

Project Appraisal Report

Authority Reference	Scheme	KX3 0195
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Defra Number	CPW/LDW	CPW 1434 LDW 39823
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Promoting Authorities	Eastbourne Borough Council and The Environment Agency
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Project Name	Redoubt Gardens to Cooden Coastal Defence Strategy
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Preface

Management of England's coastal defences is undertaken by a range of private owners and operating authorities. The latter includes maritime District Councils and the Environment Agency. In general terms, the District Councils manage frontages termed as 'coast protection' where failure of the defences would result in erosion of land above highest tide levels, and the Environment Agency manage those frontages termed as 'flood defence' where failure of the defences would result in flooding of low-lying land behind.

As a consequence of this split in responsibilities, the 45km of coastline between Beachy Head and Rye in East Sussex is managed in nine sections split between Eastbourne BC, Rother DC (2 sections), Hastings BC, the Agency (4 sections) and Sovereign Harbour Ltd as shown in Figure 1.0.

Shingle beaches form the primary sea defence along most of this coastline. The division in management responsibilities pays no heed to the mobility of these defences and natural processes. As a result, defence requirements in the past have often not been considered within a strategic framework, which takes full account of coastal processes, adjoining frontages and the wider effects of decisions taken.

In 1999 in order to further a more strategic approach, the Agency and the Local Authorities, encouraged by Defra's predecessor MAFF, set up a project team to undertake a coastal processes and resources study of the Beachy Head to Rye Harbour frontage. Completion of this study allowed the frontage to be divided into appropriate strategic lengths for discrete studies to be undertaken with the aim to develop a sustainable policy for the future management of each length. The principal objectives of the strategies to meet this aim are to:

- Manage the frontage in sympathy with natural processes.
- Ensure a co-operative and consistent management and monitoring approach by all the operating authorities.
- Provide appropriate defences, where the need has been identified and justified, that are technically sound, economically viable and environmentally acceptable.
- Provide best value to the public purse through, where appropriate, the use of combined procurement initiatives.
- Maximise recreational and environmental opportunities.

During the development of the coastal processes and resources study it became apparent that, in order to properly model the coastal process, the study boundaries should be extended to include the entire coastline from the River Cuckmere to Folkestone Harbour; a total length of 102km. The present management responsibilities for the additional lengths are also shown on Figure 1.0. (The original title of Beachy Head to Rye Harbour has been retained).

Halcrow, who won the work on competitive tender, has undertaken all the studies. The Environment Agency, Eastbourne, Hastings and Rother take a proportional share of the cost of the study. Halcrow commenced work on the studies in September 1999. The report output from the scheme will be:

- The Coastal Processes and Resources Study
- The Cuckmere Haven to Redoubt Gardens Strategy
- The Redoubt Gardens to Cooden Strategy

- The Cooden to Cliff End Strategy
- An Overarching Summary Strategy

This document, the Redoubt Gardens to Cooden Strategy, is the second of the three individual strategies to be submitted for agreement. The Cooden to Cliff End Strategy study highlighted the need for urgent works along parts of the Hastings and Bulverhythe frontages and agreement of this strategy was therefore sought first with the PAR being submitted to Defra in April 2003. The Cuckmere Haven to Redoubt Gardens Strategy is submitted together with this strategy as together they cover the main Eastbourne frontage.

On agreement of the three strategies, an overarching summary strategy will be produced. As well as summarising the three strategies above, this will also provide a summary of the two recently completed strategies covering the coastline between Cliff End and Folkestone, namely: the Cliff End to Scots Float Sluice Strategy (Halcrow 2000) and the Folkestone to Rye Strategy (HR Wallingford 2001).

The overarching strategy will then consider how future beach management along the whole 102km frontage can be undertaken most effectively and efficiently to deliver the preferred options set out in each strategy. This will include the identification of opportunities for combining shingle maintenance replenishment, recycling campaigns, and procurement across present management boundaries including the use of Public Private Partnerships. Recognising the length of time any opportunity along these lines may take to implement, the overarching strategy will identify those urgent works and schemes already under consideration for which current implementation processes would need to continue.

The coastline studied by the five strategies includes the entire length of coastline that is considered by the Beachy Head to South Foreland Shoreline Management Plan. This SMP is shortly to be reviewed and Halcrow, who are undertaking this exercise, are aware that the findings and recommendations of these five strategies need to be incorporated into the updated SMP.

Agency PM Comments 160903:

The Preface and Executive Summary to this PAR have been written by the Agency Project Manager.

The PAR document, excluding the Appendices, has been amended to include all the comments by the Eastbourne Borough Council Project Manager, the Agency Project Manager, the Agency's Project Executive and the Agency's Client Representative.

Risk Policy Analysis has reviewed the Halcrow Economic Appraisal (Appendix D of the PAR) and this has been amended to incorporate their comments.

English Nature have reviewed and have confirmed in writing that it is generally happy with the Strategic Environmental Assessment (Appendix E of the PAR)

Readers of this document need to be aware that, since starting these studies more than 4 years ago, many procedures have been changed or newly introduced and material changes in the condition of the sea defences have taken place. Whilst the PAR document has been drawn up to incorporate these some of the Appendices have not. In addition it should be noted that the Maintain Option in the PAR is referred to as the Do Minimum option in Appendix E.

1 Executive Summary / Recommendations

1.1 Description of the strategy frontage

The 11 kilometres of coastline considered by this strategy study are located between Redoubt Gardens in Eastbourne and Cooden in East Sussex (see Figure 1.1). Mobile shingle beaches provide the principal element of the coastal defences and these protect a low-lying area of 50 km² containing more than 14,000 properties.

The construction of Sovereign Harbour breakwaters and the 3,000 new houses presently under construction as part of the harbour development have had a significant impact on the study area. To the south west of the harbour lies the eastern part of Eastbourne, a densely populated area of over 9,000 residential and commercial properties. To the north-east of the harbour are located 2,000 properties in the populated coastal areas of Pevensey Bay, Beachlands, Normans' Bay and Cooden.

Behind these coastal developments there is the Pevensey Levels, a large Site of Special Scientific Interest (SSSI). The Levels, covering an area of 35 sq. km, provide freshwater habitats and rare grazing marshes that support a variety of rare and endangered species of flora and fauna as well as a wet land for over-wintering and breeding birds. Its international ecological importance is recognised by its designation as a Ramsar site.

The defences to the south-west of the harbour are managed by Eastbourne Borough Council and those in Pevensey Bay to the north-east by the Environment Agency. In June 2000 the Agency awarded a 25 year Public Private Partnership (PPP) contract to Pevensey Coastal Defence Limited (PCDL) for the management and improvement of its frontage. The recently installed groyne and recharge scheme along the Eastbourne frontage is designed to provide at least a 1:200-year standard of protection up to 2049.

1.2 Essence of the Problem

Following the completion of the Eastbourne Improvement Scheme in June 2000 and the provision of improved defences by PCDL in December 2002 the standard of protection against breach along the whole of the Redoubt to Cooden frontage is now in excess of 1 in 200. However, the economic analysis for this study was carried out in 2001. At this time the protection standards along the Agency's frontage were as existed before the award of the PPP contract and in some locations were as low as 1 in 20 for breach. It was therefore decided that the presence of the PPP contract would be ignored for this strategy appraisal. The results of the appraisal could then be used to check the PPP contract both in terms of value for money and appropriateness.

The problems encountered along the frontage in 2001 may be summarised as follows:

- Under a 'do-nothing' approach it is estimated that the defences in the Agency frontage would be permanently breached within 2 years resulting in uncontrolled flooding and land and property loss. The estimated 50 year present value (PV) of the resulting flood damages across the entire frontage would be in excess of £1,000 million. (It is pertinent to note that despite the increase in the standard of protection to 1:200 the 'do-nothing' scenario today would not alter greatly with perhaps a permanent breach occurring in 3-4 years rather than 2. This is because the solution adopted comprises a highly managed open beach).

- Analysis of the last 30 years of Annual Beach Monitoring Surveys and recharge schemes shows an average shingle loss from the study frontage of 22,000 m³ per year.
- Most of the timber groynes used to control littoral drift and maintain discontinuities on the Agency frontage are at the end of their life.

1.3 Outline of Preferred Option

The preferred option identified for the study frontage is to hold the line in all areas and improve the current standard of defence to 1 in 200 years. This option substantially agrees with both the policy set out in the SMP and the actual solution implemented by the Eastbourne Scheme and the PPP Contract.

The preferred option comprises the following principal elements:

Redoubt Gardens to Sovereign Harbour: 'Sustain' (providing at least a 1:200-year standard of protection)

- Maintenance and monitoring of the defences,
- Reconstruction of 40 timber groynes in year 30.

Sovereign Harbour to Cooden: 'Improve 200'

- The importation of 374,000m³ of shingle to provide a minimum crest width of 15m for breach and 10m in front of all crest top properties,
- Reconstruction of 43 timber groynes in year 5,
- Annual shingle recharge programme of 16,500m³,
- Annual shingle recycling programme of 7,000m³ around the Sovereign Harbour arms from west to east.
- Annual shingle recycling programme of 4,000m³ from Cooden to the eastern side of Sovereign Harbour,
- Maintenance and monitoring of the defences.

1.4 Priority Score, Costs and Benefits

The estimated Present Value (PV) cost of the recommended 50-year coastal defence strategy for the Redoubt Gardens to Cooden frontage is £54.5 million including an optimism bias of 35%. Expenditure over Years 0-4 of the strategy (not discounted) is estimated to be £18.8 million.

The table below identifies the PV cost, benefit cost ratio and priority score for the recommended strategy calculated using a 3.5% discount rate. The priority score is calculated in accordance with the latest Defra scheme prioritisation system (LDW 13).

Description	50 yr PV cost (£m)	Benefit-cost ratio	Priority Score
Redoubt to Cooden	54.5	19.2	32.4

Table 1.1 Costs, benefit-cost ratio and priority score

The 25-year PV cost figure for Redoubt to Cooden calculated by this strategy is £25.9m, when a discount rate of 6% and no optimism bias is applied. This compares (at the same discount rate and price base) to the £20.7 million PV price of the PPP Scheme and the £24.4 million scheme estimate of the 1997 strategy.

The appraisal has been carried out in accordance with the PAG Series of documents and takes account of the FCDPAG3 supplement dated March 2003. The choice of an appraisal period of 50 years and an optimism bias of 35% was seen as appropriate for this strategy. The soundness of the strategic decision using these figures has been checked using the respective figures of 100 years and 60% in the sensitivity analysis undertaken in the Economic Appraisal in Appendix D.

1.5 Environmental Impact

The Strategic Environmental Assessment (SEA) concludes that both the human and natural environments will be best served by holding the line along the strategy frontage rather than allowing natural coastal processes to take place without interference. The SEA also identifies the preferred 'improve 200 year' option identified on economic and technical grounds to be the preferred environmental option.

English Nature, who would normally wish to see natural processes hold sway, wish to preserve the freshwater habitats of the Pevensey Levels and are therefore fully supportive of the strategy's hold the line policy. The 200 year improve option, by increasing the volume of the shingle bank, will contribute to the preservation and enhancement of the nationally important vegetated shingle habitat so contributing to the Defra biodiversity target for increasing the range and quality of this priority habitat.

Eastbourne and Pevensey Bay are important beach resorts where visitors and locals enjoy a wide range of water sports. The hold the line policy and the recent improvements should preserve and enhance these activities. The policy should also preserve the three Martello Towers situated on the crest of the shingle beach. These towers are scheduled monuments and others like them have already been lost to the sea.

1.6 Conclusion and Recommendation

The preferred option justified by this strategy study, namely secure and maintain a 1 in 200 year protection standard along the whole frontage, is entirely consistent with the recently completed Eastbourne Scheme and the service specified for and provided by the PPP contract. The study also confirms that the PPP contract continues to give value for money to the Agency.

Prior to the year 2025, the strategy does not commit the Agency to any further expenditure above that which it is already committed to under the PPP contract and its agreement with Sovereign Harbour Limited. No capital expenditure is required on the 2km of Eastbourne frontage considered by this strategy before 2030.

This strategy recognises the interconnection between the eastern end of the Eastbourne frontage, Sovereign Harbour and the Agency's Pevensey Bay frontage; both from the point of view of the risk of flooding to the land behind the defences and the maintenance of the defences. However the recent completion of the adjacent Cuckmere Haven to Redoubt Gardens Strategy has highlighted the benefits of combining it with this strategy. This will result in added value being brought to the coastal defences to the west of Redoubt Gardens at no additional cost to the combined frontages. (Refer to the executive summary of the Cuckmere Haven to Redoubt Gardens Strategy)

Eastbourne Borough Council approved this strategy in July 2002 and the Agency's National Review Group agreed it in November 2003. It is recommended that this strategy is agreed by Defra to enable the Agency to move forward with its Maritime District Councils partners to complete the overarching summary strategy and achieve the objectives set out in the Preface to this document.

2 Business Case

2.1 Introduction and Background

This Project Appraisal Report (PAR) sets out a recommended coastal defence strategy for the length of coastline between Redoubt Gardens, Eastbourne and Cooden in East Sussex (Figure 1.1). Failure to improve and maintain these defences would leave urban areas in central and eastern Eastbourne at unacceptably high risk of flooding within 2 years (see Figure 2.4). This strategy frontage includes an area known as Pevensey Bay, which is currently being managed under the first flood and coastal defence Public Private Partnership (PPP) contract or Private Finance Initiative (PFI).

This PAR summarises a range of studies undertaken by Halcrow between September 1999 and August 2003, on behalf of a Client Group consisting of the Environment Agency, Eastbourne Borough Council, Hastings Borough Council and Rother District Council. Of these, Eastbourne Borough Council and the Environment Agency are the administrative authorities for coastal defence matters along this frontage. In addition, extensive consultation has been undertaken with parties directly affected by the proposed strategy, in order that the proposals are understood, accepted and in-keeping with their concerns where possible.

The strategy aims to provide (i) technical, environmental and economic assessment at an appropriate level to enable strategic decisions to be taken and to guide development of specific schemes or solutions; and (ii) the basis of an agreement concerning the general direction of future policy, identifying areas of conflict and developing partnership with key stakeholders. The strategy plan provides for sound decision-making based upon a wide-ranging appraisal, which takes account of all key issues.

This strategy provides a plan for the provision of defences up to the year 2053. Notwithstanding this, it is recognised that new information, and changes in policy could result in changes to this strategy in forthcoming years. Therefore, this document should be seen as a basis for high-level decision-making at this time, which will evolve in the future as experience is gained and as external factors change. It is recommended that this strategy should be reviewed and updated at regular intervals not exceeding 5 years.

The appraisal has been carried out in accordance with the PAG Series of documents and takes account of the FCDPAG3 supplement dated March 2003. The choice of an appraisal period of 50 years and an optimism bias of 35% is based on a number of considerations including:

- i. Timber groynes are the only proposed hard structure investment and these have an estimated life of 30 years.
- ii. The principal asset, namely the shingle bank, is already in place. It will fail within a few years if not maintained and will not deteriorate at all if it is. Factors other than deterioration, such as future shingle availability and climate change, will dictate any alteration to the proposed maintenance regime. The five-year strategic reviews are the appropriate forum for considering this.
- iii. In the Cooden to Cliff End Strategy a 35% optimism bias was proposed on the basis of the experience gained on the adjacent PPP contract where the risk figure finally agreed on the original Agency estimate was only 15%. Taking this figure for that part of the investment proposed in shingle and 60% for that in the remainder gave an aggregate

figure of 35%. For the Cuckmere to Redoubt and Redoubt to Cooden strategies a higher proportion of the investment relates solely to shingle recharge. A figure lower than 35% may therefore be justified, however in view of the relationship between these strategies it would seem appropriate that a consistent figure of 35% is used.

The soundness of the strategic decision using these figures has been checked using the respective figures of 100 years and 60% in the sensitivity analysis undertaken in the Economic Appraisal in Appendix D.

2.1.1 Environmental Baseline

The following section provides a brief synopsis of the key issues and legislative framework for the strategy frontage. It identifies designated sites of international, national and local importance and other project related areas, as well as a range of agricultural, commercial, public and domestic properties that would require protection in the event of flooding. Issues relating to the local environment are fully described in the Strategic Environment Assessment (Appendix E).

(a) Ecology and Nature Conservation

The coastline and low-lying areas inland between Redoubt and Cooden support a rich and diverse range of species and habitats of national and international importance (see Figure 2.2). Of particular note are Pevensey Levels, which are recognised as being of international importance for birds and wetland habitats and are now designated as a Ramsar Site (see Figure 2.1). The Levels are also recognised at a national level and classified as the Pevensey Levels SSSI/NNR. Some areas of the Pevensey Levels are owned and managed by the Sussex Wildlife Trust.

Regionally and locally important sites of nature conservation significance have been identified by Local Authorities in consultation with the Sussex Wildlife Trust. These sites have been designated as Local Nature Reserves (LNRs) and Sites of Nature Conservation Importance (SNCIs). There are no LNRs within this study area, although SNCIs lying within or adjacent to the intertidal area are listed below:

1. Prince William Parade SNCI – Swards of vegetated shingle, rough grassland and wasteland.
2. East Langney Level SNCI - This has an area of shingle vegetation of high quality. The Crumbles also has excellent potential for lichen. However, since 1993 much of the site has been incorporated within the Sovereign Harbour development, reducing the potential for nature conservation interest.
3. Playing Fields, Sovereign Centre SNCI – Scrub habitat comprising a mixture of dense grey and goat willow, a small area of fen type community, hawthorn, blackthorn and gorse. Notable species of slender birds foot trefoil.
4. Pevensey Bay SNCI – Evidence of shingle ridges supporting closed turf community.
5. Shingle Beach at Normans Bay SNCI - Comprises two areas of important vegetated shingle habitat and herb-rich grassland habitat on the landward slopes.

The terrestrial Natural Area Profiles that are of relevance to this study are Low Weald and Pevensey Bay.

(b) Settlements, Commerce and Industry

Eastbourne is one of the largest coastal resorts in the region, with over 2 million visitors per annum supporting an estimated 5,600 jobs. Eastbourne is one of the largest providers of tourist accommodation in the south-east, outside London, with numerous hotels, guesthouses and other forms of visitor accommodation.

Sovereign Harbour is the site of a new residential and commercial development centred round the creation of a marina at the western end of The Crumbles. Part of this development is built on two landfill sites.

This strategy considers the lower-lying, north-eastern end of Eastbourne, which is a mainly residential area and the developments along the coastal frontage of Pevensey Bay and Norman's Bay. The majority of these houses date from the inter-war period and are largely located on the shingle bank at the back of the beach. Small housing estates are also developing inland on the Levels. Several large caravan parks also exist along this frontage on either side of the A259 Eastbourne Road, some of which contain a number of static caravans.

The village of Pevensey, located 1.5km inland on the edge of the Levels, is dominated by Pevensey Castle and is a popular visitor attraction, consisting chiefly of residential and tourism related development. Many of the buildings within the main street of the village date from the 16th and 17th centuries whilst more recent development has tended to follow the A259 Pevensey Bay Road.

(c) Archaeology and Cultural Heritage

Three of the six Martello towers and the fortress, which line this frontage, have been designated Scheduled Monuments (Figure 2.2). Other SMs in the study area include Pevensey Castle, chapel sites, Medieval salt workings and Medieval and Neolithic remains.

There are twelve Conservation Areas within Eastbourne, only one of which, the Town Centre and Seafront Conservation Area, lies within the study area and in close proximity to the seafront. Much of Pevensey village has been included within the Pevensey and Westham Conservation Area due to its considerable architectural and historic interest. The only area of High Townscape Value of relevance is an area abutting the Town Centre Conservation Area in Eastbourne.

English Heritage have identified the south coast, particularly at Pevensey Levels, as being of very high archaeological potential with many known wreck sites offshore and in the intertidal zone. Known wrecks include the *Barn Hill*, together with the remains of two World War II aircraft close to the low water line of Pevensey Bay.

2.1.2 Synopsis of Previous Planning and Strategies

Existing documents relating to coastal defences and planning policies for this area have been reviewed, and a synopsis is provided below. Where appropriate, information from these previous studies has been incorporated in this strategy study.

(a) South Foreland to Beachy Head Shoreline Management Plan

The South Foreland to Beachy Head SMP is a non-statutory document, which was prepared for a consortium of local councils and the National Rivers Authority (now part of the Environment Agency). The area is divided into Management Units, reflecting zones where a coherent management approach is required in terms of coastal defence and considers opportunities for realignment. It should be noted that the Management Unit boundaries have

been reviewed as part of this Study, in the light of more detailed analysis. The SMP recommends a policy of Hold the Line throughout the study area.

(b) Eastbourne

Posford Duvivier has undertaken numerous studies along the Eastbourne frontage over the last 15 years. These studies culminated in the design and construction of a £30 million timber groyne and shingle recharge scheme along the whole Eastbourne frontage, which was completed in 2000. This scheme was designed to provide a 1 in 200 year protection standard for the next 50 years. A Beach Management Plan was produced in 1999 and has been agreed in principle with Defra until 2003/04, after which time the recommendations of this Strategy are expected to be implemented.

(c) Pevensey Bay Sea Defence Strategy

Mouchel/Risk & Policy Analysts produced a strategy for Pevensey Bay in 1997. Much of this study was based on the findings of various reports by Babbie from 1991-97. It was intended to provide a strategic framework for sea defence at Pevensey Bay based on interim MAFF (now Defra) guidance, in addition to being a source document for the promotion of the subsequent Private Finance Initiative.

(d) Pevensey Bay Sea Defences Public Private Partnership

In May 2000, the Environment Agency awarded a Public Private Partnership (PPP) contract for the Pevensey Bay Sea Defences to Pevensey Coastal Defence Limited (PCDL). The contract is for 25 years and PCDL will maintain the Existing Sea Defences, carry out Improvement Works and then maintain the Improved Sea Defences for a monthly fee. The contract is based on the provision of a service rather than the purchase of a physical asset. PCDL will be responsible for the design of all works it considers necessary to meet the Service Requirements. It will also be responsible for liaising and consulting with all Relevant Authorities and Stakeholders, obtaining all necessary consents and producing an acceptable Environmental Statement.

The main service to be provided is to protect against breaching and erosion of the sea defences up to specified service levels. PCDL's design concept to provide these services is to evolve from the existing groyned beach to a more open beach over a period of years. Improved service levels have been provided by a recharge of approximately 200,000 m³ of shingle in the summer of 2002 and continuing to make use of the remaining life of the existing groyne field to inhibit littoral drift and to maintain discontinuities. As the groyne field continues to deteriorate, it is envisaged that a further 100,000 to 150,000 m³ of shingle will be added and also some new breastwork and control structures may be constructed as the transformation to a more open beach takes place.

The timing, extent and nature of the latter recharge and new structures will be determined from comprehensive monitoring and increased understanding of beach behaviour during the first few years. Annual beach replenishment with 20-25,000m³ of shingle, beach maintenance and reprofiling, will be carried out to maintain the existing and improved services. Some recycling will be undertaken to combat the increased littoral drift expected with an open beach.

(e) Sovereign Harbour Development

Recent defence works have been completed to the immediate east of Sovereign Harbour, and comprise the construction of a rock revetment and beach recharge. This revetment will

normally be partly buried in shingle, and will serve as a back-stop defence line. The primary defence will continue to be the shingle beach, which will need to be regularly maintained to counter erosion downdrift of the harbour arms.

(f) Local Plans

There are several statutory and non-statutory documents that steer development activities within the study area. These are notably:

- The East Sussex and Brighton & Hove Structure Plan 1991 – 2011 (November 1999)
- The East Sussex and Brighton & Hove Waste Local Plan (December 1998, Consultation Draft)
- The East Sussex and Brighton & Hove Minerals Local Plan (October 1999, Modified Plan as Intended for Adoption)
- The Wealden District Local Plan
- The Rother District Plan (Consultation Draft, February 1995)
- Eastbourne Borough Plan
- Local Environment Agency Plan (LEAP) for Cuckmere and Pevensey Levels
- East Sussex Coastal Strategy Plan
- Sussex Biodiversity Action Plan

The East Sussex and Brighton & Hove Structure Plan stresses that development and change will be required to sustain, conserve and where possible enhance the character, local diversity and quality of the landscape and natural environment. This includes maintaining the coastal environment, and taking measures to restore character where it has been damaged. It promotes special consideration for the Sussex Heritage Coast in Local Plans. The Rother, Eastbourne and Wealden Local Plans have been prepared in general conformity with the adopted Policies and Proposals of the East Sussex and Brighton & Hove Structure Plan.

The Rother District Local Plan has a strong emphasis on the importance of maintaining the natural and historical environment, which is partly because 80% of the District is located in the High Weald AONB. Development in areas prone to erosion is controlled, but there are no policies restricting development in areas at risk of flooding beyond those included in PPG25. Further details on plans are contained within the Strategic Environmental Assessment (Appendix E).

2.2 Problem

2.2.1 Coastal erosion and flooding

The study area has been identified as being at risk from both widespread flooding through breaching of the defence line, and (east of Sovereign Harbour) erosion of assets located on the beach crest itself. The beach crest from Redoubt Gardens to Sovereign Harbour currently has a standard of protection of 1:200-years due to the recent installation of coastal defence measures comprising shingle recharge and timber groynes. Although a number of improvements have been carried out to the east of Sovereign Harbour in the last twenty years, the current standards of protection against flooding and erosion of the beach crest would be inadequate in the absence of the PFI contract, and would vary from 1:20-years to >1:400-

years. A breach anywhere between Redoubt Gardens and Cooden could lead to flooding in the entire risk area (see Figures 3.1 – 3.5 in Appendix D).

Figure 2.3 shows the volume of shingle retained along the study frontage over the past 30 years. These volumes include recharge activities over that period and, when these quantities are subtracted, a long-term rate of loss of 22,000 m³/yr is derived. It should be noted that the sharp increase in the beach volumes between Redoubt Gardens and Sovereign Harbour post 1994 is due to beach recharge carried out along the Eastbourne frontage. The long-term loss of shingle from the beaches, and the impacts of climate change, will lead to an increasing threat of flooding unless appropriate defence measures are implemented.

2.2.2 Historic reports of events

The most recent major beach erosion event at Eastbourne predates the existing defence scheme. On February 17th 1990, the defence line was breached and shingle spilled onto the road when 100mph winds coincided with a high tide.

To the east of Sovereign Harbour a storm on 24th October 1999 damaged more than 50 crest-top properties. Insurance claims after this event are thought to have been well in excess of £1 million. The residents of Normans Bay were evacuated in the Christmas period of 2000 when there was considered to be a significant risk of a breach in the shingle embankment. Windows of the properties immediately behind the defence line were broken by shingle, which was thrown up by wave action.

Waves overtop the shingle bank on a regular basis in some locations, causing localised flooding to roads.

2.3 Option Selection

2.3.1 Baseline scenario

Under a ‘do-nothing’ scenario, it is assumed that no further action would be taken in terms of maintaining current defences. In such a case, the defences would quickly fail along the Sovereign Harbour and Pevensey Bay frontages, leading to loss of property through erosion and wide-spread flooding, as described below. The Present Value damages of a ‘do-nothing’ scenario total £1,055m. The vast majority of these damages would be encountered in Years 2 and 7 of the strategy, when defences on different lengths of the frontage would reach the end of their residual life (see Economics Report in Appendix D for more details).

(a) Flooding

A large part of this area would be affected by flooding under a ‘do-nothing’ scenario (see Figure 2.4). This includes a large number of residential, and commercial properties, many of which lie on the outskirts of Eastbourne and are associated with the tourist industry. Also at risk would be the retail park and properties situated within the Sovereign Harbour development. Recreation and tourism pursuits would be significantly affected under a ‘do-nothing’ scenario, through regular flooding of the area leading to a reduction in the appeal of the area as a whole.

In the first year of the strategy, the beach crest from Beachlands to Culver Croft Bank is at risk from failure during a storm event of $\geq 1:20$ -years. Year 2 of a ‘do-nothing’ case would signal the failure of the beach crest at Sovereign Harbour and to the east of Beachlands,

initiating flooding under annual events. The value of asset loss in Year 2 is high, partly due to the cost of rebuilding the railway line away from the flood area. Year 7 of the strategy would see the failure of the entire frontage east of Sovereign Harbour except for the very north-eastern extents of the study area, which is predicted to fail in Year 15. The severity of flooding would gradually increase due to the effects of sea-level rise.

(b) Coastal Erosion

Coastal erosion losses under a 'do-nothing' scenario would be less extensive than those resulting from flooding, but still significant in places. The frontage from Redoubt Gardens to Sovereign Harbour has been substantially upgraded in recent years and this has resulted in a reduction in the likely coastal erosion in this region. The absence of beach management and groyne maintenance along the Eastbourne town frontage would result in a loss of a least 10,000m³/yr of shingle (ref. ABMS analysis 1970-2000). The risk of flooding and/or erosion of the promenade would increase such that defence standards fall from a 1:200-year standard to a 1:1-year standard before Year 15 (Eastbourne Beach Management Plan, Posford Duvivier, 1999).

The shingle ridge, which forms the defence along the majority of the frontage east of Sovereign Harbour, would be at significant risk from erosion. The majority of the 98 crest-top properties at Beachlands, Normans' Bay, and in the White Horses area, would be lost during the life of the strategy in the absence of defence measures.

2.3.2 Policy Options

In assessing the options for defence, consideration has been given to the suitability of the coastal defence line for advance or retreat, in addition to holding the existing line of defence. Advancing the line is not a viable option for this frontage and would interrupt sediment transport to beaches further east. Maintaining or holding the present defence line is a viable and logical solution for the frontage, but there remains the possibility of retreating the defensive line and allowing some or all of the Levels to be inundated on a regular basis. This latter option would involve the construction of new secondary defences in order to protect the significant assets that line The Levels.

Such a secondary flood defence bund could be constructed from Beachlands to Pevensey (length 3.8km), in conjunction with enhancement of the beach crest from Eastbourne up to and including Beachlands to provide a consistent high standard of defence to this developed area. Effectively this option would protect the more significant assets to the west to a higher standard than the assets at Normans' Bay and on the Pevensey Levels, in line with the indicative standards for each area (FCDPAG3, Table 6.1).

The cost of constructing such a flood defence bund is estimated at nearly £15m. It has been concluded, therefore, that whilst this strategy represents a feasible concept, the cost of constructing a secondary flood defence would not offer an economic method of improving the standard of protection. Indeed, the assets that would be defended by the secondary defence bund could be protected to the same degree but at lower cost by raising the defence standard along the beach line from Sovereign Harbour to Cooden. This would also have the added value of affording a high standard of defence to those assets on the Levels and at Norman's Bay.

2.3.3 Strategic Options

The overall strategic options relate to providing a certain level of protection or “standard of service” to the study frontage, and can be categorised by the following:

- Maintain
- Sustain
- Improve the Standard of Service

For all options, the quantity of shingle leaving the frontage at Cooden (i.e. the net eastward transport rate) has been fixed at 7,000m³ per year in order to compare options on a level basis. This is in accordance with the existing drift rate, as derived in the Sediment Budget Report, and the neighbouring Strategy Plan (Cooden to Cliff End) has demonstrated a reliance on this level of shingle input. In addition to this longshore loss, a further 15,000m³ per year is lost through winnowing of fines and offshore migration. In all options described below, 7,000m³ per year would be recycled from the west to east of Sovereign Harbour and 4,000m³/yr from Cooden to Sovereign Harbour. Clearly, if a lesser quantity is found to be accreting to the west of the harbour, then recycling would not be carried out to the detriment of updrift beaches. In such an instance, the remaining 15,000m³ per year of beach recharge that is required to maintain beach levels east of the harbour would be increased accordingly. The economic impacts of insufficient material arriving to the west of Sovereign Harbour are considered in the sensitivity testing, described in Section 4.4 of the Economics Report (Appendix D).

(a) Maintain

The maintain option (which might equally be termed ‘do-minimum’ given that the existing defences predominantly comprise a shingle ridge) is based upon the ‘least-cost’ option for preserving the existing defences by carrying out repair works as and when necessary but without raising the standard of protection. This option would result in a steady decline in the standard of service against flooding as sea levels rise as well as preserving the disparity in defence standards either side of Sovereign Harbour. The current level of defence between Sovereign Harbour and Cooden is already as low as 1 in 20 in some locations. Between Redoubt Gardens and Sovereign Harbour the recently completed Eastbourne Scheme is designed to provide a 1 in 200-year standard up to 2049.

From Redoubt Gardens to Sovereign Harbour maintenance of the beach crest and recently constructed groynes would be undertaken to preserve the 1:200-year standard of protection. A minimum of 35 groynes would be required to effectively maintain a beach between Sovereign Harbour and Cooden. Over 50 years the standard of defence between Sovereign Harbour and Cooden for this option can be expected to decline to 1 in 5 years. Ongoing monitoring of beach levels would be required to ensure the strategy objectives are being achieved.

(b) Sustain

The sustain option would maintain the current standard of service, and would compensate for the increased flood and erosion threats due to sea level rise and climate change. In order to achieve the same standard of service over the next 50 years, it would be necessary to provide additional beach material to raise beach levels yearly between Sovereign Harbour and Cooden. From Redoubt Gardens to Sovereign Harbour only maintenance of the beach crest and the recently constructed groynes would be necessary to preserve the 1:200-year standard of protection. A minimum of 35 groynes should also be maintained between Sovereign

Harbour and Cooden, as for the maintain option. Constant monitoring and ongoing maintenance of the coastal defences would need to be undertaken.

(c) Improve the Standard

Options to improve the standard of service include measures to both maintain structural integrity and to reduce the potential for coastal erosion or water ingress. For the study area, the improved standards of service were set at 1 in 50 and 1 in 200 years (commensurate with defence standards just below and within the indicative standards respectively for land use Band A as defined in FCDPAG3).

The current standard of defence between Redoubt Gardens and Sovereign Harbour meets the indicative standard of 200 years, and consideration has not been given to raising the standard further. Therefore this option can be called 'Sustain' for this part of the frontage.

For the length of coastline between Sovereign Harbour and Cooden, the following strategic options have been considered for the 'Improve the Standard' scenario:

- A) Recharge and manage the frontage as an open beach;
- B) Recharge and manage the beach with a reduced number of groynes and beach recycling; or,
- C) Recharge and manage the beach with the existing number of groynes.

A comparison of these options is provided in Appendix C. The preferred improve the standard option is Option B. In this scenario, an initial recharge campaign would be undertaken, to improve the defence standard to either 50 or 200 years. Groynes would be retained in key locations (43 No.) to manage the beach line in areas of significant discontinuity, such as at Sand Castle (see Plate 2 in Appendix C). As only key groynes would be retained (with a focus on the western part of this frontage where drift rates are highest), the net drift rates eastward would be expected to increase to a value of 11,000m³ per year. This additional movement of shingle would be managed within the strategy frontage using beach recycling of the extra material (4,000m³/yr). Following the initial beach recharge campaign, annual losses from the frontage of 22,000m³ would be replaced using 7,000m³ recycled around Sovereign Harbour and a further 15,000m³ of annual recharge.

Consideration has been given to the use of either timber or rock groynes. In both cases, it is assumed that existing groynes in key locations would only be replaced upon expiry of their residual lives. Whilst rock groynes have a greater longevity than timber groynes, their higher initial capital cost results in a preference for timber groynes to be retained under this option.

2.4 Environmental Impact Assessment

2.4.1 Strategic Environmental Assessment

The methodology adopted in the Strategic Environmental Assessment (SEA), Appendix E, focussed on the determination of environmental objectives for the study area. These objectives were compiled from both an assessment of the existing environment and through consultation with relevant stakeholders. The environmental impacts of the 'do nothing scenario' and each of the strategic 'do something' options were then assessed as set out in chapter 7 of the SEA and evaluated against the objectives.

A summary of the principal impacts on the main receptors for each of the options is as follows:

Do-Nothing

By approximately year 15 nearly all the protected area will be subject to flooding on every high tide resulting in the loss of :

14,000 properties

The A259 and South Coast Rail Link

The Pevensey Levels, a fresh water habitat of international importance now designated as a Ramsar site.

Part of the existing vegetated shingle (although new habitats may be created downdrift)

Several Scheduled Monuments

An important tourist and recreational area.

A large area of pastoral farming

Bexhill's potable water supply

Against the above losses will be the creation of a new saline environment, which could lead to the establishment of rare saltmarsh habitat in the long-term.

Maintain (Do-Minimum)

As a result of the gradual decline in defence standards to 1 in 5 years by the end of the appraisal period:

The more exposed properties at Beachlands and Normans Bay are likely to be lost

Two Martello towers (Scheduled Monuments) will be lost

The coastal edge of the Pevensey Levels and the grazing fields will become more saline.

Disruption to transport links will increase

The area of vegetated shingle will be reduced.

Sustain, 50 year and 200 year improve options

All these options seek to conserve or improve the existing environment and avoid the losses set out under the do-nothing option. The principal difference between the options is the degree of damage to properties and stress to human beings in storms.

All the do something options require a highly managed beach with annual replenishments of shingle raising the potential conflicts set out in the next section. The difference between the options centres on the quantity of shingle placed during the initial works. The 200 year improve option by increasing the volume of the shingle bank will contribute to the preservation and enhancement of the nationally important vegetated shingle habitat so contributing to the Defra biodiversity target for increasing the range and quality of this priority habitat.

The SEA concludes that both the human and natural environments will be best served by holding the line along the strategy frontage rather than allowing natural coastal processes to take place without interference. The SEA also identifies the preferred 'improve 200 year' option identified on economic and technical grounds to be the preferred environmental option.

2.4.2 Potential Conflicts

Nature conservation objectives for vegetated shingle habitat are likely to conflict with the use of the beach for recreation. Given the high degree of public pressure along this frontage, particularly during the summer months, some compromise will have to be found to enable the beach to be used for recreation whilst having separate areas that can be left undisturbed for the benefit of nature conservation. These areas may need to be fenced or other methods found to divert beach users to other parts of the beach. These pressures are greatest at Pevensy Bay and Normans Bay beaches, and remaining areas of vegetated shingle at the Crumbles, Eastbourne.

Shingle recycling activities can damage the vegetated shingle habitat along the frontage. The recycling of shingle involves machinery tracking up the shingle bank to redistribute the material. If this process is to take place, mitigation should be implemented and methods of working agreed to avoid damage. Recycling activities, however, help to protect the saline lagoon and grazing marsh habitats along the Levels that are at risk in the long term from sea level rise.

Depending on the type of defences proposed for the areas, there is the potential for a negative impact on the natural coastal processes. This area is a popular tourist location, and therefore conflict could arise from the need for sea defence and the negative effect on landscape appeal that could result.

2.4.3 Consultation

A consultation exercise was carried out to highlight any social issues that may be unresolved by legislation or otherwise relevant to the strategy proposal. As part of this exercise, it was important to gather all relevant information, to consult interested parties on their activities and objectives relating to the area, and to draw on their knowledge and experience. Consultation took place in two stages. The initial stage comprised data gathering and yielded information that was used to highlight the environmental objectives for the study. Subsequently, once a preferred strategy was developed in line with these objectives, detailed consultation was undertaken only with those users who would be directly affected by the implementation options, or who had expressed particular concerns. English Nature have reviewed the SEA (Appendix E) and have approved the modifications that were subsequently made. A letter from English Nature confirming that it is generally happy with the SEA is included in Appendix E.

2.5 Cost of Options

Cost rates come from recent similar schemes and the combined experience of the client team, as shown in Table 2.1.

Work	Rate
Shingle Placement	£20/m ³
Shingle Recycling	£7/m ³
Beach Maintenance	£10/m ³
Groyne Construction (timber)	£1000/m
Groyne Maintenance	£60/m
Monitoring	£1/m

Table 2.1 Construction Rates

Defence intervention options that are considered to be technically and environmentally sustainable were identified and their Present Value (PV) costs using a 3.5% discount rate, including an optimism bias of 35% are shown in Table 2.2. The intervention options refer to the section from Sovereign Harbour to Cooden, but the 'sustain' costs for the Redoubt Gardens to Sovereign Harbour are included in these options. All capital works are subject to a 15% cost for design and supervision. For further information on the derivation of these costs, please refer to Section 4 of the Economics Report (Appendix D).

Option	PV Cost (£k)
Maintain	40,658
Sustain	41,648
Improve 50yr	51,762
Improve 200yr	54,498

Table 2.2 Option Costs

2.6 Benefits of Options

2.6.1 Benefits from Flood and Erosion Avoidance

Table 2.3 summarises the benefits and costs for the intervention options for the Redoubt Gardens to Cooden frontage. Note that the intervention options refer to the section from Sovereign Harbour to Cooden, but the 'sustain' costs for the Redoubt Gardens to Sovereign Harbour are included in these options. The Present Value damages of this 'do-nothing' scenario total £1,055m. The vast majority of these damages would be incurred in Years 2 and 7 of the strategy, when different lengths of the frontage would be subject to Residual Life Failure. The value in Year 2 is significant due to the cost of rebuilding the railway line away from the flood area (£69.5m).

	Costs and benefits £k				
	Do-nothing	Maintain	Sustain	Improve 50yr	Improve 200yr
PV costs	-	40,658.17	41,647.93	51,762.09	54,497.59
PV damage	1,054,999.69	102,260.30	77,618.84	21,042.69	6,849.34
Total PV benefits		952,739.39	977,380.85	1,033,957.00	1,048,150.35
NPV		912,081.22	935,732.92	982,194.91	993,652.76
Benefit/cost ratio		23.43	23.47	19.98	19.23
Incr. b/c ratio			24.90	5.59	5.19

Table 2.3 Summary of Benefits and Costs

2.7 Choice of Preferred Option

2.7.1 Introduction

A generic description of the preferred strategic approach for the strategy frontage is provided in Section 2.7.2. Separate implementation plans are provided for the Redoubt Gardens to Sovereign Harbour, and Sovereign Harbour to Cooden frontages in Appendix F. These preferred strategic options would normally be developed in greater detail at scheme appraisal stage, prior to implementation.

2.7.2 Preferred Strategy

The preferred option for Redoubt Gardens to Sovereign Harbour is ‘Sustain’. This option comprises the following:

- Maintain and replace the existing timber groynes, and maintenance of the beach profile; and,
- Enhanced monitoring to measure performance of recent coast defence scheme (notably to record recharge losses and movement eastward). Monitoring will be linked to the south-east regional monitoring programme, where feasible.

The preferred option for Sovereign Harbour to Cooden is ‘Improve 200yr’. This option comprises the following:

- Import shingle (374,000m³) to increase standard of protection;
- Maintain and replace timber groynes at key locations only (43 of the existing 132 groynes to be retained).
- An annual recharge programme will be instituted, with 16,500m³ of material imported to the Sovereign Harbour to Cooden frontage annually. This will be supplemented by annual shingle recycling of approximately 11,000m³; 7,000m³ transported around the Sovereign Harbour Arms from west to east, and 4,000m³ transported from Cooden to the eastern side of Sovereign Harbour. It is anticipated that 7,000m³ of material will accumulate at Sovereign Harbour after moving along the frontage from Redoubt Gardens, with a similar quantity leaving the study area at the eastern end. This is in accordance with recorded movement in recent years; and,
- Ongoing monitoring of the beach levels on the whole study frontage will need to be carried out. Monitoring activities should include a visual inspection of the structures, bathymetric and topographic surveys, and be particularly focused on those areas considered to have the highest probability of failure. Monitoring will be linked to the south-east regional monitoring programme, where feasible.

Figure 3.1 and Table 3.1 list the full 5-year activity programme and 50-year strategy costs respectively. The Defra LDW13 prioritisation score for the study area is 32.

These recommendations, and the expenditure required to implement them, are in line with the approach taken by PCDL, the company employed by the Environment Agency to manage the Pevensey Bay coastal defences under a Public Private Partnership (PPP) contract.

The Present Value (PV) cost of the recommended defence strategy for the Redoubt Gardens to Cooden area over 50 years is approximately £49.5 million of capital works plus approximately £5.0m of maintenance and monitoring costs. Expenditure over Years 0-4 (not discounted, but including 35% optimism bias) of the strategy is estimated to be approximately £18.8 million, as shown in Table 2.4, with an associated PV Cost of £18.3 million.

	Costs (£k)				
Year	0	1	2	3	4
Capital Cost	11,621	0	0	0	0
Shingle Recharge*	1,121	1,121	1,121	1,121	1,121
Shingle Recycling	104	104	104	104	104
Maintenance	174	151	172	152	176
Monitoring	49	35	35	35	35
Total	13,068	1,411	1,432	1,412	1,436

*including cost of mobilisation and demobilisation

Table 2.4: Strategy costs (not discounted) in the first five years

2.7.3 Consultation

It is recommended that further discussions are held with the local residents and statutory and non-statutory bodies upon approval in principle of the first five years of works. These discussions should seek to finalise the detail of the preferred scheme west of Sovereign Harbour, in order that the design is sympathetic to the heritage and conservation of the area. The preferred strategy for the frontage between Sovereign Harbour and Cooden requires no further consultation, being the subject of the PPP project.

2.7.4 Sensitivities and Risks

Sensitivity and risk play an important part in determining the preferred strategy and establishing a framework for risk management through its implementation. Risk management is increasingly being seen as an important part of project appraisal and project development. When undertaking works or operating schemes in the future it is important that the risks are identified and appropriate actions are taken. This includes ongoing monitoring for the strategy area in order to assist in future strategy reviews. Early consultation with all parties, statutory or non-statutory is also important and reduces the likelihood of misinformed objections to schemes at a later date.

The preferred strategy has a benefit cost ratio of 19.2. It has been thoroughly tested in terms of economic sensitivity as shown in section 4.4 of the Economic Appraisal in Appendix D. Increasing the optimism bias to 60% will result in a benefit cost ratio of 16.2, and extending the appraisal period to 100 years changes the benefit cost ratio to 16.3. It is considered therefore, that this is an economically robust strategy.

2.7.5 Conclusions

The preferred option, when applying the ‘decision process’ set out in Section 6 of the FCDPAG3 guidelines, is ‘Improve 200yr’ for the frontage from Sovereign Harbour to Cooden. As the recently installed groyne and recharge scheme along the Eastbourne frontage (from Redoubt Gardens to Sovereign Harbour) is designed to provide at least a 1:200-year standard of protection, up to and including Year 49 of the strategy period the preferred strategy is ‘Sustain’. The strategy has been approved by Eastbourne Borough Council. It is recommended that this PAR is submitted to Defra for Agreement in Principle to the first five years of works to the west of Sovereign Harbour (see Implementation Plans in Appendix F).

The management of the Pevensey Bay frontage is controlled under a PPP contract, which will run until 2025. One of the objectives of this strategy has been to reappraise the PPP contract

in terms of value for money and appropriateness. The recommendations of this strategy plan are substantially in agreement with the approach adopted to date and the proposals for the remainder of the contract.

2.7.6 Robustness of Decision

The basis of the case for intervention on the study frontage is the magnitude of damage that would be sustained if a 'do-nothing' approach were to be adopted. Whilst the flood scenarios described in this report for a 'do-nothing' scenario could be contested, there is little doubt that frequent breaching of the beach crest would result in considerable damage to assets on the front itself and in the developed areas on the eastern side of Eastbourne. Once this premise is accepted, the most appropriate form of intervention becomes the critical issue. Although the 'Maintain', 'Sustain' and 'Improve 50yr' options all have high b/c ratios, they would provide an insufficient standard of protection for the Sovereign Harbour to Cooden frontage, according to the FCDPAG3 guidelines.

Under the best estimate of damages and costs, the chosen options are robustly demonstrated to be the preferable option with an incremental b/c ratio of 5.19. Protection to the beach crest through shingle placement is shown to be an economic method of further protecting assets at risk. Given the high incremental benefit cost ratio, subsequent analysis may justify raising the indicative level of protection, but there is confidence that the most economic method of defence improvement has been identified.

3 Project Plan

3.1 Overview

The coastal defence strategy for the Redoubt to Cooden frontage has been developed to meet the following objectives:

- Prepare a 50-year strategy for the management of flood and erosion risk that is technically viable, environmentally sound and economically justified;
- Avoid detrimental effects to neighbouring coasts;
- Prepare a detailed programme of works for the first five years of the strategy;
- Provide a sound basis for reviewing the strategy on a 5-year cycle, to account for the results of monitoring and advances in understanding.

The preferred strategy supports the recommended policy set out in Local Plans and in the Shoreline Management Plan for South Foreland to Beachy Head, which is to hold the existing defence line. The preparation of this PAR follows an assessment of the sediment budget for the coastal cell bounded by Beachy Head and Copt Point, Folkestone. In this manner, it has been possible to address any potential effects on neighbouring frontages by reference to a wider geographical study.

This PAR is one of three that have been prepared under the Beachy Head to Rye Harbour Coastal Processes and Resources study (see Scoping Report, Halcrow, 2000), namely:

1. Cuckmere to Redoubt Gardens, Eastbourne;
2. Redoubt Gardens to Cooden;
3. Cooden to Cliff End.

3.2 Scope of Works

The proposed scope of works are set out in the form of Implementation Plans for each area in Appendix F, and comprise:

Redoubt Gardens to Sovereign Harbour

- Monitoring costs of £22,950 per annum, comprising annual maintenance, topographic and bathymetric surveys. Monitoring will be linked to the south-east regional monitoring programme where feasible, supplemented by structural inspections.
- Yearly beach and groyne maintenance costs averaging at £29,600 per annum.
- Reconstruction of 40 groynes (assumed to be timber of 80m length) in Year 30, costing £4.97m.

Sovereign Harbour to Cooden

- Monitoring costs of £12,150 per annum. As part of the southeast regional monitoring package, supplemented by structural inspections.
- Shingle placement of 374,000m³ costing £11.62m in Year 0
- Annual shingle recharge of 16,500m³ to account for losses, costing £1.12m (including £675,000 for mobilisation/demobilisation)

- Annual recycling of 11,000m³ shingle costing £104,000: 7,000m³ transported around the Sovereign Harbour Arms from west to east and 4,000m³ transported from Cooden to the eastern side of Sovereign Harbour.
- Reconstruction of 43 groynes (assumed to be timber of 80m length) in Year 5 and 30, costing £5.34m.
- Significant groyne maintenance in Year 20 and 45 costing £290,250.
- Groyne and beach maintenance costing £125,550 per annum.

Shingle will be pumped ashore along a submerged pipeline, to which a trailer hopper dredger would connect when shuttling between the licensed donor site in the English Channel and the recharge location.

3.3 Key Assumptions

The positioning of the breach length along the Pevensey frontage could be a source of conjecture. Inspection of the flood mapping for Year 2 of the strategy shows however, that even when the breach is at a relatively undeveloped stretch of coastline between Beachlands and Normans' Bay, the flood waters cover the developed areas of Beachlands and Pevensey Bay under the annual event. This suggests that given the low-lying nature of this land, flooding from a breach anywhere in the beach crest would always propagate towards this location, thus making the assets located there unsustainable. As the majority of the damages come from the capital values of property at Beachlands and Pevensey Bay, the location of the first breach is therefore not considered critical.

The timing of the Residual Life Failure of the Pevensey defences is vital to the overall analysis. The projected failure of a short stretch of beach crest in Year 2 of the strategy may be considered too early. If the capital value currently written off in Year 2 (£216m) is delayed until Year 7 of the strategy, this reduces the overall Present Value damage value due to flooding to £1,023m, a fall of 3%.

Damage to property due to the erosion of the beach crest is not a major element of the analysis. At a PV of approximately £15m, this is only 1.4% of the overall damages, and so changes to this section of the damages will not make a significant difference to the overall value.

It is unlikely that there will be changes to the major beneficiaries of protection works. The most significant possible change to the analysis would be to accept the annual flooding (or greater) of the railway line. This would effectively mean that the current capital rebuild cost of the current line at £69m would be replaced by an annual disruption cost. This reduces the overall PV damages to £990m, a decrease of 6% (see Annex F in Appendix D). The value of the pumping station (£0.5m) abandoned under a 'do-nothing' scenario is negligible relative to the total value of damages.

Cost rates have been agreed by consensus within the Client Group, and have been applied to all strategy plans identified in Section 3.1. Costs include for an optimism bias of 35%, but no contingency has been applied to any of the costs. Nonetheless, sensitivity tests on the potential costs of these works, which are dominated by the cost of shingle recharge, have been carried out.

3.4 Status of Proposals

A programme of Works is provided in Figure 3.1 and a cost profile for the full 50-year strategy is included in Table 3.1. Detailed costs for the first five years are set out in the Implementation Plans (Appendix F).

When carrying out beach recharge, groyne construction and beach recycling activities, care must be taken to minimise the disturbance to any vegetated shingle within the project area. Timber for replacement groynes should be obtained from sustainable sources, with accreditation from bodies recognised by the Environment Agency.

The coastal defence strategy plan, upon which this PAR is based, has been accepted by English Nature (see correspondence in Appendix E). Eastbourne Borough Council has also approved the strategy plan.

The recommendations of this strategy should be implemented across the entire frontage, and failure to do so could increase the risk of coastal defence failure.

3.5 Procurement

This strategy addresses a frontage under the management of a PPP service provider, who should be engaged in discussions on procurement options.

There are clear opportunities for combined packages of works, with co-operation between the operating authorities. The annual recharge / recycling campaign should be let as a combined contract across both units considered in this PAR, and should also be linked to similar works recommended in neighbouring coastal defence strategy plans for Cuckmere to Redoubt and Cooden to Cliff End.

Once this strategy has been accepted by the operating authorities and Defra, detailed recommendations for the first five years will be developed in conjunction with the current PPP contract. At this stage, a Planning Supervisor should be engaged under the Construction (Design and Management) Regulations, 1994 and a Health and Safety Plan should be developed.

Year	Capital	Maint- enance	Comment	Moni- toring	Total Cash	Present Value
0	12,845,183	174,150	Shingle placement, recharge, recycling and maintenance	48,600	13,067,933	13,067,933
1	1,224,720	150,863	Shingle recharge, recycling and beach maintenance	35,100	1,410,683	1,362,978
2	1,224,720	172,463	- do -	35,100	1,432,283	1,337,051
3	1,224,720	152,213	- do -	35,100	1,412,033	1,273,572
4	1,224,720	175,703	- do -	35,100	1,435,523	1,250,975
5	6,565,320	139,388	Groyne construction, beach recharge, recycling and maintenance	62,100	6,766,808	5,697,470
6	1,224,720	139,388	Shingle recharge, recycling and beach maintenance	35,100	1,399,208	1,138,256
7	1,224,720	160,988	- do -	35,100	1,420,808	1,116,742
8	1,224,720	139,388	- do -	35,100	1,399,208	1,062,574
9	1,224,720	167,400	- do -	35,100	1,427,220	1,047,196
10	1,224,720	145,800	- do -	62,100	1,432,620	1,015,611
11	1,224,720	175,230	- do -	35,100	1,435,050	982,931
12	1,224,720	152,213	- do -	35,100	1,412,033	934,460
13	1,224,720	173,813	- do -	35,100	1,433,633	916,671
14	1,224,720	152,213	- do -	35,100	1,412,033	872,328
15	1,224,720	175,703	- do -	62,100	1,462,523	872,966
16	1,224,720	139,388	- do -	35,100	1,399,208	806,931
17	1,224,720	139,388	- do -	35,100	1,399,208	779,644
18	1,224,720	160,988	- do -	35,100	1,420,808	764,908
19	1,224,720	139,388	- do -	35,100	1,399,208	727,806
20	1,224,720	457,650	Groyne maintenance, recharge, beach recycling and maintenance	62,100	1,744,470	876,711
21	1,224,720	145,800	Shingle recharge, recycling and beach maintenance	35,100	1,405,620	682,528
22	1,224,720	175,230	- do -	35,100	1,435,050	673,255
23	1,224,720	152,213	- do -	35,100	1,412,033	640,054
24	1,224,720	173,813	- do -	35,100	1,433,633	627,870
25	1,224,720	152,213	- do -	62,100	1,439,033	608,922
26	1,224,720	175,703	- do -	35,100	1,435,523	586,896
27	1,224,720	139,388	- do -	35,100	1,399,208	552,704
28	1,224,720	139,388	- do -	35,100	1,399,208	534,014
29	1,224,720	160,988	- do -	35,100	1,420,808	523,920
30	11,533,320	132,638	Groyne construction, beach recharge, recycling and maintenance	62,100	11,728,058	4,178,454
31	1,224,720	163,350	Shingle recharge, recycling and beach maintenance	35,100	1,423,170	489,898
32	1,224,720	141,750	- do -	35,100	1,401,570	466,148
33	1,224,720	171,180	- do -	35,100	1,431,000	459,841
34	1,224,720	148,163	- do -	35,100	1,407,983	437,145
35	1,224,720	172,463	- do -	62,100	1,459,283	437,751
36	1,224,720	150,863	- do -	35,100	1,410,683	408,862
37	1,224,720	174,353	- do -	35,100	1,434,173	401,614
38	1,224,720	139,388	- do -	35,100	1,399,208	378,572
39	1,224,720	139,388	- do -	35,100	1,399,208	365,770
40	1,224,720	160,988	- do -	62,100	1,447,808	365,676
41	1,224,720	139,388	- do -	35,100	1,399,208	341,451
42	1,224,720	167,400	- do -	35,100	1,427,220	336,509
43	1,224,720	145,800	- do -	35,100	1,405,620	320,209
44	1,224,720	175,230	- do -	35,100	1,435,050	315,858
45	1,224,720	429,638	Groyne maintenance, beach recharge, recycling and maintenance	62,100	1,716,458	365,021
46	1,224,720	139,388	Shingle recharge, recycling and beach maintenance	35,100	1,399,208	287,492
47	1,224,720	139,388	-do -	35,100	1,399,208	277,770
48	1,224,720	139,388	-do -	35,100	1,399,208	268,377
49	1,224,720	139,388	- do -	35,100	1,399,208	259,301
Totals	88,505,663	8,307,968		2,011,500	98,825,130	54,497,594

Table 3.1 50-year cost stream for Preferred Strategy, including an optimism bias of 35%