



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



**Durham Council
Final Report**

February 2013

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Abbreviations and Acronyms

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

Water Levels Used in Interpretation of Changes

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

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).

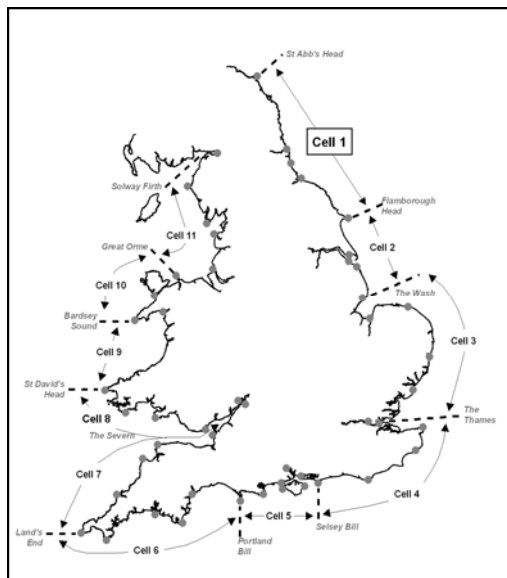


Figure 1 Sediment Cells in England and Wales

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	Sept-Dec 08	May 09	Mar-May 09	June 2009	-
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	Feb 13 (*)	

(*) The present report is **Update Report 4** and provides an analysis of the 2012 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:

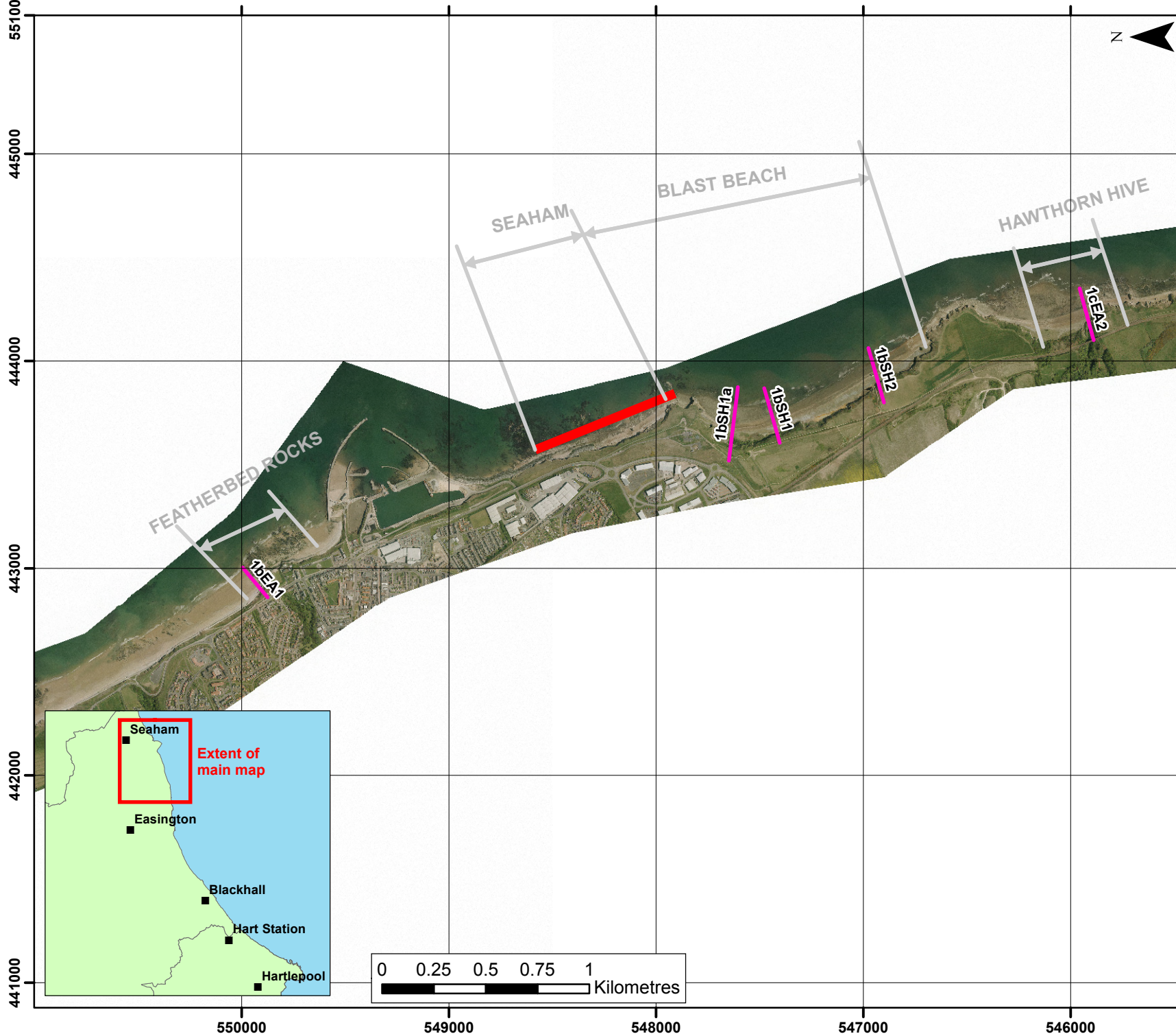
- Full Measures survey annually each autumn/early winter comprising:
 - Beach profile surveys along eight. transect lines
- Partial Measures survey annually each spring comprising:
 - Beach profile surveys along five. transect lines
- Cliff top survey bi-annually at:
 - Seaham (Dawdon)

The location of these surveys is shown in Figure 2. The Partial Measures survey was undertaken along this frontage on 3rd March 2012. During this time weather conditions were dry and cloudy, with a force 4 wind west and the sea state was calm.

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

- 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)

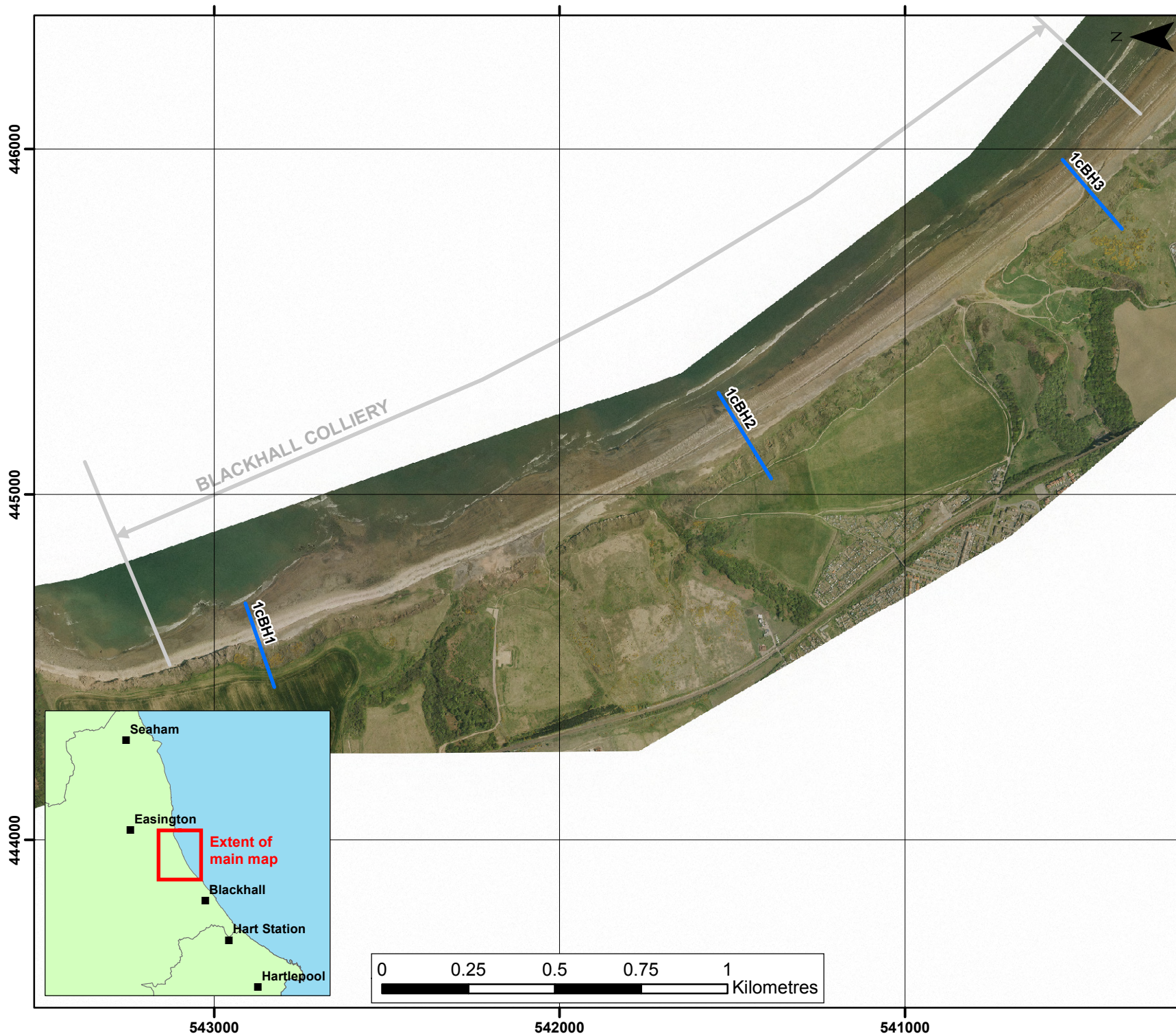
Client: North East Coastal Group
 Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

Figure 2 - Map 1
Survey Locations
Featherbed Rocks to
Hawthorne Hive
Durham County Council

Update Report 4
 Partial Measures Survey
 Spring 2012

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KEY

Topographic Profiles

— Annual

— 6 monthly

Topographic Surveys

⊠ 6 monthly

⊠ yearly

⊠ 5 yearly

Cliff Top Monitoring Pegs

■ 50m centres

■ 100m centres

■ 300m centres

(Indicative Survey Extents shown)

Client: North East Coastal Group

Project: Cell 1 Regional Coastal Monitoring Programme 2011 to 2016

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

Update Report 4
Partial Measures Survey
Spring 2012

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2. Analysis of Survey Data

2.1 Featherbed Rocks

Survey Date	Description of Changes Since Last Survey	Interpretation
9 th March 2012	<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 September 2011.</p> <p>In the previous survey, rocks were exposed at the lower foreshore but a veneer of sand covered them in the mid profile. However, in the current survey, the sand veneer has been eroded to expose a greater area of rocky shore platform. The irregular form of the upper beach in the September 2011 survey was due to the surveyors picking out individual rocks within the armour at the toe of the sea wall to give high resolution data. In contrast, the March 2012 survey points were more widely spaced, giving a lower resolution profile and therefore the morphology of the upper beach is not thought to have changed. The cliff behind the promenade remains stable in position and form.</p>	<p>The sand veneer had been eroded from the beach over the winter of 2011/12.</p> <p>Longer term trends:</p> <p>The level of the beach in March 2012 was low. The most recent survey is comparable with the lowest beach levels, recorded in March 2010. However, overall the profiles change very little.</p>

2.2 Seaham (Dawdon)

Survey Date	Description of Changes Since Last Survey	Interpretation
9 th March 2012	<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 March 2011 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 are inconclusive, and suggest that cliff have advanced in the last 6 months. This result is an artefact of errors in the survey data masking any short term change in cliff position.</p>	<p>All of the ground control points showed cliff advance since the previous survey in October 2011. As a result there is low confidence in the cliff recession data.</p> <p>Longer term trends:</p> <p>Ground Control Points 1 and 3 has shown an average recession rate of 0.3m/year since monitoring began in 2008. Point 2 has shown no erosion.</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. Additional data on cliff changes will provided by an analysis of aerial photography planned for completion in 2013.</p>

2.3 Blast Beach

Survey Date	Description of Changes Since Last Survey	Interpretation
9 th March 2012	<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 SH1a being added in October 2009.</p> <p>At SH1a the March 2012 and October 2010 surveys are very similar, showing stability overall. The main noticeable change is the appearance of a small berm between 140 and 150m chainage, which is seaward of the spoil cliff face and above HAT. Below MHWS the beach has eroded by 0.4m between 160 and 175m chainage.</p> <p>SH1 shows stable levels landward of the beach berm at 75m chainage, while seaward of the berm there has been around 0.5m of accretion from 75 to 135m chainage.</p> <p>SH2 the beach below the berm's crest has eroded by up to 0.5m over 130 to 180m chainage.</p>	<p>There has been a variable pattern of accretion and erosion along this frontage over the 2011/12 winter. The observed localised accretion is likely to be the result of alongshore sediment transport and does not suggest that new material from offshore has entered the beach.</p> <p>Longer term trends:</p> <p>Profile SH2 shows obvious progressive recession with the beach moving landward each year. Conversely both, SH1a and SH1 show fluctuations in the height and width of the beach with no obvious trend through time.</p>

2.4 Hawthorne Hive

Survey Date	Description of Changes Since Last Survey	Interpretation
9 th March 2012	<p>Beach Profiles:</p> <p>Hawthorne Hive is covered by one beach profile line (EA2) during the Partial Measures survey (Appendix A). The beach levels are comparable with the last survey, undertaken in September 2011. Above the HAT line the level of the channel and upper beach is high compared to the previous surveys. Between 115 and 160m chainage the beach has eroded by up to 0.5m. The lower beach, beyond 160m chainage has not changed between September 2011 and March 2012.</p>	<p>The beach profile is at an historically low level, with only the March 2011 beach level being lower.</p> <p>Longer term trends:</p> <p>There are no obvious trends in the available beach profiles. The profiles carried out in the spring tend to be lower than those carried out in the autumn, which is to be likely to result from the usual pattern of erosion through the winter and accretion during the summer.</p>

3. Problems Encountered and Uncertainty in Analysis

Individual Profiles

At Featherbed Rocks, profile EA2, there was some variation on accuracy in central section of the profile of the survey, due to the difficulty in surveying the vegetated cliffs.

At the Blast Beach profile, SH1a, the survey was unable to measure bottom of cliff due to vegetation.

Cliff Top Surveys

The cliff top position surveys at Dawdon are assumed to have a limit of accuracy of $\pm 0.1\text{m}$ due to the techniques used. Whilst a short term erosion rate has been calculated from these cliff top survey data, there is low confidence in the results due to the short time span of the data collection and the likely error in the method. Two of the three cliff data points show growth over the last six months, which is likely to be due to error. The longer-term rate of change is more meaningful, with cliffs either eroding at a low rate or remaining stable. Additional data on cliff recession rates will be derived from analysis of high resolution and map-accurate aerial photography, which will be documented in a separate report.

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

No changes are recommended at the present time.

5. Conclusions and Areas of Concern

- At Featherbed Rocks the level of the beach in March 2012 was low. The most recent survey is comparable with the lowest beach levels, recorded in March 2010. The lowering of the beach could be the precursor to a trend of erosion affecting the cliff. As a result, the beach level should be watched closely over the next few surveys to see if this is an erosive trend, or natural variation.
- The Dawdon Cliff survey data shows that the average recession rate since monitoring began in 2008 is around 0.3m per year although there is some uncertainty over the accuracy of the data.
- At Blast Beach there has been accretion and erosion along this frontage over the winter months. The observed accretion on the beach is likely to be the accumulation of sediment from the spoil or from along shore. There is no immediate cause for concern along this frontage. In the future the sea cliffs are likely to reactivate and erode back once the spoil has eroded from the beach.
- At Hawthorn Hive the beach profile is low compared to the other surveys, with only the March 2011 beach level being lower. However, the profiles show no reason for concern.

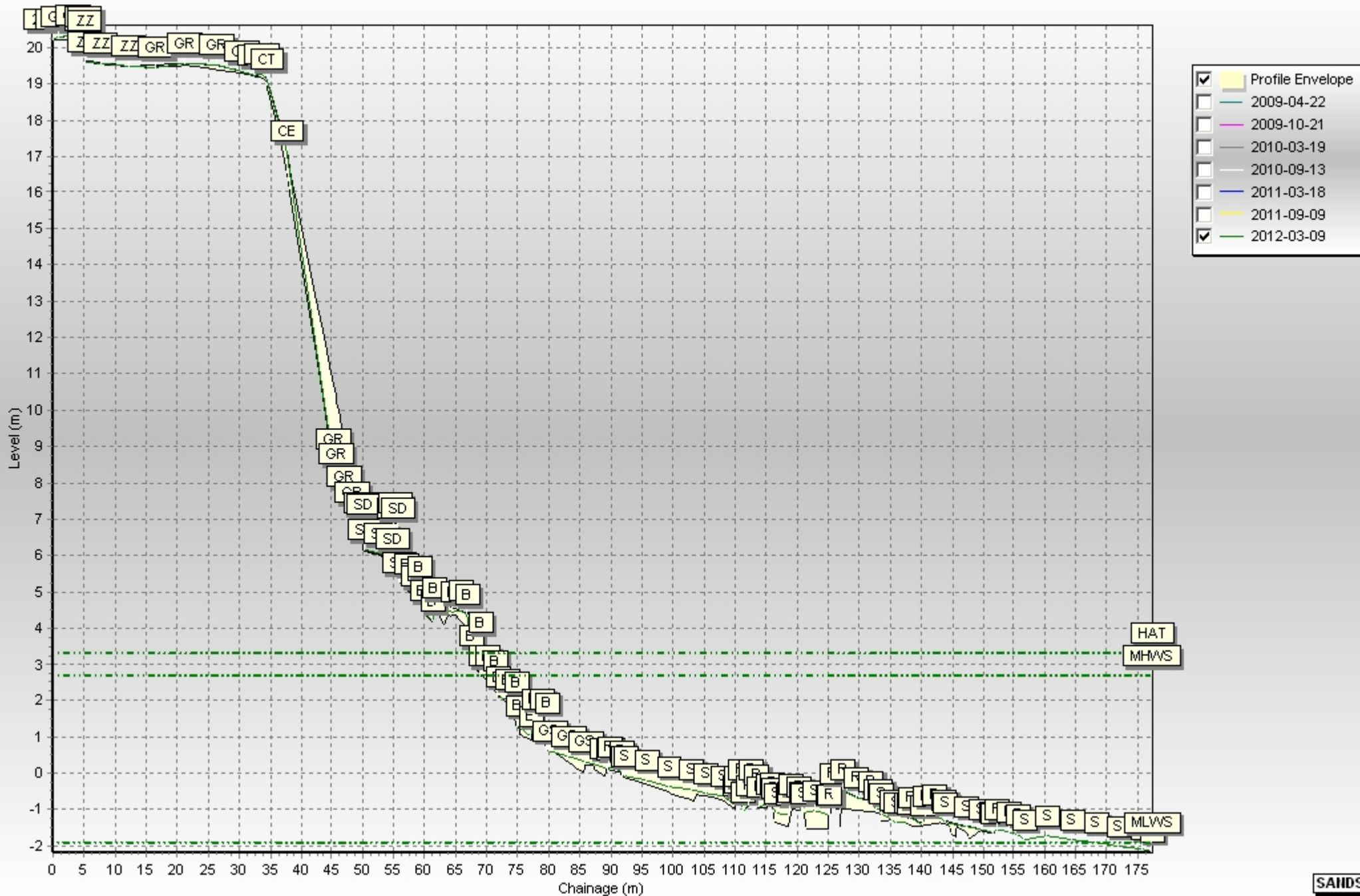
Appendices

Appendix A
Beach Profiles

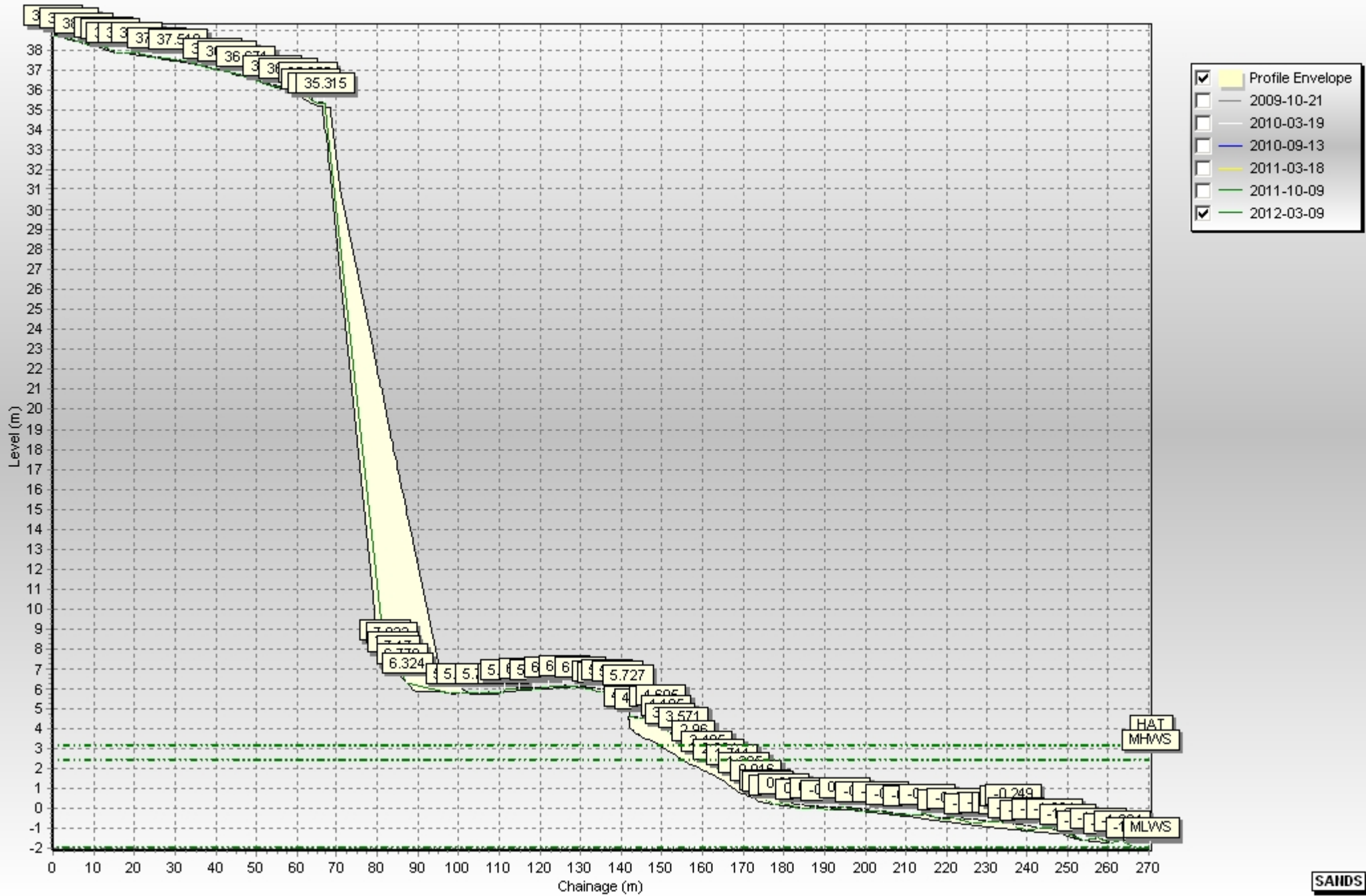
The following sediment feature codes are used on some profile plots:

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

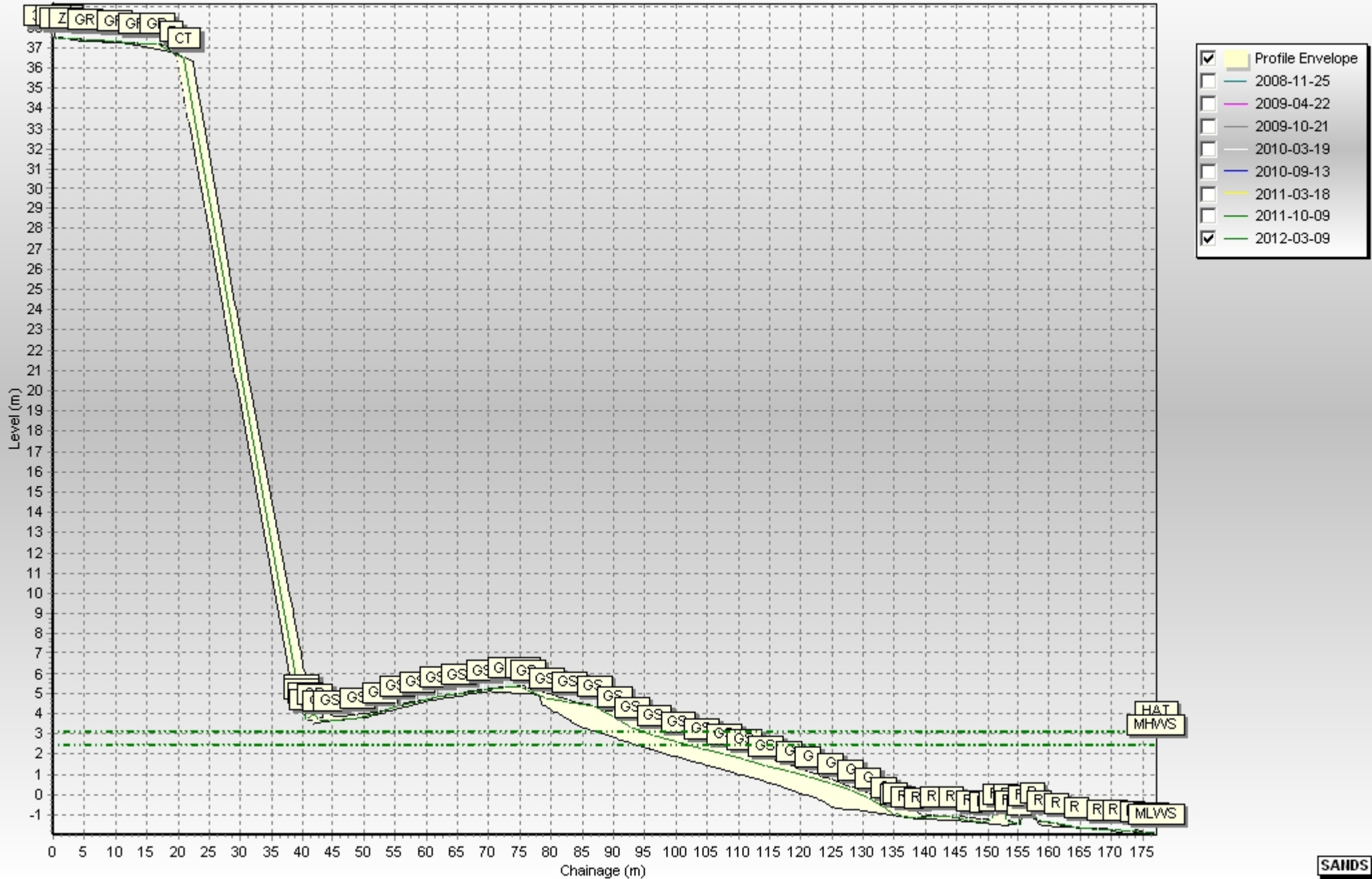
Beach Profiles: 1bEA1



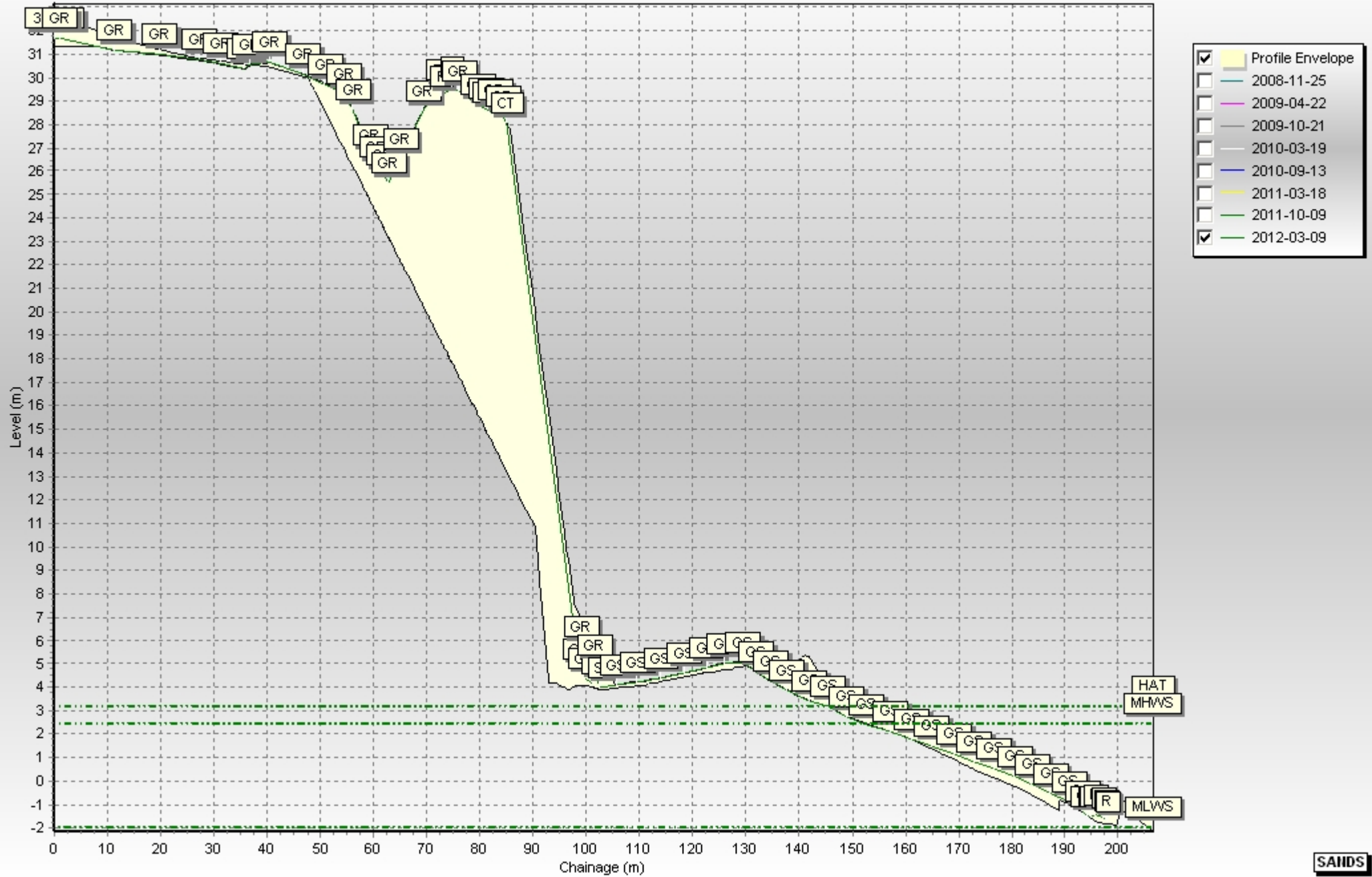
Beach Profiles: 1bSH1A



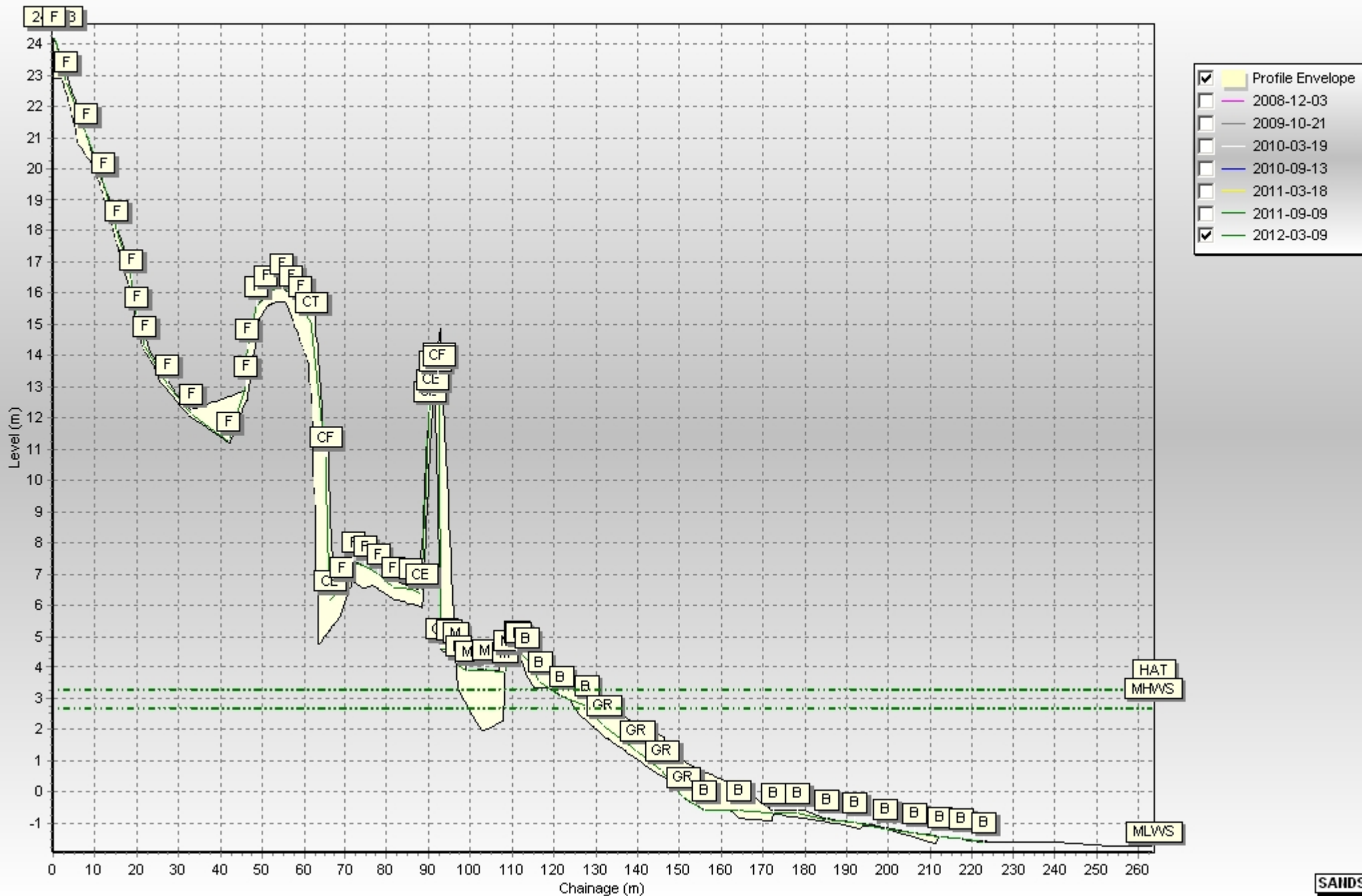
Beach Profiles: 1bSH1



Beach Profiles: 1bSH2



Beach Profiles: 1cEA2



Appendix B
Cliff Top Survey

Cliff Top Survey

Seaham (Dawdon)

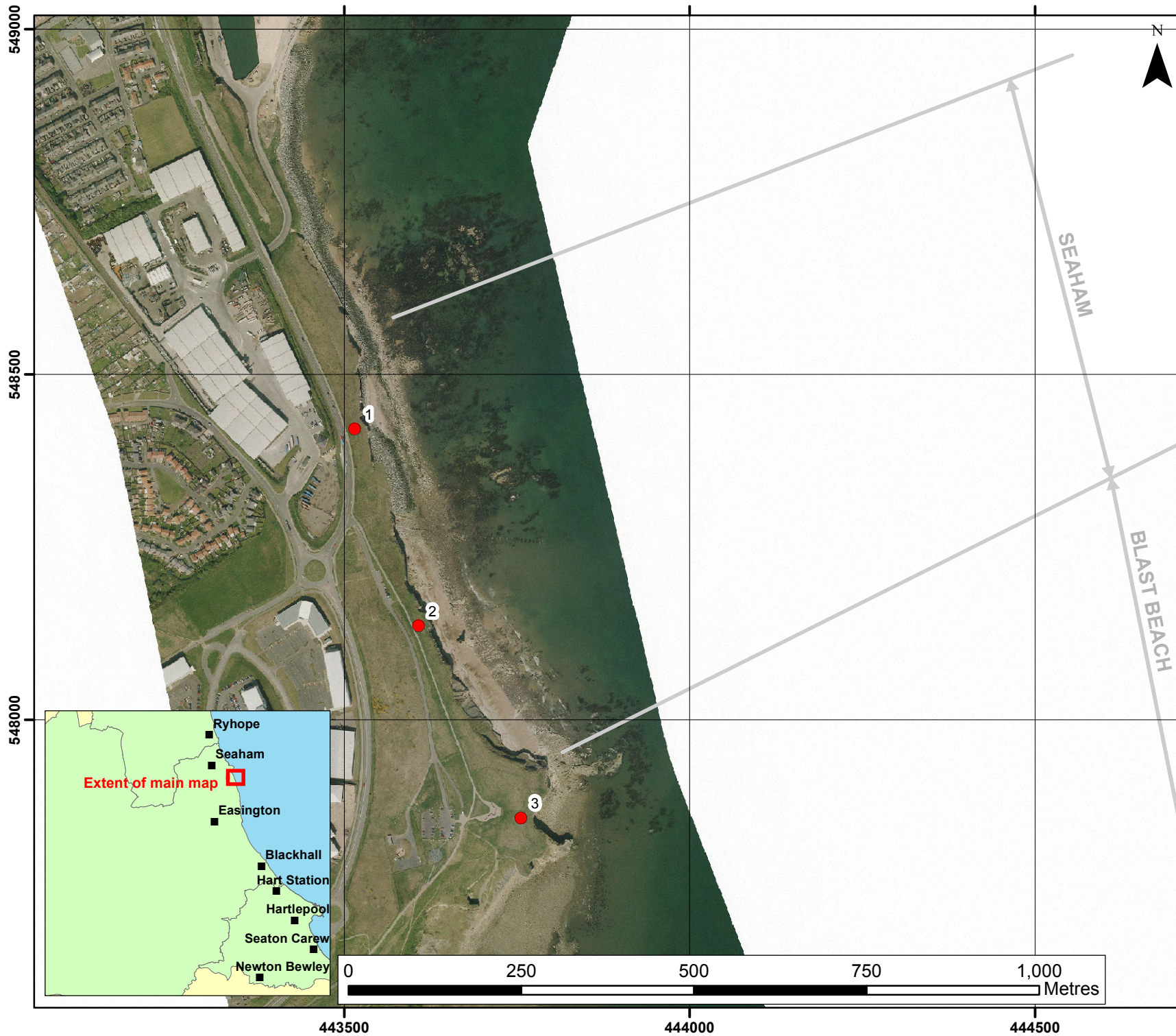
Three ground control points have been established at Dawdon (Figure B1). The maximum separation between any two points varies along the coast, reflecting the degree of risk from the erosion.

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 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 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

Ref	Distance to Cliff Top (m)			Total Erosion (m)			Erosion Rate (m/year)		
	Easting	Northing	Bearing (°)	Baseline Survey (Nov 2008)	Previous Survey (Oct 2011)	Present Survey (March 2012)	Baseline (Nov 2008) to Present (March 2012)	Previous (Oct 2011) to Present (March 2012)	Baseline (Nov 2008) to Present (March 2012)
1	443515.4	548421.7	70	16.1	15.1	15.2	-0.9	0.1	-0.3
2	443607.8	548136.3	90	13.3	13.2	13.4	0.1	0.2	0.0
3	443756.1	547858.5	95	14.8	13.4	13.9	-0.9	0.5	-0.3



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**

Update Report 4
 Partial Measures Survey
 Spring 2012



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