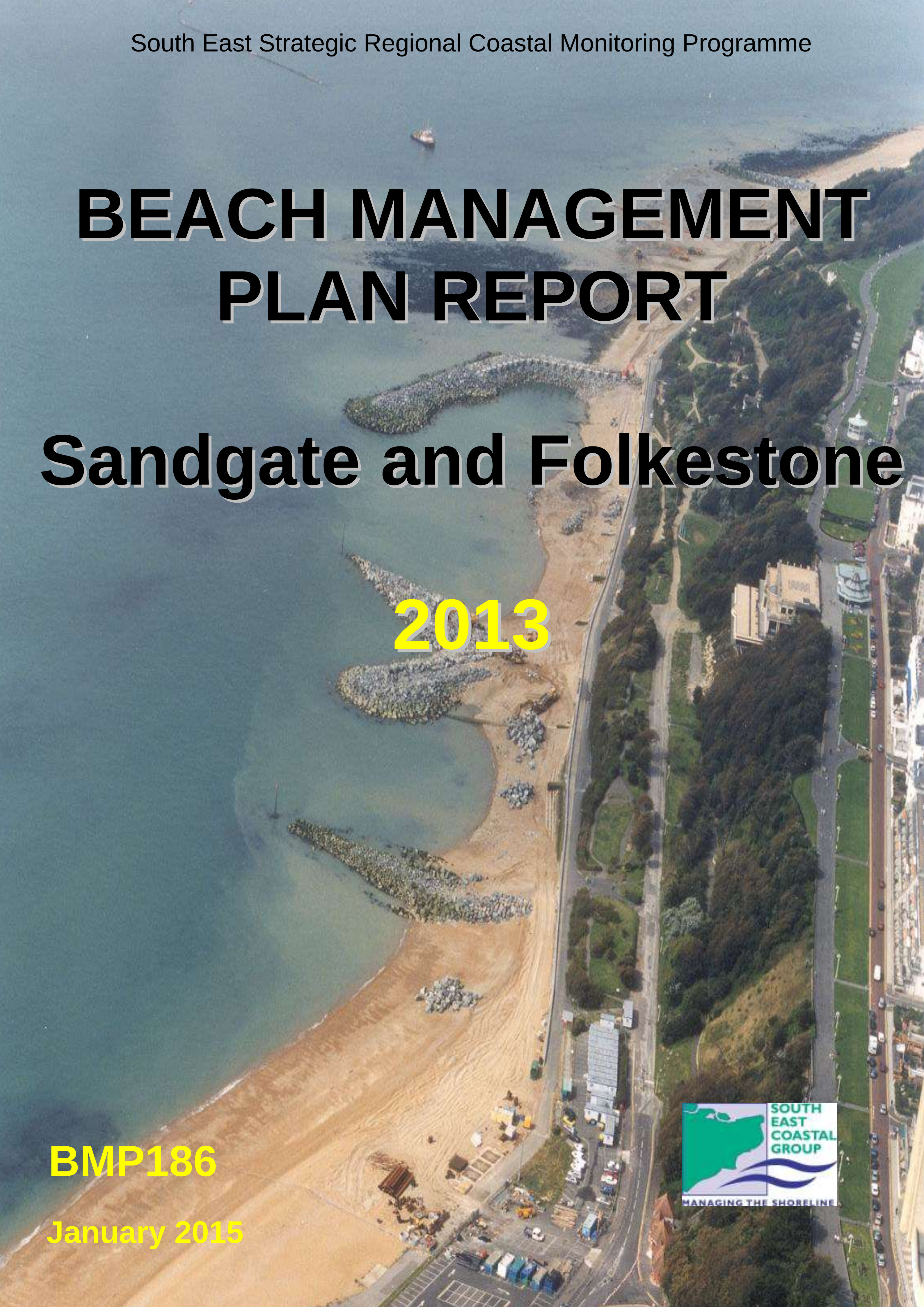

South East Strategic Regional Coastal Monitoring Programme

BEACH MANAGEMENT PLAN REPORT

Sandgate and Folkestone

2013

SOUTH EAST COASTAL GROUP
MANAGING THE SHORELINE

BMP186

January 2015

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01		Draft Report	

Report Log

Report Type	SU10 (West Direction)	This Unit (SU09 & 08)	SU07 (East direction)
Annual Report 2004	Dover Harbour to Beachy Head – AR 08		
BMP 2005	BMP29	**BMP30**	No BMP Report
Annual Report 2006	Dover Harbour to Beachy Head – AR 19		
BMP 2006	BMP42	**BMP41**	No BMP Report
Annual Report 2007	Dover Harbour to Beachy Head – AR 31		
BMP 2007	BMP057	**BMP058**	No BMP Report
Annual Report 2008	Dover harbour to Beachy Head – AR 41		
BMP 2008	BMP076	**BMP077**	No BMP Report
Annual Report 2009	Dover Harbour to Beachy Head – AR 51		
BMP 2009	BMP097	**BMP098**	No BMP Report
Annual Report 2010	Dover Harbour to Beachy Head – AR 61		
BMP 2010	BMP118	**BMP119**	No BMP Report
Annual Report 2011	Dover Harbour to Beachy Head – AR 71		
BMP 2011	BMP140	**BMP141**	No BMP Report
Annual Report 2012	Dover Harbour to Beachy Head – AR 81		
BMP 2012	BMP161	**BMP162**	No BMP Report
Annual Report 2012	Dover Harbour to Beachy Head – AR 91		
BMP 2013	BMP185	**BMP 186**	No BMP Report

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Abstract

Shingle beaches provide a vital element of the flood and coastal erosion defences along the Sandgate and Folkestone frontage. With the past completion of the two major coast protection schemes in 1996 and 2004 the frontage is now entirely dependant on the successful implementation of beach management through a sediment recycling programme. These works are essential in maintaining the current high standard of protection provided by the beaches and seawalls along this frontage and ensuring the level of risk is maintained at an acceptably low level. However, with this beach management scheme still in a stage of refinement it is imperative that monitoring continues to ensure a full analysis of the beach performance. This data will subsequently facilitate the improvement of present works and allow for a more informed decision on any future recycling procedures undertaken.

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 2012-2013 period, and compares this to baseline surveys conducted at the outset of the project in 2003. The key findings are listed below:

Survey Unit 09

The overarching sediment trend between 2004 and 2008 showed consistent net erosion for this Survey unit. This trend however was challenged in 2009 when the section recorded its first net gain since the recharge in 2003. Although it is unconfirmed, it is believed that the up drift of Survey Unit 11 may have been recharged during the 2008-2009 period which may account for the increase in material entering the unit; however without detailed logs on the recycling activities undertaken to the west, it remains difficult to comment on this change.

When analysing the volumetric change since 2009 it is evident that this Survey unit continues to loose material at differing rates. The negligible loss over the current reporting period shows that despite the intensive bi-annual recycling activities the standard of protection this beach offers continues to reduce, albeit at a slow rate.

When considering the total recycling volume for autumn 2012 and spring 2013 (approximately 39,000m^3), it is clear that the sediment budget continues to reduce despite the high levels of beach management. It can therefore be proposed that this section could benefit from larger recycling volumes in the future in an attempt to further reduce longshore loses.

Since 2003, this survey unit has lost approximately 57,400m^3. Due to the cuspate arrangement of the sections only a small proportion of the Survey unit is actually below the design standard and many of the profiles in areas of accretion are well above the 1 in 200 year standard of protection.

Survey Unit 08

Survey Unit 08 has historically shown a continual increase in sediment budget since the replenishment scheme in 2003. The data collected over the current reporting period shows another gain of approximately 13,205m^3. This change is however rather negligible when considering the size of the survey unit and long-term forecasts indicate a stable shingle budget. Accretion dominated the frontage with 6 out of 8 sections showing a gain in material whilst the two erosive sections experienced negligible loss.

During this reporting period approximately 49,100m^3 of shingle was recycled along this Survey Unit which is believed to have assisted in reducing longshore loses. It is important to note that the recycling activities were the highest since records begun due to additional funding being made available. Therefore with the current levels of recycling it appears that this section is relatively stable although some areas may benefit from larger recycling volumes.

The long term trend for this section indicates accretional processes dominating and beach levels continuing to exceed design profiles in areas.

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 2013 and Spring 2014, 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 2013 beach plan survey. All historic monitoring data is accessible online (www.channelcoast.org), and future surveys will be available after satisfying quality assurance procedures.

1.0 Introduction

The coastal frontage of Survey Units 08 & 09 extends between Hythe in the west and Folkestone in the east and offers two distinct geomorphological characteristics. The western 4km of the frontage (Hythe to Sandgate) is located within a low-lying section of alluvial deposits, whilst at Sandgate the low-lying land is replaced by a shoreline backed by cliffs of Lower Greensand which continue east to Folkestone.

These conditions therefore present two distinct coast protection issues with the western low lying land primarily at risk from coastal flooding and the eastern half primarily at risk from coastal erosion.

In general the frontage is an area of varied geology with a stratigraphical progression rising eastwards from the Atherfield Clay, Hythe Beds, Sandgate Beds (silts and clays) to the sandstones and clays of the Folkestone Beds, east of Folkestone Harbour. In broad terms, the cliff stability and beach levels deteriorate from west to east. The main reason for this trend is due to the starvation of sediment supply from the western end of the frontage, which has been enhanced by a system of groynes constructed during the 1950s to protect the up-drift coastline (Halcrow, 2004).

This section of coastline is generally south facing with an offshore normal of approximately 169^0 which is most severely impacted by waves approaching from a south westerly direction. This is principally due to the greater fetch presented from this approach and therefore the wave climate tends to be characterised by larger wave heights driven by storm events. The net littoral drift of shingle is eastwards although the supply from the west, Dungeness to Hythe, has been declining in the recent past. With a reduction in material entering this section, beach levels in front of the seawalls drop continually due to sediment erosion, and as a result of this ‘coastal squeeze’ the seawalls have been subjected to considerable wave attack.

Historically the narrow shingle beach that extended between the western harbour arm and the western end of Hythe was retained by a comprehensive groyne field. However, as part of the 1996 Hythe coast protection scheme the groynes between Hythe and Sandgate were removed and two large rock groynes constructed in their place. These were to act as terminal groynes and performed a vital function in the newly introduced ‘open managed beach’ approach adopted for this frontage. To increase the level of protection provided by the beach to the seawalls, approximately 1 million m^3 of shingle was placed on the beach as part of the capital renourishment scheme.

In 2004, the Hythe to Folkestone coast protection scheme extended this approach all the way to Folkestone harbour, with an additional $326{,}000m^3$ and the construction of additional rock groynes. Shingle recycling now takes place twice each year (in the spring and autumn), and the topographic data collected as part of the Strategic Regional Coastal Monitoring Programme is used to inform and refine these operations.

At the eastern extent of the Survey Unit, on the other side of Folkestone Harbour, there is wide sandy beach that is backed by a series of concrete arches that provide erosion protection to the cliffs. This beach is relatively stable and whilst it is included within the boundaries of Survey Unit 08, it is not subject to any beach management practices. The condition of the beach and any erosion or accretion trends are, however, discussed in this Beach Management report.

The location of the frontage is shown on Figure 1 illustrating the division between the two Survey Units and the position of the nearest wave recorder in the Hythe Bay.

Figure 1: Site Location and Wave/Tide Gauges

2.0 BMP Design conditions

As part of the 2004 scheme design the SHINGLE parametric cross shore transport model was applied to predict the response of a design beach profile to various return period storm events. A range of beach profile crest widths and crest heights were tested against a series of joint probability wave conditions. The resulting storm beach profile was then applied in an overtopping assessment to confirm the overtopping rate at the back of the beach and the standard of protection against flooding. Through an iterative approach the initial profile (crest height and crest width) was modified until the predicted storm profile provided an acceptable overtopping rate and standard of protection (URS, 2011).

An example of a SHINGLE model output is provided in Figure 2 and illustrates the initial profile (original), the post storm profile (predicted) and annotated with the critical minimum profile crest width for overtopping standard of protection and seawall stability. The profile response includes retreat of the beach crest by approximately 2.5m and erosion of the submerged beach profile, leading to the formation of a lower beach berm.

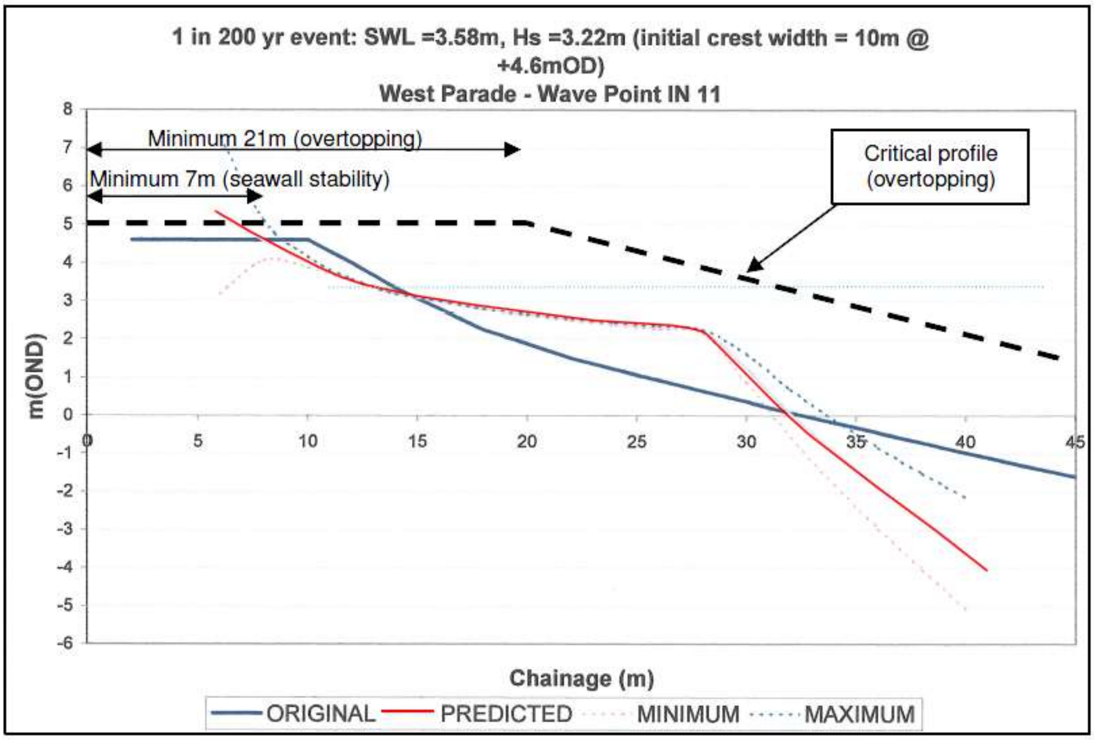


Figure 2: Example SHINGLE model output beach reporting section 1, for a 1:200 year event, annotated with the critical beach profile.

Based on the SHINGLE modelling, a series of critical beach profiles were established to achieve the 1 in 200 year standard of protection along the frontage. These profiles were then rationalised during the design stage, depending on the defence type, the elevation of the ground behind the defences and the potential depletion of material through longshore transport processes between recycling events. A final design profile in relation to the critical profile was developed for each Survey unit to ensure that prior to a storm event the beach profile is equal to or in excess of the critical profile to ensure seawall stability and overtopping standard of protection (URS, 2011).

2.1 Required Minimum Beach Crest

Using the results of the cross-shore modelling and the wave overtopping analysis, the following beach crest widths and crest elevations have been determined, as shown in table 1 below.

Table 1: 2004 Design Parameters

SU/Reporting Section	**Design crest width (m)**	**Design elevation (m)**	**Critical crest width for seawall stability (m)**	**Critical crest width for overtopping (m)**	
				1:100	**1:200**
SU09/1 West	n/a	-	-	-	-
SU09/1 Central	28	5.0	7.0	18.0	21.0
SU09/1 East	18	5.0	7.0	18.0	21.0
SU09/2	18	5.0	7.0	18.0	21.0
SU09/3&4	15	4.6	7.0	7.0	7.0
SU08/01	15	4.6	7.0	7.0	7.0
SU08/02	15	4.6	7.0	-	-
SU08/03	15	4.6	7.0	-	-
SU08/04	15	4.6	7.0	-	-
SU08/05	15	4.6	7.0	-	-
SU08/06	15	4.6	7.0	-	-
SU08/07	NA	NA	NA	NA	NA
SU08/08	NA	NA	NA	NA	NA

2.2 Maintenance of Crest Width

In order to maintain the required crest width, it is necessary to allow for the depletion of material through longshore transport processes. Under the current beach management regime the beach is recycled from the terminal groynes on a bi-annual basis. Currently the beach is placed with a generalised 15m or 18m wide crest at 4.6mODN. The length of time taken for this volume of beach to deplete to below the required volume varies greatly depending on the incident wave climate.

To establish the amount of over placement required, beach monitoring data from a five-year period was examined. The data has shown that at the worst locations (downdrift of the terminal groynes) the beach crest will reduce in width by approximately 10m over the winter period. To ensure that the minimum crest width is maintained throughout the year, it has become necessary to over-place material at the western (updrift) end of these recycling compartments (Halcrow, 2004).

2.3 Beach Management Plan

There is currently no active Beach Management Plan for SU08 &SU09 however work has begun to reassess design profiles and management techniques in the forth coming Beach Management Plan 2013. Preliminary assessment of the new guidance on extreme wave and water level conditions released by the EA in February 2011 indicates that extreme water level estimates for 2011 have been revised downwards compared to those applied in the 2004 design. A reduction in extreme water level, will lead to a reduction in overtopping rate, therefore on this basis the scheme critical profile width for overtopping should provide a standard of protection in excess of 1 in 200 years.

3.0 Surveys

All topographic and bathymetric surveys are referenced to a Global Positioning System (GPS) control grid, established for this 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 2.

Digital Ground Models of the 2013 Beach Management Plan topographic survey are shown in plate 3 and 4 (Annex B) superimposed upon the ortho-rectified aerial photograph of 2008. The method used for deriving Digital Ground Models is given in the Explanatory Notes (Annex A).

3.2 Bathymetric surveys

The schedule of surveys since the start of the Regional Monitoring Programme is given in Table3.

Table 2: Schedule of Topographic Surveys

	SU09				SU08	
Profile	**Beach Plan**	**Post Storm**		**Profile**	**Beach Plan**	**Post Storm**
15/05/2003	15/05/2003			15/05/2003	15/05/2003	
23/10/2003				23/10/2003		
27/02/2003				27/02/2003		
03/10/2004	03/10/2004			03/10/2004	03/10/2004	
16/10/2004				16/10/2004		
14/03/2005				14/03/2005		
26/06/2005	26/06/2005			26/06/2005	26/06/2005	
18/10/2005				18/10/2005		
		04/11/2005				04/11/2005
		06/12/2005				06/12/2005
04/03/2006				04/03/2006		
06/06/2006	06/06/2006			06/06/2006	06/06/2006	

07/11/2006				07/11/2006		
		08/12/2006				08/12/2006
20/02/2007				20/02/2007		
03/08/2007	03/08/2007			17/08/2007	17/08/2007	
		14/12/2007				14/12/2007
30/10/2007				31/11/07		
11/03/2008				07/03/2008		
03/09/2008	03/09/2008			21/08/2008	21/08/2008	
15/11/2008				17/11/2008		
25/02/2009				25/02/2009		
25/06/2009	25/06/2009			06/07/2009	06/07/2009	
19/10/2009				19/10/2009		
31/03/2010				01/04/2010		
01/07/2010	01/07/2010			15/07/2010	15/07/2010	
25/10/2010				25/10/2010		
06/03/2011				07/03/2011		
08/06/2011				06/06/2011		
12/10/2011				01/10/2011		
		21/12/2011				21/02/2011
27/03/2012				27/03/2012		
21/07/2012	21/07/2012			20/07/2012	20/07/2012	
04/10/2012				03/10/2012		
		18/12/2012				17/12/2012
31/01/2013				03/04/2013		
07/08/2013	07/08/2013			23/08/2013	23/08/2013	

Table 3: Schedule of Bathymetric Surveys

SU08 & SU09		
Date	**Line Spacing**	**Distance Offshore**
07/09/2003	50m	1000m
09/05/2006	50m	1000m

4.0 Beach Management Operations

Beach Management operations are currently undertaken bi-annually in the Spring and Autumn. The operations are weighted to account for the increased storm activity in the winter period and consequently larger volumes are recycled in the autumn to prepare the beach for successive storm events. The spring operations aim to readdress the losses incurred over the winter months and to regrade the beach to a more amenable profile. These operations currently utilise the annual monitoring data to accurately target areas along the frontage where excessive erosion has occurred. Figures 3 and 4 overleaf illustrate the recycling operations across the entire frontage and the proposed areas for extraction and deposition.

The Shingle Recycling Operation

Shingle is excavated from the beach crest at the source site to the east of each recycling cell using a 360 degree tracked excavator equipped with a loading bucket. The shingle is loaded into 6-wheeled articulated dump trucks and transported to the depleted site where it is tipped and graded into the required profile using a bulldozer.

The Shingle Regrading Operation

The re-grading operation is undertaken to reform the design level and width of beach crest. In the past, this operation has been carried out using a 360 degree tracked excavator to excavate the shingle from the face of the seawall and place it onto the beach crest. A bulldozer is then used to grade it into the required profile.

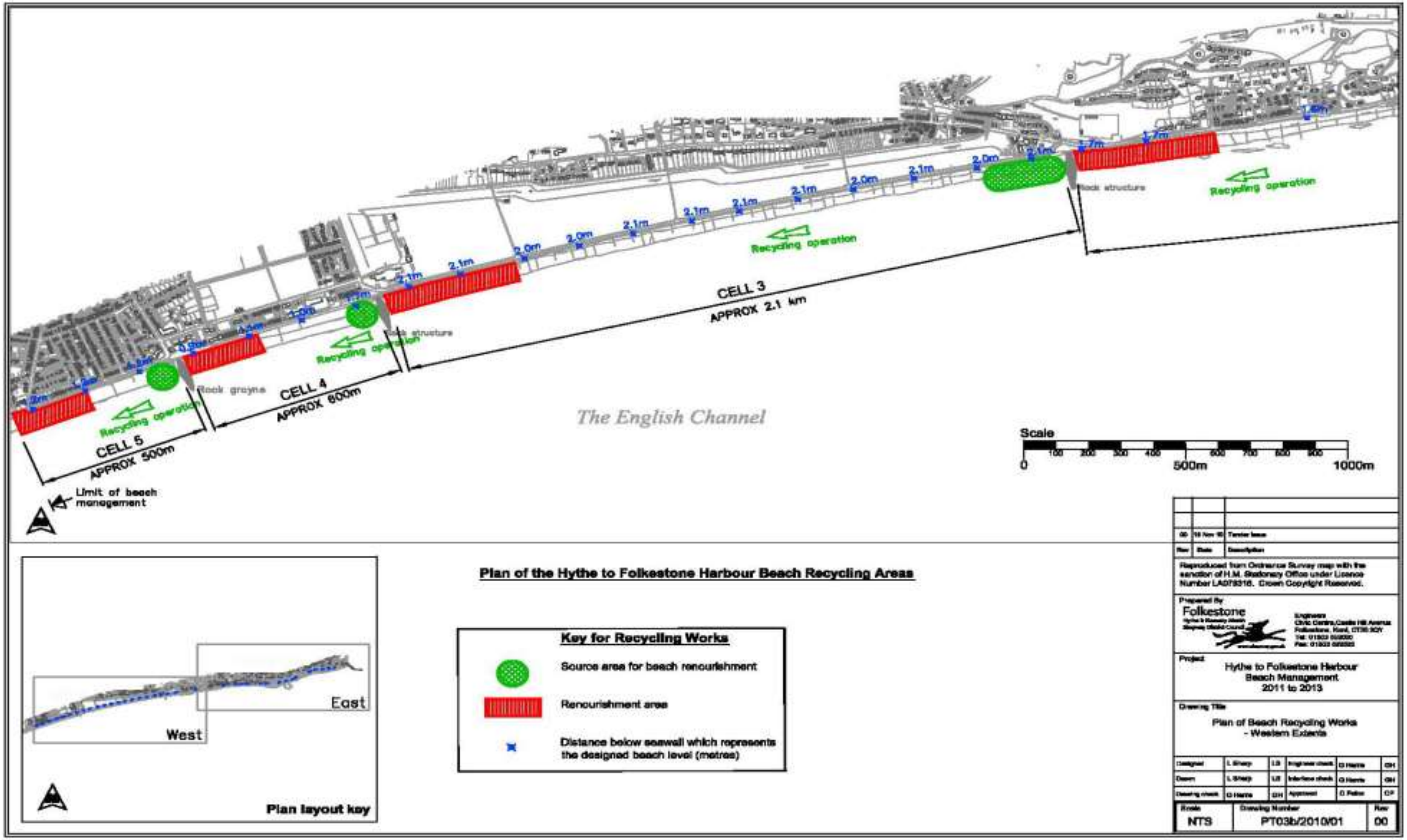


Figure 3: Beach Recycling Areas- Western Extents

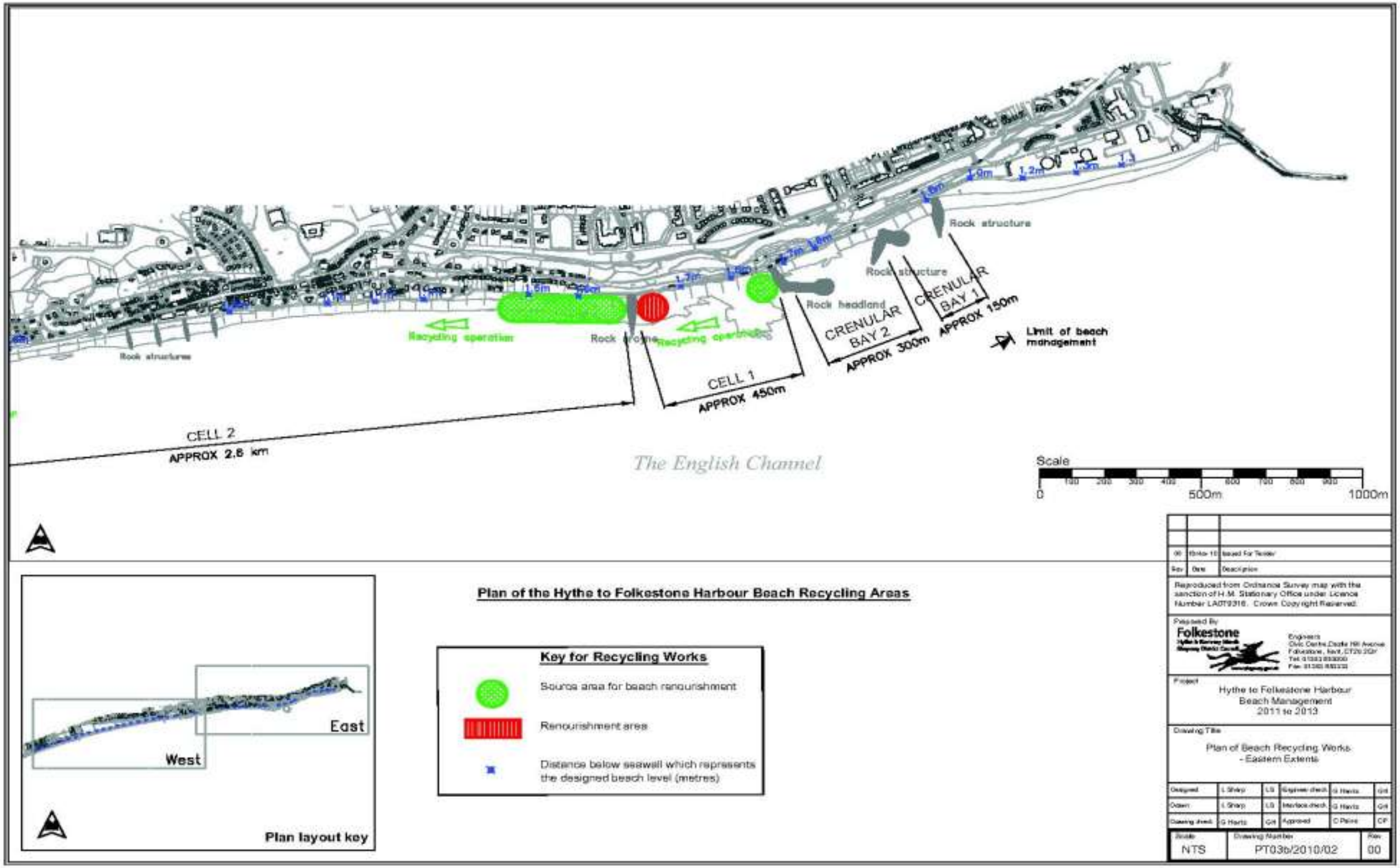


Figure 4: Beach Recycling Areas- Eastern Extents

5.0 Analysis

Difference Models

Now that the 2013 BMP data set has been compiled, it is possible to overlay the results of the survey with BMP data from 2012. 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 (1-5) and Plate 2 (1-7), 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 2012 & 2013, 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.

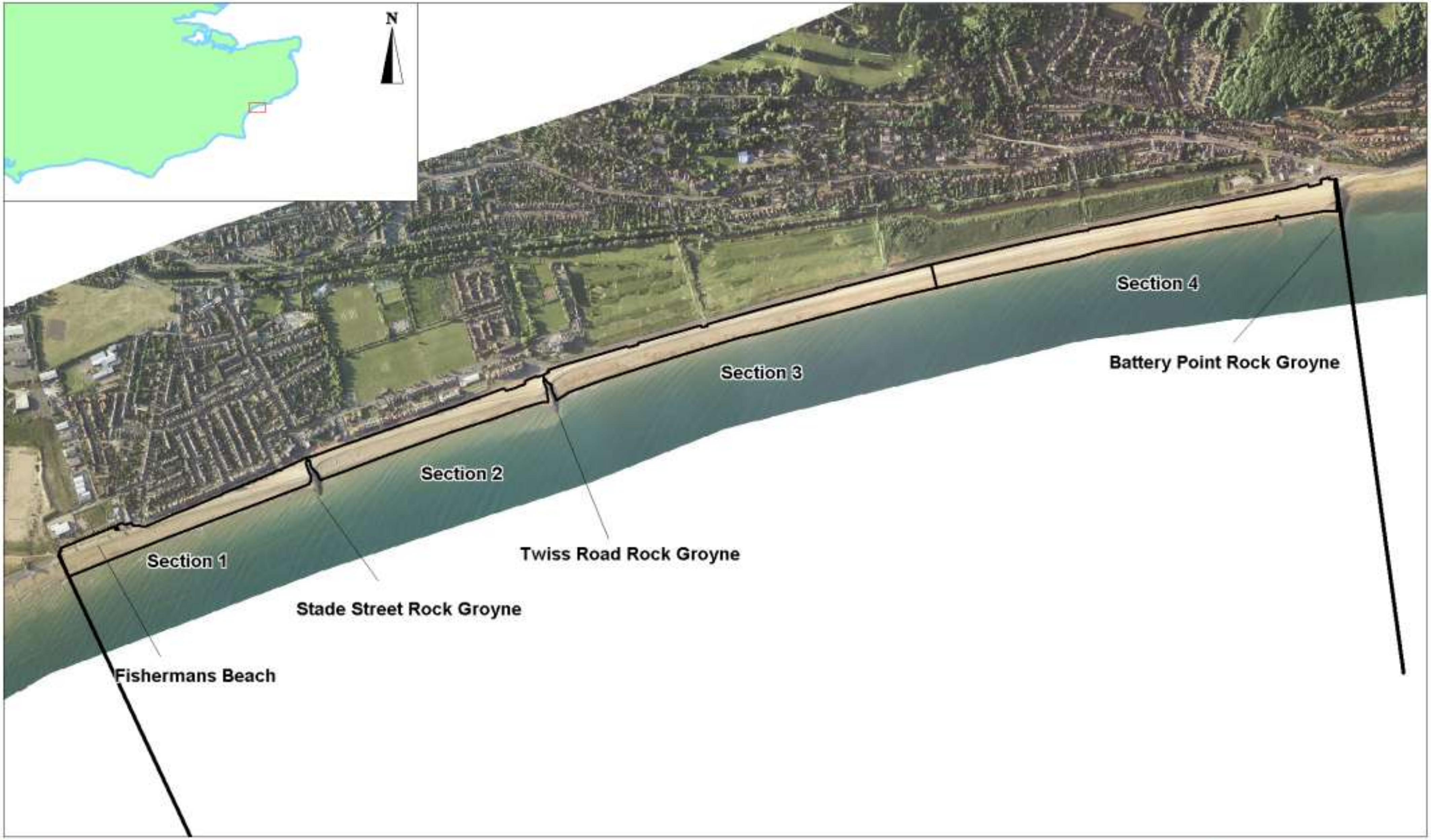
Profile Evolution

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 2013 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.

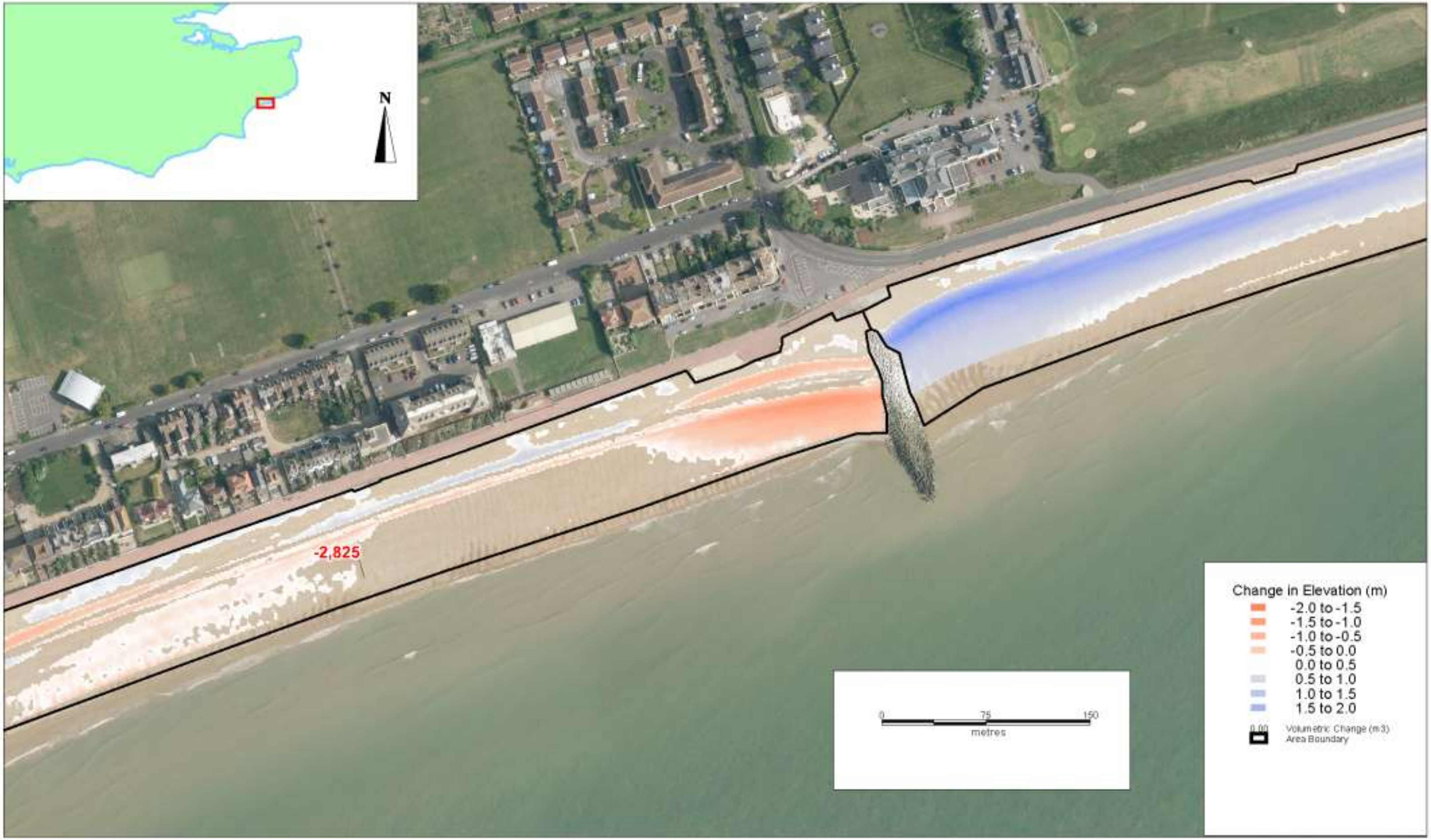
The Cross-Sectional Area (CSA) has been calculated for all beach profiles. This is calculated as the area of profile above a Master Profile (MP). In general, the lower boundary of the MP is the transition between the beach face and the foreshore (i.e. the beach toe). The landward boundary is either the 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.

Coastal Process Analysis – SU09

To aid purposeful analysis the survey unit has been split into four sections as depicted in the diagram overleaf. These reflect changes in beach configuration and/or the presence of terminal structures. In the context of this report, beach change will be described in these four sections; these being labelled one to four, passing from west to east.


N
Section 1
Section 2
Section 3
Section 4
Fishermans Beach
Stade Street Rock Groyne
Twiss Road Rock Groyne
Battery Point Rock Groyne


N
-747
Change in Elevation (m)
-2.0 to -1.5
-1.5 to -1.0
-1.0 to -0.5
-0.5 to 0.0
0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
0.00 Volumetric Change (m3)
Area Boundary
0
75
150
metres


N
-2,825
Change in Elevation (m)
-2.0 to -1.5
-1.5 to -1.0
-1.0 to -0.5
-0.5 to 0.0
0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
0.00 Volumetric Change (m3)
Area Boundary
0
75
150
metres


N
17,958
0
75
150
metres
Change in Elevation (m)
-2.0 to -1.5
-1.5 to -1.0
-1.0 to -0.5
-0.5 to 0.0
0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
0.00
Volumetric Change (m3)
Area Boundary


N
-26,521
Change in Elevation (m)
-2.0 to -1.5
-1.5 to -1.0
-1.0 to -0.5
-0.5 to 0.0
0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
0.00 Volumetric Change (m3)
Area Boundary
0 75 150
metres


N
Change in Elevation (m)
-2.0 to -1.5
-1.5 to -1.0
-1.0 to -0.5
-0.5 to 0.0
0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
0.00
Volumetric Change (m3)
Area Boundary
0
75
150
metres

5.1 Section 1

Section 1 comprises of the small stretch of frontage between the areas commonly known as Fisherman's Beach and the Stade Street rock groyne. It is important to note that due to Fisherman's Beach designation as a working beach only the central and eastern areas are subject to annual shingle recycling.

When analysing the difference model it is evident that this section has experienced a negligible loss of approximately 747m^3. This change continues the trend that occurred up until the last reporting period where a gain of approximately 7,000m^3 was witnessed.

The difference model reflects the significant recycling activities that occurred here during the Autumn of 2012 and Spring of 2013 works. Overall, 7,634m^3 of material was recycled in this unit which has helped this section remain stable during this report period.

5.2 Section 2

Section 2 stretches between the Stade Street groyne in the west and the Twiss Road groyne in the east. During the current reporting period, Section 2 has experienced a net loss of approximately 2,800m^3. As similar to Section 1, this section shows erosion at eastern end which is a direct result of the recycling activities. Approximately 4,500m^3 of material was recycled in this section during the Autumn of 2012. No recycling was undertaken in the Spring of 2013. It can be suggested that if recycling operations took place during the Spring of 2013, this section may have witnessed less erosion.

5.3 Section 3

Section 3 covers the western half of the 2km open stretch of beach between Twiss Road and Battery Point. As with the previous sections, this section has also been heavily influenced by the bi-annual recycling works.

In the current reporting period this section has see net gain of approximately 18,000m^3. The difference model shows that accretion is predominant throughout this section with only a minor sign of erosion at the eastern end. When compared to the previous reporting period this section has seen a much greater amount of material deposited through recycling activities. This has therefore resulted in this section witnessing an overall net gain.

5.4 Section 4

Section 4 is located west of Battery Point terminal groyne, and is an important site for sediment deposition. With the natural drift rate moving material west to east, this area typically accretes material and offers a standard of protection in excess of 1 in 200 years.

This section of frontage has displayed a significant net loss of approximately 26,500m³. This loss is a direct result from the recycling activities that took place during 2012/13 with approximately 26,900m³ of material being extracted compared to 4,300m³ in 2011/12.

Table 4 below provides a summary of volume change within each polygon during the period between the 2012 and 2013 summer surveys.

Table 4: SU09 - Summary of Erosion/Accretion Totals

Polygon	Area (m²)	Error Estimate* (m³)	Erosion/Accretion (2011 to 2012) (m³)	Erosion/Accretion (2012 to 2013) (m³)
1	44,567	+/- **1,337m³**	**6,829**	**-747**
2	42,933	+/- **1,288m³**	**5,780**	**-2,825**
3	68,500	+/- **2,055m³**	**-13,368**	**17,958**
4	75,200	+/- **2,256m³**	**461**	**-26,521**
Net			**-298**	**-12,135**

** 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*

Coastal Process Analysis - SU08

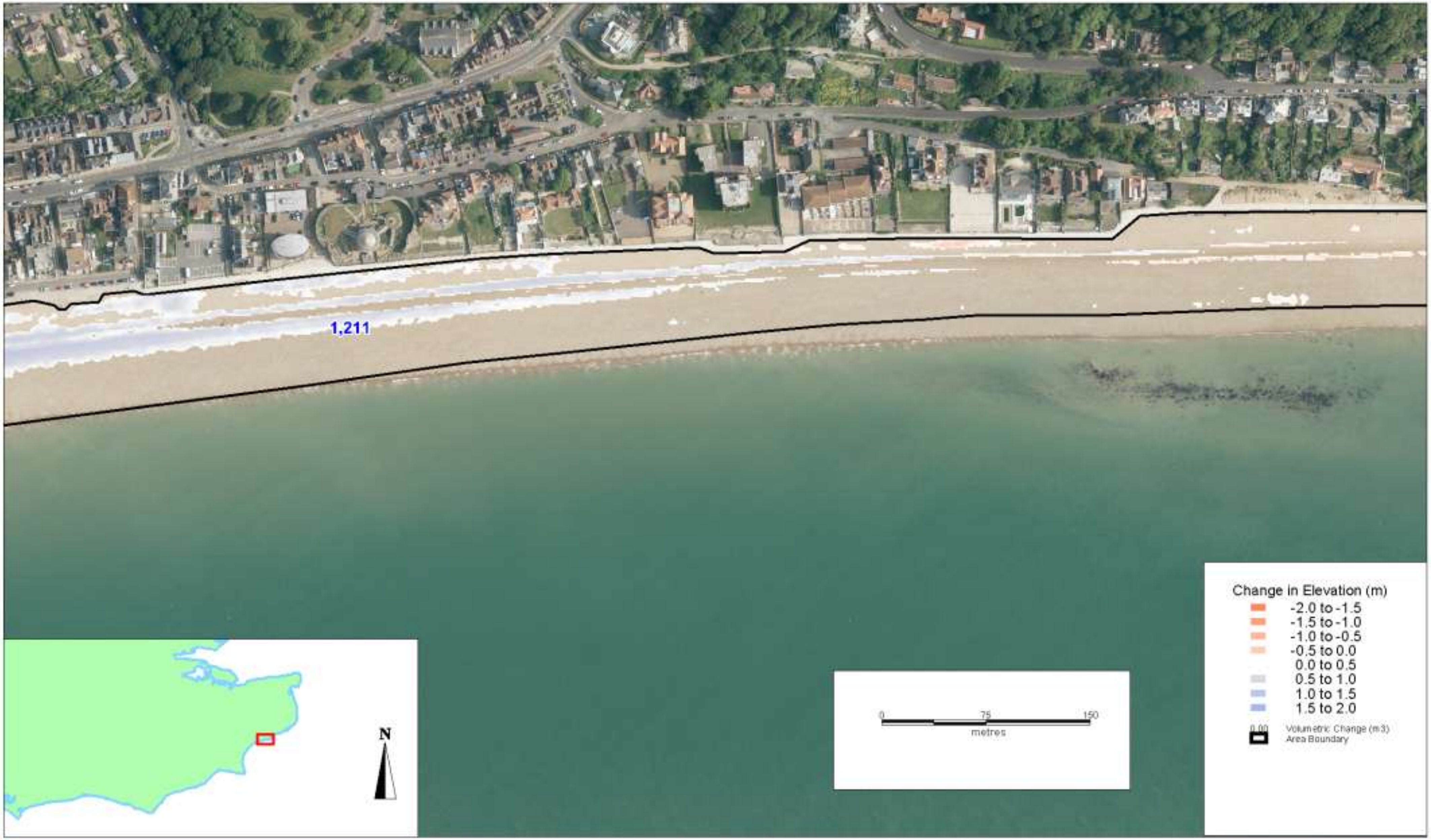
To aid purposeful analysis the unit has been split into eight sections as depicted in the diagram overleaf. These reflect changes in beach configuration and/or the presence of terminal structures.


N
Section 1
Section 2
Section 3
Section 4
Section 5
Section 6
Section 7
Section 8
Battery Point Rock Groyne
Sandgate Rock Groynes
Groyne B
Groyne C
Groyne D
Groyne E
Folkestone Harbour Arm

Beach Management Plan Site - Difference Model 2012 - 2013

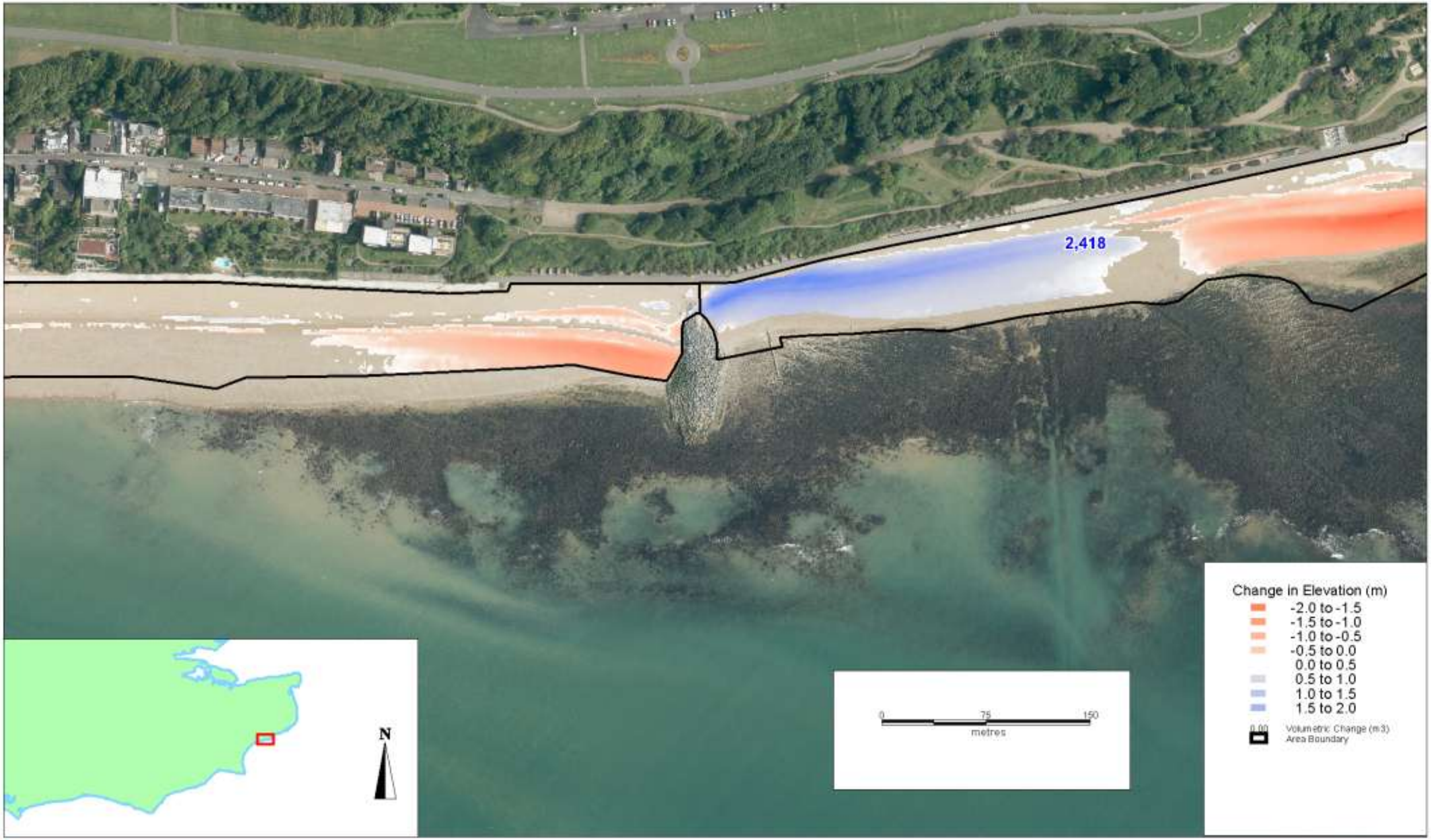
SECG - 4cSU08


157
Change in Elevation (m)
-2.0 to -1.5
-1.5 to -1.0
-1.0 to -0.5
-0.5 to 0.0
0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
0.00
Volumetric Change (m3)
Area Boundary
0
75
150
metres
N



Beach Management Plan Site - Difference Model 2012 - 2013

SECG - 4cSU08


2,418
Change in Elevation (m)
-2.0 to -1.5
-1.5 to -1.0
-1.0 to -0.5
-0.5 to 0.0
0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
0.00 Volumetric Change (m3)
Area Boundary
0
75
150
metres
N

Beach Management Plan Site - Difference Model 2012 - 2013

SECG - 4cSU08


N
4,063
0
75
150
metres
Change in Elevation (m)
-2.0 to -1.5
-1.5 to -1.0
-1.0 to -0.5
-0.5 to 0.0
0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
0.00 Volumetric Change (m3)
Area Boundary


N
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75
150
metres
Change in Elevation (m)
-2.0 to -1.5
-1.5 to -1.0
-1.0 to -0.5
-0.5 to 0.0
0.0 to 0.5
0.5 to 1.0
1.0 to 1.5
1.5 to 2.0
0.00 Volumetric Change (m3)
Area Boundary

5.5 Section 1

This section is located immediately east of the Battery Point rock groyne. Being partly in the lea of the groyne, this section suffers from continual scour as waves diffract around the rock groyne from a south westerly direction and is therefore a well known area for material depletion.

During the current reporting period this section has displayed a net gain of approximately 5,700m³. This is a substantial difference when compared to the previous reporting period which displayed a net loss of approximately 6,500m³. It is apparent that during this reporting period a greater amount of shingle was deposited in this region. This combined with less significant storms will have helped this section achieve an overall net gain.

5.6 Section 2

Section 2 comprises of a small sequence of near-buried rock groynes which were constructed in response to the Encombe landslip in the 1980's. These groynes are currently in a poor condition with no formal arrangement and as such do not contribute significantly to the overall standard of protection provided by the beach. The feasibility of modifying the existing cliff stability groynes at Sandgate has been considered in the recent 2004 Design Review. Although the high beach levels currently make these structures redundant, should in the future beach recycling be postponed, as occurred in 2007, these would be required to provide weight to the toe of the cliff to maintain stability. The outcome of the feasibility study was that therefore that the structures should remain in their current configuration (URS, 2011).

This section has remained stable with a negligible gain of 157m³. The difference model highlights that small change has occurred along the crest throughout the section. There is also a relatively large area of accretion east of the rock structures which implies that they are efficient in trapping material from continuing eastwards.

5.7 Section 3

Section 3 is the largest reporting section within this survey unit, stretching from the Sandgate rock groynes in the west to Groyne B in the east. Historically this section has had a healthy sediment budget as material accumulates beside groyne B.

Volumetrically this section has seen negligible change in the current reporting period with the addition of 1,211m³ of material. This material has accumulated primarily at the eastern boundary of this section with the western extents showing some linear erosion.

5.8 Section 4

Section 4 extends between Groyne B and Groyne C. The leeward side of groyne B has been identified as an area where material rapidly depletes and consequently can lead to the exposure of the short length of rock revetment and foundations at the seawall toe. This is illustrated in figure 5 below.

Figure 5: Photograph of beach draw down in lea of groyne B.

In the current reporting period this section has experienced a moderate change with the gain of 2,418m^3. The difference model shows the influence of the recycling operations has on this section, the eastern end shows significant accretion which opposes the longshore drift movement. During the Autumn of 2012 and Spring of 2013, approximately 19,500m^3 of shingle had been recycled in this section. From this, it is apparent that these recycling works were able to maintain the overall sediment budget in this section. Future recycling volumes in this section will need to be maintained or increase to maintain an equilibrium sediment budget.

5.9 Section 5

This section was also significantly modified as part of the 2004 Coast Protection Scheme where three large rock headland structures (Groynes C, D and E) were constructed. Groynes C and D mark the western and eastern boundaries of this reporting section respectively.

In the current reporting period this section has gained approximately 1,078m^3 of material. The difference model shows the influence of the recycling activities by moving shingle east to west to protect the vulnerable sea wall in the middle of this bay.

5.10 Section 6

Section 6 extends between Groynes D and E and constitutes the second crenular bay. This section has remained relatively stable since 2003 with both minor losses and gains recorded. During this reporting period this section has seen a material loss of 27m^3, which is negligible.

Material has mainly been lost from the western slope of the bay which is a direct result from the recycling activities that occurred in the Spring of 2013. It is theorised that as the crenular bays are comprised of material with a lower D_{50} value to that of the remainder of the frontage, the bi-annual regrading promotes shingle resorting and accelerates the winnowing out of fines.

5.11 Section 7

Section 7 is the last section of gravel beach before the Folkestone Harbour terminal groyne. This section typically accretes as material migrates from west to east along the entire frontage.

During the current reporting period this section has experienced a gain in material with 4,063m^3 gained at the crest and beach slope level. The most significant area of erosion has occurred at the western half of this section. It is important to note that no recycling operations are undertaken along this section of frontage and therefore sediment changes are a direct result of littoral movement.

5.12 Section 8

Coronation Parade is a wide sandy beach on the eastern side of the Folkestone Harbour. Due to its sheltered nature, combined with the fact that there is no contemporary feed of sediment into this survey unit, it has remained relatively stable for the last few decades. The results of the volumetric analysis show that during the present reporting period this section has witnessed negligible change of -1,438m^{3,} which is as expected for this sheltered area of beach.

Table 5 provides a summary of volume change within each section during the period between the 2012 and 2013 summer surveys.

Table 5: SU08 - Summary of Erosion/Accretion Totals

Polygon	Area (m²)	Error Estimate* (m^3)	Erosion/Accretion (2011 to 2012) (m^3)	Erosion/Accretion (2012 to 2013) (m^3)
1	71,467	**$^+/_-$ 2,144m^3**	**-6,432**	**5,743**
2	17,400	**$^+/_-$ 522m^3**	**1,447**	**157**
3	72,633	**$^+/_-$ 2,179m^3**	**2,054**	**1,211**
4	27,033	**$^+/_-$811m^3**	**474**	**2,418**
5	30,800	**$^+/_-$ 924m^3**	**-285**	**1,078**
6	11,533	**$^+/_-$346m^3**	**-809**	**-27**
7	72,966	**$^+/_-$ 2,189m^3**	**-2,202**	**4,063**
8	54,466	**$^+/_-$1,634m^3**	**-1,129**	**-1,438**
Net			**-6,882**	**13,205**

** 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*

5.13 Coastal works

During the 2012-2013 period a significant quantity of shingle was recycled along the entire frontage of SU08 & 09 during autumn 2012 and spring 2013. Table 6 below shows the volume of shingle recycled west to east in each section since 2003.

Table 6: Volume of shingle recycled in SU08 & 09 (2003-2013)

	Volume m^3									
Section	**2003/2004**	**2004/2005**	**2005/2006**	**2006/2007**	**2007/2008**	**2008/2009**	**2009/2010**	**2010/2011**	**2011/2012**	**2012/2013**
SU09										
1	9,030	3,809	6,871	5,829	2,579	8,040	13,988	8,900	11,188	7,634
2	0	0	4,455	5,551	5,408	12,396	10,993	9,401	15,663	4,482
3&4	5,690	575	4,257	6,794	3,619	7,758	10,899	16,028	4,261	26,916
	14,720	**4,384**	**15,583**	**18,174**	**11,606**	**28,194**	**35,880**	**34,329**	**31,112**	**39,032**
SU08										
1,2&3	4,830	0	9,155	8,784	0	9,124	15,361	12,233	16,285	20,367
4	0	3,358	3,555	9,060	0	19,900	13,905	11,251	13,069	19,464
5&6	0	460	3,278	412	0	2,608	4,930	4,019	5,049	9,323
TOTALS	**4,830**	**3,818**	**15,988**	**18,256**	**0**	**31,632**	**34,196**	**27,503**	**34,403**	**49,154**

It remains difficult to provide detailed commentary on the impacts of beach recycling works due to the beach sections outlined in this report covering entire recycling cells. Therefore although the difference models graphically show the divisions between western accretion and eastern erosion, the volume totals do not necessarily detail these aspects. It is however apparent that this reporting period showed the most significant shingle movement since 2003 which was due to additional funding being made available from the Environment Agency.

What is noticeable from the recycling data is that largely the bi-annual recycling volumes are failing to match the natural rates of sediment transportation for this frontage. It is also apparent that some hot spots for erosion remain significantly below the design standard for crest width and height and will require further recycling in the next access period.

The next phase of beach recycling is scheduled during the autumn of 2013 and spring of 2014.

6.0 Long Term Summary

The following section provides a narrative considering the long-term changes identified during the course of the Strategic Monitoring Programme for survey units 09 and 08.

6.1 SU09

When analysing the long-term trends highlighted by the Strategic Regional Coastal Monitoring Programme it is evident that this survey unit remains relatively dynamic. Table 7 below illustrates a summary of beach volume changes since the commencement of the programme for the four reporting sections highlighted in this report.

Section	Volume Change (m^3)										
	2003 - 2004	2004 - 2005	2005 - 2006	2006 - 2007	2007 - 2008	2008 - 2009	2009 - 2010	2010 - 2011	2011 - 2012	2012 - 2013	NET
1	862	-2,501	-3,199	2,070	-1,241	3,471	-4,939	-671	6,829	-747	**-66**
2	9,287	-4,466	-6,251	-10,473	-7,098	4,888	-1,520	-677	5,780	-2,825	**-13,355**
3	-6,649	-9,917	-1,203	-17,784	-8,505	7,513	1,544	6,795	-13,368	17,958	**-23,616**
4	17,542	1,602	1,911	1,133	-1,664	3,562	-10,955	-7,421	461	-26,521	**-20,350**
NET	**21,042**	**-15,282**	**-8,742**	**-25,054**	**-18,508**	**19,434**	**-15,870**	**-1,974**	**-298**	**-12,135**	**-57,387**

Table 7: SU09 Beach Volume Change Summary (2003 - 2013)

During 2003-2004 sediment trends were heavily influenced by the beach replenishment scheme. This artificial feed of material resulted in a net accretion of material during the first reporting period. During the subsequent years survey unit 09 has witnessed consecutive erosive years until 2008 where a complete reversal of trends was witnessed. Although it is unknown why this year showed a trend reversal it is thought that the natural tendency for this unit to lose material to the east with a minimal influx of material from the west.

In the current reporting period the survey unit has reduced in volume by 298m^3 which further supports the pattern shown in the long-term analysis. The overall change is however relatively negligible and represents the smallest annual change since records began.

Over the entire project, Section 1 has remained one of the more stable sections with regards to sediment budget. Accretion and erosion have both been explicitly present and the beach remains dynamic with no one trend particularly dominating. The volumes recorded are relatively small and indicate that this section will continue to slowly reduce in volume provided the bi-annual recycling works are continued to provide a check against large scale loses.

Section 2 has seen changing sediment trends since 2003 and follows a very similar pattern to section 1. The overall change since 2003 is relatively negligible when considering the project timescale and size of section. From this it can be inferred that the beach management works are largely counteracting the natural migration of shingle and readdressing levels locally.

Section 3 remains the most erosive section within this Survey Unit (-23,616m^3). This trend is to be expected with the absence of any controlling structure to prevent longshore migration. However during the 2008-2011 period it appeared that the bi-annual recycling activities had managed to exceed natural transportation rates and thus provide the section with a net gain.

Section 4 has lost a significant amount of material during this reporting period. Up until now this section had remained relatively stable. From the beach management recycling records it is apparent that this section saw a large amount of material extracted and deposited eastwards into Section 1, Survey Unit 08. This section generally has a stable sediment budget due to the large terminal rock structure at the eastern end reducing littoral drift.

When looking at the cumulative change in sediment budget as shown in figure 6 below, it is clear that this Survey Unit continues to loose material at a relatively constant rate. Trends indicate a continuation of erosional processes in the immediate future which will cause the standard of protection to fall. It is imperative that monitoring continues and that design volumes are established to identify when critical thresholds are met and thus initiate when any emergency works are required.

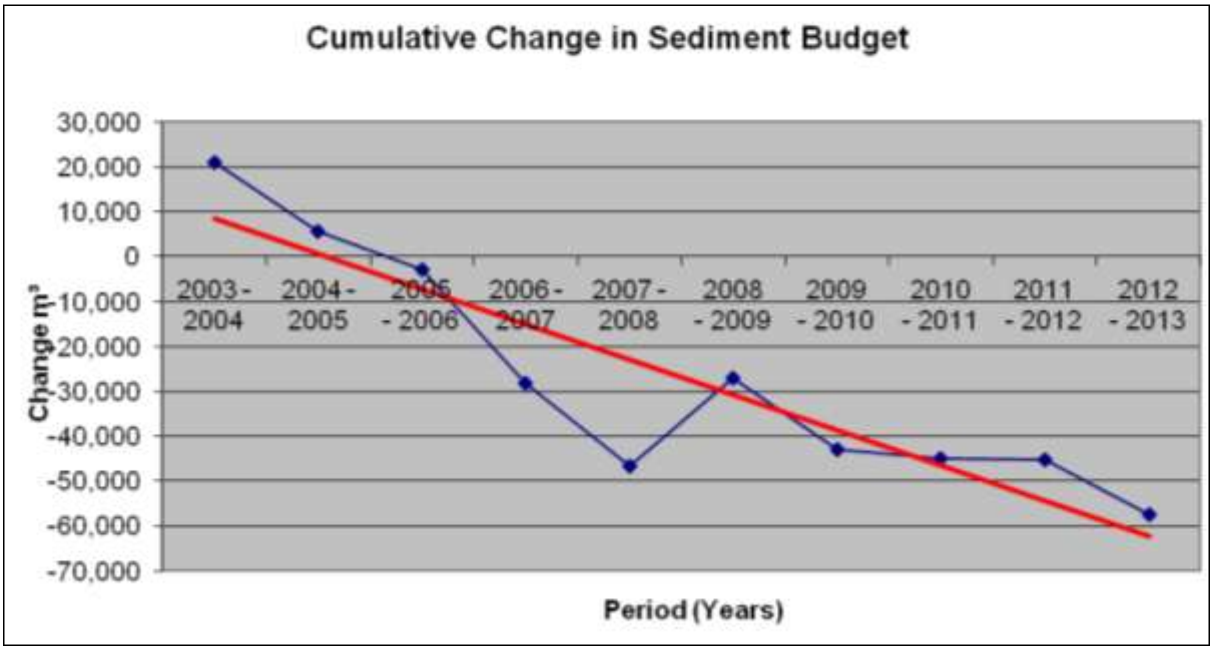

Figure 6: Cumulative change in the sediment budget for SU09.

6.2 SU08

It is apparent from Table 8 that, even ignoring the significant replenishment in 2004, survey unit 08 is stable, with accretional trends generally proving dominant.

Section	Volume Change (m^3)										
	2003 - 2004	2004 - 2005	2005 - 2006	2006 - 2007	2007 - 2008	2008 - 2009	2009 - 2010	2010 - 2011	2011 - 2012	2012 - 2013	NET
1	20,221	-11,094	-2,104	-17,052	-7,290	7,830	1,709	2,936	-6,432	5,743	-5,533
2	2,122	-1,078	1,217	-502	1,767	-634	-3502	2454	1447	157	3,448
3	44,166	-235	297	13,174	22,015	15,011	-7,358	408	2054	1,211	90,743
4	43,576	2,207	1,557	612	969	1,828	1,124	-262	474	2,418	54,503
5	34,534	-5,726	171	-2,699	-1,343	3,493	4,226	-1,814	-285	1,078	31,635
6	18,596	-2,257	-360	-1,760	-806	1,795	3,425	-839	-809	-27	16,958
7	-4,628	4,369	3,182	-9,044	-3,255	6,661	-3,723	5,935	-2,202	4,063	1,358
8	0	-610	1,030	-1,588	-833	806	-328	-144	-1129	-1,438	-4,234
NET	**158,587**	**-14,424**	**4,990**	**-18,859**	**11,224**	**36,790**	**-4,427**	**8,674**	**-6,882**	**13,205**	**188,878**

Table 8: SU08 Beach Volume Change Summary (2003 - 2013)

It is apparent that there has been a net gain in survey unit of approximately 13,200m³. This can be considered relatively negligible when taking into account the size of this Unit. Figure 7 below charts the cumulative changes in sediment budget for SU08 and illustrates a gradual accumulation of material across the frontage.

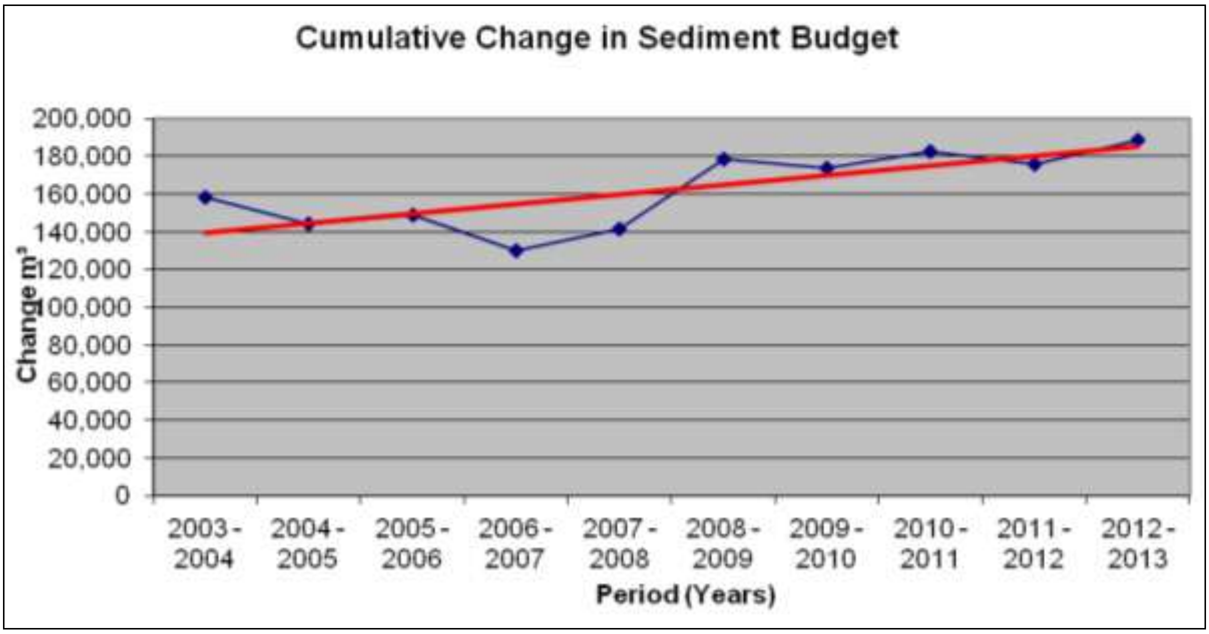

Figure 7: Cumulative change in the sediment budget for SU08.

It is important to recognise the recycling activities that took place across this Survey Unit during the current reporting period which have aided to reduce longshore loses. It therefore can be suggested that without the recycling works the overall change would have likely resulted in net loses.

When considering the entire project timescale, it is apparent that SU08 has maintained a significant proportion of the 2004 recharge material, which has subsequently been redistributed to maintain the beach levels.

The design philosophy of the 1996 and 2004 coast protection schemes relies upon there being a sufficiently wide crest to the beach to provide protection to the seawall and to reduce wave overtopping to acceptable levels. The design width values calculated during the scheme vary depending on the location, the form of defence, and the risk of flooding behind the sea wall. These values are currently being reviewed externally and once calculated will be imported into SANDS, the profile database used by the Strategic Regional Coastal Monitoring Project to analyse beach profiles, and a more detailed study will be carried out in future BMP reports.

7.0 Wave Climate & Storm Events

Wave records are recorded by a Datawell directional wave rider buoy off Folkestone, first deployed on 08 July 2003. A detailed analysis of the wave climate for September 2012 - August 2013 is given in Annex C.

Only two storms exceeded the threshold during this reporting year, in late autumn/early winter. Storm wave direction was either S or SbE. A number of moderate events occurred in late winter/early spring but nothing exceeding the threshold.

Table 9 below lists the two largest storm events recorded over the past year although a more detailed analysis can be found in annex C.

Table 9: Breakdown of storm events 2012-2013

Date/Time	H_s (m)	T_p (s)	T_z (s)	1.1..1 (°)	Water level elevation* (OD)	Tidal stage (hours re. HW)	Tidal range (m)	Tidal surge* (m)	Max. surge* (m)
14-Dec-2012 13:00	2.87	6.7	5.3	169	-	HW +2	6.1	-	-
25-Nov-2012 04:30	2.81	7.7	5.2	181	-	HW -4	4.3	-	-

Profile Location Diagrams


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