

South East Strategic Regional Coastal Monitoring Programme

# BEACH MANAGEMENT PLAN REPORT

## Dungeness Power Station

2011

**BMP 138**  
April 2013



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## Contents

<b>1.0</b>	<b>Introduction.....</b>	<b>1</b>
<b>2.0</b>	<b>BMP Design Conditions.....</b>	<b>3</b>
<b>3.0</b>	<b>Surveys .....</b>	<b>4</b>
3.1	Topographic Surveys.....	4
3.2	Bathymetric Surveys.....	5
<b>4.0</b>	<b>Beach Management Operations .....</b>	<b>5</b>
<b>5.0</b>	<b>Analysis.....</b>	<b>6</b>
5.1	Difference Models.....	6
5.2	Profile Evolution.....	6
	Management Unit 13 Analysis.....	10
5.3	Section 1 – MU13W.....	10
5.4	Section 2 – MU13E.....	12
	Summary Data.....	13
<b>6.0</b>	<b>Long Term Summary.....</b>	<b>14</b>
<b>7.0</b>	<b>Wave Climate &amp; Storm Events.....</b>	<b>16</b>

## List of Figures

Figure 1: Site Location and Wave/Tide Gauge.....	2
Figure 2: MU13 beach analysis sections.....	7
Figure 3: Cross sectional changes at profile 4c00794.....	10
Figure 4: Cross sectional changes at rofile 4c8000.....	11
Figure 5: Cross sectional losses at profile 4c00782. ....	12
Figure 6: Profile 4c00773 showing reduction in embankment height .....	13
Figure 7: The cumulative change in sediment budget for Management Unit 13.....	15
Figure 8: Comparative view of post storm changes .....	17
Figure 9: Post storm profile 4c00779.....	18

## List of Tables

Table 1: Schedule of Topographic Surveys.....	4
Table 2: Schedule of Bathymetric Surveys.....	5
Table 3: Management Unit 13 - Summary of Erosion/Accretion Totals.....	13
Table 4: Beach Volume Change Summary (2003 - 2011).....	14

## Abstract

The shingle beaches provide a vital element of the flood and coastal erosion defences along the Management Unit (MU) 13 Dungeness power station frontage. Without the protection of the shingle beach in front of the flood embankment the risk of it being overtopped or breached during a storm is significantly increased. The monitoring, analysis and feedback on the performance of the beaches is therefore vital in ensuring the level of risk is maintained at an acceptably low level.

The condition and performance of different beach sections are currently monitored through the Strategic Regional Coastal Monitoring Programme. This report evaluates changes along the coastline over the 2010-2011 periods.

The 2010-2011 reporting period witnessed the fifth consecutive year of erosion and the largest net loss since records began. The losses that have occurred over the past year have primarily occurred at the base of the shingle embankment, with crestlines lowering and retreating. Erosion has occurred linearly across the frontage however the flood protection embankment has largely remained unscathed.

The data collected over the past year provides further evidence of an erosive tendency continuing which has been present since 2006. The volumetric analysis that has been carried out for the entire project timescale has shown an overall loss of material by approximately 56,700m<sup>3</sup> over the 2km frontage. It remains difficult to comment on the practical implications of this net change as no design beach profiles have been provided.

This report also highlights the fact that the beach continues to be very dynamic along this frontage and considering the rise in sea level and climate change effects, the magnitude of change experienced on this shoreline will increase. It is therefore recommended that to compliment the ongoing beach and coastal process monitoring that is carried out as part of the Regional Strategic Coastal Monitoring Programme, a range of design beach conditions are established. With this information it will then be possible to use this annual reporting mechanism to alert when 'warning' and 'critical' thresholds are approached.

Several storms exceeded the threshold throughout November at the Rye Bay Wave Buoy during this reporting period. A Post-Storm survey was undertaken shortly after the storm on the 8<sup>th</sup> of November and has identified that only the beach crest was adversely affected. It is apparent from the beach profile that the artificially maintained embankment has experienced negligible losses and maintained a consistent crest level and critical width.

It is important to recognise the potential inconsistency in short-term trends. As with many coastal areas a lot of annual variability is expected, thus drawing conclusions with increased confidence will become possible as more data is collected, with regard to annual losses, net sediment drift and erosion/accretion trends in section sub-units.

Scheduled future monitoring includes profile surveys in Autumn 2011 and Spring 2012, and in addition post-storm surveys may be carried out if any event is deemed to have significantly affected the frontage. An interim report will be issued on completion of the

spring profile survey, with the next BMP report scheduled to be issued after completion of the Summer 2012 beach plan survey. All historic monitoring data is accessible online ([www.channelcoast.org](http://www.channelcoast.org)), and future surveys will be available after satisfying quality assurance procedures.

## 1.0 Introduction

Management Unit 13 (MU13) is situated on the south Kent coast and covers a 1.7km shingle beach fronting the Dungeness nuclear power stations. A natural beach fronts a managed 2-5m high shingle embankment that provides extra protection to the notable infrastructure here. The power station is approaching a full decommissioning programme that requires continued coastal protection of this area for the foreseeable future. The open beach acts as the only coastal defence along the frontage, and consequently the shoreline management plan's 'hold the line' policy is currently maintained by periodic renourishment of shingle and re-profiling. The far west of the MU13 beach and the immediate surrounding area of the power station development is designated as a SSSI (Sites of Special Scientific Interest), National Nature Reserve, and SAC (Special Area of Conservation), further highlighting the importance of continual beach monitoring along this frontage.

The frontage faces south and experiences storms approaching from a south-westerly and south-easterly direction. Net sediment drift direction along the frontage is predominantly from west to east (Shoreline Management Plan, 2000). Given the absence of groyne structures or hard sea defences along the frontage, the coastline is particularly dynamic and rates of change can vary year-on-year.

This report covers the changes in beach topography between the summer 2010 survey and the most recent 2011 beach management plan survey. A previous report (AR - 71: 2011) covers the observed changes until the 2011 survey period. In addition, this contains a lot of background information including site-specific information.

Unlike the majority of other coastal monitoring reports, this relatively short frontage is only divided into two individual sections for analysis. The boundary between MU13W and MU13E is derived from recycling data submitted by Halcrow (the boundary is located at profile 4c00787).

The location of the frontage is shown in Figure 1 and also includes the nearest wave buoys and tide gauges.

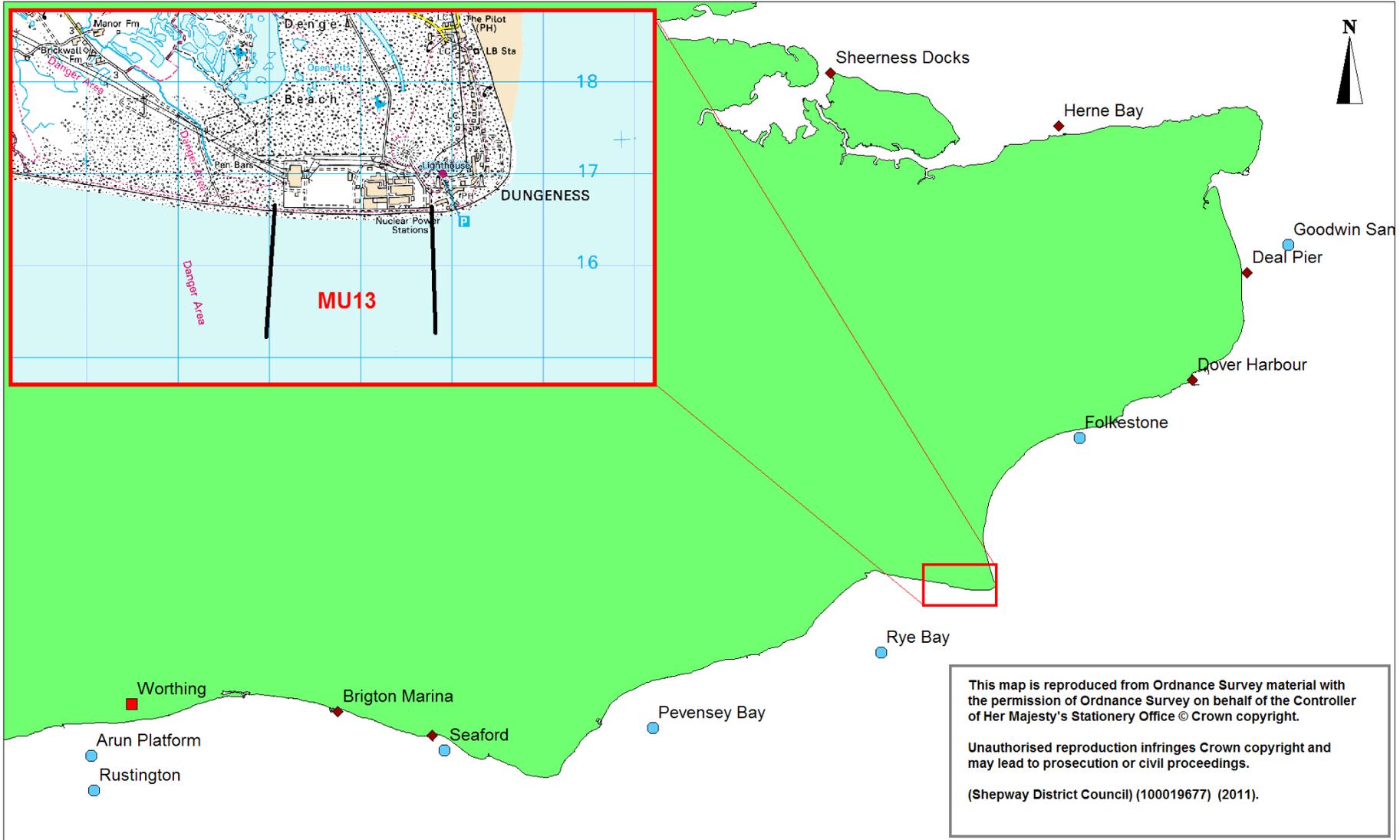


Figure 1: Site Location and Wave/Tide Gauge

## **2.0 BMP Design Conditions**

The BMP for management unit 13 has not been updated since 2007 and as such no information is available on the standard of protection provided by the beach, nor the design profiles required to achieve it. Currently planning permission is being sort to renew a license to extract material for the accretion dominant eastern section and use this material to renoursihed the beach and shingle embankment. It is hoped that once the license has been agreed the BMP will be updated with detailed data on design profiles and recycling volumes. Therefore any analysis contained within this report will be based on changes that have occurred over the past year, with no reference to the standard of protection now provided by the beach.

### 3.0 Surveys

All topographic and bathymetric surveys are referenced to a Global Positioning System (GPS) control grid, established for the Regional Monitoring Programme and conducted according to the current Environment Agency’s National Specification, summarised in the Explanatory Notes (Annex A).

#### 3.1 Topographic Surveys

The schedule of completed surveys since the start of the Regional Monitoring Programme is given in Table 1.

Digital Ground Models of the 2011 Beach Management Plan topographic survey are shown in plate 2 (1 - 2) (Annex B) superimposed upon the ortho-rectified aerial photographs of 2008. The method used for deriving Digital Ground Models is given in the Explanatory Notes (Annex A).

**Table 1: Schedule of Topographic Surveys**

<b>MU 13</b>		
<b>Profile</b>	<b>Beach Plan</b>	<b>Post-storm</b>
30/07/2003	30/07/2003	
24/10/2003		
25/02/2004		
04/06/2004	04/06/2004	
28/10/2004		
09/03/2005		
29/06/2005	29/06/2005	
21/10/2005		
02/03/2006		
17/07/2006	17/07/2006	
08/11/2006		
		08/12/2006
21/02/2007		
07/06/2007	07/06/2007	
25/10/2007		
		08/02/2008
12/03/2008		
04/07/2008	04/07/2008	
19/11/2008		
01/03/2009		
24/07/2009	24/07/2009	
22/10/2009		
		04/12/2009
21/03/2010		
12/08/2010	12/08/2010	
28/10/2010		

		12/11/2010
10/03/2011		
19/07/2011	19/07/2011	

### 3.2 Bathymetric Surveys

The schedule of bathymetric surveys since the start of the Regional Monitoring Programme is given in Table 2.

Table 2: Schedule of Bathymetric Surveys

<b>Unit 13</b>		
<b>Date</b>	<b>Line Spacing</b>	<b>Distance Offshore</b>
04/10/2003	50m	1000m
25/09/2006	50m	1000m

### 4.0 Beach Management Operations

According to records received from the operating authority, no beach management operations have taken place over the reporting period. Therefore all changes indicated by the difference models reflect natural processes and offer an improved view of the longer-term natural evolution for this section.

## **5.0 Analysis**

### **5.1 Difference Models**

Now that the 2011 BMP data set has been compiled, it is possible to overlay the results of the survey with BMP data from 2010. This enables comparative volumetric analysis to be undertaken to determine change over a given period. Through the use of three-dimensional ground models and ortho-rectified aerial photography, it is possible to create a visual interpretation of the volumetric change that has occurred during each analysis period. This is shown in Plate 1 (1-2), which indicates areas of net erosion or accretion (N.B. a 0.25m difference in elevation is considered as “no change”) and the location of any extraction/deposition sites.

Negative values represent erosion that has occurred between 2010 & 2011, and positive values indicate accretion. Whilst these figures show an overall change in beach volume within each discrete section, it should be recognised that the data is based on the BMP survey, which is undertaken once each year. It is therefore only a snapshot of one moment in time, and the particular dynamics of each frontage need to be taken into account. This ensures that the information shown in the difference models represents the net change rather than capturing a particular extreme variation caused by a large event.

### **5.2 Profile Evolution**

While beach plan surveys provide a more accurate view of morphological change and beach volume levels, profiles clearly illustrate the changes in beach cross section. In addition, the 2011 BMP survey beach profiles have been cross-referenced with the other profile surveys carried out over the past year in order to ensure that the results from the difference models are representative of net profile change. This then gives an indication of the beach variability over three time steps in each individual year.

The Cross-Sectional Area (CSA) has been calculated for all beach profiles. This is calculated as the area of profile above a Master Profile (MP). In general, the lower boundary of the MP is the transition between the beach face and the foreshore (i.e. the beach toe). The landward boundary is either the seawall or, where a hard structure is not present, the landward extent of the stable part of the beach. The Master Profile is held constant for a given profile line and therefore the changes in CSA through time can be derived.

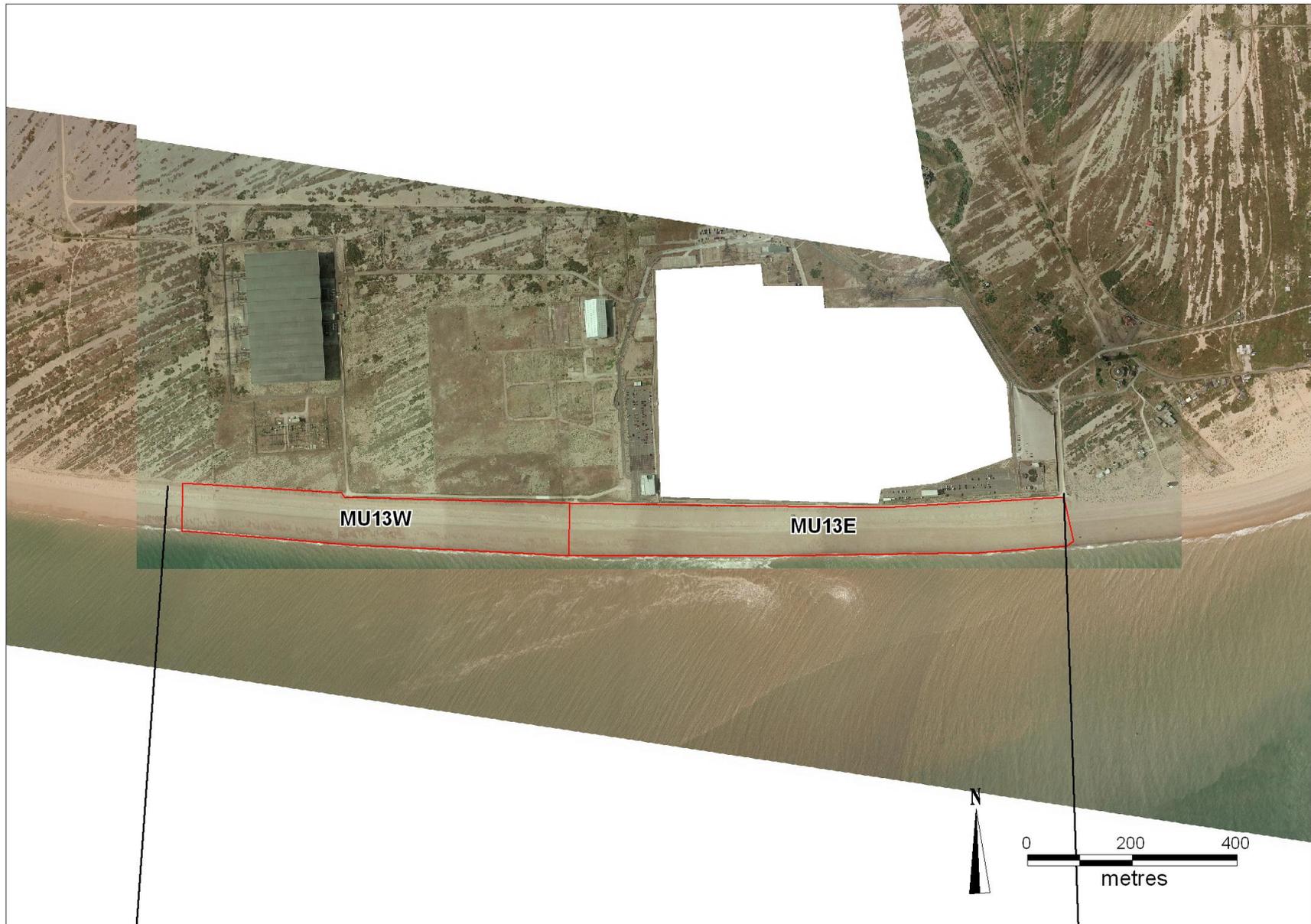
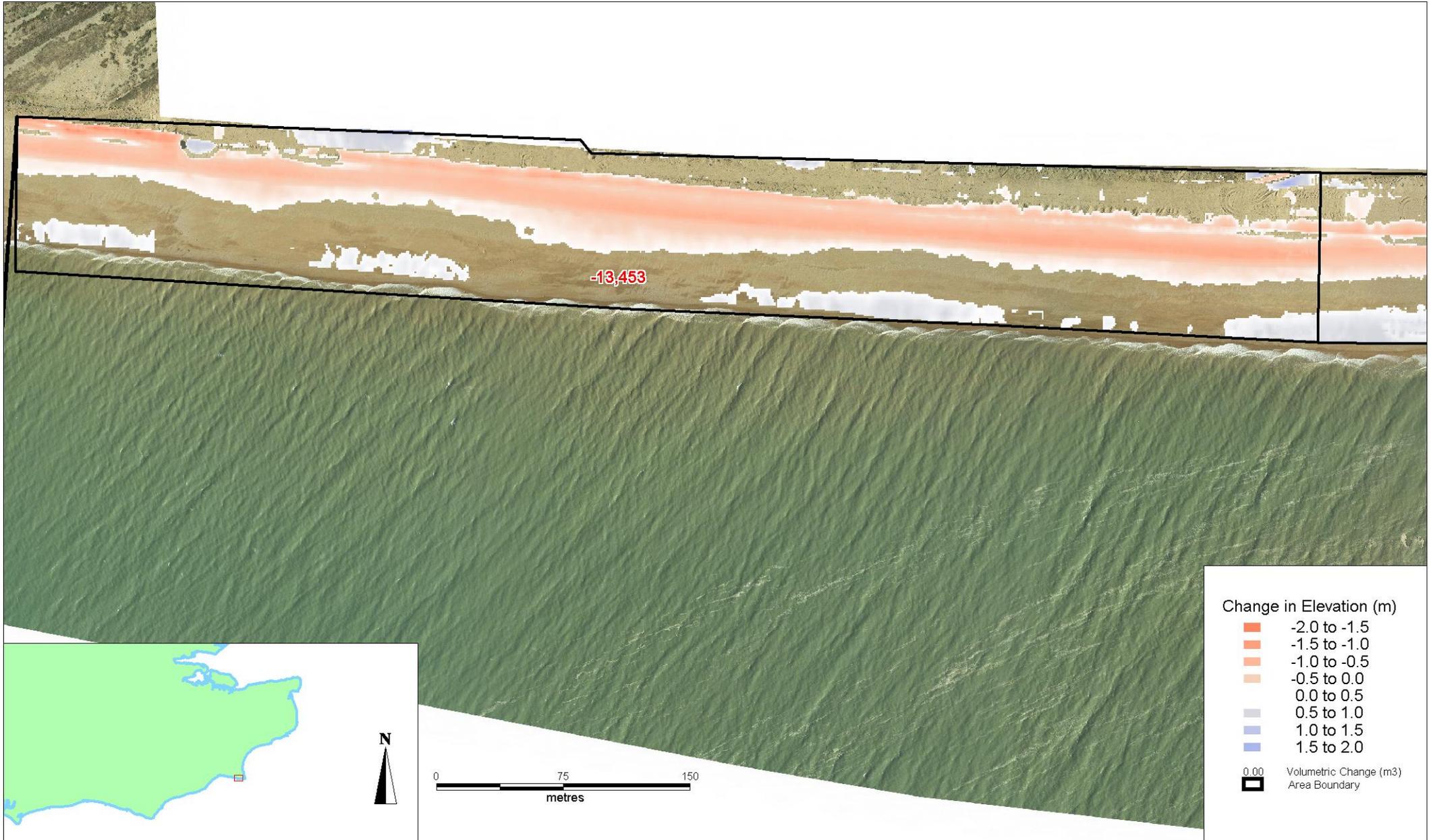
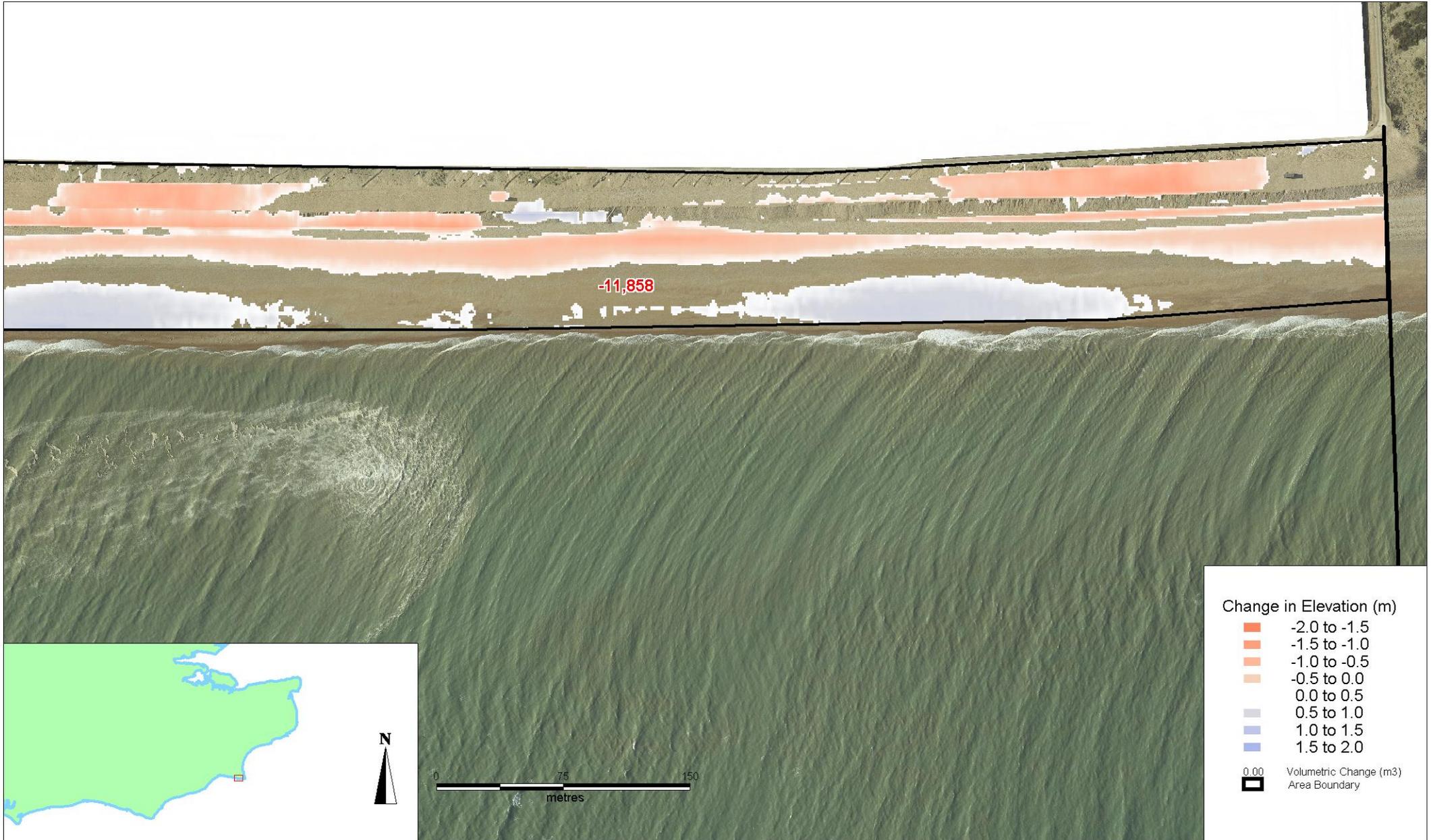


Figure 2: MU13 beach analysis sections





## Management Unit 13 Analysis

The remainder of this chapter contains a narrative summarising the changes that have taken place over the last year, and hypotheses of the processes driving these changes.

### 5.3 Section 1 – MU13W

During the 2010-2011 reporting period this section has seen a fifth consecutive year of net erosion with the loss of approximately 13,500m<sup>3</sup>. The rate of erosion is in keeping with previous years and supports a relatively consistent rate of material loss. The loss of material has primarily occurred at the base of the embankment with the embankment toe and beach crest retreating as shown in figure 3 below.

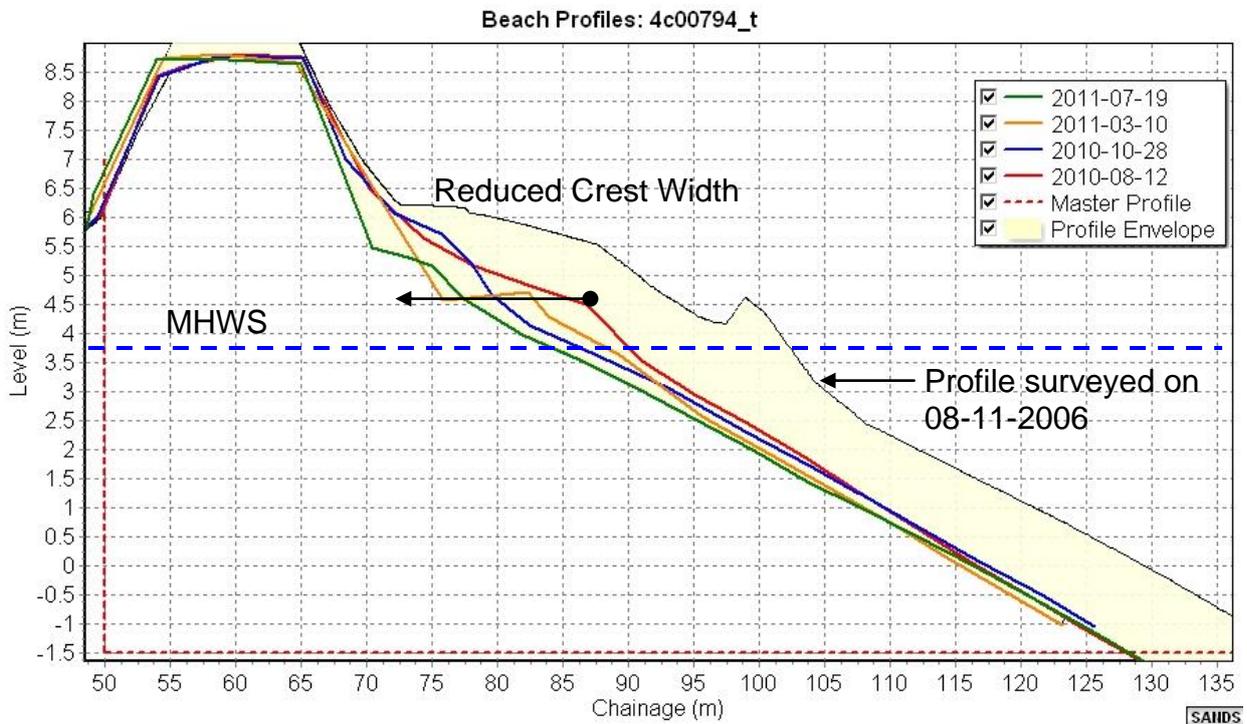
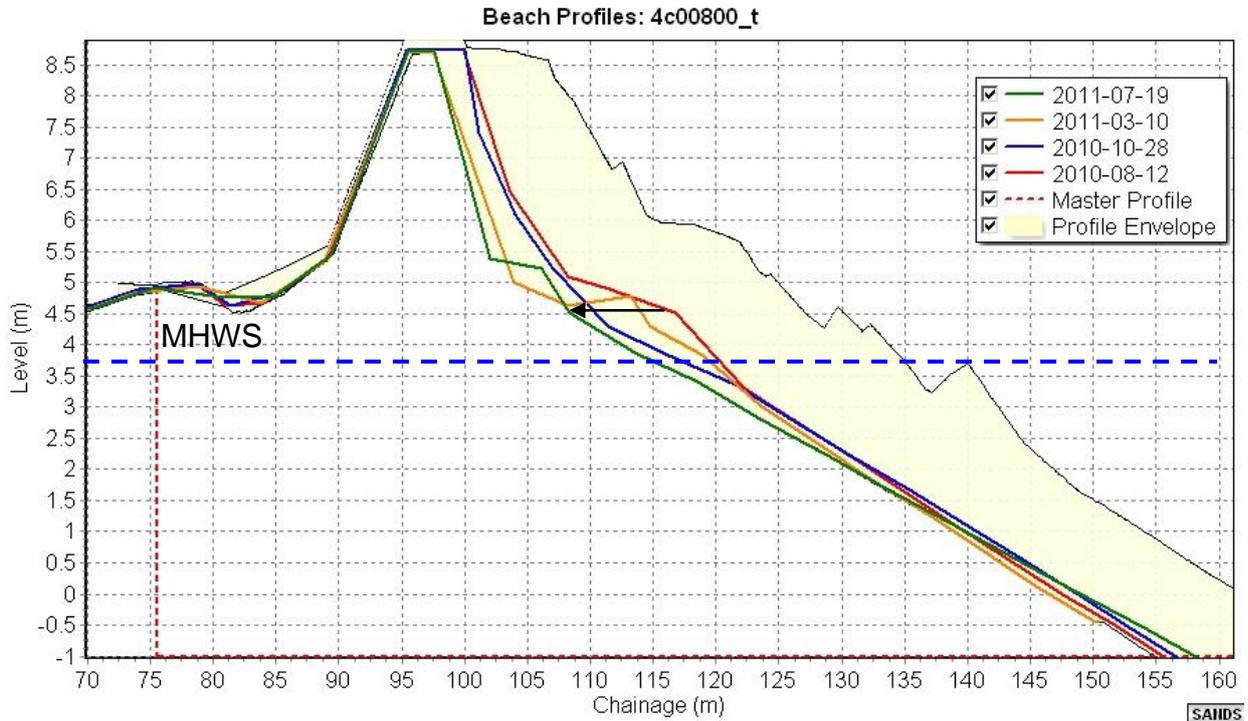


Figure 3: Cross sectional changes at profile 4c00794

From profile 3 it can be seen that between August 2010 and July 2011 the toe of the embankment has retreated by 3m with a reduced crest width. The apex of the embankment has actually remained constant over the past year which indicates that the rolling back of the crestline has not yet impacted on the embankment width or height. It can be assumed however that if the losses at the base of the embankment are to continue during the next year, the profile of the embankment is likely to change significantly. The profile envelope for this cross section also shows the reduced volume of material provided by the beach when compared with the upper profile surveyed in summer 2006. This further supports the findings of this report and graphically illustrates the cumulative effect of continual erosion since 2006.

The only location within this section that has experienced a complete reduction in embankment width is located at the western extremity of this section. Profile 4c00800 below illustrates these losses and the resultant reduction in crest width that has occurred.



**Figure 4: Cross sectional changes at rofile 4c8000.**

Figure 4 illustrates a reduction in embankment width with the loss of material occurring throughout the seaward face of the embankment. This has resulted in the embankment width reducing by 2m over the past year. It can be speculated that if the erosional processes were to continue at a similar rate in the next period, and beach management not undertaken, the embankment would likely be reduced to a form that provides little to no coast protection benefit. Again, similarly to profile 4c00794, the profile envelope reiterates the losses that have occurred over the past 5 years, however at this western extent shows a far greater degree of loss.

### 5.4 Section 2 – MU13E

During the current reporting period section 2 has again shown a continuation of erosional processes however at a slightly reduced rate to neighbouring section 1. Between 2010 and 2011 this section has lost approximately 12,000m<sup>3</sup> of material. From the difference models it can be seen that the majority of these losses have occurred linearly across the beach crest in a shore parallel band although there has also been some localised losses along the top of the embankment. Figure 5 below illustrates how these losses have affected the beach cross section for profile 4c00782 which is located in the west of this section.

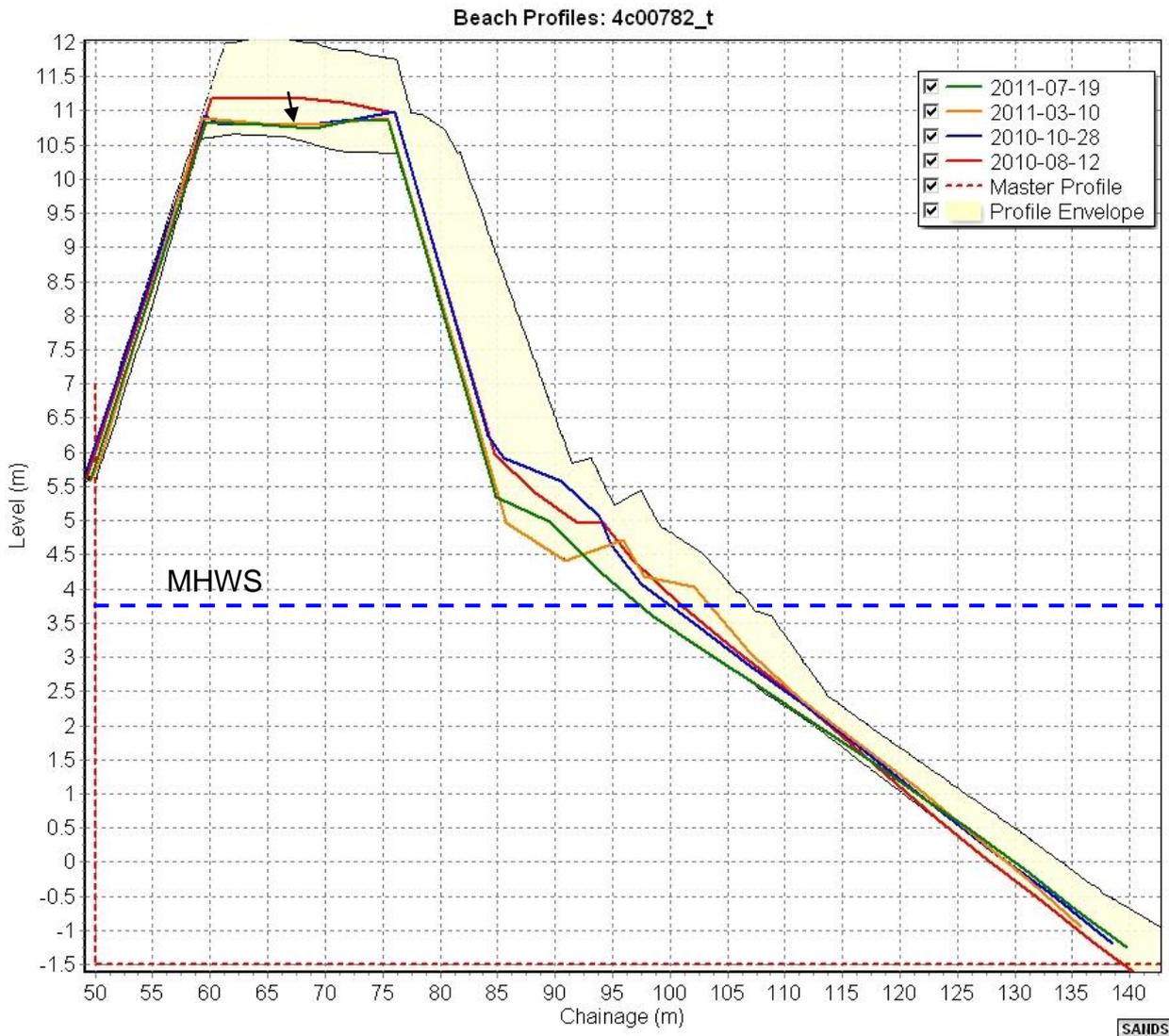


Figure 5: Cross sectional losses at profile 4c00782.

From figure 5 it can be seen that the losses over the past year have been minimal for profile 4c00782 with only a small reduction in crest height and width. The embankment has also remained relatively stable with a negligible drop in elevation at the apex. These changes are therefore relatively insignificant with regards to the beach cross

section and should be viewed in conjunction with the design levels required to maintain the standard of protection.

Figure 6 below shows the beach cross section for profile 4c00773 which is located near the eastern boundary of section 2. This profile shows a contrast to the relatively negligible changes shown in figure 5 and clearly shows a 1m reducing in embankment height.

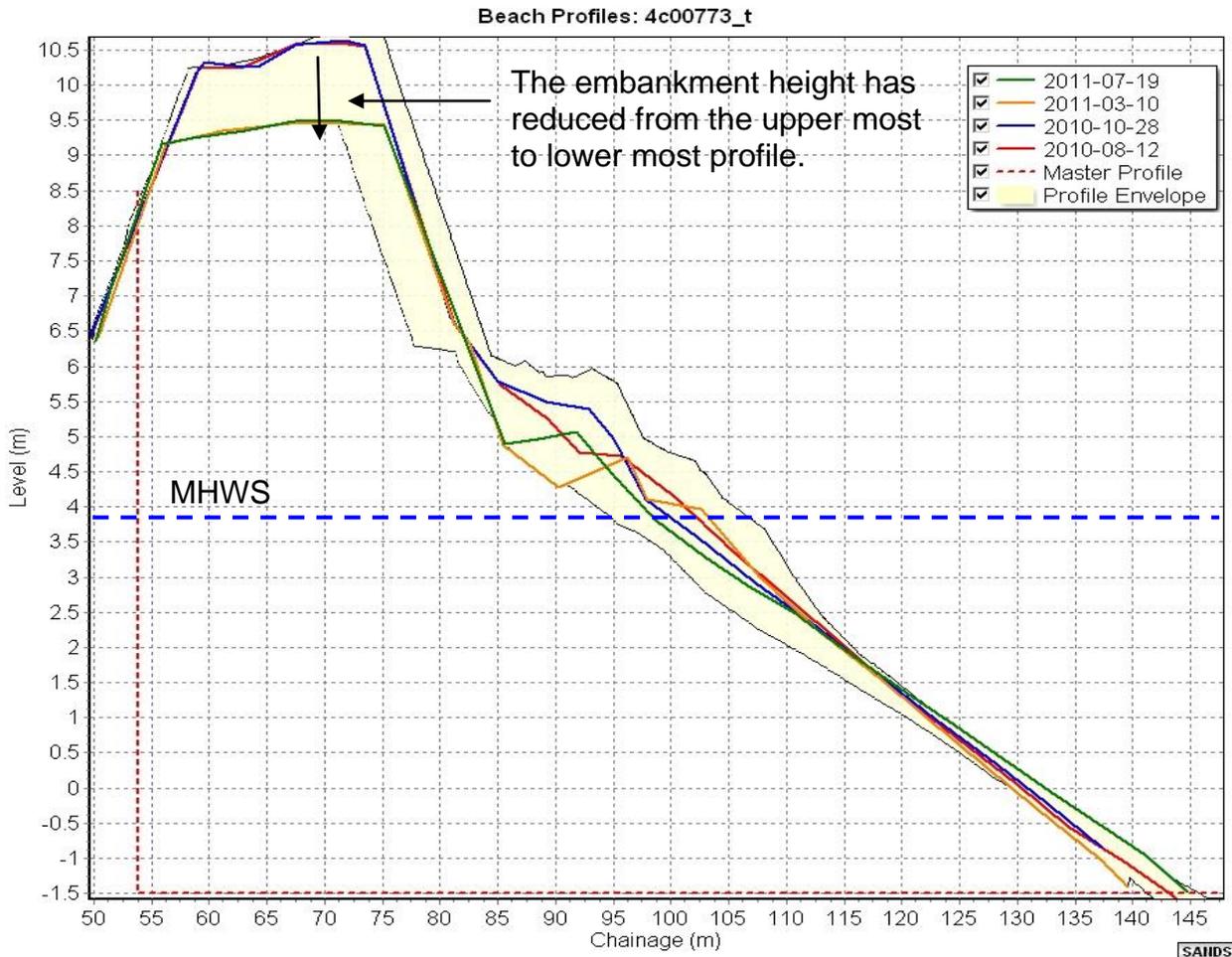


Figure 6: Profile 4c00773 showing reduction in embankment height

### Summary Data

Table 3 provides a summary of volume change within each section during the period between the 2009 and 2011 summer surveys.

Table 3: Management Unit 13 - Summary of Erosion/Accretion Totals

Area	Error Estimate*	Erosion/Accretion (2009 to 2010)	Erosion/Accretion (2010 to 2011)
1 - MU13W	+/- 2,017m <sup>3</sup>	-5,360m <sup>3</sup>	-13,452m <sup>3</sup>
2 - MU13E	+/- 2,830m <sup>3</sup>	-7,080m <sup>3</sup>	-11,858m <sup>3</sup>
<b>Total</b>	-	<b>-12,440m<sup>3</sup></b>	<b>-25,310m<sup>3</sup></b>

\* Error estimates are calculated as the survey area multiplied by a +/- .30mm error margin, although unlikely the error of combined surveys can be up to double this figure

## 6.0 Long Term Summary

Analysis of the current reporting period shows that this frontage is influenced by erosive forces and has suffered its fifth consecutive year of net losses. The continuation of losses indicates that although the embankment is maintained periodically, the works undertaken fail to maintain a consistent sediment budget and material continually passes into the adjacent management unit.

Table 4 below indicates the long-term trends for this section and magnitude of change that has occurred since 2003.

**Table 4: Beach Volume Change Summary (2003 - 2011)**

Section	Volume Change (m <sup>3</sup> )								
	2003 - 2004	2004 - 2005	2005 - 2006	2006 - 2007	2007 - 2008	2008 - 2009	2009 - 2010	2010 - 2011	NET
<b>1 (W)</b>	-2,013	16,185	1,306	-15,421	-20,487	-10,847	-5,360	-13,452	<b>-50,089</b>
<b>2 (E)</b>	6,562	14,135	2,806	-6,195	7,694	-12,382	-7,080	-11,858	<b>-6,318</b>
<b>NET</b>	<b>4,549</b>	<b>30,032</b>	<b>4,112</b>	<b>-21,616</b>	<b>-12,793</b>	<b>-23,229</b>	<b>-12,440</b>	<b>-25,310</b>	<b>-56,695</b>

When considering the net change since 2003 it is clear that there is a large disparity between the volume of change in section 1 and section 2. This likely reflects the changes in priority for providing adequate protection, with tighter control placed on the management of the eastern section where the risk is greater.

With the further reduction in net sediment budget it is clear that the capacity for localised maintenance and recycling is diminishing year on year. If trends are to continue over the next 5 years it may become necessary to assess the requirement for increased future replenishment works. Figure 7 below illustrates the cumulative change in sediment budget and identifies the trend line for this frontage.

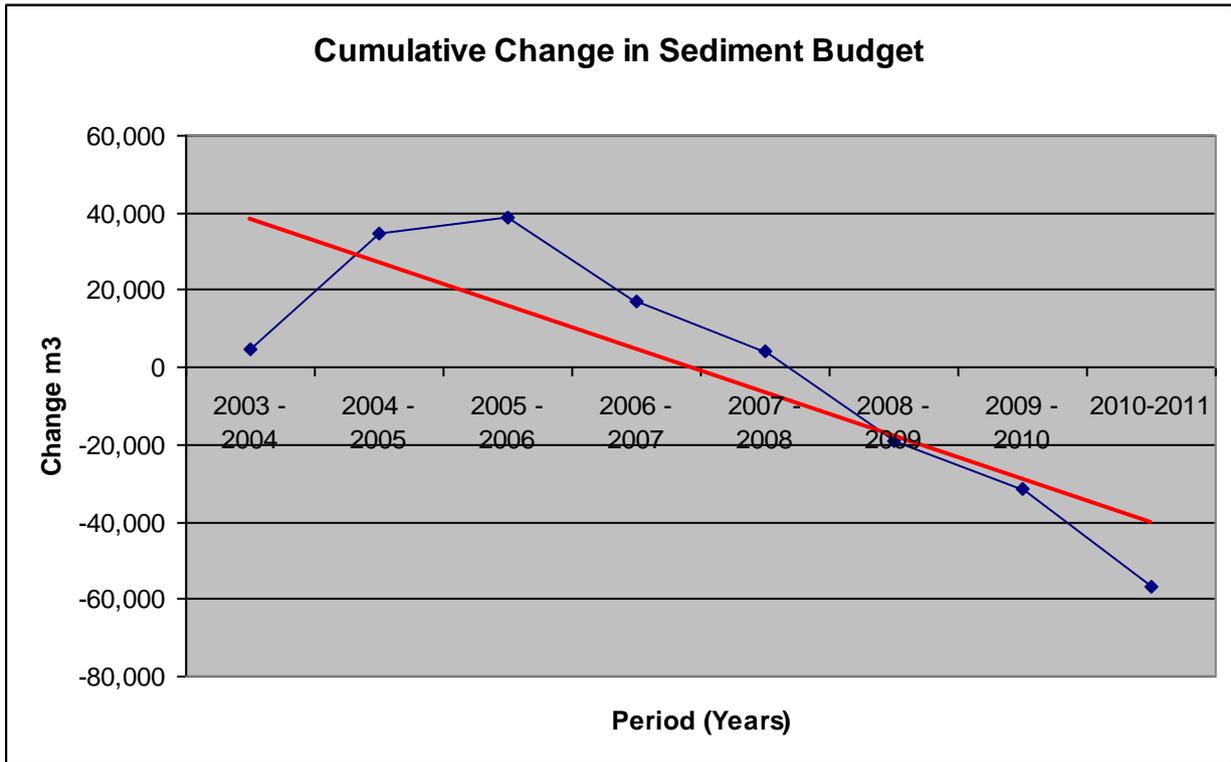


Figure 7: The cumulative change in sediment budget for Management Unit 13.

Figure 7 above clearly shows the negative trend line for this frontage and projects an increasing rate of sediment loss. These changes need to be considered in combination with the design volume for this frontage so that an assessment can be made as to when or if trigger levels have been reached. Until design levels have been provided it remains impossible to comment on the consequential effects of the changes highlighted above.

## 7.0 Wave Climate & Storm Events

Wave records are recorded by a Datawell directional wave rider buoy off Rye, first deployed August 2008. A detailed analysis of the wave climate for July 2010 to June 2011 is given in Annex C.

This reporting year was moderately active, with 5 events exceeding the 2.5m storm threshold. Dominant storm wave direction is from the south, although the highest percentage of smaller waves approach from the east.

Table 5 overleaf lists the five largest storm events recorded over the past year although a more detailed analysis can be found in annex C.

**Table 5: Breakdown of storm events 2010-2011**

Highest events in 2010/11									
Date/Time	H <sub>s</sub>	T <sub>p</sub>	T <sub>z</sub>	Dir	Water level elevation* (OD)	Tidal stage (hrs re: HW)	Tidal range (m)	Tidal surge* (m)	Max. surge* (m)
12-Nov-2010 01:00	4.35	10.0	6.7	219	1.68	HW -2	3.60	0.10	0.52
23-Oct-2010 09:00	3.60	7.7	5.9	225	1.08	HW -2	4.98	0.05	0.22
08-Nov-2010 13:00	3.58	7.7	6.0	170	2.68	HW	5.48	-0.45	-0.45
04-Dec-2010 09:00	3.51	7.7	5.9	212	2.33	HW -1	5.10	-0.03	-0.32
11-Jan-2011 04:00	3.34	7.1	5.7	181	1.83	HW +1	4.13	-0.25	-0.34

A post storm survey was carried out after the storm on the 8<sup>th</sup> of November. This survey was carried out on 12<sup>th</sup> of November to assess the impact on crest levels and embankment width. Figure 8 below shows a comparative view along profile 4c00779 which visually illustrates a loss of crest width and height. This change is further reiterated in figure 9 overleaf which shows the beach cross section for profile 4c00779.

\* Tidal information is obtained from the nearest recording tide gauge (the National Network gauge at Dover). The surge shown is the residual at the time of the highest H<sub>s</sub>. The maximum tidal surge is the largest positive surge during the storm event.

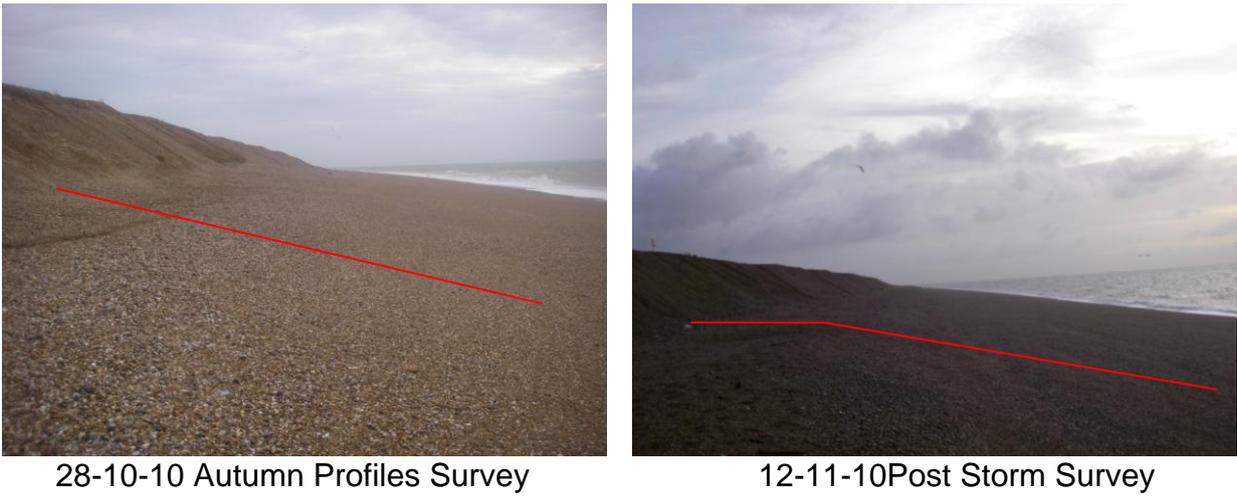
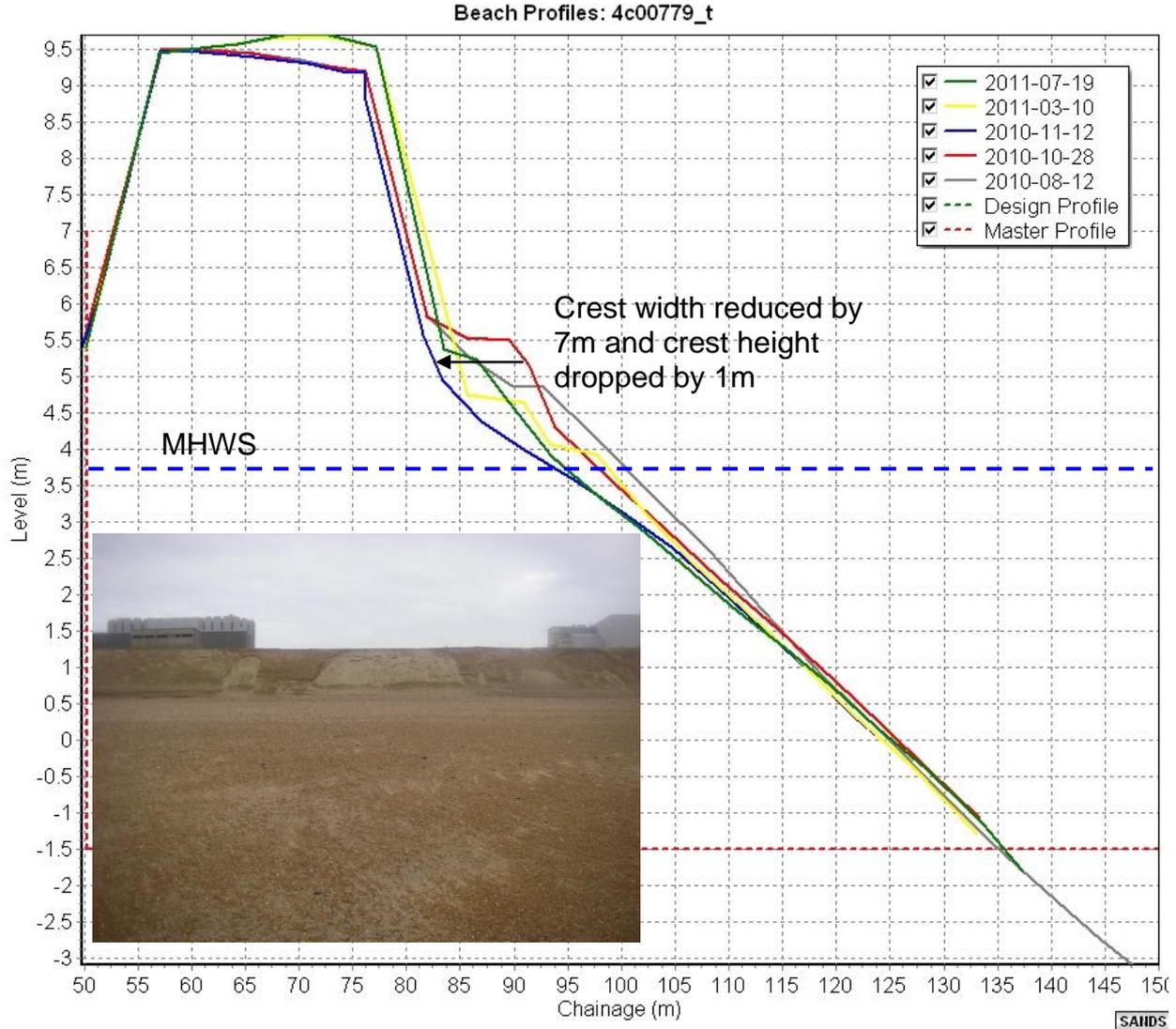


Figure 8: Comparative view of post storm changes

From the analysis of the post storm survey it is notable that the main cross sectional change to the beach has resulted in a reduced beach crest width and a lowering of the crest height. This is a typical storm beach profile however it indicates the magnitude of loss that can occur over a period of two weeks.



**Figure 9: Post storm profile 4c00779.**

The reduction in crest width as shown in figure 9 above will clearly reduce the amount of protection provided to the shingle embankment and it can be seen that the seaward face of the embankment has suffered minor losses during the storm. This is further supported by the photo taken during the post storm survey which shows fresh material being exposed on the seaward face of the shingle embankment.

## **Profile Location Diagrams**

