



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



**South Tyneside Council
Final Report**

June 2013

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Abbreviations and Acronyms

Acronym / Abbreviation	Definition
AONB	Area of Outstanding Natural Beauty
DGM	Digital Ground Model
HAT	Highest Astronomical Tide
LAT	Lowest Astronomical Tide
MHWN	Mean High Water Neap
MHWS	Mean High Water Spring
MLWS	Mean Low Water Neap
MLWS	Mean Low Water Spring
m	metres
ODN	Ordnance Datum Newlyn

Water Levels Used in Interpretation of Changes

Water Level Parameter	Water Level (m AOD)	
	River Tyne to Frenchman's Bay	Frenchman's Bay to Souter Point
HAT	2.85	2.88
MHWS	2.15	2.18
MLWS	-2.15	-2.12

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

Glossary of Terms

Term	Definition
Beach nourishment	Artificial process of replenishing a beach with material from another source.
Berm crest	Ridge of sand or gravel deposited by wave action on the shore just above the normal high water mark.
Breaker zone	Area in the sea where the waves break.
Coastal squeeze	The reduction in habitat area which can arise if the natural landward migration of a habitat under sea level rise is prevented by the fixing of the high water mark, e.g. a sea wall.
Downdrift	Direction of alongshore movement of beach materials.
Ebb-tide	The falling tide, part of the tidal cycle between high water and the next low water.
Fetch	Length of water over which a given wind has blown that determines the size of the waves produced.
Flood-tide	Rising tide, part of the tidal cycle between low water and the next high water.
Foreshore	Zone between the high water and low water marks, also known as the intertidal zone.
Geomorphology	The branch of physical geography/geology which deals with the form of the Earth, the general configuration of its surface, the distribution of the land, water, etc.
Groyne	Shore protection structure built perpendicular to the shore; designed to trap sediment.
Mean High Water (MHW)	The average of all high waters observed over a sufficiently long period.
Mean Low Water (MLW)	The average of all low waters observed over a sufficiently long period.
Mean Sea Level (MSL)	Average height of the sea surface over a 19-year period.
Offshore zone	Extends from the low water mark to a water depth of about 15 m and is permanently covered with water.
Storm surge	A rise in the sea surface on an open coast, resulting from a storm.
Swell	Waves that have travelled out of the area in which they were generated.
Tidal prism	The volume of water within the estuary between the level of high and low tide, typically taken for mean spring tides.
Tide	Periodic rising and falling of large bodies of water resulting from the gravitational attraction of the moon and sun acting on the rotating earth.
Topography	Configuration of a surface including its relief and the position of its natural and man-made features.
Transgression	The landward movement of the shoreline in response to a rise in relative sea level.
Updrift	Direction opposite to the predominant movement of longshore transport.
Wave direction	Direction from which a wave approaches.
Wave refraction	Process by which the direction of approach of a wave changes as it moves into shallow water.

Preamble

The Cell 1 Regional Coastal Monitoring Programme covers approximately 300km of the north east coastline, from the Scottish Border (just south of St. Abb's Head) to Flamborough Head in East Yorkshire. This coastline is often referred to as 'Coastal Sediment Cell 1' in England and Wales (Figure 1).

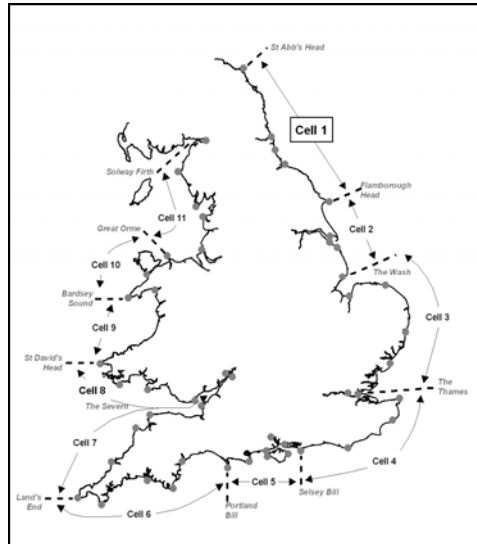


Figure 1 Sediment Cells in England and Wales

The main elements of the Cell 1 Regional Coastal Monitoring Programme involve:

- beach profile surveys
- topographic surveys
- cliff top recession surveys
- real-time wave data collection
- bathymetric and sea bed characterisation surveys
- aerial photography
- walk-over surveys

The beach profile surveys, topographic surveys and cliff top recession surveys are undertaken as a 'Full Measures' survey in autumn 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	Nov 12	Mar 13	Mar 13	June 13 (*)	

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

1. Introduction

1.1 Study Area

South Tyneside Council's frontage extends from the mouth of the River Tyne Estuary to the outfall south of Whitburn. For the purposes of this report and for consistency with previous reporting, it has been sub-divided into four areas, namely:

- Littehaven Beach
- Herd Sands
- Trow Quarry (incl. Frenchman's Bay)
- Marsden Bay

1.2 Methodology

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

- Full Measures survey annually each autumn comprising:
 - Beach profile surveys along 17 transect lines (commenced 2008)
 - Topographic survey along Littlehaven Beach (commenced 2010)
 - Topographic survey along Herd Sands (commenced 2008)
 - Topographic survey along Trow Quarry (commenced 2008*)
- Partial Measures survey annually each spring comprising:
 - Beach profile surveys along 11 transect lines (commenced 2008)
 - Topographic survey along Littlehaven Beach (commenced 2010)
- Cliff top survey bi-annually at:
 - Cliff top survey at Trow Quarry (incl. Frenchman's Bay) (commenced 2008)

*Please note that the 2008 surveys at beach profiles 1bSS11, 1bSS12 and 1bSS13 were found to be undertaken at a different location to all the profiles surveyed since then. For this reason, the 2008 profiles have been extracted from analysis undertaken herein.

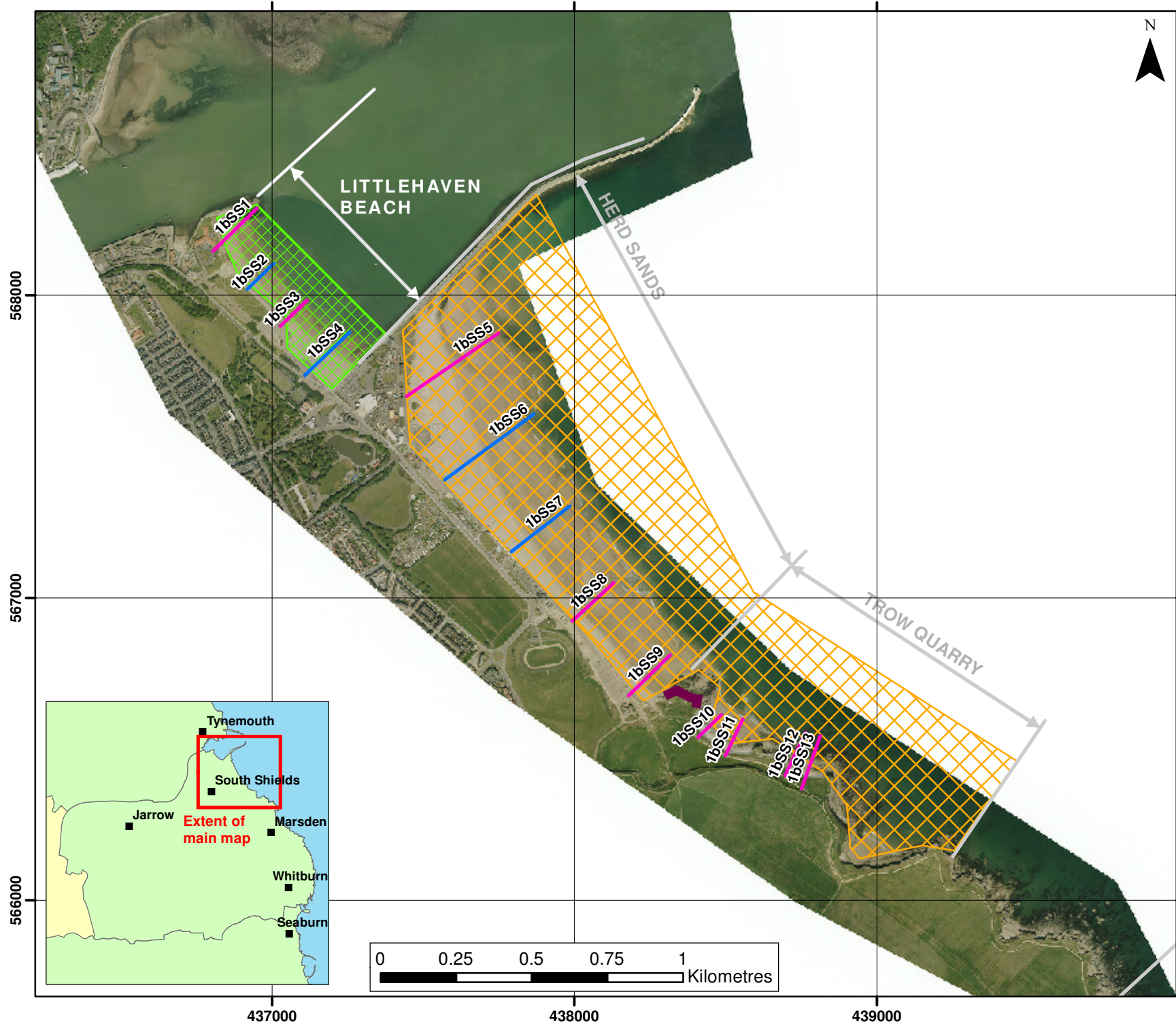
For all cliff-top surveys prior to Full Measures 2011, data was reported separately in Trow Quarry Coastal Defence Scheme - Monitoring Plan Year 2 (available from South Tyneside Council). The data was saved in '.kmz' format for plotting and comparison in GoogleEarth. For the present survey report, this data have been visualised in GIS, which revealed the quality was variable and reliable interpretations of cliff change could not be made. For this reason, the 'kmz' files are not presented or analysed as part of the present report. Therefore, cliff top survey data collected from Full Measures survey (autumn 2011) going forward is presented in this report.

The location of these surveys is shown in Figure 2. The Partial Measures survey was undertaken along this frontage between 11th March 2013 and 12th March 2013. During this time weather conditions varied considerably; refer to the survey reports for details of the weather conditions over this survey period.

This Update Report presents the following:

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

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



KEY

Topographic Profiles
 — Annual (blue line)
 — 6 monthly (pink line)

Topographic Surveys
 [Green grid] 6 monthly
 [Orange grid] yearly
 [Purple grid] 5 yearly

Cliff Top Monitoring Pegs
 [Purple bar] 50m centres
 [Green bar] 100m centres
 [Red bar] 300m centres
(Indicative survey extents shown)

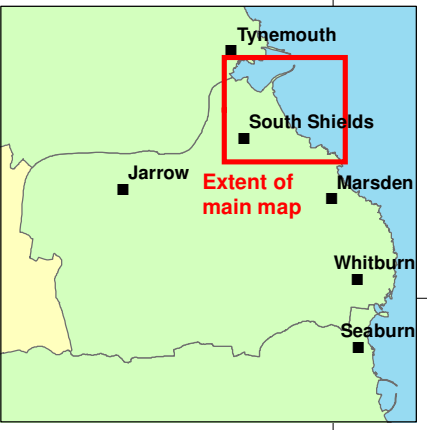
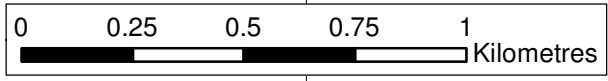
Client: North East Coastal Group
 Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

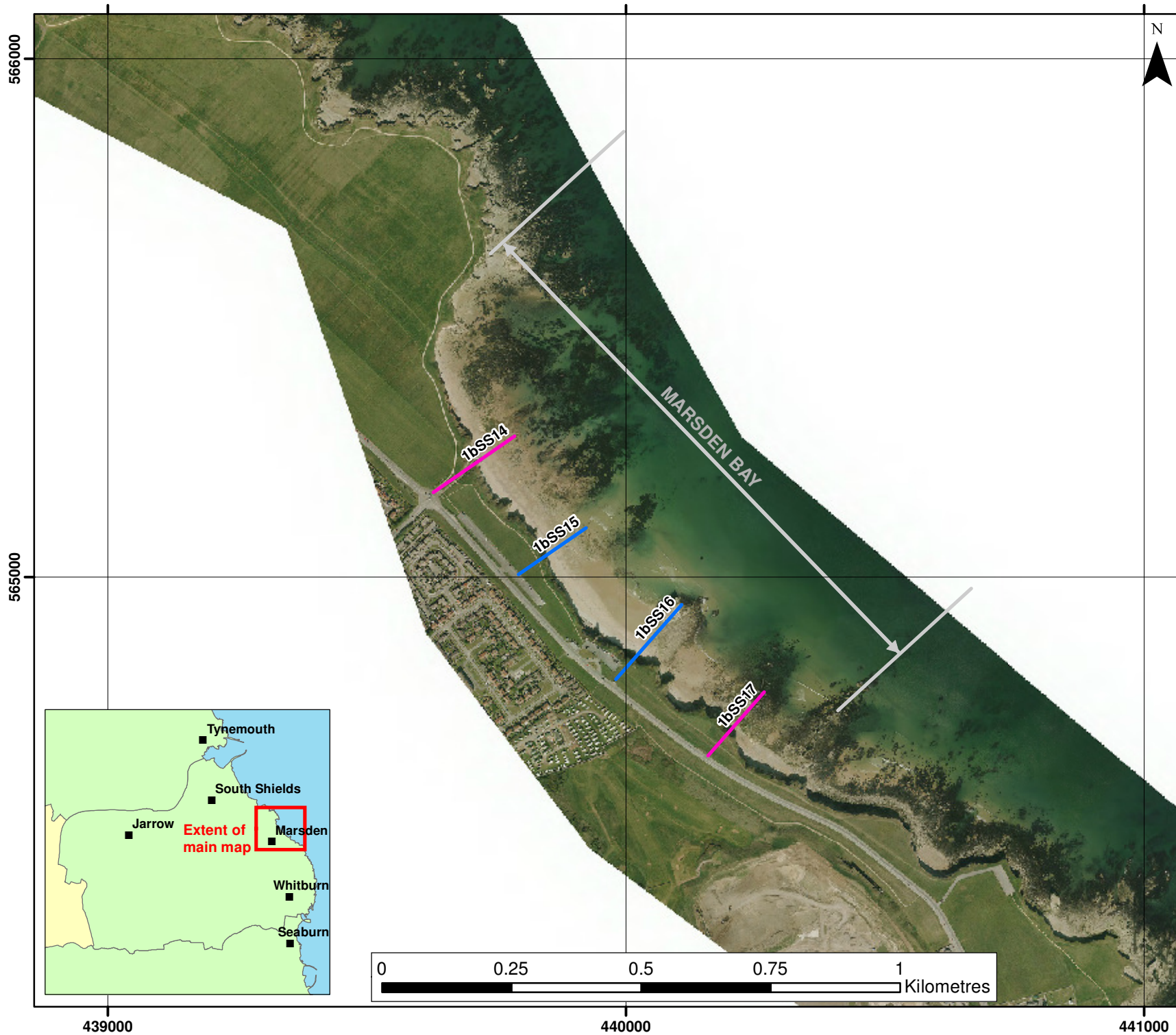
**Figure 2- Map 1
 Survey Locations
 Littlehaven Beach to
 Trow Quarry
 South Tyneside Council**

Update Report 5
 Partial Measures Survey
 Spring 2013

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





KEY

Topographic Profiles

- Annual
- 6 monthly

Topographic Surveys

- 6 monthly
- yearly
- 5 yearly

Cliff Top Monitoring Pegs

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

(Indicative survey extents shown)

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

**Figure 2 - Map 2
 Survey Locations
 Marsden Bay
 South Tyneside Council**

Update Report 5
 Partial Measures Survey
 Spring 2013

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Photography courtesy of North East Coastal Observatory
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2. Analysis of Survey Data

2.1 Littlehaven Beach

Survey Date	Description of Changes Since Last Survey	Interpretation
Mar 2013	<p>Beach Profiles:</p> <p>Littlehaven Beach is covered by two beach profile lines for the Partial Measures survey, spaced between South Groyne and South Pier (Appendix A). The previous survey was the Full Measures survey undertaken in autumn 2012.</p> <p>Profile 1aSS1 is located to the north of Littlehaven Beach, in the lee of a rocky outcrop. As with the previous Full Measures surveys (2012 and 2011), the dunes have been subject to some accretion, with a small increase on the top of the dunes and the dune face. Beach levels at the toe of the dune to a chainage of 95m have fallen by approximately 0.4m, but seaward of there, beach levels have increased by approximately the same magnitude. This suggests that material has been drawn-down from the upper beach to the middle/lower beach as a result of winter storms.</p> <p>Profile 1bSS3 extends seawards from the protruding section of Littlehaven Sea Wall. The survey photographs for the present and Full Measures 2012 survey ((refer to Plates 1 and 2), show that a large volume of water has accumulated on top of the seawall, from rainwater or wave overtopping. Beach levels have fallen considerably (up to 1.5m) between the seawall and a chainage of 55m, exposing the toe of the seawall apron and sheet piling (shown in survey photographs Plates 3 and 4). Seaward of there, beach levels have increased by approximately 0.6m to 0.8m. Together, these findings suggest the occurrence of severe storms, with overtopping and the draw-down of material from the upper beach to the middle/lower beach under storm wave action.</p>	<p>At Littlehaven Beach, the upper beach has been subject to considerable erosion, whilst the middle/lower beach has been subject to an increase in beach levels. This is evidence of beach draw-down, as material is transported across the beach by winter storms.</p> <p>At beach profile 1bSS3, beach levels have fallen to expose the toe of the seawall apron and piling. Although, the structural integrity of the seawall is not likely to be compromised under the present beach levels, the structure should be assed regularly for a further fall in beach levels and to identify if may trigger levels have been met.</p> <p>Longer term trends: When compared with previous profiles, the beach levels are the lowest observed to on the upper beach and the highest observed to date on the middle/upper beach.</p>
Mar 2013	<p>Topographic Survey:</p> <p>Littlehaven Beach is covered by bi-annual topographic survey between the South Groyne and the South Pier, which commenced in March 2010. Data from the most recent topographic survey (Partial Measures, spring 2013) have been used to create a DGM (Appendix B – Map 1a) using a Geographical Information System (GIS). A difference plot has also been produced using the DGM (Appendix B – Map 1b) produced from the last produced topographic survey (Partial Measures, spring 2011) and the</p>	<p>Comparison of the present topographic survey with the previous Full Measures (autumn, 2012) shows that the beach in the lee of the breakwaters has remained relatively stable since the last survey. Immediately in front of the seawall, at the location of the car park, beach elevation has reduced by up to 2m. Seaward of this, there is a band of beach elevation decrease,</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>present survey.</p> <p>In particular, the difference plot shows: (i) little change to beach elevation along the backshore to the north and south of Littlehaven Beach, however, towards the centre, opposite the car park, beach elevation has reduced by up to 2m; (ii) a linear band of beach elevation decrease along the upper beach, seaward of which is a linear band of beach elevation increase along the beach. These trips of change are parallel to the shoreline and indicate migration of sand bars.</p>	<p>fronted by a band of beach elevation increase. Both of which run parallel to the shoreline.</p> <p>The findings of the topographic survey reflect those of the beach profile surveys, with considerable beach elevation decrease at the toe of the seawall apron, beach elevation fall along the upper beach and beach elevation increase along the middle/lower beach. Again, this is evidence of beach draw-down, as material is transported across the beach by winter storms.</p>



Plate 1 – Survey photograph 1bSS3_20130312_N1.JPG



Plate 2 – Survey photograph 1bSS3_20121114_N2.JPG



Plate 3 – Survey photograph 1bSS3_20130312_N3.JPG



Plate 4 – Survey photograph 1bSS3_20121114_N3.JPG

2.2 Herd Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
Mar 2013	<p>Beach Profiles:</p> <p>Herd Sands is covered by three beach profile lines for the Partial Measures survey (Appendix A). The previous survey was the Full Measures survey undertaken in autumn 2012.</p> <p>Profile 1bSS5 is located to the north of Herd Sands and is located in the lee of the breakwater. The dunes have largely retained a similar form since the last survey (Full Measures, autumn 2012), however, they have accreted between a chainage of 60m and 130m. This is further evidence that the sand fencing put in prior to the Partial Measures, spring 2012 survey is encouraging accretion and is a success. Beach levels have fallen by approximately 0.5m across the profile</p> <p>Profile 1bSS8 is located to south of Herd Sands. Beach levels at the toe of the promenade revetment have increased considerably (by 1m). As observed from the survey photographs in Plates 5 and 6, which show the condition of the beach at present and previously in November 2012 (Full Measures, autumn 2012), the sand fencing at this location has also been successful by encouraging the retention of sand. It is noted from the survey photographs that wind-blown sand has accreted on the road behind the beach, which may be owed to the improved condition of the beach along the toe of the promenade revetment. Beach levels have fallen by approximately 0.5m across the profile.</p> <p>Profile 1bSS9 is located to south of Herd Sands. The dune face has retained the same form and position since the last survey but beach levels have fallen by approximately 0.5m across the profile.</p>	<p>Since the last survey, the dunes at Herd Sands have accreted. To the north and centre-south of the frontage, this is owed to the construction of sand fencing, which has encouraged sand retention. The dunes to the south of Herd Sands have remained stable with no change in form or position.</p> <p>Along the length of the Herd Sands, beach levels have fallen by approximately 0.5m. It is possible that material eroded from the beach by wind-blown activity over the winter is that which is contributing to the dune growth or it may be transported offshore by winter storm wave activity. It is noted from the survey photograph for profile 1bSS8, that sand has been blown onto the promenade and road behind, which may create a maintenance issue. Any wind-blown sand should be returned to the beach to assist in maintaining a healthy beach.</p> <p>Longer term trends: Although the beach has been subject to some lowering over the winter months, the beach levels are within the bounds of previous changes.</p>



Plate 5 – Survey photograph 1bSS8_20130311_N1.jpg



Plate 6 – Survey photograph 1bSS8_20121114_N1.JPG

2.3 Trow Quarry (incl. Frenchman’s Bay)

Survey Date	Description of Changes Since Last Survey	Interpretation
<p>Mar 2013</p>	<p>Beach Profiles:</p> <p>Trow Quarry is covered by four beach profile lines for the Partial Measures survey (Appendix A), two in Graham’s Sand and two in Southern Bay. The previous survey was the Full Measures survey undertaken in autumn 2012.</p> <p>Profiles 1bSS10 and 1bSS11 are located in Graham’s Bay. At profile 1bSS10, beach levels on the upper boulder beach (seaward to a chainage of 75m) have fallen, whilst those seaward of 75m have increased. This increase has covered the underlying rock, when compared to the previous survey (Full Measures, autumn 2012), as observed from the survey photographs in Plates 7 and 8. At profile 1bSS11, there has been little discernible change in level and form of the cobble / boulder beach.</p> <p>Profiles 1bSS12 and 1bSS13 are located in Southern Bay. At profile 1bSS12, there has been little discernible change in level and form of the boulder/cobble beach. At profile 1bSS13, there has been little discernible change in level and form of the boulder/cobble beach.</p>	<p>Since the last survey, at both Graham’s Bay and Southern Bay, the cliff and rock revetment have remained stable.</p> <p>At Graham’s Bay, the boulder/cobble beach has remained stable.</p> <p>At Southern Bay, the boulder/cobble beach has remained stable.</p> <p>Longer term trends: With the exception, the beach levels are within the bounds of previous changes and overall the beach at Graham’s Bay and Southern Bay has retained the same form and position since November 2008.</p> <p>At profile 1bSS10, beach levels between a chainage of 65m and 80m are the lowest observed to date (2008, when monitoring began).</p>
<p>Mar 2013</p>	<p>Cliff-top Survey:</p> <p>Cliff top survey data collected for the baseline survey (autumn, 2011), Partial Measures survey (autumn 2012) and the present Partial Measures survey (spring, 2013) is presented in this report.</p> <p>Six ground control points (numbered 1-6) were established along the cliff top at Trow Point in 2008 to monitor cliff erosion at the headland adjacent to the site of a former landfill. 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 ground control points.</p> <p>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</p>	<p>Since the last survey, movement greater than the survey error occurred at two ground control points, and this movement was recorded to be accretion. Therefore, it is not possible to define any discernible trends.</p> <p>Longer term trends: Since surveys began in October 2008, no cliff recession has been detected. 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</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>anticipated to have an accuracy of $\pm 0.2\text{m}$ due to the technique used.</p> <p>The results from the cliff top survey are presented in Appendix C – Table C1, showing the position from the ground control point to the edge of the cliff top along a defined bearing. Also shown is the change in measurement since the baseline (autumn 2011) and current (spring 2013) cliff top surveys.</p> <p>Results show that erosion or an amount of movement greater than the survey error has occurred has two ground control points since surveys began in September 2011. However, points 3 and 4 are calculated to have advanced by 0.3m and 0.7m respectively, which is interpreted as error associated with problems in precisely locating the cliff edge. All other points show no movement.</p> <p>Since the last survey in November 2012, erosion greater than the survey error has not occurred at any locations and it has not been possible to identify any trends. Review and analysis of the 2012 aerial photography will allow the nature of cliff recession to be better understood.</p>	<p>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.</p>



Plate 7 – Survey photograph 1bSS10_20130312_N5.JPG



Plate 8 – Survey photograph 1bSS10_20121113_N7.JPG

2.4 Marsden Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
<p>Mar 2013</p>	<p>Beach Profiles:</p> <p>Marsden Bay is covered by two beach profile lines for the Partial Measures survey (Appendix A). The previous survey was the Full Measures survey undertaken in autumn 2012.</p> <p>Profile 1bSS14 is located to the north of the bay and covers the cliffs and former lifeguard station adjacent to the Redwell Steps. As shown in Appendix A, the cliff profile suggests that the cliff face has advanced by up to 1m. As noted in the previous Full Measures (autumn 2012) report, this is likely to reflect access difficulties to the cliff toe, but may represent accumulation of talus from cliff recession. Beach levels have dropped considerably (by over 1m) at the toe of the Redwell steps (refer to the survey photographs in Plates 9 and 10. Seaward of a chainage of 135m (level of 1m), beach levels have increased. This suggests that material has been drawn-down from the upper/middle beach to the lower beach during winter storms. The survey photographs also show a change in the beach material to shingle, which is likely to have been exposed from beneath the overlying sand that was drawn down during storm events.</p> <p>Profile 1bSS17 is located to the south of the bay. As shown in Appendix A, the cliff profile suggests that the cliff face has advanced by up to 4m at the toe. As noted above and in the previous Full Measures (autumn 2012) report, this may reflect error due to access difficulties or deposition of talus at the slope toe. Beach levels in front of the cliff have remained relatively unchanged.</p>	<p>Along the length of Marsden Bay, the cliff has retained the same form and position since the last surveys.</p> <p>To the north of Marsden Bay, the beach has undergone quite considerable change, with a fall in beach levels in the region of 1m on the upper beach but an increase of a similar magnitude on the middle/lower beach suggesting that material has been drawn-down across the beach by storm activity. The overlying sand has also been removed from the beach to expose the underlying coarse shingle/cobble material, further evidence of winter storm activity. If newly deposited, this suggests some form of sediment sorting has occurred, which is a response to storm waves. To the south of Marsden Bay, the beach has remained relatively stable. At beach profile 1bSS14, beach levels have fallen to expose the toe of the Redwell steps. Although, the structural integrity of the steps is not likely to be compromised under the present beach levels, the structure should be assessed regularly for a further fall in beach levels and to identify if any trigger levels have been met.</p> <p>Longer term trends: At profile 1bSS14, beach levels at the toe of the Redwell steps, between a chainage of 110m and 120m are the lowest observed to date (*2008, when monitoring began), whilst beach levels seaward of a chainage of 136m (level of 1m) are the highest observed to date (*).</p>



Plate 7 – Survey photograph 1bSS14_20130311_N4.jpg



Plate 8 – Survey photograph 1bSS14_20121112_N2.JPG

3. Problems Encountered and Uncertainty in Analysis

Individual Profiles

At beach profile 1bSS3, beach levels have fallen to expose the toe of the seawall apron and piling. Although, the structural integrity of the seawall is not likely to be compromised under the present beach levels, the structure should be assed regularly for a further fall in beach levels and to identify if any trigger levels have been met.

It is noted from the survey photograph for profile 1bSS8, that sand has been blown onto the promenade and road behind, which may create a maintenance issue. Any wind-blown sand should be returned to the beach to assist in maintaining a healthy beach.

At beach profile 1bSS14, beach levels have fallen to expose the toe of the Redwell. Although, the structural integrity of the steps is not likely to be compromised under the present beach levels, the structure should be assed regularly for a further fall in beach levels and to identify if may trigger levels have been met.

Cliff Top Surveys

Surveying any cliff top is difficult due to the need for a consistent interpretation of the cliff edge in successive surveys, which can be challenging, especially when vegetation is thick.

For these reasons, it has been assumed that any changes of $\pm 0.2\text{m}$ may be considered as being within the accuracy of the surveying technique and that any indication of an advancing cliff line is error.

Future surveys will provide a longer data-set over which to make comparisons, and therefore provide more clarity to observed trends. Additionally, analysis of aerial photography will provide additional information on rate of cliff recession.

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

No changes are recommended at the present time.

5. Conclusions and Areas of Concern

- At Littlehaven Beach, at beach profile 1bSS3, beach levels have fallen to expose the toe of the seawall apron and piling. Although, the structural integrity of the seawall is not likely to be compromised under the present beach levels, the structure should be assed regularly for a further fall in beach levels and to identify if any trigger levels have been met.
- Elsewhere along Littlehaven Beach, the recorded profiles and topographic survey present no causes for concern.
- At Herd Sands, the recorded profiles present no causes for concern.
- At Trow Quarry, the recorded profiles present no causes for concern. The cliffs to the north-west of Trow Headland are eroding, but the magnitude of change is presently small and presents no cause for concern.
- At Marsden Bay, at beach profile 1bSS14, beach levels have fallen to expose the toe of the Redwell. Although, the structural integrity of the steps is not likely to be compromised under the present beach levels, the structure should be assed regularly for a further fall in beach levels and to identify if may trigger levels have been met.
- Elsewhere at Marsden Bay, the recorded profiles present no causes for concern.

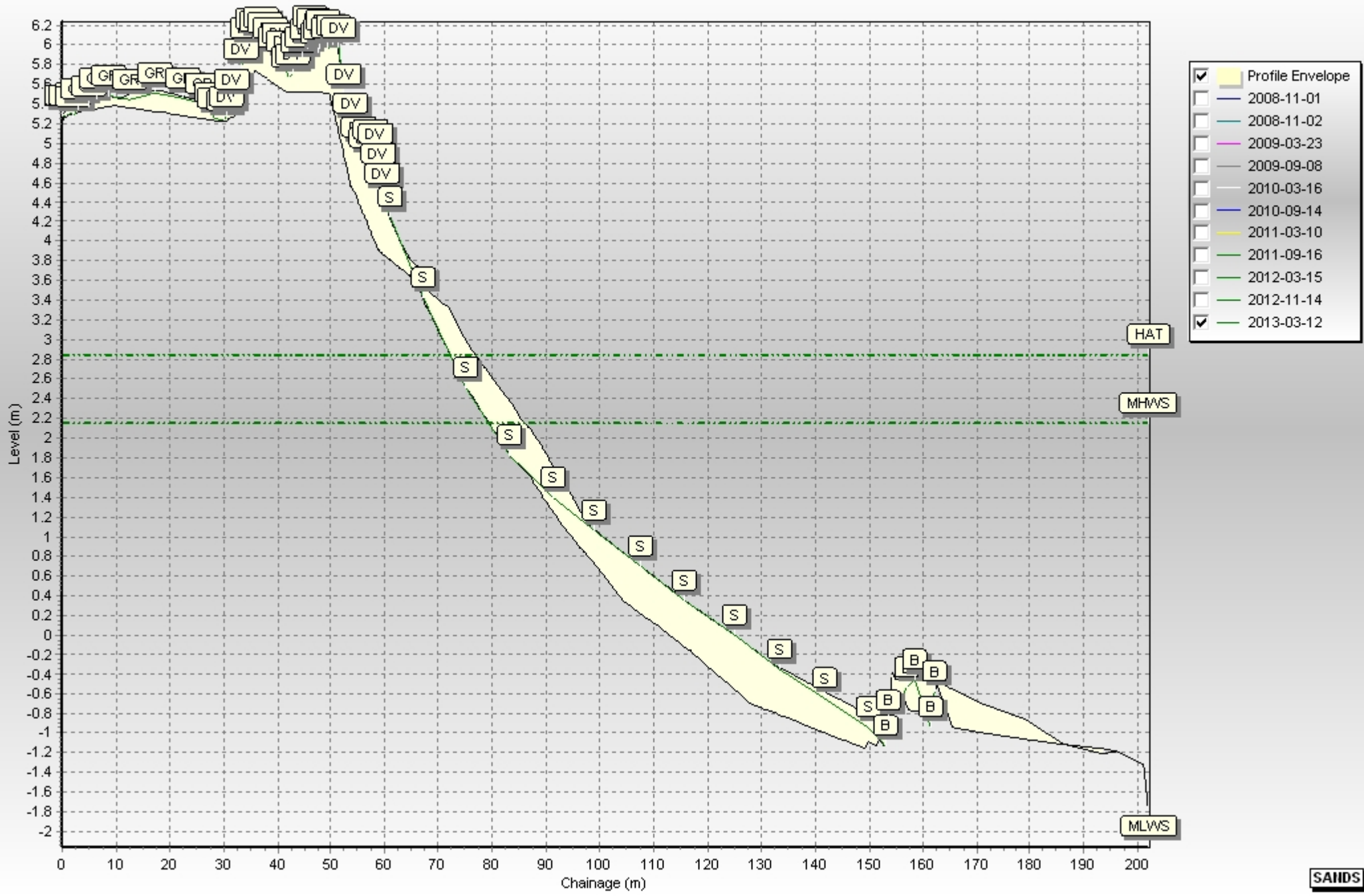
Appendices

Appendix A
Beach Profiles

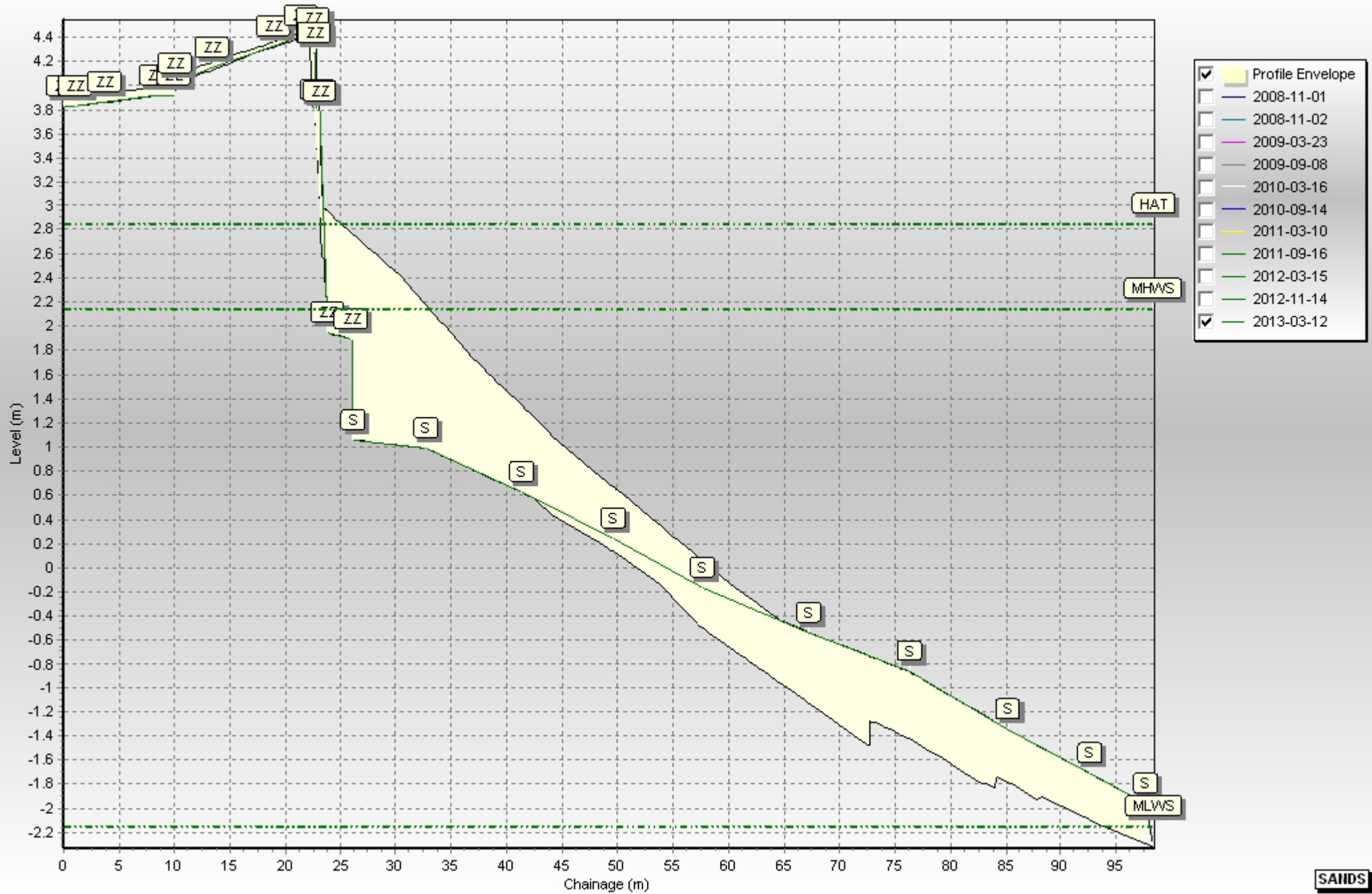
The following sediment feature codes are used on some profile plots:

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

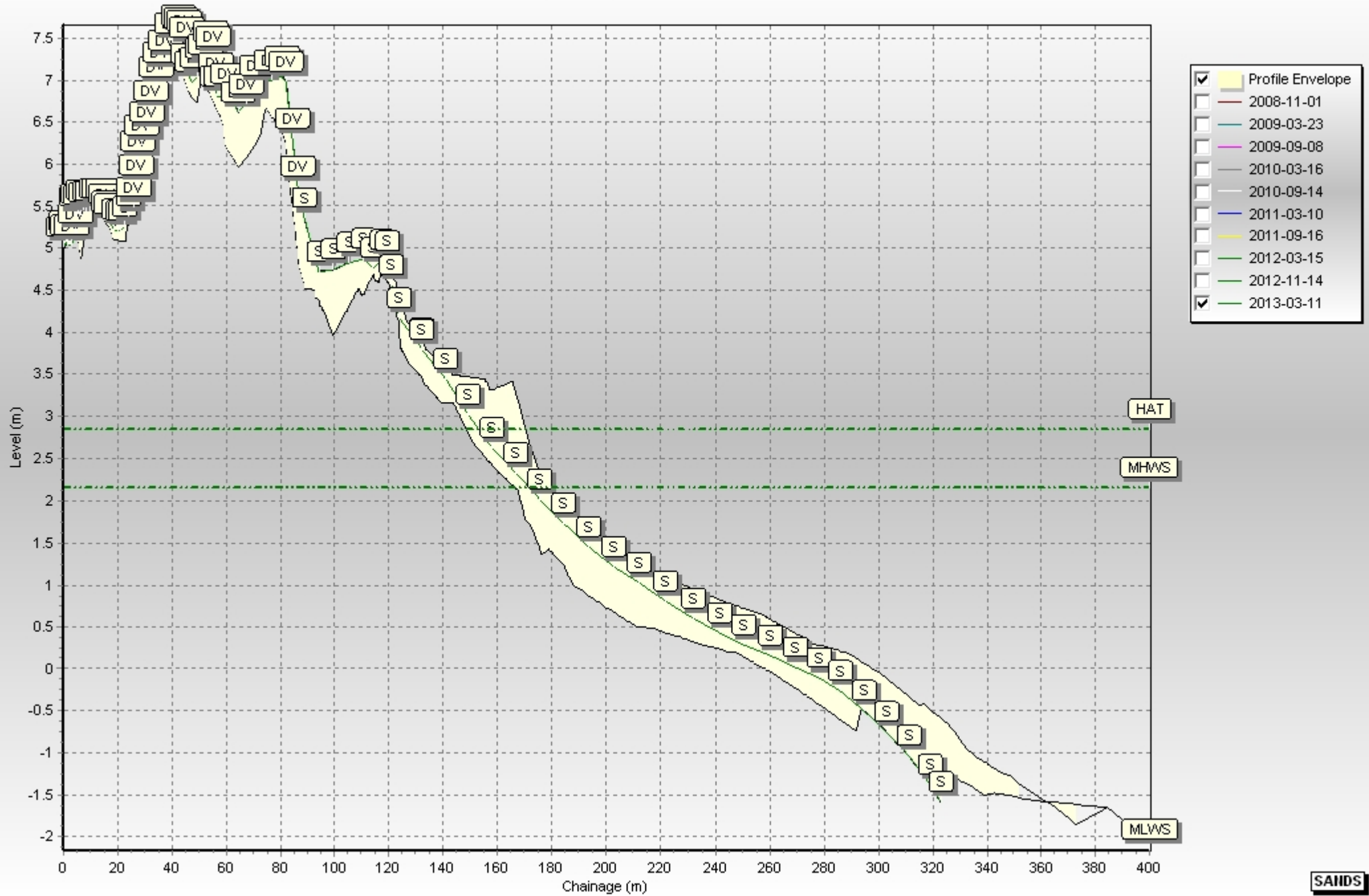
Profiles: 1bSS1



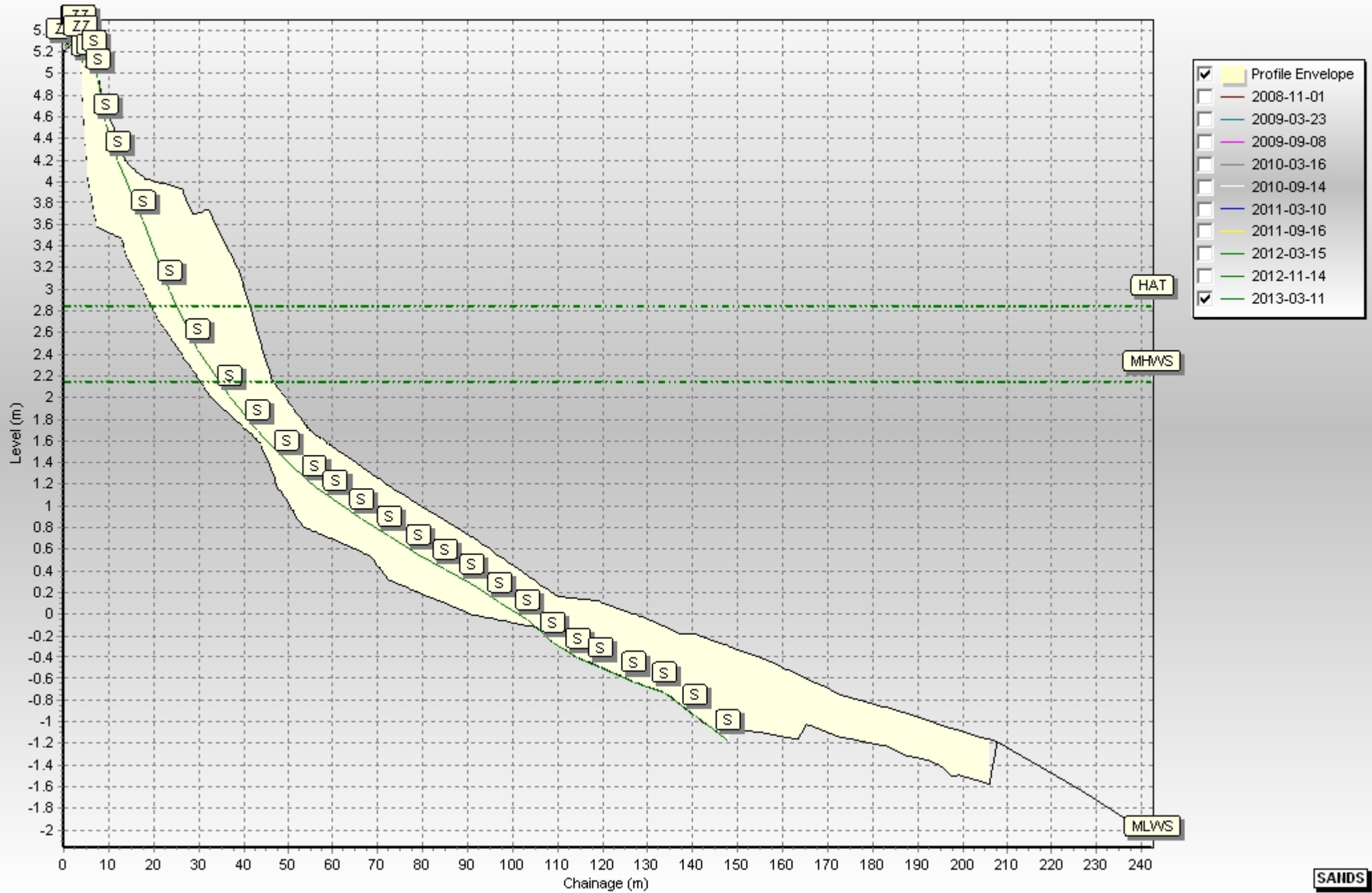
Profiles: 1bSS3



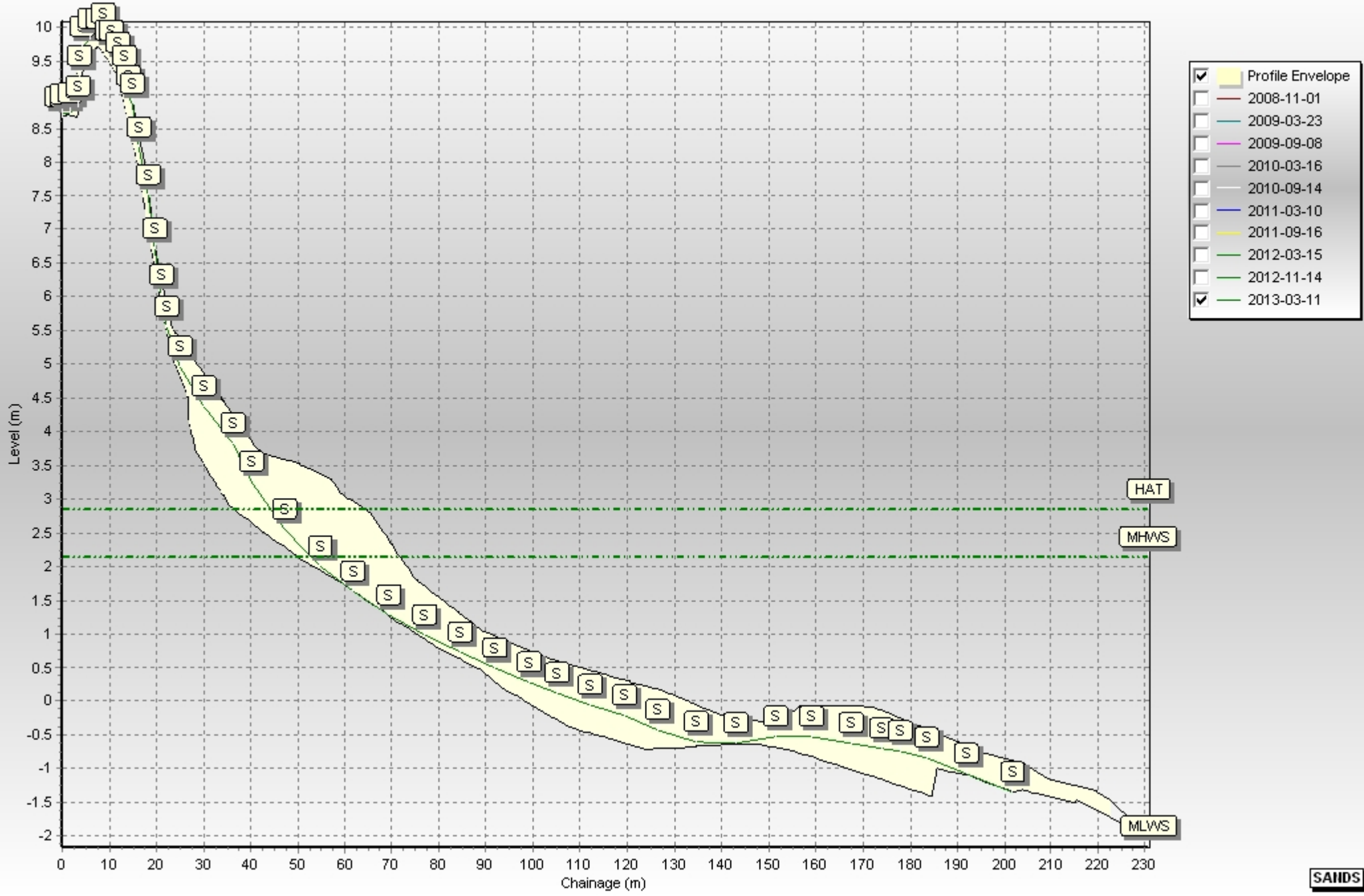
Profiles: 1bSS5



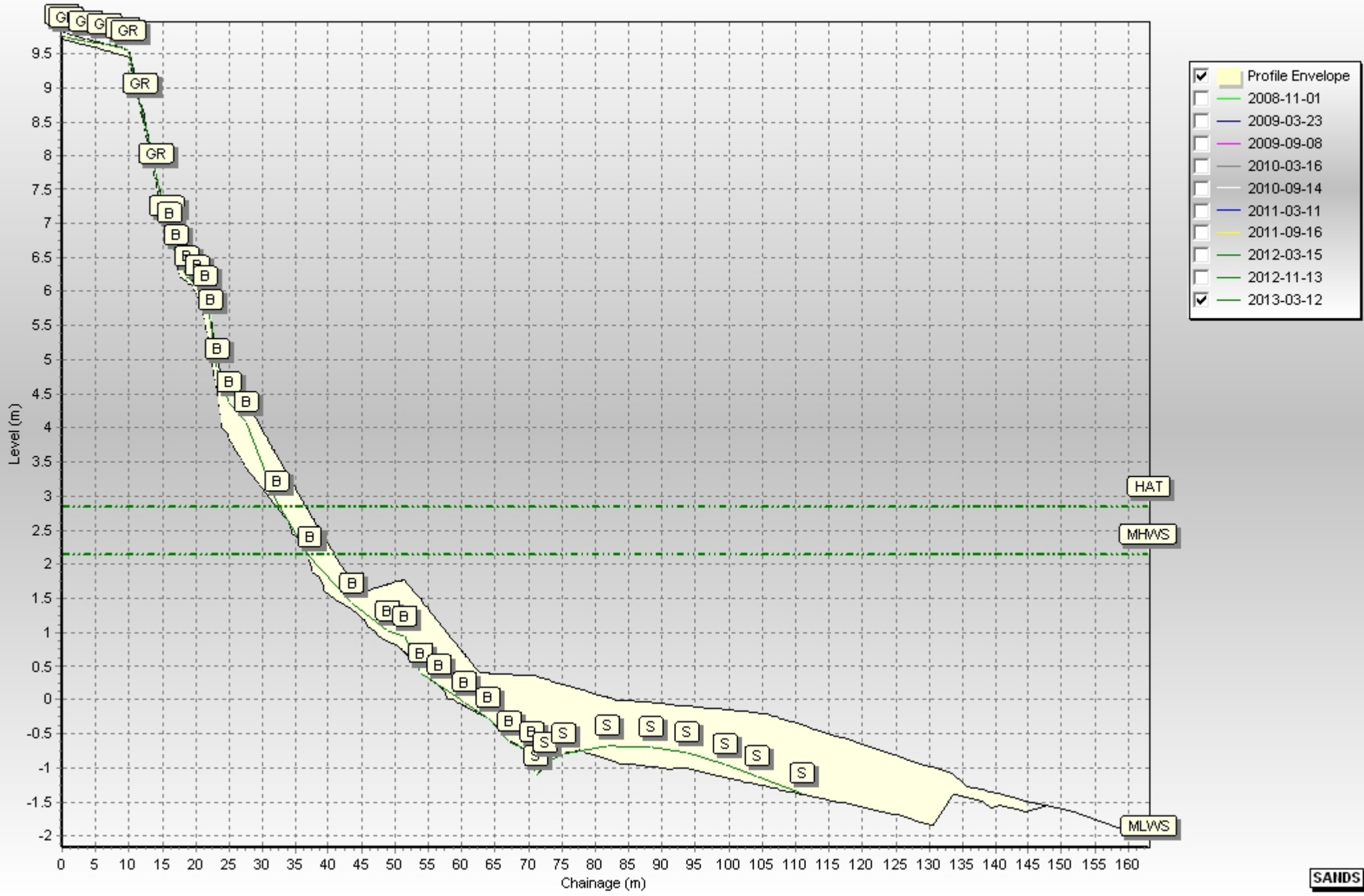
Profiles: 1bSS8



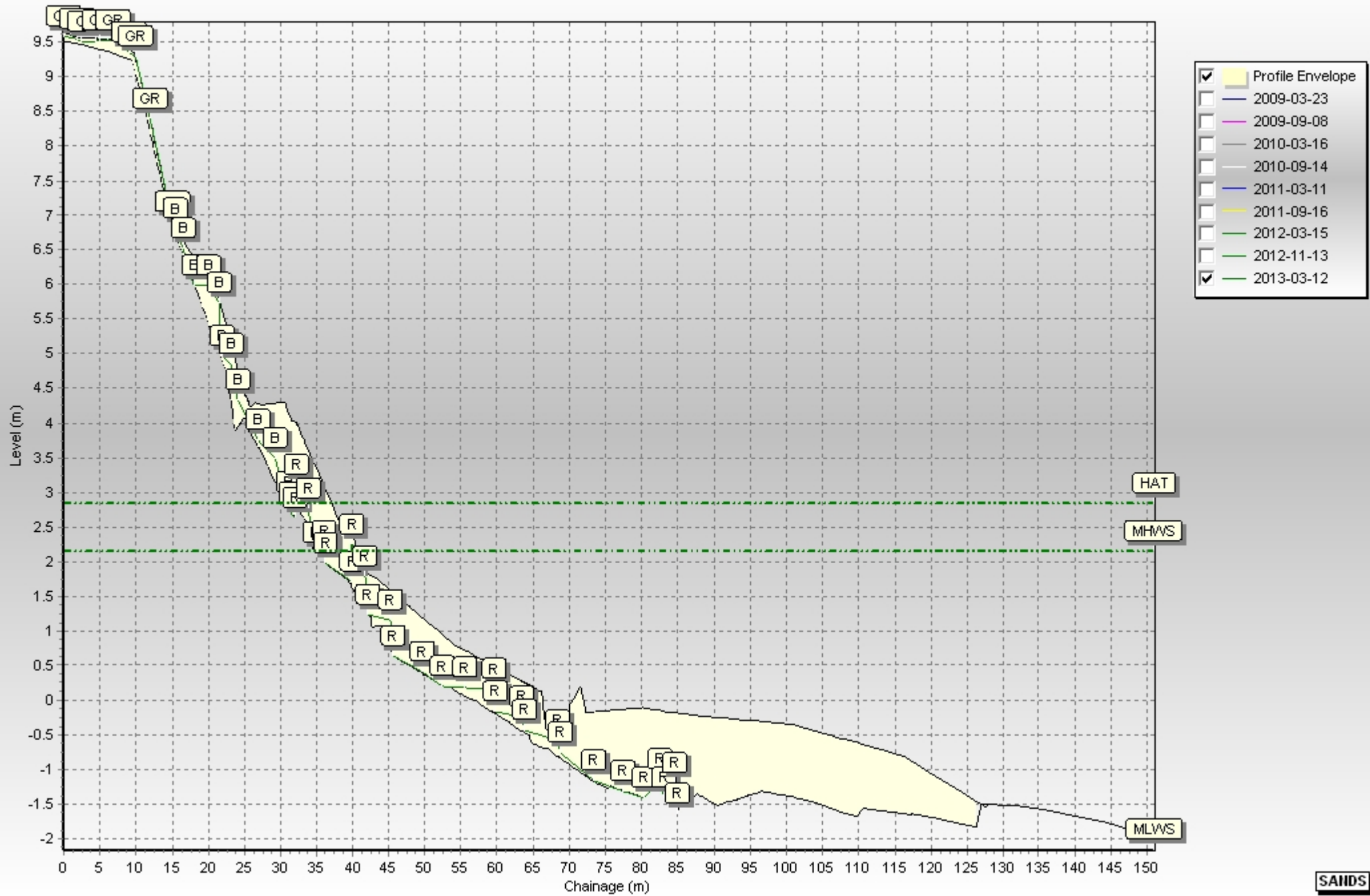
Profiles: 1bSS9



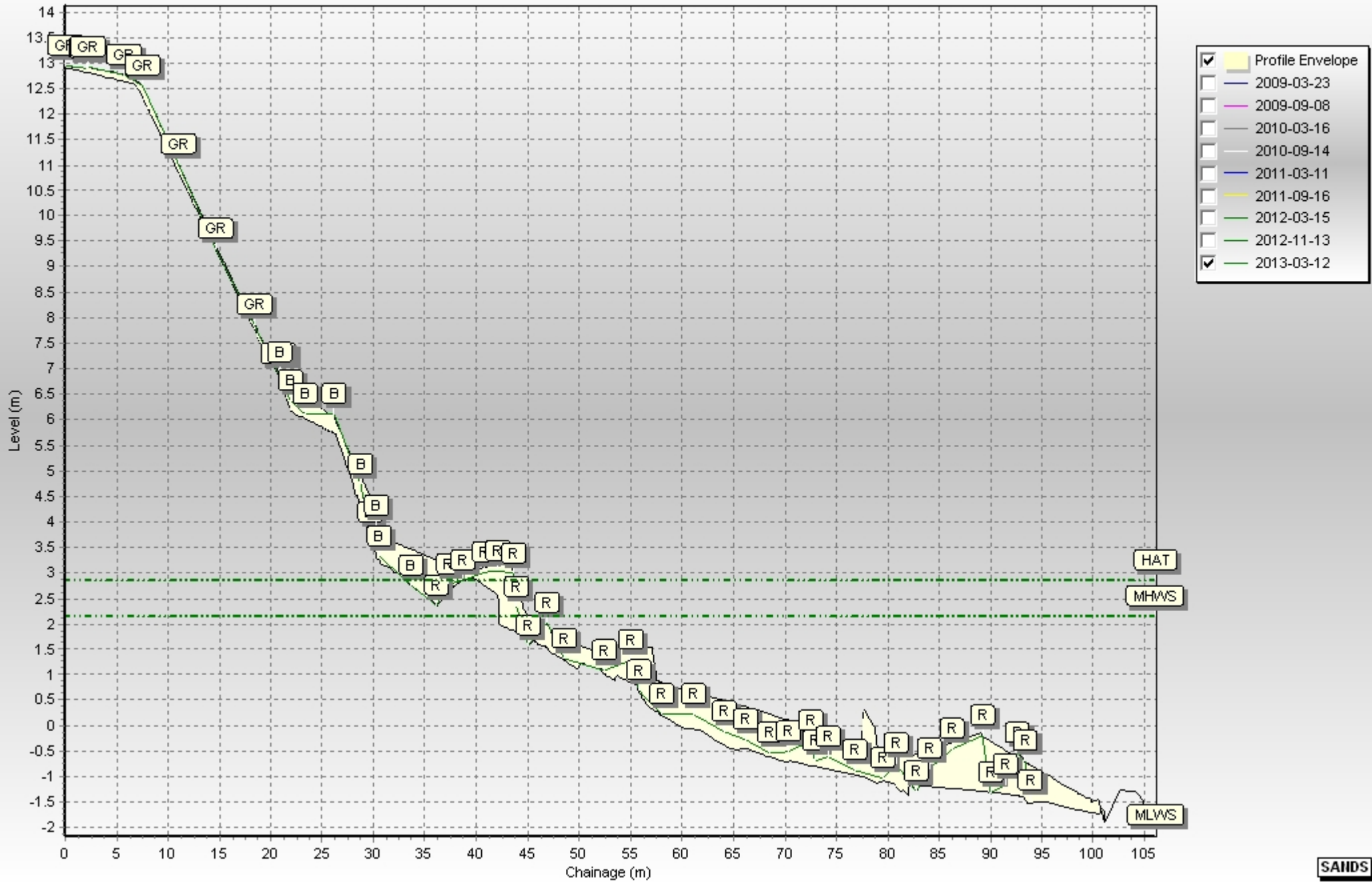
Profiles: 1bSS10



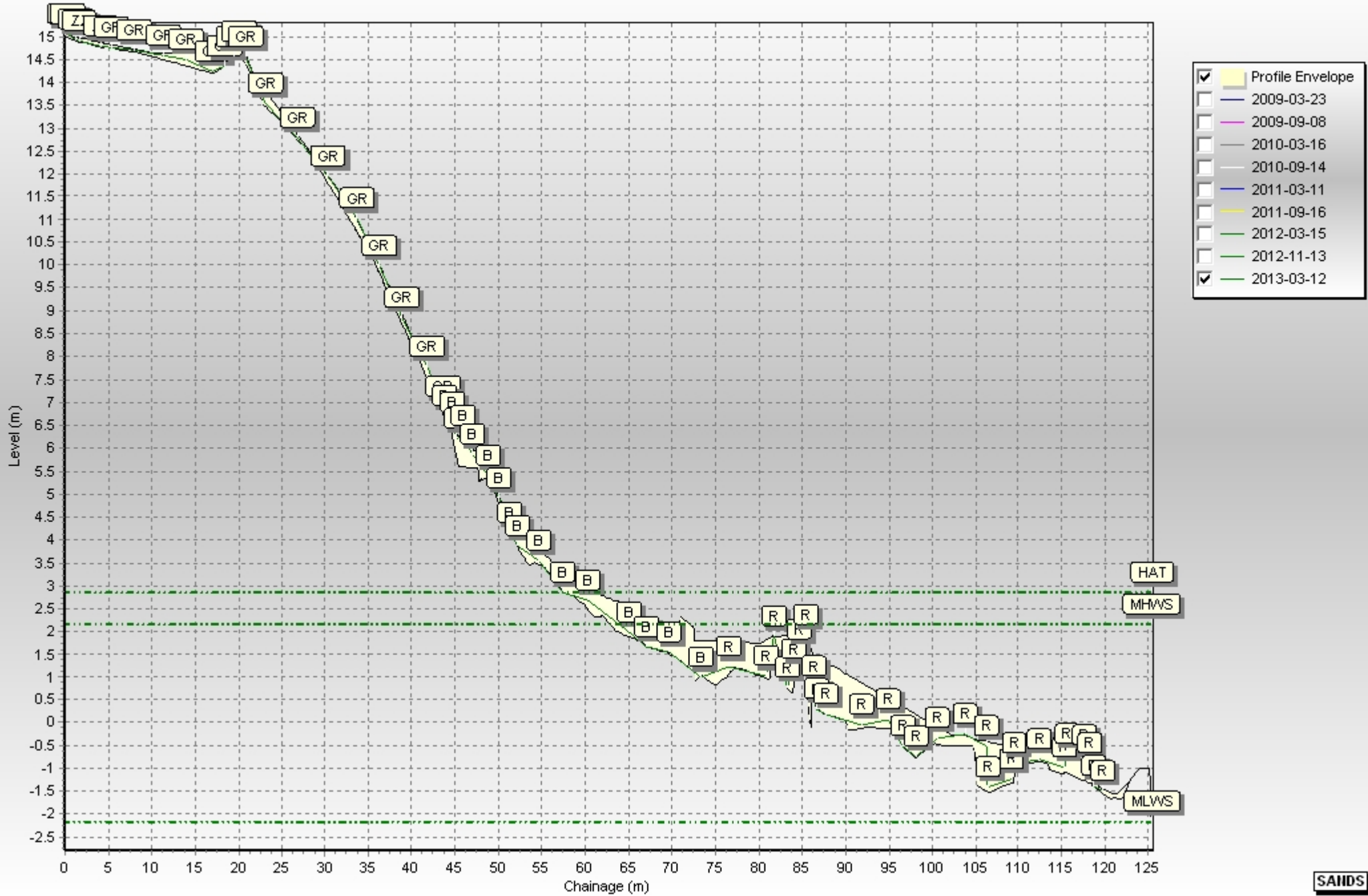
Profiles: 1bSS11



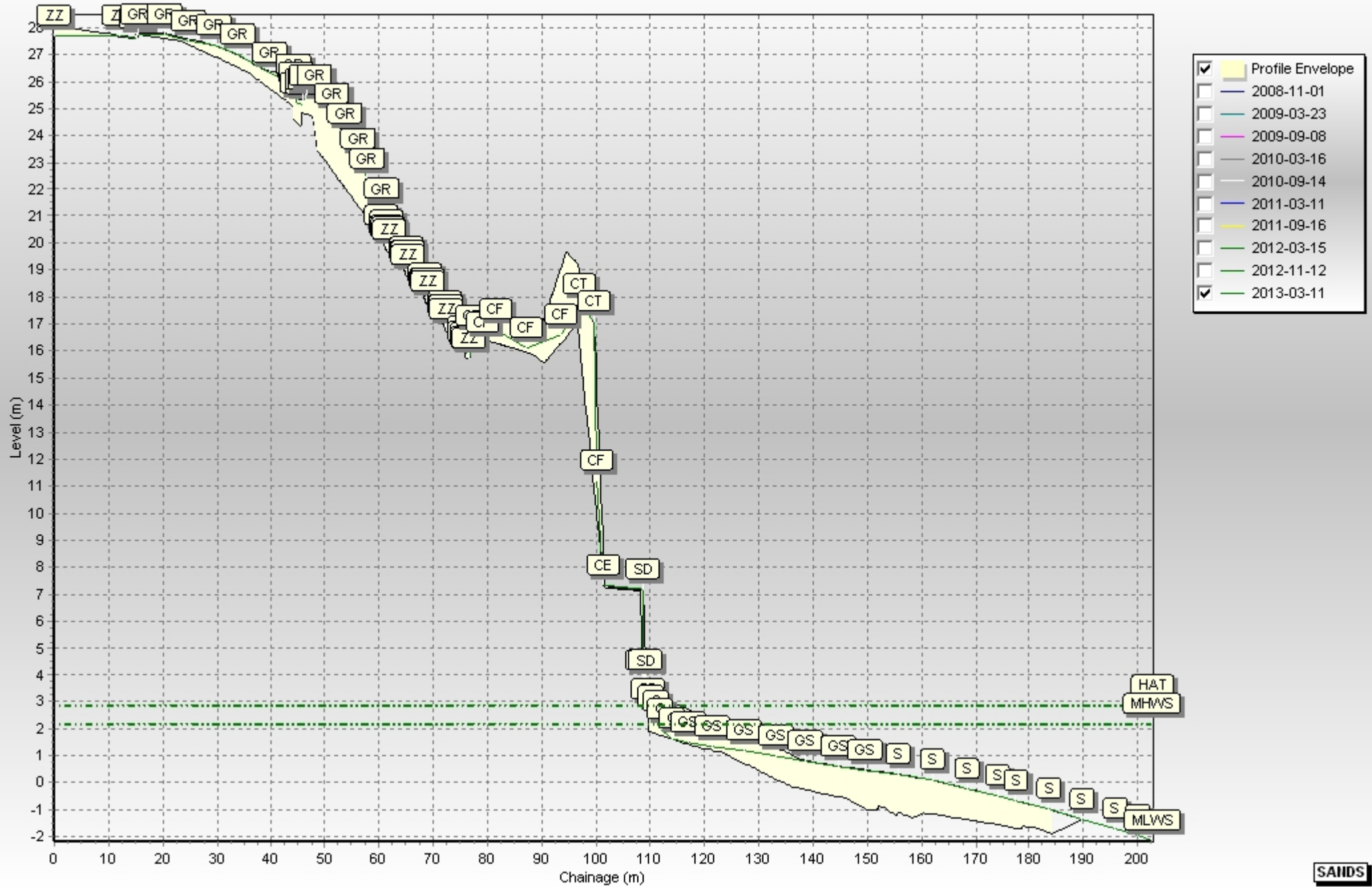
Profiles: 1bSS12



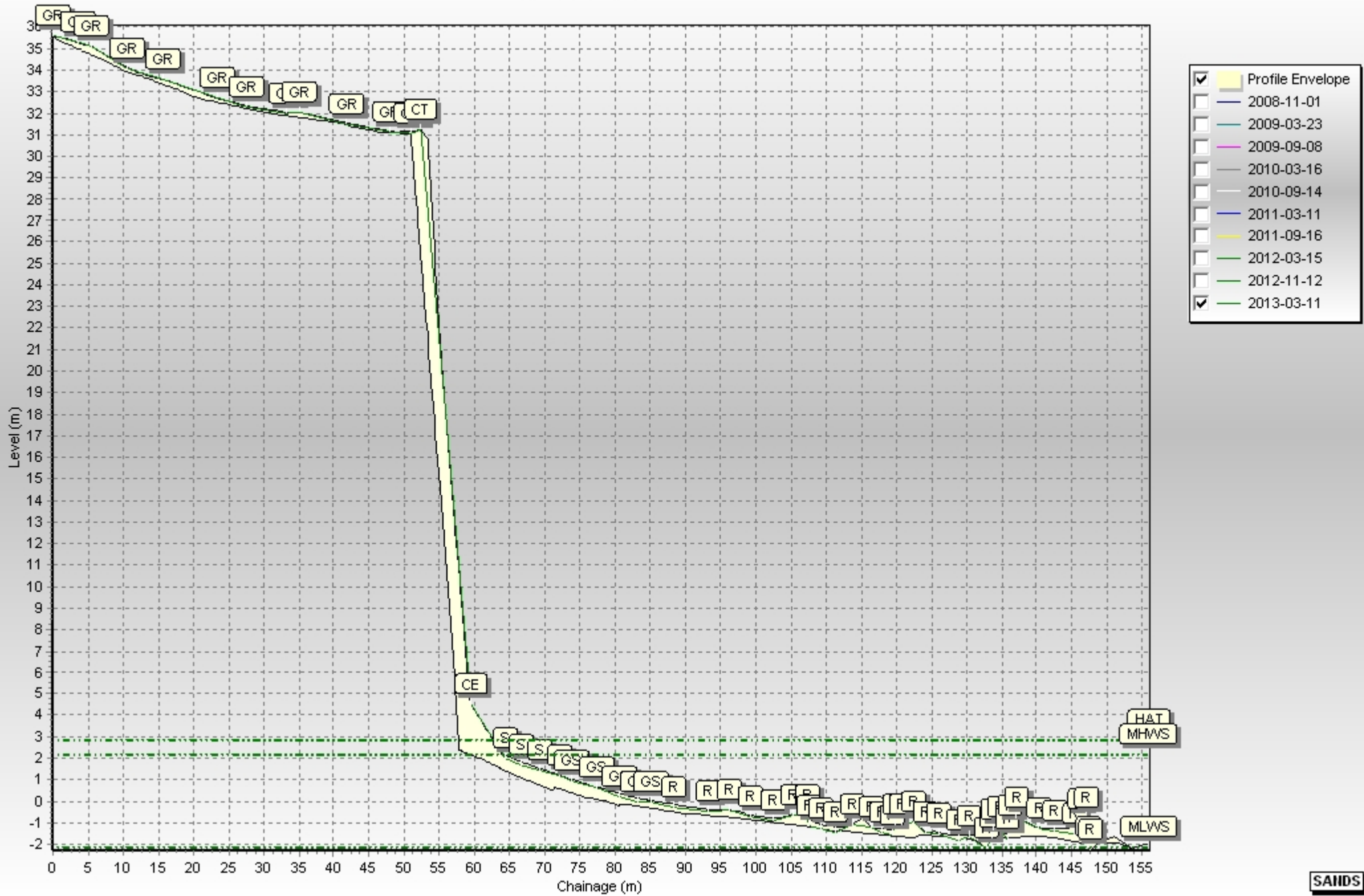
Profiles: 1bSS13



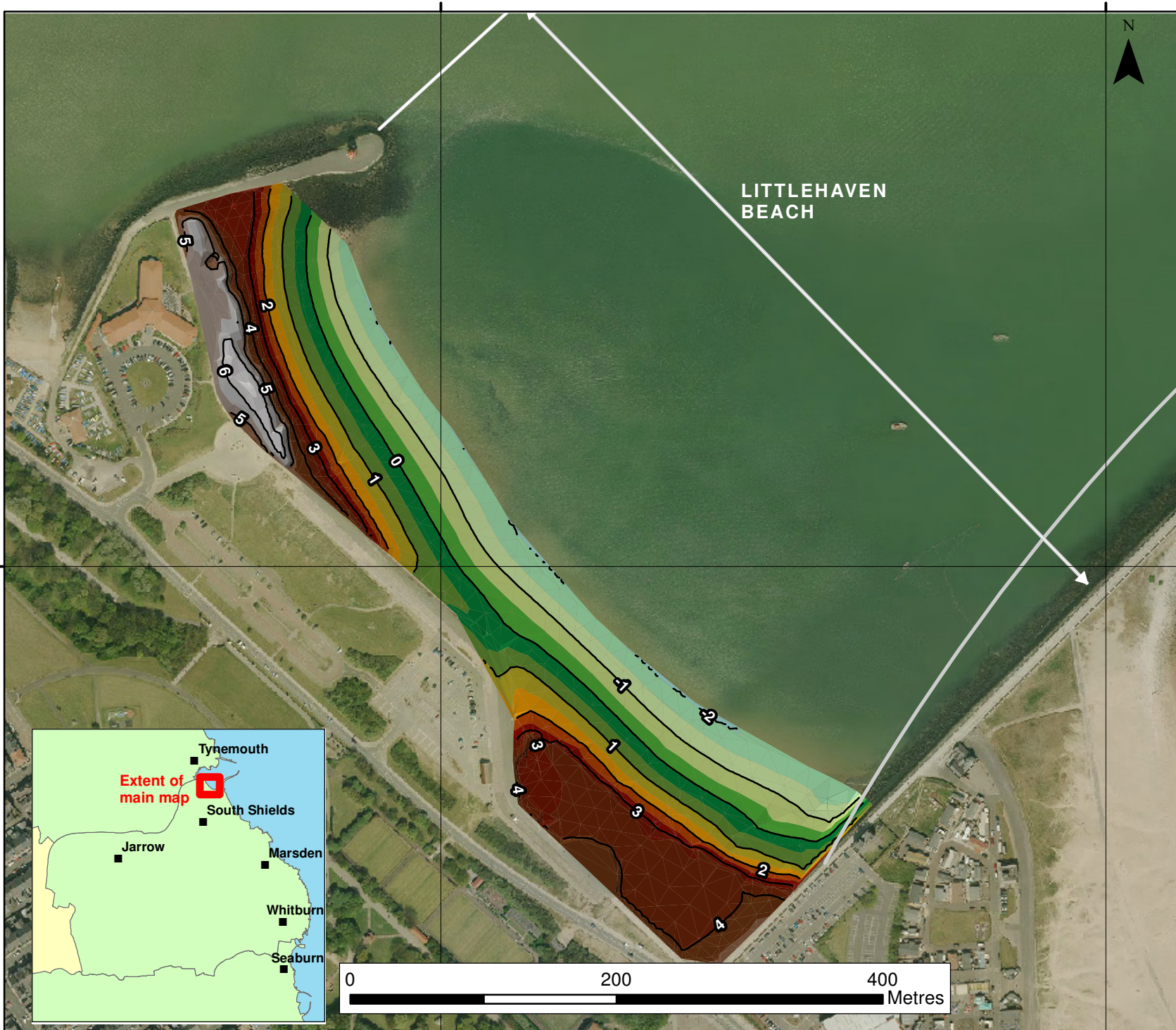
Profiles: 1bSS14



Profiles: 1bSS17



Appendix B
Topographic Survey



KEY

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

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

Appendix B - Map 1a
Topographic Survey
Littlehaven Beach
South Tyneside Council

Update Report 5
 Partial Measures Survey
 Spring 2013

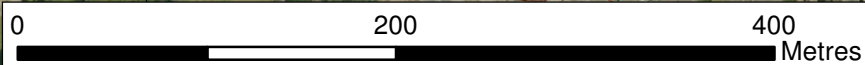
Halcrow
 A CH2M HILL COMPANY
 Halcrow Group Ltd, Lyndon House, 62 Hagley Road, Edgbaston, Birmingham, B16 8PE
 Tel: +44 (0)121 456 2345
 Fax: +44(0)121 456 1569
 www.halcrow.com

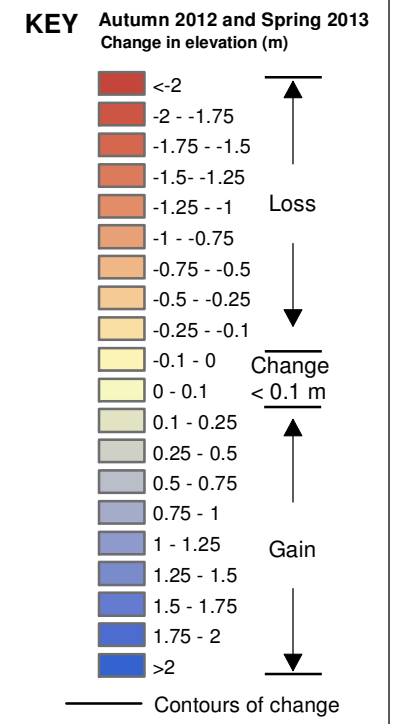
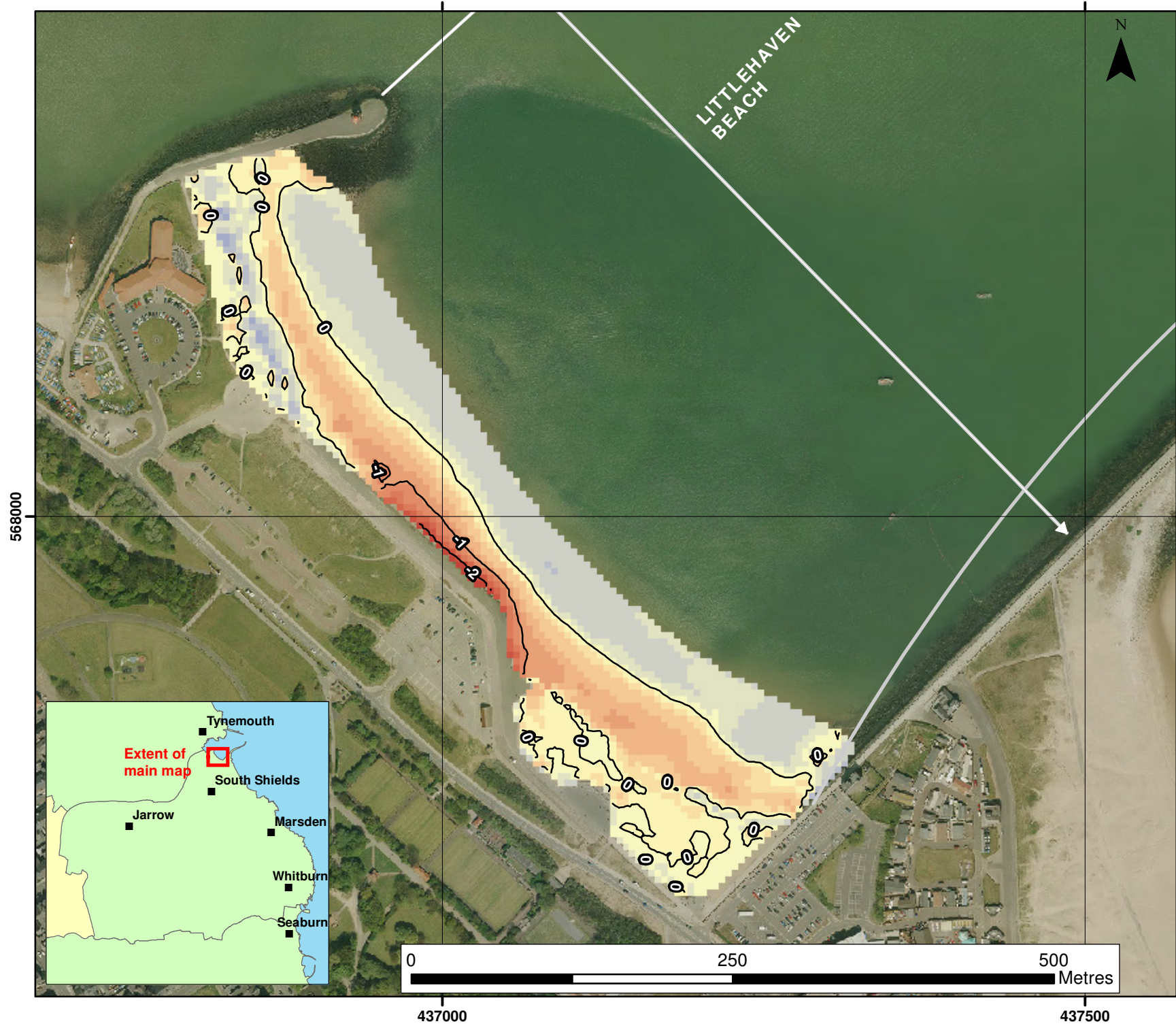
Photography courtesy of North East Coastal Observatory
 www.northeastcoastalobservatory.org.uk

568000

437000

437500





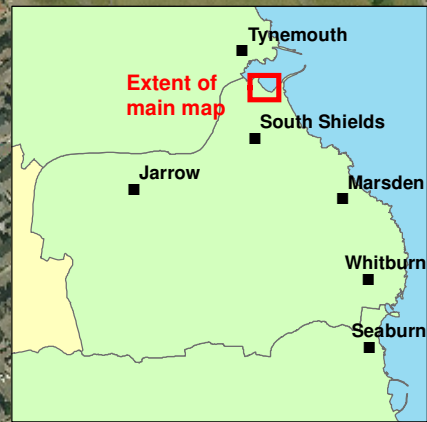
Client: North East Coastal Group
Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Appendix B- Map 1b
Short-term
Elevation Change
Littlehaven
SouthTyneside Council

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Appendix C
Cliff Top Survey

Cliff Top Survey

Trow Quarry

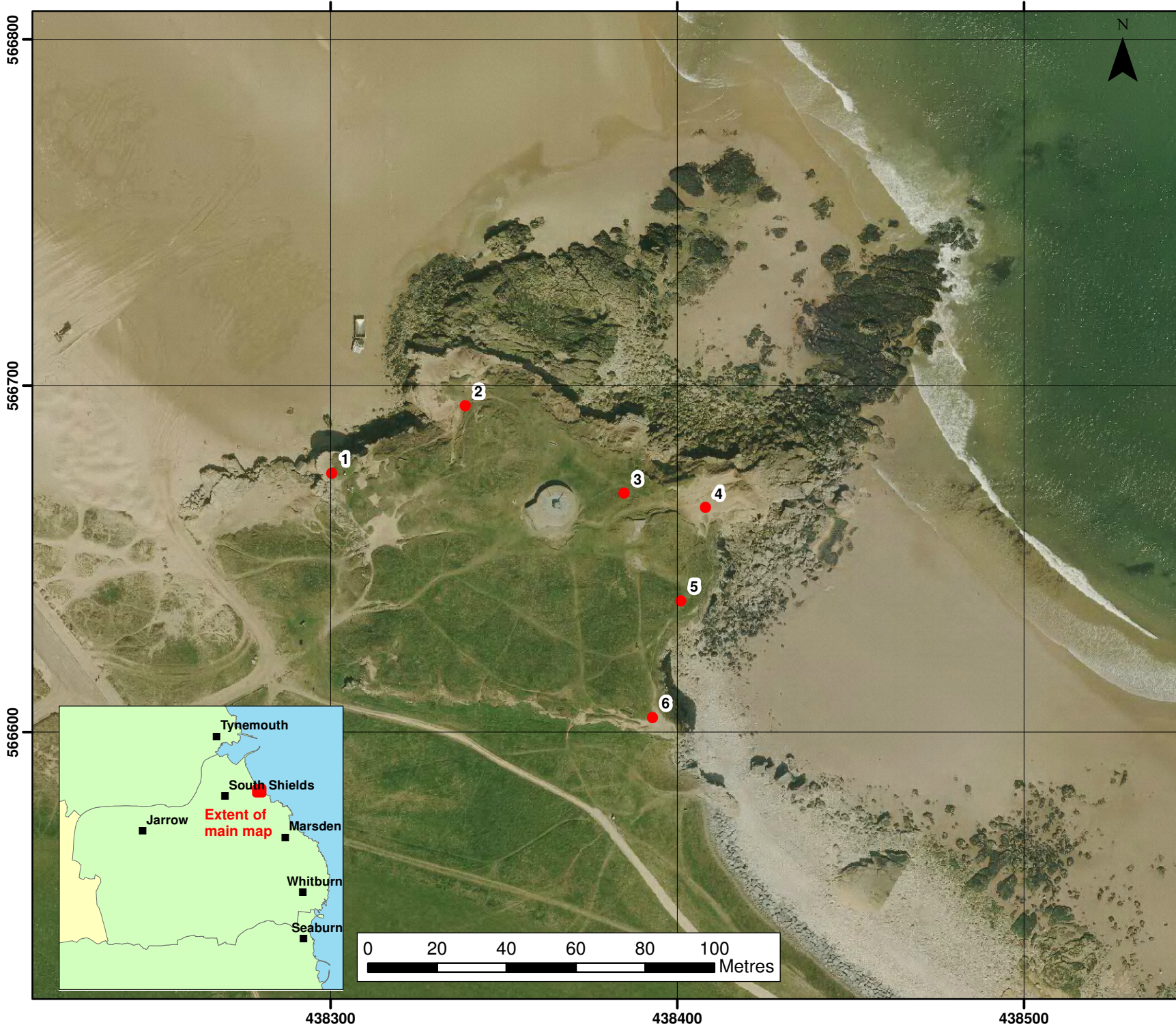
Six ground control points have been established at Trow Quarry (Figure C1). The maximum separation between any two points varies along the coast, reflecting the degree of risk from the erosion.

The cliff top surveys at Trow Quarry are undertaken bi-annually. Measurements are taken from a fixed ground control point along a fixed bearing to the edge of the cliff top.

Table C1 provides baseline information about these ground control points and results from the 2011 (baseline) survey showing the position from the ground control point to the edge of the cliff top along the defined bearing. Future reports will show results from subsequent surveys and provide a means of assessing erosion since the baseline survey.

Table C1 – Cliff Top Surveys at Trow Quarry

Ground Control Point Details					Distance to Cliff Top (m)			Total Erosion (m)		Erosion Rate (m/year)
Ref	Easting	Northing	Level (mODN)	Bearing (°)	Baseline Survey (Sept 2011)	Previous Survey (Nov 2012)	Present Survey (Mar 2013)	Baseline (Sept 2011) to Present (March 2013)	Previous Survey (Nov 2012) to Present (March 2013)	Baseline (Sept 2011) to Present (March 2013)
1	tbc	tbc	tbc	tbc	7.0	7.0	7.0	0.0	0.0	0.0
2	tbc	tbc	tbc	tbc	9.4	9.4	9.4	0.0	0.0	0.0
3	tbc	tbc	tbc	tbc	7.0	7.4	7.3	0.3	-0.1	0.2
4	tbc	tbc	tbc	tbc	10.5	10.4	11.1	0.7	0.7	0.5
5	tbc	tbc	tbc	tbc	7.0	6.5	7.2	0.2	0.7	0.2
6	tbc	tbc	tbc	tbc	10.2	10.3	10.2	0.0	-0.1	0.0



KEY

- Cliff top survey locations

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Appendix C- Map 1
Cliff Top Survey
Trow Quarry
South Tyneside Council

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