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Management R&D Programme

Annex B.2:

Case study no.2:

Assessment of the Pagham to East Head coastal
defence strategy

R&D Project Record FD2013/PR2

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1. Introduction

1.1 Overview

This report presents the MCA-based project appraisal process for part of the Pagham to East Head Coastal Defence Strategy. This strategy assessment was based on the original appraisal process - The Pagham to East Head Coastal Defence Strategy - carried out by the Environment Agency (EA), Chichester District Council and Arun District Council in 2001. The Pagham to East Head Coastal Defence Strategy has been revised since then.

The information reported here is based on the following documents:

- Pagham to East Head Coastal Defence Strategy - main document; and
- Pagham to East Head Coastal Defence Strategy - annexes

A significant amount of information was provided for this case study, including the several amended versions of the strategy appraisal.

The coastal defence strategy area extends from Pagham Beach in the east to East Head in the west, covering a distance of approximately 21km of open coastline. It also includes Pagham Harbour, which contains approximately 7.5km of enclosed shoreline.

The study frontage can be broadly described, from east to west, by the following coastal features:

- extensive shingle beaches, banks and spits at the mouth of Pagham Harbour;
- extensive areas of mudflats and saltmarsh surrounded by brackish marsh and pasture in Pagham Harbour;
- shingle beaches with coastal defences fronting extensive residential development at Selsey;
- shingle beaches and banks fronting an extensive area of low lying land used for agricultural and recreational purposes at Medmerry;
- extensive shingle beaches fronting East Wittering;
- extensive shingle beach with high quality and high value residential development along the Cakeham Frontage; and
- dynamic dune/shingle system with coastal flora and fauna at East Head.

For the original appraisal process, the coastal strip was divided into seven management units (MU - discrete lengths of coastline that possess similar characteristics in terms of natural coastal processes and land use) that in turn were subdivided into operational units (OU). A summary of the management units and operational units is given in Table 1.1.

For practical reasons it was decided to only apply the MCA-based appraisal methodology to two of the management units of the Pagham to East Head Strategy, namely:

- West Beach Selsey to Bracklesham (MU3 – OU 5A and 5B - Medmerry frontage); and
- Bracklesham to East Wittering (MU4 – OU 6A- East Wittering frontage).

There were several reasons why these two MUs were chosen:

- the MUs chosen are adjacent to each other and cover a large portion of the whole of the strategy coastal frontage;
- they are contrasting in nature, with MU 3 being mainly rural whilst MU 4 is more residential in nature; and
- the two frontages being assessed are among the areas of the strategy in most need of flooding and coastal protection attention given the residual lives of the defences and the standard of defence being provided to the adjacent land.

Table 1.1: Summary of Pagham to East Head strategy management units and operational units

Management Units		Operational Units	
No	Name	No	Name
-	Pagham Harbour	2A	Pagham Harbour (Exposed Shoreline)
		2B	Pagham Harbour (Sheltered Shoreline)
1	Pagham Beach to East Beach Selsey	1B	Pagham Harbour Shingle Spits
		1A	Pagham Beach
		1C	Church Norton
2	East Beach Selsey to West Beach Selsey	3A	Selsey East Beach
		4A	Selsey Bill
		4B	Selsey West Beach
3	West Beach Selsey to Bracklesham	5A	Medmerry Cliffs
		5B	Medmerry Shingle Bank
4	Bracklesham to East Wittering	6A	East Wittering
5	Cakeham Estate to East Head	7A	Cakeham
		7B	West Wittering Estates
		8A	East Head
-	-	8B	West Wittering Town

1.2 Summary of the project area

From East Head to Selsey Bill Peninsula the coastline is dominated by the broad sweep of Bracklesham Bay. The predominantly flint gravel beach that runs along the entire frontage is punctuated by the built up frontage of East Wittering, where the extensive sea walls and defences protect the town from erosion. The shingle ridge running from East Wittering to West Selsey provides expansive views across low-lying grade 3 agricultural land (Medmerry frontage), in its majority arable or improved grassland, although an area of semi-improved grassland lies adjacent to the coastline. Former marsh and intertidal land, this largely treeless area is now crossed by a network of drainage ditches feeding into Broad Rife, the main dyke that eventually flows into Pagham Harbour. Based on the Environment Agency classification systems, the stretch of the Broad Rife between the Selsey Sewage Treatment Works and Northcommon Farm has a “poor” chemical quality and a biological class of B (good).

At both its eastern and western edges this agricultural landscape is interrupted by tourism development. Holiday sites and caravans lie behind the sea defences along the western extent of the Medmerry frontage, and at the eastern end of East Wittering (at the eastern end of Medmerry frontage).

It is in this setting that the two management units being appraised in this case study are situated, Medmerry and East Wittering Frontage.

1.2.1 Medmerry Frontage

Operational Units 5A and 5B (MU 3) cover the stretch of coastline between Selsey and East Wittering, known as Medmerry. This frontage is part of Bracklesham Bay and is an area of natural cliffs and shingle banks.

The land use around the frontage is predominantly agricultural (arable and pasture) with one of the main commercial features of the study area being a specialist lettuce growing farm and salad-packing plant, which occupies land across the Selsey Peninsula to Medmerry.

There are residential properties along the east of the frontage. Also, there are also small industrial and retail units located in this frontage, as well as a sewage treatment work plant. The only road link to Selsey also crosses the floodplain in the Medmerry frontage.

A number of caravan sites, with fixed and touring pitches, and other holiday accommodation are located in the area. The two larger resorts are the West Sands/White Horse/Greenlawns complex that accommodates more than 2000 caravans and the Selsey Country Club, which has around 300 chalets. Both resorts provide amenities such as swimming pools, clubhouses, sports facilities and a golf club.

Tourism and recreation play a significant role in the local economy of the area, as indicated by the large caravan parks and holiday villages. The beach itself is a popular tourist attraction and site for recreation activities.

Land based recreational activities along the coast are generally informal but considered important within the region. Cycling constitutes a method of local transportation as well as recreational activity undertaken by local residents and holiday makers alike, with a route along the coast from Selsey to Bracklesham. A cycle hire shop is located at East Wittering.

Shoreline angling takes place along the coast at Bracklesham, both at club and individual level. Also, there is one access point for beach launched sailing boats at Bracklesham.

The environmental importance of the study frontage is reflected in the wide range and number of designated sites of nature conservation interest.

The inter-tidal area from West Wittering to West Street, Selsey, and an area of low-lying pasture at Broad Rife is designated as the Bracklesham Bay Site of Special Scientific Interest (SSSI). This SSSI consists of unimproved grazing pasture, which is important for the bird populations they support (including breeding redshank, ringed plover, snipe, lapwing, wintering ruff, golden plover and Brent geese amongst others), saltmarsh, shingle bank, rifes and associated reed beds, and geological exposures. The loop in Broad Rife, at Medmerry, is probably the most important site in West Sussex for over-wintering short-eared owls.

The backshore is designated for its wet grassland habitat and includes a backshore Site of Nature Conservation Importance (SNCI) - Crablands Farm Meadow. Also, located just offshore, there is a marine SNCI - Bracklesham Balls.

Much of the coastline is also of importance for its geological and geomorphological interests. Both Medmerry and East Wittering frontages are classified as Geological Conservation Review Sites (GCRs). The foreshore along the wide sweep of Bracklesham Bay provides exposures through marine clays and sands of Tertiary age that yield a diverse fossil flora and fauna, including many species of fossil fish. Quaternary deposits yielding information on past environmental conditions and flora and fauna occur in this area. Due to the frequency of geological exposures of Tertiary and Quaternary age, the use of this resource both recreationally and educationally is considered of regional and national importance. Students from primary school age up to graduates use the area for fossil collecting and scientific research.

In addition, there have been a large number of occasional archaeological findings that provide evidence of early human activity along Selsey and Bracklesham coastline. These include Palaeolithic flint tools, Bronze Age and Iron Age artefacts and a Saxon settlement.

1.2.2 East Wittering Frontage

Operational Unit 6A (East Wittering frontage) makes up the fourth management unit and extends from the edge of Medmerry, to the east end of the Strand in Cakeham. The coastline is dominated by cliff and beach features, and the existing defences include timber groynes and a reinforced concrete seawall and apron.

The East Wittering frontage includes the urban areas of Bracklesham and East Wittering. Situated at the eastern end of the frontage are the Bracklesham Caravan and Boat Club with fixed caravans and chalets. The remainder of the frontage comprises a residential housing area. There is also arable and pasture farmland located inland.

The frontage provides a popular beach for informal recreational use, including traditional beach activities, dog walking and windsurfing. Also, sub-aqua activity is undertaken from East Wittering both at club and individual levels. Under water visibility is often excellent and the rich wildlife and cultural heritage (wricks and geological features) form a significant component of the diving experience. In addition, shoreline angling also takes place along the coast East Wittering, both at club and individual level.

Like the Medmerry frontage, this area of coastline is part of the Bracklesham Bay SSSI and GCRs and Bracklesham Ball mSNCI. In addition, there are several sites of historical interest along the shoreline and in the nearshore zone. The foreshore comprises fossiliferous marine clays and sands of Tertiary age that yield a significant flora and fish fauna.

As mentioned above, today land use along the study coastline is characterised by contrasts between the urban areas such as East Wittering and adjoining agricultural land, in Medmerry. The coastal strip being assessed has been naturally retreating. The proliferation of coastal defences along the frontage, has also resulted in a reduction of a natural supply of beach-building material. During the past 20 years, beach nourishment has become common practice in attempting to maintain a balanced sediment budget along much of the frontage, in particular Medmerry.

If the existing defences were to fail the majority of the frontage would be subject to flooding and erosion and subsequently to the loss of high value assets.

1.3 Existing defences

The whole area is managed in some way at present. Existing defences along the study coastline consist mainly of shingle beaches and groynes.

Historically, the low-lying land between Medmerry and Bracklesham has been protected by a shingle bank. This bank has retreated landward and become narrower due to progressive overtopping. Defence management has been

necessary to maintain the defences. In addition, the low-lying areas are drained by a number of rifes, with either pumped or gravity outfalls.

The existing defences for the Medmerry include timber groynes in fair to poor condition and in places a sheet piled sea wall also in fair to poor condition. The frontage is characterised by a cliffed backshore approximately 3m high (5m OD), a steep (approximately 1:8) flint shingle upper foreshore and a relatively gently sloping lower foreshore comprising medium to coarse sand.

Between May 1976 and February 1980, the Environment Agency implemented a major sea defence scheme along the Medmerry frontage, which included the placement of 230,000m³ of imported shingle recharge material and the construction of false heads to all 52 groynes (Environment Agency, 1998b). After completion, the shingle banks were reported to be 30m wide in most places. Beach recycling was carried out between February 1980 and December 1989, to maintain the desired beach profiles.

However, the shingle bank was breached in three places during the storms of December 1989, and approximately 70% of the original recharge material was lost to sea and never recovered. The recharge scheme had lasted effectively for only six years, and the shingle bank width had reduced to a maximum of 25m and a minimum of 10m. This reserve was depleted further during the storms of April 1994, when the shingle bank width was reduced from 20 to 3m over a 500m length at the Broad Rife outfall and from 7 to 1m adjacent to the windmill. However, most of the shingle was recovered.

Medmerry is among the areas of the whole strategy frontage most liable to flooding and overtopping.

Along the East Wittering frontage shingle beaches are backed by hard defences in the form of concrete sea walls and timber groynes.

In the south of the frontage a sea wall is fronted by a healthy beach. However, there is evidence of abrasion and undermining of parts of the sea wall. In this part of the shoreline there are also timber groynes with low residual life due to sever abrasion and/or lowering clay levels that have reduced the level of penetration of the piles.

The north part of the frontage is protected by timber groynes, with low residual life, and timber breastworks in parts. The latter are in manageable conditions but potentially threatened if beach levels fall significantly.

The residual life of defences in both MUs is very small, with the Medmerry frontage having less than 1-year residual life and East Wittering approximately 5 years. (Posford Duvivier, 2001). The degree of protection afforded by the defences, falls below that normally considered to be appropriate for the type of land use located behind the defended frontage. In consideration of the residual life of the defences and the standard of protection currently provided, the frontage most in need of attention is the Medmerry coastline, between Selsey and East Wittering.

1.4 Policy framework

The East Solent and South Downs Shoreline Management Plans (SMP) form the policy basis for the Pagham to East Head Coastal Strategy. The first Management Unit (MU) of the East Solent SMP overlaps with the last MU of the South Downs SMP. The preferred generic policy options identified in each SMP for this overlap are compatible.

The Pagham to East Head Coastal Defence Strategy is designed to provide a strategic framework of preferred policies for the coastal defence of the study area over the next 50 years, up to the year 2050. It will be reviewed and updated on a five-yearly basis.

The Environment Agency (EA) has permissive powers for the construction of sea defences along the coast for the 3.8km Medmerry stretch of coastline. Chichester District Council is the Coast Protection Authority for the majority of the remaining study coastline. The District Council's Executive Board administers the construction and maintenance of coastal defence work.

Each of the three Operating Authorities responsible for the frontage carries out running maintenance of their structures. The EA also undertakes regular beach recharge and recycling. From time to time, major construction works are undertaken to refurbish or upgrade the defences.

The EA has a Local Sussex Flood Defence Committee, which comprises representatives from local authorities and appointments made by MAFF. The principal role of the Committee is to review the work activities carried out by the Environment Agency and approve the allocation of flood defence funds.

1.5 List of stakeholders and interested parties

The Pagham to East Head Coastal Defence Strategy consultation was undertaken in two stages:

- initial consultation: general consultation including an explanation of the study and the consultation process and a specialist consultation during the Strategic Environmental Assessment (SEA) and the economic appraisal (finished in 1999);
- full consultation: the consultation draft report was made available for public inspection in local council offices, libraries, etc, as well as three questionnaire exhibitions were undertaken. In addition, local meetings were held with smaller, specific groups of interested parties and organisations.

General consultation has been undertaken with groups that have an interest in the long-term defence of the Selsey Peninsula. Groups contacted are listed in Table 1.2.

As part of the public consultation process the Environment Agency, Chichester District Council and Arun District Council sought the opinions of members of the public through the completion of questionnaires distributed at three public exhibitions. Its purpose was twofold:

- to learn more about those who have an active interest in the coastline; and
- to seek their views on the type of coastal defences they would like to see in place.

Continuing from the initial consultation stages by letter and public displays a series of meetings were arranged with local interest groups. The meetings were held by request, following completion of the general questionnaire proforma, to gain a more detailed understanding of the issues relating to the individual frontages. The bodies that requested meetings ranged from commercial organisations, residents associations and concerned individuals. The meetings were attended by Posford Duvivier with other representatives from the Client Group sometimes present. The Local Interest Groups involved with meetings are listed in Table 1.2.

Table 1.2: Groups and individuals consulted on the Pagham to East Head Coastal Defence Strategy

Consultation stage	Groups consulted	
General Consultation	Local Authorities; Environment Agency; County Councils; Navigational Interests; Statutory Consultees (e.g. Crown Estate, MAFF, DETR); Parish Councils	Residents Associations; Commercial Interests; Major Land Owners; Conservation Groups; Recreation Bodies; Local Residents
Local Consultation	National Farmers Union; Pagham Residents Association; Mr Hume Wallace; Environment Agency (Mr P Pett); West Wittering Residents Association; Medmerry Owners; National Trust/English Nature; West Selsey Caravan Association; Natures Way (David Landmead); Sussex Beach Holiday Village	Selsey Bill Residents Association; Mr A Shaw; Earnley Parish Council; Mr M Heaton & Mr J Heinjie; Mr D Bunn, Mr J Bunn & Mr O James; Friends of the Earth; Mr D Bone; Chichester District Council Planners; Havant Borough Council; West Sussex County Council

2. Definition of objectives and management options

Posfords Duvivier (2001a) defined three different groups/levels of objectives for the Pagham to East Head Strategy:

- strategic objectives which are common to all coastal defence strategies;
- study coastline objectives which are relevant only to the frontage being assessed; and
- operational unit (OU) objectives which reflect the key interests within each OU.

The Pagham to East Head Strategy defines sustainable development as its main strategic objective. A coastal defence generic strategy is sustainable if it is:

- compatible with processes at work;
- compatible with adjacent preferred options;
- environmentally acceptable;
- technically realistic; and
- economically viable.

Table 2.1 illustrates the study coastline objectives defined by the Environment Agency for the Pagham to East Head frontage.

The appraisal of strategic options has to take into account the policy options selected by the Shoreline Management Plans. In general terms, the SMPs recommended that the preferred generic option would be to hold the line in the short term and consider managed retreat between Pagham Harbour and East Beach, and to hold line between East Beach and East Head. Table 2.2 presents the recommended policy option for the two frontages being assessed in this report.

The Pagham to East Head Coastal Defence Strategy considered a long list of options for all management units and each option was assessed in terms of the strategic, study coastline and operational objectives listed above.

The 'do-nothing' option was also assessed against the different objectives set out earlier. The Pagham to East Head Strategy considered that the 'do-nothing' option did not satisfy the strategic objectives. According to the Strategy, a do-nothing policy would result in almost immediate widespread erosion, and flooding damages along the majority of the study frontage. For these reasons the 'do-nothing' option was not carried forward in the appraisal process.

It should be noted that the MCA-based appraisal methodology will use the 'do-nothing' option as a baseline for the appraisal.

Table 2.1: Description study coastline objectives defined for the Pagham to East Head Coastal Defence Strategy.

Objective Type	Description
Coastal defence	To reduce the risk associated with flooding and erosion, taking measures to control the flooding and/or erosion to an appropriate standard.
Land use and planning	To provide protection against flooding and erosion in a manner consistent with relevant policies and objectives established within the planning framework and in other relevant management planning initiatives.
Agriculture	To provide an appropriate level of protection from flooding and erosion to the best and most versatile agricultural land.
Fisheries	To ensure that implementation of the preferred options do not have any adverse effects on the fishing industry, or that these effects are mitigated through management.
Tourism and recreation	To provide appropriate protection to amenity facilities and access presently used for recreation, or provide equivalent facilities.
Archaeology	To identify and mitigate any adverse effects that implementation of the preferred option may have on archaeological resources.
Industry and Economic activity	To provide appropriate protection against flooding and erosion to centres of industrial and economic activity.
Navigation	To identify, consider and mitigate any adverse effects that implementation of the preferred option may have on nearshore navigation, harbour facilities and beach launching sites.
Nature conservation and natural processes	To ensure that coastal defences and activities comply with the UK Biodiversity Action Plan, the statutory obligations of SSSI, SPAs, SACs, Ramsar Sites and the Habitats Directive.
Landscape	To identify, consider and mitigate any adverse effects that implementation of the preferred option may have on the natural landscape character of the study frontage.
Water quality	To identify, consider and mitigate any adverse effects that implementation of the preferred option may have on land drainage facilities, pumping stations and sewage treatment works.

Table 2.2: East Solent SMP preferred policy options for Medmerry and East Wittering frontages

Frontage	Preferred policy option
Medmerry	Hold the line in the short term
East Wittering	Hold the line

Having consideration for the generic policy options given in the East Solent SMP and long list of options referred to above, a number of potential ‘do-something’ scheme options were evaluated for each Operational Unit. Table 2.3 illustrates the ‘do-something’ options considered for the Medmerry and East Wittering Frontages. All of these options could have provided a standard of defence of 1 in 50 years or 1 in 150 years return period.

Table 2.3: ‘do-something’ options assessed by the Pagham to East Head Coastal Defence Strategy

Frontage	‘do-something’ scheme options	
Medmerry	Opt.1 (H)	Continue with existing shingle bank and timber groynes, by maintenance, renewal and upgrading as necessary
	Opt.2 (H)	As option 1 but reduced degree of upgrading and instead improved flood warning systems
	Opt.3 (H)	Construct sea wall behind shingle bank, modify shingle bank and timber groynes to form beach and groyne field in front of sea wall.
	Opt.4 (H/o)	As option 3 but construct a road on top of the sea wall.
	Opt.5 (H)	Construct rock revetment against shingle bank and no longer maintain groynes.
	Opt.6 (H)	As option 1 but no longer maintain timber groynes and instead increased maintenance of shingle bank.
	Opt.7 (H)	As option 1 but reduce degree of upgrading and instead construct offshore rock breakwaters. No longer maintain the groynes.
	Opt.8 (H/R)	As option 1 in front of the holiday parks at the east and west ends of the frontage and as option 12 over the central length.
	Opt.9 (H/R)	As option 5 in front of the holiday parks at the east and west ends of the frontage and as option 12 over the central length.
	Opt.10 (R)	As option 1 but retreat line of defences to form a shallow embayment.
	Opt.11 (R/H)	Maintain existing shingle bank and construct bastion rock groynes at wide centres, no longer maintain timber groynes and allow shingle bank to form an embayment between rock groynes.
	Opt.12 (R)	No maintenance of shingle bank and groynes and construct clay flood bank possibly up to 1000 m landward.
East Wittering	Opt.1 (H)	Continue with existing concrete or timber sea wall, timber groynes and beach by maintenance, renewal and upgrading as necessary.
	Opt.2 (H)	Maintain existing sea wall and construct substantial rock revetment in front, no longer maintain groynes and beach.
	Opt.3 (H)	As option 1 but replace spaced timber groynes with widely spaced more substantial rock groynes.
	Opt.4 (H)	Maintain existing seawall and manage beach by regular regrading, recycling and recharge and no longer maintain groyne field.
	Opt.5 (H)	Develop timber groynes and beach into shingle bank defence and no longer maintain existing sea wall.
	Opt.6 (H)	Option 1 but reduce degree of upgrading and instead construct offshore rock breakwaters. No longer maintain groynes.

During the development of the strategy, each of the above options was appraised in terms of whether it complies with the Strategic Objective, i.e. its compatibility with processes at work, its environmental acceptability, and its technical and economical viability. In addition, two other criteria were added, namely its compatibility with higher level plans and opportunities and agreement or disagreement from consultees.

Table 2.4 presents the results of the screening of options for Medmerry frontage (OUs 5A and 5B) and Table 2.5 for the East Wittering frontage (OU 6A). A tick was used to represent compliance and a cross to represent non compliance. When a tick and a cross appear together, it means that the option complies with at least half of the criteria.

Table 2.4: Screening of options for Medmerry Frontage

Criteria /Options	1-H	2-H	3-H	4-H	5-H	6-H	7-H	8-HR	9-HR	10-R	11-RH	12-R
Engineering/ Coastal proc.	✓	✓	x	✓	x	✓	x	✓/x	✓	✓	✓	✓x
Environment	✓	x	x	x	x	✓/x	x	✓/x	✓/x	✓	✓/x	✓/x
Economics	✓	✓	x	x	x	✓	x	✓	✓/x	✓	✓	✓
Higher Level Plans	✓	x	✓	✓	✓	✓	✓	✓/x	✓/x	✓	✓	X
Consultation	✓/x	✓/x	x	✓/x	✓/x	✓/x	✓/x	✓/x	✓/x	✓/x	✓/x	✓/x

Key: ✓ - compliance; X – non compliance; ✓/X – half compliance.

From Table 2.4, 2 options stand out as being preferable to the others for the Medmerry frontage, these are:

- Option 1(H) which entails continuing with existing shingle bank and timber groynes by maintenance, renewal and upgrading as necessary (beach regrading, recycling and recharge and possibly improved alignments);
- Option 10(R) which entails the same as option 1(H) but retreat the line of defences to form a shallow embayment.

Table 2.5: Screening of options for East Wittering Frontage

Criteria /Options	1-H	2-H	3-H	4-H	5-H	6-H
Engineering/ Coastal proc.	✓	x	✓	✓	✓	✓
Environment	✓	x	✓/x	✓	✓	✓
Economics	✓	x	✓	✓	✓	✓
Higher Level Plans	✓	✓	✓	✓	✓	✓
Consultation	✓	✓/x	✓/x	✓/x	✓/x	✓/x

Key: ✓ - compliance; X – non compliance; ✓/X – half compliance.

From Table 2.5, 1 option stands out as being preferable to the others for the East Wittering frontage, this is:

- Option 1(H) which entails continuing with existing concrete and timber sea wall, timber groynes and beach by maintenance, renewal and upgrading as necessary.

Although the original appraisal seemed to review all of the above options, it would not be practicable in this case study report to assess all of these options for each frontage. In addition, they do not necessarily constitute incremental options; they represent different ways of providing a standard of defence of 1 in 50 or 1 in 150 years return period.

In this context, it was decided to consider the options described in Table 2.6 for each of the management units. It was decided to take forward the preferred

option and assume that it can provide different/incremental standards of defence (1:20, 1:50 and 1:150) and assess it against the 'do-nothing' option. For the Medmerry frontage, Option 10 (R) was selected in order to consider management realignment issues.

Table 2.6 Description of options being considered for each management unit

Options	Description
Medmerry Frontage	
'do-nothing'	Walk away and abandon all maintenance and repair to existing structures, allowing nature to take its course.
Sustain 1:20	Continuing with existing shingle bank and timber groynes by maintenance, renewal and upgrading as necessary to achieve a 1 in 20 standard of defence, but retreat the line of defences up to 50m to form a shallow embayment.
Improve 1:50	Continuing with existing shingle bank and timber groynes by maintenance, renewal and upgrading as necessary to achieve a 1 in 50 standard of defence, but retreat the line of defences up to 50m to form a shallow embayment.
Improve + 1:150	Continuing with existing shingle bank and timber groynes by maintenance, renewal and upgrading as necessary to achieve a 1 in 150 standard of defence, but retreat the line of defences up to 50m to form a shallow embayment.
East Wittering Frontage	
'do-nothing'	Walk away and abandon all maintenance and repair to existing structures, allowing nature to take its course.
Sustain 1:50	Continue with existing concrete and timber sea wall, timber groynes and beach by maintenance, renewal and upgrading to a standard of 1 in 50 as necessary.
Improve 1:150	Continue with existing concrete and timber sea wall, timber groynes and beach by maintenance, renewal and upgrading to a standard of 1 in 150 as necessary.

3. Structuring the problem

This section aims to break down the problem into its component parts, identifying the set of impacts and associated criteria that will be used to make the decision. In other words a screening exercise is carried out for the Pagham to East Head Coastal Protection Strategy.

3.1 Summary of the screening exercise

This screening exercise is used to determine (i) which categories are relevant and (ii) which categories will be appraised by assigning monetary value to impacts and which will be appraised by assigning a score to the impacts. Relevant categories are those where there is a difference in the impacts of the 4 options being appraised (do-nothing, sustain, improve and improve plus).

The screening exercise for the strategy was based on the following sources of information:

- Pagham to East Head Coastal Defence Strategy - main document; and
- Pagham to East Head Coastal Defence Strategy - annexes

The detailed high level screening for both Medmerry and East Wittering Frontages is presented in Appendices B2.1 to this report - Appraisal Summary Table for Flood Management and Coastal Defence for High Level Screening (AST-FMDC-S) – Table 3.1 summarises the results of the screening exercise for both frontages.

The high level screening exercise highlighted the fact that the majority of the most significant impacts of the options for the strategy are related to economic assets, such as agricultural land for Medmerry and housing and commercial properties for East Wittering, and recreation and tourism activities in both frontages. Environmental issues are also important, in particular in what relates to physical habitats and natural processes.

The number of impact categories being assessed through monetary valuation is smaller than the number of impact categories being assessed through scoring. This is particularly the case for the East Wittering Frontage.

Table 3.1 Table summarising the results in the screening exercise

Project Name	Pagham To East Head Coastal Defence Strategy			
Category	Medmerry		East Wittering	
	Monetary Value	Score	Monetary Value	Score
<i>Economic impacts</i>				
Assets	✓		✓	
Land use	✓		✓	
Transport	✓		Not relevant	
Business development		✓		✓
<i>Environmental impacts</i>				
Physical habitats		✓		✓
Water quality		✓	Not relevant	
Water quantity	Not relevant		Not relevant	
Natural processes		✓		✓
Historical Environment		✓		✓
Landscape and visual amenity		✓		✓
<i>Social impacts</i>				
Recreation	✓		✓	
Health and safety		✓		✓
Availability and accessibility of services	✓		✓	
Equity	Not relevant		Not relevant	
Sense of community	Not relevant		Not relevant	
<i>Cross-cutting impacts</i>				
Policy Integration		✓		✓

4. Cost of options

The costs considered for each of the options being assessed are detailed in Table 4.1 for the Medmerry frontage and in Table 4.2 for the East Wittering frontage.

The cost estimates were based on those given in the original strategy (Posford Duvivier, 2001), and adjusted to take into consideration other standards of protection. The costs estimates include implementation and maintenance of the scheme for the next 50 years.

Table 4.1 Cost estimates for the Medmerry Frontage

Actions	Description	Cost
Year 0 renew 50% groynes	50 no. x 70m x £600	£2,100k
Year 0 major beach recharge	100,000m ³ x £17	£1,700k
Regular modest beach recharge	5,000m ³ x £17 x 15.762 (PV)	£1,340k
Year 20 renew 50% groynes	50 no. x 70m x £600 x 0.312 (PV)	£655k
Year 30 renew 50% groynes	50 no. x 70m x £600 x 0.174 (PV)	£365k
Annual maintenance	4.10km x £10,000 x 15.762 (PV)	£650k
Annual inspections	4.10km x £1,500 x 15.762 (PV)	£100k
Modifications to land drainage	2,200m x £250	£550k
Access arrangements	2,200m x £100	£220k
	Sub-Total	£7,680k
	Contingencies at 10%	£770k
	Planning and Engineering at 15%	£1,150k
	Other consequential costs at 5%	£390k
	Total	£9,990k
	Confidence Limits ± 20%	
Present Value Costs	1:150 year standard	£9.0m to £13m
	1:50 year standard	£8.0m to £12.0m
	1:20 year standard	£7.5m to £11m

Table 4.2 Cost estimates for the East Wittering Frontage

Actions	Description	Cost
Year 0 renew 50% groynes	40 no. x 50m x £600	£1,200k
Year 0 major beach recharge	200,000m ³ x £17	£3,400k
Regular beach recharge	2,000m ³ x £17 x 15.762 (PV)	£535k
Year 10 refurbish 50% sea wall	3,350m x 50% x 3.5m ³ x £300 x 0.558 (PV)	£980k
Year 20 renew 50% groynes	40 no. x 50m x £600 x 0.312 (PV)	£375k
Year 30 refurbish 50% sea wall	3,350m x 50% x 3.5m ³ x £300 x 0.174 (PV)	£305k
Annual maintenance	3.35km x £15,000 x 15.762 (PV)	£790k
Annual inspections	3.35km x £1,500 x 15.762 (PV)	£80k
	Sub-Total	£7,665k
	Contingencies at 10%	£765k
	Planning & Engineering at 15%	£1,150k
	Total	£9,580k
	Confidence limits ± 15%	
Present value costs	1:150 year standard	£8.0m to £11m
	1:50 year standard	£3.0m to £4.0m

5. Assessment of impacts

5.1 Qualitative and quantitative assessment

The qualitative and quantitative assessment of the different options for each of the management units was carried out using the Appraisal Summary Table for the Main Assessment (MA-AST) and it is presented in Appendix B2.2 to this Annex.

The assessment followed a stepped approach, starting with the qualitative assessment of all impact categories and moving to the quantitative assessment whenever information was available.

5.2 Monetary valuation of impacts

All of the following information was obtained from the Pagham to East Head Coastal Defence Strategy – Appendix G Economic Appraisal (Posford Duvivier, 2001). We were provided with different revised versions of the economic assessment for the Pagham to East Head Coastal Defence Strategy. It was decided to use the original version of the assessment, because the information on it was more complete. Nonetheless, some assumptions have been made and these are noted in the text.

Benefits accruing from provision of defences (i.e. damages avoided) were subdivided into 4 categories:

- write-off benefits;
- intermittent flooding after breach benefits;
- overtopping benefits; and
- erosion benefits.

5.2.1 Write-off benefits

Assets

The write-off flooding (inundation from the sea) protection benefits are the damages to the assets that would be written-off by being flooded under the 1:1 year event, following failure of defences.

For residential properties, those houses located in land that is below the 1:1 year return period water levels are considered to be flooded every year and therefore would no longer have any market value, i.e. are written-off. For the economic appraisal, the write-off value assigned to each property was based on the 1991 'middle value' Council Tax band, supplied by the Arun District Council. In order to actualise these values, they were increased by 10% which, according to the Council of Mortgage Lenders, corresponds to the average increase in property prices from 1991 to 1997 in the whole of the UK.

For commercial properties, as for residential properties, those premises located within the 1:1 year return period flood are written-off. The written-off cost of a commercial property corresponds to one half of the replacement value in £/m², taken from Spon's Architects' and Builder's Price Book (Spon & Spon, 1997). The reduction in replacement value is to cover depreciation since construction.

For significantly valued, isolated commercial property such as wastewater treatment works, the write-off benefit is capped at the cost of constructing a flood defence embankment around the asset.

For caravan parks, it was considered that caravans situated on land lying below 1:1 year flood contour can be relocated to another site and are therefore not written-off under the 'do-nothing' scenario. Instead a nominal sum of £2,000 has been assigned to each caravan to cover relocation expenses, as indicated as an appropriate upper limit by MAFF. Because, during consultation, the value of £2,000 was questioned by stakeholders, the value attributed to caravan relocation was used as a sensitivity testing parameter.

Land Use

Farmland flooded by salt water on annual basis would be unfit to support either grazing or arable crops. Such land is likely to become saltmarsh and therefore should be written-off as agricultural land. The write-off value assigned corresponds to the market value of the land (Nix (1998) average value), factored by 0.4¹.

In the assessment the value of benefits from land use are included under the asset category.

5.2.2 Intermittent flooding after breach

Assets

The intermittent flooding (inundation by the sea) protection benefits accruing from carrying coast protection works are derived from an assessment of the damages to the assets that would flood intermittently under the 1:1, 1:5, 1:20, 1:50 and 1:200 year events. These damages are related to the depth of flooding to each individual asset.

Using visual assessments of doorstep thresholds and figures extracted from Penning-Rowse (1992 - Yellow Manual), updated to 1998 prices using the Retail Price Index, residential depth-related damages were calculated. There are also indirect costs of post-flooding costs in houses to be accounted for. Costs of heating were valued at £124 per household (Red Manual values

¹ 0.4 was the value referenced in the Pagham to East Head Coastal Defence Strategy. Although it is realised that this value should be 0.45, no changes were made to the end result. It was not thought relevant for the purpose of this report to make any modifications to the values given by Posford Duvivier (2001)

updated to 1998 prices). Dehumidifier costs were valued at £610 per property suffering from over 30cm of flooding.

For commercial properties, depth-damage data was extracted from a variety of sources including Parker et al. (1997 – Red Manual) and N’Jai et al. (1990 – FLAIR).

For caravans, a doorstep threshold flood depth for static caravans was assessed at 0.5m, and depth-damage data for prefabricated buildings from Penning-Rowell (1992 - Yellow Manual) were used (in the absence of data for caravans) with the extraction of the irrelevant components.

Land use

The calculation of damages to agricultural land from intermittent flooding follow the procedure described in scenario III of PAG. An average value of £360/ha was calculated based on distribution of 70% arable land and 30% grazing land. Adjusted net margins were calculated from Nix (1998) values. As a result of crop rotation, a whole range of crops were assessed, which may not be representative of what is grown in the region at present.

Transport

Generally, local roads within the area will be flooded when the houses are flooded, hence traffic disruptions is likely to be small.

A section of the B2145 passes through low lying land which would be flooded in a 1:1 year event if defences of OU 5A/5B are allow to fail. If the road was regularly impassable by flooding it is likely that the road would be raised. Therefore, the benefits arising from its protection correspond to the cost of raising the low-lying section of the road.

Business development

According to Posford Duvivier (2001), the Red Manual notes that flooding of retail, distribution, office and leisure services is unlikely to generate significant indirect loss to the nation. Therefore this has not been assessed in monetary terms. They will, however, be considered in qualitative terms.

Accessibility and availability of services

As well as repair and cleaning costs to facilities/utilities, there are indirect costs if facilities are disrupted to consumers that have not been flooded. Consultation is on going regrading areas that are affected.

The value of emergency services was estimated to be £179 per property, according to figures in the Red Manual updated to 1998 prices.

5.2.3 Erosion protection benefits

The erosion protection benefits accruing from carrying out coast protection works are derived from an assessment of the economic value of extension to the life of, or delay in, loss of the erosion-prone properties for a period of time equal to the life of the works (Penning-Rowse et al., 1992).

For residential properties, the value assigned to each property was based on the 1991 'middle value' council tax band, supplied by the Arun District Council. In order to actualise these values, they were increased by 10%, which, according to the Council of Mortgage Lenders, corresponds to the average increase in property prices from 1991 to 1997 in the whole of the UK. A distance of 5m was adopted as a minimum acceptable safety margin between the top edge of the eroded bank, cliff or slope face following defence failure, and the building in question. The property is written-off should this safety margin be reduced by further erosion. In case of soft defences, the safety margin has been assessed from the landward edge of the active beach.

For commercial properties, the value assigned corresponds to one half of the replacement value in £/m², taken from Spon's Architects' and Builder's Price Book (Spon & Spon, 1997). The same safety margin as for residential properties is used.

5.2.4 Overtopping damages

Overtopping damages have been calculated using water volumes derived from modelling, and route from topographic data. The intermittent overtopping flooding zone is defined as the area which would flood in a storm with severity 1:200 years or less, without breaching of defences. For certain OU with soft defences overtopping damages have not been considered, because if significant overtopping was to occur then a breach would also occur.

For residential properties lying within the overtopping flooding zone, figures from Penning-Rowse et al.(1992) were used in the calculation of the damages. For commercial properties, depth-related data was extracted from Parker et al. (1997 – Red Manual) and N'Jai et al. (1990 – FLAIR).

5.2.5 Monetary valuation of intangible benefits

For the valuation of intangible benefits Posford Duvivier (2001), grouped Operational Units together, depending of the environmental resources present in the units. For the OUs being assessed in this case study, OU 5B has been assessed separately, whilst OUs 5A and 6A have been grouped together with OUs 4B and 7A. For the purpose of this economic appraisal the benefits were divided between the four OUs, have as base the % of coastline they occupy. So for example, OU 5A occupies 6 % of the coastline whilst OU 6A occupies 56%, which means that OU 5A will accrue 6% of the intangible benefits whilst OU 6A will accrue 56%.

Recreation

Operational units 5A and 6A

Deterioration of beach, groynes and seawall will occur over the next 5 years. By year 10 the defence would have collapsed and progressive erosion would have taken place.

The deterioration of the beach will affect visitor enjoyment. The loss of enjoyment is calculated using the Hastings case study from Penning-Rowse et al. (1992 – Yellow Manual). This value is separated in different values for different levels of beach, seawall and groyne deterioration. The total (central case) benefit from enjoyment from the beach is £7,584,250 (i.e. £455,055 for OU 5A and £4,247,180 for OU 6A).

In addition, it is estimated that the public slipway will deteriorate at year 5, to the extent that the structure will be deemed unsafe. The recreational value of the slipway is calculated as the cost of replacing the slipway. It is estimated that the cost of replacing the slipway is £100,000 (Posford Duvivier Environment, 1999), and thereafter it will require reconstruction every 10 years at £35,000. The total (central case) cost is £104,750.

Operational Unit 5B

The shingle bank will breach within one year, and regular flooding of the land behind will occur. Groynes will also deteriorate over the next 5 years. The shingle bank will cease to be an effective defence after 5 years. After 10 years the shingle bank will not exist and saltmarsh and mudflats will become established.

The deterioration of the beach will affect visitor enjoyment. The loss of enjoyment is calculated using the Hastings case study from Penning-Rowse et al. (1992 – Yellow Manual). This value is separated in different values for different levels of beach, seawall and groyne deterioration. However, no value for loss of enjoyment is used after year 10 because of the significant changes in habitat and the lack of data to account for this.

The annual payments for creation of saltmarsh in the Habitat Scheme in Essex (Mouchel, 1997) are used as the proxy value for creation of habitat. The values are:

- £525/ha for creation of saltmarsh on land currently in arable production;
- £448/ha for creation of saltmarsh on land which is currently set-aside; and
- £195/ha for land currently in permanent grass.

It is estimated that in the breach scenario, a total of 408ha will flood annually, and an additional 274ha will flood intermittently. Calculations were made of the area of grassland and arable land from which saltmarsh (and mudflat) will be created. The total (central case) recreational benefits are £103,000.

5.3 Scoring of impacts

Scoring of impacts across the different options and their justification is presented in tabular format below. Table 5.1 shows the scores given for the Medmerry frontage and Table 5.2 the scores for the East Wittering frontage.

Both the 'Zero to 100' and 'relative to 100' scoring systems were applied to this case study. For each impact category, under the option that scores the lowest two alternative scores are provided, separated by a dash, one being the score under the 'Zero to 100' systems and the other being the score under the 'relative to 100'.

Table 5.1: Table summarising scores for the Medmerry Frontage

Project name						Pagham to East Head Coastal Defence Strategy Medmerry Frontage (OU 5A and 5B). (scores given here are not weighted).					
Category		Option 1: DN	Option 2: S	Option 3: I	Option 4: I+	Scores justification					
Economic impacts											
Business development		0/30	100	100	100	Business development includes both impacts on regeneration/development and competitiveness. The 'do-nothing' option will have an impact on development and competitiveness by loss of tourism and recreation facilities, opportunities and consequently a loss of jobs. These conditions would be retained if any of the hold the line options were to be selected. According to Chichester Council, in the District circa 30% of employment relates to distribution, hotels and restaurants and to agriculture and fishing. The 'do-something' options would prevent the loss of tourism and recreation as they would at least sustain the situation as it is today. There would be periodical flooding, but the frequency of events is considered to be too small to influence businesses significantly. Using these assumptions and numbers as a base for scoring one could say that 'do-something' options would score 100 whilst 'do-nothing' scores 30 (or 0 in a '0 to 100' scoring system). The 0 given to 'do-nothing' may be overestimating the impacts of 'do-nothing', since not all jobs and businesses are lost and the new situation may create, in the long term, new businesses and recreation opportunities.					
Environmental impacts											
Physical habitats		0/72	100	100	100	There will be loss of a portion of Bracklesham Bay SSSI (grazing marsh), and potential creation of an area of saltmarsh and/or mudflat. This is the same for all of the options, except that for the do-nothing where the area affected would be much bigger (being all of the grazing marsh area within the perimeter formed by the Broad Rife and the coast line). So, the physical habitats should be subdivided into two subcategories, grazing marsh and saltmarsh. The grazing marsh is classified as an SSSI and is the only area of grazing marsh present in the whole of the strategy area. Saltmarsh is also an important habitat, being more natural and respectful of natural coastal processes. Because it is difficult to judge on which of the habitats is best, but taking into					

Table 5.1: Table summarising scores for the Medmerry Frontage

Pagham to East Head Coastal Defence Strategy Medmerry Frontage (OU 5A and 5B). (scores given here are not weighted).					
Project name					
Category	Option 1: DN	Option 2: S	Option 3: I	Option 4: I+	Scores justification
					consideration that grazing marsh is an SSSI and unique in this area, grazing marsh should be given slightly more importance than saltmarsh. In order to differentiate between the subcategories a weight of 0.6 will be given to the grazing marsh and a weight of 0.4 will be attributed to the saltmarsh. For grazing marsh the 'do-something' options score 100 because they are the ones that protect the biggest area of the habitat. In relation to the 'do-something', under 'do-nothing' 88% more area of grazing marsh is lost, so a score of 12 is given to this option. For the saltmarsh subcategory the exactly opposite will happen, so the 'do-something' options will score 12 whilst the 'do-nothing' option will score 100. If these scores are pondered with the weights referred to above then the 'do-something' options will score 100 whilst the 'do-nothing' will score 72 overall. Using a '0 to 100' scoring system the 'do-nothing' option would be given a score of 0. Although this is the worst option, the 0 does not reflect the gain in saltmarsh, i.e. the proportionality between options is not being respected.
Water quality	0/1	80	100	100	The impact on water quality from a wastewater treatment plant and a sewage treatment plant will be considered the same. The differences between the various options are (i) the improve and improve + options do not create water quality impacts, whilst the 'do-nothing' and sustain options do, and (ii) in the sustain option the sewage works will be flooded less frequently and to a lesser extent since it is located further in land. In addition, if one considers that the water quality will only be threatened once every 20 years under the sustain option, the time between two flood events will be sufficient for the quality of the water to be re-established to its previous state, making the impact of a temporary nature. The score of 100 will be given to, the improve and improve + options since they perform better in terms of water quality. 'do-nothing' will be always the worst option, since the waste water treatment plant would be flooded once every year, giving a score of 1. The sustain option, although not ideal, will not create significant impacts therefore it will be given the score of 80 (100 – 20), so that it will be slightly different/worst than the improve options, but significantly better than the do-nothing. In this case, because there is little information on the actual change in water quality dues to a flood event it is difficult to accurately measure the differences between the different options. In these cases a '0 to 100' scoring system becomes much easier to apply, since the worst option is always 0.
Natural processes	100	56	26	0/1	Under do-nothing the coastal processes would revert to their 'natural' state quite quickly, leading to landward migration of the shingle barrier and beach, and increased sediment supply to adjacent areas. For the do-something options the same process would occur but in a managed

Table 5.1: Table summarising scores for the Medmerry Frontage

Project name		Pagham to East Head Coastal Defence Strategy Medmerry Frontage (OU 5A and 5B). (scores given here are not weighted).			
Category	Option 1: DN	Option 2: S	Option 3: I	Option 4: I+	Scores justification
					fashion and to a smaller extent since the re-alignment of the coastline would be smaller. Another aspect to consider is that the processes under 'do-nothing' are more sustainable in the long term, whilst under the 'do-something' options they would still have to be managed and, depending on the level of the standard of defence, this would become harder as the standard is increased. Given that there are no quantitative measurements that can be associated with these consequences it is very difficult to assign scores. Useful data would be the different erosion/accretion rates under the different options, or the rates of landward movement under each option. We do know that under the 'do-something' options, only 56% of the coastline would revert to a more natural equilibrium and using this fact for scoring, 'do-nothing' would score 100 whilst the 'do-something' options would score 56. Taking account of the different standard of defences, the scores would be 100 for 'do-nothing', 56 for sustain, 26 for improve (56-30 (50-20)) and 0/1 for improve +.
Historical environment	0/69	100	100	100	The area affected by erosion and hence impact on the historical interest was used to differentiate between the magnitude of the impacts across the options. We know that under the 'do-nothing' the whole of the area of the frontage will suffer the impacts of increased erosion. Under the 'do-something' options, the frontage will be protected from erosion by the groyne fields except for where the shoreline will be realigned. This area corresponds to 69% of the total area of the frontage. In this context, the 'do-something' options will have less of an impact, and therefore will be attributed a score of 100. The 'do-nothing' option, will impact on an additional 31% of the area in comparison to the 'do-something' options, therefore it will score 69. Using a '0 to 100' scoring system the 'do-nothing' option would be given a score of 0. Although this is the worst option, the 0 does not reflect the fact that only part of the heritage interest is lost, i.e. the proportionality between options is not being respected.
Landscape and visual amenity	50	100	70	10/0	The 'do-nothing' option would produce a radical change to the landscape from a managed amenity beach to a more natural coastal landscape. The 'do-something' options would maintain and potentially improve the beach levels, but the landscape itself would not be improved due to the presence of groyne fields and potentially visually intrusive defences that could spoil it. However, landscape and amenity also depend on the perception of local people, so that for example a big change in landscape could be seen as a negative even if made it more 'natural'. If one considers that a more natural landscape is rendered more important and more sustainable than a managed one, then the 'do-nothing' option would score 100 and Improve + would score the

Table 5.1: Table summarising scores for the Medmerry Frontage

Project name					
Pagham to East Head Coastal Defence Strategy Medmerry Frontage (OU 5A and 5B). (scores given here are not weighted).					
Category	Option 1: DN	Option 2: S	Option 3: I	Option 4: I+	Scores justification
					lowest, i.e.0/1. In order to take into account peoples perception and the fact that the higher the standard of defence generally greater is the impact, the following scores were assigned, 100 for the sustain option because it maintains the landscape as it is but it is not in its natural state, 70 for improve because it maintains the landscape but is more intrusive and less 'natural' than sustain, 50 for 'do-nothing' because it totally changes the landscape but respects the natural processes and sustainability criteria, and finally 10 for Improve + because it is the least 'natural' and the most intrusive option. In categories such as this one, where different aspects of the same issue are at stake, it is preferable to have the category subdivided into subcategories, where scoring is made easier, weights assigned to these subcategories and an overall score of the category be calculated. It is important to note that this exercise may create opportunities for double counting (within this category or between this and other categories) and attention should be paid to this factor. The weights assigned at this stage should be related to policy and decision-making priorities rather than local stakeholder interests.
Social impacts					
Health and safety	0/1	80	100	100	Health and safety impacts would be most affected by the risk of flooding to the population, stress and anxiety and the risk caused by deteriorating defences. The first issue will relate mostly with frequency of flooding whilst the second will relate to the management or abandonment of the defences. This then means that do-nothing would be the worst option (most frequent flooding and no management of defences) scoring 1, the sustain option would score 80 and both improve options would score 100 (it is considered that in terms of health and safety both improve and improve + will have the same small impacts)
Cross-cutting impacts					
Policy Integration	0/1	100	100	100	For this category the option that scores the highest is the one that is in agreement with remaining policies, i.e., all of the 'do-something' options because they are in line with the SMP policy of hold the line. 'do-nothing' on the other hand is not so it will score 0 or 1. This category is fairly easy to score since during this stage of the appraisal the practitioner should have a very good idea of major policies in the study area. This category can be subdivided into subcategories, such as local, regional national policies, to which an importance weight can be given. The inclusion of such a category in the appraisal can function as a great tool for policy integration, in particular if the category is given a significant weight further on in the analysis.

Table 5.2: Table Summarising Scores for the East Wittering.

Project Name				
Pagham to East Head Coastal Defence Strategy East Wittering Frontage (OU 6A). (scores given here are not weighted).				
Category	Option 1: DN	Option 2: S	Option 3: I	Scores Justification
<i>Economic Impacts</i>				
Business development	0/70	100	100	Because the land behind the defences is raised, the losses of recreation and tourism facilities due to 'do-nothing' and its impacts on business development would be small. Erosion, under 'do-nothing', can have a bigger impact but it would be in the long term. Also, business in this urban area will tend to be more diversified and therefore the impacts on one sector will be absorbed to an extent by other sectors of the local economy. For this reason, 'do-something' options will score 100 and 'do-nothing' will score 70 (based on employment estimates from the Chichester District Council)
<i>Environmental impacts</i>				
Physical habitats	0/1	100	100	'do-nothing' option would threaten 100% of the area that is designated as an SSSI. This area would be protected by the 'do-something' options.
Natural processes	100	0/1	0/1	Under the 'do-nothing' option the coastline would naturally retreat approximately 75m in 50 years. Under any of the 'do-something' options the coastline would be protected against erosion, and the natural processes would slow down considerably.
Historical Environment	0/1	100	100	The area affected by erosion and hence impact on the historical interest was used to differentiate between the magnitude of the impacts across the options. Under the 'do-nothing' option the whole of the area of the frontage will suffer the impacts of increased erosion. Under the 'do-something' options, the frontage will be protected from erosion by the groyne fields.
Landscape and visual amenity	0/33	100	66	Erosion under 'do-nothing' could lead to significant reduction in the beach levels and therefore to the deterioration of landscape. Under the 'do-something' options this would not happen, however the landscape and amenity of the seafront would be disturbed due to the visually intrusive nature of the hard defences, in particular in the case of the improve option. It was decided that both of these impacts on landscape are significant but that the loss of the beach would be more significant than the visual impact caused by the groyne fields. Hence the sustain option was given a score of 100, whilst the improve option was given a score of 66 and the 'do-nothing' a score of 33.
<i>Social impacts</i>				
Health and safety	0/1	100	100	Health and safety impacts would be most affected by the risk of flooding to the population, stress and anxiety and the risk caused by deteriorating defences. The first issue will relate mostly to frequency of flooding whilst the second will relate to the management or abandonment of the defences. This then means that do-nothing would be the worst option (most frequent flooding and no management of defences) scoring 1, the sustain option and the improve options would score 100. The standards of defence offered by the sustain and improve options would have insignificant differences in relation to health and safety impacts.

Table 5.2: Table Summarising Scores for the East Wittering.

Project Name	Pagham to East Head Coastal Defence Strategy East Wittering Frontage (OU 6A). (scores given here are not weighted).			
Category	Option 1: DN	Option 2: S	Option 3: I	Scores Justification
<i>Cross-cutting impacts</i>				
Policy Integration	0/1	100	100	For this category the option that scores the highest is the one that is in agreement with remaining policies, i.e., all of the 'do-something' options because they are in line with the SMP policy of hold the line. 'do-nothing' on the other hand is not so it will score 0 or 1.

6. Weighting and comparison of options

6.1 Source of weights

In all cases, the Constrained Random Weight Generator (CRWG) was used to calculate minimum, maximum and average total weighted scores and total weighted incremental scores for the options under consideration. These, along with interpretation, are provided in the summary tables for each management unit.

6.2 Comparison of options

6.2.1 Medmerry

Table 6.1 provides a summary table of monetary costs and benefits and scores for the Medmerry Management Unit.

Analysis of the preferred option starts with the option with the highest benefit-cost ratio, which, in this case is Option 4: Improve +. The Benefit-Cost Ratio is (robustly) above 1. Option 4 also represents a move above the indicative standard and, as there are no 'next' options, according to FCDPAG3, this is the preferred option on the basis of monetary costs and benefits. The CRWG has been applied to detect the level of potential intangible benefit from the option to ensure primarily that there are not large intangible dis-benefits that could potentially offset the monetary benefits and change the decision. The calculations from the CRWG suggest that the intangible benefits incremental to the 'do-nothing' option are all positive and of the order of between 31 to 87.4. As such, there are no intangible dis-benefits that could change the decision context. Option 4: Improve + is the preferred option.

6.1: Summary table of costs and benefits – Medmerry

	Option 1: Do-Nothing	Option 2: Sustain (1:20)	Option 3: Improve (1:50)	Option 4: Improve + (1:150)		
PV costs from estimates						
Optimism bias adjustment						
Total PV costs for appraisal PVc		7,500,000	8,000,000	9,000,000		
PV damage PVd			-	-		
PV damage avoided						
PV assets Pva		-	-	-		
PV asset protection benefits		-	-	-		
Total PV benefits PVb		14,151,000	16,676,000	20,834,000		
Net Present Value NPV						
Average benefit/cost ratio		1.8868	2.0845	2.3148889		
Incremental benefit/cost ratio			5.05	4.158		
Required incremental B/C ratio						
Required additional benefits to meet criterion				-		
				Min	Ave	Max
Weighted Score (CRWG)				71.2	90.7	97.7
Scored intangible incremental benefit of moving to the next option (CRWG)				31.0	68.2	87.4
Comments	N/A	N/A	N/A	Justified without Extra benefit	Justified without Extra benefit	Justified without Extra benefit
Implied additional benefits per point (k) to meet criterion	N/A	N/A	N/A	-	-	-

6.2.2 East Wittering

Table 6.2 provides a summary table of monetary costs and benefits and scores for the East Wittering Management Unit.

Analysis of the preferred option starts with the option with the highest benefit-cost ratio, which, in this case is Option 2: Sustain.

The next highest option is Option 3: Improve which must attain an incremental benefit cost ratio of 3 to be the preferred option. On the basis of monetary costs and benefits, the option only achieves an incremental benefit-cost ratio of 0.03 and therefore would require some £14,870,000 of intangible benefit to achieve the criterion. However, calculations with the CRWG generator reveal that the Improve Option cannot achieve an incremental intangible benefit with any set of weights. Thus, it can be concluded that, as there are no intangible benefits and the option does not attain a high enough incremental benefit-cost ratio on the basis of monetary costs and benefits, Option 3: Improve is not justified.

The preferred option is Option 2: Sustain.

6.2: Summary table of costs and benefits – East Wittering

	Option 1: Do-Nothing	Option 2: Sustain (1:50)	Option 3: Improve (1:150)		
PV costs from estimates					
Optimism bias adjustment					
Total PV costs for appraisal PVc		3,000,000	8,000,000		
PV damage PVd	19,034,000		-		
PV damage avoided					
PV assets Pva		-	-		
PV asset protection benefits		-	-		
Total PV benefits PVb		18,500,000	18,630,000		
Net Present Value NPV					
Average benefit/cost ratio		6.17	2.33		
Incremental benefit/cost ratio			0.03		
Required incremental B/C ratio			3		
Required additional benefits to meet criterion			14,870,000		
			Min	Ave	Max
Weighted score (CRWG)			70.8	91.6	98.2
Scored intangible incremental benefit of moving to the next option (CRWG)			-7.9	-2.1	-0.4
Comments	N/A	N/A	Not Justified	Not Justified	Not Justified
Implied additional benefits per point (k) to meet criterion	N/A	N/A	Not Justified	Not Justified	Not Justified

7. References

Posford Duvivier (1999): Pagham to East Head Coastal Defence Strategy – Main Report, report produced for the Environment Agency, Chichester District Council and Arum District Council, September 1999.

Posford Duvivier (1999): Pagham to East Head Coastal Defence Strategy – Supporting Document, report produced for the Environment Agency, Chichester District Council and Arum District Council, September 1999.

Posford Duvivier (2001): Pagham to East Head Coastal Defence Strategy – Main Report, report produced for the Environment Agency, Chichester District Council and Arum District Council, January 2001.

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Royal Haskoning (2001): Pagham to East Head Coastal Defence Strategy – Economic Update, report produced for the Environment Agency, May 2003.

Appendix B2.1:

Appraisal summary table for high level screening for Pagham to East Head coastal defence strategy – Medmerry and East Wittering Frontages

Table B2.1.1 Appraisal summary table for flood management and coastal defence – high level screening

Project name	Pagham to East Head Coastal Defence Strategy – Management Unit 3: Medmerry Frontage (OU 5A and 5B).			
Assumptions:	The high level screening will correspond to the ‘do-nothing’ option.			
Impact category	Impact likely? (Y/N)	Impact details	Qualitative or quantitative assessment	Monetary valuation
<i>Economic impacts</i>				
Assets	Y	<p>There is potential for total loss of :</p> <ul style="list-style-type: none"> residential properties (20); caravans and chalets (1806); and commercial properties (56); <p>There is potential for intermittent flooding of:</p> <ul style="list-style-type: none"> residential properties (277); caravans and chalets (260); and commercial properties (95 comprising largely of farm outbuildings – will be considered under land use); flooding of Sidlesham waste water treatment works <p>There is also risk of losing cliff top properties due to 50 years of erosion (18).</p>		✓
Land use	Y	<ul style="list-style-type: none"> potential loss of 408 hectares of farmland; commercial properties (95 comprising largely of farm outbuildings); loss of 14 ha of land due to 50 years of erosion 		✓
Transport	Y	<ul style="list-style-type: none"> potential intermittent flooding of the B2145 resulting in sever disruptions and inconvenience to residents and businesses 		✓
Business development	Y	<ul style="list-style-type: none"> loss of amenities and businesses can potentially affect the business development of the area, with losses of jobs; frequent flooding may hindered the development of business due to loss of visitors as well as disruption due to flooding of the main road to the area 	✓	

Table B2.1.1 Appraisal summary table for flood management and coastal defence – high level screening

Project name	Pagham to East Head Coastal Defence Strategy – Management Unit 3: Medmerry Frontage (OU 5A and 5B).			
Assumptions:	The high level screening will correspond to the ‘do-nothing’ option.			
Impact category	Impact likely? (Y/N)	Impact details	Qualitative or quantitative assessment	Monetary valuation
Environmental impacts				
Physical habitats	Y	<ul style="list-style-type: none"> on going erosion of low cliff and foreshore (designated geological SSSI for its exposure of Pleistocene raised beach and estuarine sediments); flooding/inundation can lead to loss of Bracklesham Bay SSSI grazing marsh; potential loss of the grazing marsh habitat that is part of the Bracklesham Bay SSSI due to overtopping of the shingle ridge; potential creation of coastal habitats behind the shingle ridge (including saltmarsh, intertidal mudflats, coastal lagoons and brackish grassland); potential loss of vegetated shingle 	✓	
Water quality	Y	<ul style="list-style-type: none"> potential impact to water quality due to flooding of waste water treatment plant; 	✓	
Water quantity	N			
Natural processes	Y	<ul style="list-style-type: none"> change in the alignment of shoreline would lead to alterations of the tidal regime which in turn could result in increased erosion of OUs 4b and 6a; 	✓	
Historical environment	Y	<ul style="list-style-type: none"> potential loss of archaeological interest (artefacts within cliff sediments) 	✓	
Landscape and visual amenity	Y	<ul style="list-style-type: none"> potential loss of rough grazing/amenity land of the top of the cliff in the long term; potential loss of amenity of the beach due to erosion and overtopping 	✓	
Social impacts				
Recreation	Y	<ul style="list-style-type: none"> long term erosion could lead to loss of cliff top footpath; breach could result in cessation of direct access between Selsey and East Wittering; potential disruption of the footpath network; 	✓	✓
Health and safety	Y	<ul style="list-style-type: none"> gradual deterioration of groynes and sheet pile wall poses and health and safety issue; 		

Table B2.1.1 Appraisal summary table for flood management and coastal defence – high level screening

Project name	Pagham to East Head Coastal Defence Strategy – Management Unit 3: Medmerry Frontage (OU 5A and 5B).			
Assumptions:	The high level screening will correspond to the ‘do-nothing’ option.			
Impact category	Impact likely? (Y/N)	Impact details	Qualitative or quantitative assessment	Monetary valuation
Availability and accessibility of services	Y	<ul style="list-style-type: none"> the availability and accessibility to services may be disrupted due to flooding of major road; 	✓	
Equity	N			
Sense of community	N			
<i>Cross-cutting impacts</i>				
Policy integration	Y	<ul style="list-style-type: none"> not in line with the preferred option selected by the SMP 	✓	

Table A.1 Appraisal summary table for flood management and coastal defence – high level screening

Project Name	Pagham to East Head Coastal Defence Strategy – Assessment Unit 6: East Wittering (OU 6A).			
Assumptions:	The high level screening will correspond to the ‘do-nothing’ option.			
Impact category	Impact likely? (Y/N)	Impact details	Qualitative or Quantitative Assessment	Monetary Valuation
<i>Economic impacts</i>				
Assets	Y	<p>There is potential for total loss of:</p> <ul style="list-style-type: none"> residential properties (4); and caravans and chalets (299). <p>There is potential for flooding due to overtopping of 14 residential properties.</p> <p>There is also risk of losing 150 residential properties due to 50 years of erosion (assumes immediate wall failure in year 0).</p>		✓
Land use	Y	<ul style="list-style-type: none"> potential loss of 4 hectares of farmland; 		✓
Transport	N			
Business development	Y	<ul style="list-style-type: none"> loss of amenities and businesses can potentially affect the business development of the area, with losses of jobs; frequent flooding may hindered the development of business due to loss of visitors as well as disruption due to flooding of the main road to the area 	✓	
<i>Environmental impacts</i>				
Physical habitats	Y	<ul style="list-style-type: none"> long-term erosion could lead to loss of part of the Bracklesham Bay SSSI; there will be an increased sediment transport rate to the west (with potential beneficial impacts in OU 7A, 7B and 8A); 	✓	
Water quality	N			
Water quantity	N			
Natural Processes	Y	<ul style="list-style-type: none"> increased erosion due to groyne failure and eventual sea wall failure 	✓	
Historical Environment	Y	<ul style="list-style-type: none"> potential loss of archaeological interest 	✓	
Landscape and visual amenity	Y	<ul style="list-style-type: none"> erosion can lead to loss of beach 	✓	

Table A.1 Appraisal summary table for flood management and coastal defence – high level screening

Project Name	Pagham to East Head Coastal Defence Strategy – Assessment Unit 6: East Wittering (OU 6A).			
Assumptions:	The high level screening will correspond to the ‘do-nothing’ option.			
Impact category	Impact likely? (Y/N)	Impact details	Qualitative or Quantitative Assessment	Monetary Valuation
<i>Social impacts</i>				
Recreation	Y	<ul style="list-style-type: none"> reduction in upper beach levels would affect beach access; potential loss of promenade, footpath and slipway. 	✓	
Health and safety	Y	<ul style="list-style-type: none"> potential loss of life and injuries due to flooding; potential impacts due to deterioration of groynes and sea wall. 	✓	
Availability and accessibility of services	N			
Equity	N			
Sense of community	N			
<i>Cross-cutting impacts</i>				
Policy integration	N			

Appendix B2.2:

Appraisal summary table for main assessment – MA-AST for Pagham to East Head coastal defence strategy – Medmerry Frontage

Table B2.2.1 Appraisal summary table for flood management and coastal defence – main assessment

Project name		Pagham to East Head coastal defence strategy – management unit 3: Medmerry Frontage (OU 5A and 5B).			
Description of option		'do-nothing' option			
Description of area affected by option		Shingle beach and shingle banks with timber groynes fronting mostly low lying arable and pasture land			
Impact category	Impact likely? (Y/N)	Qualitative description of impacts	Quantitative assessment of impacts (no. units/monetary)	Score	Monetary value
<i>Economic impacts</i>					
Assets	Y	<p>In the long term, there is the potential of loss of residential properties to the east of the OU 5A frontage as the cliff line retreated landward.</p> <p>In addition, in OU 5B, tidal inundation would potentially result in damage and eventually loss of some residential properties and commercial/tourism facilities, including West Sands/White Horse/Greenlawns complex and its amenity buildings and Sussex Beach Holiday Village, and a sewage treatment works situated in land. Also, there are some residential houses to the east of the frontage that could be at risk from erosion.</p> <p>Outflanking could also result in loss of assets located in OU 6A and in the North-Western end of OU 4B (Selsey West Beach).</p>	<p>Write-off of (1:1 return period):</p> <ul style="list-style-type: none"> • 20 residential properties; • 1806 caravans and chalets; and • 56 commercial properties; <p>Intermittent flooding of:</p> <ul style="list-style-type: none"> • 277 residential properties; • 260 caravans and chalets; and • 95 commercial properties (will be considered under land use); • flooding of Sidlesham waste water treatment works. <p>Erosion of:</p> <ul style="list-style-type: none"> • 18 cliff top properties <p>Assuming that soft defences have no residual life:</p> <p>Write-of value = £17,875,064; Intermittent Flooding = £1,971,167; Erosion = £1,336,363; Total = £21,183,194</p>		<p style="text-align: center;">Damages £21m</p>

Table B2.2.1 Appraisal summary table for flood management and coastal defence – main assessment

Project name		Pagham to East Head coastal defence strategy – management unit 3: Medmerry Frontage (OU 5A and 5B).			
Description of option		‘do-nothing’ option			
Description of area affected by option		Shingle beach and shingle banks with timber groynes fronting mostly low lying arable and pasture land			
Impact category	Impact likely? (Y/N)	Qualitative description of impacts	Quantitative assessment of impacts (no. units/monetary)	Score	Monetary value
Land use	Y	In the short term, the productivity of a large area of grade 3a and 3b agricultural land and farm building in OU 5B would be affected due to periodic tidal inundation, eventually leading to its loss. There is also potential for loss of land due to erosion. In addition, large areas within caravan parks such as West Sands, Black Horse and Selsey Country Club and Sussex Beach Holiday Village, among others, would be lost.	Write-off of: • 408 ha of farmland for cereal crop and grazing; and • commercial properties (95 comprising largely of farm outbuildings); Erosion of: • 14 ha of farmland.		included in assets
Transport	Y	Intermittent flooding of the B2145 resulting in several disruptions and inconvenience to residents and businesses.	Benefits have been capped by the cost of raising 900m of the B2145 out of the write-off area.		included in assets
Business development	Y	The flooding of the B2145 can result in severe disruptions and inconvenience to residents and businesses. In addition, with large areas of land being flooded and tourism facilities and accommodation being written-off it is like that frequent flooding will have a significant impact on the local economy.		0/30	
Environmental impacts					
Physical habitats	Y	<i>In OU 5A – Medmerry Cliffs:</i> In the short term, there is potential for on going erosion of low cliff and foreshore (designated geological SSSI) and continued supply of sediment to the West. In the long term, erosion would result in loss of more of the rough grazing/amenity land. <i>In OU 5B – Medmerry:</i> In the short term, overtopping of the shingle ridge can lead to loss of part of the Bracklesham Bay SSSI grazing	<i>In OU 5A – Medmerry Cliffs:</i> the rate of erosion is estimated at 1.1 m/year for this area, which means that in 50 years the cliff could retreated a total of 55 m. <i>In OU 5B – Medmerry:</i> In a breach scenario, circa 400 ha of agricultural land would be flooded annually (240 ha of arable land and 160 ha of grassland) and turned into saltmarsh and/or	0/72	

Table B2.2.1 Appraisal summary table for flood management and coastal defence – main assessment

Project name		Pagham to East Head coastal defence strategy – management unit 3: Medmerry Frontage (OU 5A and 5B).			
Description of option		'do-nothing' option			
Description of area affected by option		Shingle beach and shingle banks with timber groynes fronting mostly low lying arable and pasture land			
Impact category	Impact likely? (Y/N)	Qualitative description of impacts	Quantitative assessment of impacts (no. units/monetary)	Score	Monetary value
		marsh habitat. Also, there are significant areas of vegetated shingle in this frontage; however, much of it has now been lost due to coastal defence works. In the medium-long term there could be significant ecological gains with the creation of coastal habitats behind the shingle ridge (saltmarsh and mudflats). There are also impacts on the notable saltmarsh area occurring behind the bank along the Bracklesham Bay Frontage (Broad Rife), where regular saline inundation occurs. An area of approximately 50ha of coastal grazing marsh occurring behind the shingle ridge just to the north of Broad Rife (and part of the Bracklesham SSSI) would also be threatened. This area is locally important for breeding waders such as redshank and lapwing. The grassland support good numbers of breeding skylark, meadow pipit and occasional yellow wagtail. The dyke system (Broad Rife) supports an impoverished flora dominated by common reed. Also, if there is a roll back of the shingle ridge the geological interest of the area can be maintained, but if there is a major and permanent breach the existing geological interest could be lost, but new exposures could be revealed.	mudflat in the long term.		
Water quality	Y	There is the potential for impact to water quality due to flooding of wastewater treatment plant in OU5B.		0/1	
Water quantity	N				

Table B2.2.1 Appraisal summary table for flood management and coastal defence – main assessment

Project name		Pagham to East Head coastal defence strategy – management unit 3: Medmerry Frontage (OU 5A and 5B).			
Description of option		‘do-nothing’ option			
Description of area affected by option		Shingle beach and shingle banks with timber groynes fronting mostly low lying arable and pasture land			
Impact category	Impact likely? (Y/N)	Qualitative description of impacts	Quantitative assessment of impacts (no. units/monetary)	Score	Monetary value
Natural Processes	Y	The change in the alignment of shoreline could lead to alterations of the tidal regime which in turn could result in increased erosion of OUs 4B and 6A. Also, there is the potential for the acceleration of foreshore erosion due to sea level rise and increased wave activity, and release of increase quantities of sediment into the transport regime. In addition, potential for the creation of a tidal inlet.		100	
Historical Environment	Y	Potential loss of archaeological interest (artefacts within cliff sediments) due to increased erosion.		0/69	
Landscape and visual amenity	Y	In the long term, there is potential for loss of rough grazing/ amenity land in the top of Medmerry cliff (accounted for under physical habitats), as well as potential loss of amenity of the beach due to erosion and overtopping (loss of beach amenity is accounted for under recreation).		50	

Table B2.2.1 Appraisal summary table for flood management and coastal defence – main assessment

Project name		Pagham to East Head coastal defence strategy – management unit 3: Medmerry Frontage (OU 5A and 5B).			
Description of option		'do-nothing' option			
Description of area affected by option		Shingle beach and shingle banks with timber groynes fronting mostly low lying arable and pasture land			
Impact category	Impact likely? (Y/N)	Qualitative description of impacts	Quantitative assessment of impacts (no. units/monetary)	Score	Monetary value
<i>Social Impacts</i>					
Recreation	Y	<p><i>In OU 5A</i>, in the long term, erosion could lead to loss of cliff top footpath. The beach will also deteriorate which together with degraded defences and loss of access will lead to loss of recreation value.</p> <p><i>In OU 5B</i>, the existing footpath network would be disrupted and would require re-routing. There would also be cessation of access between Selsey and East Wittering. There is also potential for increased visual impact due to deterioration of defences.</p>	<p><i>OU 5A</i>: 6.2% of £7,689,000 = £477,000</p> <p>This value for damages considers the value of enjoyment of the beach using values from the Yellow Manual and the Hastings case study (Penning Rowsell et al., 1992). In the original strategy the value calculated applied to OUs 4B, 5A, 6A and 7A. For the purpose of this appraisal the total value of enjoyment was divided by the percentage of shoreline belonging to each OU.</p> <p><i>OU 5B</i>: The total value of damages for recreation is £103,000, and they include value of enjoyment and value of creation of saltmarsh and mudflat.</p>		<p>Damages £0.58m</p>
Health and safety	Y	Increase in the risk to life and injury to visitors and local population due to overtopping and breaching of defences. Also, the gradual deterioration of groynes and sea wall can potentially pose a health and safety impact to visitors and local population.		0/1	

Table B2.2.1 Appraisal summary table for flood management and coastal defence – main assessment

Project name		Pagham to East Head coastal defence strategy – management unit 3: Medmerry Frontage (OU 5A and 5B).			
Description of option		‘do-nothing’ option			
Description of area affected by option		Shingle beach and shingle banks with timber groynes fronting mostly low lying arable and pasture land			
Impact category	Impact likely? (Y/N)	Qualitative description of impacts	Quantitative assessment of impacts (no. units/monetary)	Score	Monetary value
Availability and accessibility of services	Y	The availability and accessibility to services may be disrupted due to flooding of major B2145 road. Also, frequent inundation could lead to disruption in smaller local roads and street as well as businesses and public services. It is likely that emergency services may be required for coping with breaching of defences and severe flooding. In addition, cleaning services will also be required for recuperating from the flood during and after the event. However, because Medmerry frontage is mainly a rural area, these impacts were considered to be insignificant for this frontage.	The value of emergency services was estimated to be £179 per property, according to figures in the Red Manual updated to 1998 prices.		included in asset
Equity	N				
Sense of community	N				
<i>Cross-cutting impacts</i>					
Policy integration	Y	The ‘do-nothing’ option is not in line with the preferred option selected by the SMP.		0/1	

Table B2.2.2 Appraisal summary table for flood management and coastal defence – main assessment

Project name		Pagham to East Head coastal defence strategy – management unit 3: Medmerry Frontage (OU 5A and 5B).			
Description of option		Sustain 1:20 – Retreat the existing of defences landward up to 50m, widen beach crest and construct new groyne field.			
Description of area affected by option		Shingle beach and shingle banks with timber groynes fronting mostly low lying arable and pasture land			
Impact category	Impact likely? (Y/N)	Qualitative description of impacts	Quantitative assessment of impacts (no. units/monetary)	Score	Monetary value
<i>Economic impacts</i>					
Assets	Y	The majority of the assets in this frontage would be protected from a 1:20 year return period flood, except that part of the waste water treatment works would still be within the risk area. However, due to realignment of the defences an area at the front of one of the caravan parks would be lost.	Damages = £6,500,000 Benefits (damages avoided) = £14,500,000		Damages £6.5m
Land use	Y	The majority of the farmland within the flood risk area would be protected by the 1:20 standard of defence. There would still be infrequent flooding of some areas and potential for some loss of land due to erosion at the tips of the frontage. In addition, some area of agricultural land would be lost due to realignment of defences.	Approximately 1/3 of the farmland would still be at risk from flooding. Included in the assets category.		included in assets
Transport	Y	Most of the B2145 would be protected from 1:20 flood events. However, intermittent flooding would still be a reality for a portion of the road, resulting in some disruption and inconvenience to residents and businesses	Included in the assets category.		included in assets

Table B2.2.2 Appraisal summary table for flood management and coastal defence – main assessment

Project name		Pagham to East Head coastal defence strategy – management unit 3: Medmerry Frontage (OU 5A and 5B).			
Description of option		Sustain 1:20 – Retreat the existing of defences landward up to 50m, widen beach crest and construct new groyne field.			
Description of area affected by option		Shingle beach and shingle banks with timber groynes fronting mostly low lying arable and pasture land			
Impact category	Impact likely? (Y/N)	Qualitative description of impacts	Quantitative assessment of impacts (no. units/monetary)	Score	Monetary value
Business development	Y	There will still be some impacts on business development, but much less in relation to the impacts of the do-nothing option. These impacts will be related to loss of and infrequent flooding of the caravan park area (making it unavailable for business for a day, for example), and occasional flooding of the linkage road that can produce deliveries disruption, for example.		100	
Environmental impacts					
Physical habitats	Y	In the short term, there is potential for on going erosion of low cliff and foreshore (designated geological SSSI) and continued supply of sediment to the West, but new foreshore exposure could be revealed. Realignment of the defences will lead to loss of some of the Bracklesham Bay SSSI grazing marsh habitat. However some new intertidal habitat could be created. Other environmental important areas would be protected to a 1 in 20 defence standard.		100	
Water quality	Y	Wastewater treatment plant in OU5B would be protected to a standard of 1:20, but there sewage works situated further in land would be at risk from flooding in a 1:20 year event.		80	
Water quantity	N				

Table B2.2.2 Appraisal summary table for flood management and coastal defence – main assessment

Project name		Pagham to East Head coastal defence strategy – management unit 3: Medmerry Frontage (OU 5A and 5B).			
Description of option		Sustain 1:20 – Retreat the existing of defences landward up to 50m, widen beach crest and construct new groyne field.			
Description of area affected by option		Shingle beach and shingle banks with timber groynes fronting mostly low lying arable and pasture land			
Impact category	Impact likely? (Y/N)	Qualitative description of impacts	Quantitative assessment of impacts (no. units/monetary)	Score	Monetary value
Natural processes	Y	There may be a small realignment of the wave climate due to the realignment of the coastline. Also, initially the new coastline would attract sediment onto the frontage until a new balance is established, potentially at the (limited) expense of the beaches further west.		56	
Historical environment	Y	Potential loss of archaeological interest (artefacts within cliff sediments) due to increased erosion, where the coast is being realigned.		100	
Landscape and visual amenity	Y	Potential temporary loss of amenity of the beach due to regrading, recycling and recharging of the beach..		100	
Social impacts					
Recreation	Y	The existing footpath network would be maintained, as well as the beach recreational interest, except temporarily when beach is being managed. There would be some loss of recreation value due to set back of the flood bank.	Where the shingle bank and groynes are to be sustained there would be a benefit gain of approximately £0.1m (damages avoided. However, where the defence line was to be retreated there would be a loss of benefits. The amount being lost is approximately £0.9m, but a lot of uncertainty surrounds this estimate.		Damages £0.8m
Health and safety	N	The majority of the risk to life and injury to visitors and local population due to flooding and defence deterioration would disappear with a 1 in 20 standard of defence.		80	

Table B2.2.2 Appraisal summary table for flood management and coastal defence – main assessment

Project name		Pagham to East Head coastal defence strategy – management unit 3: Medmerry Frontage (OU 5A and 5B).			
Description of option		Sustain 1:20 – Retreat the existing of defences landward up to 50m, widen beach crest and construct new groyne field.			
Description of area affected by option		Shingle beach and shingle banks with timber groynes fronting mostly low lying arable and pasture land			
Impact category	Impact likely? (Y/N)	Qualitative description of impacts	Quantitative assessment of impacts (no. units/monetary)	Score	Monetary value
Availability and accessibility of services	Y	The availability and accessibility to services may be disrupted due to infrequent flooding of major B2145 road, and temporary disruption of smaller local roads and street as well as businesses and public services (such as the waste water treatment plant). These impacts were, however, considered insignificant.			included in assets
Equity	N				
Sense of community	N				
<i>Cross-cutting impacts</i>					
Policy integration	Y	The sustain option is in line with the preferred option of hold the line selected by the SMP.		0/1	

Table B2.2.3: Appraisal summary table for flood management and coastal defence – main assessment

Project name		Pagham to East Head coastal defence strategy – management unit 3: Medmerry Frontage (OU 5A and 5B).			
Description of option		Improve 1:50 - Retreat the existing of defences landward up to 50m, widen beach crest and construct new groyne field			
Description of area affected by option		Shingle beach and shingle banks with timber groynes fronting mostly low lying arable and pasture land			
Impact category	Impact likely? (Y/N)	Qualitative description of impacts	Quantitative assessment of impacts (no.units/monetary)	Score	Monetary value
<i>Economic impacts</i>					
Assets	Y	The great majority of the assets in this frontage would be protected a 1:50 defence standard. However, due to realignment of the defences an area at the front of one of the caravan parks would be lost.	Damages = £4,800,000 Benefits = £16,800,000		Damages £4.8m
Land use	Y	The majority of the farmland within the flood risk area would be protected by the 1:50 standard of defence. There would still be infrequent flooding of some areas to the west of the frontage. In addition, some area of agricultural land would be lost due to realignment of defences.	Included in the assets category.		Included in assets
Transport	Y	The B2145 would be protected from 1:50 flood events.			Included in assets
Business development	Y	The impacts to business development by this option can be considered negligible.		100	
<i>Environmental impacts</i>					
Physical habitats	Y	In the short term, there is potential for on going erosion of low cliff and foreshore (designated geological SSSI) and continued supply of sediment to the West, but new foreshore exposure could be revealed. Realignment of the defences will lead to loss of some of the Bracklesham Bay SSSI grazing marsh habitat. However some new intertidal habitat could be created. Other environmental important areas would be protected to a 1 in 50-defence standard.		100	
Water quality	Y	Both waste water treatment works and sewage works would be protected to a 1 in 50 standard.		100	

Table B2.2.3: Appraisal summary table for flood management and coastal defence – main assessment

Project name		Pagham to East Head coastal defence strategy – management unit 3: Medmerry Frontage (OU 5A and 5B).			
Description of option		Improve 1:50 - Retreat the existing of defences landward up to 50m, widen beach crest and construct new groyne field			
Description of area affected by option		Shingle beach and shingle banks with timber groynes fronting mostly low lying arable and pasture land			
Impact category	Impact likely? (Y/N)	Qualitative description of impacts	Quantitative assessment of impacts (no.units/monetary)	Score	Monetary value
Water quantity	N				
Natural processes	Y	There may be a small realignment of the wave climate due to the realignment of the coastline. Also, initially the new coastline would attract sediment onto the frontage until a new balance is established, potentially at the (limited) expense of the beaches further west.		26	
Historical environment	Y	Potential loss of archaeological interest (artefacts within cliff sediments) due to increased erosion where the coast is being realigned.		100	
Landscape and visual amenity	Y	Potential temporary loss of amenity of the beach due to regrading, recycling and recharging of the beach.		70	
Social impacts					
Recreation	Y	The existing footpath network would be maintained, as well as the beach recreational interest, except temporarily when beach is being managed. There would be some loss of recreation value due to set back of the flood bank.	Where the shingle bank and groynes are to be sustained there would be a benefit gain of approximately £0.1m (damages avoided). However, where the defence line was to be retreated there would be a loss of benefits. The amount being lost is approximately £0.9m, but a lot of uncertainty surrounds this estimate.		Damages £0.8m
Health and safety	Y	Visitors and local population would be protected from an event with a 1 in 50 frequency.		100	
Availability and accessibility of services	Y	The availability and accessibility to services may be disrupted due to infrequent on a 1:50 years event. These impacts were, however, considered insignificant.			Included in assets
Equity	N				

Table B2.2.3: Appraisal summary table for flood management and coastal defence – main assessment

Project name		Pagham to East Head coastal defence strategy – management unit 3: Medmerry Frontage (OU 5A and 5B).			
Description of option		Improve 1:50 - Retreat the existing of defences landward up to 50m, widen beach crest and construct new groyne field			
Description of area affected by option		Shingle beach and shingle banks with timber groynes fronting mostly low lying arable and pasture land			
Impact category	Impact likely? (Y/N)	Qualitative description of impacts	Quantitative assessment of impacts (no.units/monetary)	Score	Monetary value
Sense of community	N				
<i>Cross-cutting impacts</i>					
Policy integration	Y	The improve option is in line with the preferred option of hold the line selected by the SMP.		100	

Table B2.2.4: Appraisal summary table for flood management and coastal defence – main assessment

Project name	Pagham to East Head coastal defence strategy – management unit 3: Medmerry Frontage (OU 5A and 5B).				
Description of option	Improve Plus 1:150 - Retreat the existing defences landward up to 50m, widen beach crest and construct new groyne field				
Description of area affected by option	Shingle beach and shingle banks with timber groynes fronting mostly low lying arable and pasture land				
Impact category	Impact likely? (Y/N)	Qualitative description of impacts	Quantitative assessment of impacts (no. units/monetary)	Score	Monetary value
<i>Economic impacts</i>					
Assets	Y	All of the assets in this frontage would be protected to a 1:150 defence standard. However, due to realignment of the defences an area at the front of one of the caravan parks would be lost.	Damages = £ 0 Benefits = approximately £20,000,000		£0m
Land use	Y	Some area of agricultural land would be lost due to realignment of defences. The rest would be protected to a 1 in 150 defence standard.	Included in the assets category.		Included in assets
Transport	N	The B2145 would be protected from 1:150 flood events.			
Business development	N	The impacts to business development by this option were considered negligible.		100	
<i>Environmental impacts</i>					
Physical habitats	Y	In the short term, there is potential for on going erosion of low cliff and foreshore (designated geological SSSI) and continued supply of sediment to the West, but new foreshore exposure could be revealed. Realignment of the defences will lead to loss of some of the Bracklesham Bay SSSI grazing marsh habitat. However some new intertidal habitat could be created. Other environmental important areas would be protected to a 1 in 150 defence standard.		100	

Table B2.2.4: Appraisal summary table for flood management and coastal defence – main assessment

Project name	Pagham to East Head coastal defence strategy – management unit 3: Medmerry Frontage (OU 5A and 5B).				
Description of option	Improve Plus 1:150 - Retreat the existing defences landward up to 50m, widen beach crest and construct new groyne field				
Description of area affected by option	Shingle beach and shingle banks with timber groynes fronting mostly low lying arable and pasture land				
Water quality	Y	Both waste water treatment works and sewage works would be protected to a 1 in 50 standard.		100	
Water quantity	N				
Natural processes	Y	There may be a small realignment of the wave climate due to the realignment of the coastline. Also, initially the new coastline would attract sediment onto the frontage until a new balance is established, potentially at the (limited) expense of the beaches further west.		0/1	
Historical Environment	Y	Potential loss of archaeological interest (artefacts within cliff sediments) due to increased erosion where the coast is being realigned.		100	
Landscape and visual amenity	Y	Potential temporary loss of amenity of the beach due to regrading, recycling and recharging of the beach.		0/10	

Table B2.2.4: Appraisal summary table for flood management and coastal defence – main assessment

Project name	Pagham to East Head coastal defence strategy – management unit 3: Medmerry Frontage (OU 5A and 5B).				
Description of option	Improve Plus 1:150 - Retreat the existing defences landward up to 50m, widen beach crest and construct new groyne field				
Description of area affected by option	Shingle beach and shingle banks with timber groynes fronting mostly low lying arable and pasture land				
Social impacts					
Recreation	Y	<p>The existing footpath network would be maintained, as well as the beach recreational interest, except temporarily when beach is being managed.</p> <p>There would be some loss of recreation value due to set back of the flood bank.</p>	<p>Where the shingle bank and groynes are to be sustained there would be a benefit gain of approximately £0.1m (damages avoided). However, where the defence line was to be retreated there would be a loss of benefits. The amount being lost is approximately £0.9m, but a lot of uncertainty surrounds this estimate.</p>		Damages £0.8m
Health and safety	N	Visitors and local population would be protected from an event with a 1 in 50 frequency.		100	
Availability and accessibility of services	Y	The availability and accessibility to services may be disrupted due to infrequent on a 1:150 years event. These impacts were considered insignificant.			Included in assets
Equity	N				
Sense of community	N				
Cross-cutting impacts					
Policy Integration	Y	The improve + option is in line with the preferred option of hold the line selected by the SMP.			

Appendix B2.3:

Appraisal summary table for main assessment – MA-AST for Pagham to East Head coastal defence strategy – East Wittering Frontage

Table B2.3.1 Appraisal summary table for flood management and coastal defence – main assessment

Project name		Pagham to East Head coastal defence strategy – assessment unit 4: East Wittering (OU 6A).			
Description of option		'do-nothing' option			
Description of area affected by option		Shingle beaches, sea walls and timber groynes fronting built up areas, including East Wittering and Bracklesham			
Impact category	Impact likely? (Y/N)	Qualitative description of impacts	Quantitative assessment of impacts (no. units/monetary)	Score	Monetary value
Economic impacts					
Assets	Y	<p>Increased overtopping and eventual failure of defences could lead to damage to and loss of residential and commercial/ tourism properties (flooding would occur due to breaching of defences in OUs 5A and 5B, therefore the benefits would be accounted for within the Medmerry frontage appraisal).</p> <p>In addition, erosion could lead to the loss of a significant number of residential houses (assuming immediate wall failure in year 0). Also, some residential houses would be at risk from flooding due to overtopping of defences in OU 6A.</p>	<p>Write-off of (1:1 return period):</p> <ul style="list-style-type: none"> • 4 residential properties; and • 299 caravans and chalets; <p>Overtopping flooding of:</p> <ul style="list-style-type: none"> • 14 residential properties <p>Erosion of:</p> <ul style="list-style-type: none"> • 150 residential properties (assuming wall failure at year0). <p>Assuming a 5 years residual life of defence: Write-of value = £1,103,000; Intermittent Flooding (breach) = £0; Flooding through overtopping = £483,000; Erosion = £13,148,000; Total = £14,734,000</p>		Damages £14.7
Land use	Y	<p>Some arable land located within the 1:1 year water levels would be written-off.</p> <p>Overtopping and failure of defences could lead to loss of farmland (flooding would occur due to breaching of defences in OUs 5A and 5B, therefore the benefits would be accounted for within the Medmerry frontage appraisal)</p>	<p>Write-off of 4 ha of farmland;</p> <p>Included in the assets category</p>		
Transport	N				
Business development	Y	<p>There is the potential for the intermittent flooding of the B2145 (though this may be flooded through OUs 2A and 2B) resulting in severe disruptions and inconvenience to residents and businesses.</p>			
Environmental impacts					

Table B2.3.1 Appraisal summary table for flood management and coastal defence – main assessment

Project name		Pagham to East Head coastal defence strategy – assessment unit 4: East Wittering (OU 6A).			
Description of option		'do-nothing' option			
Description of area affected by option		Shingle beaches, sea walls and timber groynes fronting built up areas, including East Wittering and Bracklesham			
Impact category	Impact likely? (Y/N)	Qualitative description of impacts	Quantitative assessment of impacts (no. units/monetary)	Score	Monetary value
Physical habitats	Y	In the short term, erosion could lead to increased exposure of geological interest of part of Bracklesham SSSI. However, in the long term there may be loss of interest unless additional foreshore exposure is provided due to cliff retreat. Also, the shingle ridge that runs throughout this section of coastline supports a relatively diverse but localised flora in its landward side. Its distribution and scale depends on the scale and location of the works undertaken as part of the existing flood defence programme			
Water quality	N				
Water quantity	N				
Natural Processes	Y	Potential acceleration of foreshore erosion, retreat of the shoreline and increased sediment supply to downdrift units with resulting in increased sediment yields to the beaches.			
Historical Environment	Y	Erosion could lead to loss of archaeological interest.			
Landscape and visual amenity	Y	Erosion can lead to loss of beach amenity.	Accounted for in recreation impacts.		

Table B2.3.1 Appraisal summary table for flood management and coastal defence – main assessment

Project name		Pagham to East Head coastal defence strategy – assessment unit 4: East Wittering (OU 6A).			
Description of option		'do-nothing' option			
Description of area affected by option		Shingle beaches, sea walls and timber groynes fronting built up areas, including East Wittering and Bracklesham			
Impact category	Impact likely? (Y/N)	Qualitative description of impacts	Quantitative assessment of impacts (no. units/monetary)	Score	Monetary value
Social impacts					
Recreation	Y	<p>Erosion, overtopping and failure of defences could lead to damage to and loss of car park facilities and promenade along sea wall. Also, access to the beach would be disturbed due falling beach levels, and undercutting of steps and slipways with consequences for the amenity interest such as general beach usage, windsurfing and scuba-diving.</p> <p>Also, increase of supply of sediments could yield recreational benefits within OUs 7A, 7B and 8A.</p>	<p>Informal Recreation: 56.3% of £7,689,000 = £4,329,000.</p> <p>This value considers the value of enjoyment of the beach using values from the Yellow Manual and the Hastings case study (Penning Rowsell et al., 1992). In the original strategy the value calculated applied to OUs 4B, 5A, 6A and 7A. For the purpose of this appraisal the total value of enjoyment was divided by the percentage of shoreline belonging to each OU.</p> <p>Public Slipway: The recreational value of loss of a slip way is the same of its replacement (no other values exist). It is considered that the construction of the slipway at year 5 costs £100,000, and that it will need reconstruction every 10 years thereafter at £35,000. Total discounted cost is £104,750.</p>		Damages £4.3m
Health and safety	Y	<p>Increase in the risk to life in injury to visitors and local population due to overtopping and breaching of flood and coastal defence. Also, the gradual deterioration of groynes and sea wall can potentially pose a health and safety impact to visitors and the local population.</p> <p>The defences protects an area dominated by residential development, therefore this option is likely to create stress and anxiety to the local residents.</p>			

Table B2.3.1 Appraisal summary table for flood management and coastal defence – main assessment

Project name		Pagham to East Head coastal defence strategy – assessment unit 4: East Wittering (OU 6A).			
Description of option		'do-nothing' option			
Description of area affected by option		Shingle beaches, sea walls and timber groynes fronting built up areas, including East Wittering and Bracklesham			
Impact category	Impact likely? (Y/N)	Qualitative description of impacts	Quantitative assessment of impacts (no. units/monetary)	Score	Monetary value
Availability and accessibility of services	Y	It is likely that emergency services may be required for coping with breaching of defences and severe flooding. In addition, cleaning services will also be required for recuperating from the flood during and after the event	The value of emergency services was estimated to be £179 per property, according to figures in the Red Manual updated to 1998 prices.		
Equity	N				
Sense of community	N				
<i>Cross-cutting impacts</i>					
Policy Integration	Y	The 'do-nothing' option is not in line with the preferred option selected by the SMP.			

Table B2.3.2 Appraisal summary table for flood management and coastal defence – main assessment

Project name		Pagham to East Head coastal defence strategy – management unit 4: East Wittering Frontage (OU 6A).			
Description of option		Sustain 1:50 – Continue with existing concrete and timber sea wall, timber groynes and beach by maintenance, renewal and upgrading as necessary.			
Description of area affected by option		Shingle beaches, sea walls and timber groynes fronting built up areas, including East Wittering and Bracklesham.			
Impact category	Impact likely? (Y/N)	Qualitative description of impacts	Quantitative assessment of impacts (no. units/monetary)	Score	Monetary value
<i>Economic impacts</i>					
Assets	Y	Residential and commercial/ tourism properties would be protected from flooding from a 1 in 50 return period event and erosion. There would still be flooding from events with a frequency higher than 1 in 50 return period, due to overtopping of defences. In addition, there is still some potential flooding due to overtopping or breaching of defences in OU 5A and 5B (accounted for in Medmerry frontage).	Overtopping flooding of 14 residential properties, resulting in damages of approximately £0.5m.		£0.5m
Land use	N	Farmland would be protected from flooding and erosion from a 1 in 50 return period event. There is potential for some flooding due to breaching of defences in the Medmerry frontage (accounted for in the Medmerry frontage appraisal).			
Transport	N				
Business development	N	Businesses premises and facilities would be protected to a 1 in 50 standard.			
<i>Environmental impacts</i>					
Physical habitats	Y	The environmental interests of the area would be protected from flooding and erosion. However, recharge of the beach may lead to a temporary concealment of the geological foreshore exposures, notified as part of the Bracklesham			

Table B2.3.2 Appraisal summary table for flood management and coastal defence – main assessment

Project name		Pagham to East Head coastal defence strategy – management unit 4: East Wittering Frontage (OU 6A).			
Description of option		Sustain 1:50 – Continue with existing concrete and timber sea wall, timber groynes and beach by maintenance, renewal and upgrading as necessary.			
Description of area affected by option		Shingle beaches, sea walls and timber groynes fronting built up areas, including East Wittering and Bracklesham.			
Impact category	Impact likely? (Y/N)	Qualitative description of impacts	Quantitative assessment of impacts (no. units/monetary)	Score	Monetary value
		Bay SSSI.			
Water quality	N				
Water quantity	N				
Natural processes	N	The continued maintenance of the groyne fields would maintain the coastal sediment transport at its existing rate and direction.			
Historical environment	N	The protection against erosion would maintain the archaeological interest of the area.			
Landscape and visual amenity	Y	During breach regrading, recycling and recharge operations and renewal and upgrading of defences there would be a decline in beach amenity			
Social impacts					
Recreation	Y	Car park facilities, slipways, promenade along the sea wall and access to the beach would be protected from erosion and to a 1 in 50 standard. Beach levels would be maintained, but access along the beach would no be improved due to the maintenance of the groyne field.	Damages would be avoided in total. Benefits accruing from this option would be equal to approximately £7,689,000.		Damages £0
Health and safety	Y	The risk to life and injury due to flooding would be greatly reduced by this option. Given the 1 in 50 standard being considered, the health and safety impacts will be considered insignificant.			
Availability and	N	Availability and accessibility of services will be protected to a			

Table B2.3.2 Appraisal summary table for flood management and coastal defence – main assessment

Project name		Pagham to East Head coastal defence strategy – management unit 4: East Wittering Frontage (OU 6A).			
Description of option		Sustain 1:50 – Continue with existing concrete and timber sea wall, timber groynes and beach by maintenance, renewal and upgrading as necessary.			
Description of area affected by option		Shingle beaches, sea walls and timber groynes fronting built up areas, including East Wittering and Bracklesham.			
Impact category	Impact likely? (Y/N)	Qualitative description of impacts	Quantitative assessment of impacts (no. units/monetary)	Score	Monetary value
accessibility of services		standard of 1 in 50.			
Equity	N				
Sense of community	N				
<i>Cross-cutting impacts</i>					
Policy integration	N	The proposed option is in line with the policy preferred by the SMP.			

Table A2.3.3: Appraisal summary table for flood management and coastal defence – main assessment

Project name		Pagham to East Head coastal defence strategy – management unit 4: East Wittering Frontage (OU 6A).			
Description of option		Improve 1:150 Continue with existing concrete and timber sea wall, timber groynes and beach by maintenance, renewal and upgrading as necessary, and improve the standard of defence up to 1 in 150 return period event.			
Description of area affected by option		Shingle beaches, sea walls and timber groynes fronting built up areas, including East Wittering and Bracklesham.			
Impact category	Impact likely? (Y/N)	Qualitative description of impacts	Quantitative assessment of impacts (no.of units/monetary)	Score	Monetary value
<i>Economic impacts</i>					
Assets	Y	Residential and commercial/ tourism properties would be protected from flooding from a 1 in 150 return period event and erosion. There would still be flooding from events with a frequency higher than 1 in 150 return period, due to overtopping of defences, but these are considered negligible. In addition, there is still some potential flooding due to overtopping or breaching of defences in OU 5A and 5B (accounted for in Medmerry frontage).			£0.4m
Land use	N	Farmland would be protected from flooding and erosion from a 1 in 150 return period event. There is potential for some flooding due to breaching of defences in the Medmerry frontage (accounted for in the Medmerry frontage appraisal).			
Transport	N				
Business development	N	Businesses premises and facilities would be protected to a 1 in 150 standard.			
<i>Environmental Impacts</i>					
Physical habitats	Y	The environmental interests of the area would be protected from flooding and erosion. However, recharge of the beach may lead to a temporary concealment of the geological foreshore exposures, notified as part of the Bracklesham Bay SSSI.			
Water quality	N				
Water quantity	N				

Table A2.3.3: Appraisal summary table for flood management and coastal defence – main assessment

Project name		Pagham to East Head coastal defence strategy – management unit 4: East Wittering Frontage (OU 6A).			
Description of option		Improve 1:150 Continue with existing concrete and timber sea wall, timber groynes and beach by maintenance, renewal and upgrading as necessary, and improve the standard of defence up to 1 in 150 return period event.			
Description of area affected by option		Shingle beaches, sea walls and timber groynes fronting built up areas, including East Wittering and Bracklesham.			
Impact category	Impact likely? (Y/N)	Qualitative description of impacts	Quantitative assessment of impacts (no.of units/monetary)	Score	Monetary value
Natural processes	N	The continued maintenance of the groyne fields would maintain the coastal sediment transport at its existing rate and direction.			
Historical environment	N	The protection against erosion would maintain the archaeological interest of the area.			
Landscape and visual amenity	Y	During breach regrading, recycling and recharge operations and renewal and upgrading of defences there would be a decline in beach amenity. In addition, depending on the height of the sea wall, it may constitute an impact on the landscape.			
<i>Social impacts</i>					
Recreation	Y	Car park facilities, slipways, promenade along the sea wall and access to the beach would be protected from erosion and to a 1 in 150 standard. Beach levels would be maintained, but access along the beach would no be improved due to the maintenance of the groyne field.	Damages would be avoided in total. Benefits accruing from this option would be equal to approximately £7,689,000.		Damages £0
Health and safety	Y	The risk to life and injury due to flooding would be greatly reduced by this option. Given the 1 in 150 standard being considered, the health and safety impacts will be considered insignificant.			
Availability and accessibility of services	N	Availability and accessibility of services will be protected to a standard of 1 in 150.			
Equity	N				
Sense of community	N				
<i>Cross-cutting impacts</i>					

Table A2.3.3: Appraisal summary table for flood management and coastal defence – main assessment

Project name		Pagham to East Head coastal defence strategy – management unit 4: East Wittering Frontage (OU 6A).			
Description of option		Improve 1:150 Continue with existing concrete and timber sea wall, timber groynes and beach by maintenance, renewal and upgrading as necessary, and improve the standard of defence up to 1 in 150 return period event.			
Description of area affected by option		Shingle beaches, sea walls and timber groynes fronting built up areas, including East Wittering and Bracklesham.			
Impact category	Impact likely? (Y/N)	Qualitative description of impacts	Quantitative assessment of impacts (no.of units/monetary)	Score	Monetary value
Policy Integration	N	The proposed option is in line with the policy preferred by the SMP.			