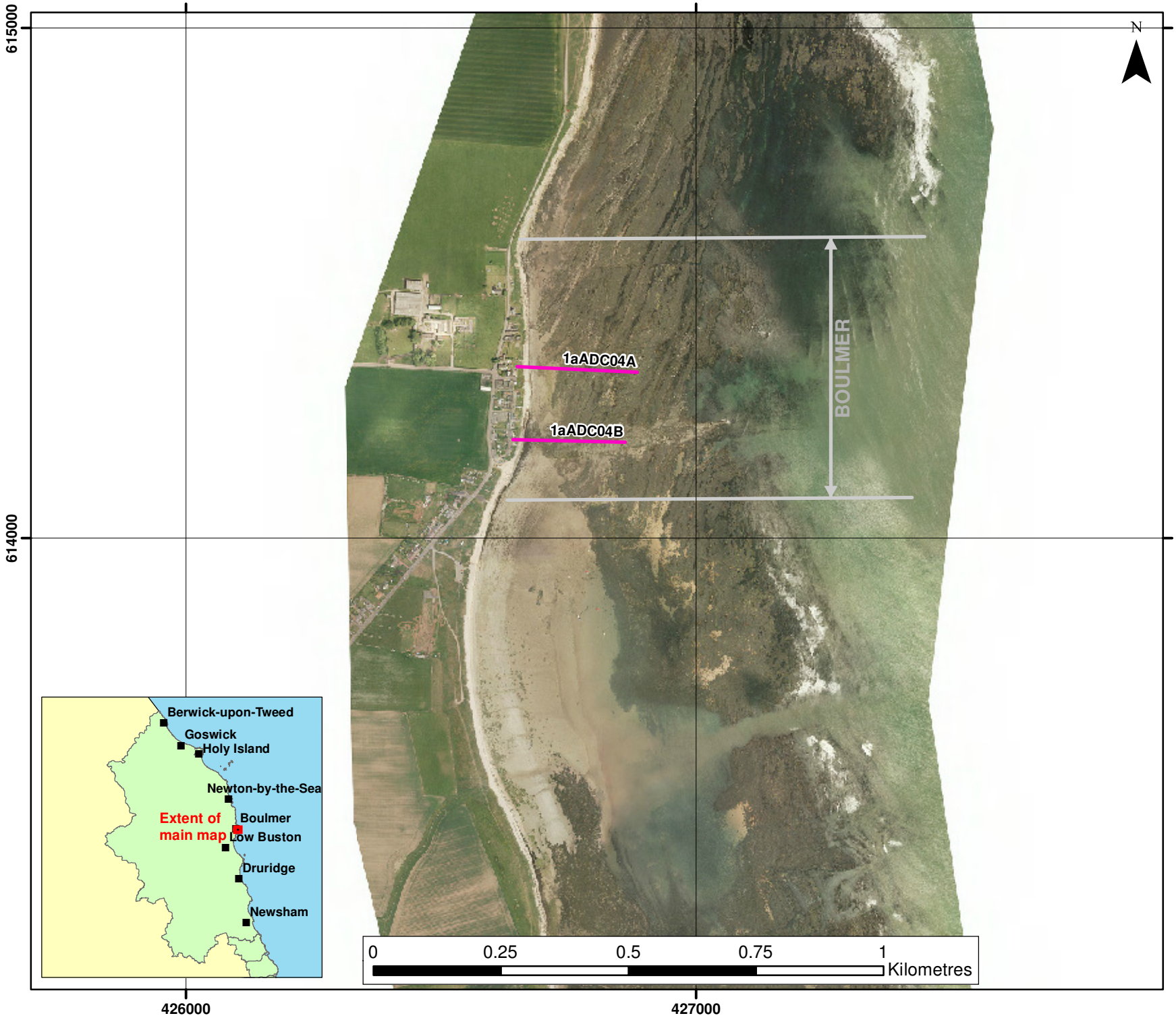

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Cliff Top Monitoring Pegs

- 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 7
Survey Locations
Boulmer
Northumberland
County Council

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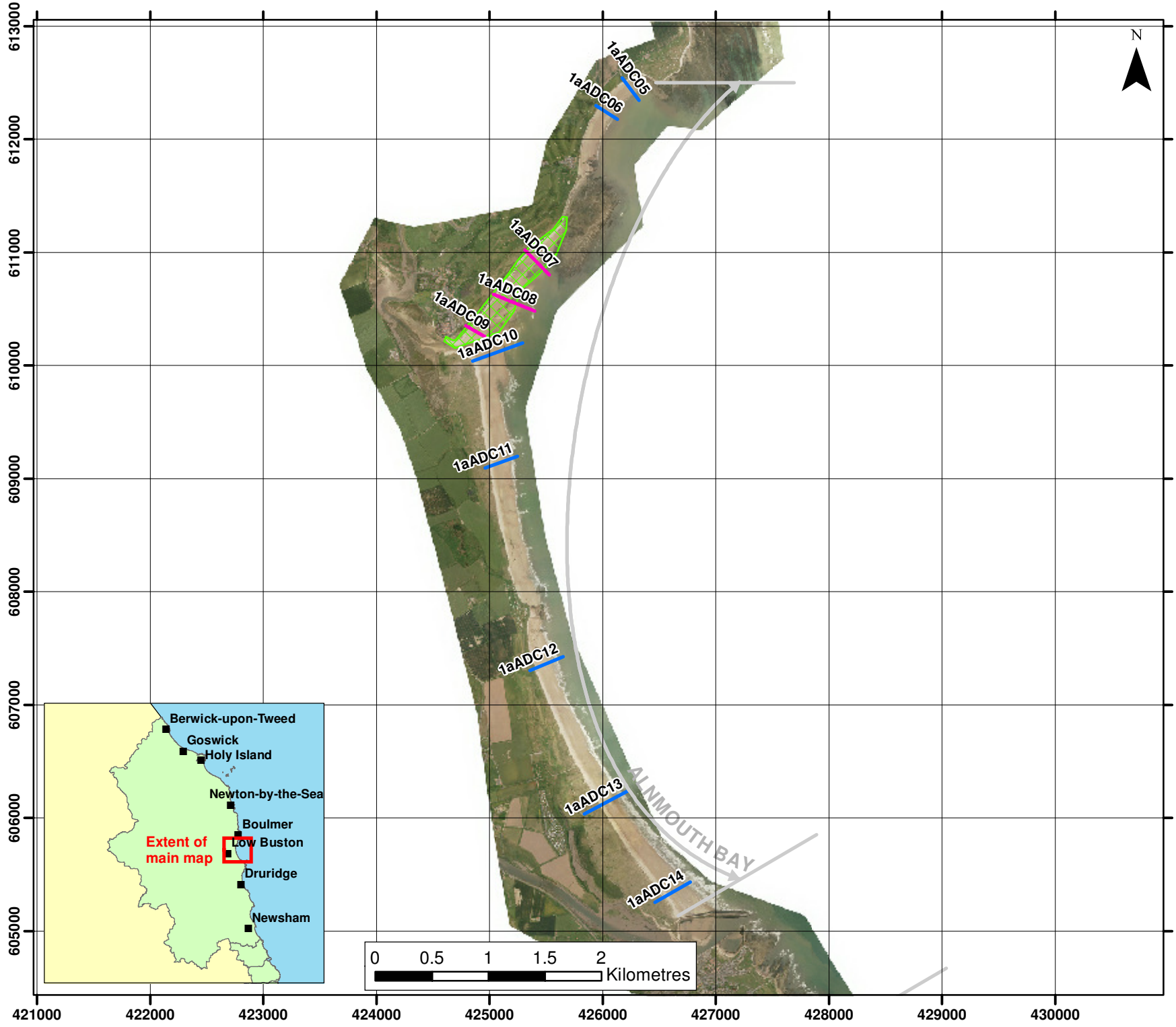

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Topographic Profiles

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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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Figure 2 - Map 8
Survey Locations
Alnmouth Bay
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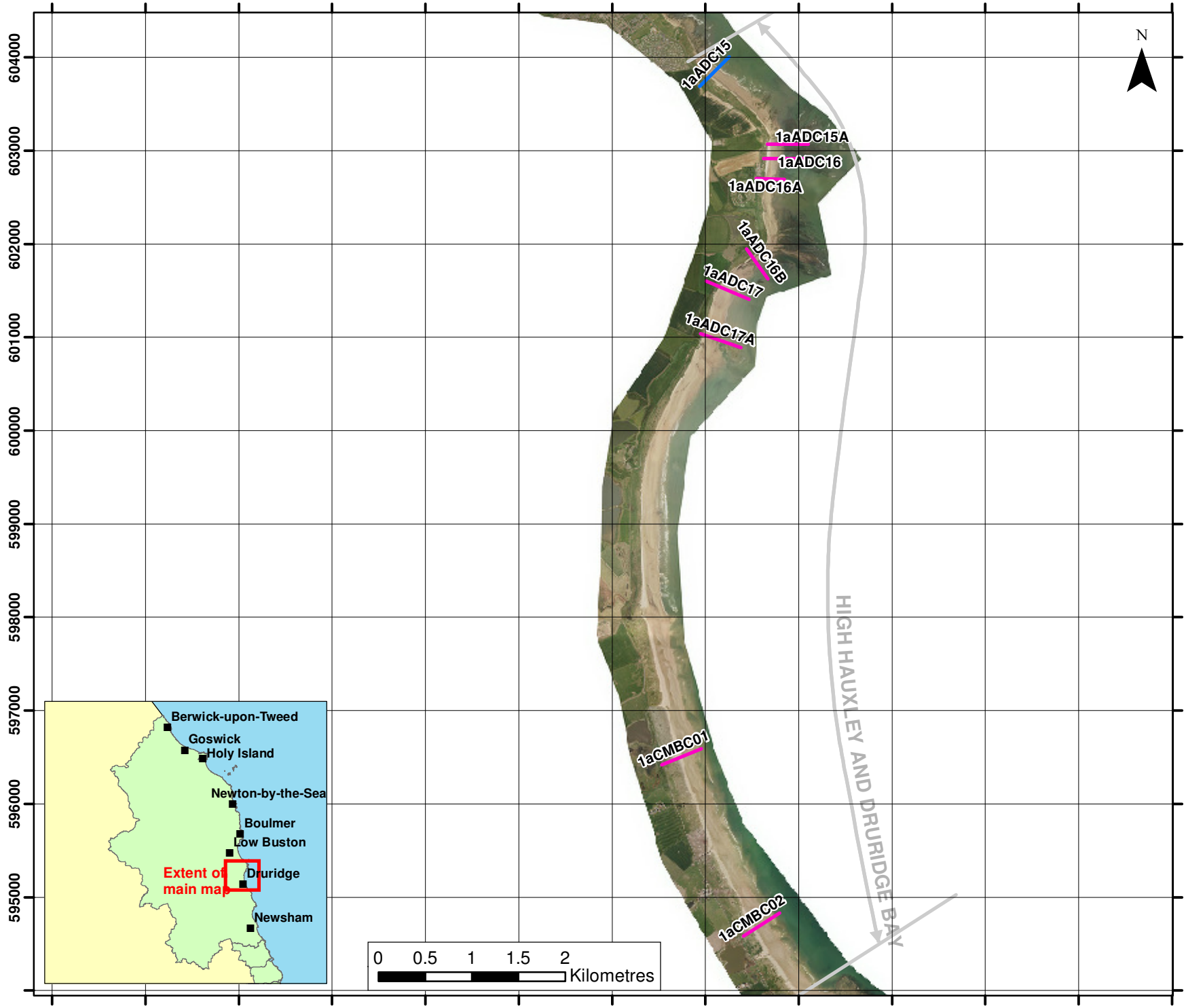

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Cliff Top Monitoring Pegs
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- 300m centres

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Client: North East Coastal Group

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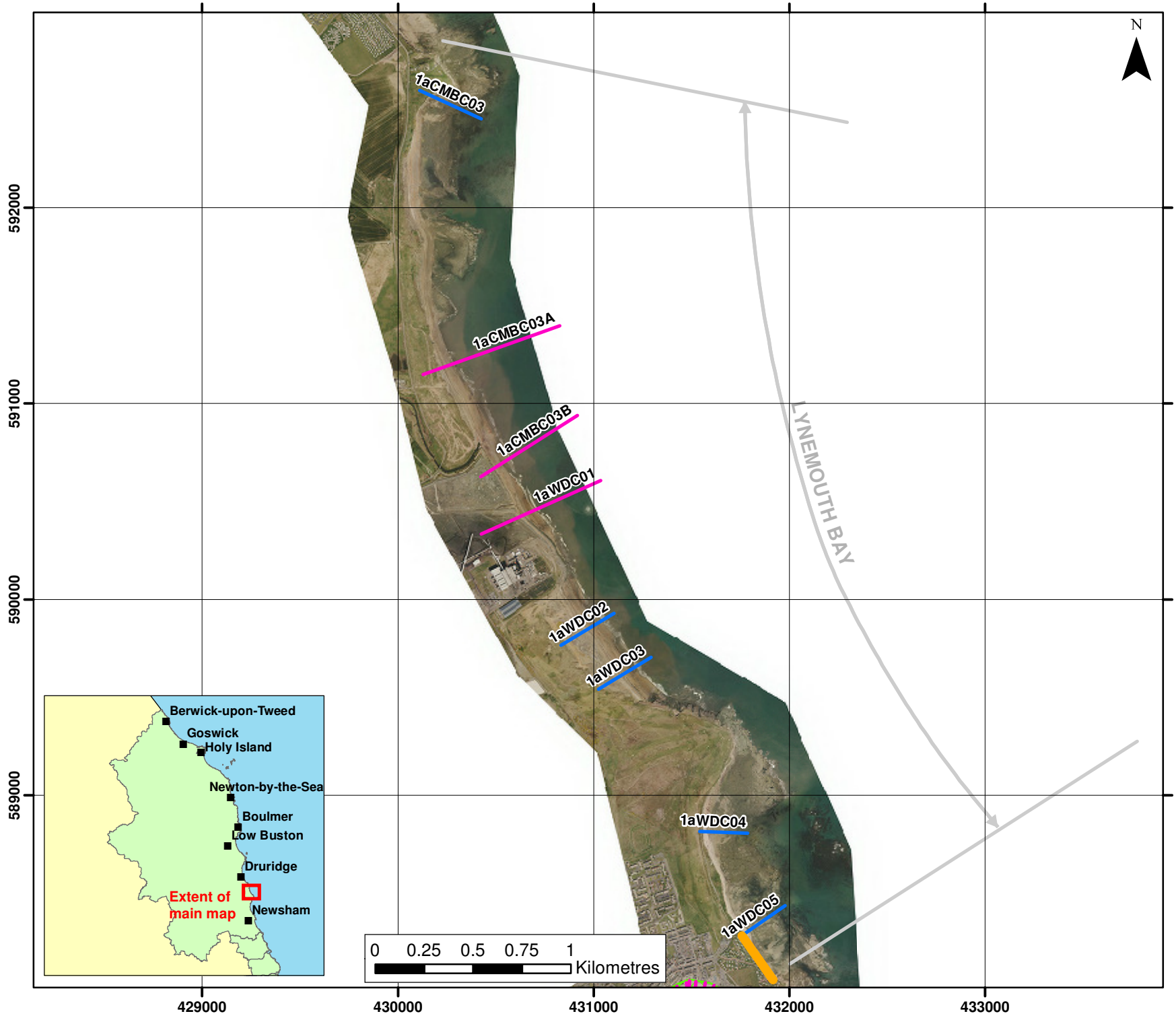

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Cliff Top Monitoring Pegs
- 50m centres
- 100m centres
- 300m centres
- Cliff Top Edge Survey

(Indicative survey extents shown)

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Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

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

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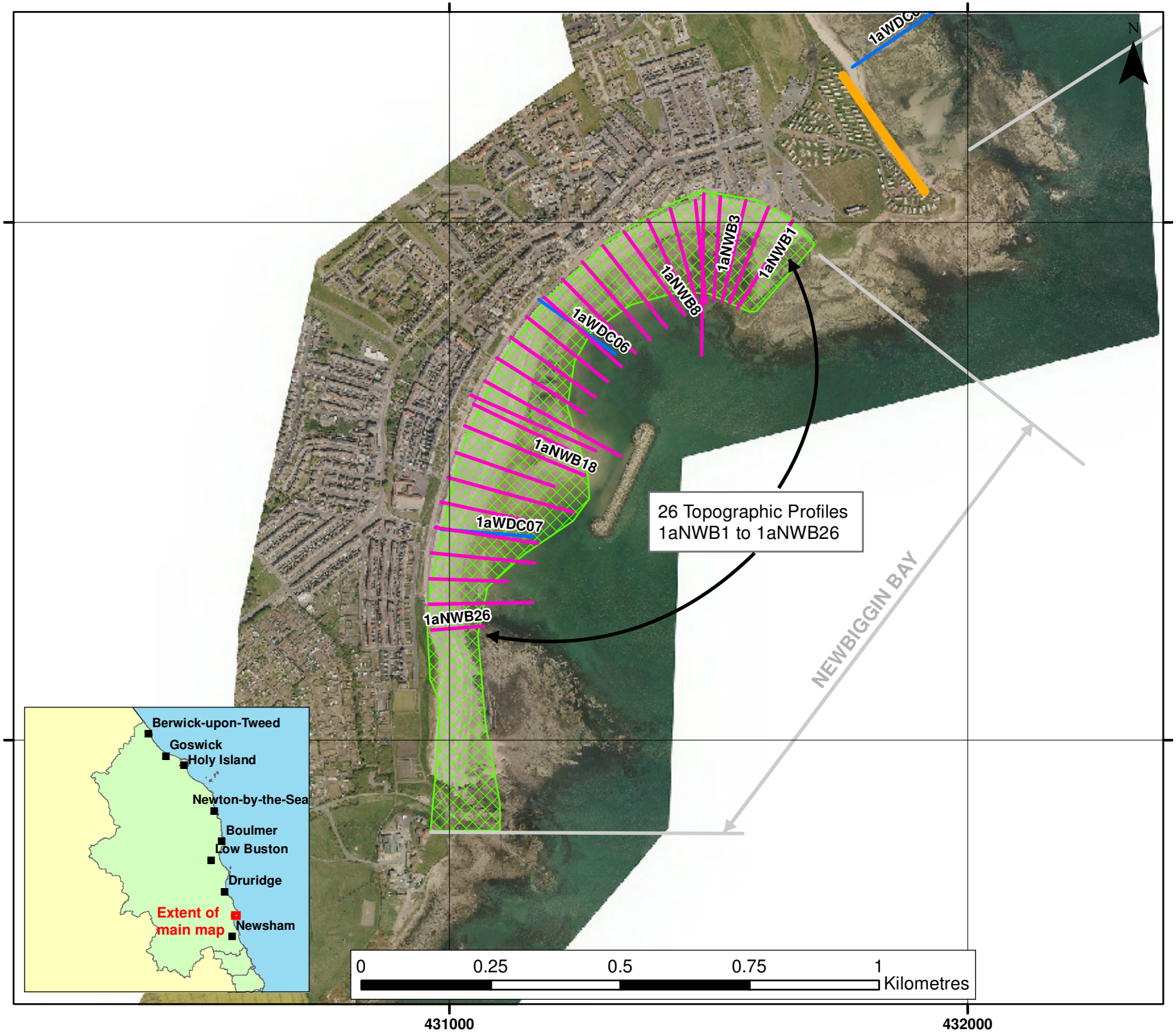

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- 50m centres
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- 300m centres
- Cliff Top Edge Survey

(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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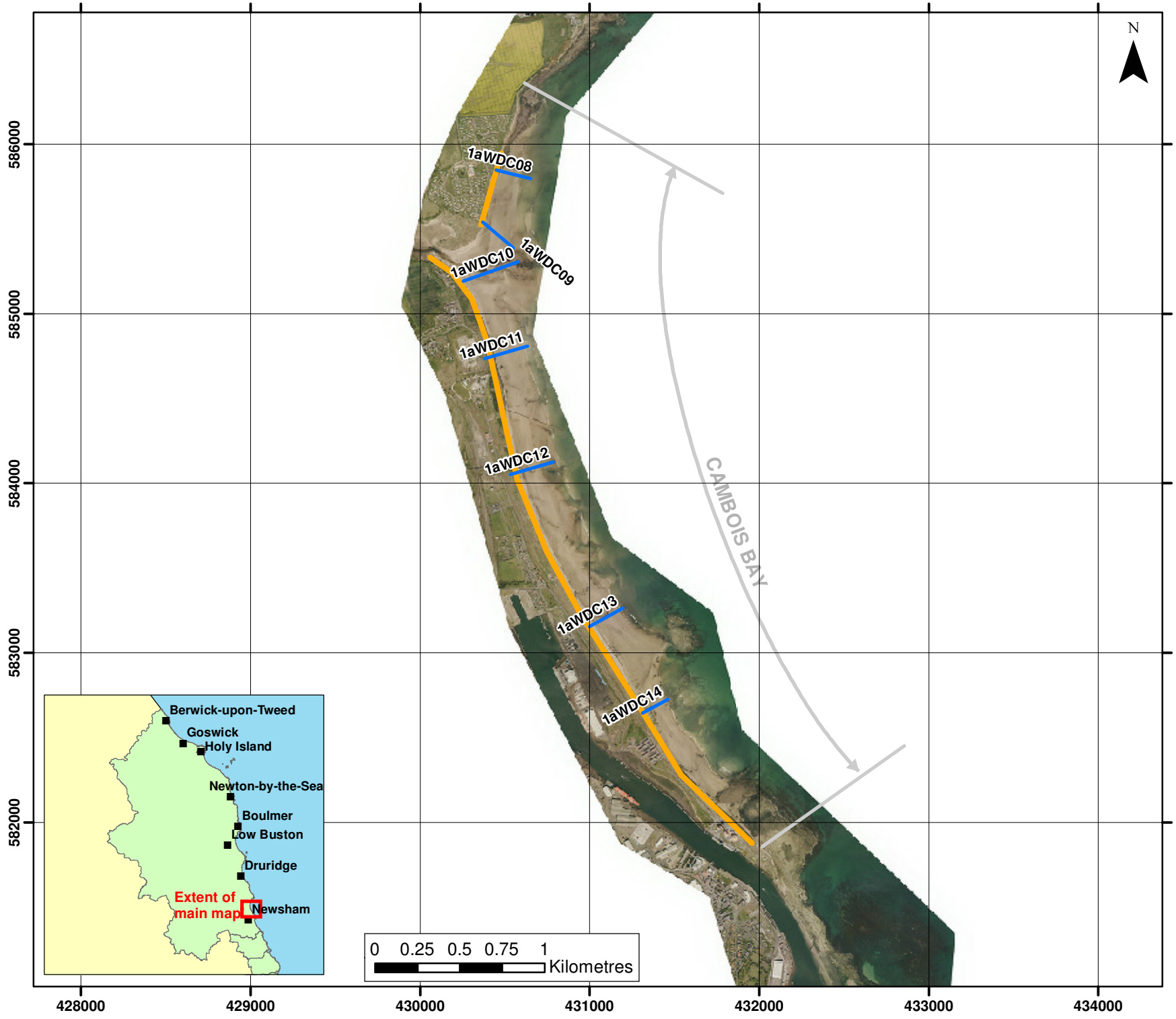

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(Indicative survey extents shown)

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Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Figure 2 - Map 12
Survey Locations
Cambois Bay
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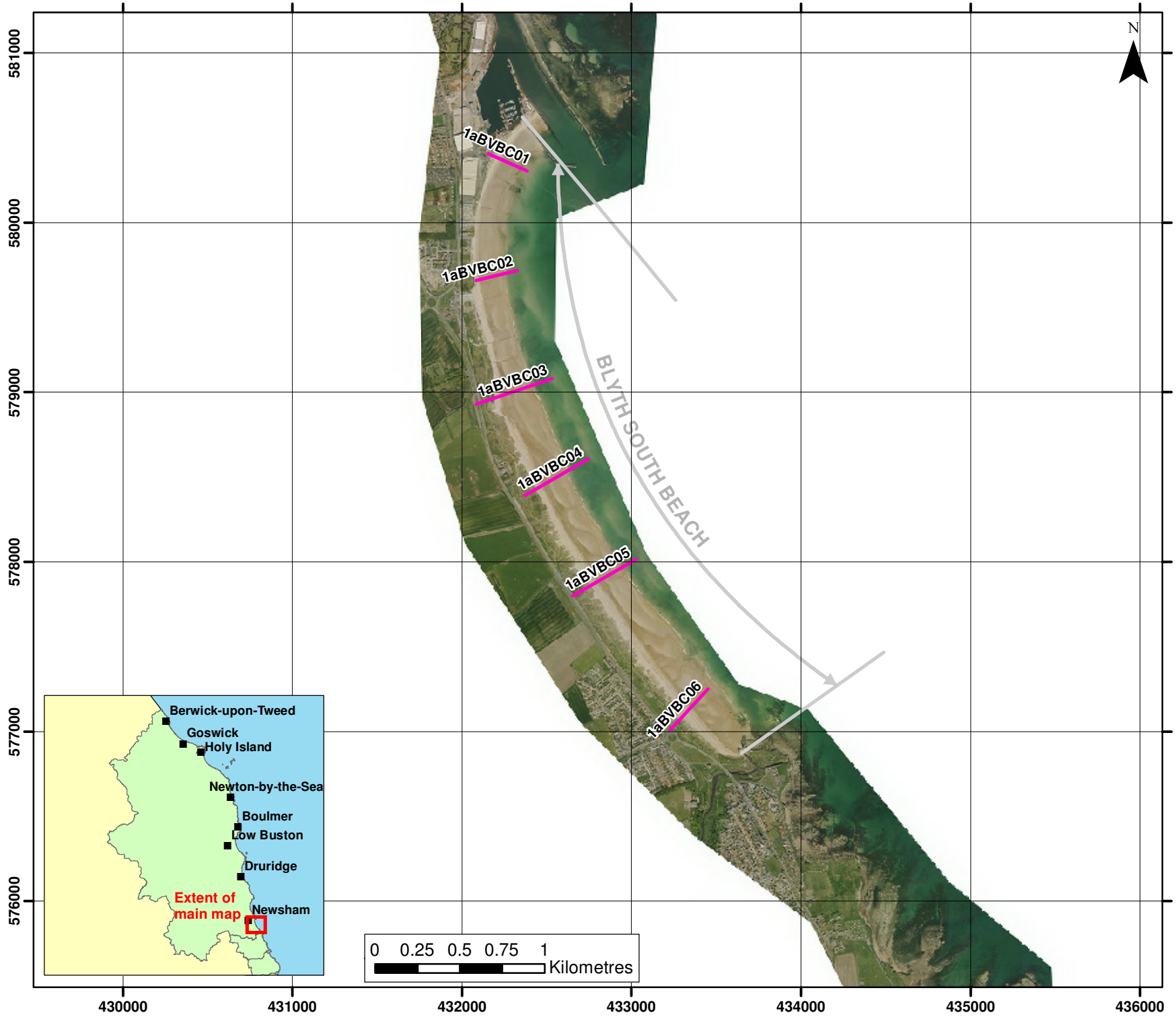

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Figure 2 - Map 13
Survey Locations
Blyth South Beach
Northumberland County Council

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Partial Measures Survey
Spring 2014

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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 2014	**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 autumn 2013. Profile **1aBTBC02** is located on the southern bank of the inner Tweed estuary. The dunes have remained mostly stable with only a slight fluctuation in height over the surface. The beach levels have also remained stable with only slight fluctuations across the profile. Profiles **1aBTBC04** (longitudinal section) and **1aBTBC05** and **1aBTBC06** (both cross-sections) cover the spit at Sandstell Point. At profile **1aBTBC04**, the beach profile shows a significant change. Beach levels have increased from the toe of the rock revetment down to about 250m chainage by around 1m. A peak of over 1m in height has developed between 275m and 300m chainage, where a gravel bank has formed on the beach (see Plate 1 and Plate 2). There has been some erosion at the toe of the profile with the edge of the spit moving back by about 18m. Profiles **1aBTBC05** and **1aBTBC06** are transects across the spit, with the open sea on the left-hand side of the plot and the river channel to the right. At profile **1aBTBC05**, the western (seawards) side of the profile has accreted by almost 1.5m between a chainage of 25m and 158m, while the crest on the eastern side has narrowed by over 50m and decreased in height by up to 0.6m. This indicates seawards movement of material during the winter months. At profile **1aBTBC06**, the beach profile has changed considerably with overall lowering of the beach profile. The beach crest has migrated westwards, resulting in significant erosion of the eastern edge of the spit (seawards side) of up to 1.5m and accretion on the western edge (riverwards side), with the edge of the spit extending approximately 10m further into the river channel.	Since the last survey, the dunes along the south bank of the River Tweed have remained mostly stable. The beach profile on the southern bank of the estuary (1aBTBC02) has also remained stable. There have been some considerable changes to the profiles around the mouth of the River Tweed on Sandstell Point. The spit has been particularly dynamic. At the southern profile there has been accretion of the riverward side and erosion of the seaward side. At the more northern profile across the spit the seaward edge has been eroded and the spit has extended further into the channel on the riverward side. **Longer term trends:** The change in dune profile is within the bounds of previous surveys, suggesting that they have remained generally stable over the past 11 years. Changes in beach levels are generally within the bounds of previous surveys.

Survey Date	Description of Changes Since Last Survey	Interpretation
Mar 2014	**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 2011. The previous survey was undertaken for the Full Measures survey in autumn 2013. Data from the most recent topographic survey (Partial Measures, spring 2014) 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 area of erosion of up to 3m on the western side of the spit where it abuts the headland (on the outerside of the bend of the river) (ii) a linear area of accretion (up to 2m), running in a north south direction from the northwest of the spit to the south of the spit where it joins the land and (iii) an area of accretion at the north eastern tip of the spit of up to 1m.	The findings of the topographic survey show similar trends to the profile survey. Notably, this is the movement of material in a riverwards direction across the middle of the spit, but with an area of erosion on the western side near to the headland and an area of accretion on the north eastern tip of the spit. **Longer term trends:** The longer term trends are covered by the long term topographic trends autumn 2011 to autumn 2014 (see next report, Full Measures 2014).

Plate 1 – Survey photograph 1aBTBC04_20140417_W13.JPG

Plate 2 – Survey photograph 1aBTBC04_20140417_W15.JPG

2.2 Spittal (Spittal B)

Survey Date	Description of Changes Since Last Survey	Interpretation
Apr 2014	**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 autumn 2013. Profile **1aBTBC11** is located to the north of Spittal Beach. Beach levels have increased across the profile by varying degrees between 0.1m and 0.8m. A berm feature has developed at around HAT (3.4mODN), with another flatter berm feature at around 0m elevation. The overall beach profile is less undulating than the previous survey (autumn 2013). Profile **1aBTBC13** is located towards the centre of Spittal Beach. Beach levels here have increased across the upper and middle profile by between 0.1 and 0.6m. The lower beach has remained stable. Similarly to profile 1aBTBC11, a berm has developed at around HAT.	Since the last survey, beach levels along Spittal have generally increased and berm has developed along the upper beach at around HAT. **Longer term trends:** At both profile locations along Spittal Beach, the changes observed from the present survey are generally within the bounds of previous surveys. At 1aBTBC13 the upper beach is towards the higher bound of previously recorded surveys.

2.3 Goswick Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
Apr 2014	**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 autumn 2013. Profile **1aBTBC16** is located to the north of Goswick Sands, between Far Skerr and Cheswick Black Rocks. The dune has remained stable since the last survey. Beach levels across the beach have increased by varying amounts between 0.1m and 0.9m. The beach has become more undulating (see Plate 3 and Plate 4) with a number of ridges and runnels forming in the sand. Profile **1aBTBC19** is located to the south of Goswick Sands. The dunes have remained stable since the last survey. Beach levels have increased across the profile but only by 0.1m or less. The survey report notes a '*step on the dune face'*.	Beach levels have generally increased at Goswick Sands since the last survey. The northern profile (1aBTBC16) Shows a greater increase in beach level than the southern profile (1aBTBC19). **Longer term trends:** At Profile 1aBTBC16 the beach levels on the upper and middle beach are the highest recorded to date. At Profile 1aBTBC19 the changes observed since the last survey are generally within the bounds of the previous surveys.

Plate 3 – Survey photograph 1aBTBC16_20140413_N12.JPG

Plate 4 – Survey photograph 1aBTBC04_20130921_N10.JPG

2.4 Holy Island

Survey Date	Description of Changes Since Last Survey	Interpretation
Apr 2014	**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 autumn 2013. **1aBTBC21** and **1aBTBC23** are located on the north-west side of the island, along The Snook. At profile **1aBTBC21** the dunes have remained stable since the last survey. The beach has accreted by approximately 0.1m across the profile. Profile **1aBTBC23** shows that the dunes and beach have remained stable since the last survey with beach levels decreasing but by <0.1m.	The dunes, sandy foreshore and sand flats around 'The Snook' on Holy Island have remained stable in both form and position since the last survey. The beach on the north west corner of 'The Snook' has accreted by a small amount across the profile. **Longer term trends:** The changes observed since the last survey are within the bounds of previous surveys.

2.5 Beadnell Village

Survey Date	Description of Changes Since Last Survey	Interpretation
Apr 2013	**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 autumn 2013. **1aBTBC31** is in Nacker Hole and extends across the promenade and seawall. Since the last survey, much of the beach profile has remained relatively stable, generally decreasing by < 0.1m. The middle section of the profile, however, around chainage 30m to 48m, shows a small drop in beach level of between 0.1 and 0.2m.	The beach to the south of Beadnell Village has generally remained stable, although there has been a small decrease in beach level towards the middle of the profile. **Longer term trends:** The changes observed since the last survey are within the bounds of previous surveys.

2.6 Beadnell Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
Apr 2014	**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 autumn 2013. 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 toe of the dunes has receded by up to 6m and steepened. This indicates wave action at the dune toe, likely to have occurred under storm conditions over the winter months. The dunes have remained stable and it is noted in the survey report *'middle of dunes missing due to dense vegetation',* which further indicates a stable dune system. The beach profile has become steeper with some slight accretion (around 0.1m) between a chainage of 80m and 130m and erosion of up to 0.8m has occurred at the beach toe. At profile **1aBTBC34**, the front face of the dunes has cut back by over 1m since the last survey and a step has formed in the profile (noted in the survey report and observed in the measured profile). The dune toe has steepened (see Plate 5 and Plate 6) and photographs indicate a change in material type with shingle now being present at the dune toe. This change in the dune profile is likely to be the result of storm waves reaching the due toe. Beach levels have fluctuated across the profile by between 0.1m and 0.65m. The upper beach has tended to reduce in level whilst the middle of the beach has accreted and the toe of the beach has eroded. The underlying rocky foreshore which was exposed in the previous spring 2013 survey but covered with sand in the autumn 2013 survey remains covered. The fluctuation in level across the profile is likely to indicate material being drawn-down the beach by cross-shore transport under winter storm conditions. At **1aBTBC37**, the dunes have remained stable since the last survey but the dune face has steepened and cut back by around 1m. Accretion has occurred between the berms which were present in the autumn 2013 profile, filling in the troughs and resulting in a smoother profile. A berm is observed on the lower beach at around 130m chainage. Profiles **1aADC01** and **1aADC02** are located along the frontage to the south of the outfall of Brunton Burn/Long Nanny. The dunes at 1aADC01 and 1aADC02 have not changed form or position. At	Along the length of Beadnell Bay, the toe of the dunes has been cut back following the winter storm waves. The beach levels across the bay have fluctuated with no clear trend of erosion of accretion, although most profiles have steepened slightly in response to the winter wave conditions. **Longer term trends:** Along the length of Beadnell Bay, the dunes are of a similar form to those observed in the past. The changes in beach profile form and position observed since the last survey are generally within the bounds of previous surveys. The exceptions to this are; (i) Profile 1aBTBC37 shows the highest level recorded to date at the profile toe; (ii) Profile 1aBTBC34 shows the lowest recorded level at the profile toe and the dune face is at its most landward position since surveys began;(iii) Profile 1aBTBC33 shows the lowest level recorded to date at the dune toe; (iv) Profile 1aADC01 shows the highest beach level recorded to date on the upper beach (at the dune toe) and the lowest level recorded to date at the beach toe, and (v) Profile 1aADC02 shows the most landward position of the due face at the toe of the dunes and the lowest level recorded to date at the beach toe.

Survey Date	Description of Changes Since Last Survey	Interpretation
	1aADC01 the beach has steepened with an increase in beach level of up to 0.6m on the upper beach (chainage 300m to 425m) and a decrease in beach level of up to 0.7 on the lower beach (chainage 425m to the seaward end of the profile at 550m) . At profile **1aADC02** the dune face has cut back by up to 0.2m towards the dune toe. Below this, towards the middle of the beach profile between a chainage of 70m and 165m, beach levels have increased by up to 0.5m. Towards the toe of the beach (chainage 180m and seawards) the beach levels have dropped by up to 0.3m. These changes in beach level have resulted in a smoother but slightly steeper beach profile.	

Plate 5 – Survey photograph 1aBTBC34_20140416_E3.JPG

Plate 6 – Survey photograph 1aBTBC34_20131005_E4.JPG

2.7 Boulmer

Survey Date	Description of Changes Since Last Survey	Interpretation
Mar2014	**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 autumn 2013. At profile **1aADC04A** the dune cliff backshore has retreated slightly since the last survey (by up to 1.1m) and at the toe of the dune cliff beach levels have accreted slightly. This may indicate a movement of material from the top of the dune cliff to the toe. The beach level has increased by about 0.25m between chainage 28m and 75m. The rocky beach toe has remained stable. It is noted in the survey report that a ramp previously located adjacent to this profile is no longer present (see Plate 7 and Plate 8). At profile **1aADC04B** it is noted in the survey report that new rock armour has been constructed at the top of the profile since the previous survey. This can been seen in Plate 9 and Plate 10 and has resulted in the backshore advancing seawards slightly. Along the beach profile the upper beach levels (chainage 15m to 55m) have increased by up to 0.2m while the lower beach levels (chainage 55m and seawards) have increased by up to 0.4m, with the increase in level decreasing seawards along the profile. It is likely that storm waves have moved material seawards from the upper beach over the winter period. This has resulted in a shallower beach profile.	The dune cliff backshore at Boulmer has retreated slightly at the northern profile, but has advanced slightly on the southernmost profile where new rock armouring has been constructed. The beach level on the northernmost profile has generally increased with the upper beach gaining material from the eroded dune cliff backshore. At the southernmost profile the upper beach has eroded while the lower beach has accreted, indicating cross shore movement of material by storm waves. **Longer term trends:** Generally, the changes in beach profile form and position observed since the last survey are within the bounds of previous surveys. The exceptions are; at profile 1aADC04A, between chainages 20m to 40m and 50m to 70m, where the beach levels are the highest recorded to date, and at profile 1aADC04B, between chainages 70m and 90m, where the beach levels are the highest recorded to date.

Plate 7 – Survey photograph 1aADC04A_20140324_Up.JPG

Plate 8 – Survey photograph 1aADC04A_20131010_Up2.JPG

Plate 9 – Survey photograph 1aADC04B_20140324_Up1.JPG

Plate 10 – Survey photograph 1aADC04B_20131010_Up3.JPG

2.8 Alnmouth Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
Mar 2014	**Beach Profiles:** Alnmouth Bay is covered by three beach profile lines during the Partial Measures survey (Appendix A). The previous survey was undertaken for the Full Measures survey in autumn 2013. The three profiles are located to the north of Alnmouth Bay between Marden Rocks and the mouth of the River Aln Estuary. At profile **1aADC07** the dunes have remained stable since the last survey, although the dune toe has been cut back slightly. Beach levels from the dune toe to a chainage of 60m have fallen by 0.15m to 0.4m since the previous survey. Seawards of this, from chainage 60m to 150m, beach levels have increased slightly (approximately 0.1m); the berm here has retained the same shape but a deeper runnel has formed on its landward side. Beach levels have dropped at the beach toe and the toe berm previously present is no longer within the measured profile. It is likely that winter storm waves have moved material down the beach and transported material from the berm further offshore. At profile **1aADC08** the dunes have remained stable since the last survey. Beach levels have increased significantly across the profile since the previous survey, with a greater increase towards the toe of the beach and a maximum increase of 1m. A berm has formed at around 180m chainage, below which the beach toe has steepened. At profile **1aADC09** the dune crest has remained stable but the dune toe has retreated (by up to 5m) and the survey report notes a '*step in the dune face'*. Beach levels have fallen considerably across the upper beach, from the dune toe down to a chainage of 70m, with a decrease in level of up to 0.5m. Across the lower beach, from a chainage of 70m and seawards, the beach levels have increased by up to 0.6m. It is likely that storm waves have cut back the dune toe and moved material seawards from the upper beach onto the lower beach during the winter period.	To the north of Alnmouth Bay, the dunes have remained stable since the last survey, although the dune toe has been subject to erosion. This is likely to have been caused by wave action during winter storms/ surge events. The beach has been very mobile. To the north and south of the bay (1aADC07 and 1aADC08) the upper beach has been subject to erosion and the lower beach has accreted indicating draw-down of material by storm waves. Towards the middle of the bay however the beach has accreted. Adjacent profiles showing different patterns of change suggest multiple influences including: channel movements in the Aln Estuary, flow to and from the estuary and the occurrence of winter storms. **Longer term trends:** The dunes have demonstrated a long-term trend of stability. Much of the changes in beach profile form and position observed since the last survey are within the bounds of previous surveys. The exceptions are; (i) at profile 1aADC07 a short section of the toe (chainage 141m to 164m) is slightly lower than all previous surveys (since 2002) (ii) at profile 1aADC08 the beach levels are the highest level recorded to date at the location of the berm (180m chainage) by 0.5m, and iii)

Survey Date	Description of Changes Since Last Survey	Interpretation
		at profile 1aADC09 the dune face is at the most landward location recorded to date.
Mar 2014	**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 (Partial Measures, spring 2014) 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 (Full Measures, autumn 2013) and the present survey. The difference plot shows patchy areas of increased elevation interspersed with patchy areas of decreased elevation, in particular: (i) an area of accretion towards the middle of the bay of up to 1m (which coincides with the accretion noted in the profile survey at 1aADC08); (ii) an area of erosion extending from the toe to the back of the beach near the mouth of the river, which is adjacent to an area of accretion upstream (iii) patches of erosion of up to 1m towards the toe of the beach, indicating that material previously stored in the sand berms has been moved further offshore or alongshore during winter storms. The survey report notes ”*dune line at approximately 424780 610310 have been knocked back due to winter storms. Also at this location an anti tank block has fallen from the upper dune. Again around this location there are many concrete sandbags on the beach that have washed out of the missing dune*”.	The findings of the topographic survey show patchy areas of increased elevation interspersed with patchy areas of decreased elevation. This complies with the findings of the beach profile surveys, which show the beach to be very dynamic. **Longer term trends:** The longer term trends are covered by the long term topographic trends autumn 2011 to autumn 2013 (see next report, Full Measures 2013).

2.9 High Hauxley & Druridge Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
Apr 2014	**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' suffixes) were added to the programme in October 2007. The previous survey was undertaken for the Full Measures survey in autumn 2013. **1aADC15A**, **1aADC16** and **1aADC16A** are located around Hauxley Haven. At these three profiles the dune crest has remained stable since the last survey but the dune face and toe have cut back by up to 2m and the survey report notes a "*step on the dunce face*". Plate 11 and Plate 12 show dune face erosion at Profile 1aADC15A. At profile **1aADC15A**, with the exception of the dune toe, beach levels have increased across the profile by approximately 0.05 to 0.4mm. At profile **1aADC16** beach levels have decreased on the upper and lower beach by about 0.2m and the upper beach has steepened. The berm previously observed between HAT and MHWS is no longer present and there has been a drop in beach level at this location of up to 0.8m. The flatter middle section of the beach has accreted slightly (by approximately 0.25m). Profile **1aADC16A** shows a similar trend to 1aADC16 with a decrease in beach level on the upper beach and lower slope and slight accretion on the flatter middle beach. The rock platform at the toe of the beach has remained stable. **1aADC16B**, **1aADC17** and **1aADC17A** are located to the north of Druridge Bay, between Bondi Carrs and Hadston Carrs and extend seawards from Togston Links. At**1aADC16B** and **1aADC17**, the dune face has cut back since the last survey and the survey report notes '*step on dune face'* (see Plate 13 and Plate 14). At profile **1aADC16B**, beach levels have fallen across the gravel and sand sections of the beach while the rock sections have remained stable. This has led to further rock being exposed as sand/ shingle was removed (see Plate 15 and Plate 16). At profile **1aADC17**, beach levels have increased across the majority of the profile; from a chainage of 55m to the seaward end of the profile. Landward of this there has been some erosion of the dune toe. At profile **1aADC17A** the dunes have remained stable. The beach levels between the toe of the dunes and a chainage of 85m have decreased by up to 0.6m. Seaward of this point they have increased by up to 1m across the profile with the formation of a large berm at around 85m chainage and a trough at around 70m chainage (Plate 17). **1aCMBC01** and **1aCMBC02** are located in the southern section of Druridge Bay. At both locations, the dunes have remained fairly stable since the last survey with only slight erosion of the dune face at	At Hauxley Haven, the dune face and toe have been subject to erosion over the winter period. The beach to the north has accreted, while the beach to the centre and south of Hauxley Haven has been more dynamic with the upper and lower beach eroding and the flatter middle beach showing some accretion. North of Druridge Bay, the dunes to the north and middle of the bay have cut back while those to the south have remained stable, retaining the same form and position since the last survey. To the north, in the lee of the rocky outcrop of Bondi Carrs / Elm Bush, the beach has eroded with more rock being exposed as the sand/shingle has been removed. To the south, the beach levels have increased to form a slightly more concave profile. South of Druridge Bay, the dunes have remained stable and beach levels have increased with 2 or 3 berms forming on the profile. The profiles show that the impact of the Winter storm surge at Druridge Bay is more evident in the northern part of the bay where the notable dune erosion has occurred. To the south of the bay the wider foreshore is likely to have minimised the impacts, resulting in the dunes remaining stable. **Longer term trends:** At Hauxley Haven, the dunes have eroded at the dune face. At Profile 1aADC16A the dune toe is at its lowest recorded level to date. At profile 1aADC15A the dune face is in the most

Survey Date	Description of Changes Since Last Survey	Interpretation
	1aCMBC01. At profile **1aCMBC01**, beach levels have increased considerably (by over 1m in places), to form a steeper profile with two large berms, one at around HAT (2.8m) and one below this. At profile **1aCMBC02**, beach levels have also increased considerably (by up to 0.8m), and three smaller berms have formed.	landward position recorded to date. The changes in beach profile form and position observed since the last survey are generally within the bounds of previous surveys at Hauxley Bay with the exception of: (i) Profile 1aADC15A the beach toe is at the highest level recorded to date (ii) Profiles 1aADC16 and 1aADC16A the beach toe is at the lowest level recorded to date. North of Druridge Bay, the dunes have previously demonstrated a long-term trend of stability and this is continued in the southernmost profile (1aADC17A). At the two northernmost profiles, however, the dune face has cut back to the most landward position recorded to date. The changes in beach profile form and position observed since the last survey are mostly within the bounds of previous surveys apart from the northernmost profile (1aADC16B) which is on the lower boundary of all the recorded surveys for much of the profile, and the upper beach of the southernmost profile (1aADC17A), which is at the lowest level recorded to date by up to 0.35m. South of Druridge Bay, the dunes have demonstrated a long-term trend of stability. The changes in beach profile form and position observed since the last survey are within the bounds of previous surveys on the southern profile, but the beach levels at the location of the lower berm on the northernmost profile are currently the highest levels recorded to date (chainage 245m to 275m)

Plate 11 – Survey photograph 1aADC15A_20140415_Up1.JPG

Plate 12 – Survey photograph 1aADC15A_20131006_Up1.JPG

Plate 13 – Survey photograph 1aADC16B_20140415_Up2.JPG

Plate 14 – Survey photograph 1aADC16B_20131006_Up3.JPG

Plate 15 – Survey photograph 1aADC16B_20140415_N11.JPG

Plate 16 – Survey photograph 1aADC16B_20131006_N10.JPG

Plate 17 – Survey photograph 1aADC17A_20140414_N7.JPG

2.10 Lynemouth Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
Apr 2014	**Beach Profiles:** Lynemouth is covered by three beach profile lines during the Partial Measures survey (Appendix A). Profile 1aWDC01 was added to the programme in May 2002. Profiles 1aCMBC03A and 1aCMBC03B were added to the programme in October 2007. The previous survey was undertaken for the Full Measures survey in autumn 2013. **1aCMBC03A** is located opposite Lynemouth and extends across the extensive slag banks before reaching the foreshore. The profile of the slag bank has not experienced any change since the last survey. Beach levels have, however, decreased at the toe of the slag bank (from chainage of 84m to 102m) but seawards of this the beach levels have increased and a berm has formed at around 4m elevation (110m chainage). It is likely that storm waves have eroded the toe of the slag bank and distributed the material seawards across the profile. **1aCMBC03B** is located to the north of Lynemouth Power Station and extends across the extensive slag banks before reaching the foreshore. The process of slag bank erosion has been progressively ongoing for some years. Since the last survey, the slag bank has retreated by about 15m. The beach has also retreated, becoming slightly steeper and moving back by between 14m and 20m. It is possible that the severe surge and storm waves over the winter period have resulted in the erosion of the slag bank. There is no evidence of the beach level increasing as a result of the material released by this erosion and so it is likely that the material was transported either offshore or alongshore by wave action. **1aWDC01** extends from landwardof the rock revetment down to low water across the revetment and slag banks. The beach profile is shorter than previous years, stopping at a chainage of -54m, on the revetment. The survey report notes *'unable to measure bottom of revetment, boulders far too slippery'.* The profile section that has been measured shows no significant change compared to the previous survey (autumn 2013).	Opposite Lynemouth, the slag bank has remained stable. The beach has eroded at the toe of the slag bank but accreted seawards of this and a berm has developed at around 4m elevation. To the north of the power station, the slag bank has continued to erode, retreating by approximately 15m. The beach has steepened and retreated. Opposite the power station (at profile 1aWDC01), only a short section of the profile was able to be measured due to slippery conditions on the revetment The landward profile and revetment that has been measured has remained stable. **Longer term trends:** Opposite Lynemouth, the slag bank has demonstrated a long term trend of stability. The changes in beach profile form and position observed since the last survey are within the bounds of previous surveys with the exception of a short section of beach at the toe of the slag bank where the levels observed are the lowest recorded to date (at approximately 90m to 100m chainage) To the north of the power station, the slag bank has continued to recede and the beach has lowered as part of an ongoing trend. The beach and slag bank are approximately 15m lower/ further back than previous surveys. At 1aWDC01 the profile has not extended forward of

Survey Date	Description of Changes Since Last Survey	Interpretation
		the revetment since 2012. If it is not possible to extend the profile seaward of the revetment then the inclusion of the profile in the survey programme should be reviewed. .
Apr 2014	**Cliff-top Survey:** Cliff top survey data collected for baseline survey (autumn, 2008), the previous Full Measures survey (autumn 2013) and the present Partial Measures survey (spring, 2014) is presented in this report. 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 the 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. Furthermore, problems in precisely locating the cliff top, due to vegetation growth or its smooth form, have also affected the data quality. Appendix C – Table C1 provides results from the cliff top survey, showing the position from the datum to the edge of the cliff top along each transect. Results show that erosion or an amount of movement greater than the survey error since surveys began in October 2008 has occurred at ground control point 1, where retreat of 0.8m is recorded. Note that an advance of 0.3m is recorded at ground control point 3. This is greater than the error band but is likely to be the result of inaccuracy in precisely locating the cliff top rather than cliff advance. Since the last survey in October 2012, cliff movement greater than the survey error occurred at ground control point 1 where movement of 0.3m was recorded. Review and analysis of the 2012 aerial photography will allow the nature of change to be better understood.	Since the last survey, movement greater than the survey error occurred at ground control point 1, where retreat of 0.3m is recorded. Movement of other ground control points is within the error band. **Longer term trends:** Since surveys began in October 2008, cliff movement greater than the survey error has occurred at 1 ground control point, Point 1, where cliffs are recorded to have eroded by 0.8m. 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.

2.11 Newbiggin-by-the-Sea

Survey Date	Description of Changes Since Last Survey	Interpretation
Apr 2014	**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 autumn 2012. **1aWDC05A** is in the north of Newbiggin Bay. Since the last survey, beach levels have increased across the majority of the beach profile seawards of the seawall. The rock platform at the toe of the beach has remained stable. **1aWDC06** is located in the centre of the northern part of Newbiggin Bay, between the two breakwaters. The beach levels have generally increased since the previous survey with the greatest increase on the lower beach (up to 0.4m). The upper beach has steepened. The beach levels remain lower than those of 2007 and 2008, however, and the survey report notes that the previously buried sea wall remains exposed. **1aWDC06A** is located in the centre of Newbiggin Bay, behind the offshore breakwater. Beach levels have increased across much of the profile by between 0.1m and 0.8m. The berm observed in the previous survey is no longer present resulting in a reduction in beach level at this location (chainage 142m to 172m) where the beach has flattened. It is likely that storm waves have redistributed this material over the winter period. **1aWDC07** is located towards the south of Newbiggin Bay. Beach levels seaward of the rock revetment have fluctuated. There is an increase in level at the toe of the revetment down to a chainage of about 13m. Seaward of this down to a chainage of 35m the beach levels have lowered. Seaward of this there are small fluctuations the profile and a berm has formed at the toe of the beach.	Since the last survey, the beach at Newbiggin-by-the-Sea has generally accreted, with the exception of the southernmost profile which has fluctuated and shows no clear trend. This may be due the impacts of wave interactions with the offshore breakwater. It is not thought that beach management works have been carried out since the last survey. **Longer term trends:** Data from when monitoring began (in May 2002), reflects the change in beach width resulting from the beach nourishment scheme implemented at Newbiggin-by-the-Sea. This change is also reflected in the beach profile plot in Appendix A. The changes in beach profile form and position observed since the last survey are within the bounds of previous surveys. The only exceptions are a small section of beach at the crest of profile 1aWDC05 and at the crest and toe of profile 1aWDC06A, where beach levels are higher than previously recorded.

Survey Date	Description of Changes Since Last Survey	Interpretation
Apr 2014	**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. The scheme involved beach replenishment and construction of 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. There is a distinct area of increased beach levels behind the offshore breakwater. To the south of the bay there are smaller distinct areas of erosion (up to 2m) in a linear pattern towards the middle of the beach. This area of loss coincides with a note in the survey report of 'a large sand step at the southern end of the beach'. A general trend is observed of (i) erosion either side of the offshore breakwater, (i) accumulation of sediment at the north and south margins of the bay and (ii) accumulation of sediment on the tombolo which has formed in the lee of the offshore breakwater. It is noted in the topographic survey report for Newbiggin Bay 'buried sea wall visible between sections 1aNWB10 and 1aNWB12', which compares well to an area of beach elevation decrease in the topographic survey data. The survey report also noted that sand was being removed from the promenade and in front of the Museum, indicating that sand had been moved onshore from the dunes during winter storms.	The topographic survey shows areas of both gain and loss across the beach. The general trend is for erosion either side of the offshore breakwater with accumulation of sediment at the north and south margins of the bay and on the tombolo in the lee of the offshore breakwater. **Longer term trends:** The longer term trends are covered by the long term topographic trends autumn 2011 to autumn 2014 (see next report, Full Measures 2014).
Apr 2014	**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 concerns that the beach recharge scheme undertaken in Newbiggin Bay may have impacts on the Spital Carrs SSSI and SPA if sand from	Since the last survey, there has been some movement to the north where the sand extent has moved slightly seaward and to the south where the sand extent has moved slightly landwards. Otherwise, there are no discernible trends.

Survey Date	Description of Changes Since Last Survey	Interpretation
	the recharge scheme moves to the south to cover the rock shore platform. The sand extent survey therefore identifies the boundary of the sand beach on the rock platform. Data from the most recent sand extent survey (Partial Measures, spring 2014) has been plotted onto aerial imagery (refer to Appendix D – Map 1). The plot shows that there is some variation of the extent of sand between the autumn 2012 and the spring 2014 survey. There is some movement to the north and south where the sand has moved landwards a significant distance. The sand extent has remained more stable towards the middle of the survey area.	**Longer term trends:** Review of the sand extent surveys for the past three surveys, shows that extent of the sand has oscillated. There are sections of beach to the north and to the south where the sand has retreated further landward than has previously been recorded (since surveys began in 2012).

12.12 Cambois Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
Apr 2014	**Cliff-top Survey:** Cliff top survey data collected for the baseline survey (autumn 2008), the Full Measures survey (autumn 2013) and the present Partial Measures survey (spring 2014) is presented in this report. 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. These cliff top surveys are undertaken bi-annually. Measurements are taken from each ground control point along a fixed bearing to the edge of the cliff top. The results from the cliff top monitoring are anticipated to have an accuracy of ±0.2m due to the technique used. The results from the cliff top survey are presented in Appendix C – Table C2, showing the position from the ground control point to the edge of the cliff top along a defined bearing. Results show that change greater than the survey accuracy has occurred at two ground control points since surveys began in October 2008; point 3 and point 5. However, point 3 is indicating cliff advance, which probably reflects difficulty in precisely locating the cliff edge and/or vegetation growth. Point 5 shows cliff erosion of 2.8m. Other locations have not changed, or erosion is within the error band. Since the last survey in October 2013, change greater than the survey accuracy has occurred at one ground control point; point 4. Other locations have not changed, or erosion is within the error band. The cliff has eroded by 0.3m at ground control point 4. Other locations have not changed, or erosion is within the error band. Review and analysis of the 2012 aerial photography will allow the nature of change to be better understood.	Since the last survey in October 2013, the cliffs are eroding at one ground control point, point 4, by 0.3m. **Longer term trends:** Since surveys began in October 2008, change greater than the survey accuracy has occurred at two ground control points (point 3 and point 5), where cliffs are recorded to have eroded by 2.8m and accreted by 0.4m respectively. Other locations have not changed, or erosion is within the error band. 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. This data will be analysed in a separate report to give more accurate information on the behaviour of the cliffs.

Survey Date	Description of Changes Since Last Survey	Interpretation
Apr 2014	**Cliff/Dune-top Survey:** Cliff top survey data collected for baseline survey (autumn 2008), the Full Measures survey (autumn 2013) and the present Partial Measures survey (spring 2013) is presented in this report. 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 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. Results show that erosion or an amount of movement greater than the survey error has occurred at 19 ground control points since surveys began in May 2009. Other locations have not changed, erosion is within the error band, an increase is recorded or data is not available. Since the last survey in October 2013, erosion that is greater than the survey error occurred at 18 points; 11, 13-15, 18, 19, 21-29, 32, 33 and 35. The greatest erosion is seen between points 21 to 29, with erosion peaking at 5.7m and 4.9m at Points 23 and 24 respectively. Accretion that is greater than the survey error is recorded to have occurred at 17, 31 and 41. This is most likely to be the result of inaccuracies in identifying the cliff edge rather than cliff advance.	Since the last survey in October 2012, erosion that is greater than the survey error occurred at points 11, 13-15, 18, 19, 21-29, 32, 33 and 35. Accretion is recorded to have occurred at 17, 31 and 41, but this is likely to be error related to difficulty in precisely locating the cliff edge. **Longer term trends:** Since surveys began in May 2009, erosion or an amount of movement greater than the survey error has occurred at 19 ground control points. Other locations have not changed, erosion is within the error band, accretion is recorded (likely to be due to survey error) or data is not available. Erosion greater than the survey error is recorded to have taken place at: (i) ground control point 8 (to the north of Cambois, close to the mouth of the River Wansbeck) (ii) ground control points 12 to 13 (between Cambois, and the mouth of the River Wansbeck) (iii) ground control points 16 to 24 (the centre of the frontage, opposite Cambois) (vi) ground control points 26 and 29 (opposite the tidal basin), and (v) ground control points 32 to 35 (opposite Blyth). 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. This data will be analysed in a separate report to give more accurate information on the behaviour of the cliffs.

2.13 Blyth South Beach

Survey Date	Description of Changes Since Last Survey	Interpretation
Mar 2014	**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 autumn 2013. **1aBVBC01** is located towards the north of South Beach, in front of the land owned by the Port of Blyth. There have been no significant changes to the position and form of the dune crest since the last survey. The front dune face, however, has cut-back by up to 2.5m and the beach levels have decreased by up to 0.5m between the dune toe at 32m chainage and 49m chainage. Across the middle of the profile beach, levels have increased by approximately 0.2m and at the toe a berm has developed with beach levels increasing by as much as 0.9m. This suggests that storm waves have eroded the dune face and drawn material down the beach, eroding the upper beach and building up the lower beach, forming in a shallower beach profile. At profile **1aBVBC02**, a similar trend can be observed as at 1aBVBC01. Beach levels have decreased across the upper beach, with the berm previously observed at around HAT no longer being present, and increased across the across the lower beach (from chainage 55m seawards) by up to 1m. At profile **1aBVBC03**, there have been no significant changes to the position and form of the dune crests since the last survey, but the front face of the dune has steepened and cut back (see Plate 18 and Plate 19). Beach levels have reduced by up to 1m in front of the dune toe around HAT/MHWS but generally increased across the remainder of the profile. There is now one berm present at around MHWS (2.4mAOD), whereas the previous survey (autumn 2013) recorded one landward of the current berm near the dune toe and another seaward of the current berm. At profile **1aBVBC04**, there have been no significant changes to the position or form of the dunes since the last survey. Beach levels have increased at the toe of the dune, where the berm previously at HAT (3.1mAOD) has moved landwards to around 4mAOD. The upper and middle beach has steepened, with a reduction in beach level of 1m to 0.1m from a chainage of 53m to 100m. Seaward of this there is a berm at the toe of the beach, just above MLWS. This lower section was not measured in the previous survey (autumn 2013) so it cannot be compared, but it is likely that it was not measured as beach levels	Since the last survey, the dune crests at Blyth South Beach have remained stable, retaining the same form and position. The beach has been subject to erosion, with a considerable drop in beach levels (in the order of 1m) on the upper beach, but the subsequent deposition of this eroded material, on the lower shore, forming a berm on the more northern profiles. This indicates that storm waves have eroded the upper beach during the winter period and drawn material down the beach. The exception is profile 1aBVBC05, towards the southern end of the bay near Mile Hill, where the berm at HAT has moved landwards resulting in slight accretion of the upper beach and slight erosion of the middle beach while the lower beach has remained fairly stable. **Longer term trends:** At Blyth South Beach, the dunes have generally demonstrated a long-term trend of stability. Data from when monitoring began (in May 2002), shows that prior to April 2007 (inclusive), the seaward face of the dune and dune crest were positioned further seaward and 1.5m higher. Thereafter the dune was narrower and the crest height lower, however, this position and form has been retained since then. The changes in beach profile form and position observed since the last survey are within the bounds

Survey Date	Description of Changes Since Last Survey	Interpretation
	were lower and hence water levels were too deep. At profile **1aBVBC05**, there have been no significant changes to the position and form of the dunes since the last survey. There has been a small amount of accretion on the upper beach at the dune toe (of up to 0.4m) where the berm at HAT has moved up the beach. Below this there has been some lowering of beach levels where the beach slope has moved back due to the new berm position and there has been slight accretion on the lower beach. The changes appear to be the result of the profile reshaping rather than a trend of erosion or accretion. **1aBVBC06** is located at the southern end of the beach, towards Seaton Sluice. There have been no significant changes to the position or form of the dunes since the last survey. Beach levels have generally reduced across the upper beach and increased on the lower beach. The change in beach profile indicates that storm waves have cut back the upper beach slope and moved material onto the lower beach. Some lowering of beach levels is observed at the toe of the profile.	of previous surveys at profile 1aBVBC01 and 1aBVBC05. At Profile 1aBVBC02 and 1aBVBC03 the dune face has cut back to its most landward position recorded to date and a short section of the upper beach is at the lowest level recorded. At Profile 1aBVBC04 the toe of the beach (from 140m chainage seawards) is at the lowest level recorded to date. It may have been lower in the previous survey (autumn 2013) but was not measured, indicating that it may have been outside the survey depth limit. At Profile 1aBVBC06, for a short section below the berm (117m to 140m chainage) and a short section at the very toe of the beach, the beach levels are the lowest recorded to date.

Plate 18 – Survey photograph 1aBVBC03_20140331_Up3.JPG

Plate 19 – Survey photograph 1aBVBC03_20131008_Up3.JPG

3. Problems Encountered and Uncertainty in Analysis

Individual Profiles

- At Profile BTBC19 and 21, the offshore extent of the survey is limited by a drain.
- At Profile BTBC23 there was no drain present on the section, and so the surveyor was able to measure to the sea. However the survey line was limited by soft sand beyond the location where the drain is usually located.
- At BTBC33 the middle of dunes could not be measured due to dense vegetation. Care is therefore needed when interpolating the data.
- Profile ADC09 ends at the river.
- At Profile ADC15A a new deck has been built since the storm surge (Dec 2014) which is just south of the profile line.
- At Profile ADC16 and 16A there are gaps in the profile data due to dense vegetation. Care is therefore needed when interpolating the data.
- At Profile ADC16B a new fence was being installed at the start of the profile. This fence line is likely to become a new profile start point.
- At Profile WDC01 surveyors were unable to measure the bottom face of the revetment as the boulders were too slippery.

Topographic Surveys

At Alnmouth, the topographic survey report notes 'Dune line at approximately 424780 610310 have been knocked back due to winter storms. Also at this location an anti-tank block has fallen from the upper dune. Again around this location there are many concrete sandbags on the beach that have washed out of the missing dune'.

At Newbiggin-by-the Sea, the topographic survey report notes 'Buried sea wall visible between sections NWB 10 and NWB 12, large sand step at southern end of beach (and) sand being removed from promenade and from in front of Museum'.

At Cambois, the topographic survey report notes 'Undergrowth at north end of cliff hinders survey of line'.

Cliff Top Surveys

Surveying any cliff top is difficult due to: (i) the 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. In particular, surveying the cliff top has been made challenging by growth of vegetation that makes identification of cliff edge in successive surveys difficult. 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 and that advances in the cliff front are error.

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 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 t hindered surveying. This was also noted in previous reports (partial measures, spring 2012 and full measures, autumn 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

At 1aWDC01 the profile has not extended forward of the rock revetment since 2012. If it is not possible to measure the profile seaward of the revetment then the inclusion of this profile in the survey programme should be reviewed.

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 changes in beach profile form and position observed since the last survey are generally within the bounds of previous surveys or higher and present no causes for concern. The exceptions to this, however, are:
    - Profile 1aBTBC34 shows the lowest recorded level at the profile toe and the dune face is at its most landward position since surveys began;
    - Profile 1aBTBC33 shows the lowest level recorded to date at the dune toe;
    - Profile 1aADC01 shows the highest beach level recorded to date on the upper beach (at the dune toe) but the lowest level recorded to date at the beach toe; and,
    - Profile 1aADC02 shows the most landward position of the dune face at the toe of the dunes and the lowest level recorded to date at the beach toe.
- At Boulmer the recorded profiles present no causes for concern.
- At Alnmouth Bay, the topographic survey notes that the dune line at approximately 424780 610310 has been knocked back due to winter storms. At this location an anti-tank block has also fallen from the upper dune and there are many concrete sandbags on the beach that have washed out from the missing dune.
- At profile 1aADC07 a short section at the beach toe (chainage 141m to 164m) is slightly lower than previous surveys (since 2002) and at profile 1aADC09 the dune face has retreated to the most landward location recorded to date.
- Elsewhere along Alnmouth Bay, the recorded profiles and topographic survey show no cause for concern.
- At Hauxley Haven, at profile 1aADC16A the dunes have been cut back and the dune toe is at it's the lowest recorded level. At Profile 1aADC15A the dune face has retreated to its most landward location measured to date.
- At Hauxley Haven, at profiles 1aADC16 and 1aADC16A, the beach toe is at the lowest level recorded to date.
- At Druridge Bay, the upper beach of the southernmost profile (1aADC17A), is at the lowest level recorded to date by up to 0.35m.
- Elsewhere at High Hauxley & Druridge Bay, the recorded profiles present no causes for concern.
- At Lynemouth Bay, to the north of the Power Station (profile 1aCMBC03B), the slag bank and beach have eroded by approximately 15m.
- At Newbiggin Bay, the recorded profiles and the sand extent survey present no causes for concern.

- At Cambois, the cliff top survey shows notable erosion between points 21 and 29, with erosion peaking at points 23 and 24 where cliff recession of 5.7m and 4.9m respectively are recorded.
- At Blyth South Beach, at profiles 1aBVBC02 and 1aBVBC03, the dune face has cut back to its most landward position recorded to date and a short section of the upper beach is at the lowest level recorded.
- At Profile 1aBVBC04 the toe of the beach (from approximately 140m chainage and seawards) is at the lowest level recorded to date. It is possible that it may have been lower in the previous survey (autumn 2013) but was not measured as it was outside the of the survey depth limit.
- At Profile 1aBVBC06, for a short section below the berm (from approximately 117m to 140m chainage) and for a short section at the very toe of the beach, the beach levels are the lowest recorded to date.

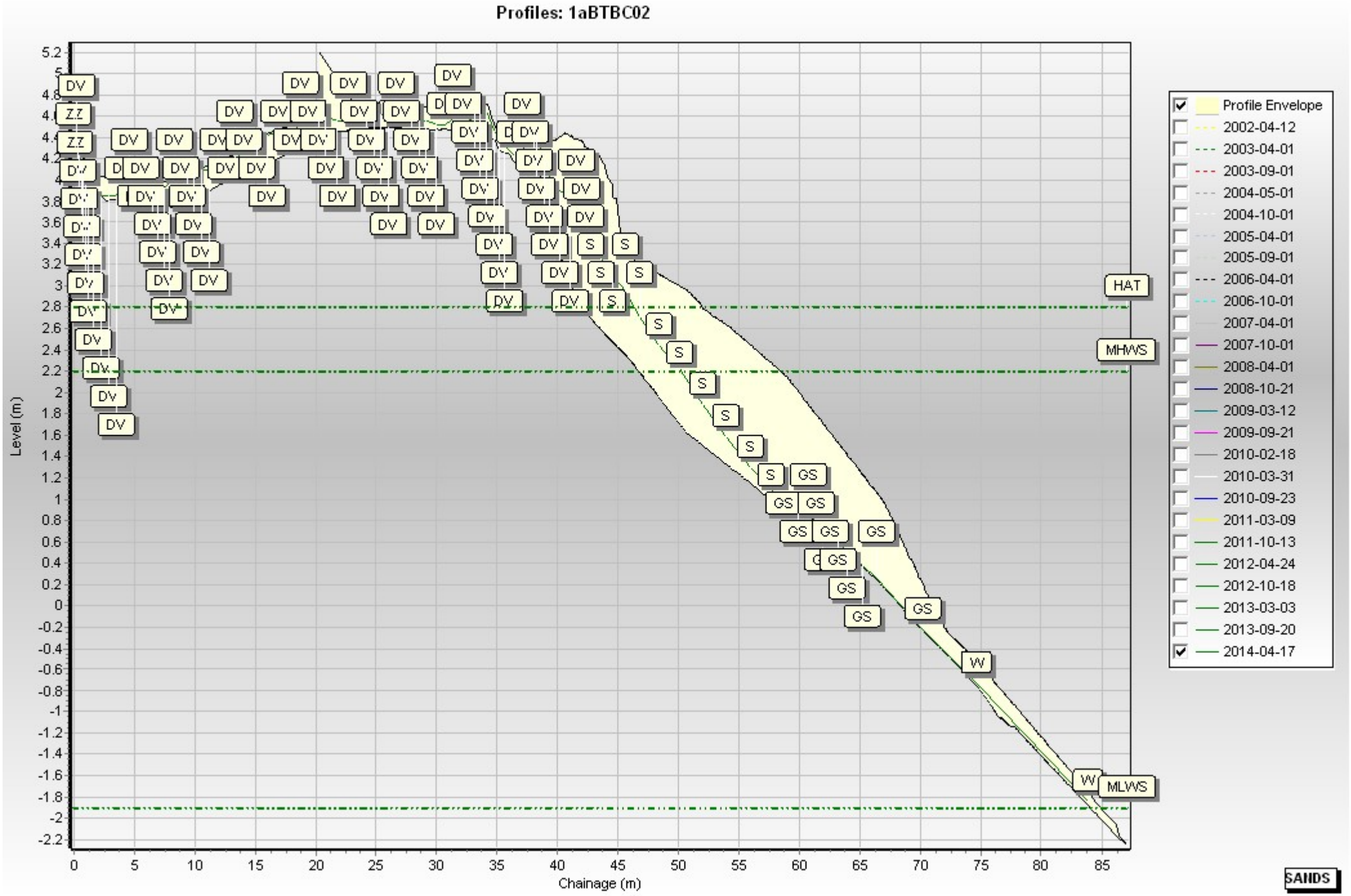
Appendices

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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MLWS
Profile Envelope
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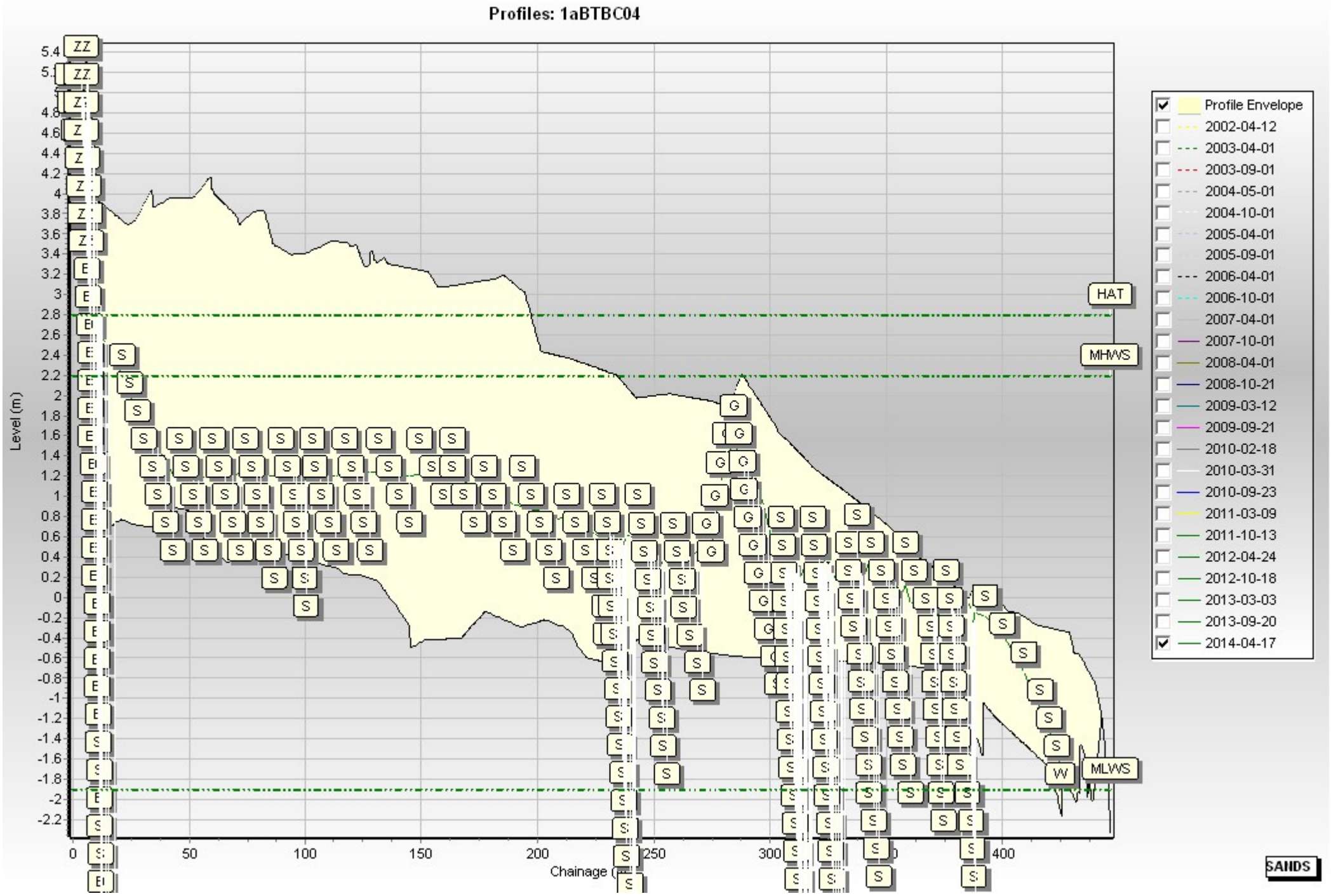
SANDS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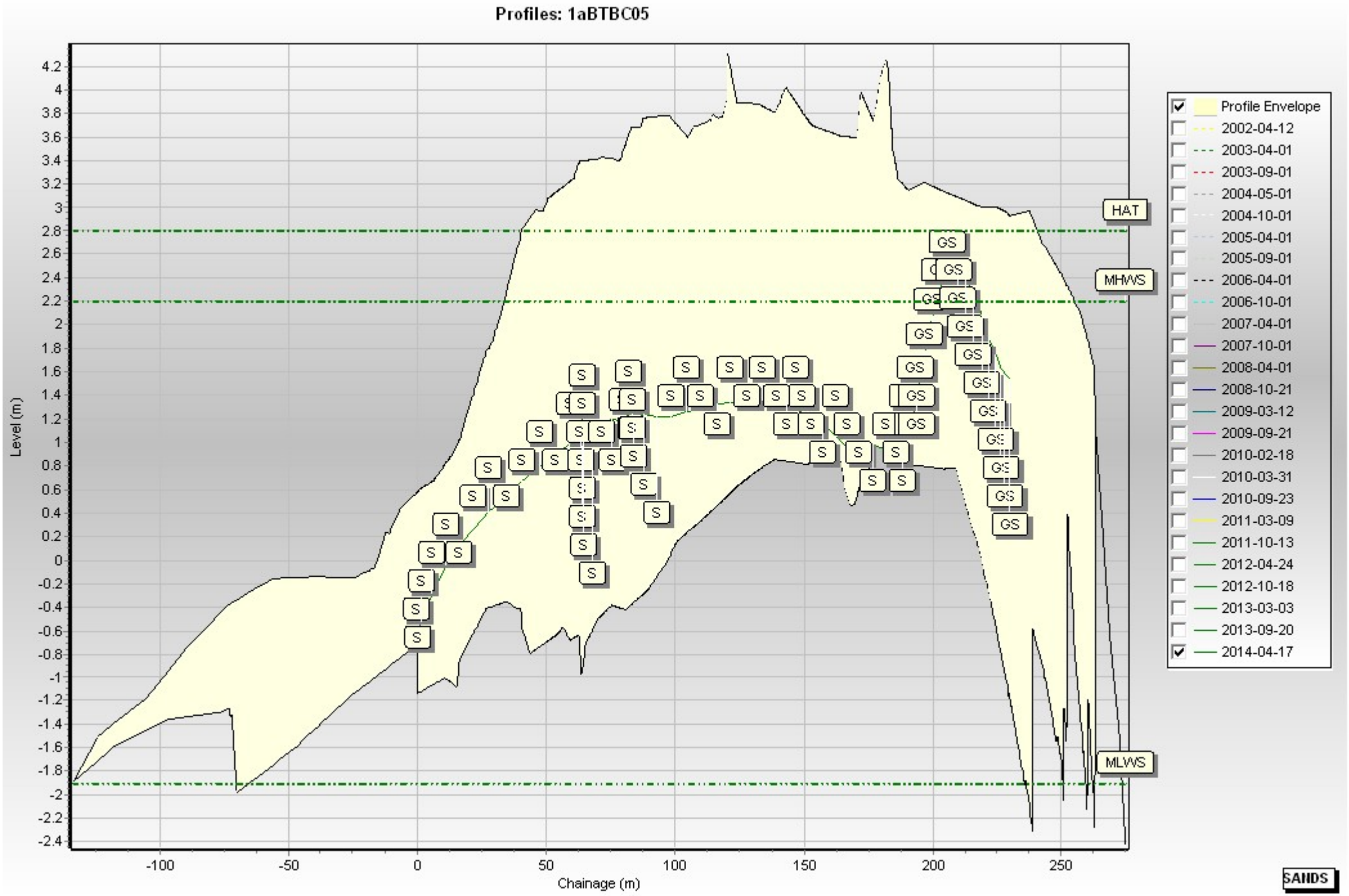
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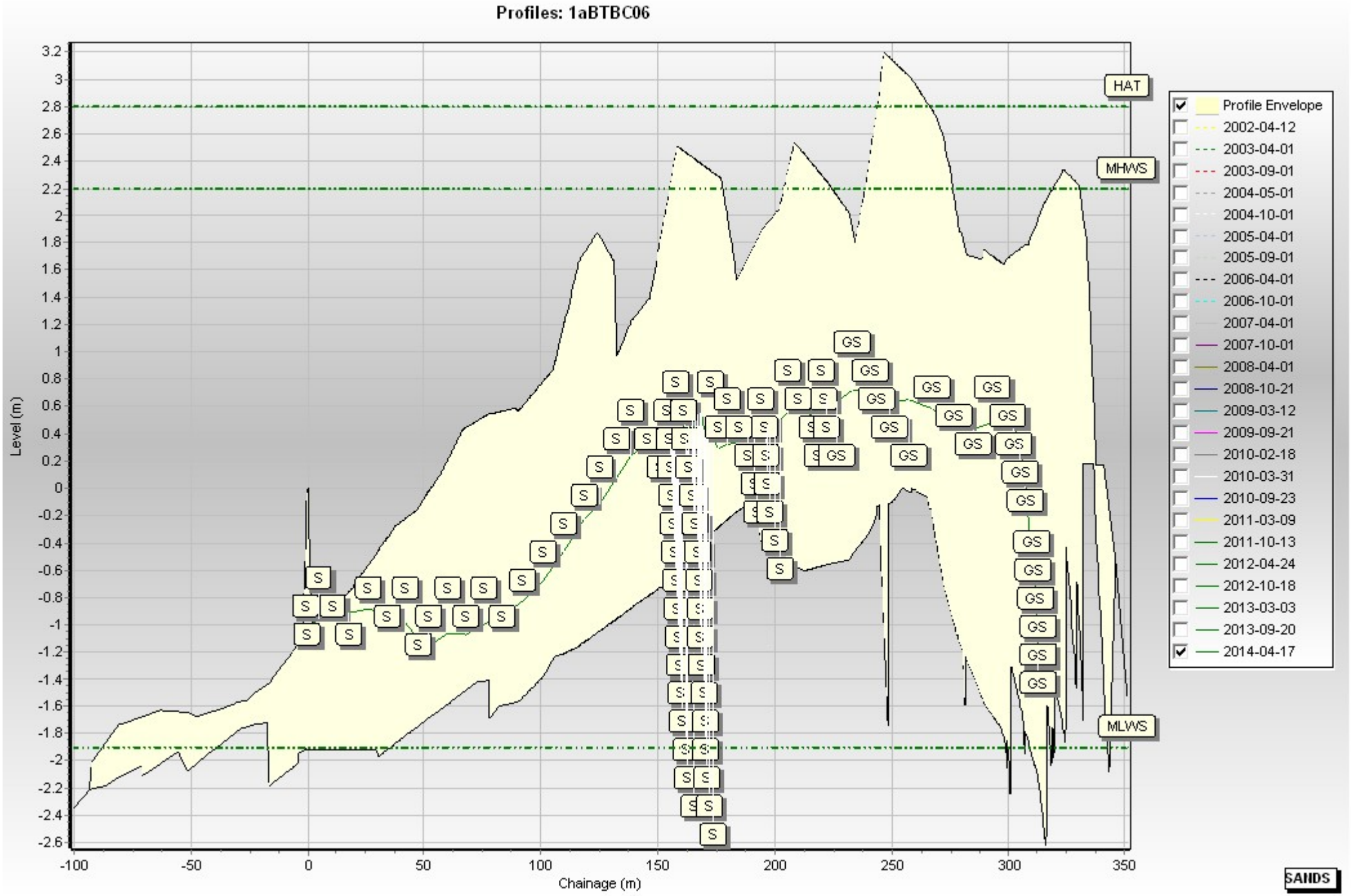
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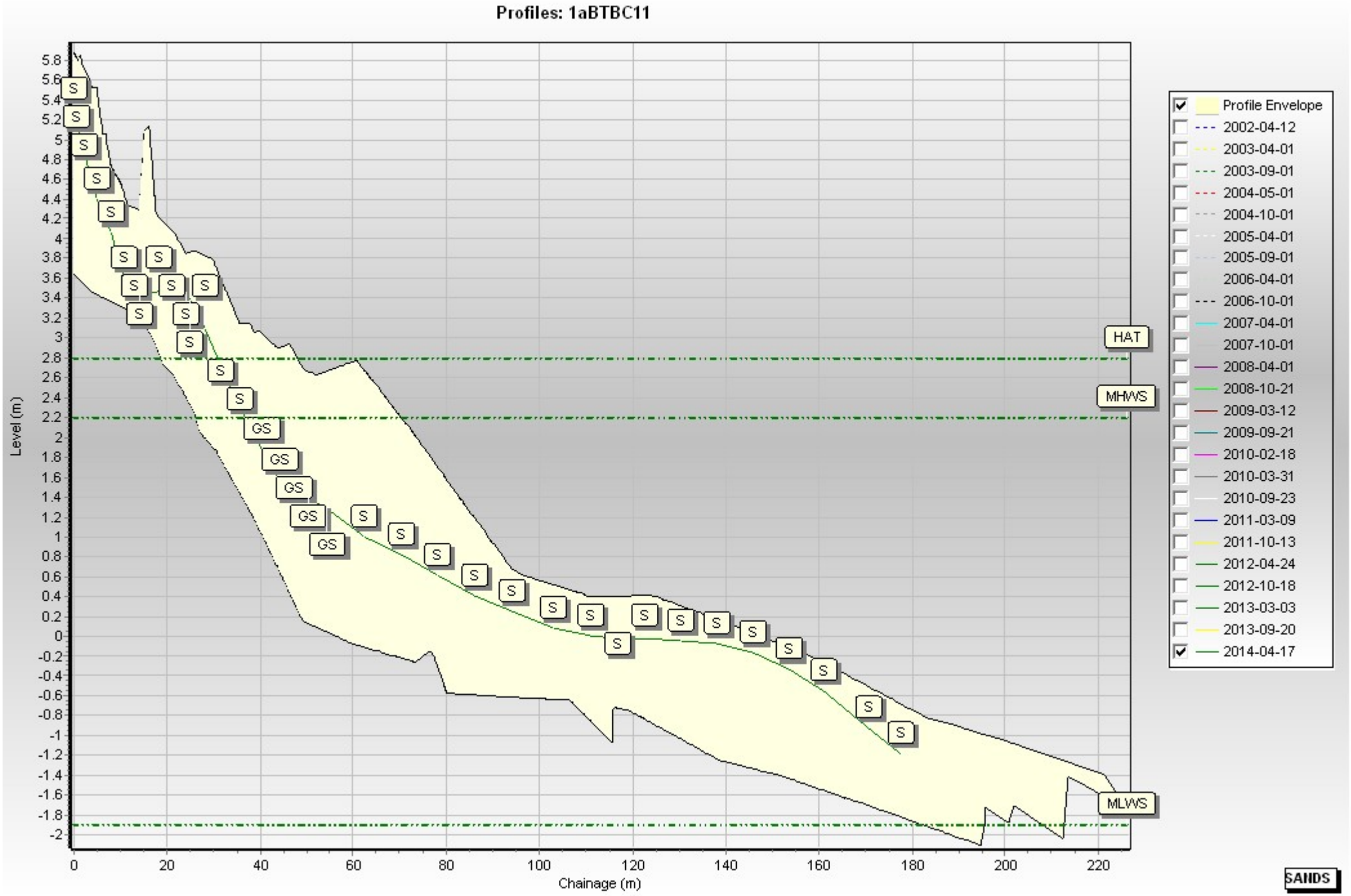
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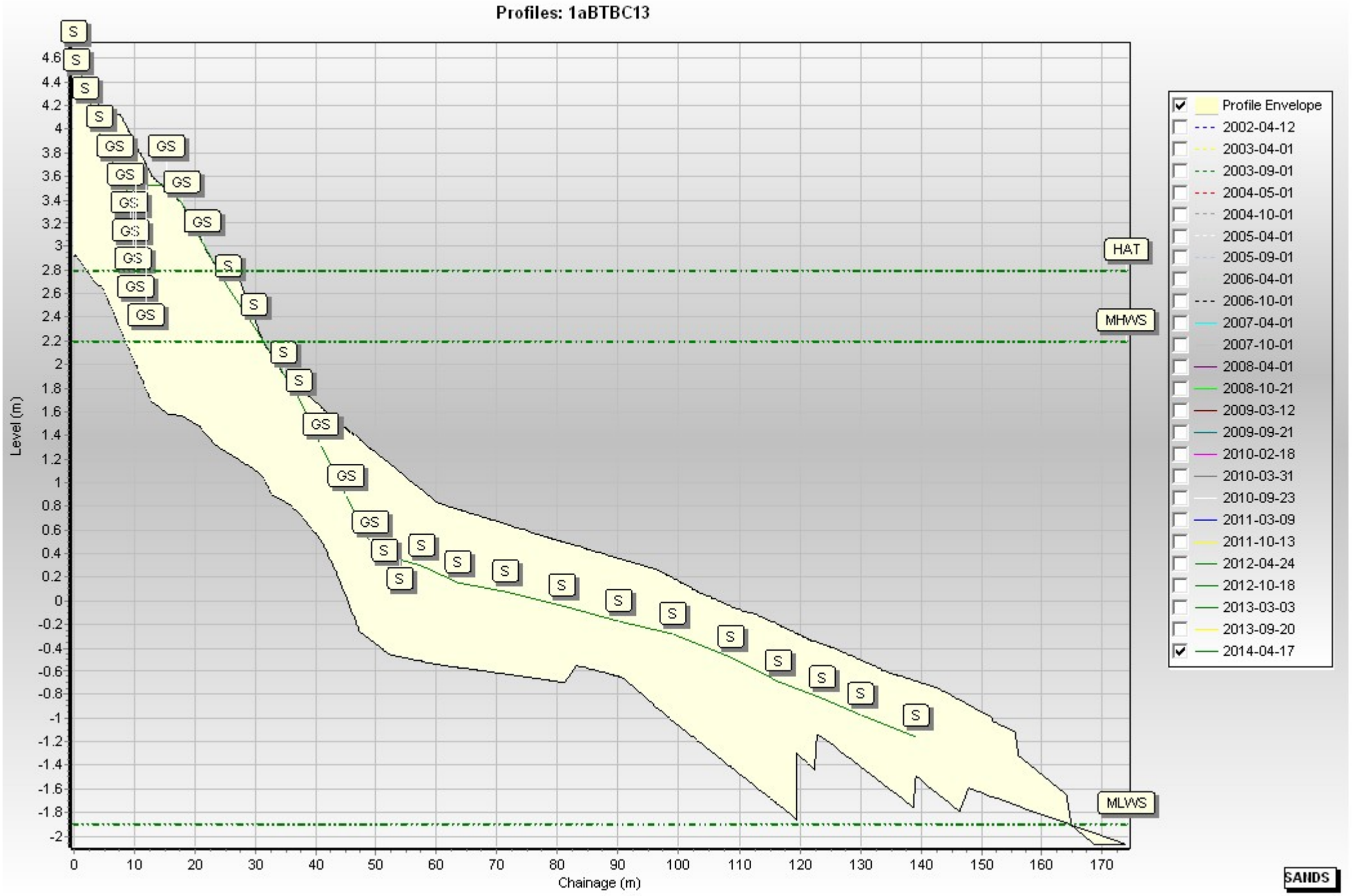
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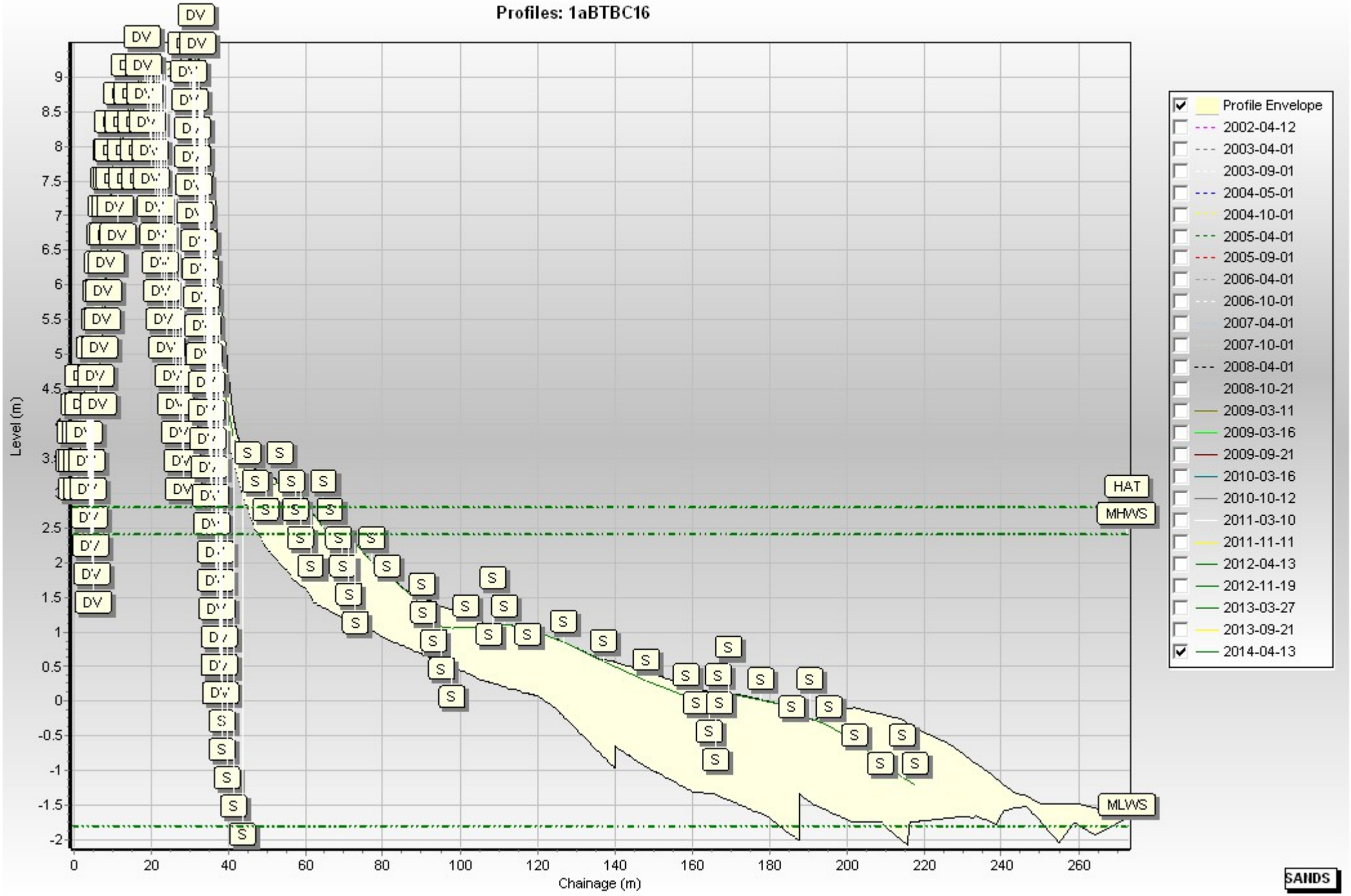
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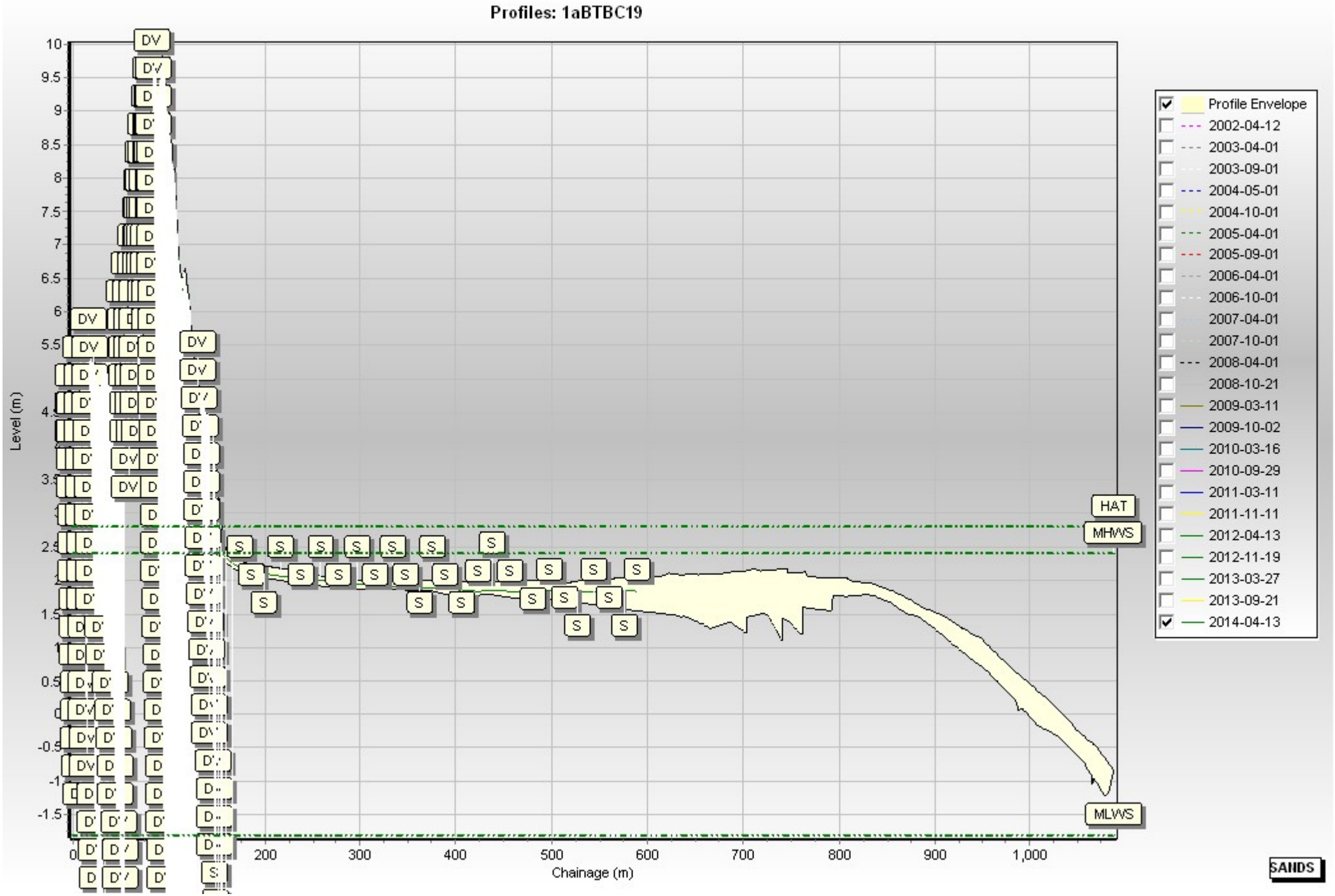
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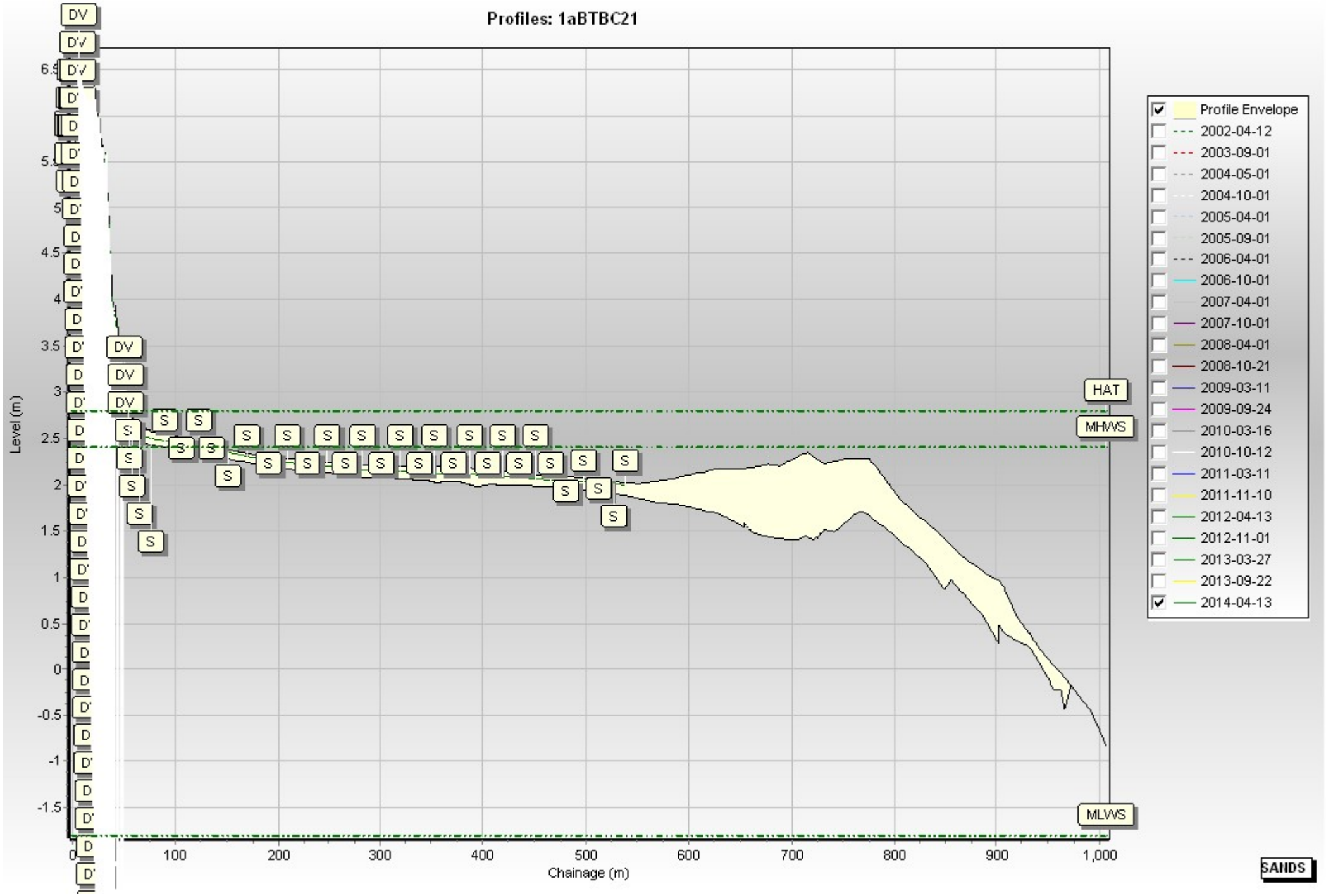
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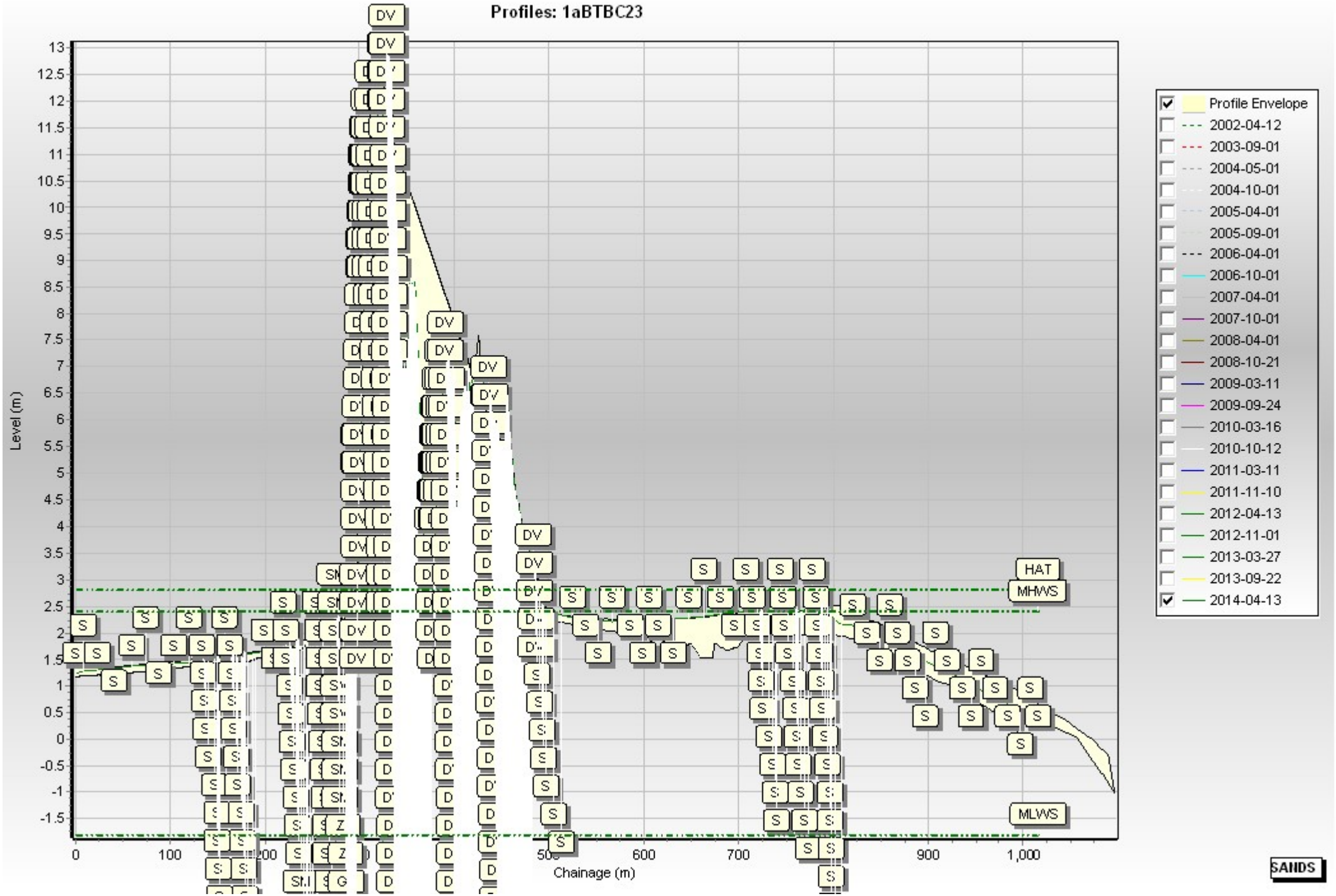
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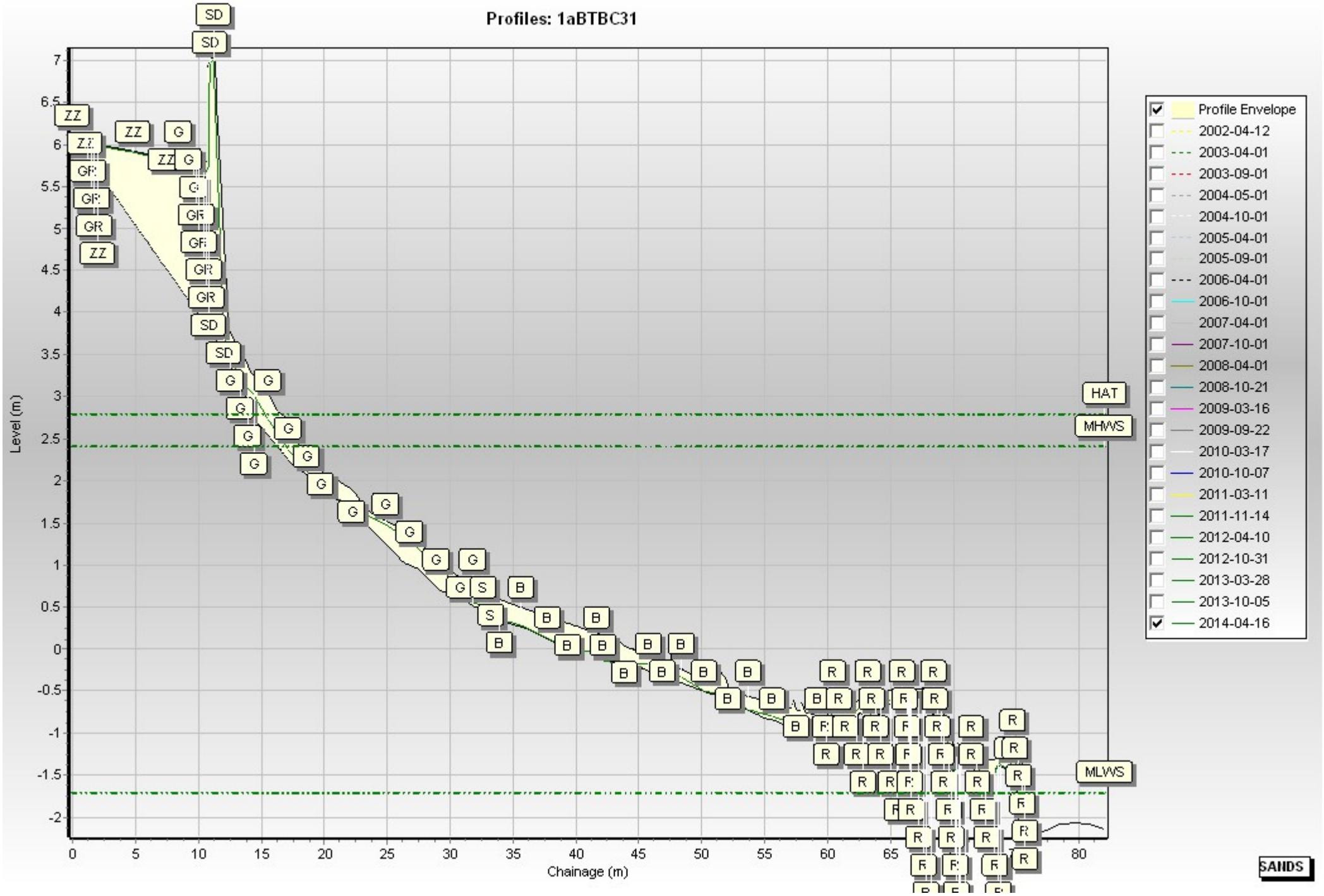
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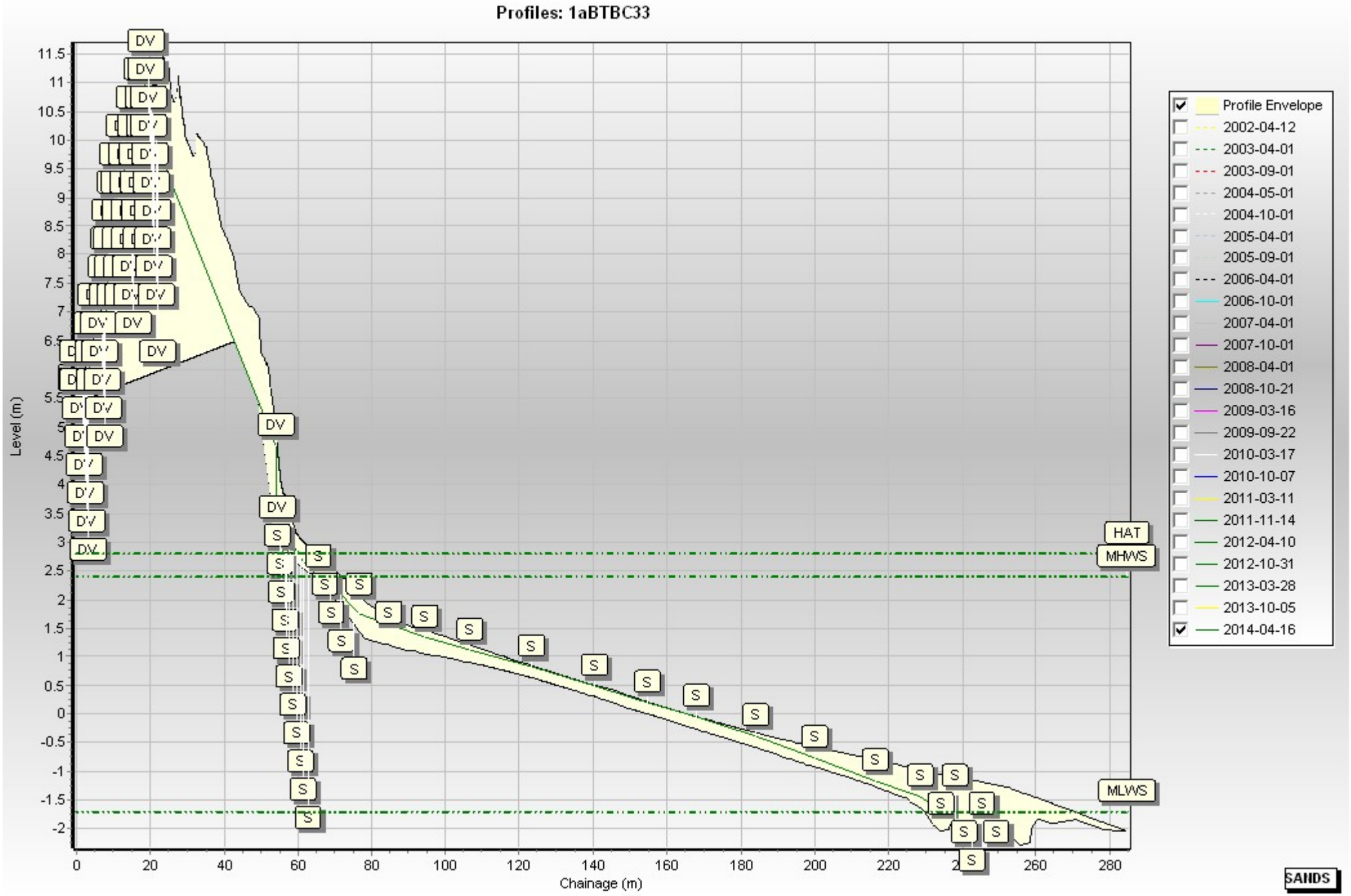
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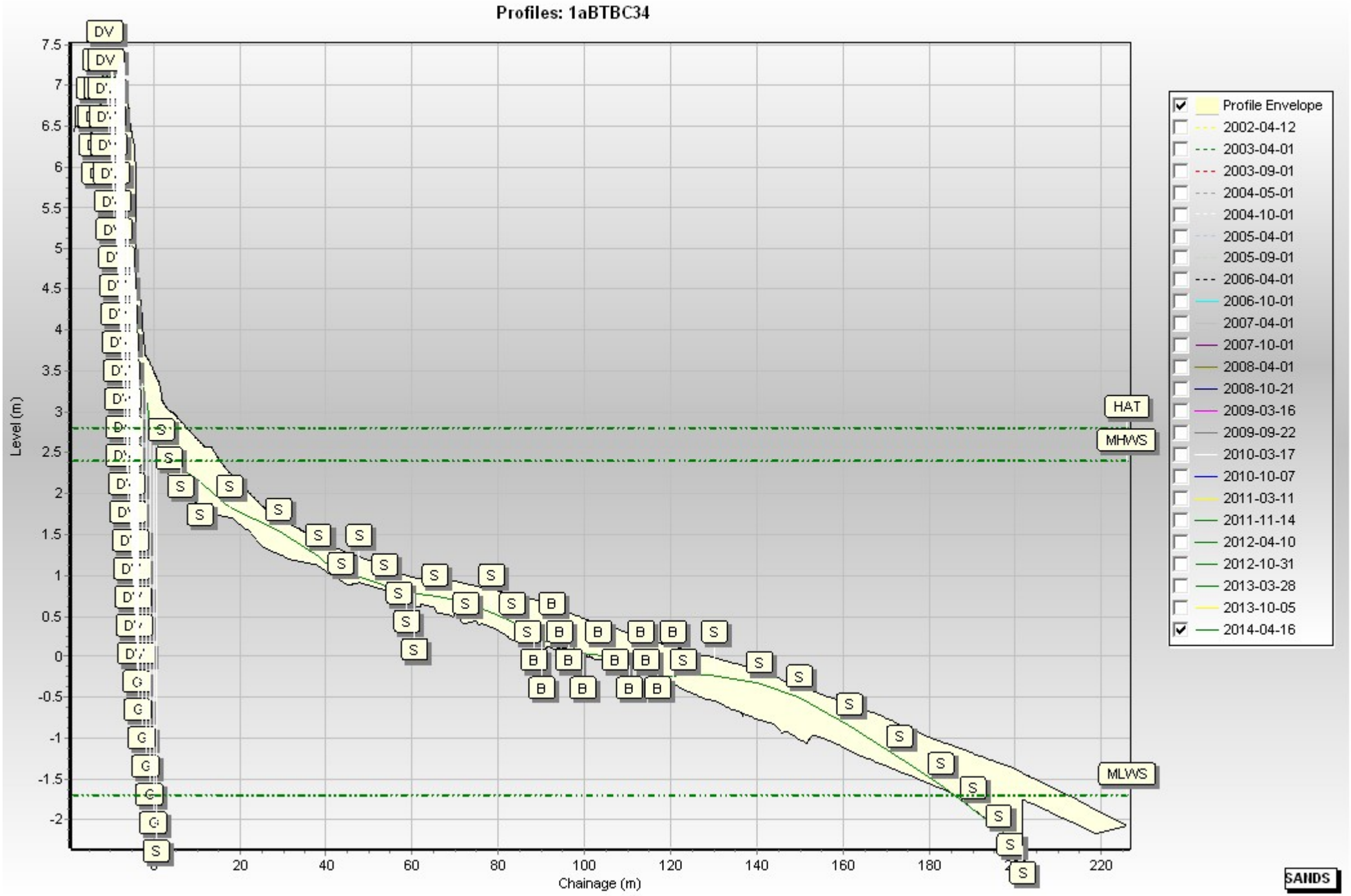
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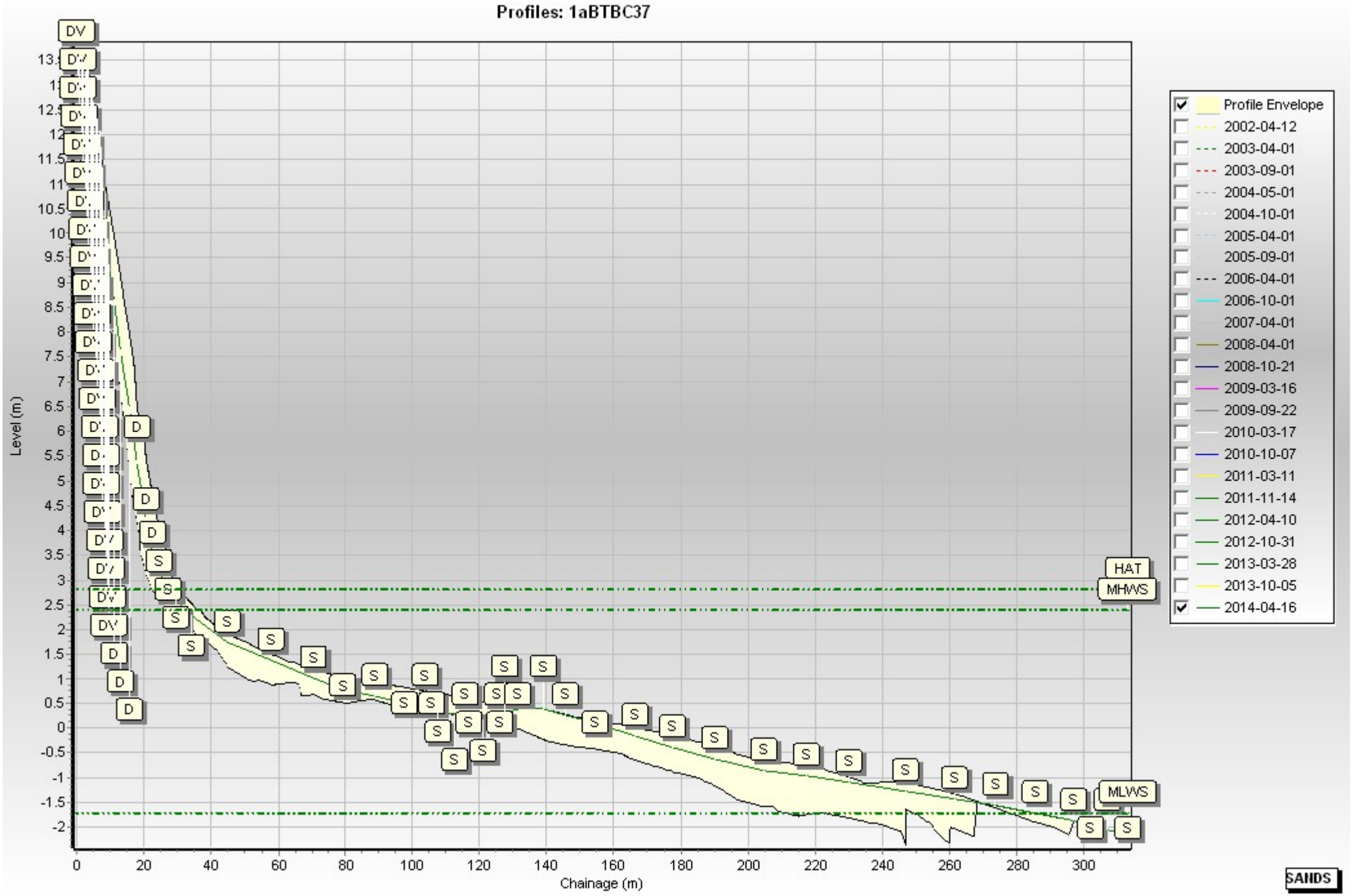
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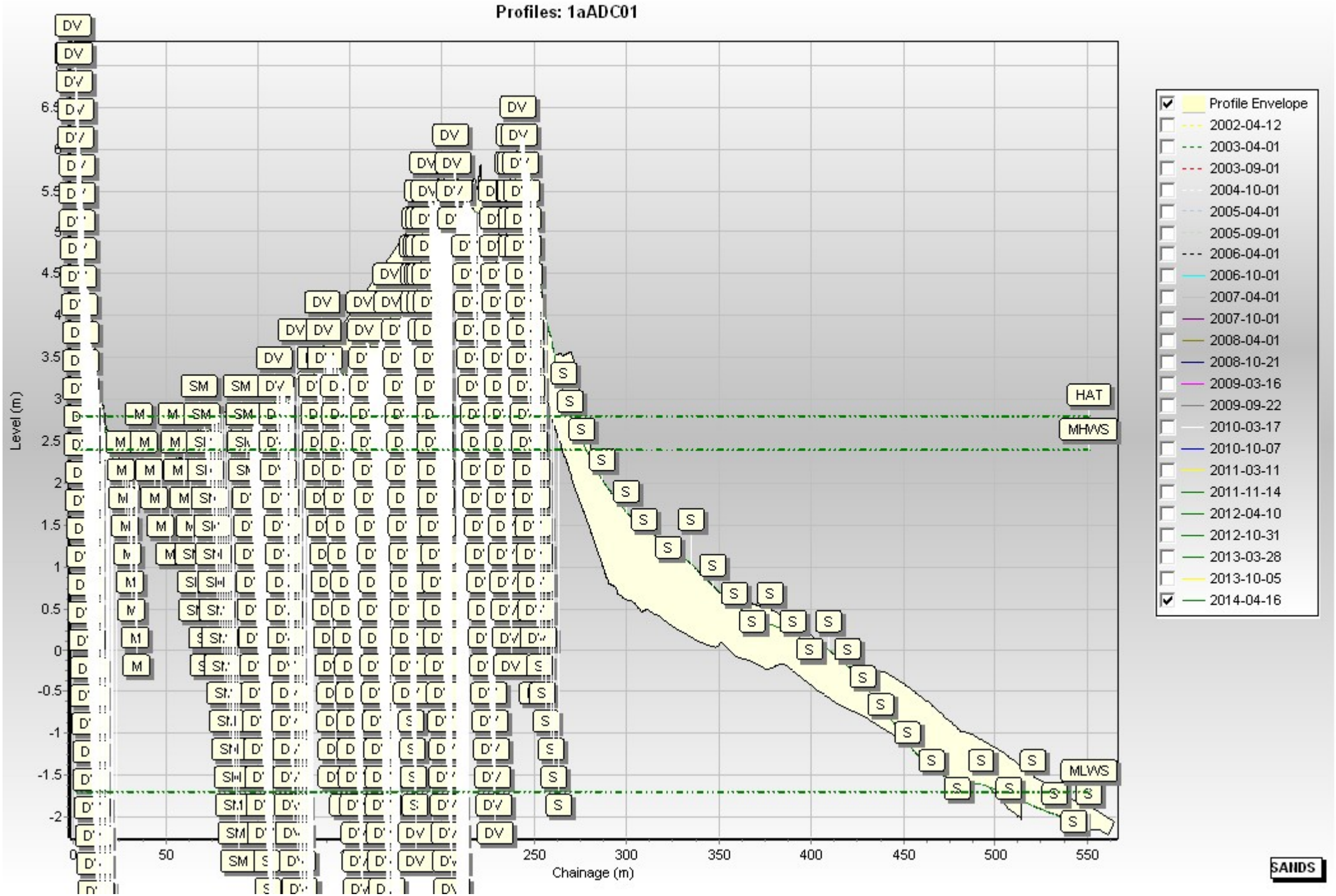
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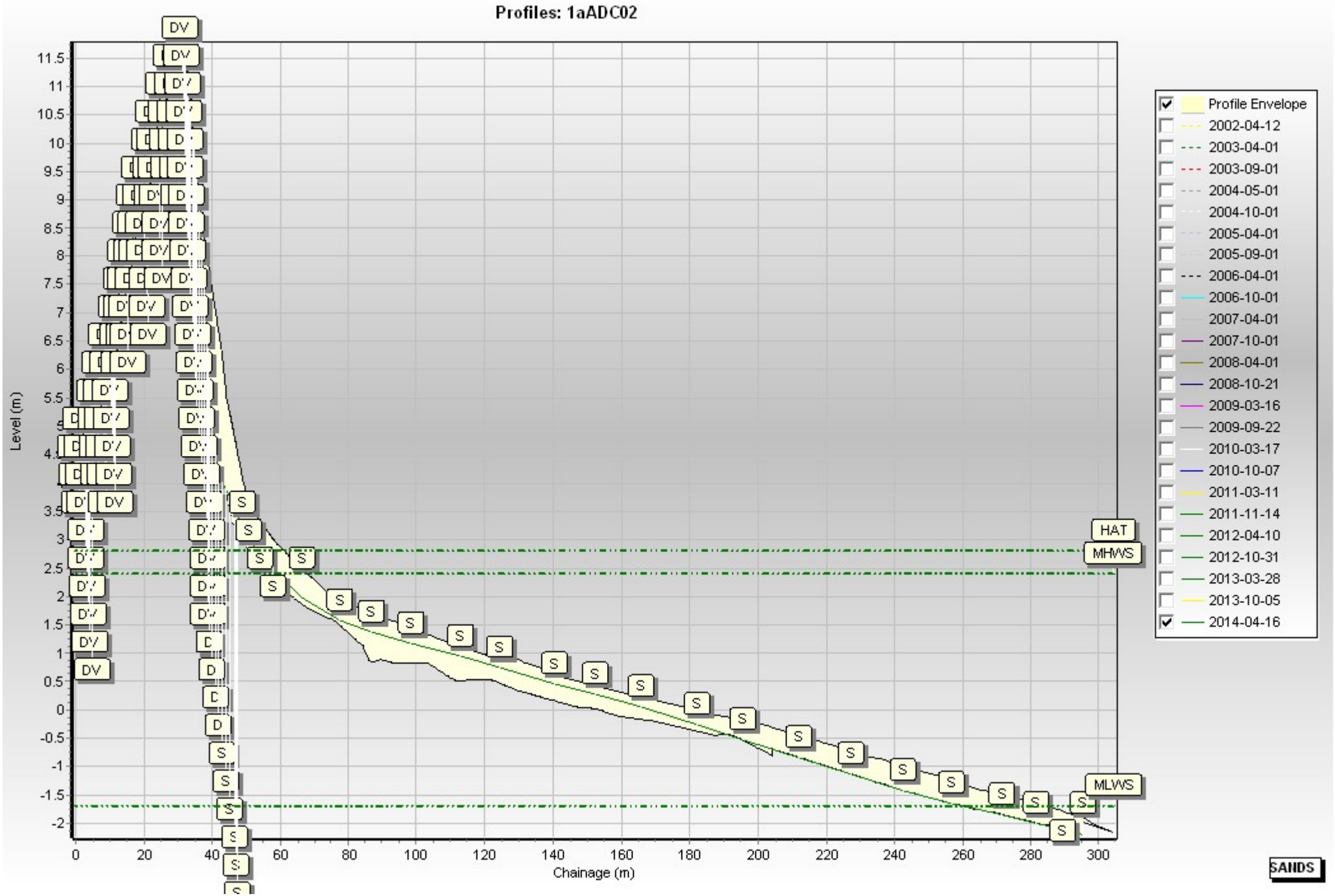
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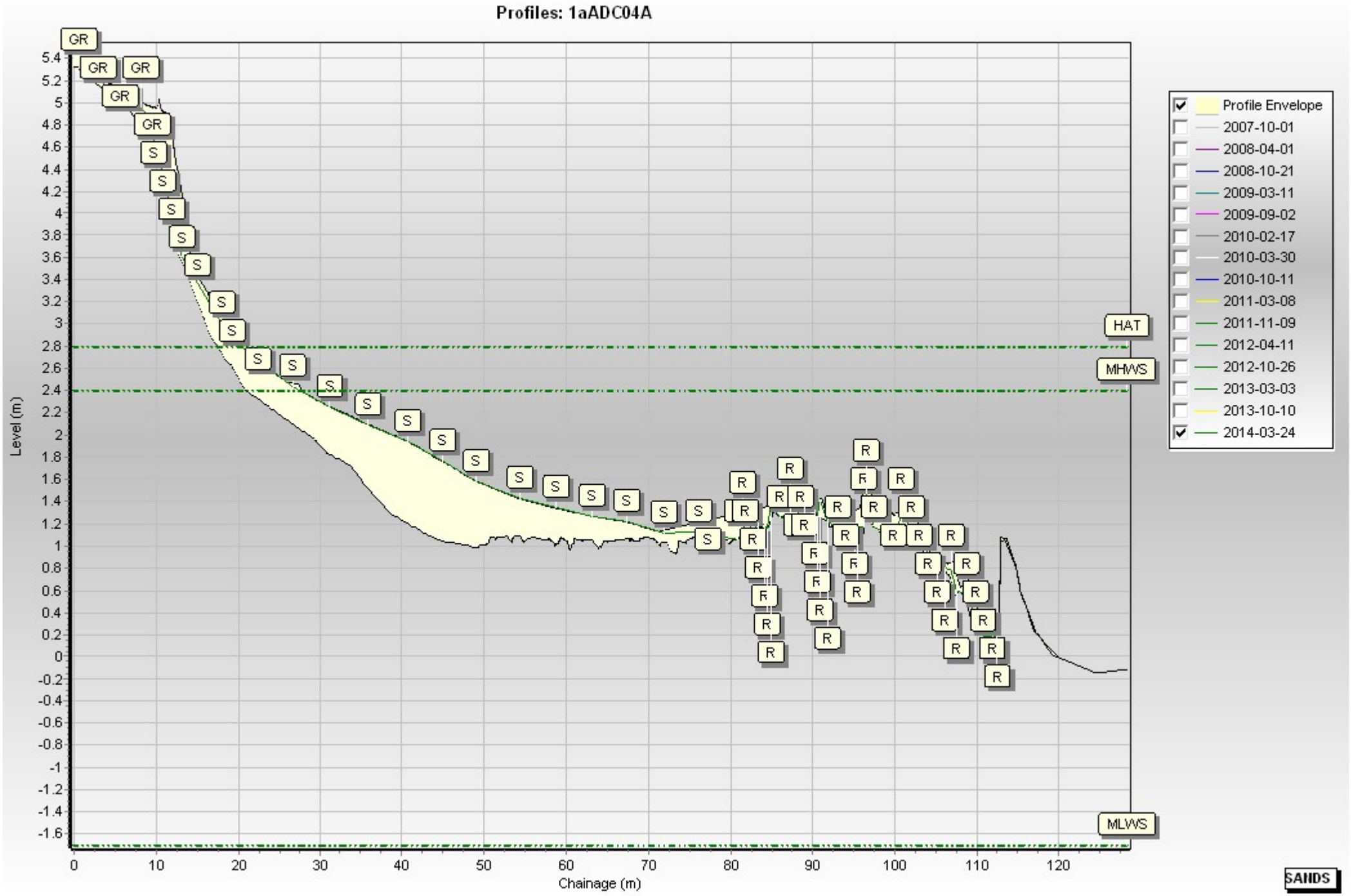
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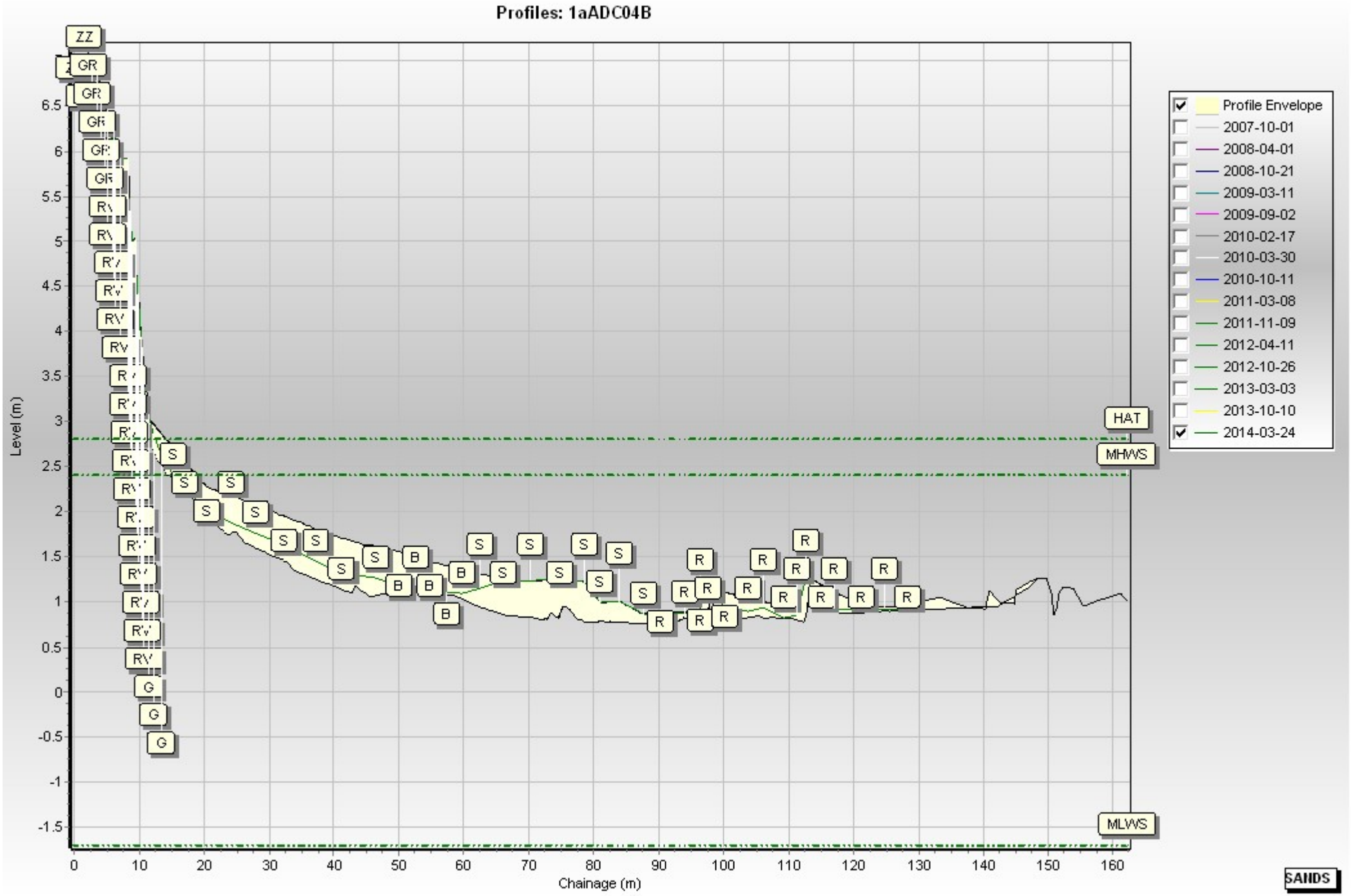
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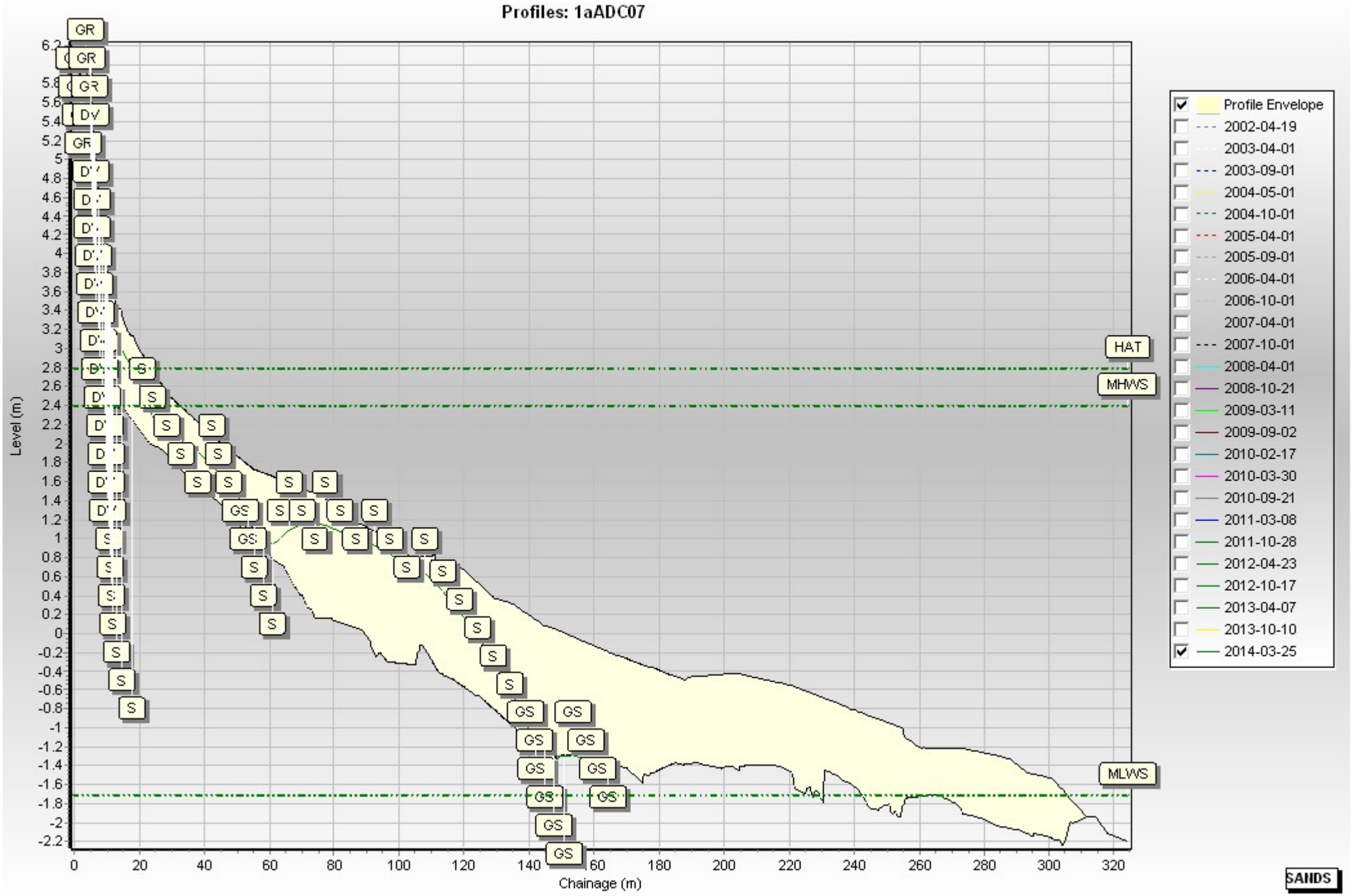
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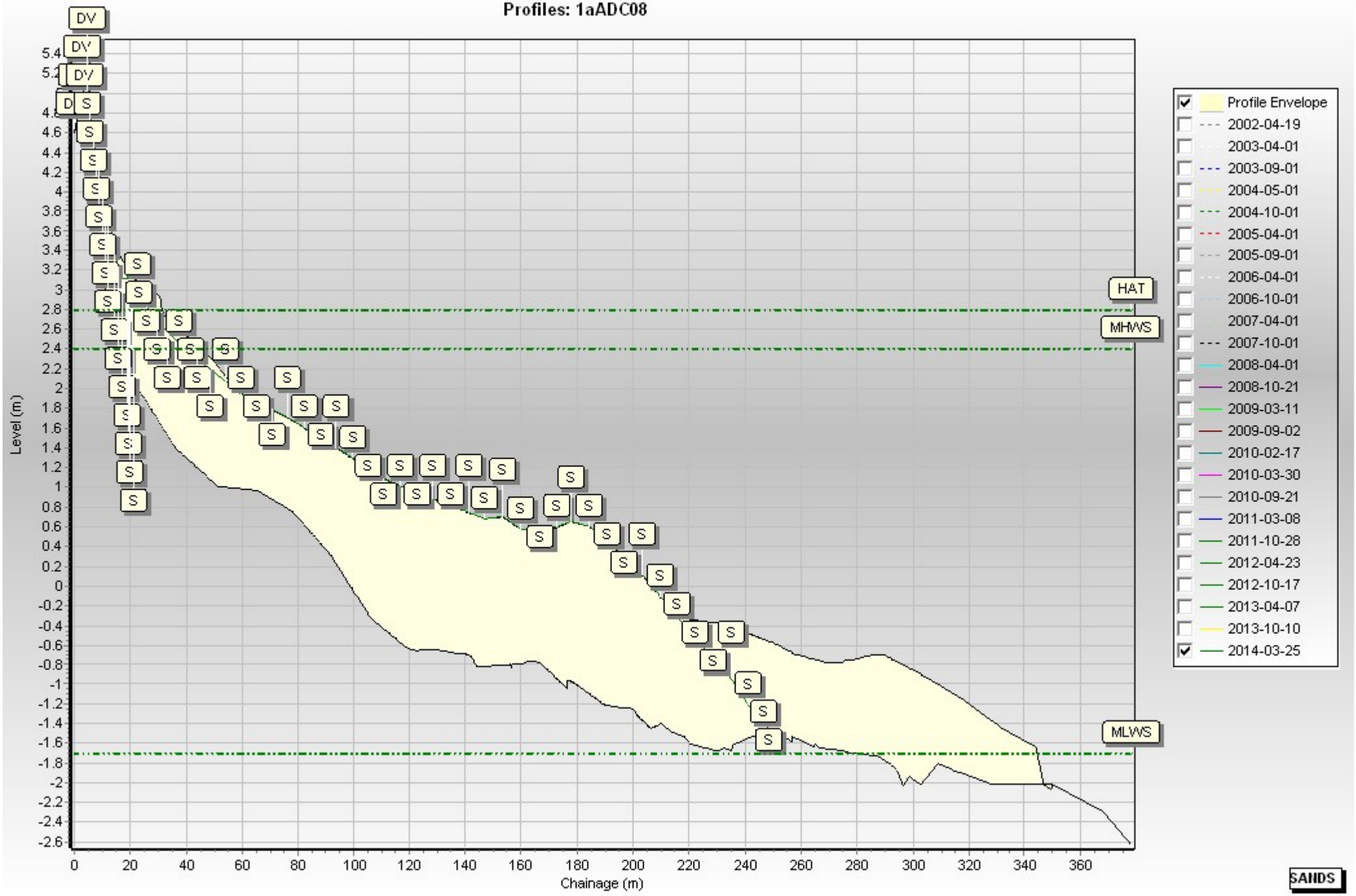
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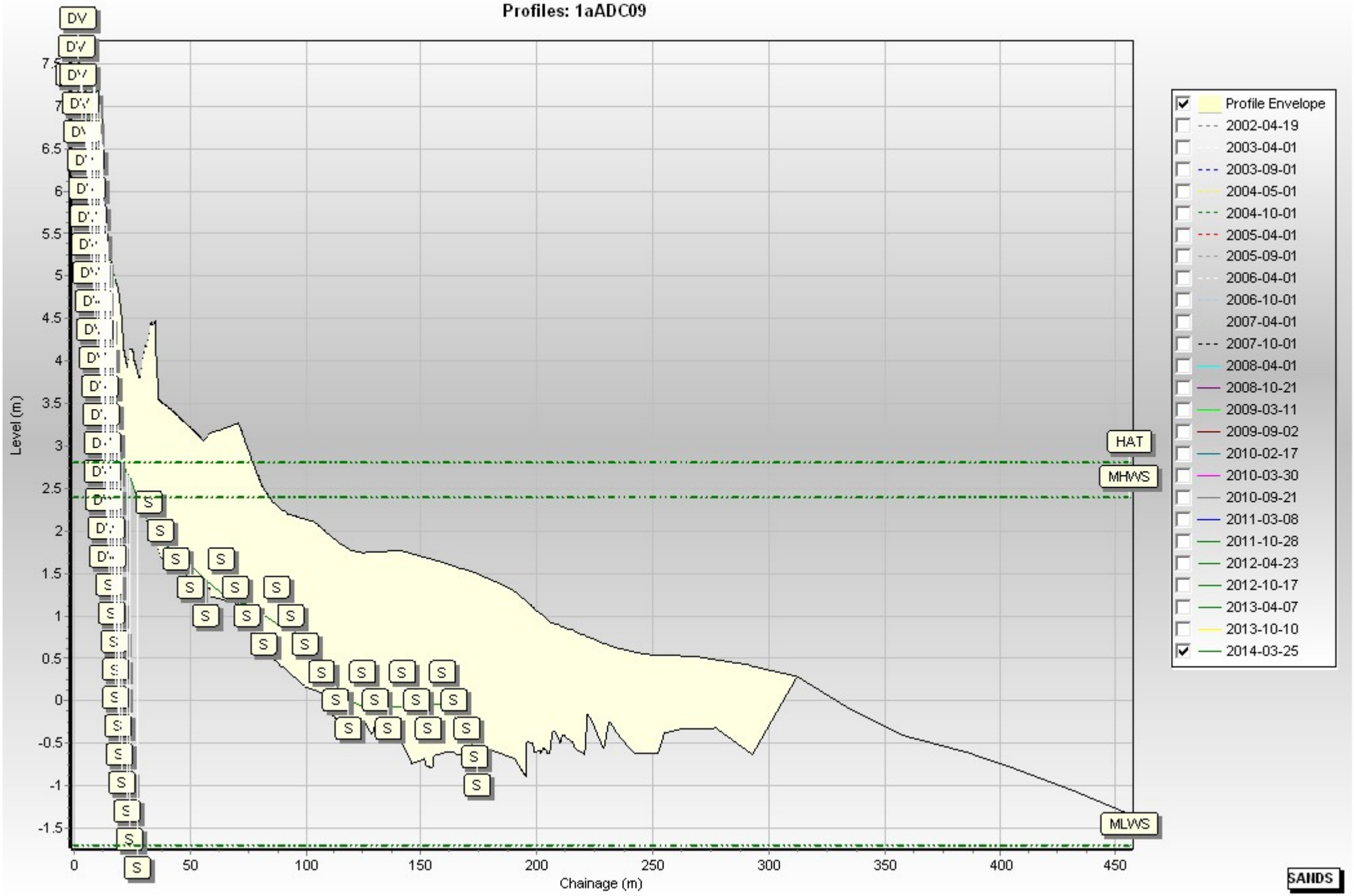
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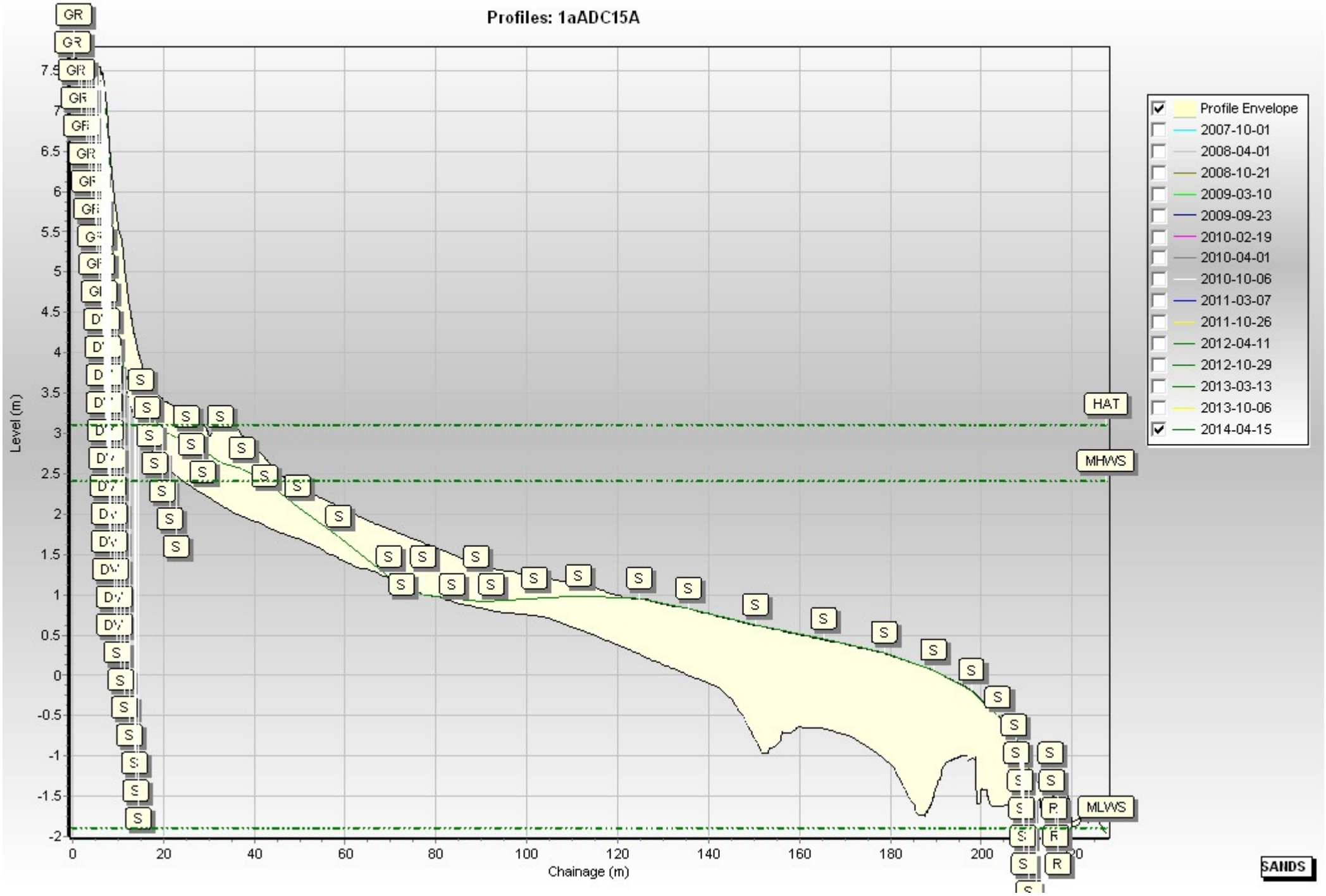
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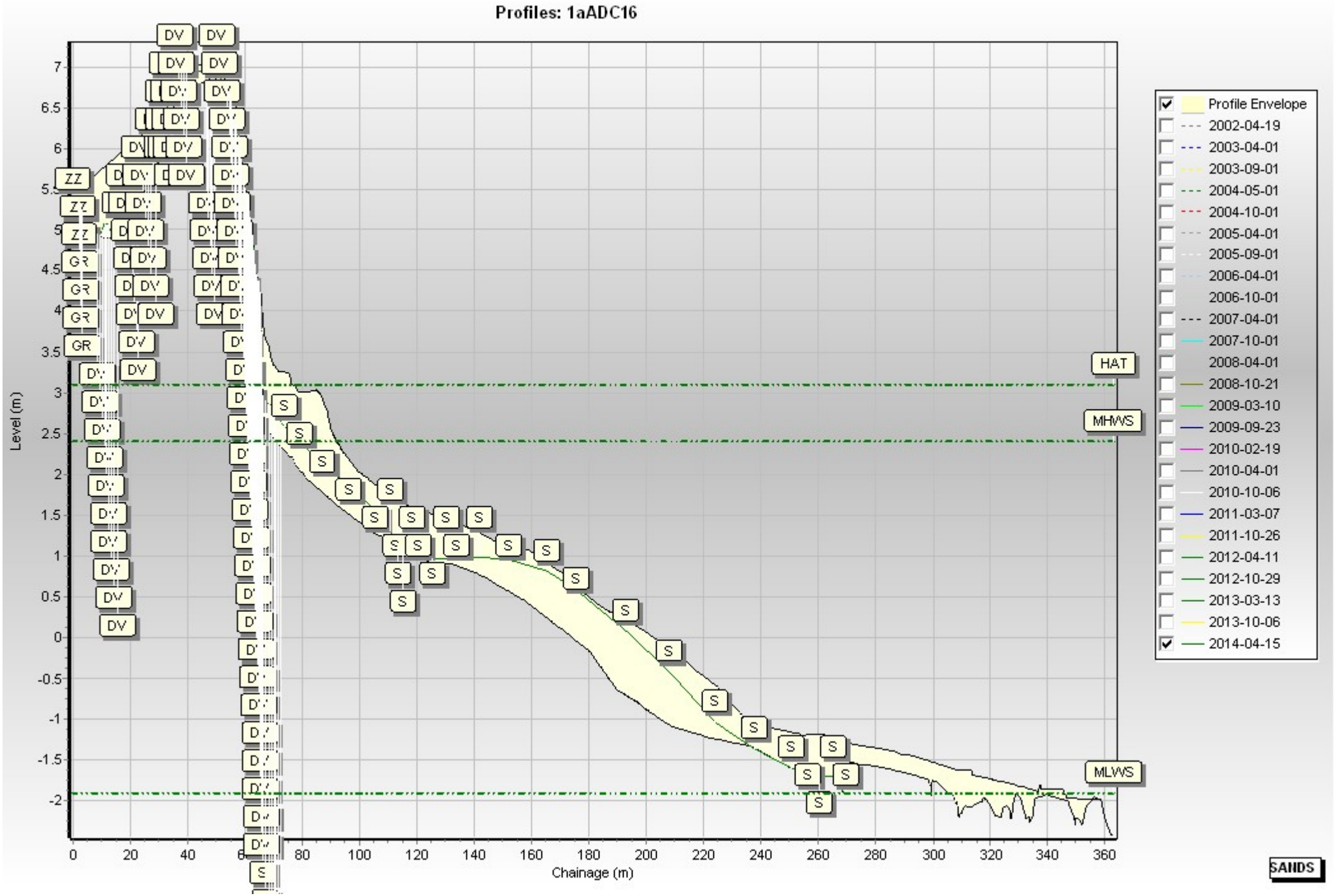
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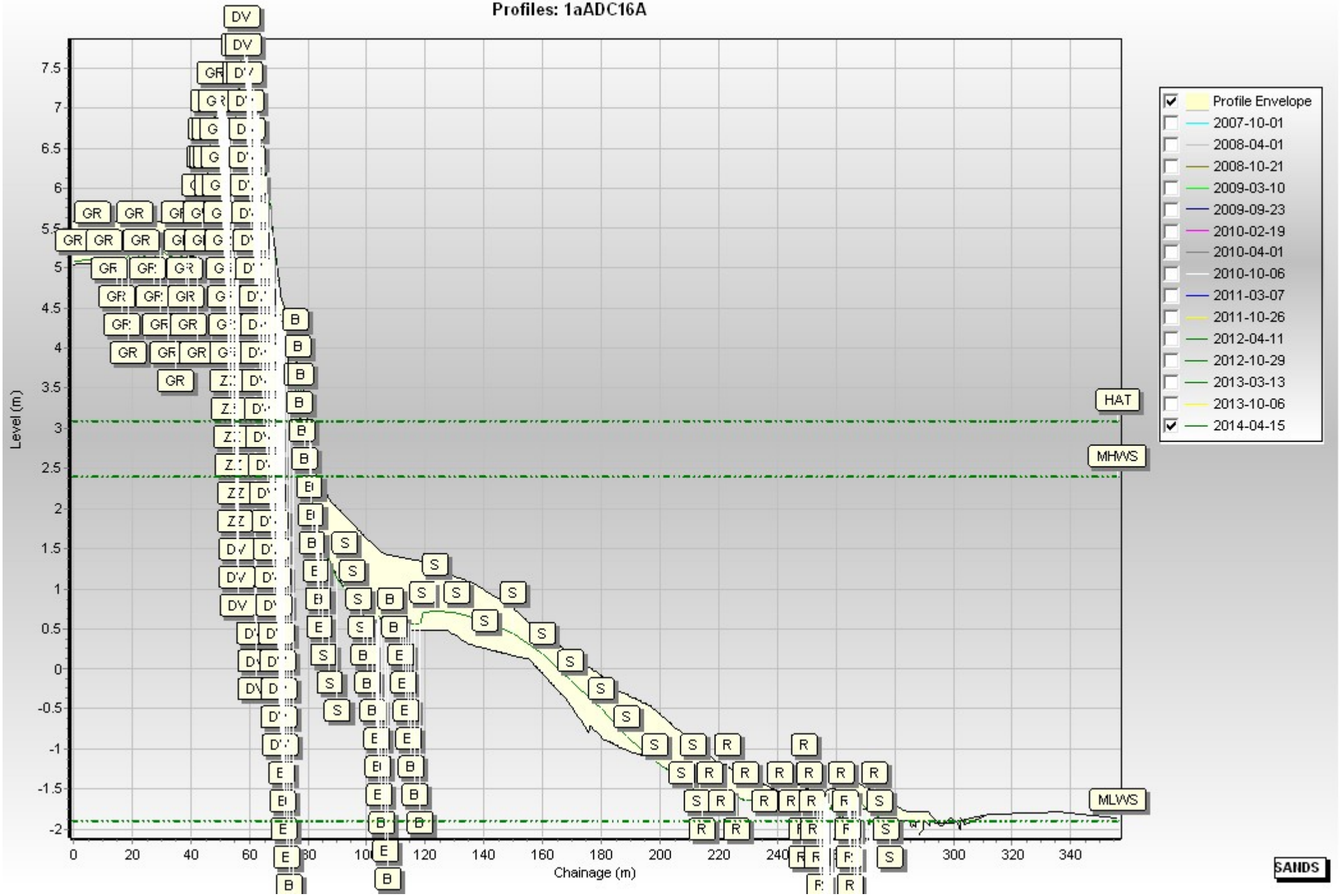
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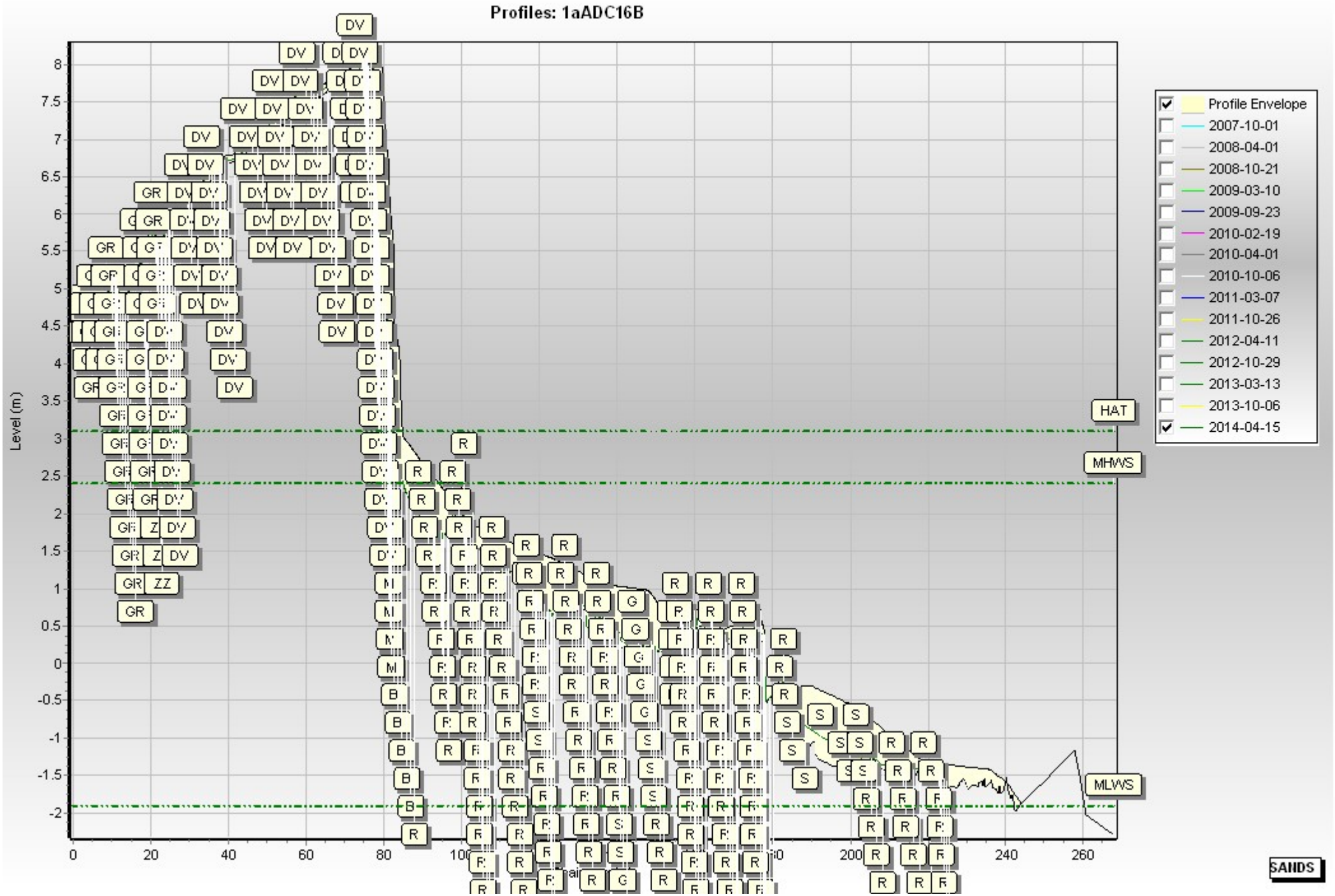
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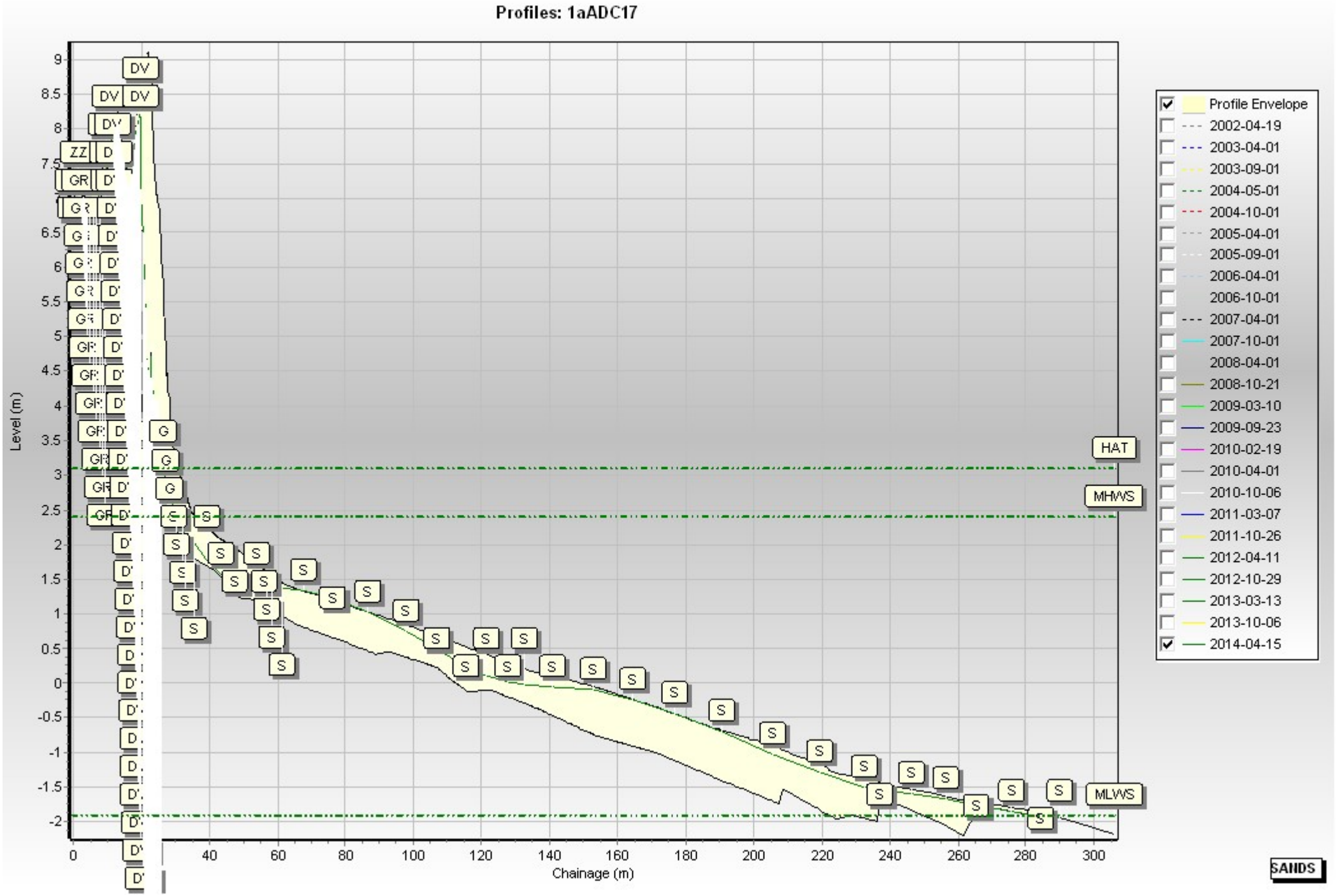
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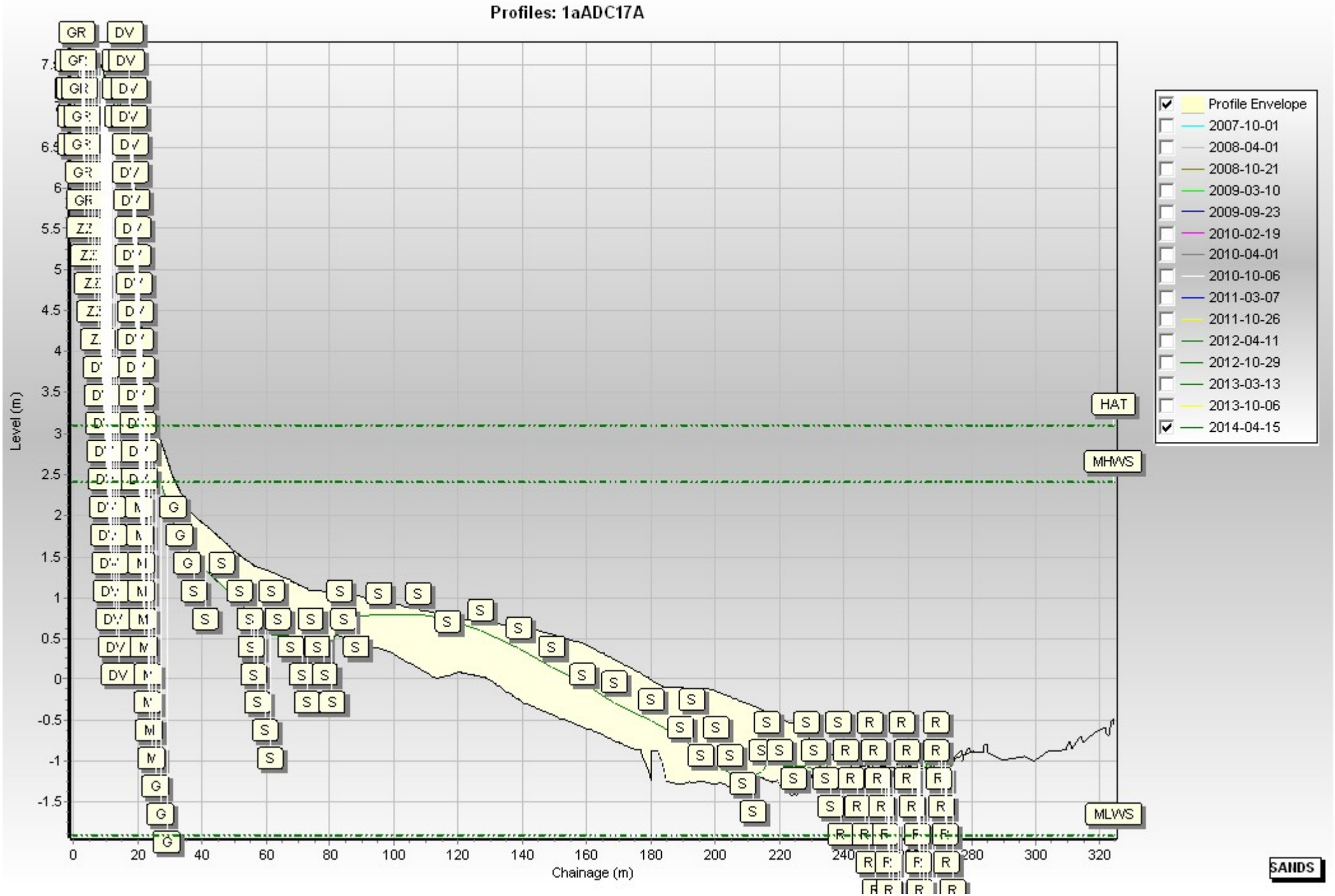
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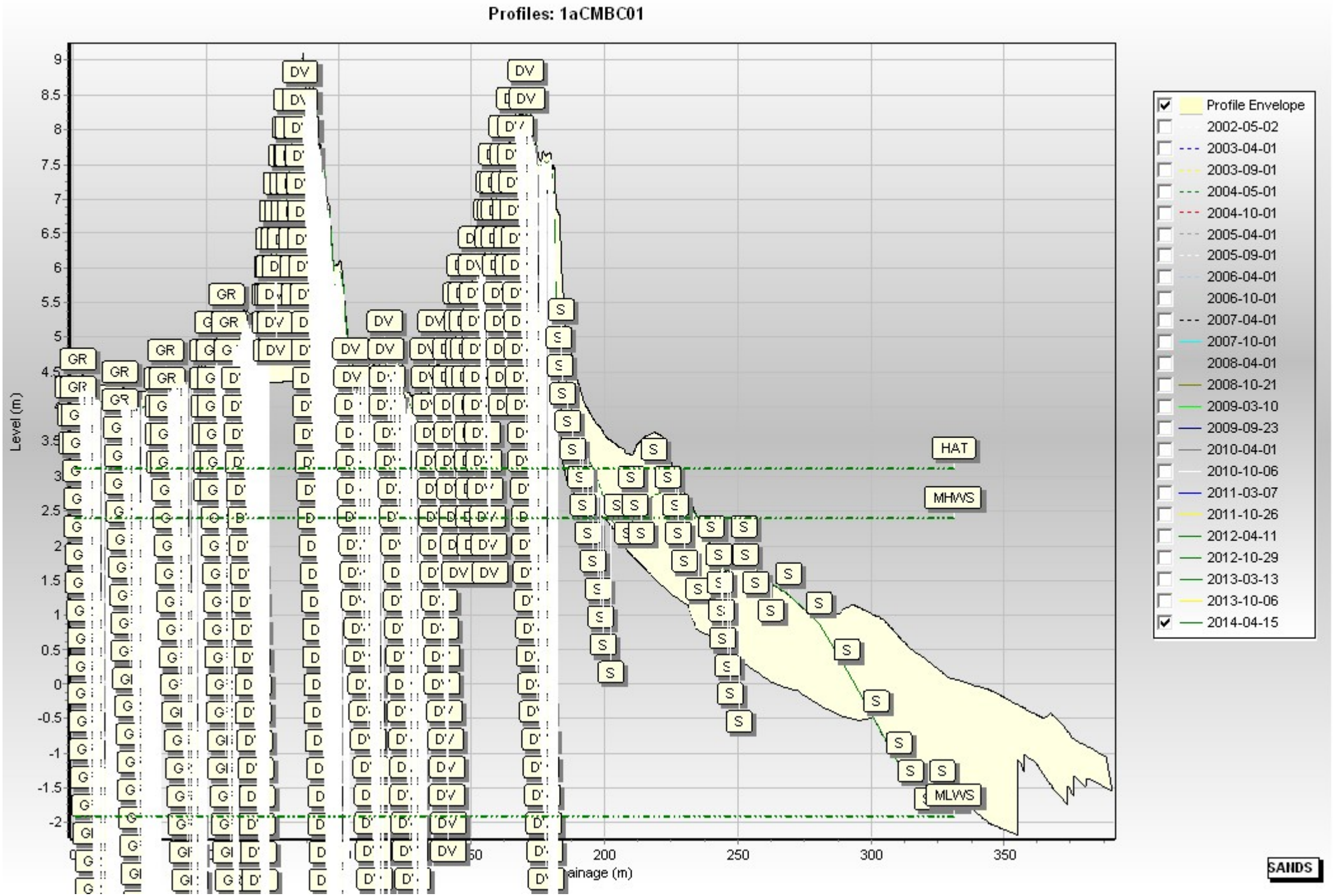
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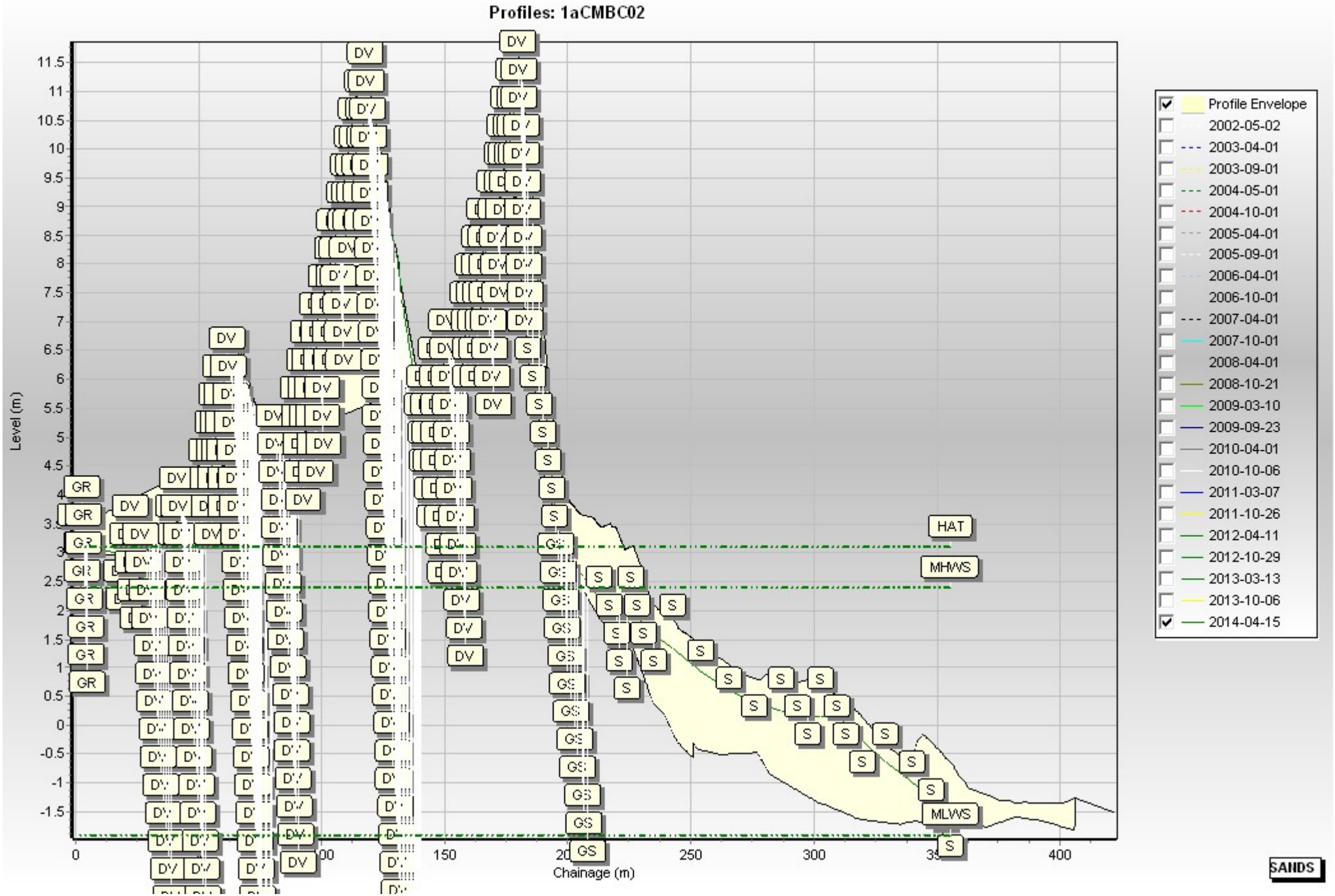
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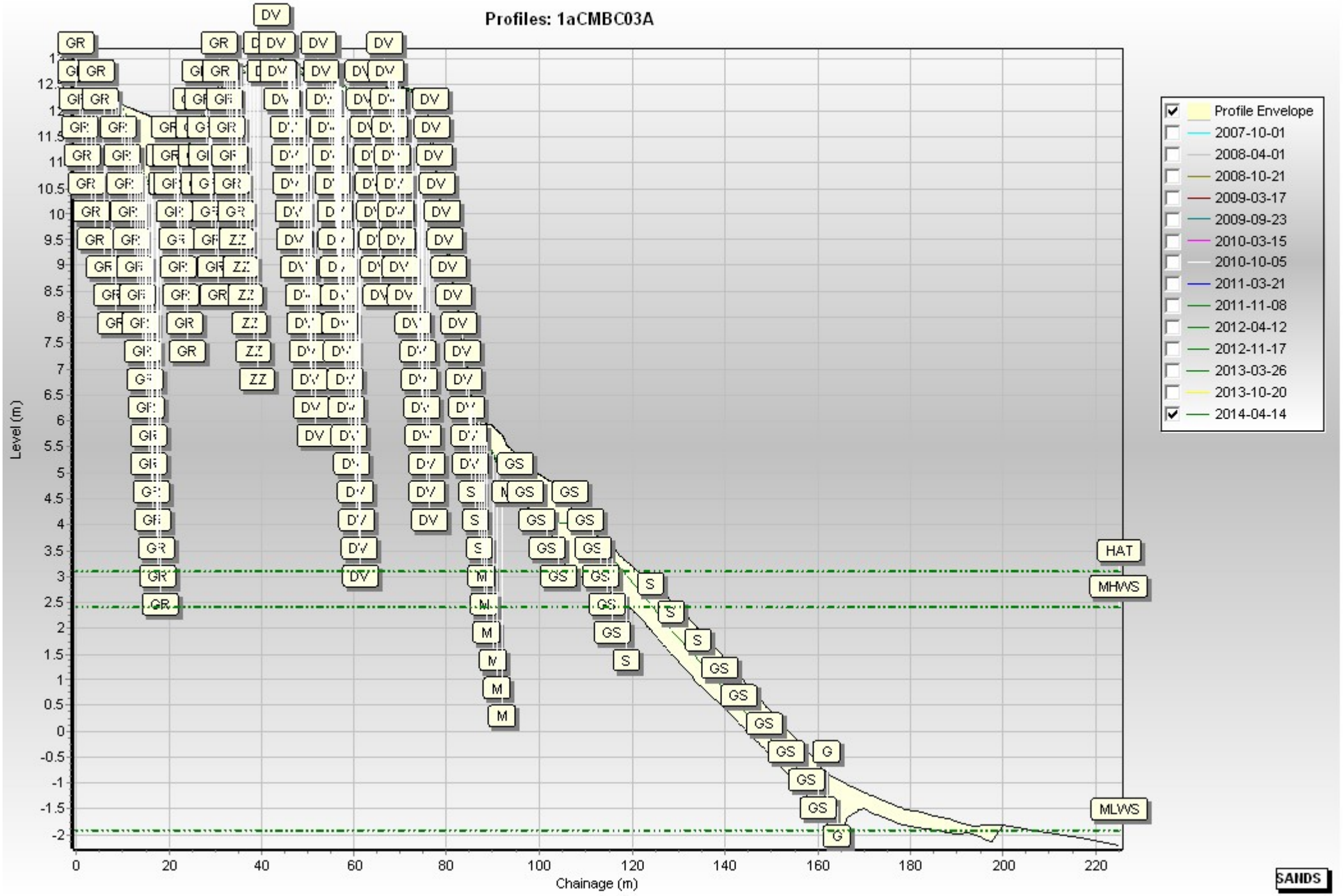
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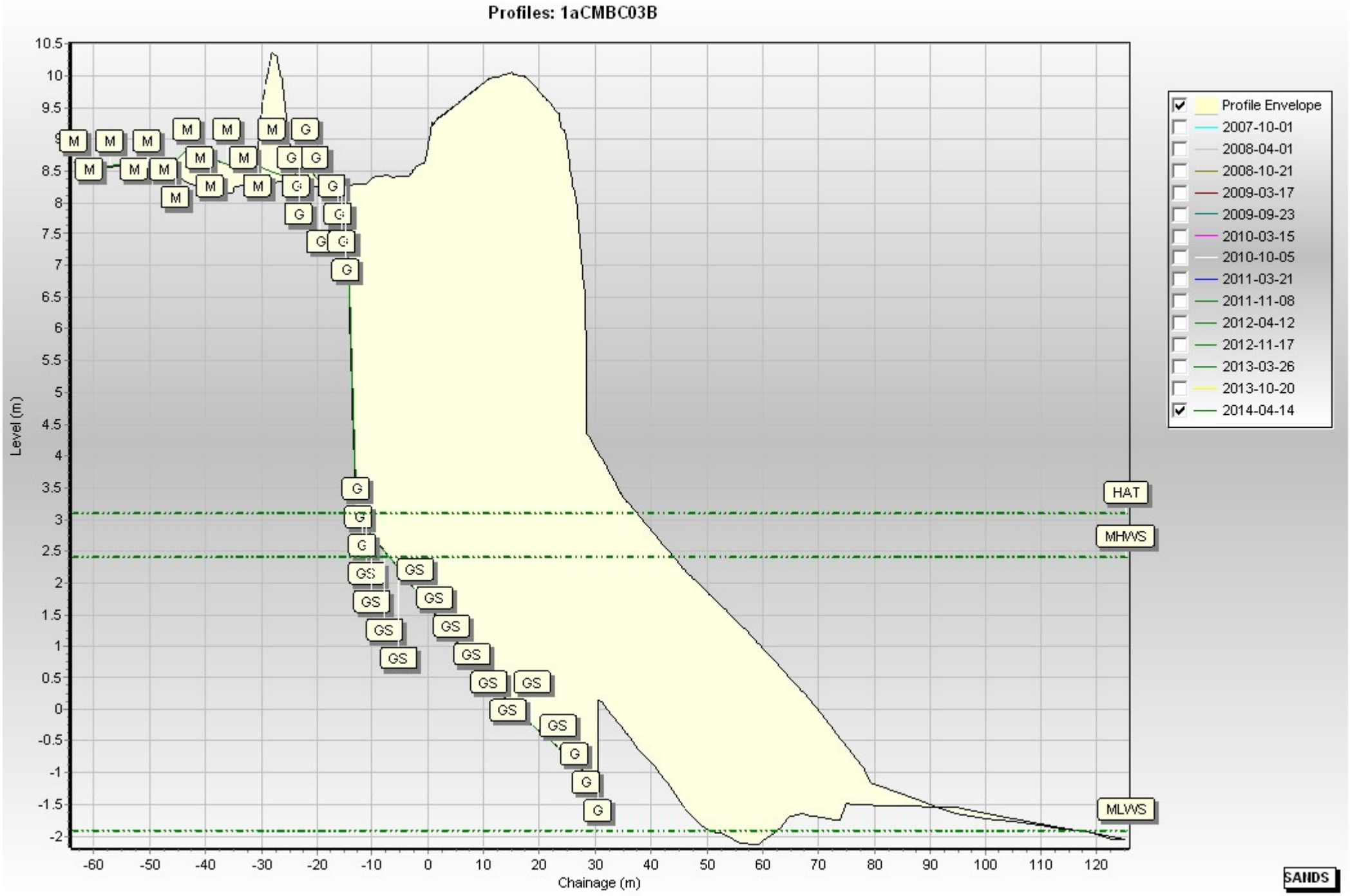
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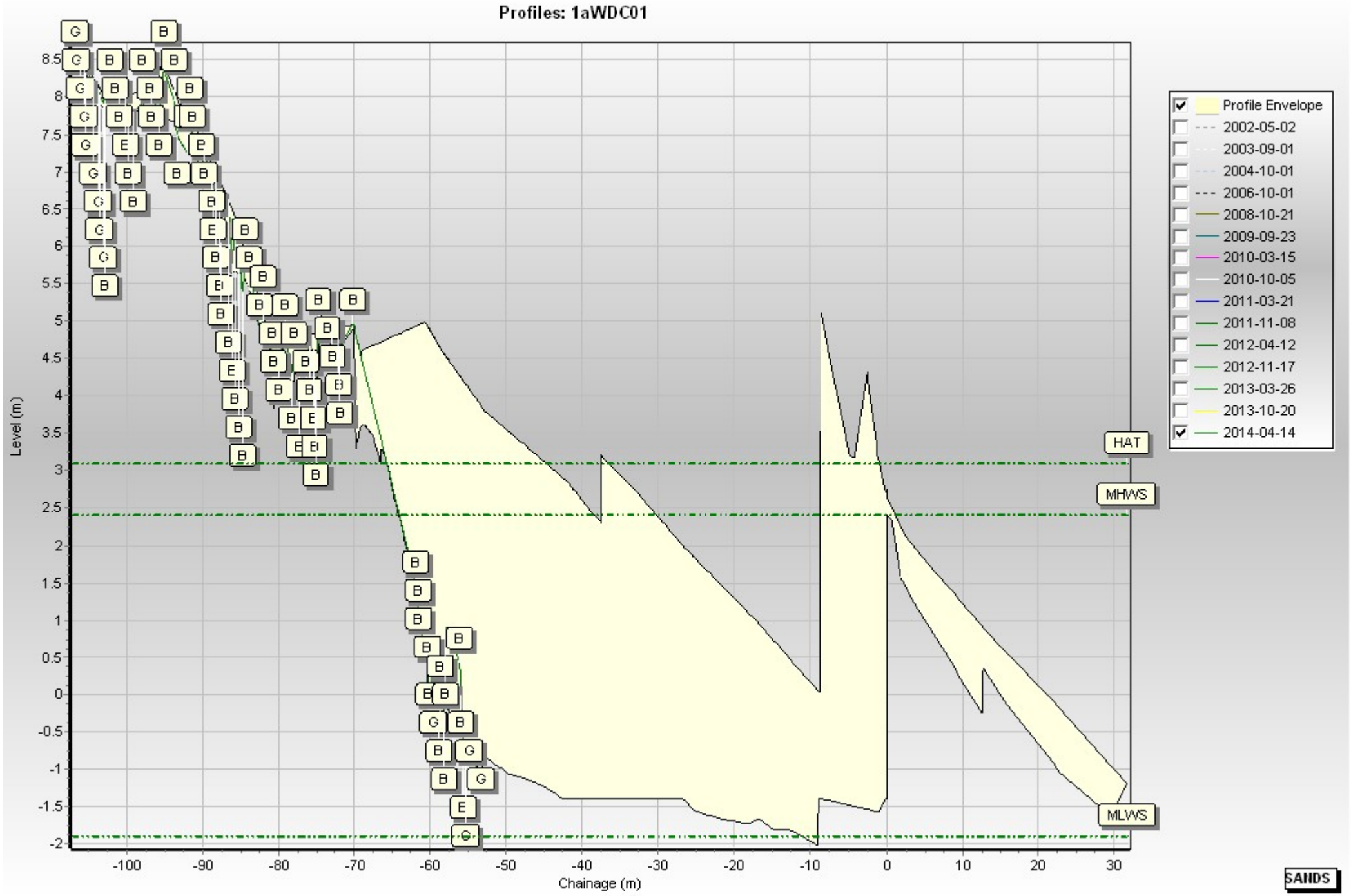
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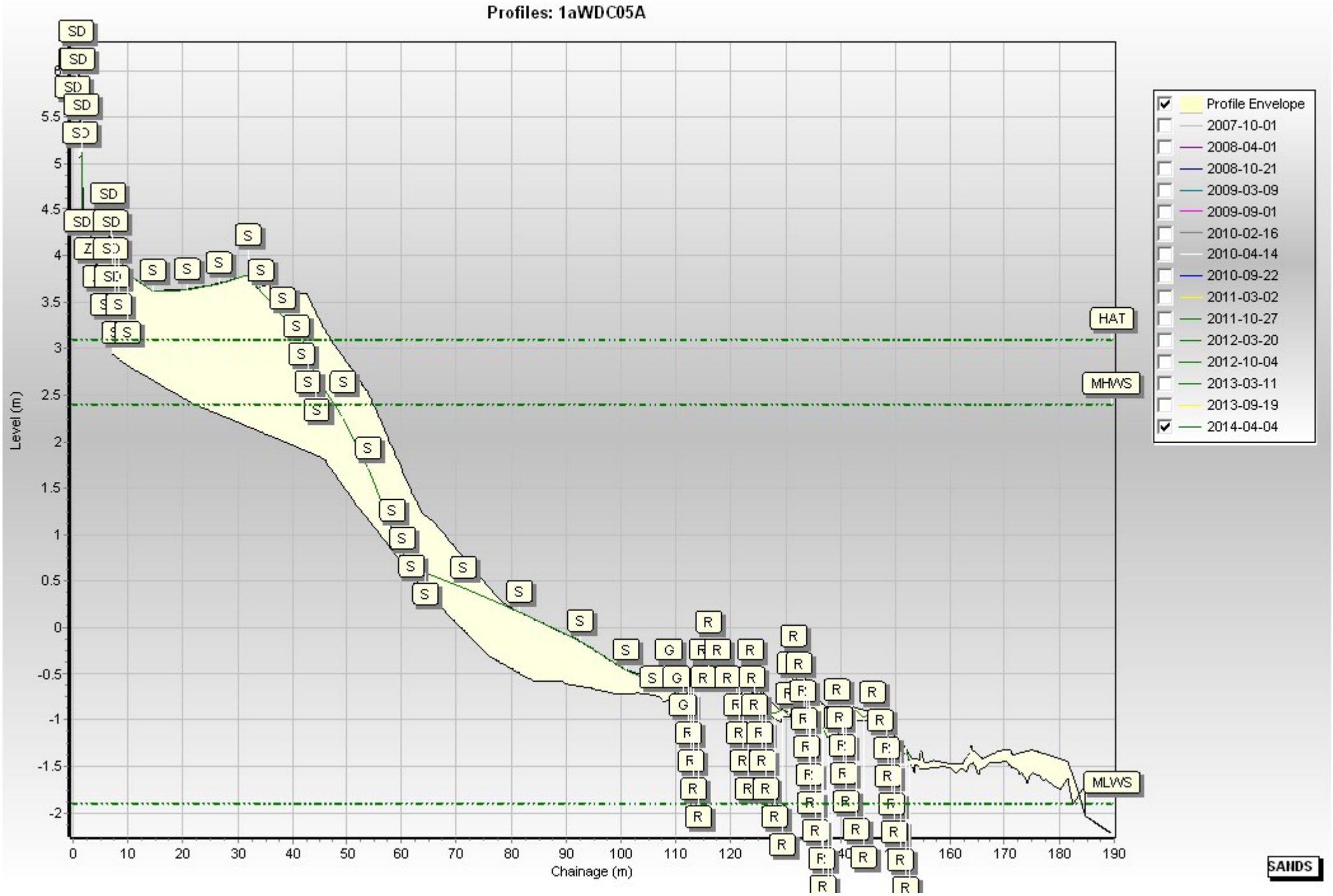
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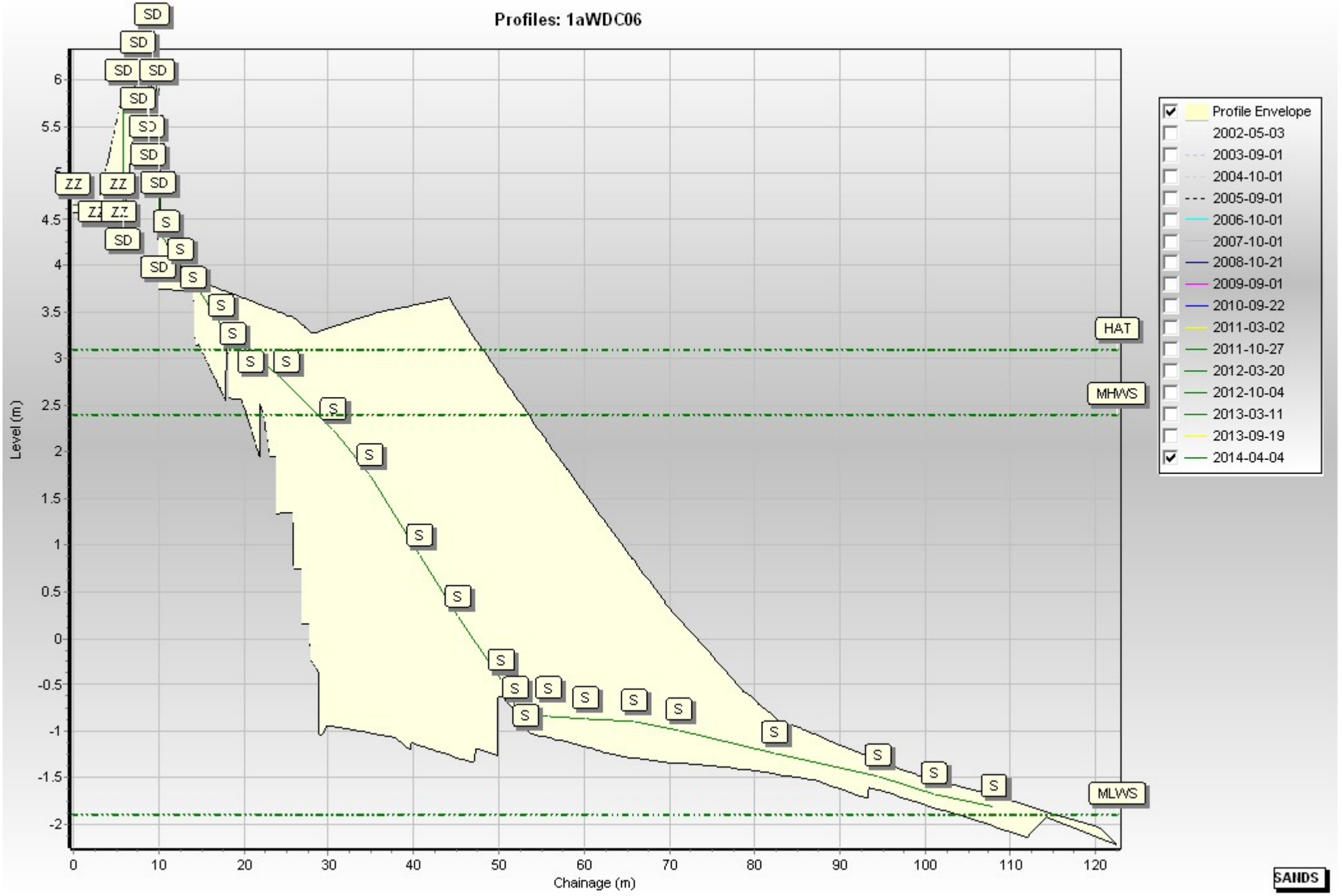
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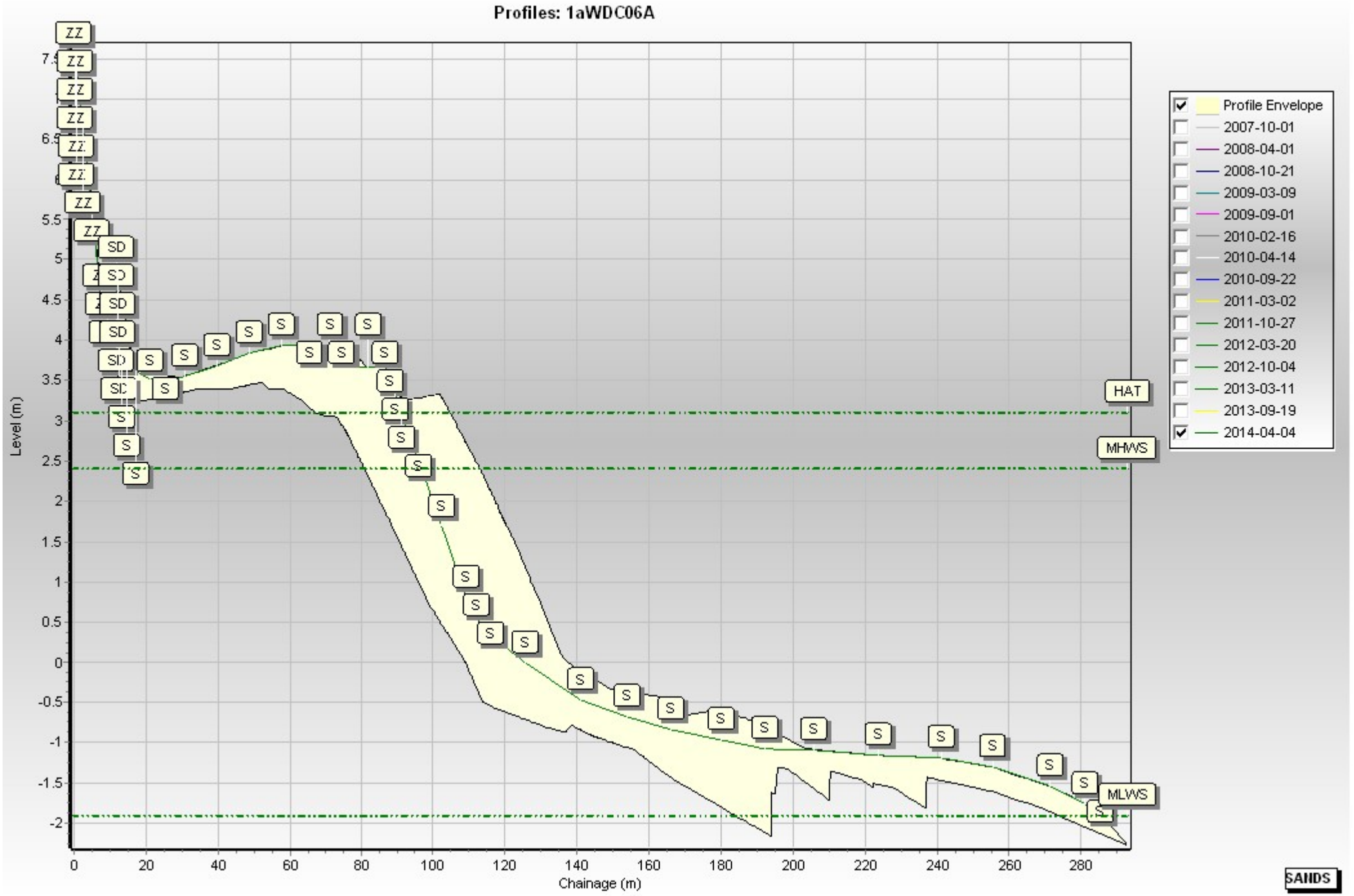
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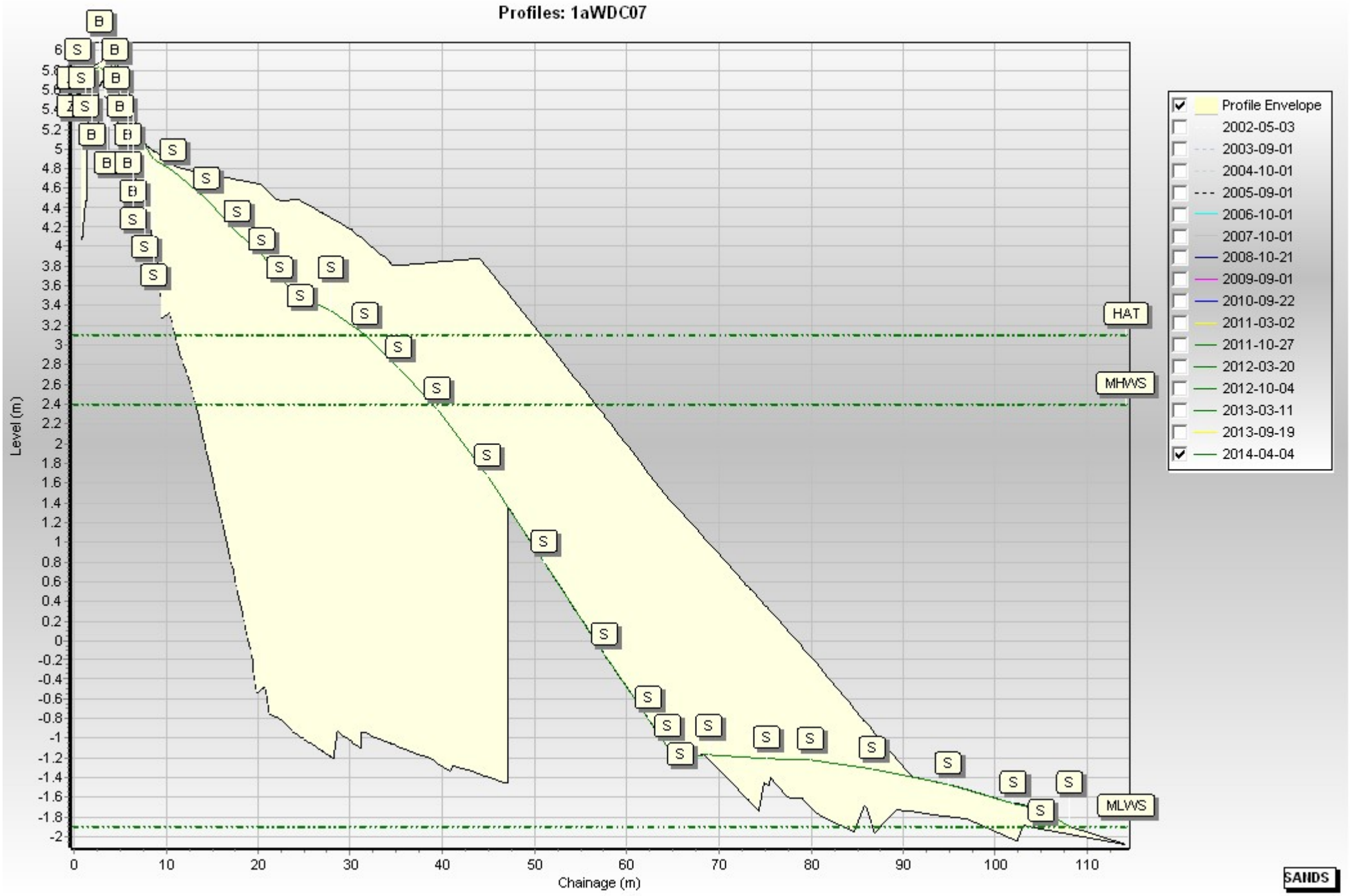
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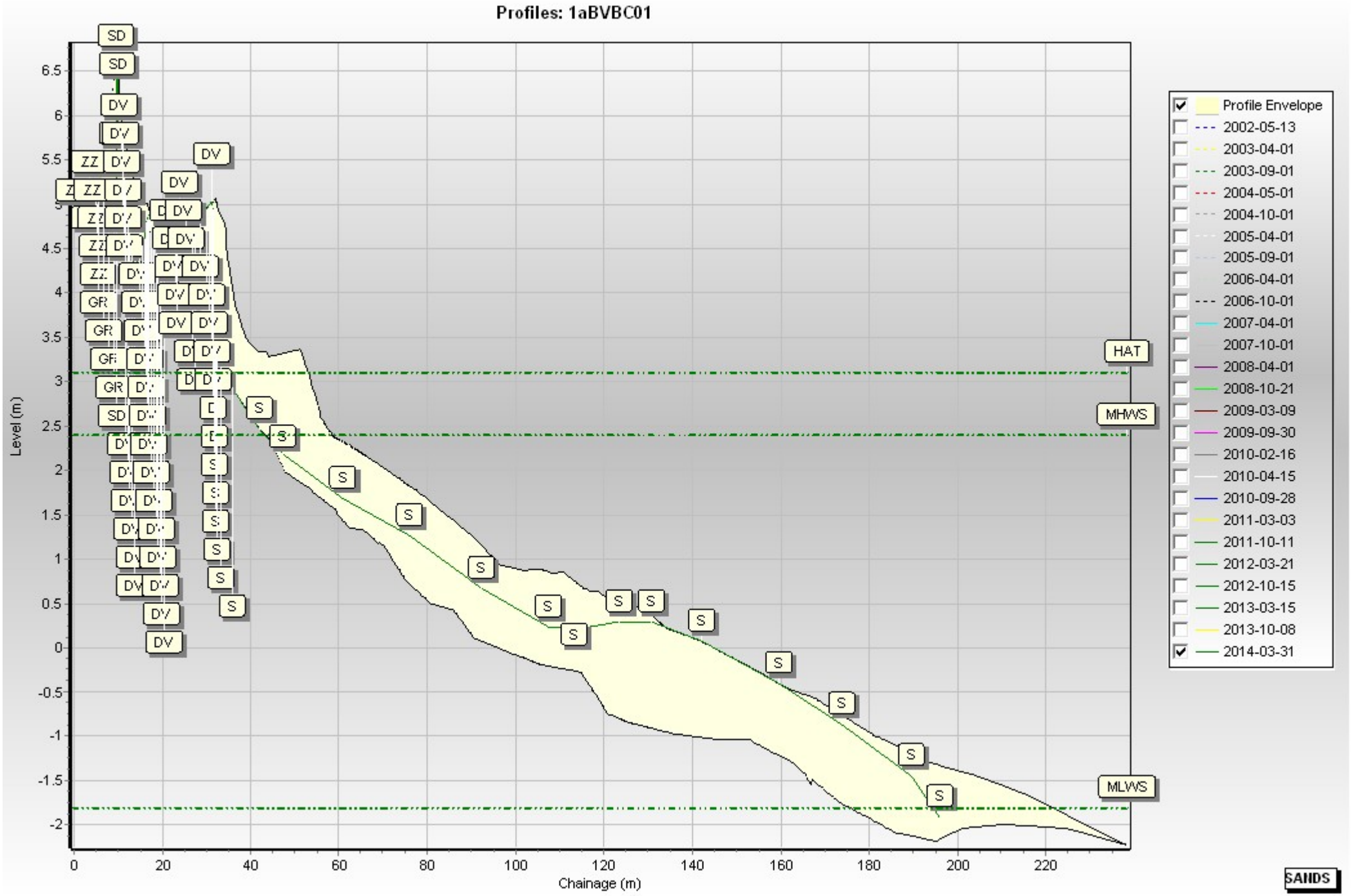
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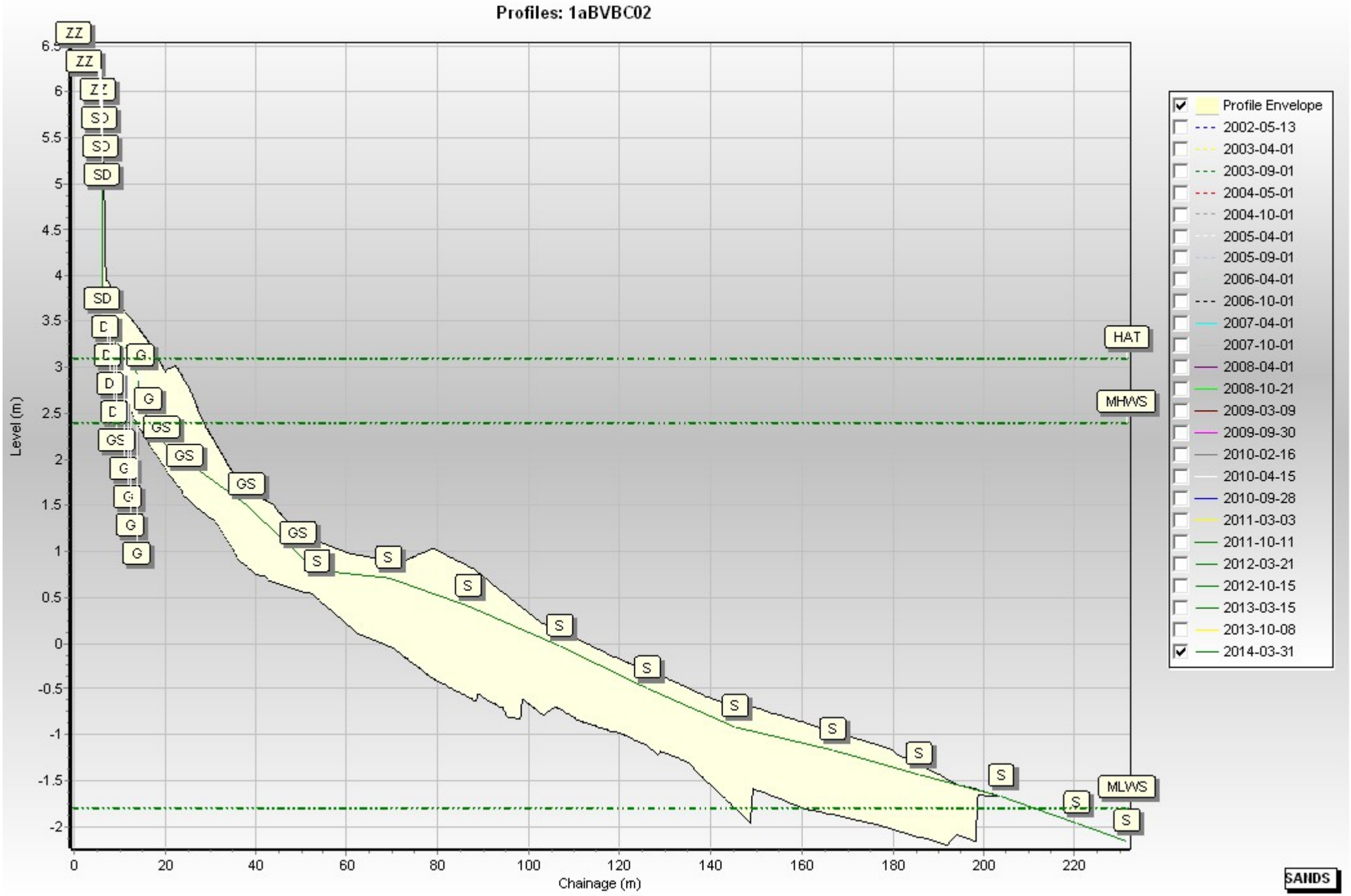
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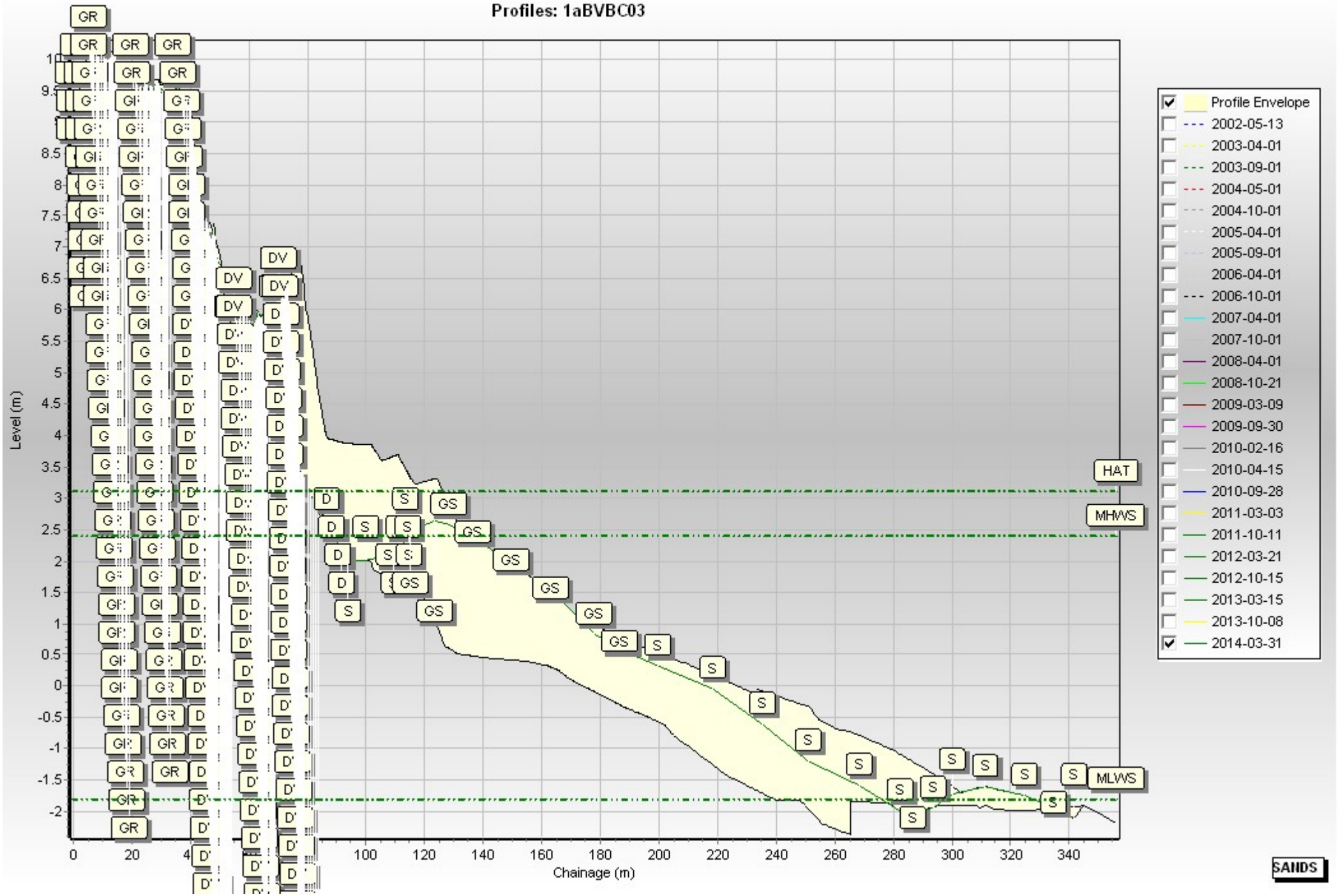
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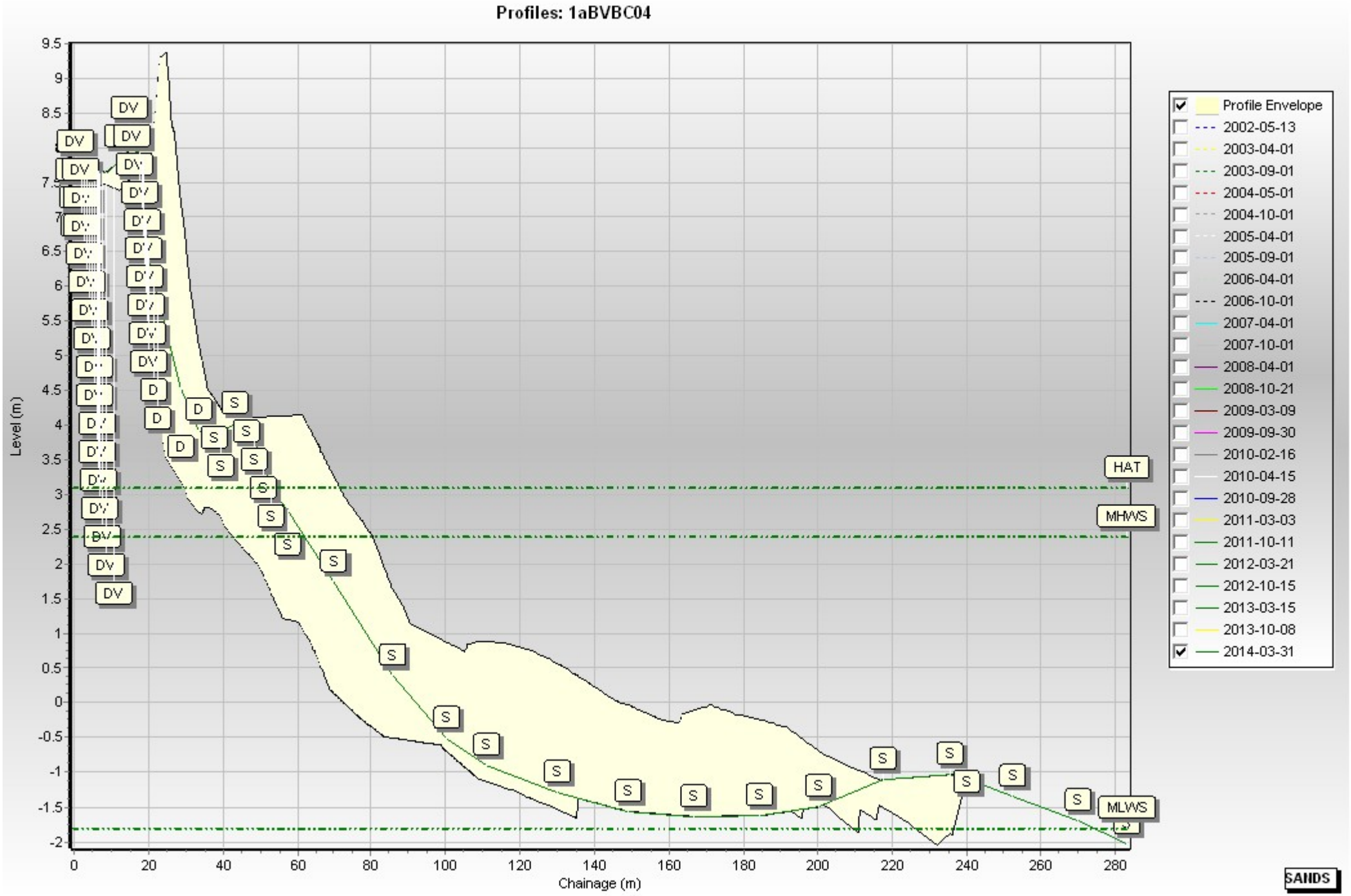
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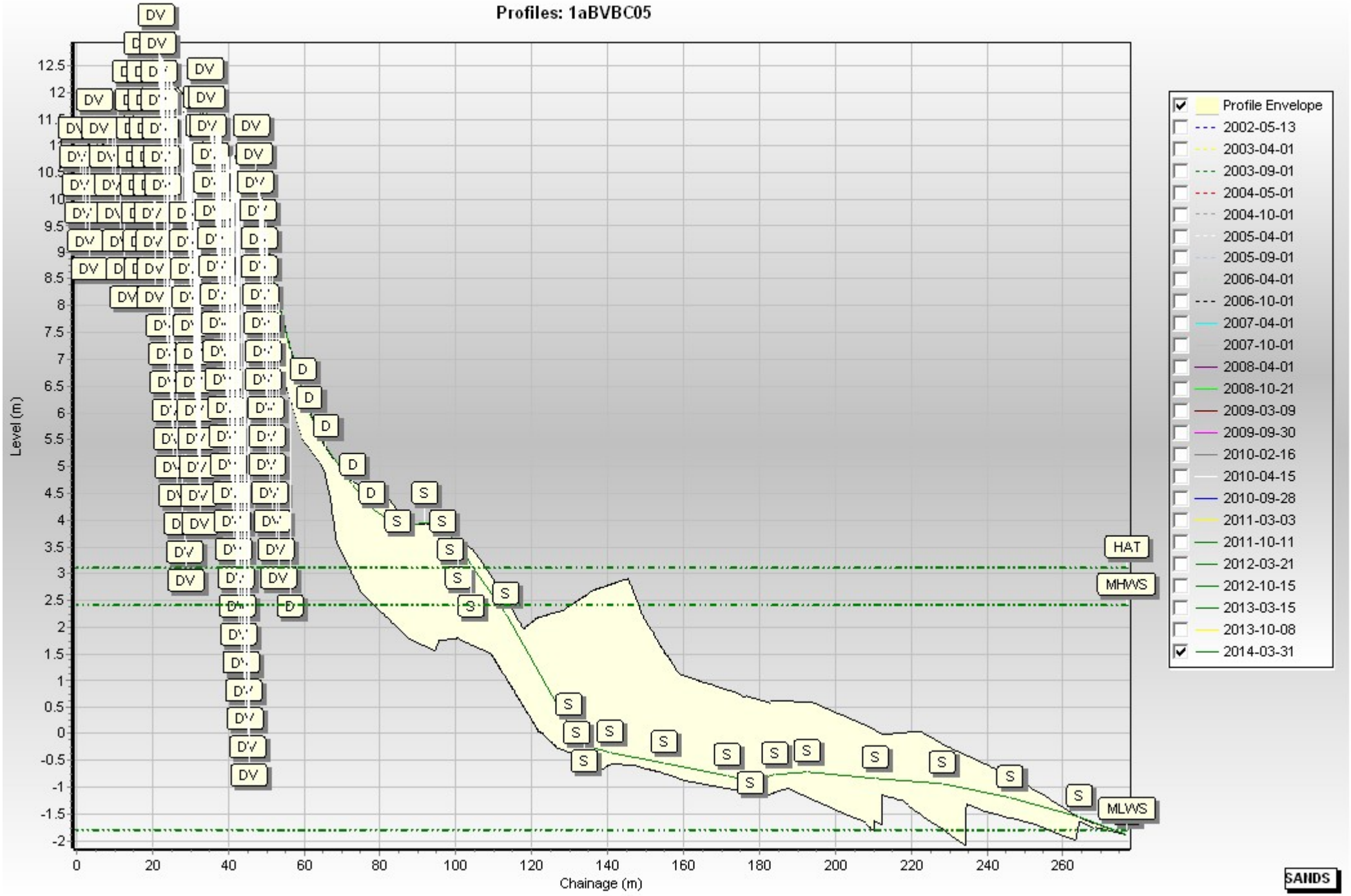
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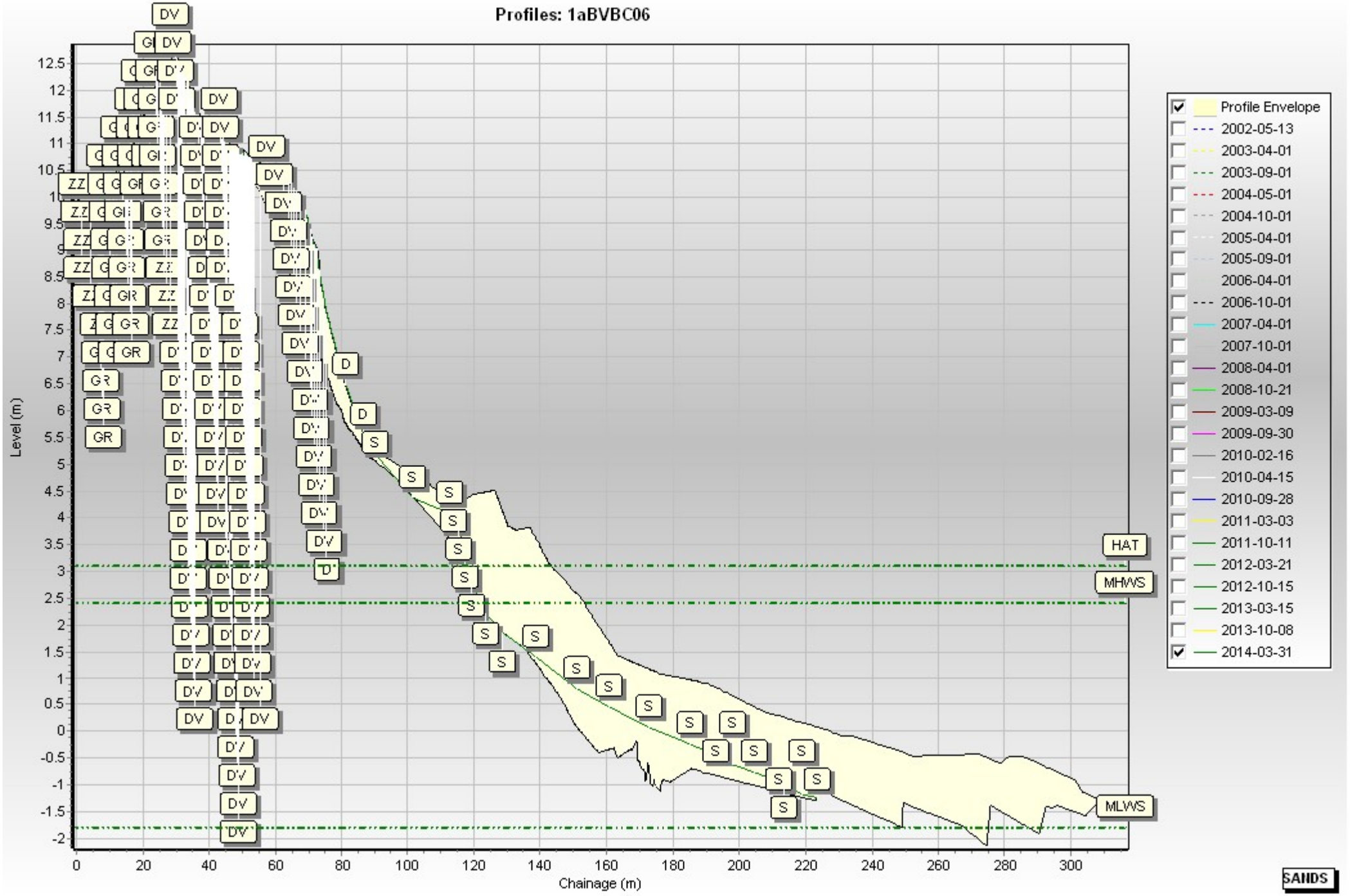
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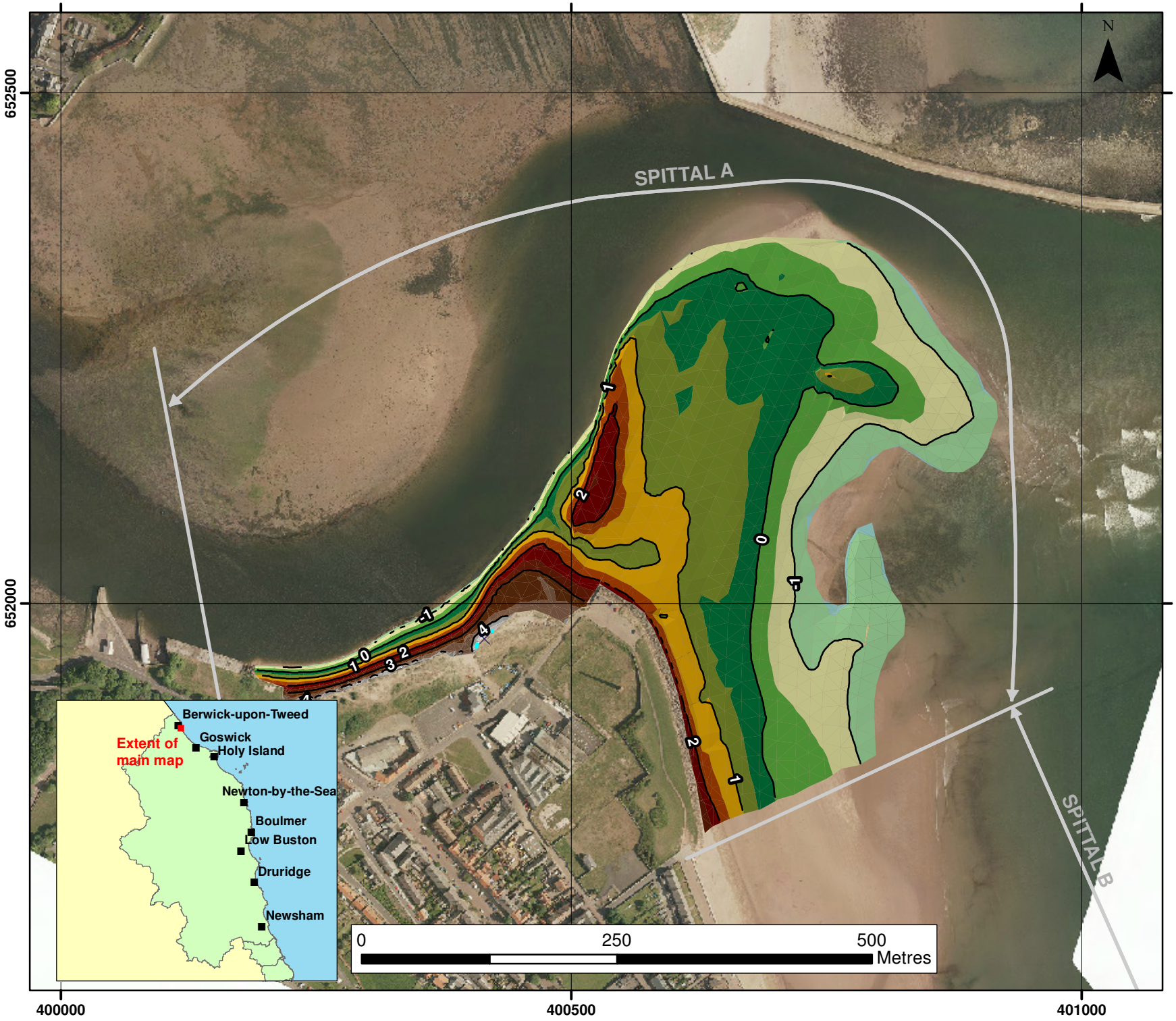
Appendix B

Topographic Survey



KEY

Elevation (m AOD)

- 5 - 5.5
- 4.5 - 5
- 4 - 4.5
- 3.5 - 4
- 3 - 3.5
- 2.5 - 3
- 2 - 2.5
- 1.5 - 2
- 1 - 1.5
- 0.5 - 1
- 0 - 0.5
- -0.5 - 0
- -1 - -0.5
- -1.5 - -1
- -2 -1.5
- 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 6
Partial Measures Survey
Spring 2014

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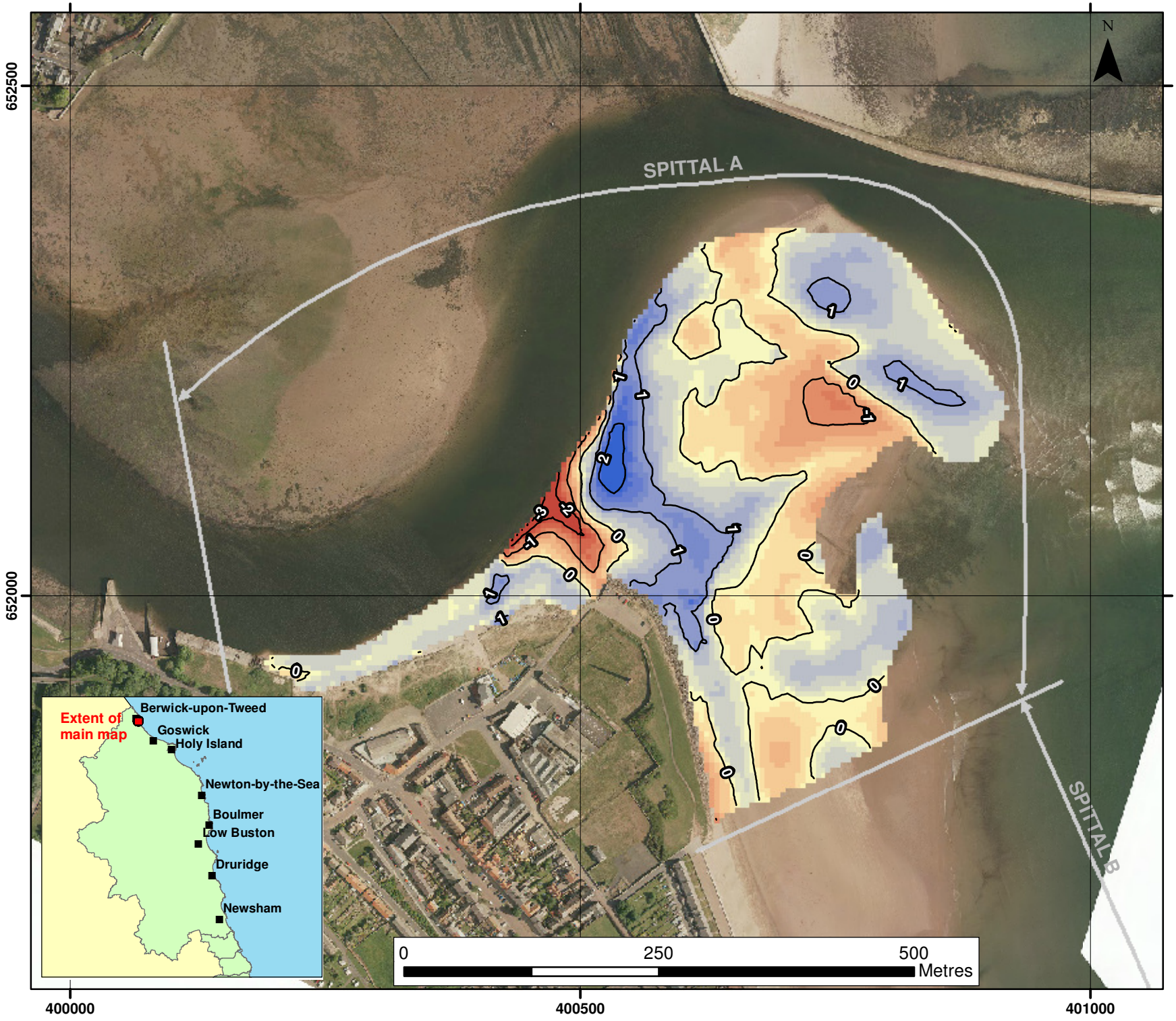
www.halcrow.com



KEY

Autumn 2013 and Spring 2014
Change in elevation (m)

<-2	Loss
-2 - -1.75	
-1.75 - -1.5	
-1.5- -1.25	
-1.25 - -1	
-1 - -0.75	
-0.75 - -0.5	
-0.5 - -0.25	
-0.25 - -0.1	
-0.1 - 0	Change < 0.1 m
0 - 0.1	
0.1 - 0.25	Gain
0.25 - 0.5	
0.5 - 0.75	
0.75 - 1	
1 - 1.25	
1.25 - 1.5	
1.5 - 1.75	
1.75 - 2	
>2	

Contours of change

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

Appendix B - Map 1b
Short-term Elevation Change
Berwick
Northumberland County Council

Update Report 6
Partial Measures Survey
Spring 2014

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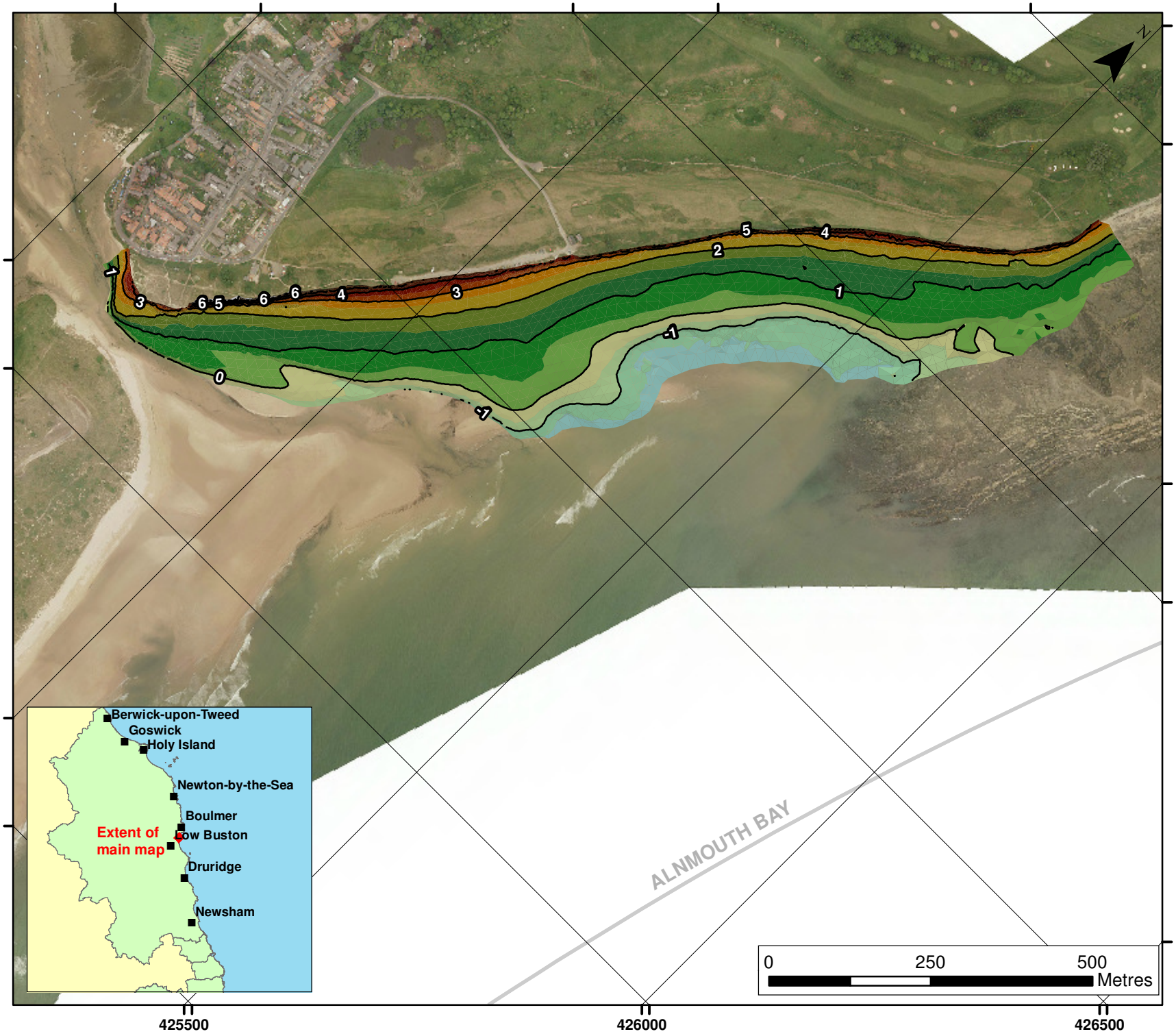
Photography courtesy of North East Coastal Observatory
www.northeastcoastalobservatory.org.uk



KEY

Elevation (m AOD)

- 8 - 8.5
- 7.5 - 8
- 7 - 7.5
- 6.5 - 7
- 6 - 6.5
- 5.5 - 6
- 5 - 5.5
- 4.5 - 5
- 4 - 4.5
- 3.5 - 4
- 3 - 3.5
- 2.5 - 3
- 2 - 2.5
- 1.5 - 2
- 1 - 1.5
- 0.5 - 1
- 0 - 0.5
- -0.5 - 0
- -1 - -0.5
- -1.5 - -1
- -2.0 - -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 6
Partial Measures Survey
Spring 2013

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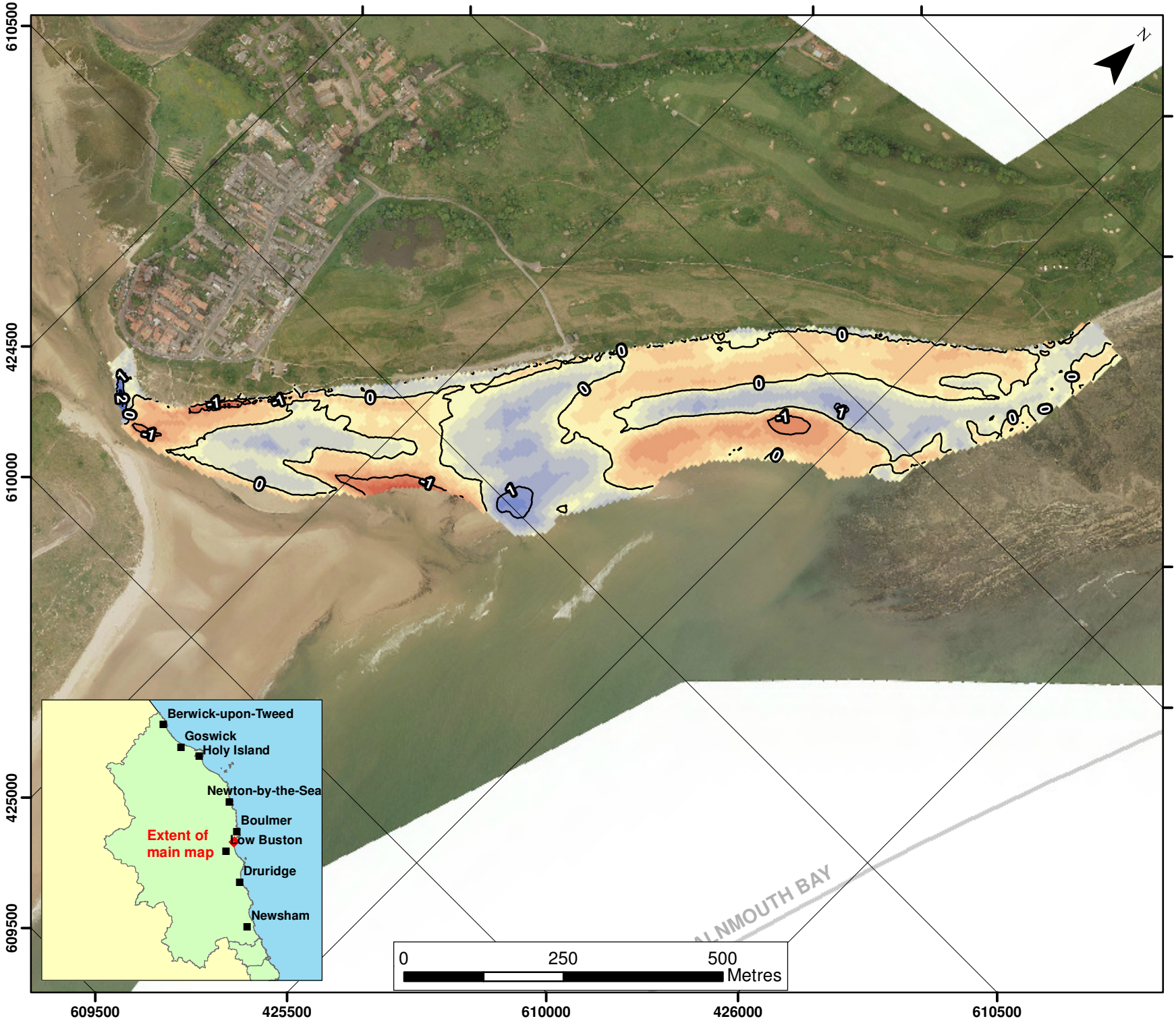

KEY Autumn 2013 and Spring 2014
Change in elevation (m)

- <-2
- -2 - -1.75
- -1.75 - -1.5
- -1.5- -1.25
- -1.25 - -1
- -1 - -0.75
- -0.75 - -0.5
- -0.5 - -0.25
- -0.25 - -0.1
- -0.1 - 0
- 0 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 1.25
- 1.25 - 1.5
- 1.5 - 1.75
- 1.75 - 2
- >2

Loss
Change < 0.1 m
Gain

Contours of change

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

Appendix B- Map 2b
Short-term Elevation Change
Alnmouth
Northumberland County Council

Update Report 6
Partial Measures Survey
Spring 2014

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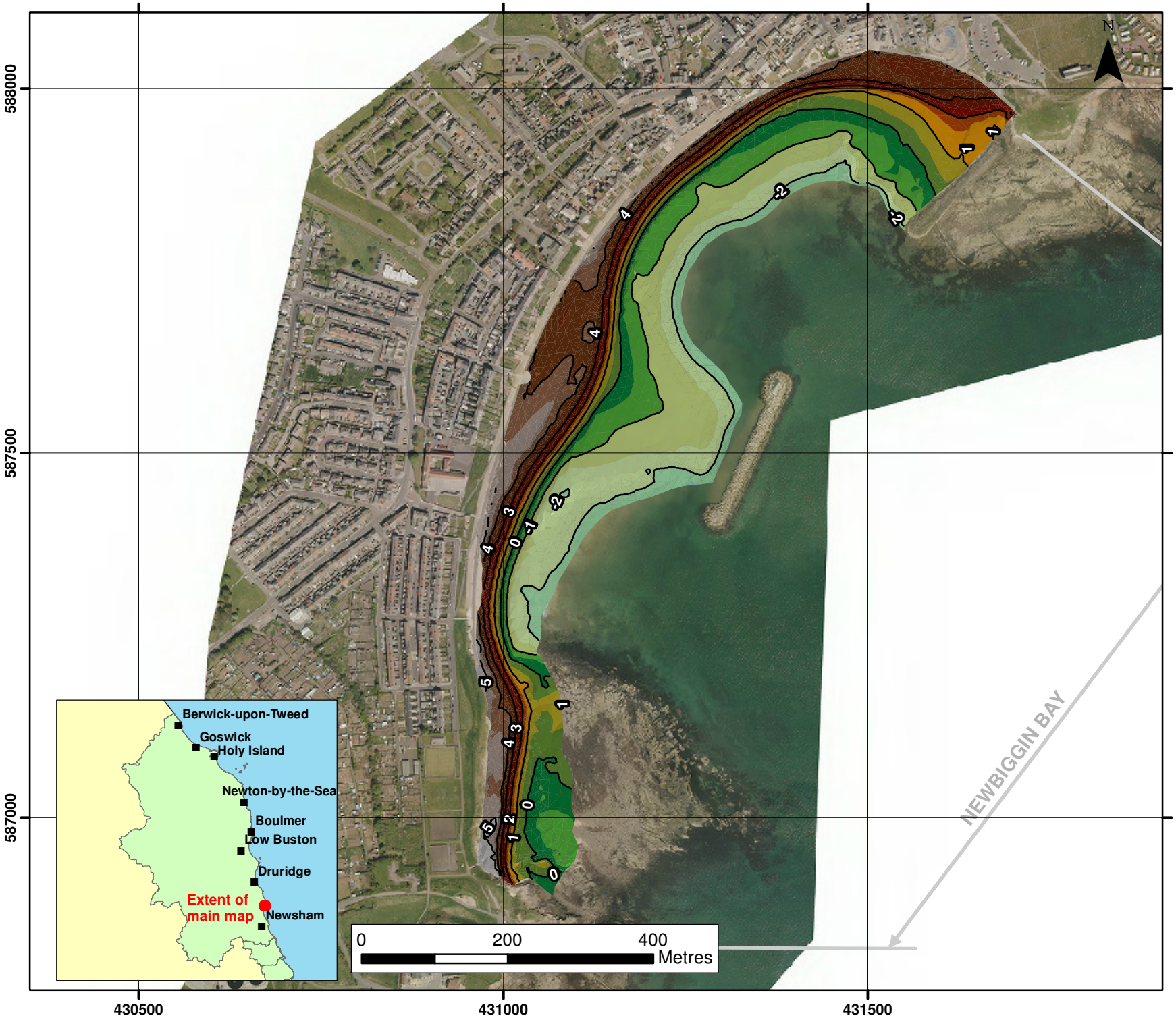

KEY
Elevation (m OD)

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

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 6
Partial Measures Survey
Spring 2013

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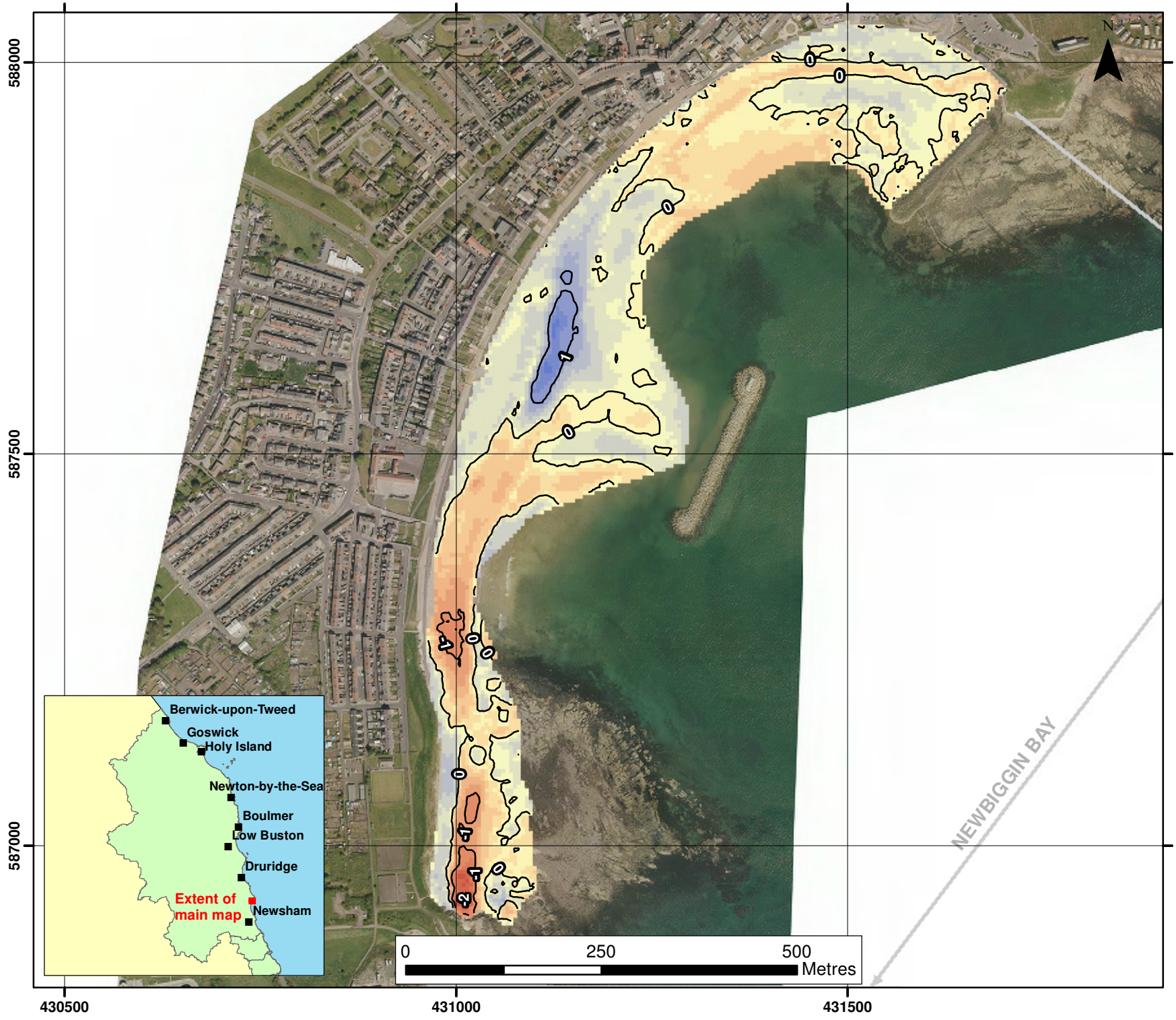

KEY Autumn 2013 and Spring 2014 Change in elevation (m)

<-2	Loss
-2 - -1.75	
-1.75 - -1.5	
-1.5- -1.25	
-1.25 - -1	
-1 - -0.75	
-0.75 - -0.5	
-0.5 - -0.25	
-0.25 - -0.1	
-0.1 - 0	Change < 0.1 m
0 - 0.1	
0.1 - 0.25	Gain
0.25 - 0.5	
0.5 - 0.75	
0.75 - 1	
1 - 1.25	
1.25 - 1.5	
1.5 - 1.75	
1.75 - 2	
>2	

Contours of change

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

Appendix B Map 3b
Short-term Elevation Change
Newbiggin
Northumberland County Council

Update Report 6
Partial Measures Survey
Spring 2014

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Appendix C

Cliff Top Survey

Cliff Top Survey

Lynemouth Bay

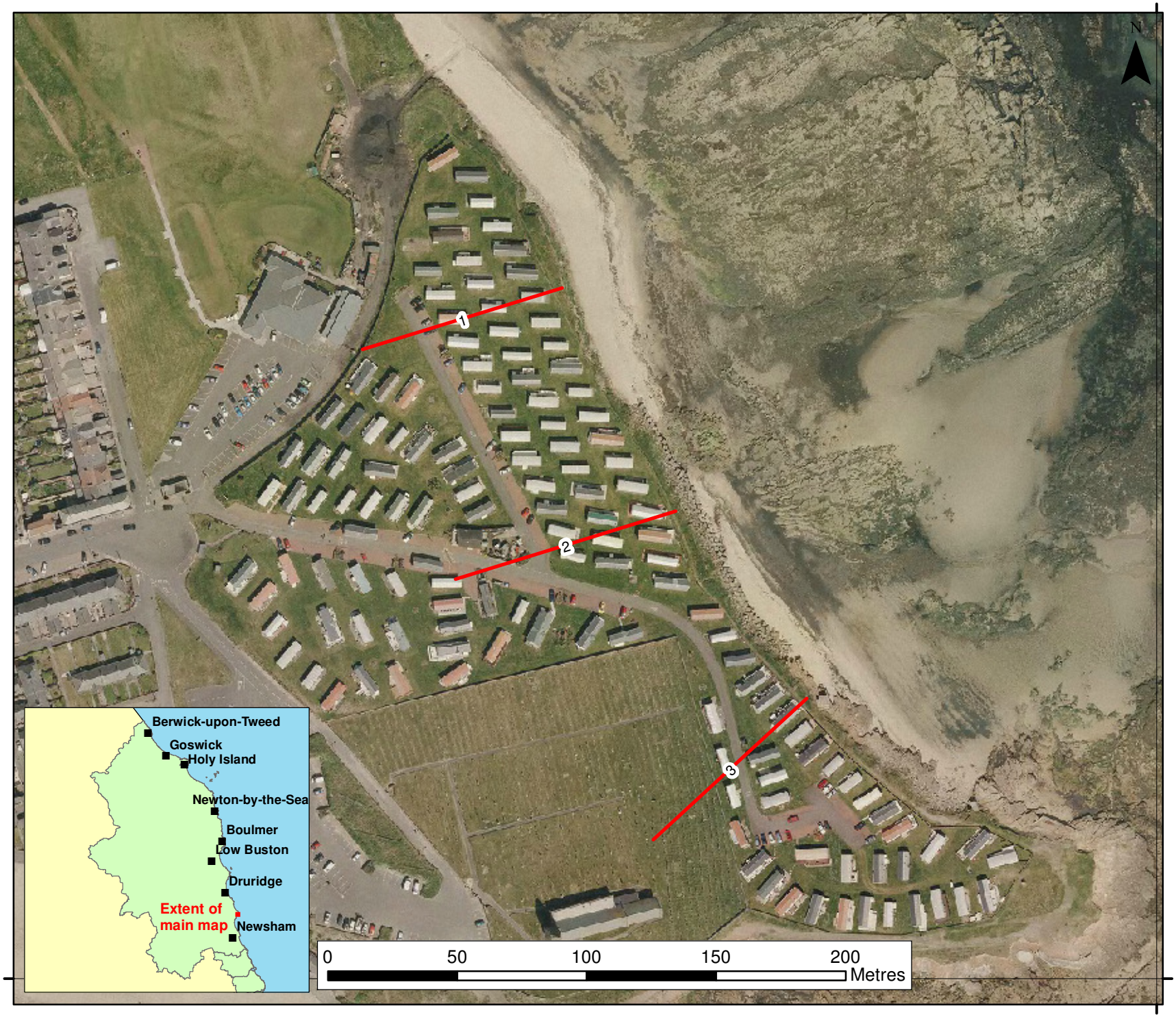
Three ground control points have been established at Lynemouth Bay (Map 1). The maximum separation between any two points varies along the coast, reflecting the erosion risk.

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 (Oct 2012)	Present Survey (April 2014)	Baseline (Oct 2008) to Present (April 2014)	Previous (Oct 2012) to Present (April 2014)	Baseline (Oct 2008) to Present (April 2014)
1	Cliff	80.62	80.0	79.8	-0.8	-0.3	-0.2
2	Defended	88.88	88.9	88.7	-0.2	-0.2	0.0
3	Cliff	80.23	80.5	80.5	0.3	0.0	0.0



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
County Council

Update Report 6
Partial Measures Survey
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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 (Oct 2013)	Present Survey (April 2014)	Baseline (Oct 2008) to Present (April 2014)	Previous (Oct 2012) to Present (April 2014)	Baseline (Oct 2008) to Present (April 2014)
1	Cliff	125.47	125.2	125.3	-0.2	0.2	0.0
2	Defended	146.01	145.9	145.9	-0.1	0.0	0.0
3	Defended	116.4	116.7	116.8	0.4	0.1	0.1
4	Cliff	114.44	114.9	114.6	0.2	-0.3	0.0
5	Cliff	110.04	107.2	107.3	-2.8	0.0	-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.

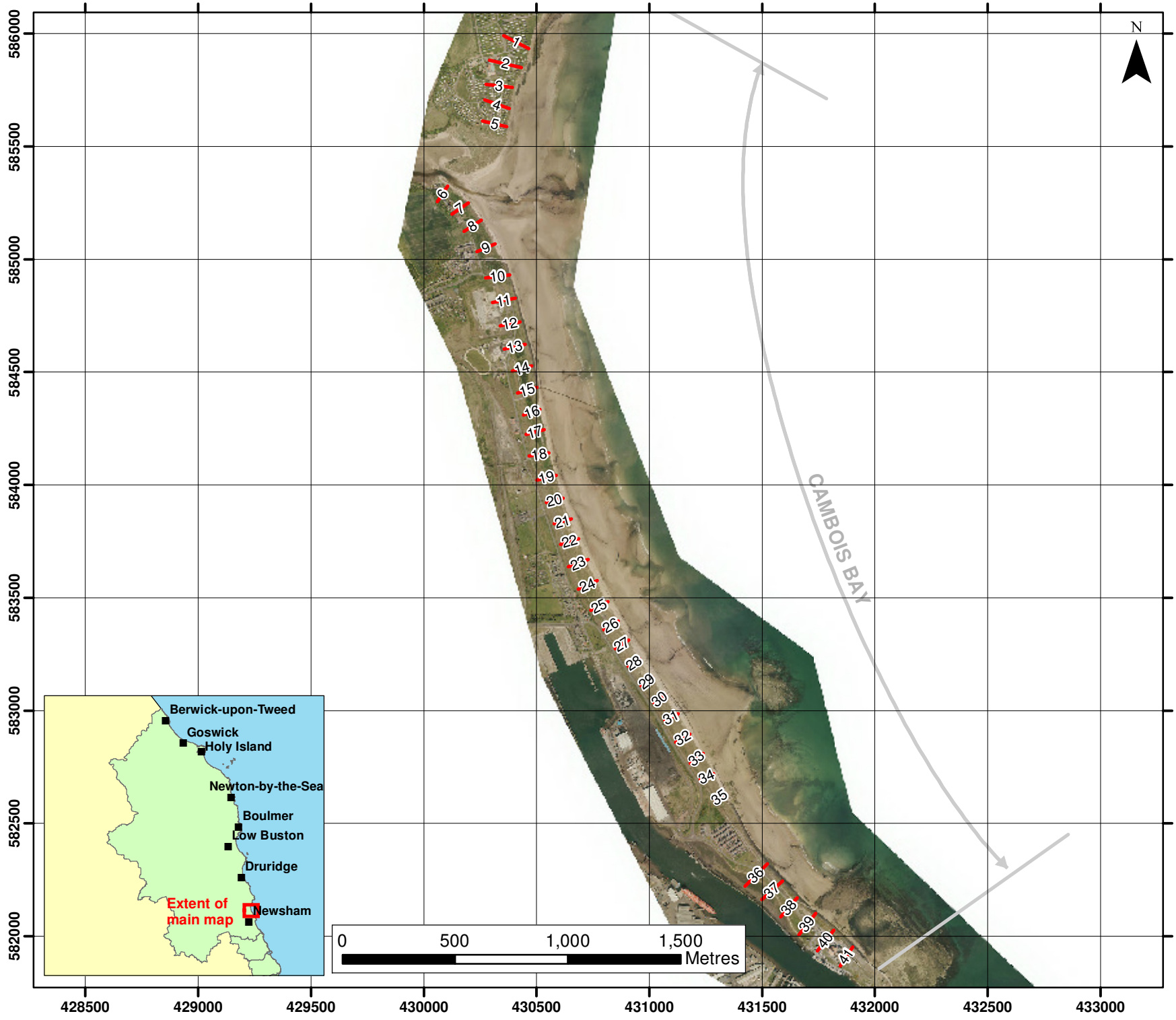
The cliff top surveys at Cambois Bay (south) are undertaken bi-annually. Measurements are taken from a fixed ground control point along a fixed bearing to the edge of the cliff top.

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 (May 2009)	Previous Survey (Oct 2013)	Present Survey (April 2014)	Baseline (May 2009) to Present (April 2014)	Previous (Oct 2012) to Present (April 2014)	Baseline (May 2009) to Present (April 2014)
6	Dune	74.5	75.2	75.0	0.5	-0.2	0.10
7	Cliff	80	79.9	80.0	0.0	0.1	0.00
8	Cliff	82.62	80.6	80.7	-1.9	0.1	-0.39
9	Cliff	76.91	76.8	76.8	-0.1	0.0	-0.03
10	Defended	94.47	94.6	94.7	0.2	0.1	0.04
11	Defended	90.65	91.0	90.6	0.0	-0.4	-0.01
12	Defended	83.25	82.8	82.9	-0.4	0.1	-0.07
13	Defended	87.72	87.7	87.4	-0.3	-0.3	-0.06
14	Defended	80.09	80.3	80.0	-0.1	-0.3	-0.01
15	Defended	81.24	80.8	80.3	-0.9	-0.5	-0.19
16	Cliff	71.65	70.2	69.9	-1.7	-0.2	-0.34
17	Cliff	81.5	78.4	79.6	-1.9	1.2	-0.39
18	Cliff	85.72	84.9	84.0	-1.7	-0.9	-0.34

Ground Control Point Details		Distance to Cliff Top (m)			Total Erosion (m)		Erosion Rate (m/year)
Ref	Type	Baseline Survey (May 2009)	Previous Survey (Oct 2013)	Present Survey (April 2014)	Baseline (May 2009) to Present (April 2014)	Previous (Oct 2012) to Present (April 2014)	Baseline (May 2009) to Present (April 2014)
19	Cliff	81.48	81.3	80.1	-1.4	-1.2	-0.28
20	Dune	71.04	69.8	69.7	-1.3	-0.1	-0.27
21	Dune	75.11	72.4	70.2	-4.9	-2.2	-0.98
22	Dune	78.69	75.7	72.1	-6.6	-3.7	-1.33
23	Dune	86.59	81.8	76.1	-10.5	-5.7	-2.10
24	Dune	87.99	84.4	79.5	-8.5	-4.9	-1.71
25	Dune	78.24	83.9	80.3	2.0	-3.7	0.41
26	Dune	67.08	67.0	64.3	-2.8	-2.7	-0.56
27	Dune	61.31	67.0	63.4	2.1	-3.6	0.42
28	Dune	55.83	56.9	55.7	-0.1	-1.2	-0.02
29	Dune	57.66	57.1	56.3	-1.4	-0.8	-0.27
30	Dune	56.66	56.5	56.6	-0.1	0.1	-0.02
31	Dune	63.03	63.5	64.5	1.5	1.0	0.30
32	Dune	68.35	68.3	67.9	-0.4	-0.4	-0.09
33	Dune	65.17	65.0	63.6	-1.6	-1.4	-0.32
34	Dune	60.34	59.3	59.2	-1.1	0.0	-0.22
35	Cliff	42.21	40.7	40.5	-1.7	-0.3	-0.35
36	Defended	129.88	129.9	129.8	0.0	-0.1	-0.01
37	Defended	113.71	113.7	113.7	0.0	0.0	-0.01
38	Defended	101.81	101.9	101.8	0.0	-0.2	-0.01
39	Defended	111.71	111.7	111.6	-0.1	-0.1	-0.01
40	Defended	109.02	109.4	109.4	0.4	0.0	0.09
41	Defended	94.35	94.7	94.7	0.3	0.4	0.07



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
County Council

Update Report 6
Partial Measures Survey
Spring 2014

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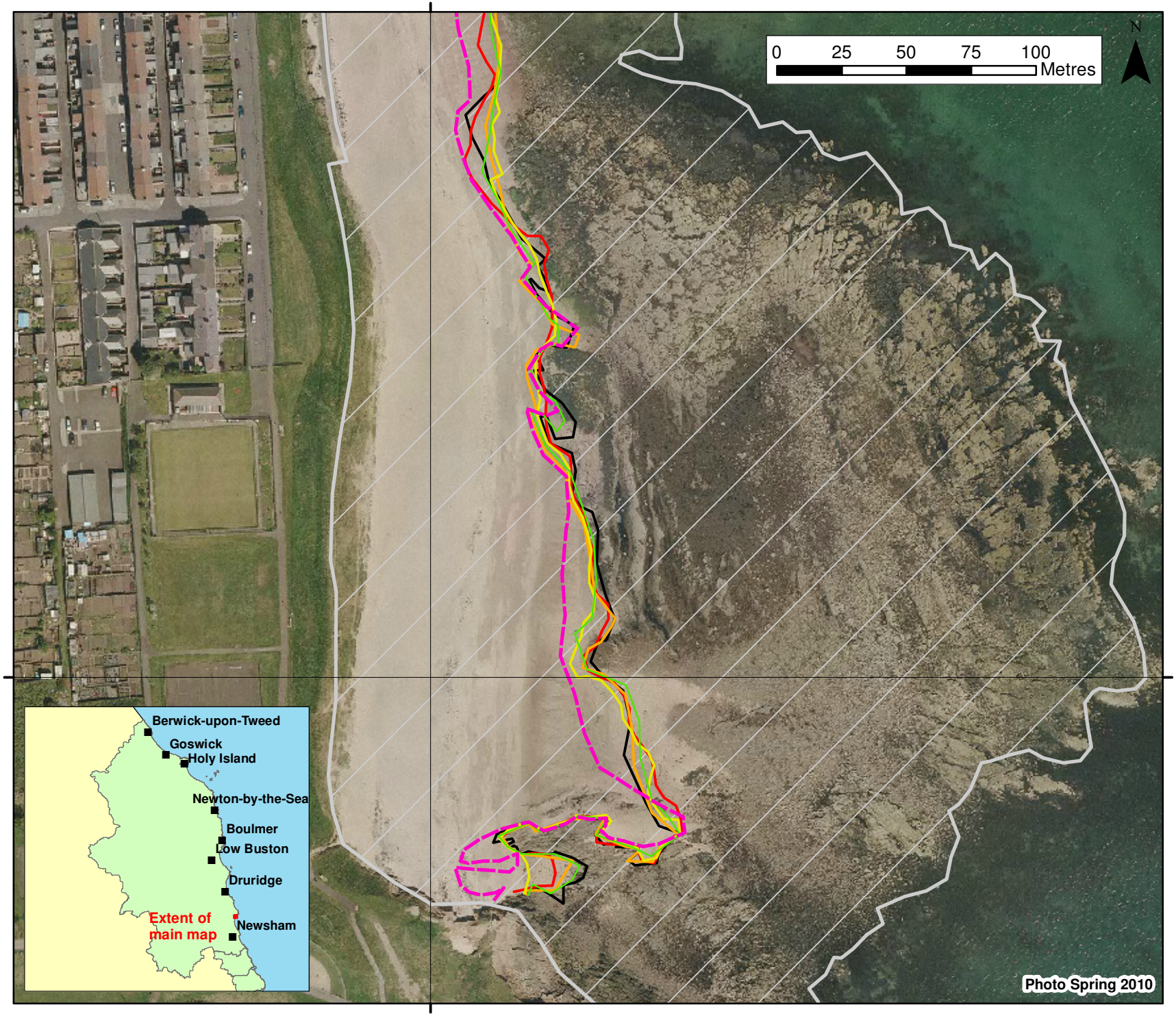
Appendix D

Sand Extent Survey



KEY

- Extent of sand (Autumn 2011)
- Extent of sand (Spring 2012)
- Extent of sand (Autumn 2012)
- Extent of sand (Spring 2013)
- Extent of Sand (Autumn 2013)
- Extent of Sand (Spring 2014)
- Extent of SSSI

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 6
Partial Measures Survey
Spring 2014

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