



**Cell 1 Regional Coastal Monitoring Programme
Analytical Report 1: 'Full Measures' Survey 2008**

**Hartlepool Borough Council
Final Report**

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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
MLWN	Mean Low Water Neap
MLWS	Mean Low Water Spring
m	metres
ODN	Ordnance Datum Newlyn

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). Within this frontage the coastal landforms vary considerably, comprising low-lying tidal flats with fringing salt marshes, hard rock cliffs that are mantled with glacial till to varying thicknesses, softer rock cliffs, and extensive landslide complexes.

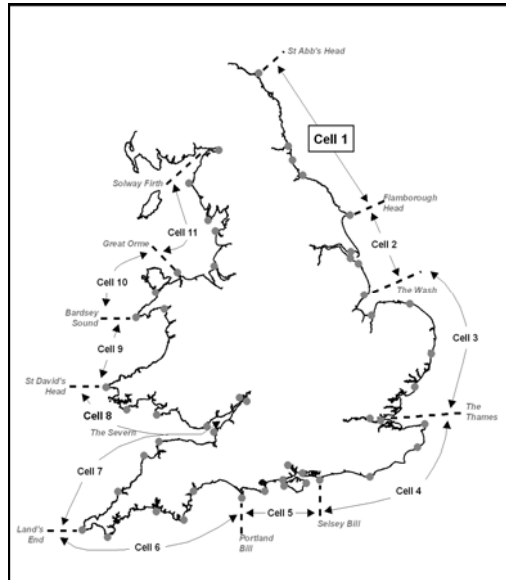


Figure 1 Sediment Cells in England and Wales

The programme commenced in its present guise in September 2008 and is managed by Scarborough Borough Council on behalf of the North East Coastal Group. It is funded by the Environment Agency, working in partnership with the following organisations.



The data collection, analysis and reporting is being undertaken as a partnership between the following organisations:



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.

Each year, an Analytical Report is produced for each individual authority, providing a detailed analysis and interpretation of the 'Full Measures' surveys.

This is followed by a brief Update Report for each individual authority, providing ongoing findings from the 'Partial Measures' surveys.

Annually, a Cell 1 Overview Report is also produced. This provides a region-wide summary of the main findings relating to trends and interactions along the entire Cell 1 frontage.

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		-

^(*) The present report is **Analytical Report 1** and provides an analysis of the 2008 'baseline' Full Measures survey for Hartlepool Borough Council's frontage.

In addition, separate reports are produced for other elements of the programme as and when specific components are undertaken, such as wave data collection, bathymetric and sea bed sediment data collection, aerial photography, and walk-over visual inspections.

For purposes of analysis, the Cell 1 frontage has been split into the sub-sections listed in the Table 2.

Table 2 Sub-divisions of the Cell 1 Coastline

Authority	Zone
Northumberland County Council	Spittal A
	Spittal B
	Goswick Sands
	Holy Island
	Bamburgh
	Beadnell Village
	Beadnell Bay
	Embelton Bay
	Boulmer
	Alnmouth Bay
	High Hauxley and Druridge Bay
	Lynemouth Bay
	Newbiggin Bay
	Cambois Bay
Blyth South Beach	
North Tyneside Council	Whitley Sands
	Cullercoats Bay
	Tynemouth Long Sands
	King Edward's Bay
South Tyneside Council	Littehaven Beach
	Herd Sands
	Trow Quarry (incl. Frenchman's Bay)
	Marsden Bay
Sunderland Council	Whitburn Bay
	Harbour and Docks
	Hendon to Ryhope (incl. Halliwell Banks)
Durham County Council	Featherbed Rocks
	Seaham
	Blast Beach
	Hawthorn Hive
	Blackhall Colliery
Hartlepool Borough Council	North Sands
	Hartlepool Headland
	Middleton
	Hartlepool Bay
Redcar & Cleveland Borough Council	Coatham Sands
	Redcar Sands
	Marske Sands
	Saltburn Sands
	Cattersty Sands (Skinningrove)
Scarborough Borough Council	Staithes
	Runswick Bay
	Sandsend Beach, Uppgang Beach and Whitby Sands
	Robin Hood's Bay
	Scarborough North Bay
	Scarborough South Bay
	Cayton Bay
Filey Bay	

1. Introduction

1.1 Study Area

Hartlepool Borough Council's frontage extends from Crimdon Beck in the north to the North Gare Breakwater in the south. For the purposes of this report, it has been sub-divided into four areas, namely:

- North Sands
- Hartlepool Headland
- Middleton
- Hartlepool Bay

1.2 Methodology

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

- Full Measures survey annually each autumn/early winter comprising:
 - Beach profile surveys along 9 no. transect lines
 - Topographic survey along part of North Sands (referred to as Hartlepool North or 'HN')
 - Topographic survey along Middleton (referred to as Hartlepool Central or 'HC')
 - Topographic survey along Hartlepool Bay (referred to as Hartlepool South or 'HS')
- Partial Measures survey annually each spring comprising:
 - Beach profile surveys along 9 no. transect lines
- Additionally, every five years (starting with 2008 as the baseline year), the Full Measures survey at Hartlepool North is extended to fully cover the whole of North Sands and Hartlepool Headland with a topographic survey. This extends across the boundary of jurisdiction between Hartlepool Borough Council and County Durham Council. For purposes of completeness, this report contains analysis of the full survey extent, including the area in County Durham Council's jurisdiction between Crimdon Park and Crimdon Beck.

The location of these surveys is shown in Figure 2. Also enclosed on the accompanying CD-rom is a file which can be opened in Google Earth showing the locations of the surveys.

The baseline Full Measures survey at Hartlepool North was undertaken in November 2008, when weather conditions were fair but windy. The sea state was rough. The survey at Hartlepool Central was also undertaken in November 2008, although weather conditions were fine and sunny and the sea state was flat and calm.

The survey at Hartlepool South, originally intended for incorporation in the Full Measures programme in 2008 was postponed and re-scheduled to be included in the spring 2009 Partial Measures programme. The reason for this was that a similar survey along most of Hartlepool South (extending south from Newburn Bridge to the Tees Estuary) was undertaken in December 2008 as part of the work associated with the Seaton Carew Coastal Strategy Study. To have undertaken two surveys of, mostly, the same frontage so close together would have been unnecessary duplication and postponing the survey until Partial Measures spring 2009 offered much better value from the surveying activities.

All data have been captured in a manner commensurate with the principles of the Environment Agency's *National Standard Contract and Specification for Surveying Services* and stored in a file format compatible with the software systems being used for the data analysis, namely SANDS and Arc-GIS. This data collection approach and file format is comparable to that being used on other regional coastal monitoring programmes, such as in the South East and South West of England.

Upon receipt of the data from the survey team, they are quality assured and then uploaded onto the programme's website for storage and availability to others and also input to SANDS and GIS for subsequent analysis.

The Analytical Report is then produced following a standard structure for each authority. This involves:

- 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.

SURVEY LOCATIONS

Topographic Profiles

- Annual
- Bi-Annual

Topographic Surveys

- 6 monthly
- yearly
- 5 yearly

Cliff Top Monitoring Pegs

- @ 50 centres
- @ 100 centres
- @ 300 centres

(Indicative Survey Extents shown)

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

**Figure 2 - Map 1
 Hartlepool Borough
 Council Frontage**

Analytical Report 1
 'Full Measures' Survey 2008

Drawing Scale 1:15,000 at A4

Drawn by: TC Date: 08/05/2009
 Checked by: NC Date: 08/05/2009
 Approved by: NC Date: 08/05/2009

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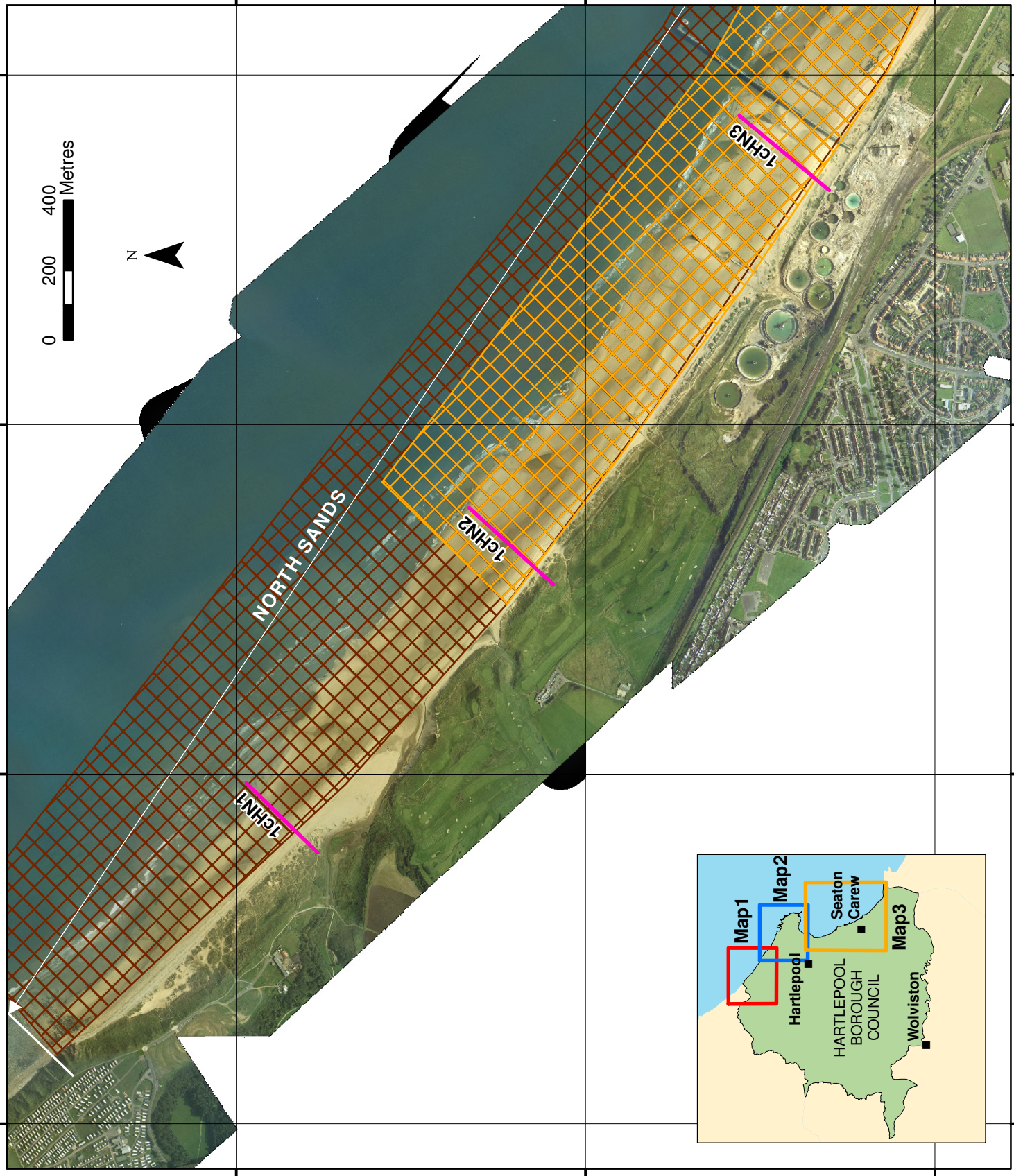
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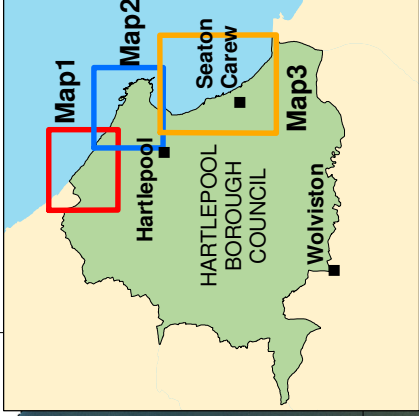
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SURVEY LOCATIONS

Topographic Profiles

- Annual
- Bi-Annual

Topographic Surveys

- 6 monthly
- yearly
- 5 yearly

Cliff Top Monitoring Pegs

- @ 50 centres
- @ 100 centres
- @ 300 centres

(Indicative Survey Extents shown)

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

**Figure 2 - Map 2
 Hartlepool Borough
 Council Frontage**

Analytical Report 1
 'Full Measures' Survey 2008

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 Approved by: NC Date: 08/05/2009

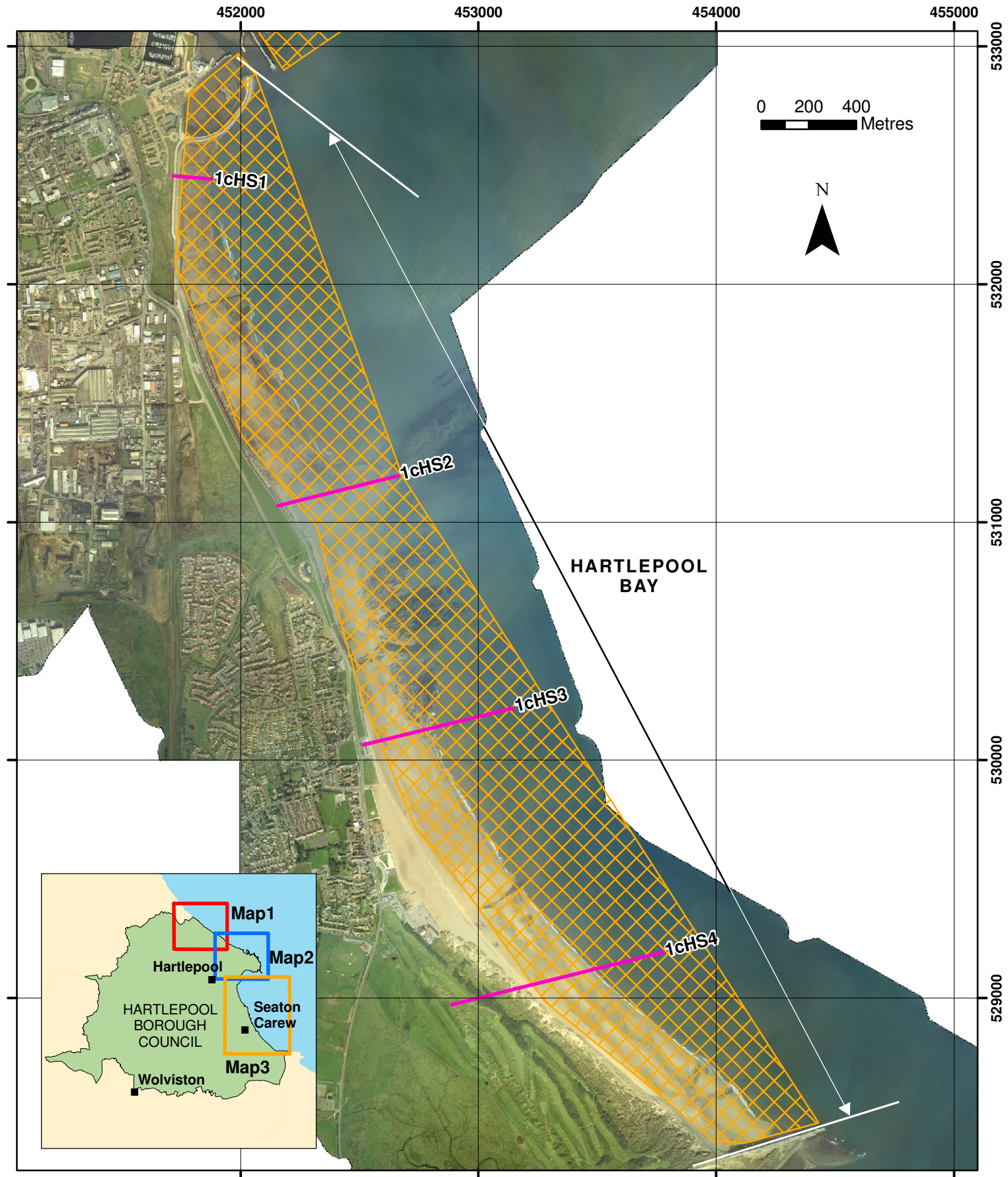
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- TOPOGRAPHIC SURVEY LOCATIONS**
- Annual Profile
 - Bi-Annual Profile
 - 6 monthly Survey
 - Yearly Survey
 - 5 yearly Survey
 - Cliff Top Survey @ 50 centres
 - Cliff Top Survey @ 100 centres
 - Cliff Top Survey @ 300 centres
- (Indicative Survey Extents shown)*

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

**Figure 2 - Map 3
 Hartlepool Borough
 Council Frontage**

Analytical Report 1
 'Full Measures' Survey 2008

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2. Analysis of Survey Data

2.1 North Sands

Survey Date	Description of Changes Since Last Survey	Interpretation
<p>11-2008 (Baseline)</p>	<p>Beach Profiles:</p> <p>North Sands is covered by four beach profile lines (Appendix A).</p> <p>HN1 is at the northern end, about 400m north of the outfall channel of Crimdon Beck. The profile line extends from the landward side of the dune crest, which reaches a peak level of 5.7mODN, before dropping down to beach level. There is a good width of beach between the level of MHWS and the main dune ridge.</p> <p>HN2 is about 550m south of the outfall channel of Crimdon Beck. Here the dunes are much greater in height, peaking at about 18mODN. There is a width of about 15m between the level of MHWS and the dune toe.</p> <p>HN3 lies about 100m north of the timber pier which carries the pipeline to sea. The beach is backed by slag banks which are high and steep. There is a narrow berm at the toe of the slag bank presently protecting it from marine action.</p> <p>HN4 is about 180m south of the Marine Drive sea wall. The profile line starts at the wall to the rear of the promenade, just seaward of the road, which is at an elevation of around 9.2mODN. It then extends across the promenade, which is around 10m wide, and down the vertical face of the sea wall. The wall crest level is at 6.2mODN with upper beach levels some 2.6m lower than the wall crest. The foreshore then adopts a classic curve down to low water at the time of the survey.</p>	<p>HN1 and HN2 are profiles where we may expect to see interactions between the beaches and dunes, and changes in profile form due to storm action. In the immediate vicinity of the outfall channel of Crimdon Beck, we may expect to see changes in the backing dunes due to changing exposure associated with migration in the channel alignment. Any such changes will be recorded by the 5-yearly topographic surveys and the 2-yearly walk-over inspections.</p> <p>Along HN3 and neighbouring frontages, the beach is backed by high and steep slag banks from the former industrial practices along the shoreline. At present, there remains a narrow width preventing marine action from impacting the toe of the slag banks, but they are known to be suffering from slumping in places. Future surveys will reveal whether the beach width in front of the banks is changing, thus altering the risk of these areas to marine-induced erosion and the release of industrial waste material to the foreshore.</p>
	<p>Topographic Survey:</p> <p>North Sands is covered by an annual topographic survey. Every five years, including this baseline survey, coverage is extended further north along North Sands and further south around Hartlepool Headland. Data from the 2008 baseline have been used to create a DGM (Appendix B – Map 1a and</p>	<p>Along Marine Drive, profile HN4 will record any fluctuations that may occur in foreshore level in front of the sea wall. The lower foreshore levels here suggest that during storm events wave action will impact directly on the structure, causing a degree of</p>

Survey Date	Description of Changes Since Last Survey	Interpretation
	<p>part of Map 2a).</p> <p>This shows the generally high beach levels fronting the dunes around Crimdon, the outfall channel of the Beck, and the narrower width of protective berm at the upper beach along the disused industrial frontage. Also notable is how the foreshore levels fronting the Marine Drive sea wall are lower.</p> <p>This DGM has been compared against a similar DGM that was created using survey data collected in March 2000 between North Sands and Newburn Bridge (Appendix B – Map 1b and part of Map 2b). This was collected as a series of 57 beach profiles along this wider frontage at nominally 100m spacings. From these figures, it can be seen that much of the foreshore along North Sands gained material between these dates. A particular concern, however, is the loss of material from the upper beach along a 600m frontage extending north from the end of the Marine Drive sea wall, and a similar distance southwards along this structure.</p>	<p>wave reflection. The changes observed here in upper beach levels between 2000 and 2008 give an indication of the amount of variability already occurring.</p>

2.2 Hartlepool Headland

Survey Date	Description of Changes Since Last Survey	Interpretation
<p>11-2008 (Baseline)</p>	<p>Topographic Survey:</p> <p>Hartlepool Headland is covered by a topographic survey every five years. Data from the 2008 baseline have been used to create a DGM (Appendix B – Map 2a).</p> <p>This shows low foreshore levels fronting the Marine Drive sea wall and even lower foreshore levels around the Headland itself.</p> <p>This DGM has been compared against a similar DGM that was created using survey data collected in March 2000 between North Sands and Newburn Bridge (Appendix B – Map 2b). This was collected as a series of 57 beach profiles along this wider frontage at nominally 100m spacings. From these figures, it can be seen that foreshore levels around the entire headland were notable lower in 2008 than they were in 2000.</p>	<p>Due to low foreshore levels, it is anticipated that the sea walls extending around Hartlepool Headland would be subject to quite severe wave attack. The 2-yearly visual inspections will need to look for evidence of structural damage to the face of the walls and undermining at the toe due to lowering foreshore levels.</p>

2.3 Middleton

Survey Date	Description of Changes Since Last Survey	Interpretation
11-2008 (Baseline)	<p>Beach Profiles:</p> <p>Middleton is covered by one beach profile line (Appendix A). HC1 extends from the access road, across the vertical wall down to beach level, where the foreshore drops gradually down to low water level at the time of the survey.</p>	<p>It is envisaged that beach material will be relatively well contained within the shelter of the Middleton Jetty and the North Pier.</p>
	<p>Topographic Survey:</p> <p>Middleton is covered by an annual topographic survey between Middleton Jetty and North Pier. Data from the 2008 baseline have been used to create a DGM (Appendix B – Map 2a). This shows a small pocket of sand accumulation against the landward end of Middleton Jetty, but in general beach levels are greater in the south of the frontage than in the north.</p>	

2.4 Hartlepool Bay

Survey Date	Description of Changes Since Last Survey	Interpretation
11-2008 (Baseline)	<p>Beach Profiles:</p> <p>Hartlepool Bay is covered by four beach profile lines (named HS1 – HS4). These were not surveyed during the Full Measures 2008 survey to avoid unnecessary duplication with a survey of the frontage between Newburn Bridge and the North Gare Breakwater that was undertaken in December 2008 as part of the work associated with the Seaton Carew Coastal Strategy Study.</p>	<p>The topographic survey scheduled originally for the Full Measures survey 2008 will be undertaken as part of the Partial Measures 2009 survey and then repeated as scheduled in the Full Measures 2009 survey.</p>
	<p>Topographic Survey:</p> <p>Hartlepool Bay is covered by an annual topographic survey between the South Pier and the North Gare Breakwater. This was not surveyed during the Full Measures 2008 survey for identical reasons to above.</p>	

3. Problems Encountered and Uncertainty in Analysis

There were no major problems encountered during the surveys, although access to some areas was difficult and the foreshore survey around Hartlepool Headland was over rock outcrops which were difficult to survey.

It should be noted that beach profile HN1 is located within Durham County Council's jurisdiction but has been reported here so changes can be interpreted in association with those observed along HN2, HN3 and HN4. Similarly, the 5-yearly North Sands topographic survey extends into Durham County Council's jurisdiction between Crimdon Park and Crimdon Beck but again is reported here for consistency of interpretation.

A survey was undertaken by WS Atkins in March 2000 between North Sands and Newburn Bridge and data were provided by Hartlepool Borough Council to add value to the analysis presented in this report. This survey was undertaken in the form of 57 no. beach profiles at nominally 100m intervals. These data were used to create DGMs of the Hartlepool North and Hartlepool Central frontages. These DGMs were compared against those created from the 2008 Full Measures data to investigate changes over the intervening 8½ years. The 'difference plots' have been created using the maximum overlap between survey extents, but the 2000 survey did not extend north along North Sands beyond the disused industrial areas and so Hart Warren was not covered.

As discussed in Section 1, the survey at Hartlepool South was removed from the Full Measures programme in 2008 and postponed until the Partial Measures programme in spring 2009. This was done to avoid unnecessary duplication with a similar survey that was undertaken in December 2008 by Digital Surveys Ltd. between Newburn Bridge and the Tees Estuary as part of the work associated with the Seaton Carew Coastal Strategy Study. The section between the South Pier and Newburn Bridge was not covered by the December 2008 survey.

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

No changes are needed at the present time.

5. Conclusions and Areas of Concern

- The Hart Warren frontage may be subject to seasonal variations in profile form and interactions between the beaches and dunes, particularly in response to storm events.
- In the immediate vicinity of the outfall channel of Crimdon Beck, changes in the backing dunes may result from changing exposure associated with migration of the channel.
- Along much of North Sands, the beach is backed by high and steep slag banks which front the disused industrial sites. At present, there remains a narrow width preventing marine action from impacting the toe of the slag banks, but these are known to be suffering from slumping in places.
- Along Marine Drive and around Hartlepool Headland, wave action will impact directly on the sea wall, causing a degree of wave reflection. It is important to monitor how foreshore levels change in response to this since such changes could affect overtopping potential and increase undermining risk.
- It is envisaged that beach material will be relatively well contained within the shelter of the Middleton Jetty and the North Pier.

- The topographic survey scheduled originally for the Full Measures survey 2008 will be undertaken as part of the Partial Measures 2009 survey and then repeated as scheduled in the Full Measures 2009 survey, given a good representation of changes over an 18 month period.

Appendices

Appendix A
Beach Profiles

Beach Profile

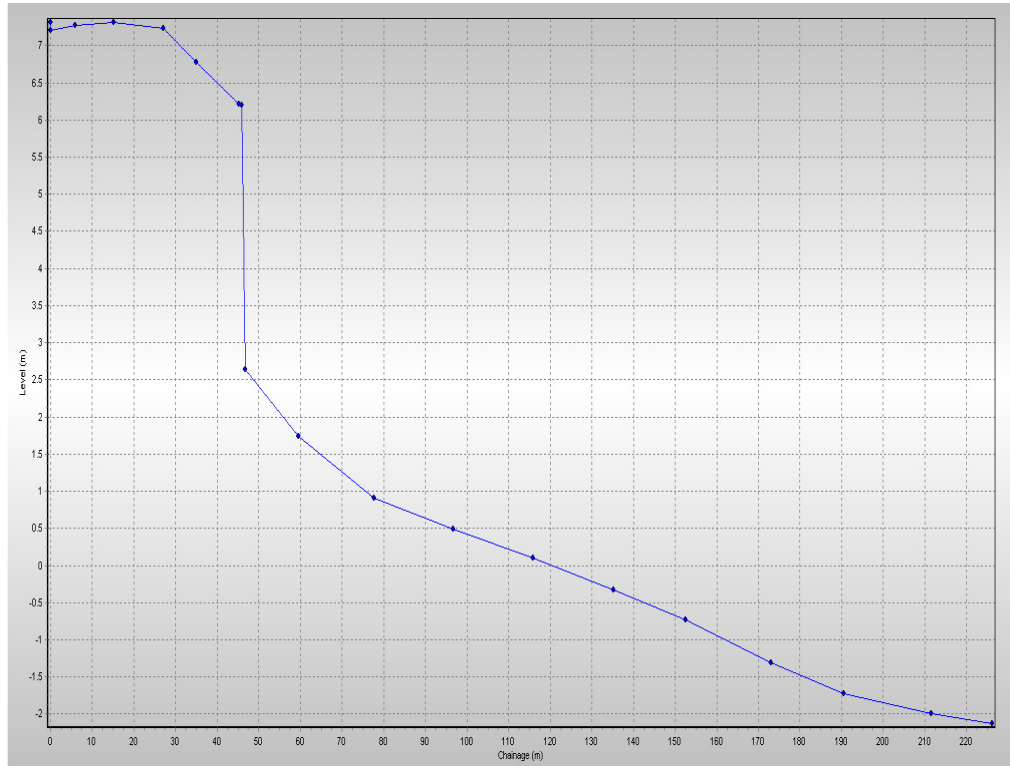
1cHC1

Date 25/11/2008 **Inspector** RH
Wind Light **Sea State**
Summary

Low Tide (m)
Visibility Good **Low Tide Time**
Rain No

Easting 452108.080 **Northing** 533506.120 **Bearing** 141

Chainage	Level
0.000	7.311
0.083	7.199
5.891	7.266
15.071	7.313
27.052	7.227
35.036	6.773
45.216	6.211
45.880	6.197
46.733	2.641
59.505	1.735
77.720	0.909
96.710	0.491
115.915	0.096
135.222	-0.322
152.593	-0.733
173.111	-1.312
190.548	-1.728
211.528	-1.997
226.165	-2.128



Beach Profile

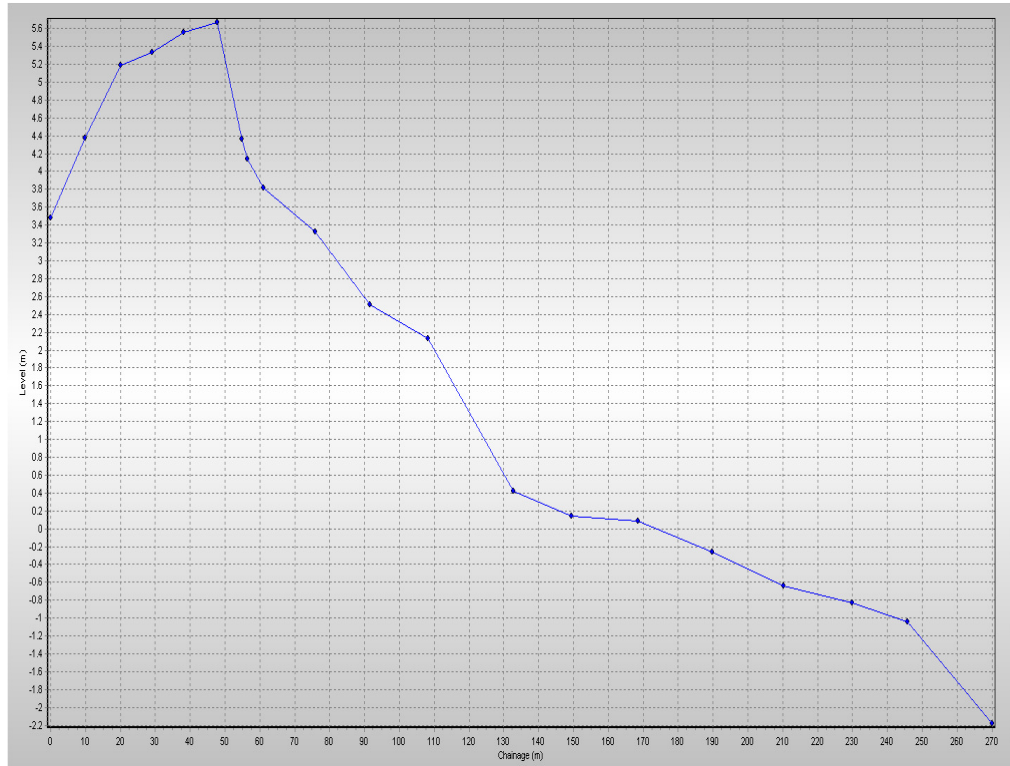
1cHN1

Date 10/11/2008 **Inspector** RH
Wind Light **Sea State**
Summary

Low Tide (m)
Visibility Good **Low Tide Time**
Rain No

Easting 448779.620 **Northing** 536767.420 **Bearing** 44

Chainage	Level
0.000	3.479
9.886	4.372
20.048	5.185
29.107	5.334
38.177	5.553
47.799	5.669
54.842	4.361
56.520	4.139
61.088	3.819
75.895	3.323
91.474	2.504
108.208	2.127
132.818	0.416
149.386	0.144
168.409	0.081
189.704	-0.263
210.143	-0.643
229.945	-0.830
245.677	-1.040
270.065	-2.182



Beach Profile

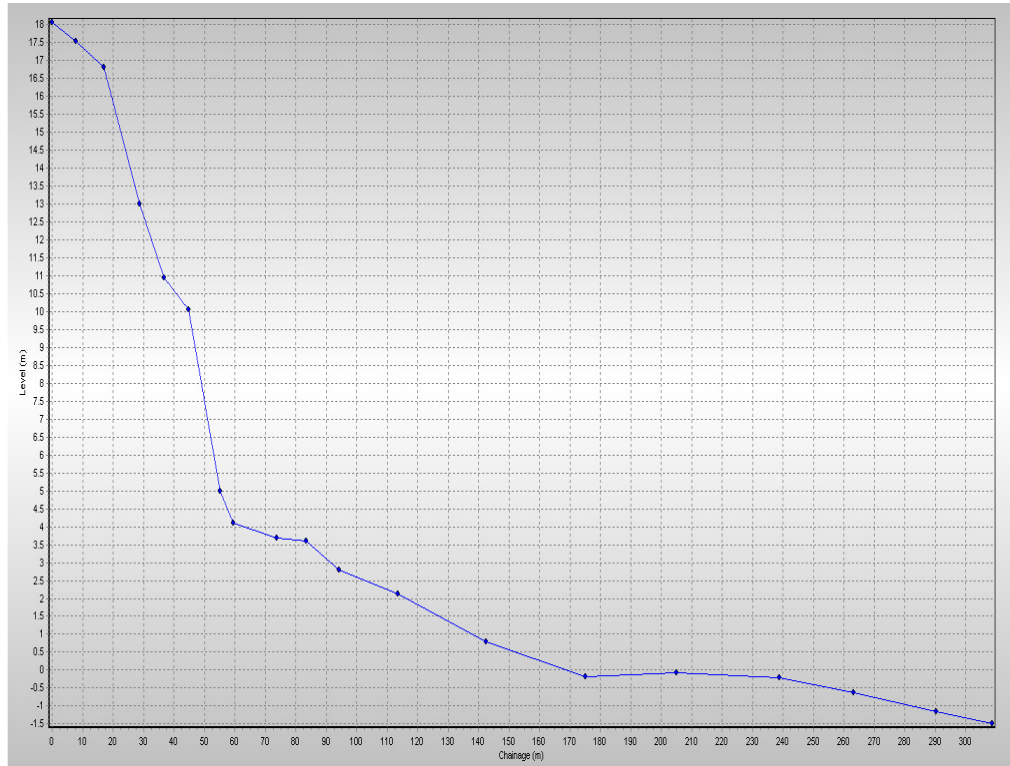
1cHN2

Date 10/11/2008 **Inspector** RH
Wind Light **Sea State**
Summary

Low Tide (m) **Low Tide Time**
Visibility Good **Rain** No

Easting 449547.220 **Northing** 536095.460 **Bearing** 42

Chainage	Level
0.000	18.069
7.716	17.546
17.065	16.815
28.698	12.999
36.873	10.935
44.873	10.064
55.089	5.005
59.617	4.095
73.712	3.675
83.495	3.601
94.326	2.805
113.456	2.113
142.588	0.787
175.070	-0.188
205.002	-0.070
238.788	-0.210
263.118	-0.617
290.255	-1.145
308.629	-1.492



Beach Profile

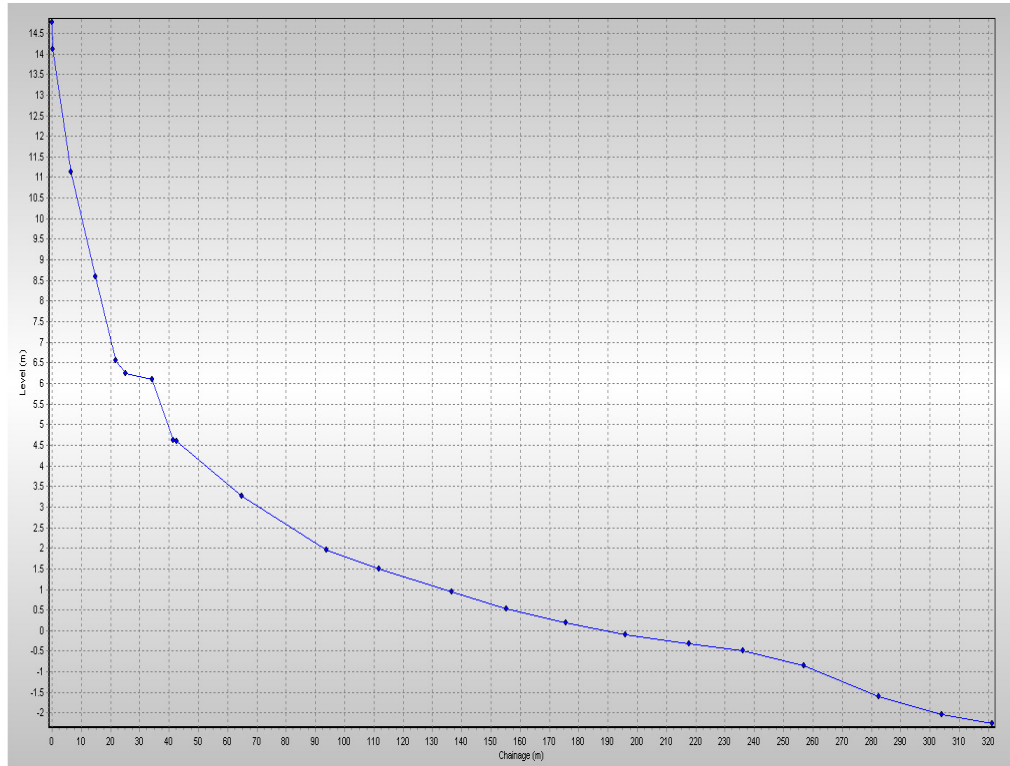
1cHN3

Date 10/11/2008 **Inspector** RH
Wind Light **Sea State**
Summary

Low Tide (m)
Visibility Good **Low Tide Time**
Rain No

Easting 450674.420 **Northing** 535305.140 **Bearing** 40

Chainage	Level
0.000	14.764
0.203	14.111
6.449	11.141
14.788	8.584
21.654	6.553
25.072	6.254
34.322	6.095
41.310	4.631
42.521	4.605
64.914	3.270
93.750	1.947
111.649	1.492
136.517	0.947
155.239	0.533
175.593	0.188
195.988	-0.096
217.584	-0.314
236.041	-0.495
256.916	-0.855
282.574	-1.602
304.088	-2.032
321.260	-2.256



Beach Profile

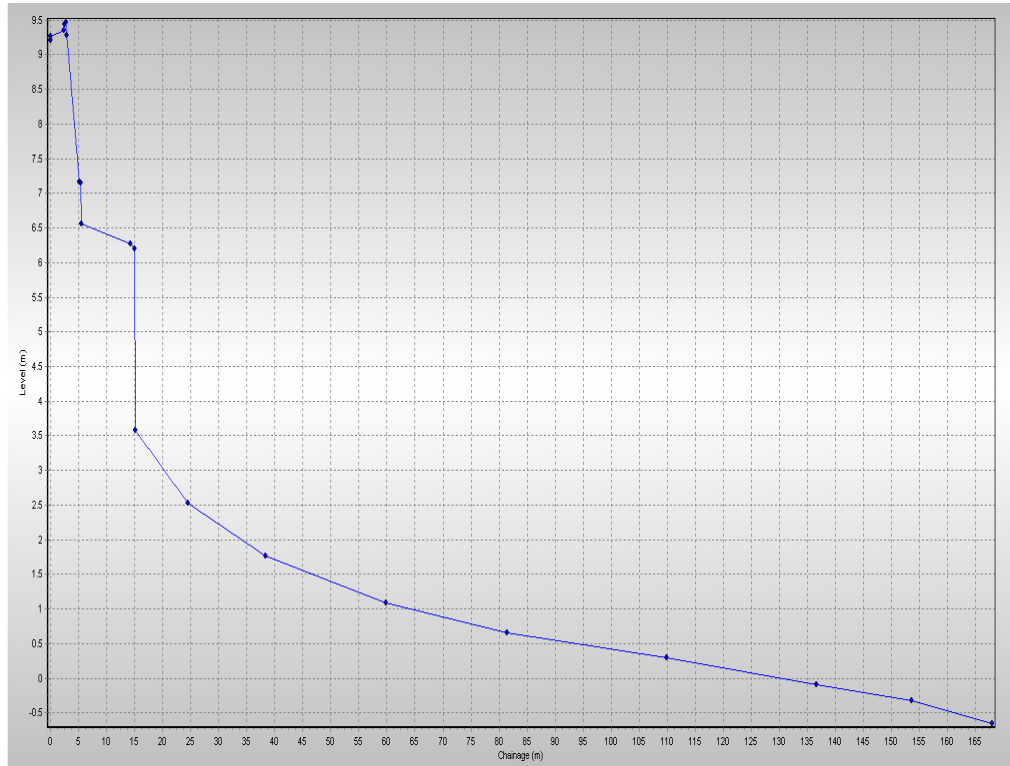
1cHN4

Date 10/11/2008 **Inspector** RH
Wind Light **Sea State**
Summary

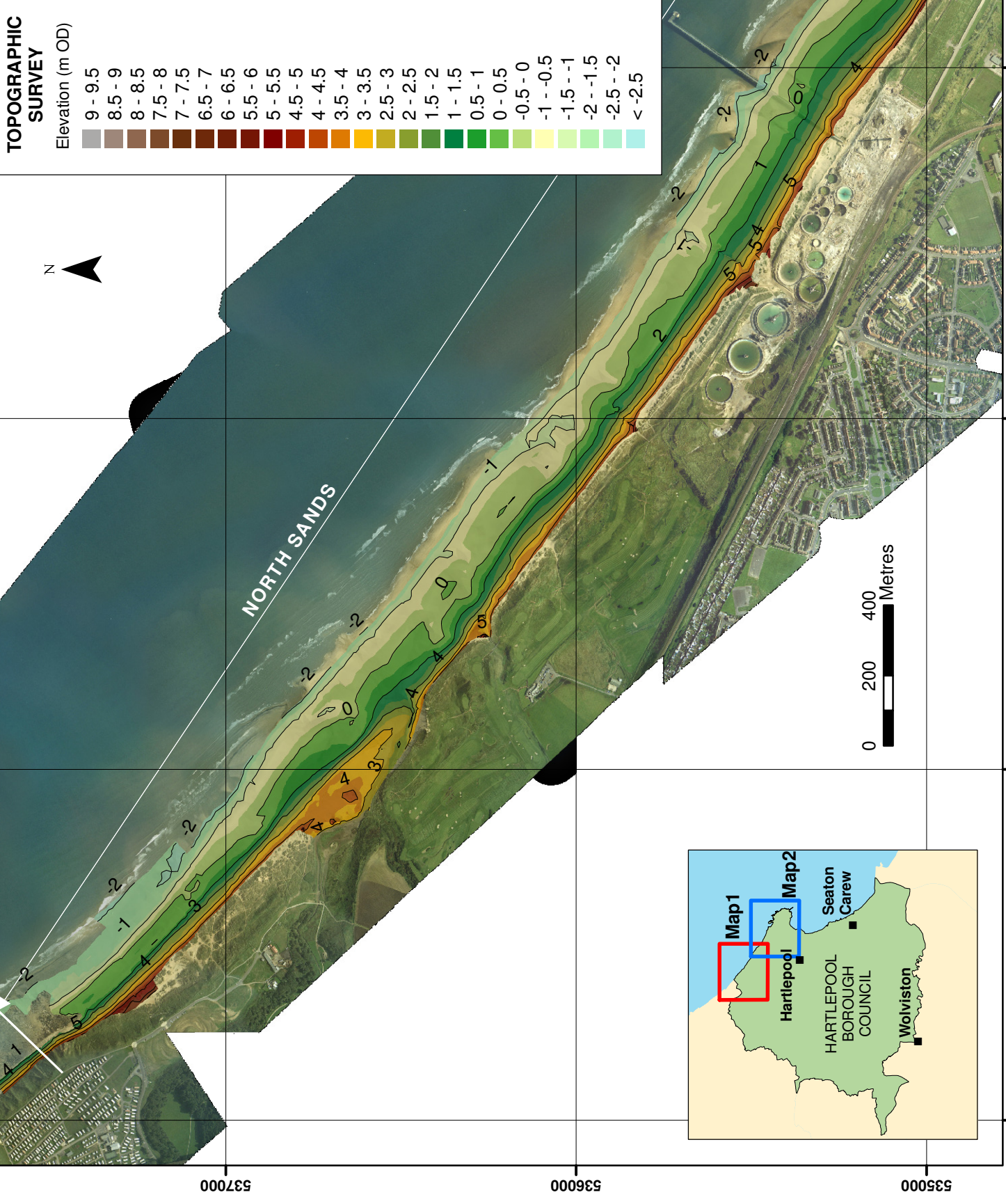
Low Tide (m)
Visibility Good **Low Tide Time**
Rain No

Easting 451997.110 **Northing** 534616.630 **Bearing** 31

Chainage	Level
0.000	9.215
0.012	9.263
2.426	9.351
2.501	9.441
2.778	9.467
2.909	9.273
5.144	7.157
5.382	7.144
5.461	6.558
14.234	6.267
14.969	6.204
15.164	3.577
24.507	2.532
38.332	1.763
59.812	1.081
81.380	0.652
109.935	0.295
136.592	-0.087
153.569	-0.326
167.965	-0.654

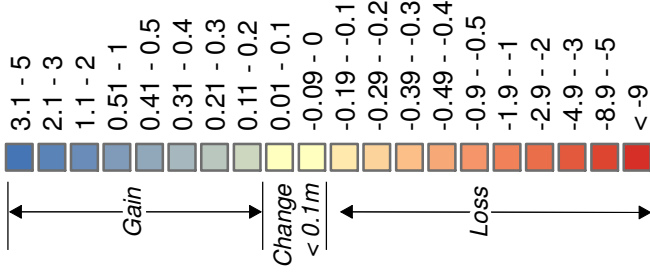


Appendix B
Topographic Survey

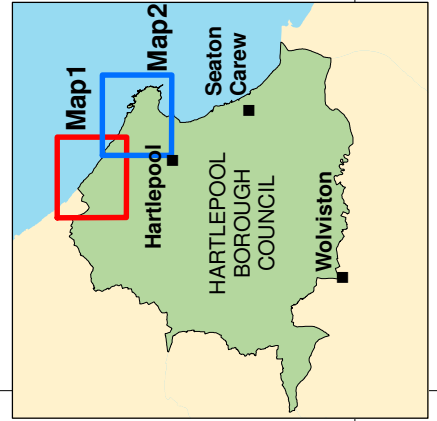
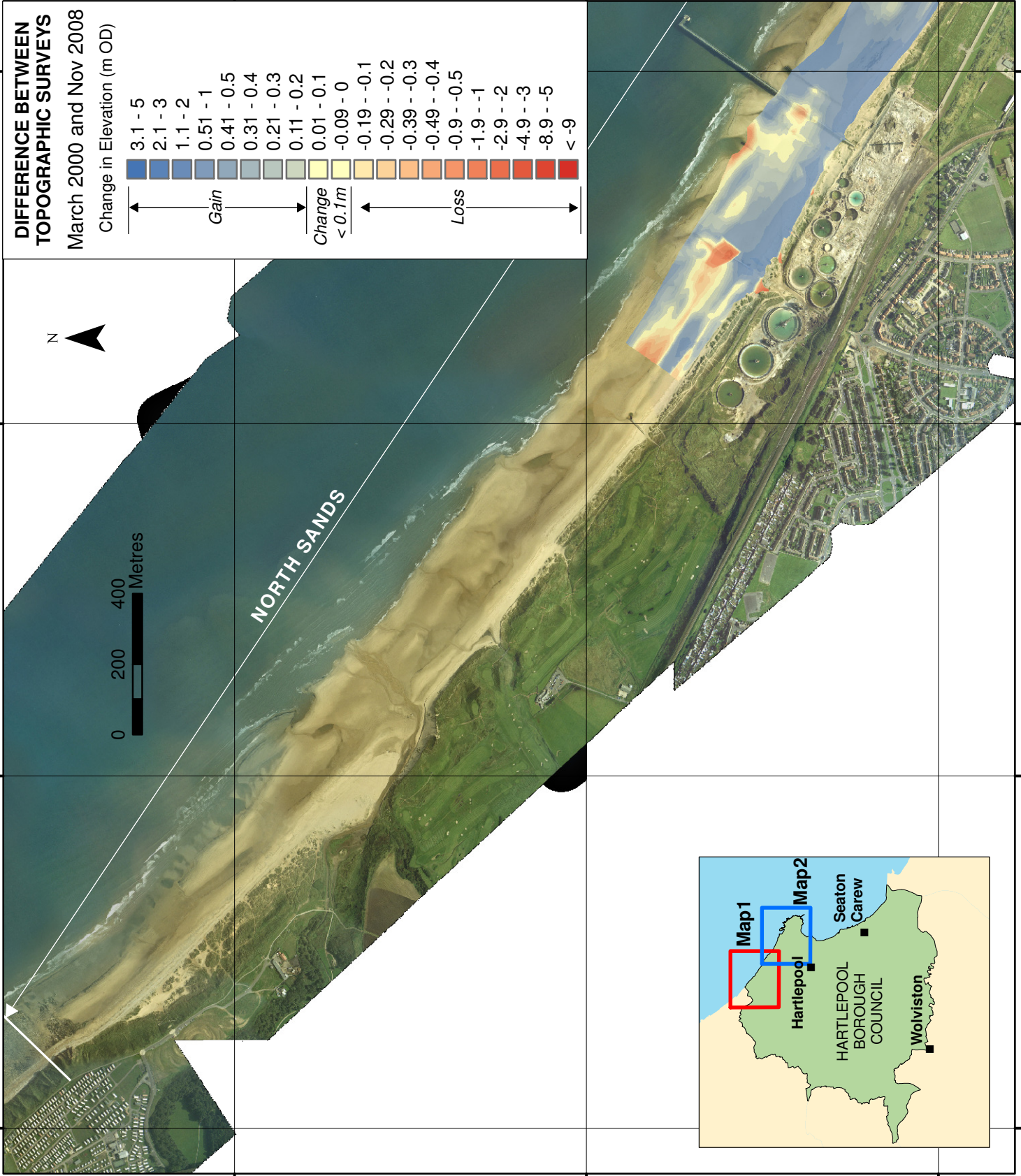


DIFFERENCE BETWEEN TOPOGRAPHIC SURVEYS
March 2000 and Nov 2008

Change in Elevation (m OD)



NORTH SANDS



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

Appendix B - Map 1b
Hartlepool Borough
Council Frontage

Analytical Report 1
 'Full Measures' Survey 2008

Drawing Scale 1:15,000 at A4

Drawn by: TC **Date:** 08/05/2009
Checked by: NC **Date:** 08/05/2009
Approved by: NC **Date:** 08/05/2009



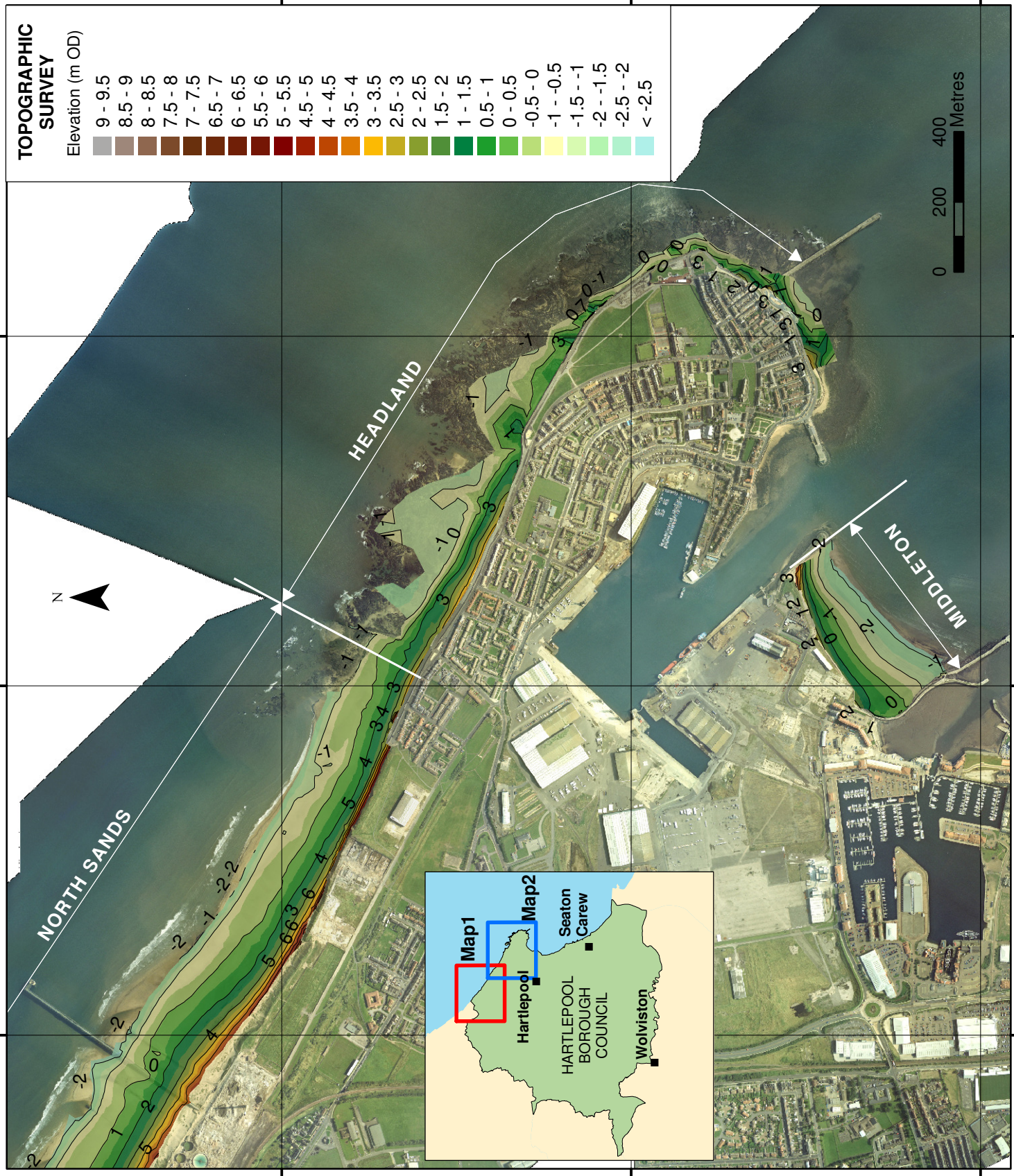
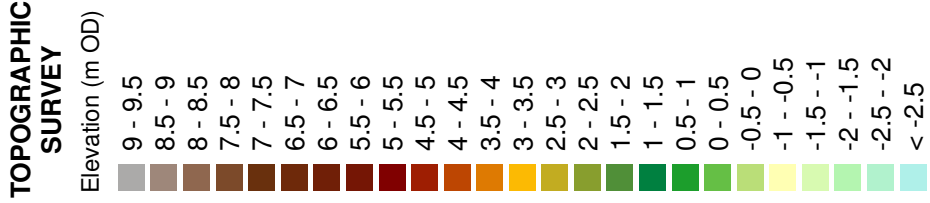
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Halcrow Group Ltd
 Lyndon House
 62 Hagley Road
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 B16 8PE

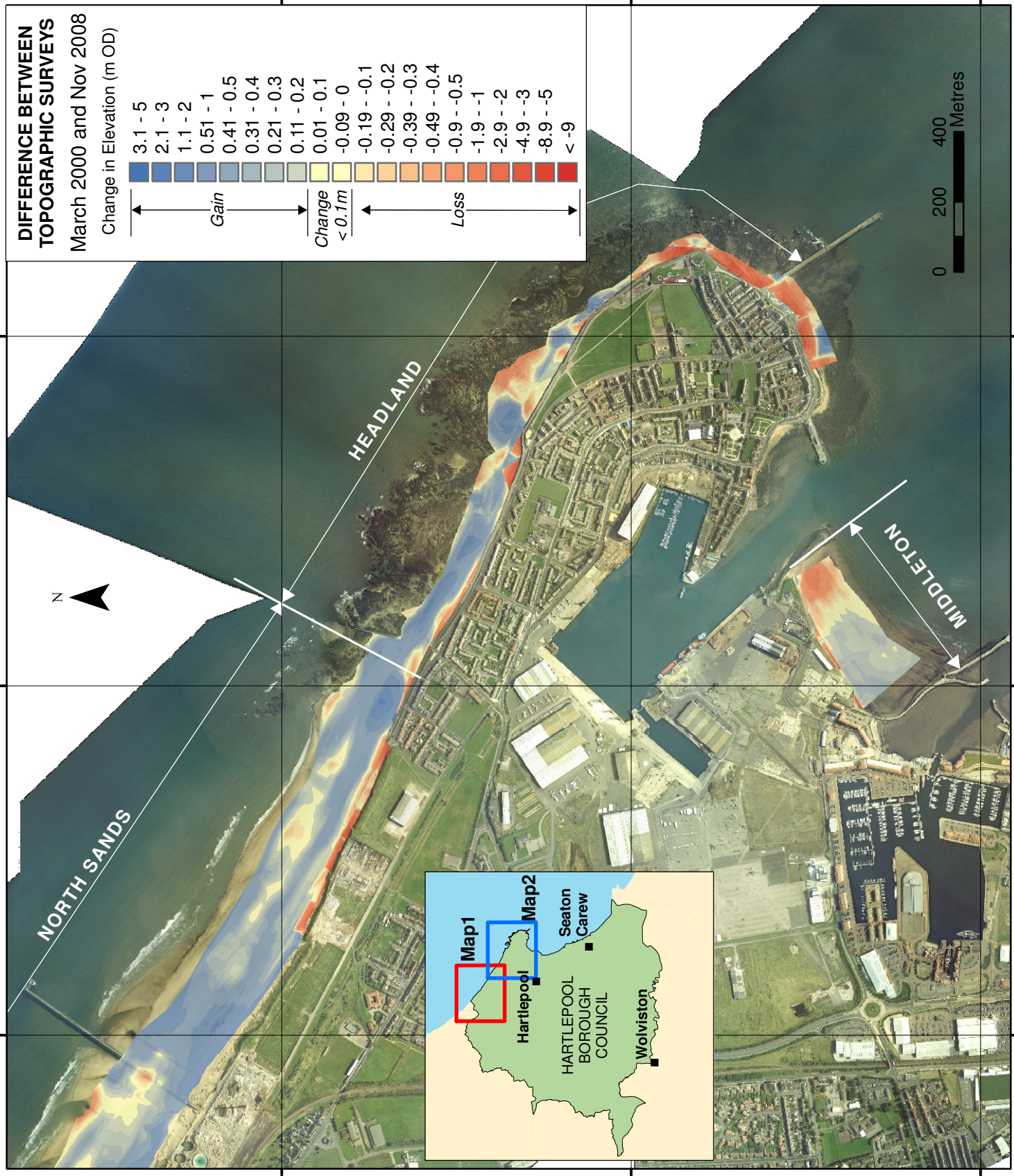
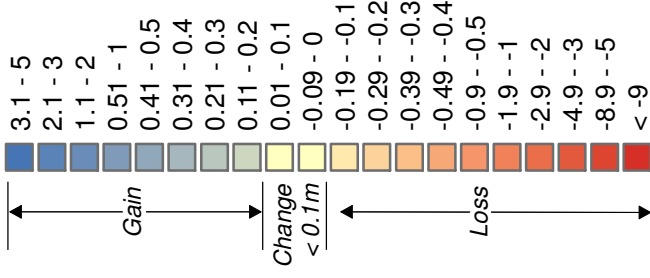
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DIFFERENCE BETWEEN TOPOGRAPHIC SURVEYS
March 2000 and Nov 2008

Change in Elevation (m OD)



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

Appendix B - Map 2b
Hartlepool Borough
Council Frontage

Analytical Report 1
 'Full Measures' Survey 2008

Drawing Scale 1:15,000 at A4
 Drawn by: TC Date: 08/05/2009
 Checked by: NC Date: 08/05/2009
 Approved by: NC Date: 08/05/2009

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