BEACH MANAGEMENT PLAN REPORT

Sandwich Bay

2005

BMP 24
9 December 2005
Contents

1. Executive Overview........................................................................................................3
2. Introduction................................................................................................................3
3. Design conditions .........................................................................................................7
4. Surveys .......................................................................................................................8
5. Difference models ......................................................................................................9
6. Profile change analysis ..............................................................................................12
7. Wave climate................................................................................................................13
8. Storm event performance............................................................................................14
9. Determination of critical beach conditions ...............................................................14
10. Special site conditions..............................................................................................14
11. Recycling operations .................................................................................................14
12. Conclusions................................................................................................................15
i. Executive Overview

The beaches along this 8.5km frontage range from narrow shingle beaches to a wide and well established sand dune system. The surveys that have been undertaken on this frontage between 2003 and the present day, together with the analysis based on this collected data, show that there is a significant variation in beach volumes within the Management Unit. Further investigation shows that the majority of this volume change occurs on the lower sandy foreshore at the northern end of the frontage.

To some extent these large fluctuations on the lower foreshore have disguised the volume changes on the upper shingle beach and it is this that provides the existing embankment with the much needed protection from wave action.

The data collection period is too short to derive any behavioural trends at this point in time, although the information provided within this report does show that there has been an overall net gain of 33,300m$^3$ of material over the 2003/05 period. However, when put into context with the range in volumetric change over the last two years it can be seen that this does not necessarily represent an increase in the volume of shingle on the frontage.

Inspection of the survey profiles show that whilst there have been changes in the cross shore profile, these generally relate to the movement and reformation of storm crests. There are no areas along the frontage where there has been significant erosion of the beach crest except for an area approximately 0.5km in length, which is some 200m north of Sandown Castle. At this location the beach crest is relatively wide and the erosion that has been recorded here does not represent a significant reduction in protection to the embankment, although the continued monitoring of this location is recommended.

1. Introduction.

Unit 8C extends from Shell Ness at the mouth of the River Stour to Sandown Castle at the northern end of the town of Deal on the East Kent Coast. The frontage is approximately 8.5km long and virtually unpopulated along its length. As the coastline extends south along the Sandwich flats the hinterland is dominated by high grade agricultural and open space recreational areas, namely the prestigious golf courses of Prince’s Golf Links, Royal St George’s Golf Links and the Royal Cinque Ports Golf Links. In addition there is the Sandwich Bay Estate which comprises some 58 properties.

For the purpose of this Beach Management Plan Site Report, the frontage has been sub-divided into four discrete lengths and these are described below.

The northernmost section extends between Shell Ness and the Princes Drive Car Park and this is characterised by natural sand dunes, which are protected by a wide sandy beach. This extends approximately 1km seaward to the low water line at its widest point and tapers in width gradually towards the car park. The beach is predominantly sand, although approximately midway along this section an overlying veneer of shingle is present, and this becomes more pronounced further southwards. The composition of the beach approximately 200m north of the car park can be seen in the photograph below (Plate 1) and this clearly shows the covering of large pebbles that have been thrown up during storm events and overly the seaward extent of the sand dunes.
Between the Princes Drive car park and the northern extent of the Sandwich Bay Estate the sand dunes become less pronounced and the primary defence is the shingle beach. There is still a sandy foreshore, however, this reduces in width along this frontage to a minimum of 50m at the northern end of the Sandwich Bay estate.

The coastline between the northern extent of the Sandwich Bay Estate and the Sandwich Bay Sailing Club is the only section of this management unit that is populated and it is primarily due to this fact that a more formal sea defence structure exists along this length. This is a concrete armour unit revetment that protects the existing embankment from erosion. In front of the revetment there is an un-groyned shingle beach and at low water a sandy foreshore extends seawards for approximately 50m.

The southernmost section of this beach management frontage extends between the Sandwich Bay Sailing Club and Sandown Castle. The nature of the sea defences along this frontage changes from a formal revetment to a flood embankment that is some 4m higher than the immediate hinterland. This embankment is constructed of colliery shale and is protected from the erosive effect of the waves by the shingle beach that runs along the entire length of this frontage. The other notable change within this length of the frontage is that there is no longer a sandy foreshore as the low water line becomes coincident with toe of the shingle beach.

The frontage faces north-northeast and is consequently sheltered from the direct affects of the predominant south-westerly waves. However, through the affects of diffraction and refraction, the inshore wave climate is still to some extent influenced by offshore waves from the south and south-west. Storms from the northern and eastern sector are generally the most damaging and waves from this direction also strongly affect beach behaviour.
Offshore of the frontage the Goodwin Sands have a pronounced effect on wave propagation and this feature significantly attenuates the offshore wave climate, thus providing considerable protection to the frontage. Closer inshore are the Brake Sands, which whilst being significantly smaller that the Goodwin Sands, still locally affect the inshore wave climate.

The net sediment drift direction along the frontage is from south to north although there is a significant secondary wave direction from the northeast, which influences littoral transport and can cause annual variations in transport volumes. Due to the mixed sand and shingle beach composition and the highly mobile nature of these materials, this frontage is very dynamic in the way it responds to storm events in both the cross shore and alongshore aspect.

The location of the frontage is shown on Figure 1.1, which includes the location of the nearest wave buoy or tide gauge.
2. Design conditions

<table>
<thead>
<tr>
<th>Tide Level</th>
<th>Tide Height at Ramsgate (mODN)</th>
<th>Tide Height at Deal (mODN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MHWS</td>
<td>2.62</td>
<td>2.80</td>
</tr>
<tr>
<td>MHW</td>
<td>2.02</td>
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<td>MHWN</td>
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<td>1.60</td>
</tr>
<tr>
<td>MSL</td>
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</tr>
<tr>
<td>MLWN</td>
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</tr>
<tr>
<td>MLW</td>
<td>-1.58</td>
<td>-1.95</td>
</tr>
<tr>
<td>MLWS</td>
<td>-1.98</td>
<td>-2.60</td>
</tr>
</tbody>
</table>

The following design conditions have been taken from the Sandwich Bay Coastal and Tidal Defence Strategy Plan (August 2004) and the JBA Extreme Sea Levels Report (December 2004). Extreme wave conditions were only generated for a single location along this frontage and the results have been set out in Table 1 below along with the extreme water levels for the corresponding return period events.

No joint probability analysis has been undertaken for the frontage at this present time. However, through reference to the methodologies outlined in the recently published Technical Report ‘Use of Joint Probability Methods in Flood Management – FD2308/TR1’ that has been developed as part of the Defra/Environment Agency R&D Programme, an indication of the level of dependency between wave and water level events has been estimated.

This indicates that in general, there is a low correlation between wave heights from all directions and water levels. However, when wave heights and water levels are examined for the particular sector in which the dependence is significantly higher, it is suggested there is a modest correlation between waves from the north or northwest sector and water levels. Furthermore, it is also suggested that there is a strong correlation between wave heights and tidal surge conditions.
### Extreme Water Level Design Conditions

<table>
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<tr>
<th>Location</th>
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<tr>
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<td>4.4</td>
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<td>4.54</td>
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<tr>
<td>Deal</td>
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<td>4.2</td>
<td>4.3</td>
<td>4.5</td>
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</table>

*Table 1. Extreme Water Level Design Conditions*

### Extreme Wave Heights at Sandwich Bay (m)

<table>
<thead>
<tr>
<th>Return Period (yrs)</th>
<th>Offshore Wave Height (m)</th>
<th>Inshore Wave Height (m)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>3.64</td>
<td>2.18</td>
</tr>
<tr>
<td>5</td>
<td>4.23</td>
<td>2.51</td>
</tr>
<tr>
<td>10</td>
<td>4.49</td>
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<td>5.08</td>
<td>2.96</td>
</tr>
<tr>
<td>100</td>
<td>5.34</td>
<td>3.10</td>
</tr>
</tbody>
</table>

*Table 2. Extreme Wave Height Design Conditions*

### 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. The schedule of completed surveys since the start of the Regional Monitoring Programme is given in Table 3.

#### Table 3. Completed surveys

<table>
<thead>
<tr>
<th>Profile</th>
<th>Beach Plan</th>
<th>Post-storm</th>
<th>Bathymetric</th>
</tr>
</thead>
<tbody>
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<td>25/03/2004</td>
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<tr>
<td>07/07/2004</td>
<td>07/07/2004</td>
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</tr>
<tr>
<td>16/08/2004</td>
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<td>12/04/2005</td>
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</tr>
<tr>
<td>06/09/2005</td>
<td>06/09/2005</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Digital Terrain Models of the 2003 Baseline topographic survey are shown at Annex B Figure 3.1 with Figures 3.2 and 3.3 showing the 2004 and 2005 Beach Management Plan (BMP) surveys respectively, superimposed upon the ortho-rectified aerial photograph of 2001. The methods used for deriving Digital Terrain Models is given in the Explanatory Notes.

Hydrographic baseline surveys are shown at Figure 3.4. Contours are shown at 0.5m intervals.
4. Difference models

Now that a sufficient data set has been compiled, it has been possible to overlay the results of the baseline survey with the successive year’s data. This then enables comparative volumetric analysis to be undertaken to determine change over a given period. Through the use of three dimensional ground models and the ortho-rectified aerial photographs it has been possible to create a visual interpretation of the volumetric change that has occurred during each analysis period. This is shown in Figures 4.1 to 4.3, which indicate areas of net erosion or accretion (note that 0.25m difference in elevation is considered as “no change”) and the location of any extraction/deposition sites.

Figure 4.1 is the difference model of the 2004 survey minus the baseline survey with negative values representing erosion that has occurred during that past period and positive values accretion. Figure 4.2 is the difference model of the most recent survey minus the previous year’s survey and Figure 4.3 is the difference model of the most recent survey minus the baseline survey. This final figure represents the overall erosion or accretion that has taken place since the start of the programme.

Whilst these figures show an overall change in beach volume within each discrete ‘area change boundary’ it should be recognised that the data is based on the beach management survey, which is undertaken once each year. It is only a snapshot in time and therefore the particular dynamics of each frontage need to be considered. This will ensure that the information shown in the difference models represents the net change rather than capturing a particular extreme variation caused by a large event.

The remainder of this section of the report contains a narrative summarising the changes that have taken place over the last two years, and as part of this exercise a hypothesis of the processes driving these changes has been made. This has been carried out for a number of locations along the frontage, with the extent and nature of the change generally depicting the boundaries of each location. Also, to ensure that the results from the difference models are representative of the year’s change rather than a particular event that may have been captured by the survey, the difference models have been cross referenced with the other beach profile surveys carried out each year. This then gives an indication of the beach variability over three time steps in each individual year.

The northern most section of this frontage extends between Shell Ness and the Princes Drive Car Park. From inspection of the difference model plots that are shown in Figures 4.1, 4.2 and 4.3 it can be seen that overall the ness itself is relatively stable, although there is both accretion and erosion within the cell. The accretion has been at the very northern tip of the ness and this is probably limited by the ebb flows from the river, which will prevent the northern progression of the ness. The erosion has taken place approximately 200m further south. These observations concur with the historic evolution of the ness and suggest that the geomorphological processes that formed and maintained this feature remain unchanged.

In 2003/04 the overall trend along this frontage shows a net loss of material in the region of 27,000m³, with the majority of this material being lost from the sandy foreshore. During the period 2004/05 there was a considerable amount of accretion within this section and this amounts to approximately 39,000m³. Again, inspection of the difference model shows that the majority of this accretion has occurred on the lower sandy foreshore.
When the overall analysis period between 2003 and 2005 is considered, the results show that there has been significant accretion in the northern half of this section and the southern half has shown a slight trend of erosion. Overall, between Shell Ness and the Princes Drive car park, there has been a net accretion of just over 12,000m$^3$ in the 2003/05 period.

The difference models for the Princes Drive Car Park to the Sandwich Bay Estate (North) show a significant variation in erosion and accretion trends over the two year period. During 2003/04 the model shows that there has been approximately 10,000m$^3$ of material lost from the frontage during this period, whereas in 2004/05 a net accretion of 26,000m$^3$ is shown. On balance, this represents a net gain of 16,000m$^3$ on the frontage.

As with the section to the north of the car park there is a significant change in volume on the lower sandy foreshore. However, there is also a similar amount of change occurring on the upper beach section.

The coastline between the northern boundary of the Sandwich Bay Estate and the Sandwich Bay Sailing Club has been relatively stable over the two year analysis period. In 2003/04 there was a net loss of approximately 7,000m$^3$ of material, whereas in the following year the frontage gained approximately 3,500m$^3$. This is a relatively small change in comparison to the rest of the frontage, although the erosion and accretion trends shown in each year do reflect those seen along the rest of the 8C Management Unit.

The nature of the beach along this section is slightly different to the neighbouring section to the north. The upper shingle beach is held slightly forward by the presence of the revetment and road behind and this has had the affect of squeezing the low water line closer to the toe of the shingle beach. Consequently, the lower sandy foreshore along this section is much narrower and as such the proportion of volumetric change is similarly reduced.

The length of beach between the Sandwich Bay Sailing Club and Sandown Castle is approximately 2.8km and over this distance the change in beach volume between the two periods is significant. As for the rest of the frontage, there has been a net loss of material during 2003/04, although this only amounted to 2,500m$^3$ which is a relatively small amount. In 2004/05 there was an overall accretion along this length of 11,000m$^3$, giving a net increase of 8,500m$^3$ over the two year analysis period with the majority of this accretion occurring just to the north of Sandown Castle.

Given that the net drift direction along this frontage is from south to north, this accretion at the southern end of the frontage would not normally be expected. However, during the last year there has been a notably higher number of northerly storms and this has allowed material to accumulate up against the Sandown Castle structure, which acts like a terminal groyne.

**Frontage Overview**

The graph shown below in Plate 4.1 shows the volumetric change per linear metre of the frontage. From inspection of this plot it is possible to draw some rudimentary conclusions as to how the frontage is behaving as a single unit.
Firstly, the most striking thing to note from the graph is the significant variation in the overall beach volume. In 2003/04 the data shows a net loss of 46,500m$^3$, whilst in 2004/05 the beach has increased in volume by nearly 80,000m$^3$ when compared against the baseline survey of 2003.

When the figures are analysed, it can be seen that 80% of the overall volume change in any one year occurs between the northern extent of the Sandwich Bay Estate and Shell Ness.

The graphical plots from the difference model also show that between the Sandwich Bay Estate and Shell Ness the majority of volumetric change is occurring on the lower sandy foreshore.

The significant volume changes that have occurred to the frontage as a whole during the two year analysis period suggest that as well as an alongshore component, the calculated volumes along this frontage are also significantly affected by the cross-shore transport. It is postulated that a large component of the volume change is as a result of the finer sandy sediments moving on and offshore as wave conditions at the site vary. This will have the affect of moving material in and out of the polygons used to calculate volume change and hence registering large changes.

The overall net loss/gain along this frontage is summarised below:

- 2003/04 – Net loss of 46,500m$^3$
- 2004/05 – Net gain of 79,800m$^3$
- 2003/05 – Net gain of 33,300m$^3$

The high variability in overall volume change that is shown by these figures, combined with the evidence of considerable change in the elevation of the sandy foreshore,
suggests that the net volume change within this Management Unit is dominated by fluctuations in the sandy foreshore. At the level of analysis undertaken for this Beach Management Plan Site Reports it is not possible to differentiate between volume changes in the upper and lower beach sections and as such the results given above should not be relied upon to quantify the state of the shingle beach.

5. Profile change analysis

A Cross-sectional area (CSA) has been calculated for all beach profiles. This is calculated as the area of profile above a Master Profile. Along the Sandwich frontage, the lower boundary of the Master Profile is set as the intersection between the shingle beach and the sandy foreshore. This level varies from approximately 0.5m AOD in the north to −1.0mAOD in the south. The landward boundary, which is either the seawall or, where a hard structure is not present, the landward extent of the stable part of the beach has been adopted. The Master Profile is held constant for a given profile line and therefore the changes in CSA through time can be derived. Graphs of the individual profiles plus the Master Profile are included at Annex D and on the CD attached to this report, as are the time series of change in CSA for individual profiles.

Figure 5.1 shows the location of the profile lines, which are colour-coded to represent the change since the previous year. The method of calculation of change in CSA, can be found in the Explanatory Notes.

Whilst much of the beach behaviour has been inferred from the beach change models, which are discussed in detail in Section 4 of this report, the beach profiles also play an important part in describing the way in which the beaches along this frontage have changed. The location of each profile is shown on Figure 5.1 and as well as profile location, these figures also give an indication of the annual change in terms of actual and percentage change in cross sectional area at that location.

These changes in cross sectional area correspond with the overall erosion and accretion trends that are depicted in the beach change model figures in Section 4. However, because the profile surveys are carried out more frequently than the beach management surveys, it is possible to gain a better understanding of the beach’s behaviour throughout each year. The profiles also give a more accurate representation of the cross-shore change in the beach and the following comments have been made based on inspection of the profiles.

Shell Ness (Profile 4b00131) – Upon examination of the upper beach profiles it can be seen that the two major storm crests have moved landwards approximately 5m since the initial survey in 2003. Throughout the rest of the profile there is a general trend of recession between MHWS and MSL. Below this point the beach slope flattens considerably and is also more stable.

Prince’s Golf Links Frontage (Profile 4b00147 to 4b00209) – The profiles along this length of the Management Unit show that the dune crest and the beach between the crest and MHSW has remained relatively unchanged. Over 50% of the total volume change that has taken place during the 2003/05 period has occurred between profiles 4b00147 and 4b00179 and from these profiles it can be seen that this fluctuation in level has occurred between +3.6mAOD and MSL. Below this level the beach flattens and is relatively stable.
The profiles south of 4b00179, i.e. between the Princes Golf Club House and the car park, show that the beach is relatively stable between the crest and +1.2m AOD. Between this elevation and about -0.5m AOD the beach profile is changeable and although the net balance of material remains relatively constant, this change is generally seen as an exchange of material above and below the 0.5m AOD level.

**Royal St George's Golf Links Frontage (Profile 4b00217 to 4b00257)** – Whilst the dunes themselves have not shown any signs of erosion or accretion over this period, there has been a net accretion at the toe of the dunes. The lower section of the beach along this part of the frontage has been relatively stable.

**Sandwich Bay Estate (Profile 4b00262 to 4b00280)** – The shingle beach along this part of the frontage is more formal than the beach to the north as it is restrained by the revetment and road behind it. The upper crest has remained relatively stable with the average width between 3m and 5m at an elevation of 6.5m AOD. The majority of the change along this section has occurred between this elevation and +2m AOD, which suggests that there is only sufficient wave energy present to cause significant profile change when water levels are above MHW.

**Royal Cinque Ports Golf Links Frontage (Profile 4b00288 to 4b00361)** - Again, the shingle beach is restrained by the presence of the embankment that runs along the entire length of this section. At the northern end of the embankment, the profiles show an accumulation of material on the upper section of the beach and a corresponding loss of material below +5m AOD. Along all but the southernmost 200m of this section there is a wide crest in front of the embankment and this has remained relatively stable throughout the analysis period except for profiles 4b00342 to 4b00356, which show approximately 3-5m of erosion of the crest. This erosion is likely to be as a result of the predominance of northerly storms experienced over the last two years and whilst the beach crest is relatively wide here, this level of erosion does not represent a significant reduction in protection to the embankment. Notwithstanding this, the continued monitoring of this location is recommended.

The 200m length of beach that is adjacent Sandown Castle is lower and narrower that the rest of this frontage, however, there has been an accumulation of material here over the last two years.

**6. Wave climate**

There were no storms above the threshold during the reporting period, but the largest events were all from the south. The extended period of strong south-easterly winds, which caused extensive coastal flooding the West County in late October 2004, produced nothing significant at Folkestone, although they contributed to a 10-day period of moderate wave conditions. A detailed analysis of the wave climate for 2004/5 is given at Annex F.

The recently installed tide/wave radar on Deal Pier has only been operational for a few months and therefore no analysis has been possible. This will be included in future reports.
7. Storm event performance

There were no storm events, during the reporting period, that exceeded the storm threshold, therefore no post storm profiles have being taken. Systems have now been put in place to allow early notification of storm threshold ascendance thus allowing early mobilisation of survey contractors to collect post storm profile data.

Whilst the wave buoy at Folkestone can alert the existence of a storm it is difficult to access which areas of the coastline will have been affected. Local frontage managers can assist in this process by notifying the lead authority of any possible 'damage' to beaches.' so that survey contractors can be mobilised and the most beneficial data collected.

8. Determination of critical beach conditions

There has been no formal definition of critical beach conditions along the Sandwich Bay frontage, although because of the varied nature of the beach, types of formal defence structure and the hinterland it is beyond the scope of this report to attempt to determine them. It is acknowledged that the shingle beach provides a vital protective function along the section between the Sailing Club and Sandown Castle as the embankment here is constructed from colliery shale and is very susceptible to erosion. Along the northern half of the frontage the sand dunes are currently stable; however, they do provide the only protection against coastal flooding at this location and as such need be continually monitored.

Given the high dependence on the beach as an integral part of the sea defences along the Sandwich Bay frontage, it is recommended that beach performance thresholds be established.

9. Special site conditions

Sandwich Bay is an extremely important and sensitive coastal zone. Its ecological and geological value is reflected in the raft of National, European and International designations which confer considerable protection to these resources. The area as a whole forms part of the Thanet Coast and Sandwich Bay Ramsar Site, the Sandwich Bay dune system is a Special Protected Area (SPA) and candidate Special Area of Conservation (SPA). Also, it contains specific areas that are designated as Local Nature Reserves, Sites of Nature Conservation Importance and Sites of Special Scientific Interest (SSSI).

10. Recycling operations

No beach recharge has taken place along this frontage in the last 5 years, however the beach is checked annually to and reprofloed as necessary. This was last carried out in January 2006
11. Conclusions

The beaches along the Sandwich Bay frontage are diverse in their composition and also in the way in which they respond to the forcing affects of the waves and tides. The net transport of sediment along the frontage is from south to north and it is postulated that there is a feed into the frontage at the southern boundary from Management Unit 9A (Deal). This volume is as yet unquantified, however, initial data suggests that there is a net loss of material from Unit 9A of approximately 25,000m$^3$ a year.

In terms of the feed of sediment into this Management Unit there are a number of ways in which the finer sediments can enter the frontage. Alongshore transport mechanisms bring in material from the southern and northern boundaries and there is also likely to be a significant interaction with the offshore sand banks. The existing strategy for this frontage does not quantify the volumetric exchange of material between the frontage and offshore sources although it does suggest that there is a strong interaction with the Goodwin Sands, which lie offshore some 6km to the southeast.

The survey data and beach inspections that have been undertaken as part of this programme show that the shingle beach diminishes towards the Princes Drive car park and at the mid point between the car park and Shell Ness the beach is almost entirely made up of sand. There are also no shingle deposits to the north of the frontage at Pegwell Bay or on the sandy foreshore. This evidence suggests that at some point along the Sandwich Bay frontage wave energy becomes insufficient to transport larger sediment and thus it is unlikely that there is any net loss of shingle from the northern boundary.

Based on the assumption that there is no net loss of shingle from the frontage and that there is also a potential feed of material from the neighbouring management unit (Unit 9A), a net increase in material each year in Management Unit 8C would be expected. From the net volume changes highlighted by the difference model it can be seen that there are large fluctuations in the volume of material measured by the surveys. However, this analysis shows that 80% of the annual variation in volume occurs between the northern boundary of the Sandwich Bay Estate and Shell Ness. The difference model also shows that the majority of the volume change along this section of the frontage is occurring on the lower sandy foreshore and is possibly as a result of finer sediments moving on and offshore.

It has therefore not been possible to quantify the amount of shingle that maybe entering the frontage at this point in time; however, as the volume of data grows with time, the confidence in the results shown from its analysis will increase. Also, due to the large rate of volume change associated with the finer sediments along this frontage, the volume change associated with the upper shingle beach is somewhat masked.

Whilst an understanding of the foreshore morphology is important in terms of its impacts on coastal processes, an understanding of the way in which the shingle is moving along this, and the neighbouring frontage of Deal, is paramount in informing and developing future beach management practices. It is therefore recommend that the next strategy review seek to take the information gathered as part of this monitoring programme and use this to look in more detail at the individual rates of sand and shingle movement along the frontage.

If critical and warning thresholds can also be established for this frontage as part of the strategy review, the information provided as part of this annual Beach Management
Report will provide invaluable data for those responsible for the management of the sea defences along this frontage.