



# Cromer to Winterton Ness Coastal Management Study

Non-Technical Summary

November 2013

North Norfolk District Council





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# Issue and revision record

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# Contents

<b>Chapter</b>	<b>Title</b>	<b>Page</b>
<b>1</b>	<b>Introduction</b>	<b>1</b>
1.1	Background to the Study _____	1
1.2	Aims and Objectives of the Study _____	2
<b>2</b>	<b>The SCAPE Model</b>	<b>4</b>
2.1	Introduction to the SCAPE Model _____	4
2.2	Key coastal processes modelled within SCAPE _____	4
2.3	Scenarios tested within this Study _____	5
<b>3</b>	<b>Large Scale Coastal Change between Cromer and Winterton Ness</b>	<b>8</b>
3.1	SMP6 Scenario Results _____	8
3.2	Modified SMP6 Scenario Results _____	9
3.3	SMP6 with Sediment Nourishment Scenario Results _____	9
3.4	Summary _____	10
<b>4</b>	<b>Small Scale Coastal Change</b>	<b>11</b>
4.1	SMP Units _____	11
4.2	Erosion and sediment transport over the SMP Units _____	11
<b>5</b>	<b>Conclusions</b>	<b>21</b>
5.1	Potential Funding _____	21
5.2	Next Steps _____	21
5.3	Summary of proposed policies for each SMP Unit _____	22
<b>6</b>	<b>Glossary</b>	<b>23</b>

# 1 Introduction

## 1.1 Background to the Study

The 35km coastline between Cromer and Winterton Ness (Figure 1.1) consists of cliffs, sand dunes, beaches, towns and villages. Erosion of this coastline is an important issue and requires careful management. Due to the inter-connected coastal processes (e.g. wave action, tides, coastal erosion) occurring along the coast, large scale management is needed to ensure each coastal defence scheme does not cause a negative impact further along the coast.

The Kelling to Lowestoft Ness Shoreline Management Plan (SMP6, 2005) sets out the high level coastal management policies for the North Norfolk coastline over the next 100 years. The coastline between Cromer and Winterton Ness is divided into 13 Policy Units within the SMP6 (Figure 1.1). The SMP6 recommends coastal management policies for the short term (0-20 years), medium term (21-50 years) and long term (51-100 years). These policies consist of:

- **Hold the Line** – Current defences are maintained and/or improved so that the coastline is defended against erosion or flooding;
- **Managed Realignment** - Defences are not maintained and the coastline is left to erode. However, some maintenance of defences is carried out to manage the erosion and retreat of the coastline, in addition to managing and re-location of assets/properties that is required; and
- **No Active Intervention** – Defences are left to fail with no maintenance of the defences undertaken.

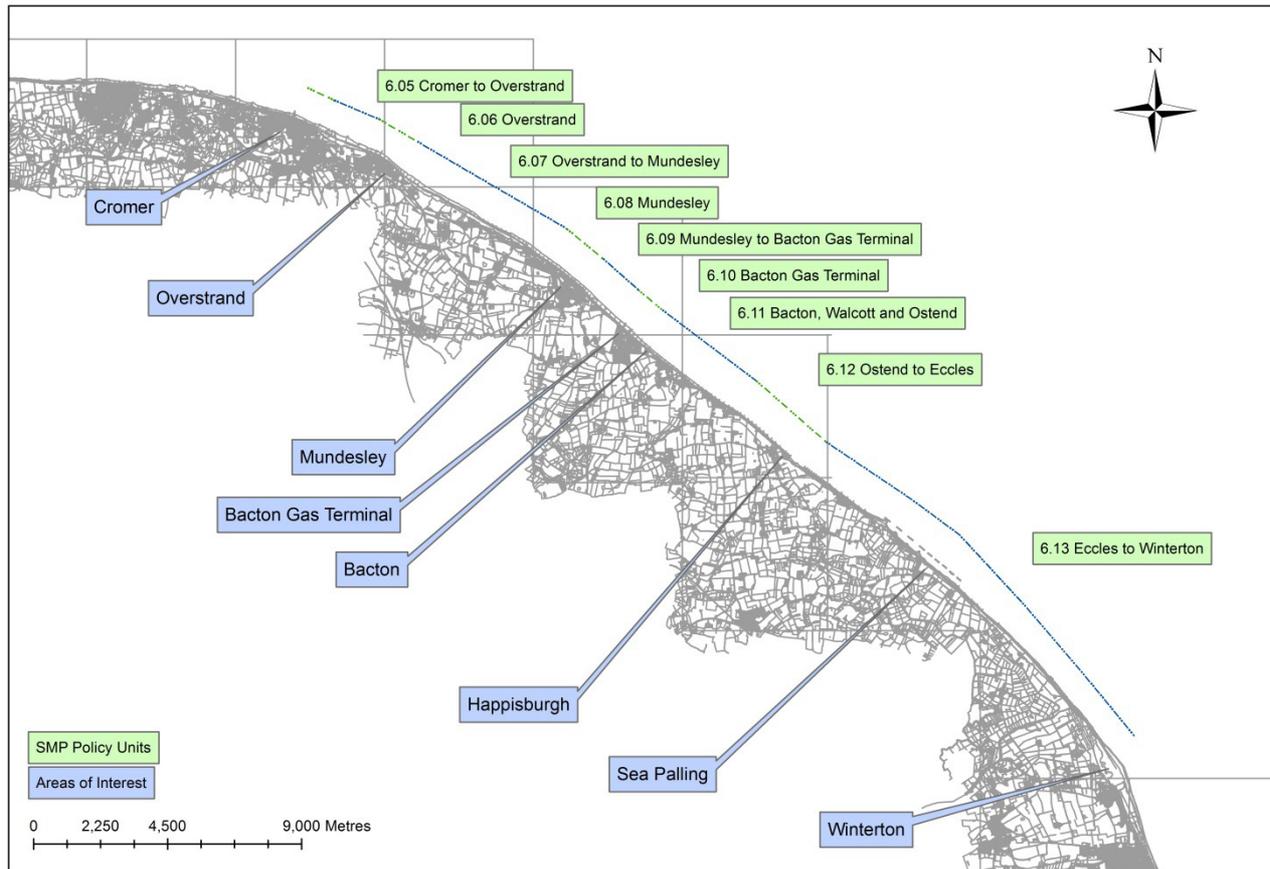
The recommended coastal management policies for each Policy Unit vary between Cromer and Winterton Ness (Table 1.1). For example, some areas (e.g. Overstrand) have a Hold the Line policy for the short term only, with Managed Realignment recommended in the medium and long term.

As a result of the recommendations for each Policy Unit, there may be impacts on the wider coastline in other Policy Units. For example, a Hold the Line policy may reduce sediment transport down the coast and therefore could increase the risk of erosion at areas down the coast. During the development of the SMP it was recognised that there was some uncertainty regarding the impacts policies may have along the coast and further detail is needed to develop coastal management options. This initiated the development of this study which aims to inform the future approach to coastal management.

Table 1.1: Coastal management policies as recommended under the SMP6

SMP6 Policy Unit	Short term (0-20 years)	Medium term (21-50 years)	Long term (51-100 years)
6.05 Cromer to Overstrand	Managed Realignment	No Active Intervention	No Active Intervention
6.06 Overstrand	Hold the Line	Managed Realignment	Managed Realignment
6.07 Overstrand to Mundesley	Managed Realignment	No Active Intervention	No Active Intervention
6.08 Mundesley	Hold the Line	Hold the Line	Managed Realignment
6.09 Mundesley to Bacton Gas Terminal	Managed Realignment	No Active Intervention	No Active Intervention
6.10 Bacton Gas Terminal	Hold the Line	Hold the Line	Hold the Line
6.11 Bacton Walcott and Ostend	Hold the Line	Managed Realignment	Managed Realignment
6.12 Ostend to Eccles	Managed Realignment	Managed Realignment	Managed Realignment
6.13 Eccles to Winterton	Hold the Line	Hold the Line	Hold the Line (conditional)

Figure 1.1: Map of the Cromer to Winterton Ness coastline showing the Policy Units and main areas of interest



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## 1.2 Aims and Objectives of the Study

North Norfolk District Council (NNDC) appointed Mott MacDonald to complete a Coastal Management Study to validate and refine the current SMP6 coastal management policies. This Study follows on from the high level SMP6 and will provide recommendations for individual schemes to be taken forward to Project Appraisal Report (PAR) stage. This Study improves understanding of the coast under different coastal management options and through this will assist with informing the need for adapting communities to coastal change and the development of a Coastal Management Plan. Although the Study has generated indicative erosion lines under different coastal management options, these have not been produced to supersede those in the adopted SMP6. However, the information contained in this report may be used in future SMP6 reviews.

This Non-Technical Summary has been structured to summarise the large scale impact of the management scenarios on the entire coastline, before assessing the impact of the management scenarios on each individual Policy Unit. This is followed with a brief discussion of potential policy options and funding:

- **Section 2** provides an introduction to the SCAPE model which has been used to assess potential coastal erosion over 100 years;

- **Section 3** presents the results for potential erosion between Cromer and Winterton Ness over 100 years;
- **Section 4** focuses on smaller spatial scales and the technical and economic implications of different management options; and
- **Section 5** provides a summary of the recommended policies and potential funding opportunities for coastal defence schemes.

The completion of this Study aims to provide further understanding of the coast and some opportunities for further consideration/investigation. However, it must be understood that this Study will not replace information contained within the SMP6, but provides further context in which future management and decisions can be assessed. This Study focusses primarily on coastal processes and relates this to economic analysis; it is not the intention to take into account other aspects such as environmental or social impacts. These important considerations were included during the development of the SMP6, and further work would be required to take account of these during any further development of future coastal management approaches.

## 2 The SCAPE Model

### 2.1 Introduction to the SCAPE Model

The Soft Cliffs And Platform Erosion (SCAPE) model (developed by the Tyndall Centre) has been used to assess the potential erosion of the coastline between Cromer and Winterton Ness over the next 100 years. The SCAPE model has the benefit of enabling a high level strategic assessment of the whole coastline evolution in addition to focussing on changes in individual Policy Units. This allows a consideration of how the recommended policy in one area of the frontage may impact the coastal processes in an area further along the coastline by assessing longshore sediment transport.

The SCAPE model was specifically designed to investigate erosion and sediment transport on the Norfolk coast. The main coastal processes within the SCAPE model are: **erosion of the cliff toe**, **longshore sediment transport** and **wave action**. These are explained further in Section 2.2.

The outputs from the SCAPE model have been processed to illustrate:

- Annual values for cliff top retreat.
- Annual southerly sediment transport rates.

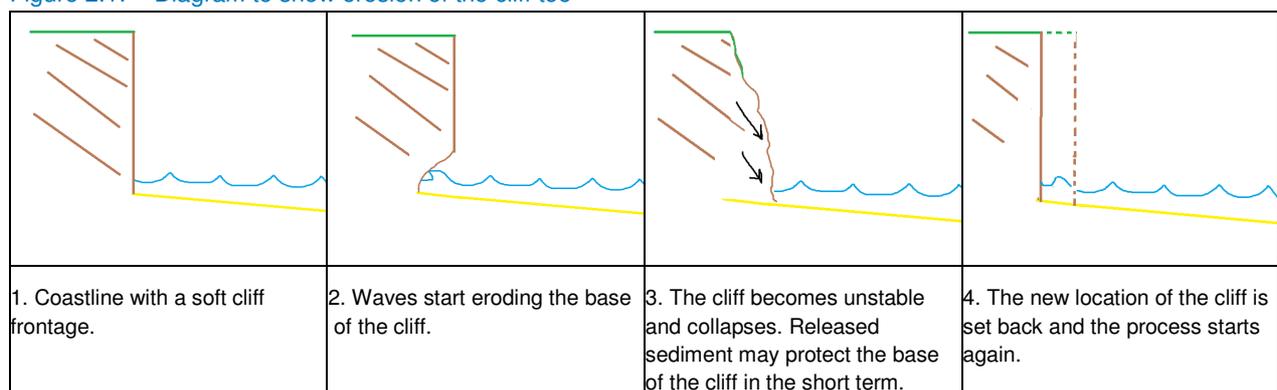
It is important to note that the discussions within this Report are based on interpretations of the results from the SCAPE model. Although the SCAPE model provides an indication of how coastal processes may change and impact recession rates under the different management scenarios, the results only show potential impacts under different management scenarios.

### 2.2 Key coastal processes modelled within SCAPE

#### Erosion of the cliff toe

Coastal frontages which are characterised by soft cliffs are vulnerable to wave action at the base of the cliff (which is often referred to as the cliff toe). This acts to decrease the stability of the cliff and can cause large amounts of erosion leading to cliff retreat. This process is summarised in Figure 2.1. If there is increased sediment in front of the cliff toe (due to cliff falls along the coastline), the risk of erosion can be reduced. This is because the sediment can act as a barrier in the short term between the waves and the base of the cliffs. Different cliffs will erode at different rates depending on the composition of the cliffs; cliffs made of softer material will erode much quicker than cliffs made of harder material.

Figure 2.1: Diagram to show erosion of the cliff toe



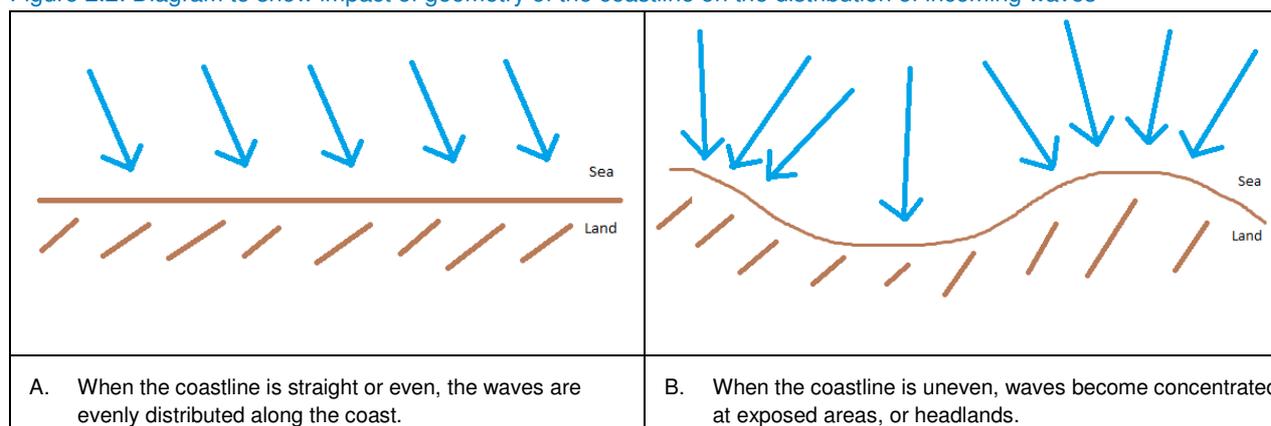
### Longshore sediment transport

Longshore sediment transport refers to the process where sediment is moved along the coast by the waves. This process is particularly important in the context of this Study as it is through the transport (or lack of transport) of sediment along the coastline that coastal management policies in one area can affect another area further along the coast. The overall drift of sediment in the study area moves from west (at Cromer) to east (at Winterton Ness).

### Wave action

As described above, wave action on the coastline, particularly on beaches and at the base of the cliffs, causes erosion and retreat of the coastline. The amount of erosion caused by wave action depends on a number of factors, one of which is the geometry (alignment) of the coastline. In situations where the coastline is straight, the incoming waves are distributed evenly along the coastline (Illustration A in Figure 2.2). However, where the geometry of the coastline is uneven, exposed areas (headlands) are formed (Illustration B in Figure 2.2). Waves can become concentrated at the exposed areas often causing increased erosion.

Figure 2.2: Diagram to show impact of geometry of the coastline on the distribution of incoming waves



### 2.3 Scenarios tested within this Study

Three management scenarios were considered in order to represent a range of policies along the coastline:

- SMP6 Scenario;
- Modified SMP6 Scenario; and
- SMP6 with Sediment Nourishment Scenario.

In addition to these scenarios, a Do Nothing Baseline was assessed for comparative purposes.

#### **SMP6 Scenario**

The SMP6 Scenario considers the erosion of the coastline under the recommended policies from the adopted SMP6. Table 2.1 shows the recommended SMP6 policies over 100 years for each SMP6 Policy

Unit. This Scenario has been used to consider how implementing the recommended policies might impact different areas of the coastline.

Table 2.1: Coastal management policies as recommended under the SMP6

SMP6 Policy Unit	Short term (0-20 years)	Medium term (21-50 years)	Long term (51-100 years)
6.05 Cromer to Overstrand	Managed Realignment	No Active Intervention	No Active Intervention
6.06 Overstrand	Hold the Line	Managed Realignment	Managed Realignment
6.07 Overstrand to Mundesley	Managed Realignment	No Active Intervention	No Active Intervention
6.08 Mundesley	Hold the Line	Hold the Line	Managed Realignment
6.09 Mundesley to Bacton Gas Terminal	Managed Realignment	No Active Intervention	No Active Intervention
6.10 Bacton Gas Terminal	Hold the Line	Hold the Line	Hold the Line
6.11 Bacton Walcott and Ostend	Hold the Line	Managed Realignment	Managed Realignment
6.12 Ostend to Eccles	Managed Realignment	Managed Realignment	Managed Realignment
6.13 Eccles to Winterton	Hold the Line	Hold the Line	Hold the Line (conditional)

### Modified SMP6 Scenario

The Modified SMP6 Scenario considers the potential impacts of extending the Hold the Line policies over the long term in three of the SMP6 Policy Units (6.06, 6.08 and 6.11). This would provide long term protection to the towns of Overstrand, Mundesley, Bacton, Walcott and Ostend from coastal erosion. This scenario was used to consider how Hold the Line in the long term along the three Policy Units would impact different areas of the coastline. Table 2.2 displays the modified SMP6 policies over 100 years for each SMP6 Policy Unit.

Table 2.2: Modified SMP6 coastal management policies (modified policies highlighted in red).

SMP6 Policy Unit	Short term (0-20 years)	Medium term (21-50 years)	Long term (51-100 years)
6.05 Cromer to Overstrand	Managed Realignment	No Active Intervention	No Active Intervention
6.06 Overstrand	Hold the Line	Hold the Line	Hold the Line
6.07 Overstrand to Mundesley	Managed Realignment	No Active Intervention	No Active Intervention
6.08 Mundesley	Hold the Line	Hold the Line	Hold the Line
6.09 Mundesley to Bacton Gas Terminal	Managed Realignment	No Active Intervention	No Active Intervention
6.10 Bacton Gas Terminal	Hold the Line	Hold the Line	Hold the Line
6.11 Bacton Walcott and Ostend	Hold the Line	Hold the Line	Hold the Line
6.12 Ostend to Eccles	Managed Realignment	Managed Realignment	Managed Realignment
6.13 Eccles to Winterton	Hold the Line	Hold the Line	Hold the Line (conditional)

### SMP6 with Sediment Nourishment Scenario

Sediment nourishment (also known as beach recharge) is the process by which sediment is mechanically placed along a beach frontage to add additional material to the natural beach. This helps to provide increased protection against wave action and cliff erosion. The Environment Agency currently undertakes sediment nourishment, on average every four years, along the Sea Palling to Horsey frontage in Policy Unit 6.13. For the purpose of this scenario, we have assumed that the requirement for sediment nourishment at the Sea Palling to Horsey frontage will continue over the next 100 years.

The SMP6 with Sediment Nourishment Scenario considers the same policies as under the SMP6 Scenario (Table 2.1) but with the addition of a sediment nourishment event (beach recharge), every four years along the north west of the frontage (by Overstrand). The reasoning for this Scenario was to test whether the presence of increased beach volumes could be likely to reduce erosion at the base of the cliffs along the whole frontage (Section 2.2).

An important aspect of this Scenario was to consider if sediment transport rates increased at Sea Palling as a result of providing sediment nourishment by Overstrand. If this was true under this scenario, the sediment nourishment at Overstrand could potentially replace the sediment nourishment at Sea Palling, with little (or no) additional cost requirements for the management of the frontage.

### ***Do Nothing Baseline***

The Do Nothing Baseline assumes the current defences are left to fail and no further works are undertaken. This is used as a Baseline Scenario for the economic assessment to calculate the benefits of implementing coastal defence schemes in contrast to allowing the coastline to naturally erode.

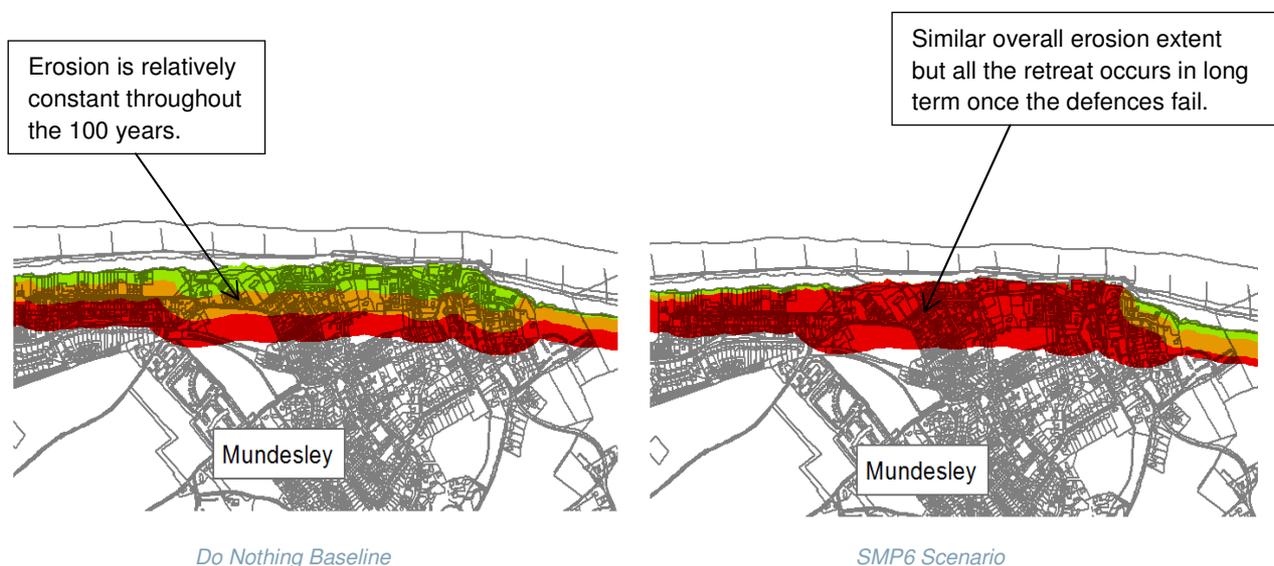
## 3 Large Scale Coastal Change between Cromer and Winterton Ness

### 3.1 SMP6 Scenario Results

Over the long term there is likely to be **similar erosion** along the coastline when compared with a Do Nothing Baseline. However, **erosion is delayed** in the SMP6 Scenario in the short and medium term in areas with a Hold the Line policy (see Table 2.1), as coastal defences are maintained. This scenario allows time in the short and medium term to potentially adapt and relocate properties to areas at a lower risk from coastal erosion.

Similar levels of erosion occur because, although sections of the coastline are defended in the short and medium term, in the long term the majority of the defences are not maintained and eventually fail. During the short and medium terms, where a stretch of the coastline is defended under the SMP6 policy, the surrounding areas of coastline experience retreat due to continued erosion. This acts to **increase the exposure** of the lengths of coastline under a Hold the Line policy. In the long term **accelerated erosion** would be experienced once the defences fail in these areas. The coastline would then respond to the increased exposure and **establish an equilibrium geometry** (straight coastline) which provides a **technically/naturally sustainable coastline** in the long term. An example of where this occurs is at Policy Unit 6.08 (Mundesley) (Figure 3.1).

Figure 3.1: Diagram demonstrating the predicted erosion at Mundesley, where increased long term exposure leads to increased long term rates of erosion. The Do Nothing Baseline and SMP6 Scenario show similar 100 year erosion. **KEY: Green – erosion 0-20 years, Orange – erosion 21-50 years, Red – erosion 51-100 years.**



Under the SMP6 Scenario, due to erosion occurring along the frontage, **increased sediment** would be supplied to beaches further along the coast. This would provide a **positive influence** on the frontages further along the coastline by reducing erosion in those areas. In the long term, similar sediment transport rates are likely to occur along the Study frontage compared to the Do Nothing Baseline. This indicates that the SMP6 Scenario is **technically sustainable** over the 100 years when compared with the Do Nothing Baseline.

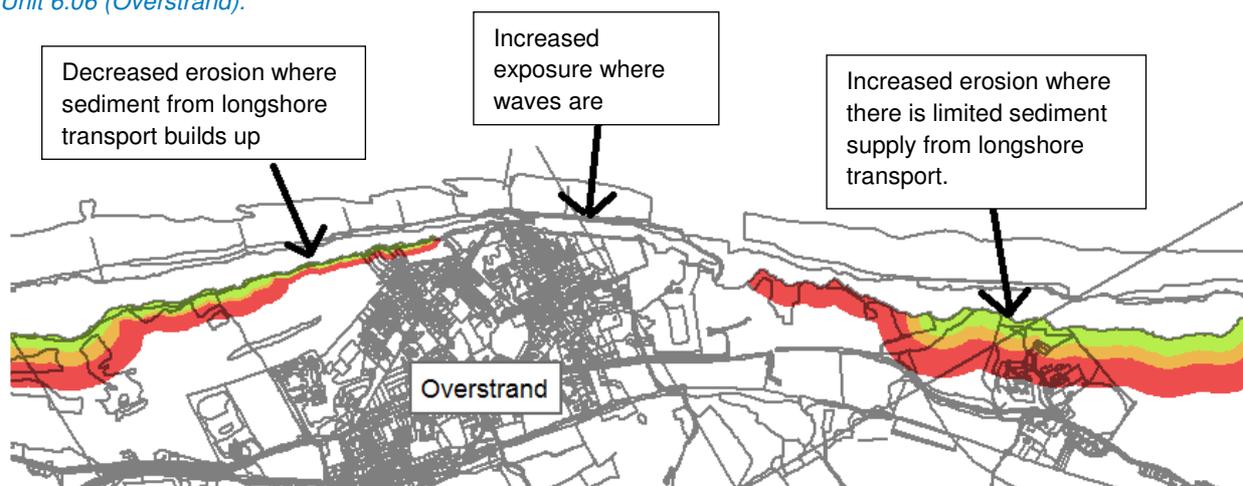
### 3.2 Modified SMP6 Scenario Results

Under the Modified SMP6 Scenario, the erosion along the frontage becomes much more **uneven** than when compared to the Do Nothing Baseline and SMP6 Scenario. The impact of Holding the Line in the long term decreases erosion in Policy Units 6.06, 6.08 and 6.11. However, surrounding undefended areas would continue to erode creating **exposed areas** where there is a Hold the Line policy which are increasingly vulnerable to wave action and therefore erosion.

Figure 3.2 shows how the creation of exposed areas can create a build-up of sediment to the north west of the Policy Unit (consequently **reducing** erosion rates). However this then limits the sediment supply to the south east of the section (consequently **increasing** erosion rates).

The uneven coastline formed over the 100 years, as a result of maintaining Hold the Line policies, is likely to be **unsustainable**. Exposed areas will be increasingly vulnerable to erosion and coastal defence failure. This will either cause **very rapid erosion** if allowed to retreat or require substantially **increased maintenance costs**.

Figure 3.2: Diagram to show impact of Hold the Line policy on surrounding areas of coast using the example of Policy Unit 6.06 (Overstrand).



Over the long term in this Scenario, sediment supply to areas south east of the study frontage (i.e. Policy Unit 6.13 and further down drift) increase from present day values. Although values are smaller than under the SMP6 and SMP6 with Sediment Nourishment Scenarios, it is likely that this sediment supply will be **sufficient** to allow **sustainable coastal management** further along the frontage (rather than restricting sediment supply and causing increased erosion).

### 3.3 SMP6 with Sediment Nourishment Scenario Results

Overall there would be **reduced erosion** associated with the SMP6 with Sediment Nourishment Scenario when compared with the SMP6 Scenario. Increased beach levels from additional sediment **decrease the wave action** at the frontage and hence decrease erosion rates. The impact would be greatest to the north west of the study frontage where the nourishment is undertaken.

The resulting long term geometry of the coastline would be **more uneven** when compared with the SMP6 Scenario. Increased protection from erosion is likely to be a consequence of increased sediment volumes and hence areas where the sediment accumulates undergo less erosion. This creates some **exposed areas** (see Figure 3.2). However, this effect is likely to be less pronounced than under the Modified SMP6 Scenario.

Under the SMP6 with Sediment Nourishment Scenario, similar sediment transport processes would occur as under the SMP6 Scenario; erosion over the frontage **increases sediment supply** to the frontages south of the study area (Policy Unit 6.13 and beyond) over 100 years. Although sediment supply is similar to under the SMP6 Scenario, the input of sediment at Overstrand, and the longshore transport of this sediment through the system, means that the sediment supply is as high even through erosion along the frontage is reduced.

It is important to consider that under all of the Scenarios, there is the potential that sediment nourishment at Sea Palling could be reduced over the 100 years. Therefore potential costs associated with implementing sediment nourishment at Overstrand over 100 years under the SMP6 with Sediment Nourishment Scenario may need to be reconsidered.

### 3.4 Summary

Table 3.1 below summarises the overall impact of the different management scenarios on the coastline between Cromer and Winterton Ness. The key impacts have been focussed on:

- Erosion – extent of erosion occurring over the coastline;
- Sediment supply - the amount of sediment being delivered to frontages further along the coast; and
- Geometry of the coastline – whether the coastline is relatively even or straight or whether exposed areas are created.

Table 3.1: Table summarising impacts of management scenarios on the coastline between Cromer and Winterton Ness.

Key: Green = positive impact; Orange = some positive and some negative impacts; Red = negative impact

Scenario	Erosion of the coastline	Sediment supply/impact further along the coastline	Long term coastline geometry
SMP6 Scenario	Erosion reduced in short term in some areas due to Hold the Line policies. In long term similar to Do Nothing Baseline.	Sediment transport rates increase over 100 years and current nourishment could potentially be reduced in the future. No significant impacts on the management of Policy Units outside this study area.	Relatively even coastline – likely to be in equilibrium
Modified SMP6 Scenario	No erosion in some Policy Units due to Hold the Line policies. Increased erosion in other Policy Units.	Sediment transport rates increase over 100 years and current nourishment could potentially be reduced in the future. No significant impacts on the management of Policy Units outside this study area.	Uneven coastline – unlikely to be sustainable in the long term.
SMP6 with Sediment Nourishment Scenario	Erosion reduced compared to SMP6 Scenario with the greatest reduction in erosion occurring at the location of the nourishment. Very similar erosion rates to the east of the frontage when compared to the SMP6 Scenario.	Sediment transport rates increase over 100 years and current nourishment could potentially be reduced in the future. No significant impacts on the management of Policy Units outside this study area.	Geometry of coastline in some areas not even due to build-up of sediment

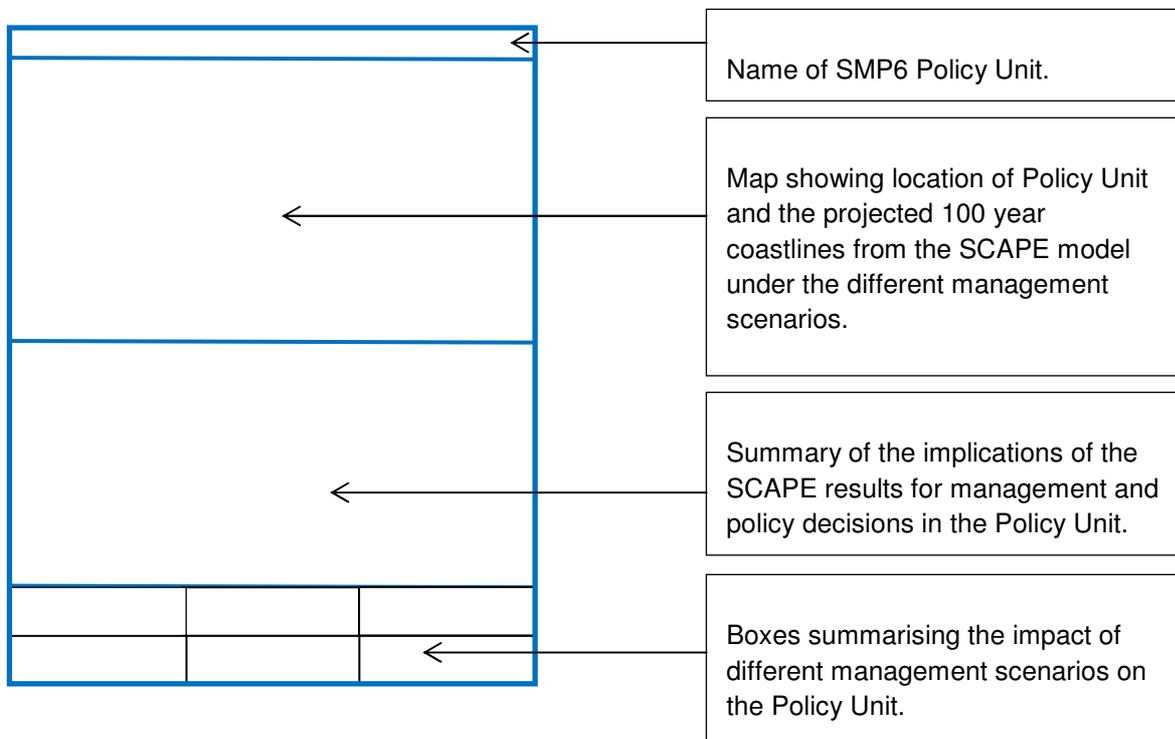
# 4 Small Scale Coastal Change

## 4.1 SMP Units

An assessment of the large scale coastal change, as outlined in Chapter 3, is important to ensure sustainable management. However, it is also important to assess changes at smaller scales where individual policies are applied. For this reason, to assess the small scale coastal change the SMP6 Policy Units have been used (shown in Figure 1.1).

## 4.2 Erosion and sediment transport over the SMP Units

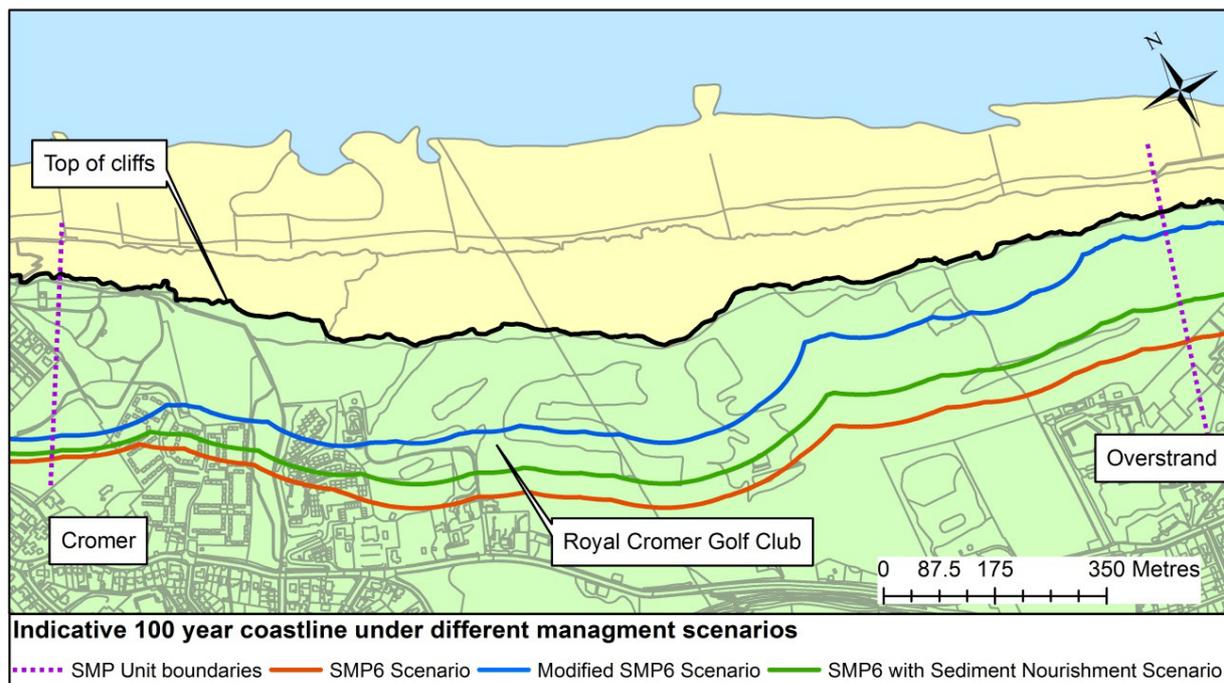
The economic justification, in addition to impacts on coastal processes has been evaluated for each SMP6 Unit. This information is displayed within one page summary cards (as explained below).



**SMP6 POLICY  
 UNIT 6.05**

**Cromer to Overstrand**

**Map**



**Key Issues**

- The SMP6 policy is Managed Realignment in the short term with No Active Intervention in the medium and long term.
- The SMP6 policy is technically and economically feasible as no coastal defence scheme is recommended.
- Despite the location of the Royal Cromer Golf Club, due to the small number of commercial and residential buildings or other key infrastructure, in this SMP6 Policy Unit no coastal defence scheme would be economically justified for funding.
- Managed Realignment will require adaptation and management of the impacts of erosion.

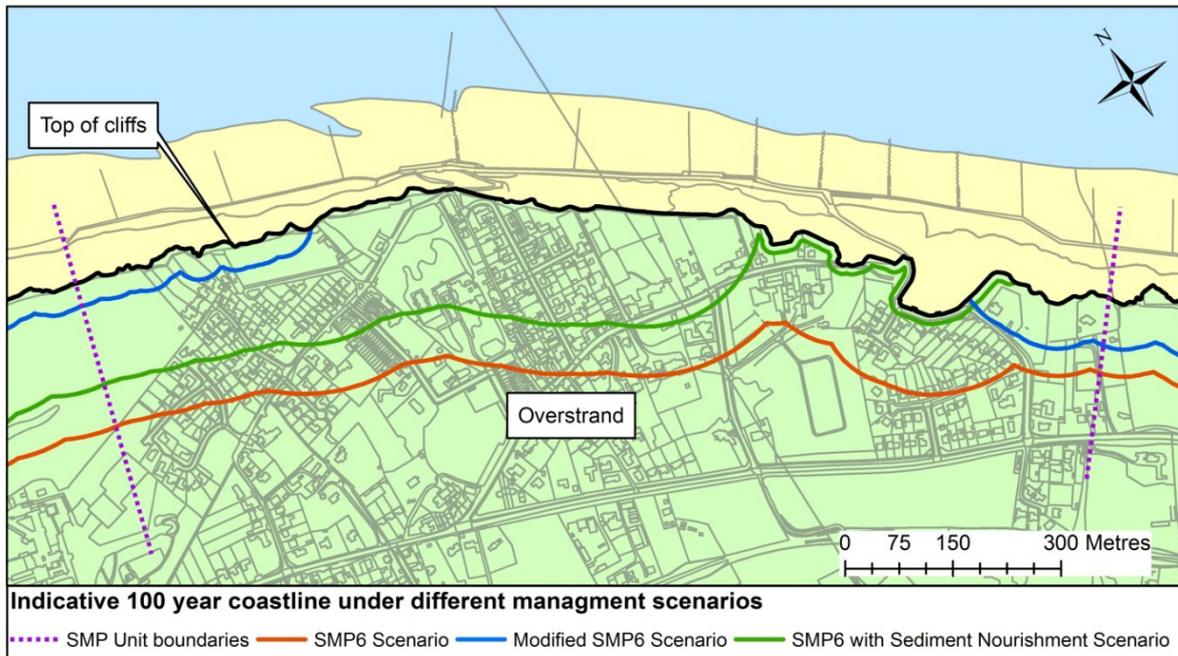
**Summary**

	<b>SMP6 Scenario</b>	<b>Modified SMP6 Scenario</b>	<b>SMP6 with Sediment Nourishment Scenario</b>
<b>Technical Feasibility</b>	<i>Large amount of erosion due to no sediment supplied from Cromer (where defences are held).</i>	<i>Less erosion as sediment build up in front of Overstrand reduces erosion at the toe of the cliffs (Figure 3.2).</i>	<i>Less erosion as sediment recharge reduces erosion at the toe of the cliffs.</i>
<b>Economic Feasibility</b>	<i>No justification for implementing a coastal protection scheme.</i>	<i>No justification for implementing a coastal protection scheme.</i>	<i>No justification for implementing a coastal protection scheme.</i>

**SMP6 POLICY  
 UNIT 6.06**

**Overstrand**

**Map**



**Key Issues**

- The SMP6 policy is Hold the Line in the short term with Managed Realignment in the medium and long term.
- The SMP6 policy is technically and economically feasible, however third party funding would be needed to contribute to any DEFRA funded scheme.
- Implementing a Hold the Line policy throughout the 100 years (Modified SMP6 Scenario) would be more economically justifiable however it is not as technically sustainable in the long term.
- It is recommended that this Policy Unit could be taken forward to develop a scheme to implement defences to Hold the Line in the short or medium term.
- Managed Realignment will require adaptation and management of the impacts of erosion.

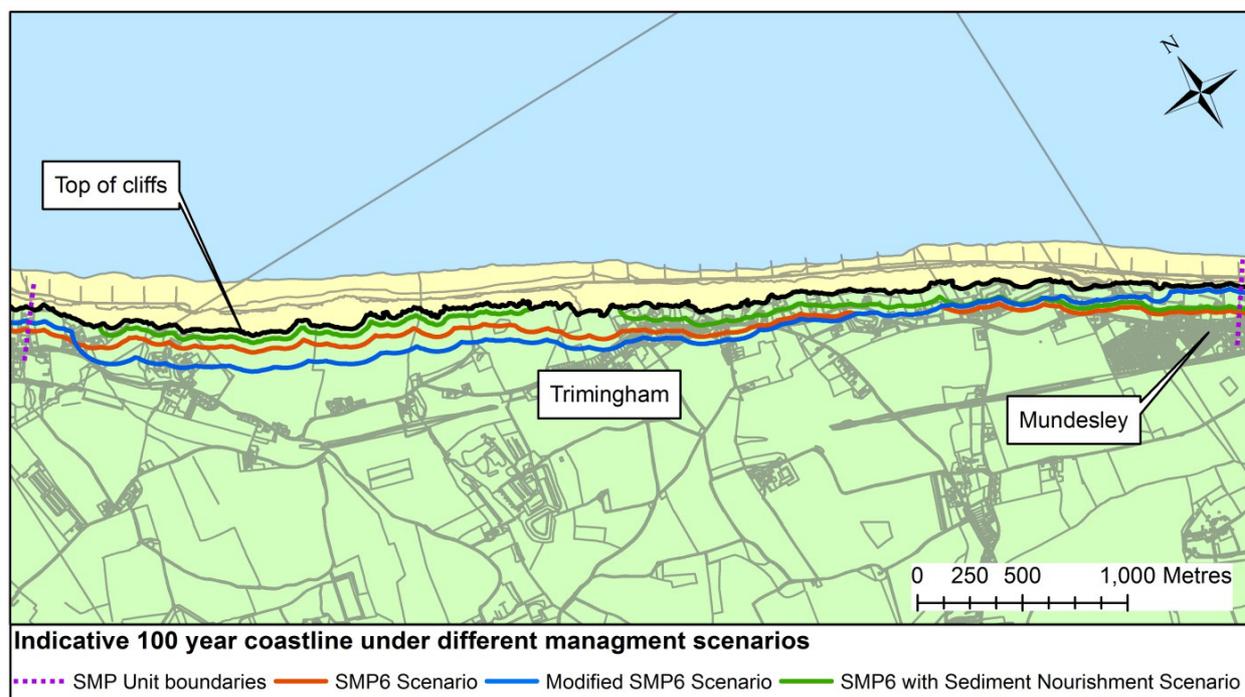
**Summary**

	<b>SMP6 Scenario</b>	<b>Modified SMP6 Scenario</b>	<b>SMP6 with Sediment Nourishment Scenario</b>
<b>Technical Feasibility</b>	<i>Acts to straighten out coastline – sustainable.</i>	<i>Creates exposed area – unlikely to be sustainable in long term.</i>	<i>Build-up of sediment to the south east reduces erosion.</i>
<b>Economic Feasibility</b>	<i>Many houses still at risk from erosion. However smaller costs mean it is economically justifiable as only justifying 20 years of work.</i>	<i>Expensive to implement scheme over 100 years, but increased number of properties protected from erosion means it is economically justified.</i>	<i>Less houses at risk compared to SMP6 Scenario therefore it is economically justifiable.</i>

**SMP6 POLICY  
UNIT 6.07**

**Overstrand to Mundesley**

**Map**



**Key Issues**

- The SMP6 policy is Managed Realignment in the short term with No Active Intervention in the medium and long term.
- The SMP6 policy is technically and economically feasible as no coastal defence scheme is proposed.
- Due to the small number of commercial and residential buildings in this SMP6 Policy Unit, no coastal defence scheme would be economically justifiable.
- The SMP6 with Sediment Nourishment Scenario has the benefit of significantly reducing the risk of erosion at Trimingham due to increased sediment reducing erosion of the cliff toe.
- Managed Realignment will require adaptation and management of the impacts of erosion.

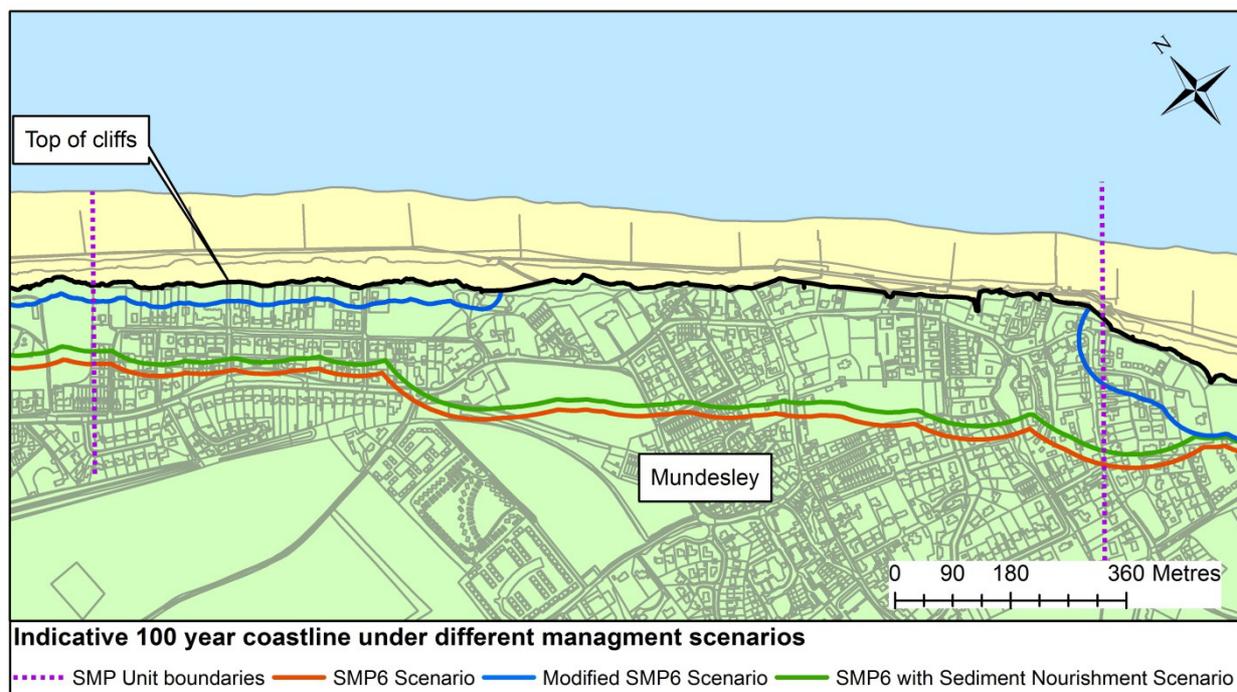
**Summary**

	<b>SMP6 Scenario</b>	<b>Modified SMP6 Scenario</b>	<b>SMP6 with Sediment Nourishment Scenario</b>
<b>Technical Feasibility</b>	<i>Erosion as less sediment is supplied in the medium term from the frontage at Overstrand.</i>	<i>Increased erosion as less sediment is supplied in the long term from the frontage at Overstrand.</i>	<i>Less erosion as sediment recharge reduces erosion at the toe of the cliffs.</i>
<b>Economic Feasibility</b>	<i>No justification for implementing a coast protection scheme.</i>	<i>No justification for implementing a coast protection scheme.</i>	<i>No justification for implementing a coast protection scheme.</i>

**SMP6 POLICY  
UNIT 6.08**

**Mundesley**

**Map**



**Key Issues**

- The SMP6 policy is Hold the Line in the short and medium term with Managed Realignment in the long term.
- The SMP6 policy is both economically and technically feasible.
- Under the Modified SMP6 Scenario, the frontage is protected over 100 years which is economically justified due to the number of properties protected from erosion.
- However, the geometry of the coastline formed under the Modified SMP6 Scenario is less sustainable compared to the SMP6 and SMP6 with Sediment Nourishment Scenarios.
- It is recommended that this Policy Unit could be taken forward to develop a scheme, to implement defences to Hold the Line in the short, medium or long term.
- Managed Realignment will require adaptation and management of the impacts of erosion.

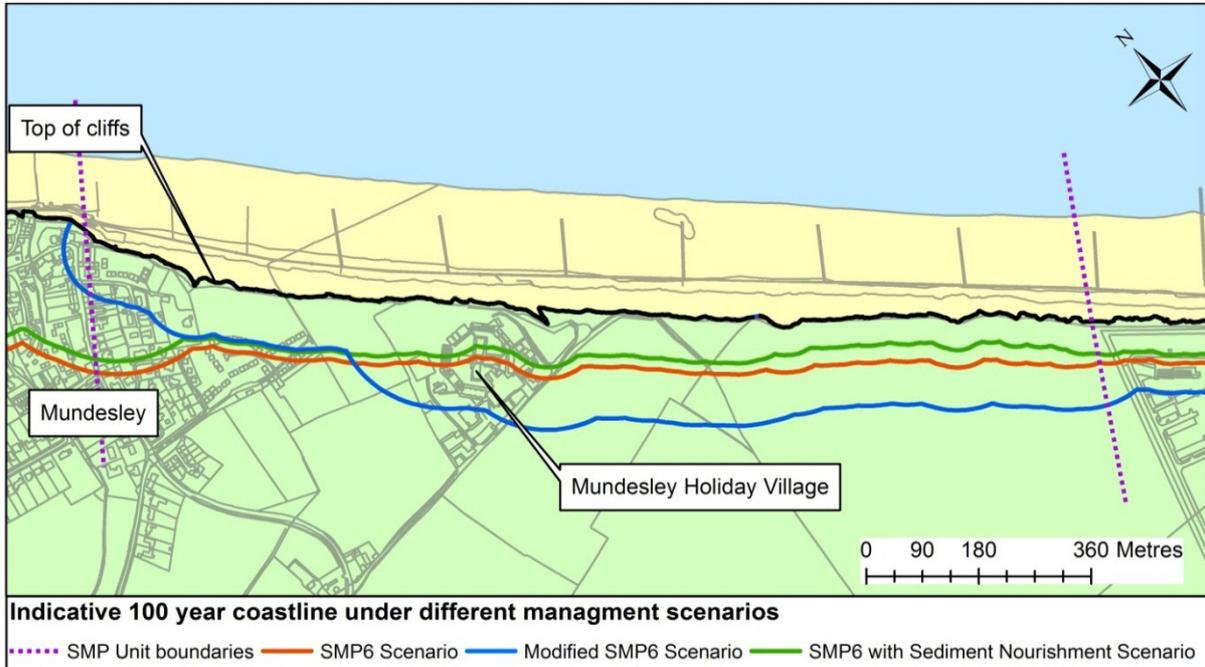
**Summary**

	<b>SMP6 Scenario</b>	<b>Modified SMP6 Scenario</b>	<b>SMP6 with Sediment Nourishment Scenario</b>
<b>Technical Feasibility</b>	<i>Erosion in the long term creates an even/sustainable coastal geometry.</i>	<i>Erosion is significantly reduced however creates an exposed area which is likely to be unsustainable.</i>	<i>Erosion in the long term creates an even/sustainable coastal geometry.</i>
<b>Economic Feasibility</b>	<i>A scheme can be economically justified and is likely to receive funding.</i>	<i>A scheme can be economically justified and is likely to receive funding.</i>	<i>A scheme can be economically justified and is likely to receive funding.</i>

**SMP6 POLICY  
 UNIT 6.09**

**Mundesley to Bacton Gas Terminal**

**Map**

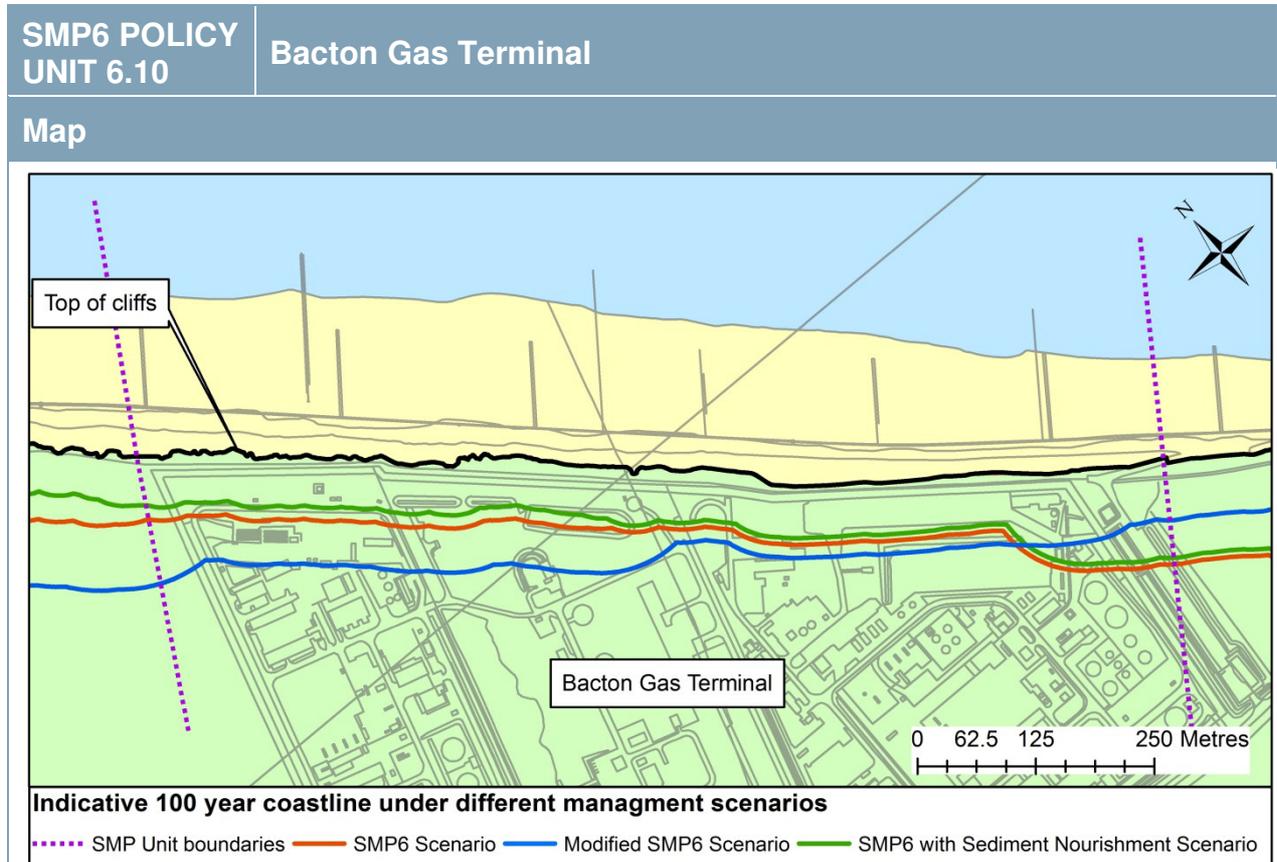


**Key Issues**

- The SMP6 policy is Managed Realignment in the short term with No Active Intervention in the medium and long term.
- The SMP6 policy is technically and economically feasible as no coastal defence scheme is proposed.
- Increased erosion occurs under the Modified SMP6 Scenario due to decrease in sediment supply from Mundesley.
- Due to the small number of commercial and residential buildings, and key infrastructure, in this SMP6 Policy Unit no coastal defence scheme would be economically justified.
- Managed Realignment will require adaptation and management of the impacts of erosion.

**Summary**

	<b>SMP6 Scenario</b>	<b>Modified SMP6 Scenario</b>	<b>SMP6 with Sediment Nourishment Scenario</b>
<b>Technical Feasibility</b>	<i>Erosion acts to even out the geometry of the coastline – sustainable.</i>	<i>Increased erosion due to less sediment being supplied from Mundesley.</i>	<i>Erosion acts to even out the geometry of the coastline – sustainable.</i>
<b>Economic Feasibility</b>	<i>No justification for implementing a coastal protection scheme.</i>	<i>No justification for implementing a coastal protection scheme.</i>	<i>No justification for implementing a coastal protection scheme.</i>



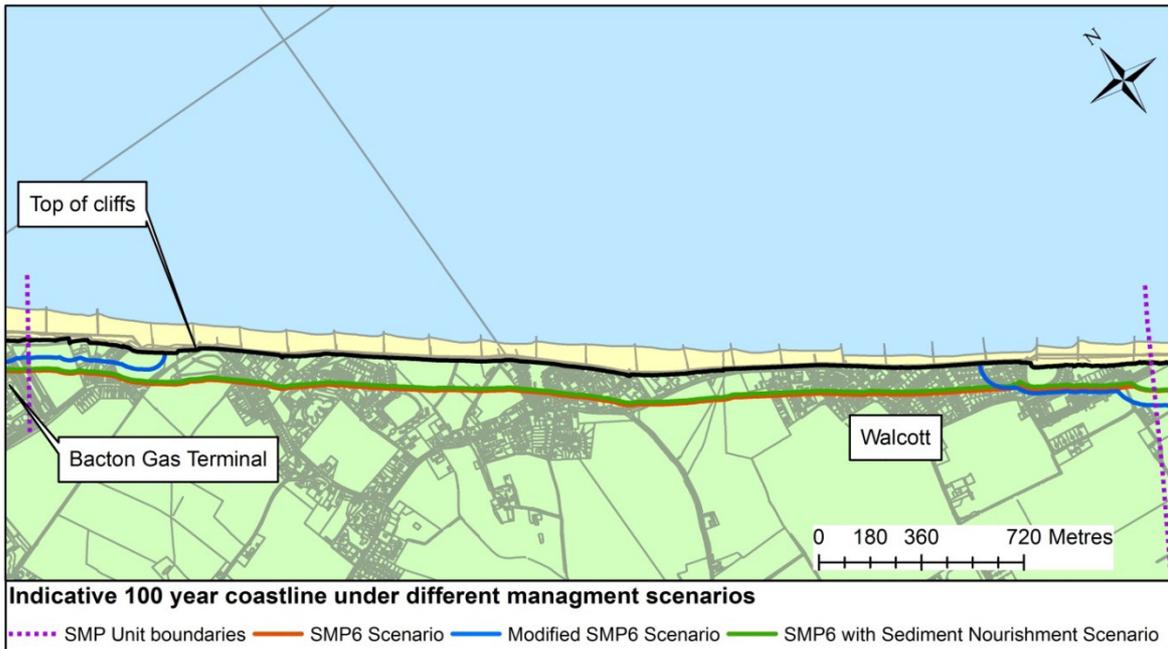
- Key Issues**
- The SMP6 policy is Hold the Line in the long term.
  - The current defences would not sufficiently protect the toe of the cliffs over the long term, causing erosion over 100 years.
  - The defences would therefore need to be upgraded to Hold the Line.
  - This is both economically and technically feasible.
  - This is likely to need a large amount of private funding as the only asset at risk in the area is commercial.

<b>Summary</b>	<b>SMP6 Scenario</b>	<b>Modified SMP6 Scenario</b>	<b>SMP6 with Sediment Nourishment Scenario</b>
<b>Technical Feasibility</b>	<i>Erosion still occurs under the current defences therefore an upgrade of the current defences is desirable.</i>	<i>Erosion still occurs under the current defences therefore an upgrade of the current defences is desirable.</i>	<i>Erosion still occurs under the current defences therefore an upgrade of the current defences is desirable.</i>
<b>Economic Feasibility</b>	<i>A scheme can be economically justified due to the high value of the gas terminal.</i>	<i>A scheme can be economically justified due to the high value of the gas terminal.</i>	<i>A scheme can be economically justified due to the high value of the gas terminal.</i>

**SMP6 POLICY  
 UNIT 6.11**

**Bacton, Walcott and Ostend**

**Map**



**Key Issues**

- The SMP6 policy is Hold the Line in the short term and Managed Realignment in the medium and long term.
- There is no economic justification for implementing a scheme along the entire frontage.
- However it is likely that a scheme to maintain the coastal defences in the short or medium term would be justified for particular sections of this Policy Unit; particularly in the built up areas such as at Walcott.
- Therefore it is recommended that this Policy Unit is further divided and sections are considered for taking through to scheme development stages.
- Managed Realignment will require adaptation and management of the impacts of erosion

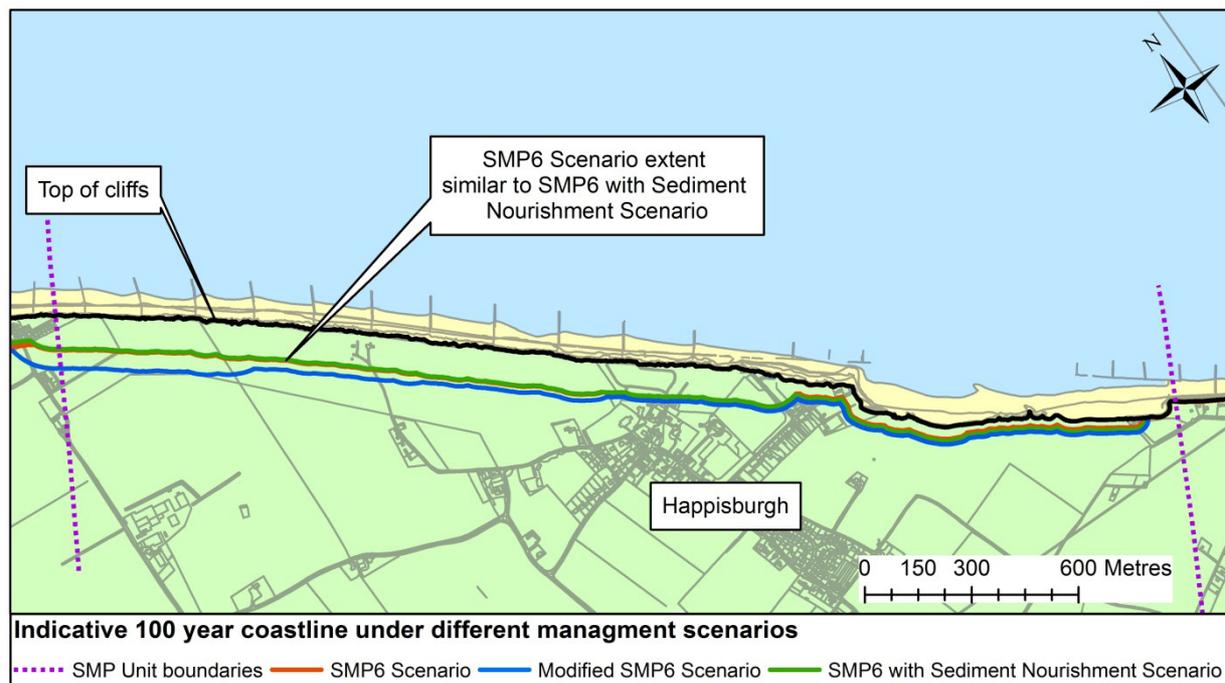
**Summary**

	<b>SMP6 Scenario</b>	<b>Modified SMP6 Scenario</b>	<b>SMP6 with Sediment Nourishment Scenario</b>
<b>Technical Feasibility</b>	<i>Erosion acts to even out the geometry of the coastline – sustainable in the long term.</i>	<i>Erosion is reduced along the frontage however creates a more uneven geometry.</i>	<i>Erosion acts to even out the geometry of the coastline – sustainable in the long term.</i>
<b>Economic Feasibility</b>	<i>No economic justification for implementing a scheme however smaller sections are recommended to be considered for a coastal defence scheme.</i>	<i>No economic justification for implementing a scheme however smaller sections are recommended to be considered for a coastal defence scheme.</i>	<i>No economic justification for implementing a scheme however smaller sections are recommended to be considered for a coastal defence scheme.</i>

**SMP6 POLICY  
UNIT 6.12**

**Ostend to Eccles**

**Map**



**Key Issues**

- The SMP6 policy is for Managed Realignment in the short, medium and long term.
- The SMP6 policy is both technically and economically feasible as no coastal defence scheme is proposed.
- No DEFRA funded coastal defence scheme is economically justified for this frontage as the majority of the frontage is agricultural land.
- Managed Realignment will allow adaptation and management of the erosion at Happisburgh.
- This Study indicates that under the Scenarios tested, coastal erosion is less pronounced than indicated in the SMP6 (Environment Agency, 2010) due to longshore transport of sediment from north west of the frontage.

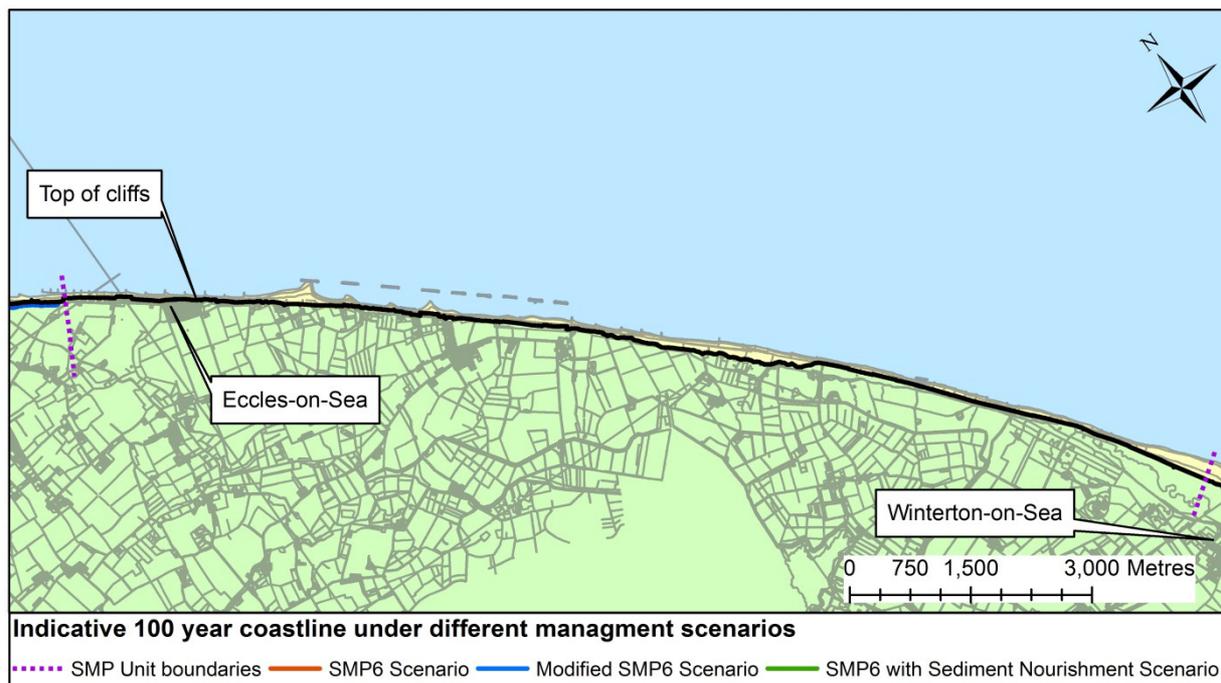
**Summary**

	<b>SMP6 Scenario</b>	<b>Modified SMP6 Scenario</b>	<b>SMP6 with Sediment Nourishment Scenario</b>
<b>Technical Feasibility</b>	<i>Erosion acts to straighten the coastline and allows sediment transport down coast.</i>	<i>Erosion acts to straighten the coastline and allows sediment transport down coast.</i>	<i>Erosion acts to straighten the coastline and allows sediment transport down coast.</i>
<b>Economic Feasibility</b>	<i>No justification for implementing a coastal protection scheme.</i>	<i>No justification for implementing a coastal protection scheme.</i>	<i>No justification for implementing a coastal protection scheme.</i>

**SMP6 POLICY  
UNIT 6.13**

**Eccles to Winterton**

**Map**



**Key Issues**

- The recommended SMP6 policy is Hold the Line in the short, medium and long term (conditional).
- This area already has a coastal defence scheme in place and therefore specific costs and economic justification has not been assessed in this Study.
- Currently sediment nourishment takes place on average every 4 years.
- This area is likely to continue to be defended for the foreseeable future.

**Summary**

	<b>SMP6 Scenario</b>	<b>Modified SMP6 Scenario</b>	<b>SMP6 with Sediment Nourishment Scenario</b>
<b>Technical Feasibility</b>	<i>No erosion as the coastline is defended. Sediment transport onto this frontage is predicted to increase over time due to erosion to the north west.</i>	<i>No erosion as the coastline is defended. Sediment transport onto this frontage is predicted to increase over time due to erosion to the north west.</i>	<i>No erosion as the coastline is defended. Sediment transport onto this frontage is predicted to increase over time due to erosion to the north west.</i>
<b>Economic Feasibility</b>	<i>Scheme already in place. Possible reduced need to nourish in the long term.</i>	<i>Scheme already in place. Possible reduced need to nourish in the long term.</i>	<i>Scheme already in place. Possible reduced need to nourish in the long term.</i>

## 5 Conclusions

### 5.1 Potential Funding

Coastal defence schemes may be partly funded through national Flood Defence Grant in Aid. Application for this grant is made through submission of a Project Appraisal Report to the Environment Agency. The amount awarded to a scheme will depend on presentation of the 'benefits' of the schemes. These are calculated by assessing how many residential and commercial properties, in addition to key infrastructure such as roads and water company assets, will be protected from erosion if the defences are built. This is assessed against the cost of the defences in addition to the technical, environmental and social impacts of a scheme.

However, most schemes require additional third party funding to make up a shortfall in the Flood Defence Grant in Aid funding and enable the scheme to be fully funded. Third party funding is also identified in the Project Appraisal Stage. Third party funding may involve:

- Funding from District and County Council Reserves
- A local levy which places a small increase on local taxes
- Funds such as the coastal communities fund and growing places fund
- Private investment e.g. from water companies, energy companies or other commercial companies
- Flood bonds which are fixed-income financial bonds linked to climate change solutions

### 5.2 Next Steps

Following this Study, a decision will need to be made as to whether coastal defence schemes are taken forward for the identified Policy Units. Areas which are identified for a coastal defence scheme will need to be taken through to Project Appraisal Report (PAR) Stage to gain approval and funds from DEFRA. During the PAR stage, opportunities for third party contributions to the proposed scheme will be identified (see Section 5.1). Following the funding application and if funding has been approved, detailed design of the defences can be carried out. This would lead to appointment of a Contractor and construction of the defences.

The two main areas recommended to progress to PAR stage from this Study at this point are 6.06 Overstrand and 6.08 Mundesley. Policy Unit 6.08 (Mundesley) has already been put forward to the Environment Agency for initial consideration. In addition, Policy Unit 6.11 (Bacton, Walcott and Ostend) is recommended to either be further split into smaller units or taken through to PAR stage for the short term.

Further understanding of the costs associated with potential sediment nourishment events at Overstrand, and the different options for these events would need to be considered before taking this Scenario further. As this Scenario creates benefits across the whole frontage, a large scale benefit coast analysis would be needed. Combining this economic analysis with DEFRA funding would require further conversations with the Environment Agency.

Further understanding of the costs and the benefits of adapting communities to coastal change will be required to be investigated alongside how these may be incorporated and presented as part of the coastal management approach for the coast.

### 5.3 Summary of proposed policies for each SMP Unit

Table 5.1: Summary of the recommended management for each Policy Unit from the results of this Study.

SMP6 Policy Unit	Summary of economics and erosion
6.05 Cromer to Overstrand	Very few 'benefits' in this area and therefore a capital scheme cannot be economically justified. The SMP6 policies of Managed Realignment in short term and No Active Intervention in the long term are recommended to be taken forward.
6.06 Overstrand	A scheme could be economically justified under the SMP6, Modified SMP6 and SMP6 with Sediment Nourishment Scenarios. Funding from the Flood Defence Grant in Aid is likely to only cover a portion of the funding; third party funding would need to be identified. <b>It is recommended that this Policy Unit is taken forward to PAR stage for further investigations/study.</b>
6.07 Overstrand to Mundesley	Very few 'benefits' in this area and therefore a capital scheme cannot be economically justified. The SMP6 policies of Managed Realignment in short term and No Active Intervention in the long term are recommended to be taken forward.
6.08 Mundesley	A scheme could be economically justified under the SMP6, Modified SMP6 and SMP6 with Sediment Nourishment Scenarios. The resulting 100 year coastline geometry under the Modified SMP6 and SMP6 with Sediment Nourishment Scenarios are suggested to be less stable compared to the SMP6 Scenario, however all scenarios are suggested to be technically and economically justified over the 100 year life. <b>It is recommended that this Policy Unit is taken forward to PAR stage for further investigations/study.</b>
6.09 Mundesley to Bacton Gas Terminal	Very few 'benefits' in this area and therefore a capital scheme cannot be economically justified. The SMP6 policies of Managed Realignment in short term and No Active Intervention in the long term are recommended to be taken forward.
6.10 Bacton Gas Terminal	A scheme could be economically justified under the SMP6, Modified SMP6 and SMP6 with Sediment Nourishment Scenarios. This Policy Unit would not be eligible for Flood Defence Grant in Aid funding and therefore any scheme would need to be developed through discussions with private investors. <b>However, a coastal defence scheme for this area is economically and technically justified.</b>
6.11 Bacton Walcott and Ostend	A scheme is not economically justified within this section under the SMP6, Modified SMP6 or SMP6 with Sediment Nourishment Scenario. <b>It is recommended that if this Policy Unit was further sub-divided, areas of this coastline with higher concentrations of assets could be justified for capital schemes at PAR stage.</b>
6.12 Ostend to Eccles	Very few 'benefits' in this area and therefore a capital scheme cannot be economically justified. The SMP6 policy of Managed Realignment in long term is recommended to be taken forward.
6.13 Eccles to Winterton	Although this Policy Unit was not considered in detailed in the economic assessment, analysis of the SCAPE model results suggest that the increased sediment supply through erosion of the coastline provided under all management scenarios will allow continued sustainable management of the frontage at 6.13. Increases in the sediment supply could reduce the need for nourishment over 100 years at Policy Unit 6.13.

## 6 Glossary

**Long Term** – over the next 51 to 100 years

**Longshore Sediment Transport** – movement of sediment along the coastline by wave action

**Maintenance Works** – small bits of work undertaken on the current coastal defences to ensure they continue to defend the coastline from erosion

**Medium Term** – over the next 21 to 50 years

**Recession (of the coastline)** – the position of the coastline retreats landwards due to coastal erosion

**Scheme** – used to describe a coastal defence project which includes the design and construction of the coastal defences

**Sediment Nourishment** – within this Report sediment nourishment is used to describe a beach recharge event (addition of beach material to increase beach levels)

**Shoreline Management Plan** – a high level policy document for coastal management published by the Environment Agency

**Short Term** – over the next 0 to 20 years