

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



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

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

Glossary of Terms

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

Preamble

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

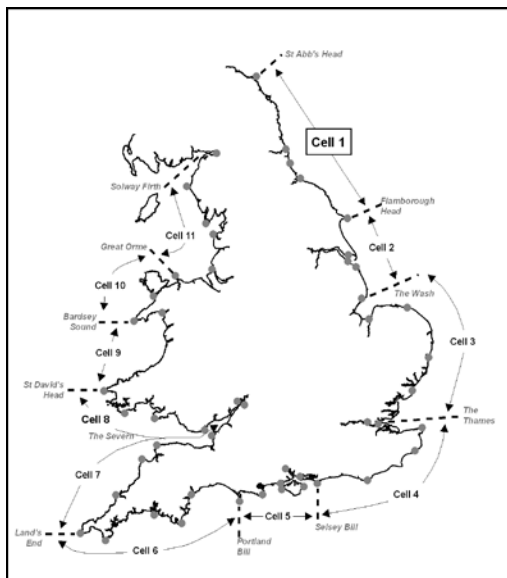


Figure 1 Sediment Cells in England and Wales

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

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

The beach profile surveys, topographic surveys and cliff top recession surveys are undertaken as a 'Full Measures' survey in autumn/early winter every year. Some of these surveys are then repeated the following spring as part of a 'Partial Measures' survey. To date the following reports have been produced:

Table 1 Analytical, Update and Overview Reports Produced to Date

Year		Full Measures		Partial Measures		Cell 1 Overview Report
		Survey	Analytical Report	Survey	Update Report	
1	2008/09	Sep-Dec 08	May 09	Mar-May 09		-
2	2009/10	Sep-Dec 09	Mar 10	Feb-Mar 10	July 10	-
3	2010/11	Aug-Nov 10	Feb 11	Feb-Apr 11	Aug 1	Sep 11
4	2011/12	Sep 2011	Aug 12	Mar-May 12	Feb 13	
5	2012/13	Sept 2012	Feb 13	Mar-Apr 13	May 13	
6	2013/14	Oct 2013	Feb 14	Mar-Apr 14	July 14(*)	

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

1. Introduction

1.1 Study Area

Durham Council's frontage extends from Ryhope Dene to Crimdon Beck. For the purposes of this report, it has been sub-divided into four areas, namely:

- Featherbed Rocks
- Seaham (Dawdon)
- Blast Beach
- Hawthorn Hive
- Blackhall Colliery

1.2 Methodology

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

- Full Measures survey annually each autumn/early winter comprising:
 - Beach profile surveys along eight transect lines
- Partial Measures survey annually each spring comprising:
 - Beach profile surveys along five transect lines
- Cliff top survey bi-annually at:
 - Seaham (Dawdon)

The location of these surveys is shown in Figure 2. The Partial Measures survey was undertaken along this frontage on 01 April 2014. During the survey the weather varied between sunny and dry during the survey at Featherbed Rocks and Hawthorn Hive to cloudy and dry at Seaham and Blast Beach, the wind was from the east at both locations and force 2 at Featherbed Rocks and Hawthorn Hive and force 3 at Seaham and Blast Beach. The sea state was calm at all locations.

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 has been 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 following 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

This Update Report presents the following:

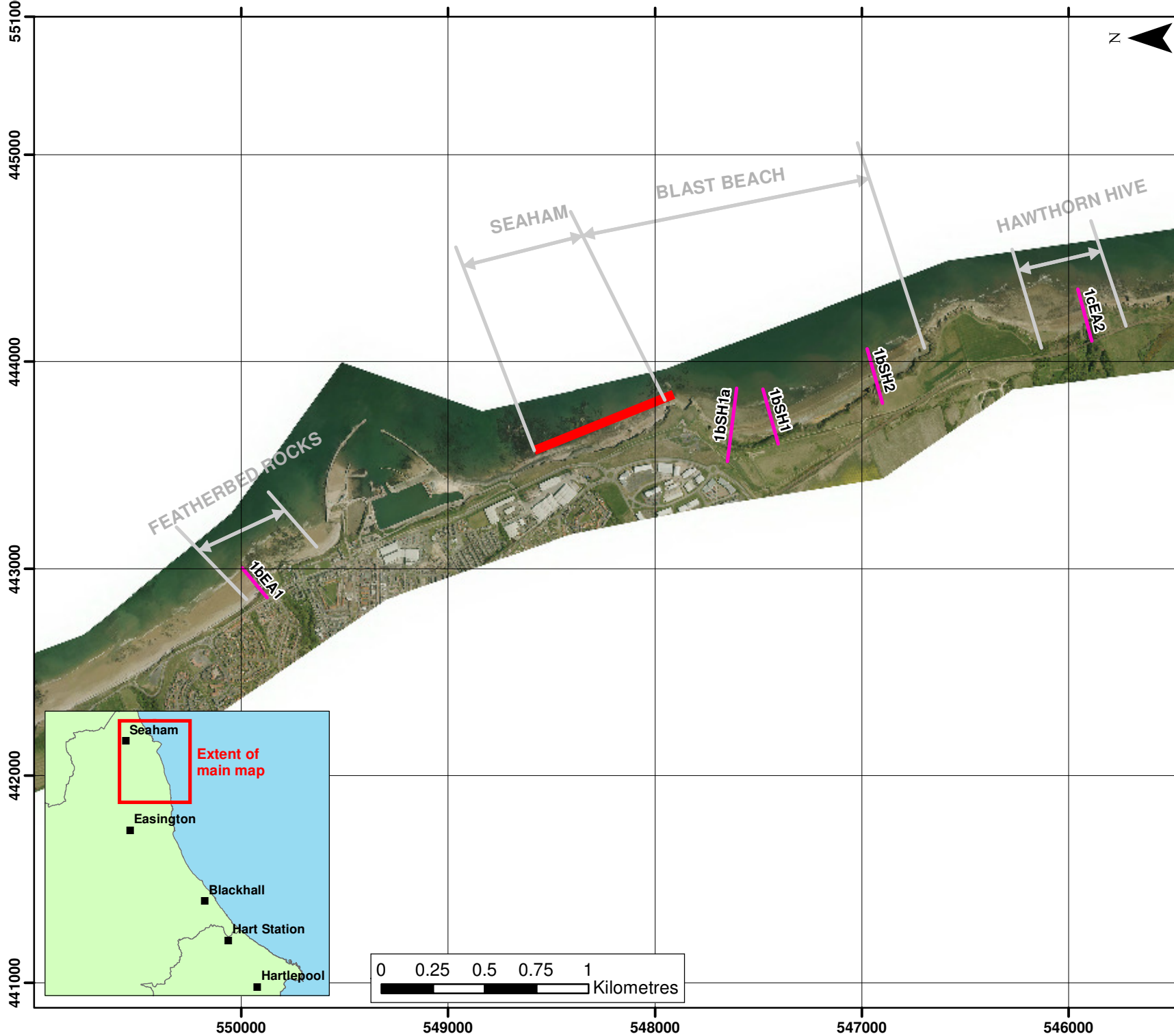
- description of the changes observed since the previous survey and an interpretation of the drivers of these changes Particular attention is paid to determining any residual impacts of the storm surge that occurred in December 2013 (Section 2);
- documentation of any problems encountered during surveying or uncertainties inherent in the analysis (Section 3);
- recommendations for 'fine-tuning' the programme to enhance its outputs (Section 4); and
- provides key conclusions and highlighting any areas of concern (Section 5).

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

2. Analysis of Survey Data

2.1 Featherbed Rocks

Survey Date	Description of Changes Since Last Survey	Interpretation
1 st April 2014	<p>Beach Profiles:</p> <p>Featherbed Rocks is monitored by one beach profile line (EA1) during the Partial Measures survey (Appendix A). The previous survey was October 2013.</p> <p>Profile EA1 has changed very little to 55m chainage. As in October 2013, the profile continues to show a more uneven profile at the base of the sea wall than earlier surveys between 55m and 80m reflecting the rock armour that is present there. Changes in profile elevation are up to 1m between 75m and 80m. From 80m chainage to 150m chainage the rocks on the foreshore are exposed and very little change in elevation is evident from the previous survey. The profile is near the lowest recorded since the start of monitoring.</p>	<p>The rocky nature of the foreshore means it is unlikely to undergo significant changes in morphology unless sediment is deposited on it. Previous reports indicate that a veneer beach tends to accumulate over the summer and is stripped off by winter storms, giving rise to small and localised changes in profile. Rock armour is present between 75m and 80m and small changes in the profile suggest slight deviations in the survey line around boulders.</p> <p>Longer term trends:</p> <p>The level of the beach in April 2014 was comparable with the lowest beach levels recorded in March 2010, April 2013 and October 13. This indicates that the absence of a veneer beach at the end of the previous summer has not resulted in any substantial change to the beach despite storm surge conditions in December 2013.</p>



KEY

Topographic Profiles

- Annual (Blue line)
- 6 monthly (Pink line)

Topographic Surveys

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

Cliff Top Monitoring Pegs

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

(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
Featherbed Rocks to
Hawthorne Hive
Durham County Council

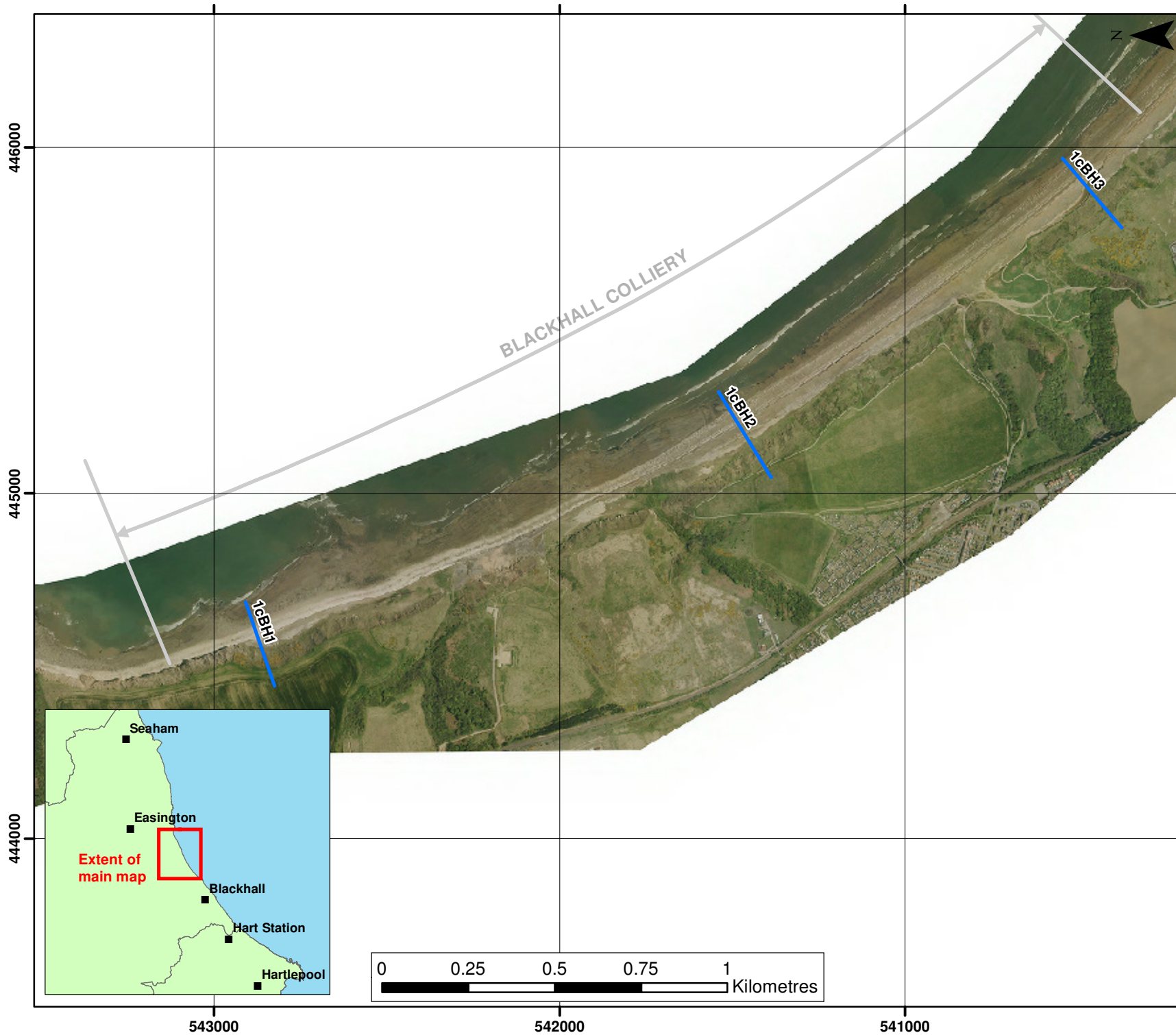
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 Partial Measures Survey
 Spring 2014

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 www.northeastcoastalobservatory.org.uk



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(Indicative survey extents shown)

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

**Figure 2 - Map 2
 Survey Locations
 Blackhall Colliery
 Durham County Council**

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2.2 Seaham (Dawdon)

Survey Date	Description of Changes Since Last Survey	Interpretation
4 th April 2014	<p>Cliff-top Survey:</p> <p>Three ground control points have been established along the cliff top at Dawdon (Figure B1). The separation between any two points is nominally 300m. These cliff top surveys are intended to inform on erosion rates of the undefended sea cliffs extending south of the rock armour revetment to the south of Seaham Harbour. The cliff top surveys at Dawdon are undertaken bi-annually.</p> <p>Measurements are taken from a fixed ground control point along a fixed bearing to the edge of the cliff top. Appendix B provides results from the April 2014 survey showing the position from the ground control point to the edge of the cliff top along the defined bearing and changes since the November 2008 baseline survey.</p> <p>The cliff monitoring data show no change in the last 6 months.</p>	<p>None of the three ground control points showed any change in the last 6 months</p> <p>Longer term trends:</p> <p>There is more confidence in the long-term pattern of change, where the cumulative measured erosion is greater than the error inherent in the technique.</p> <p>Ground Control Points 1 and 3 have both shown an average recession rate of 0.2m/yr since monitoring began in 2008. Point 2 shows no erosion in the longer term.</p>

2.3 Blast Beach

Survey Date	Description of Changes Since Last Survey	Interpretation
4 th April 2014	<p>Beach Profiles:</p> <p>Blast Beach is covered by three beach profile lines during the Partial Measures survey (Appendix A). Two of these commenced in November 2008, with 1bSH1a being added in October 2009.</p> <p>At 1bSH1a the crest of the eroding face of spoil at around 141m chainage and shows little since October 2013 .Between 141m and 215m chainage the beach has accreted by up to 2m and has advanced the area of gravel and sand nearly 20m seaward. From 215m to the end of the survey at 270m chainage, where the rocks are exposed, the beach has not changed.</p> <p>At 1bSH1 the profile is similar to the previous surveys as far as the beach crest at 75m. From 75m to 85m chainage the beach level has increased by up to 0.25m and dropped by around 0.1m between 85m and 82m chainage. Below 100m chainage to MLW the beach has accreted by up to 1.6m until around 155m where the profiles achieve similar elevations.</p> <p>At 1bSH2 the beach below the berm's previous crest at around 125m chainage has eroded by around 0.75m. The lower part of the beach has been eroded, reducing the beach elevation by around 1.2m and a small (0.4m high) cliff has developed at around 140m chainage. The photographs also show substantial change in the morphology of stack near to the line of 1bSH2.</p>	<p>There has been a variable pattern of accretion and erosion along this frontage over the winter of 2012/13. The greatest observed accretion has been at 1bSH1a and the greatest erosion at 1bSH2. This indicates a possible northwards transfer of material eroded from around 1bSH2 which has been deposited near 1bSH1 and 1bSH1a. The substantial change in morphology of the stack visible in the photos of the lower beach at 1bSH2 also indicates greater erosion at the southern end of the bay.</p> <p>Longer term trends:</p> <p>The beach at 1bSH1a shows an overall pattern of accretion since October 2012 and little change in the position of the small cliff in spoil since 2009. Over the same period, lowering of the beach around 1bSH2 is evident.</p>

2.4 Hawthorne Hive

Survey Date	Description of Changes Since Last Survey	Interpretation
1st April 2014	<p>Beach Profiles:</p> <p>Hawthorne Hive is covered by one beach profile line 1cEA2 during the Partial Measures survey (Appendix A). The survey report notes “unable to measure start of Section EA2 as the vegetation has choked out the section line and route over cliff faces” and therefore the April 2014 survey starts at 95m chainage, which is comparable with the previous three surveys. Until the partial measures survey in April 2013, a channel was present between 95m and 105m chainage. At the last survey in October 2013, this channel had infilled, but in the April 2014 survey the channel appears to be incising once more into the beach sediments. Between 107m chainage and 150m chainage the beach elevation has fallen by 1.2m through removal of gravel and sand to expose boulders.</p>	<p>Despite limited data collected between April and October 2013, the beach profile has returned to its lowest level since 2008.</p> <p>Longer term trends:</p> <p>The profiles show that the beach is undergoing progressive erosion. The limited recovery of beach elevation seen between April and October 2013 has been reversed and the beach is now at its lowest level since monitoring began in 2008. The infilling and incision of the channel seems to be an episodic process and is likely to reflect a combination of annual and seasonal variations in the flow of Hawthorn Burn and storm events which move sediment onshore to block the outflow of the burn.</p>

3. Problems Encountered and Uncertainty in Analysis

Individual Profiles

At Blast Beach, the surveyor was unable to measure the bottom and top of section 1a and the top of section 2 due to vegetation. Dense vegetation was also present at the top of section 1.

At Hawthorne Hive the surveyor was unable to measure start of Section EA2 due to vegetation cover.

Cliff Top Surveys

While there is low confidence in the short term erosion rates due to the short time span of the data collection and the likely error in the method, longer-term data is more reliable, and long-term erosion rates of up to 0.2m/yr are indicated.

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

No changes are recommended at the present time.

5. Conclusions and Areas of Concern

- At Featherbed Rocks the level of the beach in April 2014 continues to be very low, with rocks on the foreshore exposed. However, no substantial change has occurred since the previous survey. This lowering is therefore not attributable to the storm surge.
- At Seaham Cliffs, the survey data indicates that the average recession rate since monitoring began in 2008 is around 0.2m/yr. Apparent short term changes are likely to be error.
- At Blast Beach colliery spoil still prevents the sea from actively eroding the cliffs. However, there have been significant changes in the beach profile. The accretion of the beach at the northern end of the bay and its erosion at the southern end of the bay may indicate a north-south transfer of material within the bay.
- At Hawthorn Hive the limited recovery of the beach profile between the April and October 2013 survey has been reversed and beach levels are now at their lowest since monitoring began in 2008. This may reflect an impact of the storm surge.

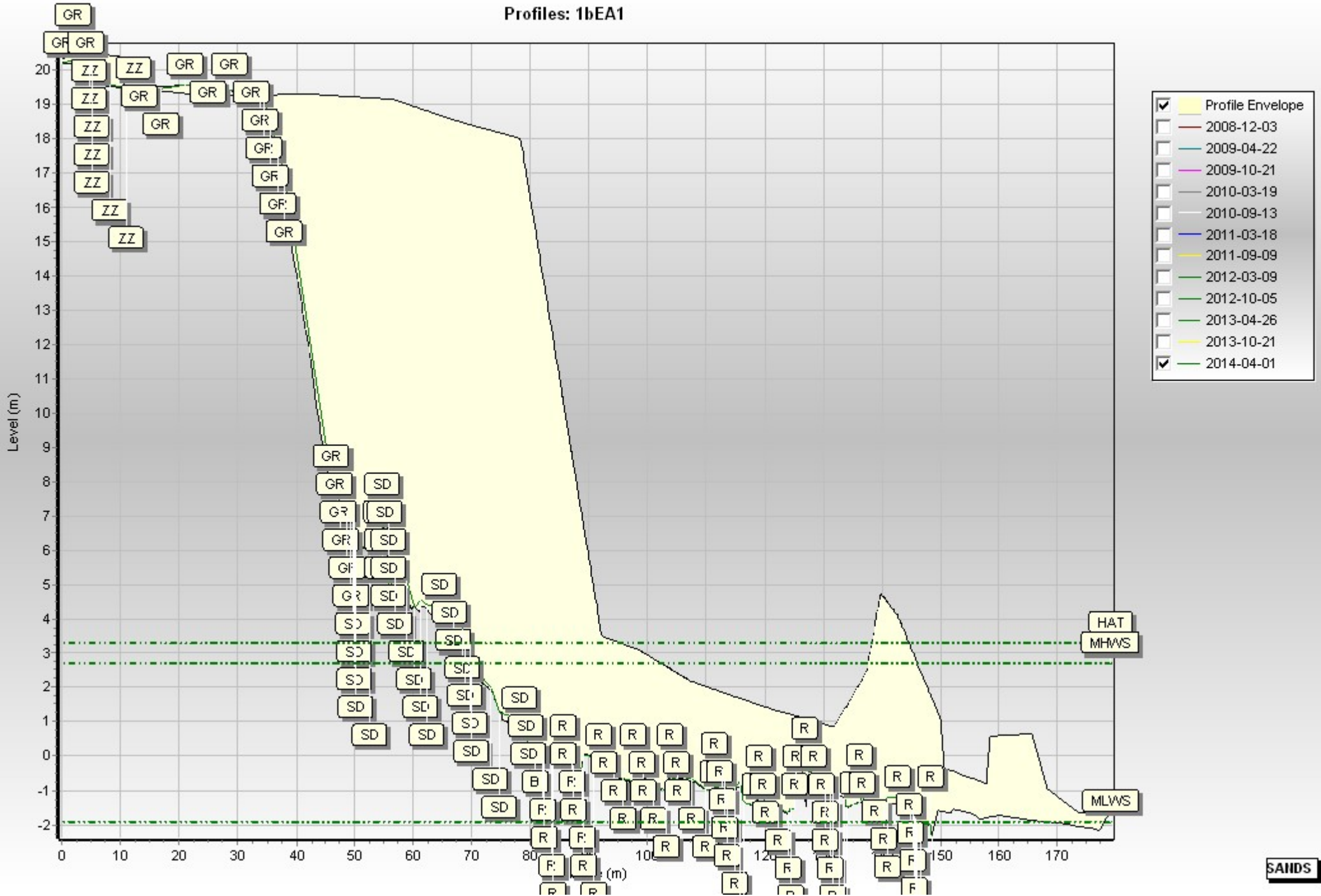
Appendices

Appendix A
Beach Profiles

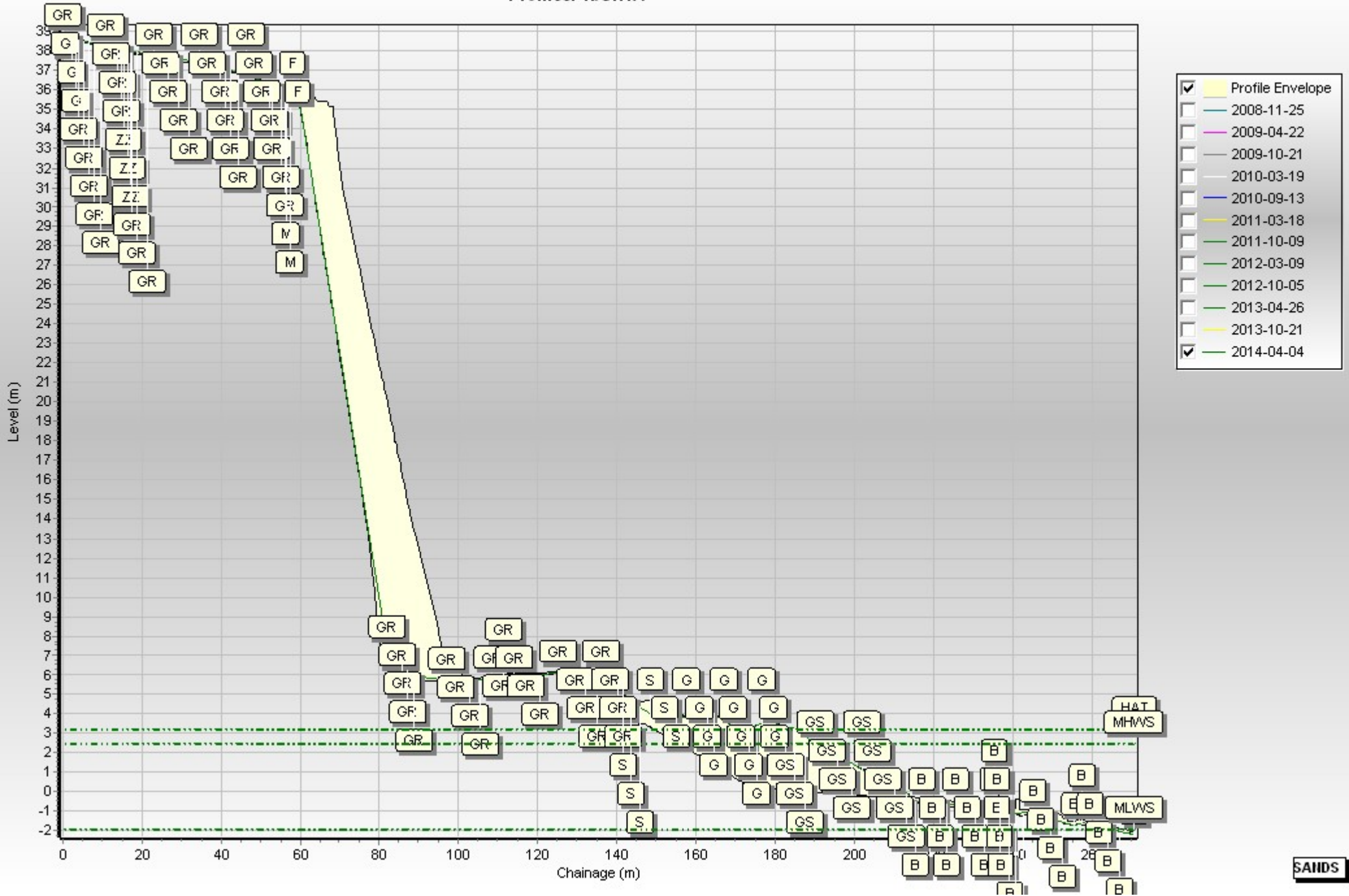
The following sediment feature codes are used on some profile plots:

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

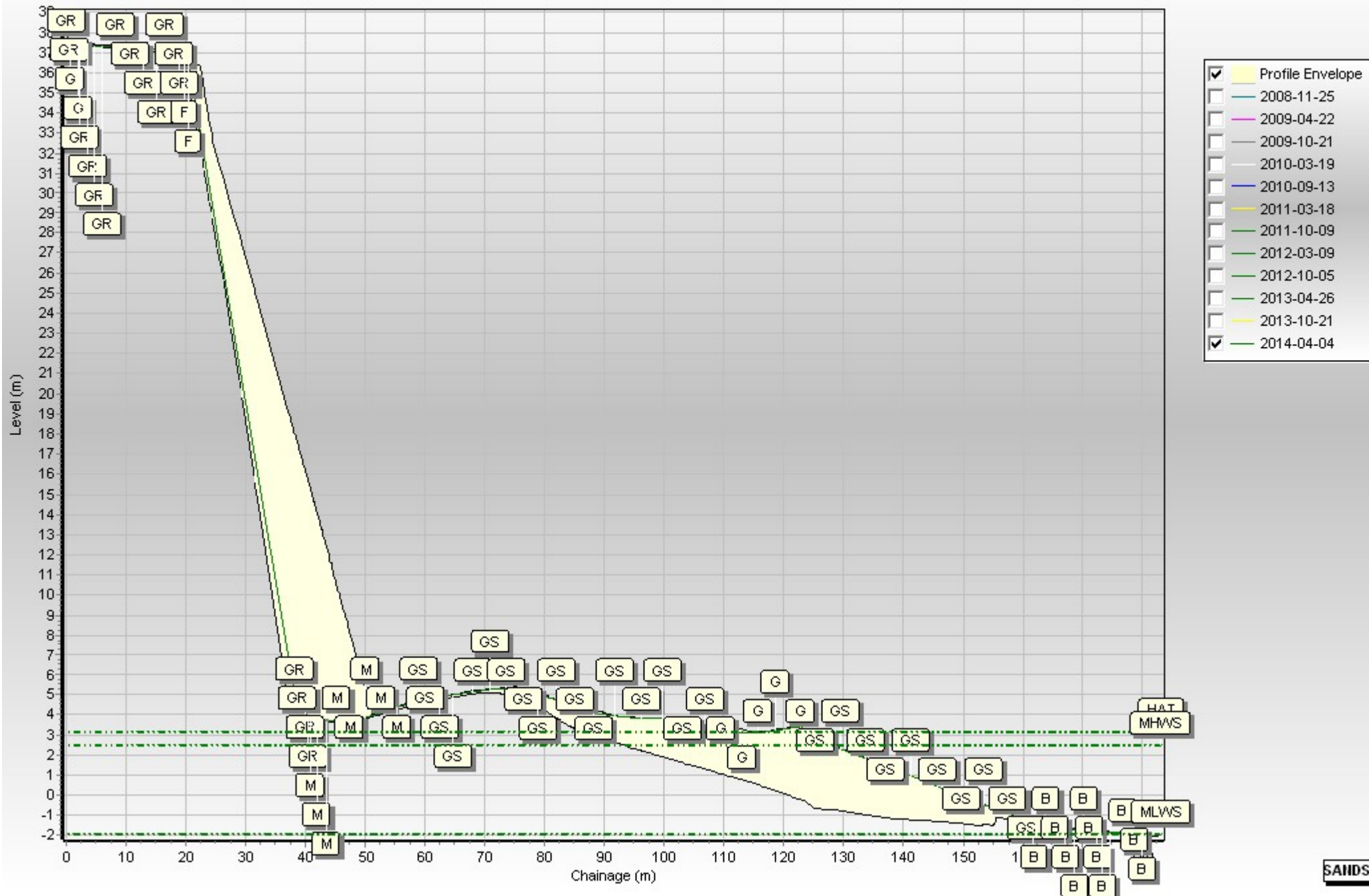
Profiles: 1bEA1



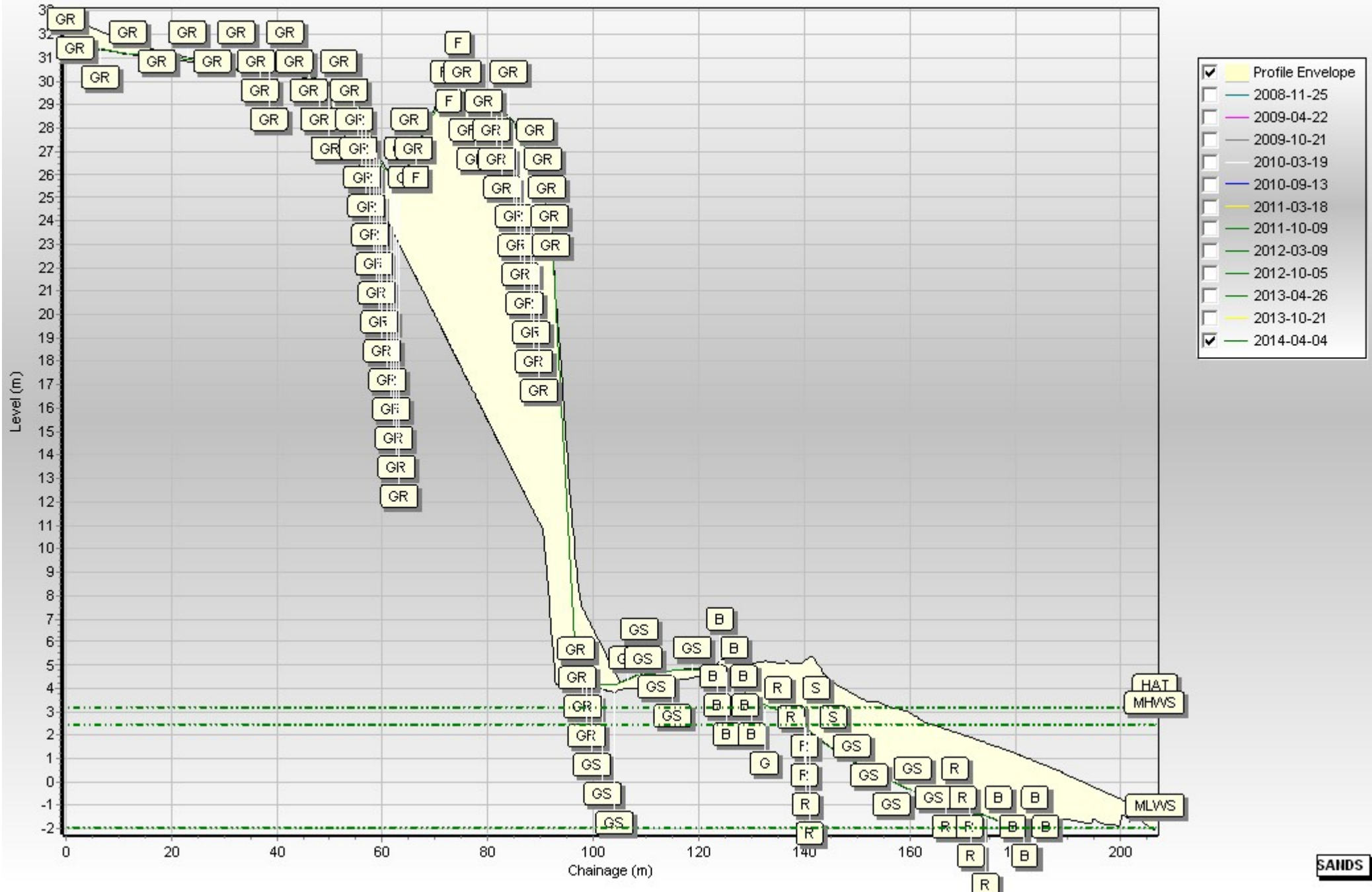
Profiles: 1bSH1A



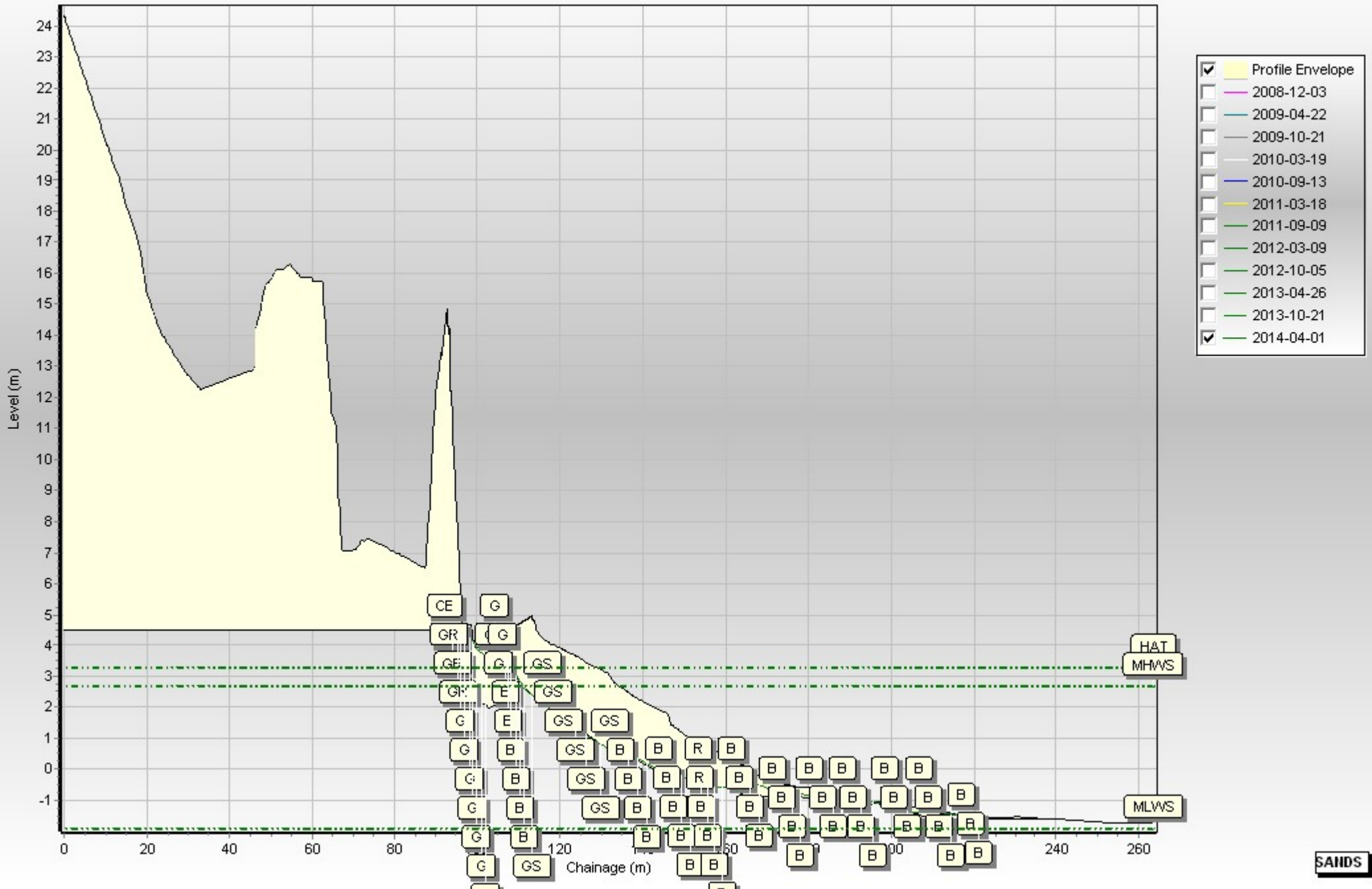
Profiles: 1bSH1



Profiles: 1bSH2



Profiles: 1cEA2



Appendix B
Cliff Top Survey

Cliff Top Survey

Seaham (Dawdon)

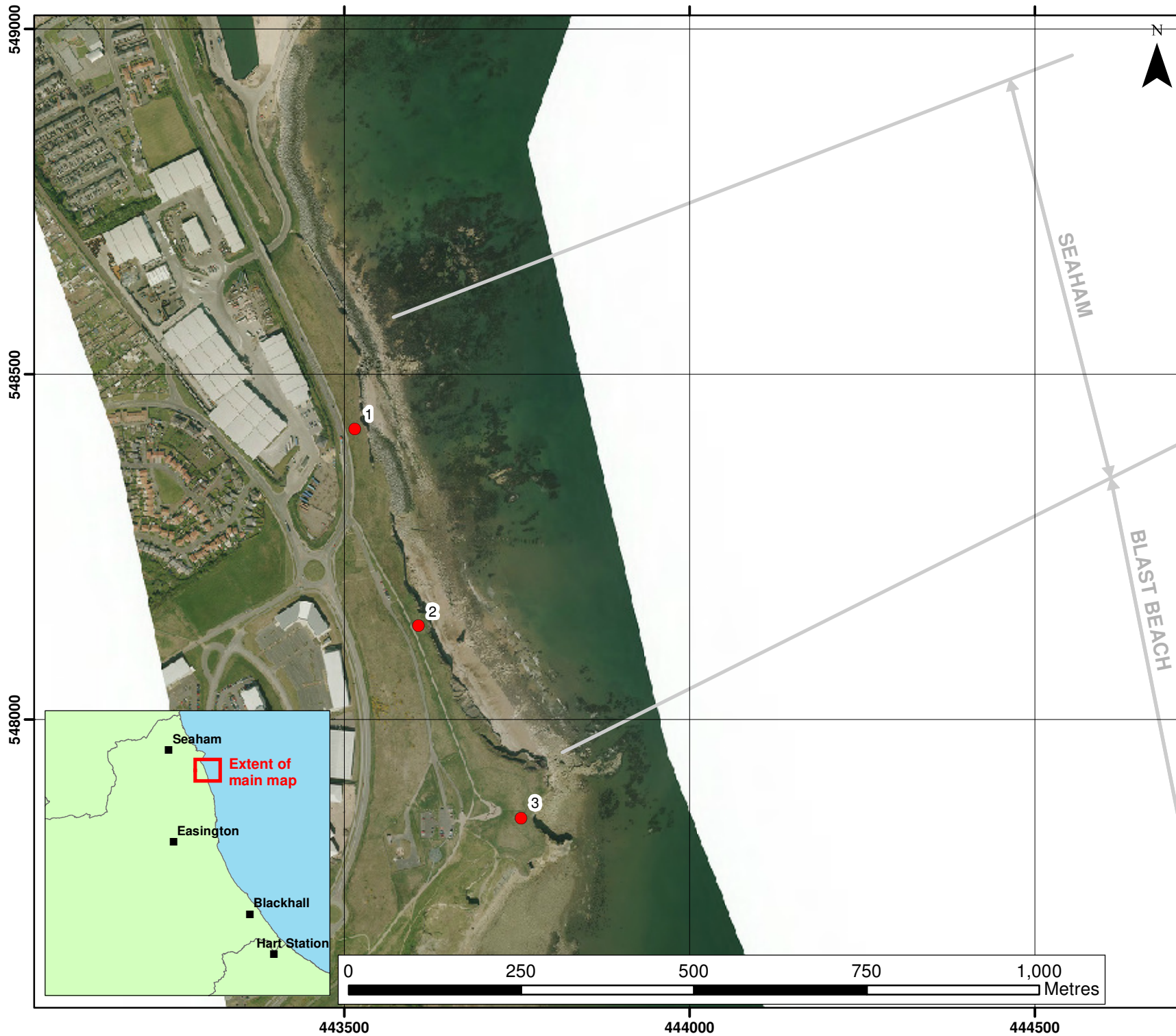
Three ground control points have been established at Dawdon (Figure B1). The maximum separation between any two points varies along the coast, reflecting the degree of risk from the erosion.

The cliff top surveys at Dawdon 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 B1 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 B1 – Cliff Top Surveys at Dawdon

Ground Control Point Details				Distance to Cliff Top (m)			Total Erosion (m)		Erosion Rate (m/year)
Ref	Easting	Northing	Bearing (°)	Baseline Survey (Nov 2008)	Previous Survey (Oct 2013)	Present Survey (April 2014)	Baseline (Nov 2008) to Present (April 2014)	Previous (Oct 2013) to Present (April 2014)	Baseline (Nov 2008) to Present (April 2014)
1	443515.4	548421.7	70	16.1	15.2	15.2	-0.9	0.0	-0.2
2	443607.8	548136.3	90	13.3	13.3	13.4	0.1	0.1	0.0
3	443756.1	547858.5	95	14.8	13.6	13.5	-1.3	-0.1	-0.2



KEY

- Ground Control Points

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

**Appendix B - Map 1
 Ground Control Points
 Seaham
 Durham County Council**

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