Suffolk Coast and Estuaries

Coastal **Ha**bitat **M**anagement **P**lan

Executive Summary

October 2002

Life

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Environment Agency

English Nature

Natural Environment Research Council

1 INTRODUCTION

The coastline is a dynamic environment, where habitats and species, under natural conditions and functions, are able to respond to changes in physical processes (e.g. the balance between sediment provision and coastal form). Man's activities, particularly through the construction of coastal defence systems (flood defence and coastal protection) may interfere with and modify physical processes and, hence, the way in which habitats respond to process change.

The Suffolk coastline and its associated estuaries clearly illustrate this classic cause and effect mechanism and the interaction between man's activities, process modification and habitat response. Significant areas of the Suffolk coastal inter-tidal area (e.g. Alde-Ore and Deben estuaries) were subjected to extensive reclamation between the 15th and the 19th Centuries. Integral to this phase of reclamation was the construction of coastal defences in order to protect the fertile agricultural land from flooding. The presence of these man-made defences and the decrease in the width of the estuarine channel (due to reclamation) has constrained the ability of intertidal habitats (notably saltmarsh) to move landward in response to sea-level rise. This inevitably results in specific habitat loss; the term 'coastal squeeze' has been coined for this effect. With a predicted significant increase in sea-level due to climate change this process is likely to continue, resulting in the loss of greater areas of intertidal habitat.

In some locations, habitats protected by man made coastal defences or natural beach systems are designated (under national and international legislation) for the freshwater and terrestrial features that are present (e.g. reedbed habitat at Minsmere, grazing marsh adjoining the Orwell Estuary). Potentially, in situations where internationally designated features are present to seaward and landward of the defences, options to remove coastal defences to enable coastal habitats to migrate landward may lead to direct conflict between the conservation of freshwater (i.e. terrestrial) and coastal designated habitats. This potential conflict between the maintenance of ecological interests either side of artificial boundaries (in an ecological context) is one of the key issues facing the conservation of habitats and species in the coastal environment.

The Suffolk Coast and Estuaries support significant assemblages of habitats and species which are recognised for their ecological and nature conservation importance through designation as Special Areas of Conservation (SACs) under the European Union Habitats (Council Directive 92/43/EEC) and Special Protection Areas (SPAs) under the Birds Directive (Council Directive 79/409/EEC) and Ramsar sites under the Ramsar International Convention on Wetlands (1971).

Coastal Habitat Management Plans (CHaMPs) form an important link in the coastal planning process for managing European and Ramsar sites. The primary functions of the Suffolk Coast and Estuaries CHaMP are:

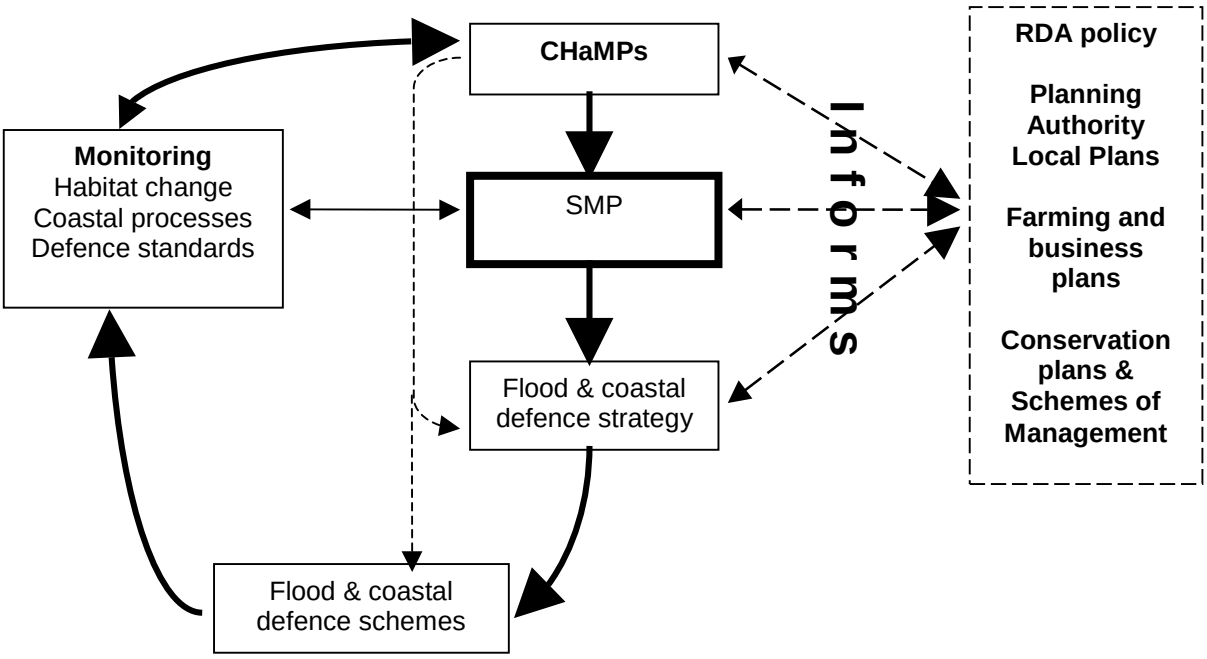
- To offer a long-term strategic view on the balance of losses and gains to habitats and species of European interest likely to result from sea-level rise, and the flood and coastal defence response to such change;
- To develop a response to these losses and gains by informing the strategic direction for the conservation measures that are necessary to offset predicted losses;

- Identify suitable areas for new habitats that may need to be created; and
- Make recommendations to the Shoreline Management Plan and flood and coastal defence strategies to ensure defence options address the requirements of the Habitats and Birds Directives.

Available information has been used to predict geomorphological change and likely shoreline changes over the next 50 years, taking into account predicted climate change and sea-level rise over the study time period. Using this prediction, an analysis has then been undertaken of the likely effect of continuing with existing coastal defence policy on the designated ecological interests (cSAC, SPA and Ramsar). Throughout this process, for designated features landward of a sea defence, there is a presumption in favour of maintaining the habitat *in situ*, where it would be sustainable to do so (the sustainability of defences is normally considered over the probable design-life of a structure). Where it is determined that an adverse effect on ecological interests could occur, then the CHaMP sets out measures to either avoid an adverse effect or to compensate for it, including consideration of alternative flood and coastal defence options and the development of suitable replacement habitats.

The CHaMP is a non-statutory document setting out the best available scientific conclusions, advice and guidance to inform revisions of the SMP and relevant flood and coastal defence strategies. This process is represented graphically in Figure 1.

Figure 1 The CHaMP planning cycle



The Suffolk Coast and Estuaries CHaMP covers the area between Lowestoft in the north and the Stour Estuary in the south. This area includes the following European sites, Ramsar sites and their constituent Sites of Special Scientific Interest (SSSIs): Benacre to Easton Bavents cSAC and SPA; Minsmere to Walberswick cSAC; SPA and Ramsar; Alde-Ore and Butley cSAC; Alde-Ore Estuary SPA and Ramsar; Orfordness to Shingle Street cSAC; Deben Estuary SPA and Ramsar; and Stour and Orwell Estuaries SPA and Ramsar (see Figure 2, which shows the location of the European sites from north to south).

Figure 2 European Sites and Area Covered by the CHaMP – Benacre to Easton Bavents

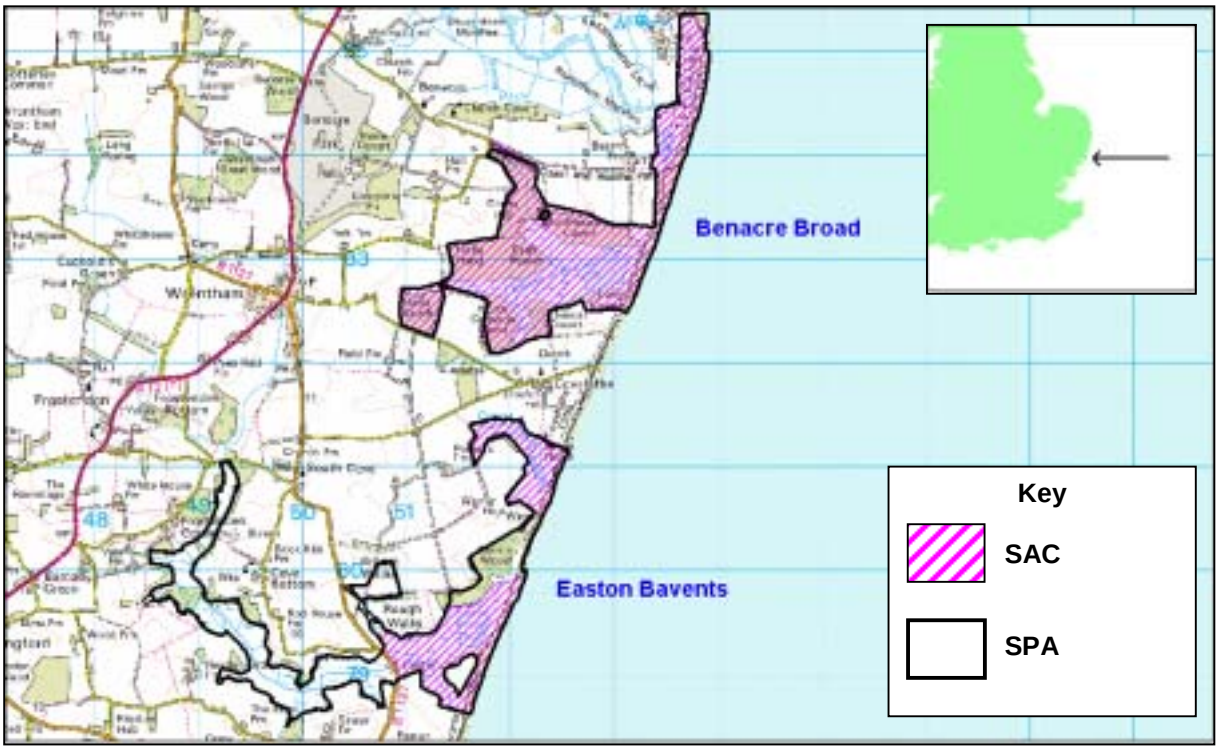


Figure 2 (continued) Blyth Estuary to Minsmere

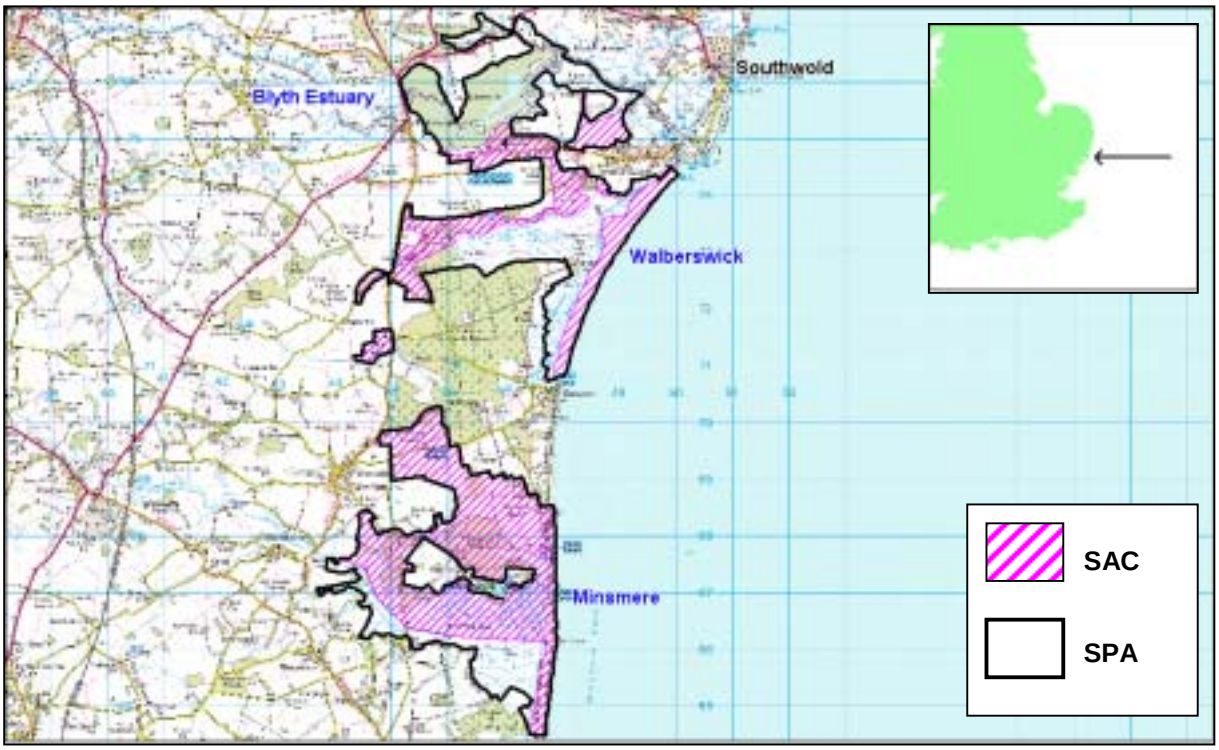


Figure 2 (continued) Alde-Ore Estuary

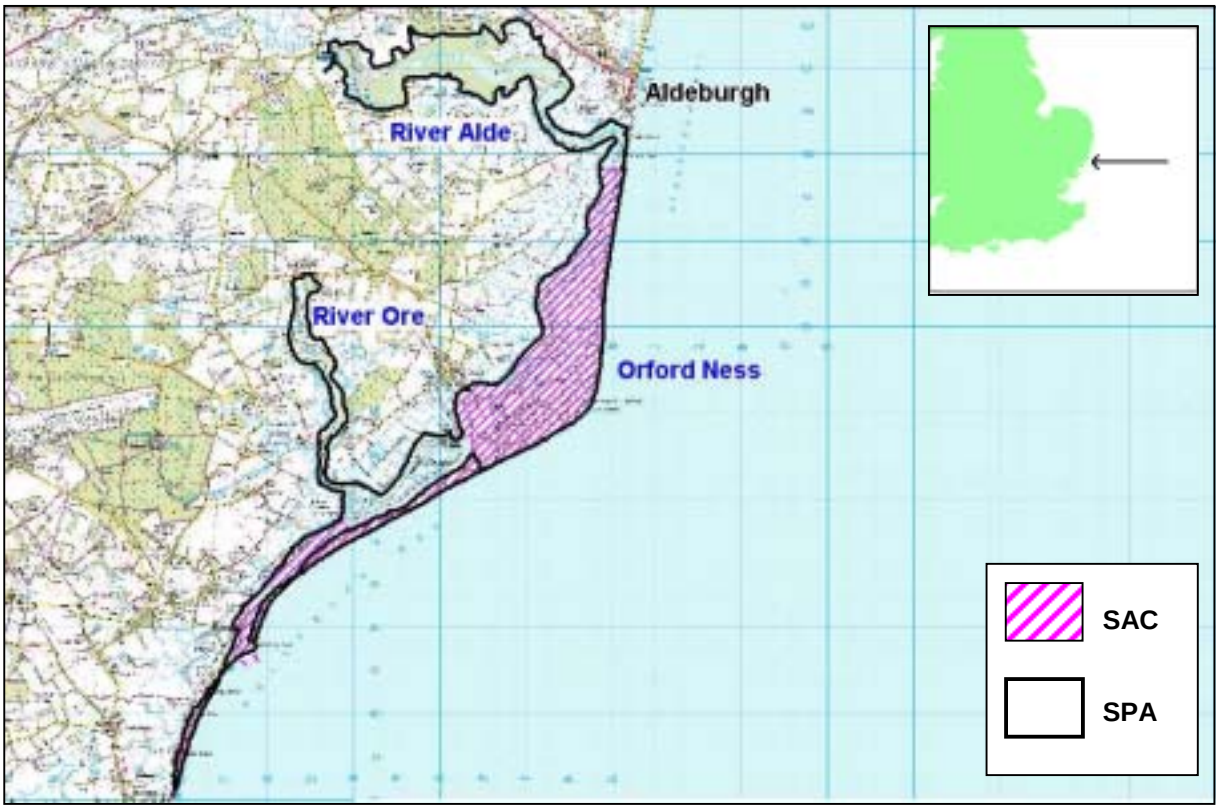
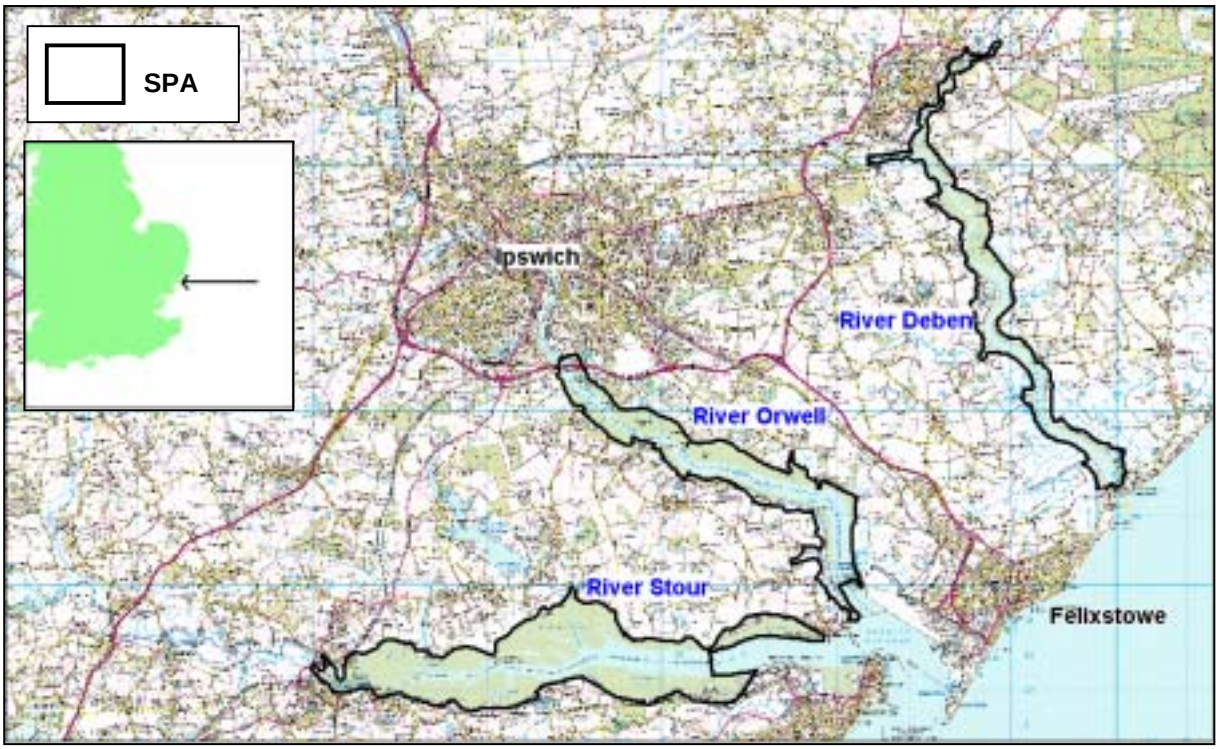


Figure 2 (continued) Deben, Stour and Orwell Estuaries



1.1 Physical aspects of the CHaMP area

The open shoreline comprises, predominantly of shingle backed beaches with sand to shingle foreshores. In areas, the upper beaches have a greater sand content, giving way, in a few specific cases, to a predominance of sand. Characteristically, the land above the beach or the backshore falls into three interspersed categories:

- Clay cliffs; such as at Easton, Covehithe, Sizewell and Thorpeness, Bawdsey Manor and Cobbles Point;
- Shingle ridges at Benacre and Covehithe but, more typically, in front of large areas of low lying land, such as at Easton Broad, Dunwich, Minsmere, Aldeburgh, the Alde-Ore valleys (i.e. Orfordness), and coastal frontages at Alderton, Felixstowe Ferry and Felixstowe itself; and
- Short sections of narrow dune such as to either side of Walberswick Harbour or at Minsmere, Sizewell and Thorpeness.

Within the estuaries, there is a different structure. The three main northern estuaries (the Blyth, the Alde-Ore and the Deben) are strongly constrained by man-made defences within quite broad flood plains. The Orwell is less constrained by man's intervention but is still generally restricted in its development by natural features. The Stour, in contrast, is relatively unrestricted and is constrained principally by natural form and processes within a wider open estuary.

On the open coast the net wave energy direction is from the east, comprising principal components from the northeast and southeast to southwest. Tidal flows flood southward and return north. The general sediment drift is to the south but with major sections of the coast in relative equilibrium.

To the north of Southwold the shoreline drift is strongly to the south, with a weak supply being delivered past Benacre Ness. Beyond Southwold and down to Thorpe Ness, there is a weak southerly net drift through the Blyth ebb delta into the relative equilibrium of the shore of the main bay, with material moving from beneath Dunwich cliff and accumulating in front of the sluice at Minsmere. Little sediment moves south beyond Thorpe Ness and the shoreline of Aldeburgh Bay is again in relative, but dynamic equilibrium, differing only in the slight promontory created by Aldeburgh and in the increased southern drift along Orford Ness.

South of the Ness, the drift is strong, feeding off the bulk of shingle of the Ness itself before material becomes retained within the banks of Orford Haven and Hollesley Bay. Superficial sediment transfer across the shore of the bay feeds further south to the banks of the Knolls and the mouth of the Deben, from whence material is fed intermittently south to Felixstowe and Landguard Point.

1.2 Existing Defence Structures and Policy

On the open coast there is relatively little hard defence, the main activities being maintenance of otherwise natural features. Fixed defences are at present at Kessingland, Southwold, Thorpeness, Aldeburgh, East Lane, and the mouth of the Deben to Landguard Point. The SMP policy (extended by the policies for agreed strategies where appropriate) in each of these areas is to Hold the Line.

Work at present is undertaken to maintain the shingle banks across the Broads to the north of Southwold, in front of Corporation and Dunwich Marches and between Aldeburgh and Orford

Ness. The preferred policy for all but the last of these areas is realignment and involves a continuation of the policy of rebuilding the shingle bank following a breach.

The greater part of the coast is in effect unmanaged, including; the clay cliffs to the north of Southwold, Dunwich Cliffs and through Minsmere past Sizewell and down to Thorpeness, the Haven, and the majority of Orford Spit, Hollesley Bay and Bawdsey cliffs. Defence policy varies across these sections of the coast. North of Southwold the policy is largely for realignment, as is the policy for the Dunwich and Minsmere sections. North of Thorpeness the policy is Do Nothing (apart from Sizewell, which is Hold the Line), while the policy for the Haven is Hold the Line. Orford Spit is again Do Nothing, while a Hold the Line policy for Hollesley Bay has been adopted.

A strategy has been developed for the three northern estuaries. For each estuary the overall policy would be to maintain as far as possible the existing shape of the estuaries, but there are significant lengths of defence where the existing policy for individual frontages could be altered. Key areas where potential changes are identified in the Strategy are the potential closure of the tidal system at the top end of the Blyth and possible realignment of the defences at Tinkers Marsh. On the Alde-Ore, the main recommendation relates to the possible realignment at Hazelwood Marshes, Aldeburgh Town Marshes and Boyton Marsh. In addition, the Strategy for the Alde-Ore recommends that realignment is not undertaken over the marshes of Orford Ness, but that there is a need to manage these areas differently from current practice. Only limited change has been advocated for the Deben, with potential managed realignment identified for a section of land at Nursery Wood.

There is currently no flood defence strategy or defence management plan in place for the Orwell Estuary. The southern side of the Stour Estuary was included in the Essex SMP, for which the preferred policy is to hold the existing defence line except for areas of naturally eroding cliff where the policy is to Do Nothing.

1.3 Ecology

The Suffolk CHaMP area incorporates four areas that have been designated as cSACs:

- Benacre to Easton Bavents Lagoons cSAC;
- Minsmere to Walberswick Heaths and Marshes cSAC;
- Alde-Ore and Butley cSAC; and
- Orfordness to Shingle Street cSAC

These cSACs contain the following seven Annex I habitat features as listed under the EU Habitats Directive.

1.3.1 Annual vegetation of driftlines

This habitat type occurs on deposits of shingle, at or above mean high water springs (MHWS). The habitat supports a number of recognisable communities and colonising species are able to tolerate periodic disturbance of the substrate and saltwater inundation (during overtopping events or through wave spray).

At Orfordness, driftline vegetation occurs on the sheltered, western side of the spit, at the transition from shingle to saltmarsh. The driftline community is widespread on the site and comprises sea beet *Beta vulgaris* spp. *maritima* and orache *Atriplex* spp. in a strip 2-5m wide.

Along the Walberswick to Minsmere frontage, driftline vegetation occurs on a well-developed beach strandline of mixed sand and shingle. Species include those typical of sandy shores, such as sea sandwort *Honkenya peploides* and shingle, such as sea beet. The main areas supporting

this vegetation type are the Walberswick to Dunwich shingle ridge and the shoreline between the southern end of the Dunwich cliff section and Sizewell.

1.3.2 Perennial vegetation of stony banks

Perennial vegetation of stony banks occurs where a sequence of foreshore beaches is deposited at the limit of the high tide. Several beaches may be piled against each other and extensive structures can form. Stability is the crucial determining factor in the ecology of these structures, along with the amount of fine material accumulating between pebbles, climatic conditions, width of the foreshore and past management of the site.

Orfordness spit has been selected as a cSAC as it supports some of the largest and most natural sequences in the UK of shingle vegetation affected by salt spray. The southern extremity of the spit has an excellent series of undisturbed ridges, with zonation of communities determined by the ridge pattern. The vegetation of Orfordness tends to be restricted to the shingle ridges, associated with the presence of fine shingle rather than exposure or elevation. Newly accreted ridges are colonised by pioneer species such as sea kale *Crambe maritima*, yellow-horned poppy *Glaucium flavum*, sea pea *Lathyrus japonicus* and yellow vetch *Vicia lutea*. Orfordness contains the second largest area of acid shingle heath in Britain. The dominant flowering species are sea-campion *Silene uniflora* and English stonecrop *Sedum anglicum*, with early hair grass *Aira praecox*, common cat's ear *Hypochaeris radicata* and false oat-grass *Arrhenatherum elatius* being common. The shingle heath has an extensive cover of lichens and mosses, in some parts dominating the vegetation.

1.3.3 Saline lagoons

Saline lagoons are areas of typically (but not exclusively) shallow, coastal saline water, wholly or partially separated from the sea by sandbanks, shingle or, less frequently, rocks or other hard substrata. They retain a proportion of their water at low tide and may develop as brackish, fully saline or hyper-saline water bodies.

In the northern part of the CHaMP area, at Benacre, Covehithe and Easton Broads, lagoons have formed behind shingle barriers and are a feature of the geomorphologically dynamic system. Seawater enters the lagoons by percolation through the barriers, or by overtopping them during high spring tides or storms. The lagoons display a wide range of salinities (both spatially and temporally) and support a number of specialist lagoon species including the crustacean *Sphaeroma hookeri*.

In the last decade, significant overtopping and landward movement of the shingle bar in front of Benacre Broad has resulted in a reduction in the size of the lagoon and dieback of reed at its distal arms. To combat this loss, new lagoons and bunds to landward of the existing Broad were constructed in 1996. Easton Broad has also significantly reduced in size due to landward movement of the shingle barrier over the past few decades.

At Orfordness-Shingle Street there are three areas of saline lagoons. Former clay extraction areas on the western side of Orfordness (Lantern Marsh and Kings Marsh) support a relatively diverse fauna and flora, including the tasselweed *Ruppia*, with which many of the lagoonal animals are associated. On the eastern side of the ness, a series of former gravel extraction areas, which are fed through percolation and rainfall, support a varied and diverse fauna and flora with large populations of the starlet sea-anemone *Nematostella vectensis*, lagoon cockle *Cerastoderma glaucum* and lagoon winkle *Littorina saxatilis tenebrosa* being present.

A number of lagoons are also present at Shingle Street and have developed in the shingle bank adjacent to the shore at the mouth of the Ore estuary in response to dynamic movement of the shingle. The salinity of the lagoons is maintained by percolation through the shingle with supplementary overtopping on extreme tides. The fauna of these lagoons includes typical lagoon species, such as the lagoon cockle, lagoon winkle and starlet sea anemone.

1.3.4 Atlantic salt meadows

Although saltmarsh vegetation is present within all of the Suffolk estuaries, only the Alde-Ore-Butley system has been selected as a cSAC for this feature.

Along the River Ore, significant stands of two pioneer communities, annual *Salicornia* and *Suaeda maritima* occur. Significant stands of sea-aster and saltmarsh grass occur on both sides of the Butley River and along the west side of the River Ore. Low-mid and mid-marsh communities make up almost 50% of the well-established and stabilised saltmarsh blocks on the Alde-Ore. The low-mid marsh is dominated by communities of sea-purslane *Atriplex portulacoides*, particularly as a linear community along creek sides. Large blocks of sea-lavender *Limonium vulgare* dominated saltmarsh occur along the middle and lower sections of the estuary.

Upper marsh forms about 15% of the overall saltmarsh area on the Alde-Ore. A community dominated by common saltmarsh grass *Puccinellia maritima* occurs mainly along the highest edge of the saltmarsh, the vast majority of this being on floodwalls. In the Upper Alde this community dominates on the old river walls in the middle of the estuary. Elsewhere it occurs on Orfordness in areas that have been extensively disturbed.

1.3.5 Estuaries and intertidal mudflats

Of all of the Suffolk estuaries, only the Alde-Ore-Butley system has been selected as a cSAC representative of the range and types of estuaries found in the UK.

The Alde-Ore Estuary is a relatively complex estuary combining elements of the typical coastal plain estuary with that of a bar-built estuary. Over the last two thousand years the development of the estuary has been largely related to the evolution of Orford Ness. It has been postulated that at one stage the River Alde used to flow into the sea through a wide mouth at Slaughden. As a spit developed southwards from Slaughden, however, the estuary mouth was forced southwards with it. By the time Orford Castle was constructed in AD 1165 the spit had grown as far as the northern tip of Havergate Island, and by the late 1800's it had grown to its present length.

The estuary is fed by the rivers Alde and Butley and comprises in its upper part of a broad area of intertidal mudflat and saltmarsh through which the main estuary channel meanders. Here variable salinity sandy mud dominates and is characterised by the variable salinity bivalve *Macoma balthica* and *Manayunkia aestuarina* community, which is widespread throughout the estuary. At the head of the Alde, the muddy substrate supports a typically upper estuarine community dominated by polychaete worms such as *Hediste diversicolor* and *M. aestuarina*. Beyond the broad, upper reaches of the Alde, the alignment and width of the main channel is restricted by the presence of flood defences and Orfordness, so that east of the basin the channel changes direction through 90^{o} and flows in a narrow channel for some 8km to its confluence with the Butley. The River Butley itself has its tidal limit adjacent to Butley Mills, and from here meanders downstream through extensive areas of reedbed, saltmarsh and intertidal mudflats in its upper reaches.

Downstream of the Butley/Ore confluence, towards Orford Haven at the mouth of the estuary, the river is at its widest. It is also largely uncontrolled by man, running between the shingle spit to the

south and the shingle and marsh frontage backed by set-back embankments to the north. The river flows into the sea past the shingle expanses of North Weir Point at the far southern end of Orfordness, and Shingle Street to the west.

1.3.6 Dry Heaths

The main area of heath vegetation relevant to the CHaMP is present along the cliff top between Dunwich Village and Minsmere RSPB Reserve. The heathland is predominantly a type most characteristic of western parts of the UK, dominated by heather, western gorse and bell heather and is found in a mosaic with acidic grassland.

1.4 Interest Features of the Special Protection Areas

There are six SPAs designated within the CHaMP area, as listed in Table 1. Between them these sites support internationally important populations of breeding and wintering waterfowl populations and qualify for designation as SPAs under the Birds Directive as summarised in Table 1.

Table 1 – Summary of designated interests of SPAs within the Suffolk Coast and Estuaries CHaMP area

SPA	Annex I	Migratory species of international importance	5 year peak mean (1995/96-1999/00) or national importance	Key Habitats
Benacre to Easton Bavents	Marsh harrier, bittern and little tern			Saline lagoons (open water), shingle, reedbed and grazing marsh
Minsmere - Walberswick	Hen harrier, marsh harrier, bittern, avocet, nightjar and woodlark		Nationally important breeding populations of gadwall, teal and shoveler. Nationally important wintering populations of European white-fronted geese, gadwall and shoveler.	Grazing marsh with dykes, reedbed, intertidal mudflat, saltmarsh, lagoons, shingle, woodland and lowland heath
Alde-Ore Estuary	Avocet, marsh harrier, Sandwich tern, little tern	Lesser-black backed gull and redshank	16,252 individual waterfowl including: black-tailed godwit dunlin, lapwing, shoveler, teal, wigeon, shelduck, European white-fronted goose, redshank and avocet. During the breeding season, the area regularly supports 59,118 individual seabirds including: herring gull, black-headed gull, lesser black-backed gull, little tern and Sandwich tern.	Vegetated shingle, intertidal mudflat, saltmarsh, semi-improved grazing marsh, and saline lagoons.
Deben Estuary	Avocet			Intertidal mudflat and saltmarsh
Stour and Orwell Estuaries	Hen harrier	Dark-bellied brent goose, shelduck, pintail, ringed plover, grey plover, dunlin, black-tailed godwit, redshank and turnstone	58,851 individual waterfowl including: including: cormorant, pintail, ringed plover, grey plover, dunlin, black-tailed godwit, redshank, shelduck, great crested grebe, curlew, dark-bellied brent geese, wigeon, goldeneye, oystercatcher, lapwing, knot and turnstone.	Intertidal mudflat, saltmarsh and grazing marsh.

2 ASSESSMENT OF HABITAT CHANGE

2.1 Introduction

The CHaMP area has been divided into six Habitat Behaviour Units (HBUs) in order to assist the process of assessing the impact on the internationally designated sites of both natural and manmade change related to coastal defence management. These units focus on the designated sites but are defined broadly enough to take in supporting areas of habitat and or land. The HBUs are set out in Table 2 which also highlights the key associations and distinctions used in making the divisions.

For each of the HBUs, information has been collated and a process of assessment of the designated nature conservation features undertaken. This process can be summarised as follows:

- Identification of the basic elements making up the HBU, with a summary of key features and designations;
- A summary of shoreline management. Including:
  - Identification of future trends in the behaviour of the coast
  - An overall description of the way in which the unit is managed at present
  - Description of an overall policy for future management;
- A brief discussion of issues related to the integrity of the designated features and their interrelationship, both internal and external to the HBU;
- Assessment and discussion of whether non-intervention or existing policy would be likely to deliver a sustainable and practical approach to maintaining the internationally important features. Where either approach would maintain features then alternative approaches are discussed and potential opportunities for habitat enhancement or development identified; and
- Provision of a baseline assessment of the physical extent of habitat and features. For each potentially feasible management alternative a revised assessment is made of the extent of habitat that would result if it were implemented.

Unlike the SMP process, the CHaMP assessment process does not set out to prescribe a single preferred option for the HBU. The CHaMP aims to provide advice and guidance to the SMP and coastal managers; defining, and explaining, the consequence of different alternatives of management, identifying where these run counter to conservation objectives or to the desire to maintain sustainable internationally designated features. Where appropriate, the assessment identifies what actions may be realistic in addressing such issues.

Table 2 - Distinguishing Features of Habitat Behaviour Units

HBU	A. Covehithe	B. Blyth	C. Minsmere	D. Orford and Alde	E. Deben	F. Stour and Orwell
Extent	Kessingland Levels to Southwold	The Denes to Dunwich including the Blyth Estuary	Dunwich to Thorpeness	Slaughden to East Lane including the Alde-Ore Estuary	The Deben Estuary from Bawdsey Manor cliffs to the Dip	The Stour and Orwell estuaries including Landguard Point
Designations	cSAC/SPA	cSAC/SPA/Ramsar	cSAC/SPA/Ramsar	cSAC/SPA/Ramsar	SPA/Ramsar	SPA/Ramsar
Morphology	Open shingle and sand coast controlled by Benacre Ness/ Kessingland and Southwold	Principally estuary with open shingle coast with low land contiguous to estuary behind	Open shingle coast, part of larger Bay structure. Held partially by Dunwich Heath cliffs and by Thorpe Ness	Principally estuary constrained over its lower end by massive shingle ridge of Orford Ness	Estuary unit with coastal interaction at entrance.	Estuary unit fixed by high ground throughout, with manmade fixity at the estuary mouth
Sediment transport	Weak input from north.	Weak input from north	Weak input from north.	Little input from north	Input from north	Input from north deposited in mouth
	Differential net drift to south.	Weak net drift south. Marine sediment input and internal redistribution within estuary.	Differential north and south movement converging at Minsmere and Sizewell	Weak then strong southerly drift. Principally redistributed sediments within estuary	Some marine input to estuary, but principally sediment redistribution within estuary.	Marine input to accreting Orwell, generally eroding Stour
	Weak outdrift to south	Weak outdrift south		Intermittent input to south	Intermittent drift across estuary feeding south.	Little interaction
General features under threat	Fresh/ brackish habitats		Fresh water habitats	Fresh/ brackish habitats		Freshwater marsh
		Saltmarsh		Saltmarsh	Saltmarsh	
	Shingle		Shingle & dunes	Shingle		
			Heathland			
				Brackish/ saline lagoons		
Opportunity habitat	Brackish/ saline lagoons	Freshwater-brackish habitats Saltmarsh	Brackish/ saline habitats Saltmarsh	Freshwater habitats Brackish habitats Saltmarsh	Freshwater habitats Saltmarsh	Freshwater habitats Brackish habitats Saltmarsh

2.2 HBU A. Covehithe Kessingland to Southwold

Elements:		
1. Benacre Ness	*Designation*	Part of the Benacre to Easton Bavents cSAC and SPA
	Key Features	Saline lagoons (cSAC), also supporting shingle habitat of the Ness (Not designated as part of the cSAC interest, but included within the SPA)
2. Benacre Broad	*Designation:*	Part of the Benacre to Easton Bavents Lagoons cSAC and SPA
	Key Features:	Saline lagoons (cSAC), Brackish/freshwater reedbed and shingle beach (SPA).
3. Covehithe Broad	*Designation:*	Part of the Benacre to Easton Bavents Lagoons cSAC and SPA
	Key Features:	Saline lagoons (cSAC), Shingle beach (SPA) and reedbed.
4. Easton Broad	*Designation*	Part of the Benacre to Easton Bavents Lagoons cSAC and SPA
	Key Features	Saline lagoons (cSAC), Brackish/freshwater reedbed and associated wet fen grassland habitats up the Easton Valley.

Management

Trends	*Constraints:*	The unit is an eroding shoreline (average 350m over 150 years) with clay cliffs interspersed by small valleys fronted by shingle banks. The frontage runs between Kessingland and Benacre Ness to the north and Southwold to the south. The alignment of both these locations is likely to be held in the future.
	Evolution:	The frontage is predicted to continue eroding until a more stable shoreline shape develops (up to 800m landward of the existing shoreline in places). This would result in the loss of the lower sections of each of the tributary valleys to the frontage with the new shoreline lying across the upper spur valleys. Gradual reduction of sediment to supplement attrition of banks.
Current Practice	*Description*	No works are carried out to the clay cliffs and they continue to erode. The shingle ridges fronting Benacre and Easton Broads breach occasionally and are repaired and reprofiled following such events.
	Implications	Regular influx of saline water into the brackish and freshwater lagoons during breach of the fronting single banks. Erosion of the cliffs gradually exposes the tributary valleys to greater saline influence. There is a continuing, but small loss of sediment to the south with resulting loss to the foreshore.
Policy	*Description*	Retreat; allowing the shoreline to move back while maintaining the integrity of the shingle banks.
	Intent	To allow natural erosion to continue, fixed by the Hold the line policy to north and south. Provide continuity of sediment supply to the coast to south.

HBU issues: Continuing erosion, coupled with an increasing attrition of material to shingle ridges would result in a reduction and potential complete loss of the designated saline lagoons (cSAC interest features). Intermittent, but potentially more frequent breaching and overtopping of the shingle ridges at Benacre and Easton would lead to the loss of brackish and freshwater reedbed habitats and the SPA designated bird populations (bittern and marsh harrier) that these areas support. Changes to the foreshore may result in loss of open coast shingle habitat, potentially leading to the loss or reduction of suitable habitat for breeding little tern (designated SPA interest).

The evolution of Benacre Ness has been pivotal to the development of this coastal frontage. As it has progressively moved northwards so the protection provided by the structure to this area has decreased. There is no active management of the adopted SMP **retreat** policy for the Benacre Ness frontage, although in reality, there would need to be some transition from the Hold the Line Policy further north. From the SMP it is implied that the main strong point would be at the main

outfall flume for Kessingland Pumping Station. Under the retreat scenario the remaining saline lagoon on Benacre Ness would not be maintained.

During the early part of the 20th Century, Benacre Broad was situated behind Benacre Ness, held in position by the high ground of Covehithe Cliffs. The area of lagoons was more extensive, continuing southwards behind the Ness. With erosion of the cliffs and movement north of the Ness, Benacre Broad has been retained within the broad valley base between Long Covert and Boathouse Covert. The Broad is contained in this area by a relatively natural broad-crested bank of shingle and sand.

At present, under the adopted **retreat option** the shingle bank across Benacre Broad may be repaired and remain in a relatively natural condition. As the coast moves back, with the Hold the Line policy to the north, the sediment supply to the frontage may reduce. This, together with attrition of material and loss due to continuing drift, will reduce the ability to maintain the profile of the shingle bank.

Easton Broad, until quite recently (1945), was the largest of the three broads between Southwold and Benacre; being some 25ha in extent. The Broad has reduced in size to some 4ha of open broad, which is backed by approximately 120ha of brackish/ freshwater reedbed and associated wet fen and grasslands up into Easton Valley. The SMP policy for the frontage is one of **managed retreat**. This is being actively pursued, but the limits on available beach material coupled with the need to maintain a high level bank has resulted in a very steep, narrow and artificial profile to the bank.

Under the basic and confirmed policy of non-, or limited intervention, erosion of the low cliffs between Southwold and Benacre would continue. Roll-back and breach of the shingle bar/beach system fronting the saline lagoons and wetland complexes at Benacre, Covehithe and Easton will be an ongoing process. As a consequence, it is predicted that a significant component of the designated SPA features of this area would be lost. The gradual northwards shift of Benacre Ness would also increase the vulnerability of low-lying areas such as Kessingland levels to tidal flooding. Selective measures such as the installation of a tidal barrier as Pottersbridge in the Easton Valley would safeguard freshwater reedbed and other wetland habitats to landward and therefore maintain part of the ecological interest of this site. Other measures could be undertaken to either reduce the rate of erosion and to maintain areas of degraded habitat in their present locations. However, to do so would represent intervention and the emplacement of engineered structures along a section of coastline which is fundamentally dynamic and open to natural processes. The implications of either retreat or managing the frontage go beyond those under consideration in the CHaMP process.

The long-term loss of the saline lagoons and associated wetland habitats represents a ‘natural’ progression in the evolution of these features. Saline lagoons of the percolation type are ephemeral features and their presence on this stretch of coastline reflects a period of time when conditions (e.g. sediment supply) were suitable for their formation. Trying to maintain the features is technically feasible but would reduce the dynamic nature of the frontage with potential knock on effects for other ecological and socio-economic interests. While potentially sustainable from a purely technical perspective this would involve significant intervention. Allowing dynamic processes to operate would require acceptance that these habitat features would be lost over the next 100 years. A summary of predicted habitat changes within the designated areas (i.e. within the defined boundaries of the cSAC/SPA) is given in Table 3. This Table relates change to the existing baseline of area of habitat within the site boundaries and provides an indication of the likely habitat creation requirements under the scenarios that have been investigated.

Based on the work undertaken it is apparent that unless intervention occurs, then there will be significant loss of habitat from the designated areas. As such, areas for the creation of new habitat may need to be sought. The overall requirement depends to a certain extent on the view as to whether the change over the CHaMP period is 'natural' (see above). Within the immediate area of the HBU, Kessingland Levels offers the opportunity to offset predicted freshwater and terrestrial habitat loss. Appropriate development of this habitat would take a number of years. The site is unlikely, without heavy modification, to provide replacement for loss of the saline lagoons and shingle banks. In order to advance this measure, it would be necessary to implement and maintain a policy of Hold the Line for this frontage. This policy is currently in place in order to provide protection to the pumping station at Kessingland and prevent inundation of the levels.

Table 3 – Predicted habitat changes to designated areas (cSAC/SPA) for the Kessingland-Easton frontage.

BENACRE	**Mudflat**	**Saltmarsh**	**Saline lagoons**	**Reedbed**	**Wet grassland**	**Shingle**
Baseline			*18ha*	*170ha*	*20ha*	*1800m*
Non-intervention.	40ha	10ha	2ha	30ha	10ha	800m
Current policy.			2ha	110ha	20ha	800m
In situ protection measures.			12ha	150ha	20ha	1800m

2.3 HBU B Blyth Estuary and Southwold to Dunwich Village

Elements:		
1. Blyth Estuary	*Designation*	Part of Minsmere/ Walberswick SPA, Ramsar
	Key Features	Mudflats, Freshwater/brackish reed beds (SPA/Ramsar).
2. Southwold Town Marsh	*Designation:*	Part of Minsmere/Walberswick SPA, Ramsar
	Key Features:	Wet grassland habitat (SPA/Ramsar)
3. Tinkers Marsh	*Designation:*	Part of Minsmere/Walberswick SPA, Ramsar site
	Key Features:	Wet grassland habitat and diverse brackish water habitat
4. Dunwich to Walberswick Marshes and shingle banks	*Designation*	Part of Minsmere/ Walberswick cSAC, SPA, Ramsar
	Key Features	Freshwater/brackish reedbed with associated wet grassland. Brackish/saline reedbed (SPA/Ramsar) and associated lagoons (not designated as cSAC). Shingle banks (SPA/Ramsar) and drift line vegetation (cSAC).

Management

Trends	*Constraints:*	The open coast comprises a relatively stable, though still dynamic shingle to sand shoreline. Southwold and Dunwich Cliffs provide the main natural structure to both coast and estuary; the harbour training walls at Southwold are imposed upon this. There is believed to be little supply of sediment down the coast. The estuary is under considerable stress with an artificially narrow entrance and large intertidal area upstream. The shape of the estuary is controlled naturally by high ground and artificially by the A12 road bridge, the footbridge and the harbour channel and training walls.
	Evolution:	The coastal frontage has moved back relatively slowly over the last 100 years and is likely to continue to retreat. Through both extension and attrition, the shingle ridge between Walberswick and Dunwich is likely to become increasingly vulnerable to fragmentation. The evolution of the Blyth estuary will be dictated significantly by management decisions. The failure of flood defences would have the potential to result in increased pressure on defences, through an increase in tidal volume, and further failure of defences and loss of designated habitat may result.
Current Practice	*Description*	Breaches in the open coast shingle ridge are repaired by reforming and re-profiling the bank. Flood defences are maintained within the estuary.
	Implications	Maintaining the shingle ridge is resulting in an increasingly vulnerable defence. A severe breach may not be repairable and the full extent of Westwood Marshes (Walberswick) could be liable to saline flooding. Within the Blyth Estuary there is a recognised need for increased investment in the existing defences. A severe event resulting in failure may lead to the present defence line becoming unsustainable. There would be significant change and/or loss of existing designated areas of habitat adjacent to the estuary, although potentially new areas of intertidal habitat could be created.
Policy	*Description*	Retreat along the shoreline, allowing the shingle ridge to move back as a unit. Hold the shape of the estuary, while abandoning some defences and allowing realignment to occur in selected locations.
	Intent	To allow natural change to occur on the coast while maintaining control within the estuary.

HBU issues: Continued coastal defence management work on the immediate coastline potentially damages cSAC (annual vegetation) and SPA/Ramsar interests. Significant loss of ecological interest could occur over the long term due to failure of the fronting shingle ridge and tidal inundation of freshwater and brackish wetland habitats to landward. Realignment or uncontrolled failure of defences within the Blyth Estuary would result in significant change to existing designated ecological interests.

Within this area of the CHaMP there are two issues critical to the future development of the internationally designated habitats and the overall extent and distribution of ecological interests.

The first issue concerns the future management of the Blyth Estuary. The present morphology of the estuary has developed, over the last several centuries, largely through reclamation up to the principal low water channel. Subsequent loss of defences, around Bulcamp Marshes, has led to an unbalanced estuary, with considerable stress on sections of remaining defence.

Current management practice is to **maintain the existing defences**. This approach would result in the continued loss of saltmarsh habitat through coastal squeeze and although this would lead to a concomitant increase in intertidal mudflat this would decrease over time due to the landward migration of Low Water Mark. Internationally designated features to landward of the defences (e.g. Tinker's Marsh) would be maintained. This option would require increasing investment and long-term commitment, potentially leading to an inflexible approach to both management of defences and the natural environment of the estuary. This may result in decisions being made elsewhere, which further reduce future choice in management. With a recognised need for responsive management, in the face of climate and sea level change, this approach is considered unsustainable.

It is suggested that re-alignment of the defences to Tinker's Marsh on the southern side of the Blyth and Robinson Marsh towards the mouth of the estuary would offer a more sustainable approach to the management of the estuary. Defences within the rest of the estuary would be maintained, including those to Southwold Town Marshes. This approach, while creating the opportunity for development of additional intertidal habitats that could significantly contribute to the international interest of the SPA/Ramsar site, would, however, fail to maintain the existing designated SPA/Ramsar features to landward at Tinker's Marsh.

Within the Blyth Valley, but outside of the designated SPA/Ramsar, the valley section immediately upstream of the A12 is viewed as a critical area. The flood defences to the tidal channel in this area are in poor condition and without significant works to them potentially a significant area of the Blyth Valley would be inundated. This would lead to a large increase in the tidal volume of the estuary and result in the erosion of downstream estuarine habitats (notably saltmarsh) and increase the pressure on flood defences to other sections of the estuary. The continued maintenance of flood defences to this area is therefore a crucial aspect of the overall management of the estuary. If this route is taken then this also opens up the opportunity to improve the management of the valley floor riverine habitats and to create a significant area of freshwater wetland habitat (e.g. grazing marsh, reedbed). This area could mitigate for the potential loss of freshwater wetland habitats at Tinkers Marsh and possibly other sites within the CHaMP area.

The second main issue associated with this area is the predicted evolution of the shingle ridge fronting the coastal section between Walberswick and Dunwich and the habitats to landward that this ridge protects from extensive and potentially detrimental tidal inundation. The shingle bank has developed as a result of long term erosion of the Blyth/Dunwich delta, moving back to form the present coastline. Movement of the bank over the last century has been relatively slow, on average approximately 0.5m per year, which emphasises the basic stability of the bay. The frontage is, however, dynamic with movement of material both north and south, and regular overtopping and flattening of the artificially maintained steep shingle ridge.

Current management practice, supported by the SMP policy, is to allow the existing defences to **retreat**. This involves responding to weakening or breach of the shingle bank by reforming the ridge to maintain its height and general integrity. There is a problem with a lack of new material

being transported along the frontage, such that continued retreat and continual reworking of material is increasingly creating a fragile and unsustainable defence. The prediction under sea-level rise and increased storminess is for the shingle ridge to continue its gradual roll-back. If existing management measures are maintained then the potential for catastrophic failure is increased, as the morphology of the ridge would be maintained in a state which is out of keeping with the prevailing physical conditions. A potential breach and failure of the barrier would have a significant and detrimental impact on freshwater habitats to landward.

Consideration of a number of alternatives (including non-intervention) suggests that the most sustainable option within the timeframe of the CHaMP would be to allow dynamic processes to operate along the open coast but to provide a retired defence to landward in order to maintain much of the reedbed and wetland complex of Westwood Marshes. Under this option there is the possibility that significant tidal inundation could occur to the area forward of the retired defence line in the longer term. If this were the case then significant change to existing and designated ecological interests would take place, leading to the development of an interesting complex of brackish-saline coastal habitats (e.g. saltmarsh, saline lagoons etc.) as part of a functional and dynamic section of coastline.

A summary of predicted habitat changes within the designated areas (i.e. within the defined boundaries of the cSAC/SPA/Ramsar) is given in Table 4. This Table relates change to the existing baseline of area of habitat within the site boundaries and provides an indication of the likely habitat creation requirements under the scenarios that have been investigated. The key point to make here is the likely requirement for the creation of freshwater/brackish grassland and reedbed under the continued policy of reprofiling of the shingle bank between Dunwich and Walberswick. Potential sites for the replacement of this habitat include Kessingland Levels and the Blyth Valley upstream of the A12. Between them these sites have the capability to provide in the order of 500ha of suitable land which would more than offset loss from this area and from Benacre to the north.

The section between Walberswick and Dunwich represents an example of the classic issue of trying to deal with dynamic coastal change whilst ensuring protection (i.e. maintenance) to existing designated features to landward. In the time period covered by the CHaMP it may be feasible to maintain features to landward of the shingle barrier. However, over the longer term and under accelerated sea-level rise this situation is not considered to be sustainable and therefore consideration should be given to seeking sites for the creation of new wetland habitats which could eventually replace those present at Walberswick.

Table 4 – Predicted habitat changes to designated areas (cSAC/SPA/Ramsar) for the Blyth Estuary and Walberswick-Dunwich frontage.

BLYTH-DUNWICH	**Mudflats**	**Saltmarsh**	**Saline lagoons**	**Reedbed**	**Wet grassland**	**Drift line vegetation**	**Shingle**
Baseline	*155ha*	*60ha*		*240ha*	*240ha*	*4.8km*	*10ha*
Non Intervention	435ha	185ha		35ha	15ha	8km	10ha
Current policy	335ha	150ha		45ha	138ha	8km	10ha
Maintain open coast + retreat Tinkers	195ha	65ha		240ha	192ha	4.8km	10ha
Retreat open coast + retreat Tinkers	305ha	135ha		160ha	92ha	6.8km	20ha

2.4 HBU C. Minsmere Dunwich Village to Thorpeness

Elements:		
1. Dunwich Heath	*Designation*	Part of Minsmere/ Walberswick cSAC, SPA/Ramsar
	Key Features	Cliff top heathland (cSAC/SPA).
2. Minsmere	*Designation:*	Part of Minsmere/Walberswick cSAC, SPA/Ramsar
	Key Features:	Freshwater/brackish reedbed, grazing marsh, open water, shingle frontage (all SPA) and annual drift line vegetation (cSAC).

Management

Trends	*Constraints:*	The apparent straight section of the coast between Dunwich cliffs and Thorpeness is gently distorted by the forward position of the shore at Minsmere Sluice. The frontage is controlled by the relatively resistant cliffs at Dunwich and the bulk of Thorpeness to the south. There has been very little change at Minsmere Sluice over the last century and it seems likely that this point in the coast is semi-fixed by differential drift patterns dictated by the influence of the offshore banks, possibly reinforced by the Sluice structure itself.
	Evolution:	The main area of retreat over the last century has been to the cliffs, this is likely to continue at least in the short term and more so in the event of change in sea level. The rest of the coast has remained very stable with only minor erosion at Thorpeness. The soft frontage across the Minsmere Reserve is always vulnerable to change, as seen in the recent erosion to the south of the sluice. It is, however, difficult to predict the evolution of this section given the variability of factors influencing change.
Current Practice	*Description*	Little action is taken in terms of defence management. It is assumed, however, that action would be taken in event of threat of breach at Minsmere or erosion at Sizewell.
	Implications	As the Dunwich Cliffs continue to erode, it is intended to reinforce the weak spot between the cliffs and the Minsmere Bank. Similar action may be required between Sizewell and Minsmere Sluice.
Policy	*Description*	The policy for this unit of coast is managed retreat over the northern length, Holding the Line at Sizewell and Do Nothing down to Thorpeness, but Holding the Line at Thorpeness.
	Intent	To minimise intervention and the impact on sediment movement, relying on and supporting, where necessary, the line of the coast.

HBU issues: The cliffs at Dunwich will continue to erode with loss of cliff top heathland vegetation (designated cSAC/SPA). Any failure of the natural shoreline defence and secondary embankment to landward at Minsmere would cause saline inundation and potentially result in significant change to existing designated habitats and features depending on the scale and duration of inundation.

The current policy is for **retreat**. Under this approach, works would be undertaken to strengthen any potential breach areas (e.g. the southern end of the Dunwich Cliff section) and, as necessary, to maintain the shingle ridge should change result in this rolling back. The gradual roll back of the shingle beach/barrier fronting the wetland complex at Minsmere would result in the loss of some shingle and sand dune habitat along the immediate coastal fringe. However, features to landward could be maintained *in situ*, particularly given the presence and maintenance of the retired flood defence.

At Dunwich Cliffs, the continued erosion of the cliffs would result in the loss of cliff top heathland (designated cSAC/SPA). It is recommended that the cliffs remain undefended, as is the present policy, to ensure that the supply of sediment that the frontage provides is maintained, particularly given that this supply may be important to the Minsmere frontage to the south. The loss of heathland, based on current rates of erosion, would amount to approximately 20ha. This loss

could be attributed to natural change and therefore may not need to be replaced. However, if it is determined that it is important to maintain the overall resource it is considered that a new area of heathland could be re-created during the period covered by the CHaMP on existing agricultural land adjacent to heathland in the Minsmere-Walberswick area.

If no works were taken to strengthen the existing retired defence then non-intervention could potentially result in the formation of a new estuary system/embayment at Minsmere Levels. Whilst the formation of a significant area of new coastal and estuarine habitats would be beneficial with respect to the overall extent of these habitat types and the longer term functionality of the coastal system, the loss of features to landward would constitute a major change in biodiversity terms.

Again, as with the situation at Walberswick-Dunwich, in the longer term, consideration should be given to undertaking large-scale habitat creation to replace terrestrial-freshwater features away from the immediate coastline. The context of such works with respect to areas such as Minsmere should be borne in mind. Many of the wetland habitats at Minsmere and Walberswick have been in existence for less than 60 years (since the end of World War II). Allowing a long time period (i.e. >50 years) for the creation of wetland complexes to replace sites such as Minsmere would allow decisions on enabling and establishing dynamic coastal functionality to be more easily made.

A summary of predicted habitat changes within the designated areas (i.e. within the defined boundaries of the cSAC/SPA/Ramsar) is given in Table 5. This Table relates change to the baseline area of habitat within the site boundaries and provides an indication of the likely habitat creation requirements under the scenarios that have been investigated. As can be seen there is, under existing policy, unlikely to be a significant requirement for the replacement of designated habitats. Both the loss of heathland and sand dune habitats could be attributed to natural change and, therefore, there may be no requirement to directly offset their loss. Potentially in the longer term there may be a need to replace the freshwater habitat complex at Minsmere (see discussion above) and, if this is the case, then an area in the order of 350ha would be required. Replacement sites include former estuarine areas around the Alde-Ore and the Deben estuaries which between them could provide approximately 1500ha of suitable land. Alternatively, the potential exists for the creation of a new wetland complex away from the immediate coastal area (e.g. the Fens). However, significant consideration would have to be given to the likely ecological differences between an inland and coastal site and whether such differences were acceptable with respect to the Habitats Directive and regional biodiversity issues.

Table 5 – Predicted habitat changes to designated areas (cSAC/SPA/Ramsar) for the Minsmere frontage.

MINSMERE	**Mudflats**	**Saltmarsh**	**Saline lagoons**	**Reedbed**	**Wet grassland**	**Drift line vegetation**	**Sand dunes**	**Heath**
Baseline				*155ha*	*205ha*	*3.5km*	*40ha*	*290ha*
Non-intervention	200ha	60ha	0	35ha	65ha	>3.5km	10ha	270ha
Current policy	0	0	0	0	0	0	20ha	270ha

2.5 HBU D. Alde-Ore and Orford Ness Slaughden to East Lane

Elements:		
1. Alde-Ore Estuary	*Designation*	Alde-Ore SPA, Ramsar and cSAC
	Key Features	Mudflats and sand flats (cSAC & SPA), Saltmarsh (cSAC & SPA), Estuary (cSAC), Saline lagoons and waterbodies (SPA *Havergate*).
2. Butley	*Designation:*	Part of Alde-Ore SPA, Ramsar and cSAC
	Key Features:	Intertidal mudflat and saltmarsh, Estuary (cSAC), Reedbeds (SPA/Ramsar)
3. Hazelwood	*Designation:*	Part of Alde-Ore SPA and Ramsar
	Key Features:	Wet grassland habitat (SPA).
4. Orford Ness and Marshes	*Designation*	Part of Alde-Ore SPA, Ramsar and cSAC
	Key Features	Intertidal mudflat & saltmarsh (cSAC/SPA). Shingle habitat (SPA), annual and perennial vegetation (cSAC). Wet and maritime grasslands (SPA). Saline lagoons (cSAC)
5. Shingle Street	*Designation*	Part of Alde-Ore Ramsar and cSAC
	Key Features	Shingle habitat annual and perennial vegetation (cSAC). Saline lagoons (cSAC)

Management

Trends	*Constraints:*	There is a weak supply of material moving south past Aldeburgh. Beyond Aldeburgh net drift tends to increase to Orford Ness. Once beyond the Ness material moves south to Shingle Street. The key control points are Aldeburgh and East Lane, with the entrance to the Alde-Ore estuary retaining and controlling material moving south. The Ness is a relic shingle accumulation, now slowly eroding. Within the estuaries, reclamation and subsequent failure of defences upstream of Aldeburgh have had a major impact on the estuary. The shape of the main channel is influenced by topography and coastal processes. The balance between flows in the estuary and the energy and sediment of the open coast dictate the length and vulnerability of Orford Spit.
	Evolution:	The coastal frontage is attempting, in effect, to straighten between Aldeburgh and Shingle Street. The neck at Slaughden would breach, if not artificially managed. The estuary itself, assuming no breach at Slaughden, is changing with relative sea-level rise both increasing pressure on defences and with respect to its interaction with the coast at Shingle Street
Current Practice	*Description*	Maintain the defence at Slaughden and generally maintain the overall shape and performance of the estuary.
	Implications	Maintaining the neck at Slaughden requires beach management from the Ness. Maintaining the principal defences of the Estuary and ensuring that there is no major impact on the coastal regime requires balancing any realignment with the subsequent increase in tidal volume.
Policy	*Description*	Hold the Line at Slaughden and at Shingle Street but Do Nothing elsewhere. Maintain all defences within the estuary.
	Intent	To allow natural change to occur on the coast but continue to restrain estuary development.

HBU issues: Natural long-term change could cause major change to the existing designated features.

There is recognition in the designation of the Alde-Ore and Butley as a cSAC, that the estuary as a whole, with its varied habitats, is an important functioning system. This same interaction is reflected in the physical performance of the estuary, not least in the balance achieved over the lower reaches between estuary flow and coastal dynamics.

The current management practice for the main estuary and the Butley, in the absence as yet of adopting an estuary strategy for defence, is for *ad hoc* **response maintenance** and repair of existing defences. The most critical area of stress within the estuary is around the Aldeburgh Bends. Due to increased flows through this area, there is a significant loss of saltmarsh fringe and potential for further loss in the area of Cob Island and along the High Street (East Iken Marsh) frontage.

Under realistic sea-level change scenarios, maintenance of all defences would become increasingly difficult and greater flow pressure would increase the loss of fringe habitat (i.e. saltmarsh). Furthermore, with potential short-medium term failure of defences to Lantern and Kings Marsh (the defences to these areas are the responsibility of the National Trust) and the consequential increase in intertidal area of some 350ha and increase in tidal volume of some 20%, there would be substantial increased pressure over the lower reaches of the estuary. Almost certainly, an increase in tidal volume of this nature would restrict the ability for realignment elsewhere within the estuary. This overall approach restricts balanced responsive management of the estuary, while resulting in a loss of internationally designated intertidal habitats. This approach would require habitat mitigation and is considered to be unsustainable in the longer term.

The defences to Hazelwood Marshes are in generally poor condition and will require upgrading. Even so, there is little stress in relation to estuary behaviour and there is no technical reason for not maintaining these defences, thereby maintaining the SPA/Ramsar designated grazing marsh to landward.

Along the open coast frontage of Orfordness there is a reducing supply of sediment from the north, resulting in an increasing loss of material along the face of the Spit (south of the Ness). In effect this is leading to a gradual straightening of the shoreline between Aldeburgh and Shingle Street. Such change would be over a very long time scale (500 to 2000 years) but provides the context over which the change should be viewed. The present day impact of this process is the vulnerability of the neck of land between the river and the sea at Slaughden.

The potential for a breach at Slaughden and the impact that this could have on the rest of the system represents one of the key topics for the management of the estuary. The neck of land between the river and the sea at Slaughden has been variously protected by hard defences and more recently by beach management, bringing material from the beach seaward of Lantern Marshes. In the absence of some form of management it is likely that the neck of land would breach and probably in the longer term remain as a new opening to the Alde Estuary.

Based on a best estimate of likely evolution of the estuary, it is considered that as a breach or entrance developed at Slaughden the complex interaction of tide through both entrances would be likely to result in increased water levels in the vicinity of Kings Marsh, although flows would be reduced. This increase in water level would make the Kings and Lanterns Marshes more vulnerable to flooding and, due to the lack of defence maintenance, it is likely that failure of the defences would result. It remains uncertain how flows would distribute between the two entrances but there is a distinct possibility that the northern entrance may dominate. Certainly there would be a reduction in flow within the Ore entrance and, as a consequence, there is likely to be an increased rollover of Orford Spit towards the marshes of Boyton and Orford Haven. Whether the reduced flow within the river Ore would be sufficient to maintain its entrance is again uncertain. There is a possibility that Orford Spit may, in time, attach itself to the shoreline. Although there is the potential that a breach at Slaughden would lead to the development of a more sustainable estuary form, the implications for the designated habitats and species (as well as socio-economic interests) are extremely significant. The potential changes have not been investigated in detail in

this CHaMP. Examination of this issue within the Estuary Strategy recommended holding the current form of the Estuary.

From Orford Spit, sediment moves down the coast and is transferred onto the Shingle Street frontage. This transfer can occur as a gradual feed through the series of banks at Orford Haven or as a process by which the banks detach from the northern side of the estuary mouth and attach themselves to the Shingle Street frontage. The shoreline to the south of Shingle Street is maintained at its southern end by the promontory of East Lane. The bay between Shingle Street and East Lane is relatively stable in alignment, although material feeding from the north tends to make its way along the frontage and is lost to the coast further south.

Developing from the SMP policy of **Hold the Line**, the strategy for the frontage is to maintain the existing line by actions to defend East Lane. This would again allow the existing processes at Shingle Street to continue, bringing an intermittent supply of shingle to the frontage which would help to sustain the ecological interest of the area. This approach maintains the coastal process allowing saline lagoons to form and to be lost periodically and the existing policy for the frontage is therefore considered sustainable.

The overall prediction for the Alde-Ore system is that the designated internationally important features cannot be retained in their existing extent and distribution either by intervention or by allowing the natural systems of the coast and estuary to continue. Allowing ‘natural’ change to occur could have significant consequences with respect to the entire morphology of the estuary and its associated habitats and socio-economic interests. While significant gains in coastal intertidal habitats could be realised, the overall change is of such a scale that it would be difficult to justify.

In order to address potential habitat change within the system, a number of alternative defence scenarios and overall approaches to the management of the estuary have been considered. The main objective behind the alternatives is to allow a more controlled and adaptive approach to be taken.

The main scenario considered is one whereby all defences within the estuary are maintained apart from those to Kings and Lantern Marshes on Orfordness. This is because it is considered that it is almost inevitable that there will be change to Orfordness and in order to prevent significant disruption to the rest of the estuary system and allow a more natural transition to a new ecological state/equilibrium this change should be managed. It is proposed that the line and integrity of the estuary defences to Kings and Lantern Marshes should be maintained but no attempt made to raise their level, in effect **lowering the defence level** as sea level rise occurs. This would allow, gradually, more frequent tidal inundation from extreme events over the next 50 years. A similar attitude would be taken to the seaward defence in not attempting to maintain the current defence standards in the face of sea-level change. The management of this in relation to the use of the marshes to act as control to mitigate extreme increases in tidal volume would need to be examined in more detail. The longer-term intent of this approach would be to allow movement to a saline dominated environment, over the next 50 to 100 years, which would minimise the need for future intervention.

The ecological interest of the Ness would therefore largely be left to evolve, albeit through a more controlled and gradual process. The main impact would be a change from existing terrestrial grassland habitats at Kings and Lantern Marshes into saline features, probably intertidal mudflat and saltmarsh. This would provide benefits, most notably with respect to SPA estuarine bird populations. It is likely that there would be a loss of saline lagoon interest due to the overall development of intertidal habitat. The approach is sustainable but would require a long-term

programme of mitigation for the loss of terrestrial SPA/Ramsar designated features and the cSAC saline lagoons.

A summary of predicted habitat changes within the designated areas (i.e. within the defined boundaries of the cSAC/SPA/Ramsar) is given in Table 6. This Table relates change to the baseline area of habitat within the site boundaries and provides an indication of the likely habitat creation requirements under the scenarios that have been investigated. The loss of the existing SPA/Ramsar brackish grassland, grazing marsh and reedbed at King's and Lantern Marshes (approximately 280ha) could be offset by the management of land around the estuary in order to re-create these habitat types. Suitable areas include the main block of Sudbourne and Orford Marshes (approximately 500ha) and Gedgrave Marshes (approximately 200ha) where wet grasslands and potential reedbed development could be undertaken at the heads of freshwater flows into the area. Similarly, areas adjacent to the Butley would provide appropriate mitigation for these wetland habitats (e.g. Stone Marshes, 150ha).

Offsetting the long-term loss of shingle habitat from Orfordness and the loss of saline lagoons from Kings and Lantern Marshes is more problematic. It is considered impractical and unsustainable to replace the shingle habitat, as this would require the import and retention of sediment in place. Potentially, saline lagoon habitat could be engineered and incorporated into wetland habitat creation schemes to replace the brackish grassland lost from the estuary (see above).

Two other areas for potential habitat creation exist at Boyton Marsh and Aldeburgh Town Marsh. Both areas offer the potential for the creation of either wet grassland or intertidal habitat. Re-alignment of Aldeburgh Town Marsh may be advanced as a solution to dealing with the stress on the defences in this area rather than solely as a habitat creation measure. There is, therefore, quite extensive scope for a balance of habitat extent and distribution to be achieved, while still maintaining control of the estuary.

Table 6 – Predicted habitat changes to designated areas (cSAC/SPA/Ramsar) for the Alde-Ore Estuary and Orfordness.

ALDE-ORE	**Mudflats**	**Saltmarsh**	**Saline lagoons**	**Reedbed**	**Wet grassland**	**Drift line vegetation**	**Shingle**
Baseline	*600ha*	*310ha*	*Approx65*	*50ha*	*430ha*	*17km*	*500ha*
Non-intervention	980ha	280ha	10No.	15ha	5ha	15km	375ha
Current practice	850ha	345ha	10No	15ha	75ha	17km	450ha
Reduce defence to Kings and Lantern	750ha	445ha	10No.	15ha	75ha	17km	480ha

2.6 HBU E. Deben Bawdsey to the Dip including Estuary

Elements:		
1. Deben Estuary	*Designation*	The Deben Estuary SPA/Ramsar
	Key Features	Saltmarsh, Intertidal mudflats (important wet grassland features outside the SPA).

Management

Trends	*Constraints:*	On the open coast material generally moves down from the north along the shore, being held up at the mouth of the estuary within the Knolls system of banks. There is a continuing feed across the estuary with a more intermittent break up of the Knolls, with banks attaching themselves to the opposite shore. The entrance channel to the estuary is relatively constrained. The upper estuary is principally constrained in its overall movement by high ground but opens out in the lower reach with the wide meanders being held by the flood defence works. Change in tidal volume of the estuary would influence the entrance and the coastal processes.
	Evolution:	There is a growing pressure within the estuary, particularly at the lower end. Sea-level rise is likely to result in increasing loss of saltmarsh. Some lateral movement of the meanders within the lower estuary would be expected due to tidal volume increases.
Current Practice	*Description*	In general, defences within the estuary are maintained although there has been some minor realignment at the head of the estuary. The mouth of the estuary is being defended, with the line of defence still allowing some change within the hydraulic performance of the estuary.
	Implications	The decision to maintain the general configuration of the estuary mouth limits the degree of tidal volume increase within the estuary.
Policy	*Description*	The general policy for the coast is to maintain the coastal processes, allowing a continuation of sediment feed to the south. Within the estuary, the general policy is to maintain the major defended areas. Consideration has been given to realignment over small areas of grassland adjacent to the estuary and outside of the designated boundary of the SPA/Ramsar.
	Intent	To allow some natural change to occur while maintaining control of the development of the estuary as a whole.

HBU issues: There has been extensive loss of saltmarsh over the last 30 years (71ha). The small wet grassland areas adjacent to the estuary are an important supporting habitat to the SPA, although not designated. Similarly, the extensive areas of agricultural land to the lower estuary are important feeding and roosting areas for some waterfowl species.

Over the last several centuries, reclamation within the Deben Estuary, principally within the lower estuary, up to the main low water channel has occurred. Reclamation has not been as extensive in the upper part of the estuary and has largely been confined to offshoot valleys. There has been considerable development of saltmarsh within the natural width of the upper estuary. This is now suffering from erosion.

Current management practice is to **maintain the existing defences** throughout the estuary. This would require significant investment but is sustainable. The approach would, however, lead to a continuing loss of SPA designated saltmarsh habitat which would require mitigation in order to offset loss. This policy would also maintain the potential for freshwater grassland habitat creation within areas of low-lying land on either side of the estuary.

Selective realignment from critical defences would provide the opportunity for the creation of intertidal habitat and offset the loss of saltmarsh vegetation through sea-level rise while

maintaining control of the development of the estuary. This provides a more sustainable approach without extensive disruption to the rest of the estuary system or open coast processes. Particular areas identified for realignment within the estuary strategy are at Melton, Martlesham Creek, White Hall, Waldringfield, Ramsholt Lodge and Ramsholt, and at Nursery Wood.

A summary of predicted habitat changes within the designated areas (i.e. within the defined boundaries of the SPA/Ramsar) is given in Table 7. This Table relates change to the baseline area of habitat within the site boundaries and provides an indication of the likely habitat creation requirements under the scenarios that have been investigated. The loss of saltmarsh habitat from within the estuary could not be offset from within the confines of the existing SPA/Ramsar designated area. Re-alignment of areas adjacent to the estuary (as listed above) could provide for the predicted loss of saltmarsh habitat.

Table 7 – Predicted habitat changes to designated areas (cSAC/SPA/Ramsar) for the Deben Estuary.

DEBEN	**Mudflats**	**Saltmarsh**	**Saline lagoons**	**Reedbed**	**Wet grassland**	**Drift line vegetation**	**Shingle**
Baseline	*360ha*	*250ha*					
Non-intervention	580ha	100ha					
Current practice	430ha	150ha					

2.7 HBU F. Stour and Orwell Estuaries Stour and Orwell

Elements:		
1. Orwell Estuary	*Designation*	Part of Stour and Orwell SPA/Ramsar
	Key Features	Mudflats, Saltmarsh and Wet grassland.
2. Stour Estuary	*Designation:*	Part of Stour and Orwell SPA/Ramsar
	Key Features:	Mudflats and Saltmarsh

Management

Trends	*Constraints:*	The development of both estuaries is strongly influenced by the higher ground abutting the estuaries. In the case of the Orwell, the upper reaches lie predominantly within a narrow steep-sided valley. Only at the southern, lower reach is the potential flood plain wider. Even here the estuary channel is quite strongly controlled by the high ground of Collimer Point, Shotley Point, Sleighton Hill and Fagbury, although at this latter point the development of Felixstowe Port has superseded the natural control. The Stour is a more open estuary within a wider valley, allowing the development of the channel and flats in a more uncontrolled manner between high ground.
	Evolution:	On balance the Orwell is seen as an accreting estuary, although there has been erosion of intertidal area at its southern end. The estuary is not, however, under man-made constraint. The Stour, with the exception of its most upper reaches, tends to be an erosive estuary. However, there is evidence that the erosion within the estuary may be slowing. The dredged entrance to both estuaries acts as a sediment sink tending to reduce the availability of fine material to upper sections of the estuaries. The development of Felixstowe Port and associated dredging works have and will continue to have an impact on the evolution of the estuaries.
Current Practice	*Description*	The main areas of defence on the Orwell are at Shotley and at Trimley. Defences to both areas are at present maintained although there is no strategy developed for their management. In the Stour, defence management has had little impact on the development of the estuary. There is continuing maintenance dredging of the Harbour area.
	Implications	Continued dredging may influence the ability of the estuaries to accrete in line with sea-level rise.
Policy	*Description*	There is no formal defence policy for either estuary.
	Intent	To allow natural change to occur.

HBU issues: There is continuing loss of saltmarsh and intertidal area within both estuaries. Based on extrapolation of recorded rates it is estimated that all of the existing saltmarsh habitat would be lost from the estuaries during the period covered by the CHaMP. Trimley Marshes provides an important function within the system although this is not recognised within the SPA designation.

There is currently no strategy plan for flood defences within the Orwell and the general policy for the southern side of the Stour Estuary is to Hold the Line. Within the Orwell, private effort has been put in to **maintaining the existing defences** at Trimley. Such an approach is seen as being sustainable but would require considerably greater investment than at present. While this policy does act to defend an important supporting habitat this is outwith the designation of the SPA. Continued maintenance of the flood defences to grazing marsh habitat at Shotley could reduce the brackish water influence on this site. Additionally, the maintenance of both the Trimley and Shotley frontages would significantly limit opportunities within the estuaries to offset the loss of saltmarsh habitat from within the estuary.

In the Stour Estuary, **maintaining the existing defences** would have no significant impact on the estuary. Under this approach there would continue to be general squeeze on the saltmarsh habitats within the estuary and no opportunity to re establish saltmarsh. A Hold the Line policy would maintain the existing small tributary valleys along the northern side of the estuary. These valleys have some existing ecological interest (e.g. Holbrook) although none of them are included within the SSSI or SPA/Ramsar site. As such, they do offer the potential for some small-scale freshwater grassland or intertidal habitat creation.

There is little scope for the creation of intertidal habitat within the designated area. Within the Orwell the most suitable areas are located towards the mouth of the estuary (Shotley and Trimley) and, as such, are in morphologically suitable locations. However, from an ecological perspective the loss of either area would have consequences for the maintenance of terrestrial ecological interests. Shotley Marshes are designated SPA/Ramsar and their loss to intertidal habitat would therefore require mitigation. Trimley lies outside of the designated SPA and re-alignment over this area would indirectly impact upon the SPA/Ramsar site. However, Trimley Marshes have been developed as a wetland habitat by the Suffolk Wildlife Trust and now supports a significant assemblage of wintering and breeding birds which form part of the designated SPA populations. As such, its loss could impact upon the ecological integrity of the SPA. A brief examination of the Trimley site indicates that there is potential scope for the landward translation of wetland habitats. If this were undertaken then there could be an overall gain of habitat within the estuary with an increase in intertidal area resulting from managed realignment. Replacement of the grazing marsh habitat from Shotley could potentially be undertaken in and around the Deben Estuary or possibly the Alde-Ore Estuary.

On the Stour, some of the tributary valleys on the northern side of the estuary offer some potential for managed realignment. Although these areas are small they could offset some of the predicted loss of saltmarsh habitat from the estuary. Alternatively, the predicted loss of 180ha of saltmarsh (under existing flood defence practice) could be offset by habitat creation in adjacent areas, notably Hamford Water and/or one or other of the Essex Estuaries. These areas lie within the same overall estuarine complex and would support SPA population assemblages similar to those that use the Stour and Orwell Estuaries.

A summary of predicted habitat changes within the designated areas (i.e. within the defined boundaries of the SPA/Ramsar) is given in Table 8. This Table relates change to the baseline area of habitat within the site boundaries and provides an indication of the likely habitat creation requirements under the scenarios that have been investigated.

Table 8 – Predicted habitat changes to designated areas (cSAC/SPA/Ramsar) for the Stour and Orwell Estuaries.

STOUR AND ORWELL	**Mudflats**	**Saltmarsh**	**Saline lagoons**	**Reedbed**	**Wet grassland**	**Drift line vegetation**	**Shingle**
Baseline	*2000ha*	*190ha*			*75ha*		
Non intervention	1860ha	25ha			0ha		
Current practice	1800ha	10ha			75ha		
Re-alignment – Shotley	1845ha	40ha			0ha		

3 MONITORING

An essential component of the development of a CHaMP is to monitor the state of the physical and biological systems with which the CHaMP is dealing with. Specifically the CHaMP sets out a number of predictions for change and potential management measures that may be required in order to maintain ecological interest in light of change.

The ultimate aim of monitoring must be to demonstrate the effects on habitats of geomorphological change. In order to achieve this, monitoring must cover those physical aspects most likely to change and of greatest influence on ecological interests. Also, the monitoring must be targeted towards those habitats, which would demonstrate changes related to geomorphology as clearly as possible. For example, an area of diverse habitats may require monitoring at frequent intervals (spatially and/or temporally) in order to determine the impact on each habitat. A more uniform habitat may be better monitored by more intensive sampling at a lesser frequency. The data and the range of information must be comprehensive and coherent.

Some monitoring work is already undertaken, (e.g. Environment Agency beach profiles), but to ensure adequate data is obtained it is recommended that a five yearly plan should cover:

- Open coast beach profiles;
- Rates of cliff recession (northern section of CHaMP area);
- Selected shore profiles within the estuaries; and
- Analysis of aerial photographs to record habitat extent and distribution.

The opportunity should be taken during monitoring and future reviews of the CHaMP to include a further forward look so that management measures can be refined and contingency made for the potential loss of areas of habitat at sites such as Minsmere, which although sustainable to maintain within the framework of the existing CHaMP period, is likely to come under increasing pressure and therefore may need to be replaced.

3.1 Physical monitoring

3.1.1 Saltmarsh and Mudflats

The monitoring of saltmarshes and mudflats can range from highly sophisticated electronic instrumentation attached to a frame which is deployed *in situ* on the sediment surface, to manual field measurements using simple pieces of equipment. For small areas, a topographic survey can be carried out to assess surface elevation changes using a total station with datalogger.

In view of the costs and practical difficulties of regular monitoring of large areas of mudflat or saltmarsh for elevation change by *in situ* methods, there is an increasing role for remote sensing techniques from aircraft or satellite. Remote sensing has the potential for large spatial coverage with high resolution, which would not be practicable with *in situ* methods. For example, experience is being gained with technologies for measuring elevation, such as airborne Laser Induced Direction and Range (LIDAR). Surveys repeated every year would provide digital data to indicate broad-scale changes in elevation through time.

The extent and morphology of intertidal areas can be derived from black and white, 1:5000 scale, stereoscopic aerial photography. It is recommended that, the monitoring be undertaken consistently at periods of low water. Provision of inter-tidal mudflat baselines is the first priority of such a survey, with five-yearly repeat surveys as a minimum ongoing requirement.

3.1.2 Beach systems

Beach morphology can be monitored using cross-shore beach profile data (as already undertaken by the Environment Agency) to assess changes in beach width, slope and volume, and to describe beach behaviour and its variability. These data can be used to identify trends and areas of high net change and high variability. The frequency of beach profiles depends on the specific aim of the monitoring, but for longer term trends bi-annual surveys are considered sufficient. A set of photographs at each of the beach profiling localities allows a comparison to be made between surveys, providing a rapid and cheap complimentary system of monitoring more severe events when time may limit the opportunity for more formal monitoring.

3.1.3 Shingle accumulations and large-scale coastal features

Satellite imagery can provide a comparison of large areas over decadal time scales. Yearly vertical aerial surveys of a stretch of coastline can provide quantitative data on large-scale changes, such as the retreat of cliffs, changes in channels and movement of the salt marsh edge. Oblique aerial photography at yearly intervals can both provide background data on coastal and geomorphological processes and be used to monitor features such as banks and channels, spits and the development of saltmarsh or features within estuaries. This type of monitoring also provides important qualitative data.

3.1.4 Grazing marsh/reedbed and habitat features to landward

The extent of grazing marsh/reedbed area can be derived from aerial photography as for intertidal mudflat and saltmarsh (i.e. use of 1:5000 black and white or colour photos, with repeat surveys at a minimum of 5 yearly intervals). The same photos could also be used to measure the extent of the internal dyke system within selected areas of grazing marsh, or possibly the entire network depending on the overall requirement.

Measurements of salinity within reedbeds and grazing marshes can be taken using a conductivity meter from selected sites where it is known that important brackish water communities are present. It is suggested that measurements should be undertaken on a minimum basis of once every five years and preferably be combined with monitoring of the biological communities at the same time in order to elucidate any potential linked fluctuations/changes.

3.2 Biological monitoring

As previously stated, predicted changes in morphology are effectively the driving force behind any potential ecological change and, therefore, the CHaMP should focus on the monitoring of physical components. However, in isolation, the monitoring of physical attributes would not provide an indication of any changes in habitat quality or species populations. It is suggested that these components should be monitored through separate programmes developed to inform and ascertain favourable condition for the designated features rather than as a specific element of the CHaMP. Information from the biological monitoring programme would, however, be important in providing an integrated picture of system change and confirming, or not, the predictions outlined in the CHaMP.

4 OVERVIEW AND CONCLUSIONS

The Suffolk Coast and its estuaries represent one of the most undeveloped and dynamic sections of coastline within eastern and southern England. This is reflected, in part, by the significant extent of habitats present within the area. However, despite the presence of these habitats their future existence in their present form cannot be assured.

Rather than taking a position of continued *in situ* maintenance, it is considered appropriate that a more flexible and ultimately sustainable philosophy towards the management of the coastal area and its constituent habitats should be taken. This could be achieved through a combination of allowing 'natural' processes to continue, limited change to existing flood and coastal defence policies and habitat creation. This combination of actions would result in the development of a more sustainable and ultimately ecologically functional coastal area.

Table 9 provides a summary of the overall predicted changes for areas of designated habitat within the Suffolk CHaMP area under a scenario of continuation with current flood and coastal defence policy. As can be seen, it is clear that, apart from intertidal mudflat, there are likely to be losses in extent of all other coastal habitats. This loss is built up from a number of factors including:

- Natural erosion of the open coast as a result of sea-level rise and loss of shingle and sand dune habitat;
- Roll back of shingle barriers at Benacre, Easton and Walberswick and loss of reedbed and grazing marsh habitat to landward;
- Failure of defences and tidal inundation of grassland and saline lagoon habitats on Orfordness (Lantern and Kings Marshes);
- Loss of saline lagoons at Benacre, Covehithe and Easton due to 'natural' coastal erosion;
- Increase in area of intertidal mudflat as a result of failure of shingle barrier and tidal inundation at Walberswick and failure of defences at Kings and Lantern Marshes, Orfordness;
- Loss of saltmarsh due to continued coastal squeeze in the Blyth, Alde-Ore, Deben, Stour and Orwell Estuaries. It is predicted that additional growth of saltmarsh in areas such as Walberswick and Orfordness would not compensate for predicted losses due to coastal squeeze.

Potentially, some of these predicted losses could be offset through a change in the current policy (e.g. re-alignment of the defence line in some areas) or through further intervention and management. However, it is suggested that the most sustainable approach is to work with coastal processes and to offset predicted loss through additional habitat creation. The main requirement would be for freshwater and brackish habitats (e.g. reedbed and grazing marsh) and saltmarsh. It is considered that all of the habitat requirement could be met from within the CHaMP area but, if appropriate, that some of the intertidal habitat creation requirement (saltmarsh) could be undertaken in the Essex CHaMP area.

Table 9 – Overall predicted habitat change to designated habitats within the CHaMP area under continued flood and coastal defence policy.

	Mudflats	**Saltmarsh**	**Saline lagoons**	**Reedbed**	**Wet grassland**	**Drift line vegetation**	**Shingle**	**Sand dune**	**Heathland**
Baseline	*3115ha*	*810ha*	*38ha*	*615ha*	*970ha*	*22km*	*500ha*	*40ha*	*290ha*
Current policy	3415ha	655ha	8ha	170ha	308ha	21.5km	450ha	20ha	270ha
Change	+300ha	-155ha	-30ha	-445ha	-662ha	-0.5km	-50ha	-20ha	-20ha

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