

## **ADDENDUM TO STRATEGY APPRAISAL REPORT**

An Addendum has been added to the PAR to test the economics of delaying the intervention by Havant BC on the southern frontage from 06/07 to 07/08, 08/09 & 11/12. It is also necessary to delay the EA work at Bracklesham Road by splitting the scheme PAR, design and construction document preparation cost from the construction cost and moving the construction cost to 2007.

The Executive Summary and Business Case have been revised accordingly. Figures struck through and replaced originate from the July 2006 Addendum.

The Addendum is located in the Appendix.

**ENVIRONMENT AGENCY**

**HAVANT BOROUGH COUNCIL**

**STRATEGY APPRAISAL REPORT**

**HAYLING ISLAND: EASTOKE SECTORAL STRATEGY STUDY  
OCTOBER 2006**

**SUBMISSION TO ENVIRONMENT AGENCY  
NATIONAL REVIEW GROUP**

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## 1 EXECUTIVE SUMMARY

### **SUBMISSION TO OBTAIN STRATEGY APPROVAL**

**Southern Region: Hayling Island Eastoke Sectoral Strategy**

**Approval Value: £44,109,000**

**Sponsoring Director: Paul Leinster - Director of Operations**

*Section A9 of the Financial Scheme of Delegation states that, for whole life costs in a Flood Risk Management Strategy, Chief Executive approval is required between £10,000,000 and £50,000,000.*

<b>Approval Route:</b>	National Capital Programme Manager	Miles Jordan
	National Review Group	David Cotterell
	Regional Director	Howard Davidson
	Director of Operations	Paul Leinster
	Director of Finance	Nigel Reader
	Chief Executive	Barbara Young
	Defra	not required
	Treasury	not required

### 1.1 INTRODUCTION AND BACKGROUND

Eastoke Peninsula lies to the south east of Hayling Island on the south coast of England. It is a low-lying predominantly residential area. 1,743 residential properties are at risk from flooding.

This strategy covers the northern frontages (Northern Main and Bracklesham Road) and the southern frontages of the peninsula (Southern Main and Eastoke Point).

The Environment Agency is the operating authority for the flood defence walls on the northern frontage. Approval to construct the Eastoke Northern Main frontage works was given by the Environment Agency Board in September 2004, in advance of Defra approving the strategy. This was due to the extent of flood risk in the area. The works have now been completed.

The shingle beach on the southern frontage is maintained by Havant Borough Council (HBC). Beach recycling, as recommended by the strategy has been implemented annually since 1992.

HBC is currently planning a capital shingle recharge for the Southern Main frontage for 2006/2007, as recommended by this strategy, for which they received consent under the Town and Country Planning Act 1990. HBC are also undertaking long term studies to better understand the geomorphology of Sandy Point.

The works recommended by the strategy will be carried out under the Water Resource Act 1991 and Coast Protection Act 1949.

The Strategy recommends works to protect the Peninsula from coastal erosion and flooding over a 100 year appraisal period.

Approval of this strategy is requested particularly as HBC need to implement their shingle recharge in 2006/2007. The Environment Agency also needs to complete the works to the

Northern Bracklesham Road frontage in ~~2006~~2007. Should funding not be available for either scheme in 2007, this strategy demonstrates that the business case remains robust for the following five years.

## **1.2 PROBLEM**

The Eastoke Peninsula is protected by a beach to the south and walled defences to the north. It is bounded to the south by the English Channel, to the east by the entrance to Chichester Harbour and to the north by an inlet within Chichester Harbour known as Eastoke Creek. There is a single access road onto the Peninsula.

Piecemeal walls on the Northern Frontage provide a 5% standard of protection (SOP). The works completed on the Northern Main frontage in advance of the strategy provide a 1% SOP.

Currently, the beach along the Southern Frontage of the Peninsula offers protection against erosion for a 0.5% return period storm. However, there are a few locations where the beach is less effective against overtopping and the current SOP against flooding is between 10% and 5%.

The Peninsula is entirely surrounded by a Candidate Special Area of Conservation, whilst Chichester Harbour is designated as a Site of Special Scientific Interest, a Special Protected Area / Ramsar site and an Area of Outstanding Natural Beauty.

The Peninsula has been subject to coastal flooding on a number of occasions (1978, 1979, 1985 and recently in 2005) and flooding from an extreme surge in 1989. The principal concern along the coastal frontage is that if unmanaged, the shingle beach would erode leading to a breach causing widespread flooding of properties. Equally, surges within Chichester Harbour have historically threatened to overtop the poorly maintained seawall on the northern frontage, which if breached would lead to widespread flooding.

Without intervention the Peninsula would be cut-off and 1,743 properties, a nature reserve, marina, sailing club, extensive holiday chalets and caravan parks and associated infrastructure would be lost through flooding from both the northern and southern frontages. The access road onto the Peninsula is also at risk.

The risk area is defined as land use Band A, with an indicative 1% to 0.33% SOP.

## **1.3 OPTIONS**

The Peninsula has been split into four frontages for the benefit of the strategy. The primary options considered for each are shown below. The operating authority for each is shown in brackets:

- Southern Frontage – Main Section (Havant Borough Council)
  - Beach management.
  - Revetment / rock groynes.
  - Seawall.
  - Offshore breakwater.
  
- Southern Frontage – Eastoke Point (Havant Borough Council)
  - Beach management.
  - Revetment / rock groynes.

- Inland flood defence.
- Northern Frontage - Main Section (Environment Agency)
  - Full scheme of wall raising and replacement.
  - Phased scheme of wall raising and replacement.
  - Full scheme of raising inland road.
- Northern Frontage – Bracklesham Road (Environment Agency)
  - Full scheme of embankments and road raising.
  - Phased scheme of embankments and road raising.

No action is proposed for Black Point Spit on the Bracklesham Road frontage, as it is an area of single ownership private land.

#### **1.4 PREFERRED OPTION**

The preferred option for each frontage is:

- Southern Frontage – Main Section (Havant Borough Council)
  - Beach management to consistent 0.5% SOP. The present value cost of this option is ~~£9,017k~~ £8,867k.
- Southern Frontage – Eastoke Point (Havant Borough Council)
  - Hold the Line to provide protection to a 0.5% SOP. The present value cost of this option is £2,681k.
- Northern Frontage - Main Section (Environment Agency)
  - Phased scheme of wall raising and replacement to a 1% SOP. The present value cost of this option is £6,719k.
- Northern Frontage – Bracklesham Road (Environment Agency)
  - Phased scheme of embankments and road raising to a 1% SOP. The present value cost of this option is ~~£777k~~ £770k.

#### **1.5 ECONOMIC CASE AND PRIORITY SCORE**

The following table shows the key information for the strategy:

**Table 1.1**

Location	Havant Borough Council Southern Frontages*	Environment Agency		Total
		Northern Frontage Main	Northern Frontage Bracklesham Road	
Present Value Benefits £k	<del>£75,142</del> £73,788	£44,838	£9,460	<del>£129,440</del> £128,086
Present Value Costs £k	<del>£11,698</del> £11,549	£6,719	<del>£777</del> £770	<del>£19,194</del> £19,038
Net present value £k	<del>£63,442</del> £62,240	£38,119	<del>£8,683</del> £8,690	<del>£110,246</del> £109,049

Benefit cost ratio	<del>6.42</del> 6.39	6.67	<del>12.17</del> 12.29	<del>6.74</del> 6.73
Priority score	Economics <del>12.5</del> , People 8.7, Environment 0, Total <del>21.2</del> <i>Economics 12.4, People 8.9, Environment 0, Total 21.3</i>			
Assets protected	No. of residential properties: 1743, no. of other properties 25 Primary road network on the Peninsula, local utilities Areas of habitat protected/enhanced: 5 hectares			
Asset improved	Future maintenance of over 3.2 km of shingle beach providing coastal protection against erosion and overtopping and the upgrading/extension of 1.8km of sea wall providing flood defence			
Current threshold	Generally 0.5% but between 10% and 5% in places	5%	5%	
Proposed SOP	0.5%	1%	1%	
Key programme dates	Construction in 2007, capital recharge in <del>2006</del> 2007, annual beach monitoring and recycling	Completed	Construction in <del>2006</del> 2007	

\* Main and Eastoke Point combined.

## 1.6 ENVIRONMENTAL CONSIDERATIONS

Environment Agency policy from 2004 is to complete SEA for Flood Risk Strategies. However, a full SEA was not produced as part of this strategy update as the strategy commenced in 2000. The current status of flood defence policies is well developed on the Peninsula (with policy options for schemes along the southern and northern frontage already having been developed and implemented), therefore a Strategic Environmental Framework Report (SEFR) has been completed. The SEFR summarises the environmental constraints and decision making but does not comprise a formal SEA document. Subsequent projects resulting from the Eastoke Sectoral Strategy will be subject to Environmental Impact Assessment.

The other relevant existing environmental reports for the Peninsula are:

- Eastoke Beach Renourishment Scheme: Environmental Statement, Halcrow (2005).
- Eastoke Northern Flood Defence Scheme: Environmental Statement, Atkins (2003).
- Eastoke Northern Flood Defence Scheme: Addendum to Appropriate Assessment and Environmental Statement, Atkins (2004).

The following designations apply to the Peninsula:

- Langstone, Chichester Harbour and Sandy Point Sites of Special Scientific Interest.
- Chichester Harbour and Langstone Harbour Special Protection Areas.
- Chichester Harbour and Langstone Harbour Ramsar sites.
- The Eastoke Peninsula lies on the boundary of the Solent Maritime Candidate Special Area of Conservation.
- Sandy Point Local Nature Reserve.

The Eastoke Peninsula is predominantly residential with extensive caravan sites and is accessed from the larger part of Hayling Island by a single highway that is at risk from flooding and erosion.

There are no Scheduled Ancient Monuments on the Eastoke Peninsula. There are two sites identified on the Sites and Monuments Register; a post-medieval saltern and an early-medieval settlement.

There are no footpaths directly affected by the recommendations of the strategy. However, the beach along the Southern Frontage is an important asset for both recreation and tourism in the area (refer to Indicative Landscape Plan, Figure 7).

Planning approval will be required for Eastoke Point.

Coastal squeeze losses of 1ha have been identified for maintaining the line along the main northern frontage, and 0.4ha at Sandy Point. We are actively seeking to create compensatory habitat through the Southern Region Habitat Creation Programme and individual feasibility studies.

The schemes for the southern and northern main frontages are supported by Environmental Statements and Appropriate Assessments. The inland line at Bracklesham Road will result in minimal risk of environmental impact and it is anticipated that an Environment Agency level four environmental impact assessment will be required.

## **1.7 RISKS**

The following table shows the five highest risks and mitigation associated with the implementation of the strategy:

**Table 1.2**

<b>Risk</b>	<b>Key Mitigation</b>
Acceptance of strategy by stakeholders	Stakeholders fully engaged in development of strategy and subsequent schemes.
Damage to the environment during the works	Continued assessment and mitigation at scheme level, including addressing the need for habitat creation.
Operation of the defences	Flood management plans in place, especially for operation of floodgates.
Reliance on regular capital funding	Maintain a rolling 5 year programme for approval by the Environment Agency.
Climate change	Ongoing monitoring of the defences and climate change. The option selected has some potential to be adaptive to climate change.

## **1.8 IMPLEMENTATION**

Subject to Environment Agency approval, the strategy will be submitted to Defra on behalf of Havant Borough Council, who will apply directly to Defra for funding for the southern frontage works. This strategy supports their application.

The plan of action recommended by the strategy is shown in the table below:

**Table 1.3**

EASTOKE STRATEGY 5 YEAR ACTION PLAN						
Year	2004	2005	2006	2007	2008	2009
Appraisal Year	1	2	3	4	5	
SOUTHERN FRONTAGE						
			<del>Capital Recharge</del>	<i>Capital Recharge</i>		
	Eastoke Point Study					
	Eastoke Point Works					
	Monitoring	Monitoring	Monitoring	Monitoring	Monitoring	Monitoring
	Groyne / Splash wall Maint.	Groyne / Splash wall Maint.	Groyne / Splash wall Maint.	Groyne / Splash wall Maint.	Groyne / Splash wall Maint.	Groyne / Splash wall Maint.
	Recycling	Recycling	Recycling	Recycling	Recycling	Recycling
NORTHERN FRONTAGE						
			<del>Bracklesham Road Works</del>	<i>Bracklesham Road Works</i>		
	Northern Section Flood Defences					
	Solent Dynamic Coastline Study					
						Habitat Creation
	Maintenance	Maintenance	Maintenance	Maintenance	Maintenance	Maintenance

The scheme at Bracklesham Road will be developed through the Environment Agency National Capital Programme Management Service using a framework consultant and framework contractor.

Works on the southern frontage will be managed and procured in accordance with HBC's procurement rules. HBC and the Environment Agency will investigate joint procurement opportunities to realise potential economies where the similar nature and programme of the works allows.

The capital whole life cost of the strategy including maintenance over the 100 year appraisal period is shown in the table below:

**Table 1.4**

Location	Havant Borough Council Southern* Frontage <sup>1</sup>	Environment Agency		Total
		Northern Main <sup>2</sup>	Bracklesham Road <sup>3</sup>	
Environment Agency/HBC Staff Costs	£230k	£140k	£16k	<b>£386k</b>
Consultants Fees	<del>267</del> £268k	£559k	£70k	<b>896 £897k</b>
Construction Costs	£3,003k	<del>2,069</del> £2,096k	£100k	<b>5,172 £5,199k</b>
Compensation	£30k	£100k	£30k	<b>£160k</b>
Contingency	<del>1229</del> £1,530k	£336k	£130k <sup>2</sup>	<b>1,695 £1,995k</b>
Future Costs	£17,456k	<del>6,930</del> £6,931k	£600k	<b>24,986 £24,987k</b>

Future Contingency	£6,536k	£3,588k	£360k	<b>10,484</b> <b>£10,485k</b>
Whole Life Cost (WLC) inc. Maintenance	<del>29,052</del> £29,053k	£13,750k	£1,305k	<b>44,107</b> <b>£44,109k</b>

<sup>1</sup> 30% optimism bias applied to works up until year 50, 60% optimism bias for beyond year 50

<sup>2</sup> 60% optimism bias for future upgrading of the Eastoke Northern Frontage scheme.

<sup>3</sup> 60% optimism bias applied to the Bracklesham Road Frontage

\* Main section and Eastoke Point combined

## **1.9 CONTRIBUTIONS AND FUNDING**

The Environment Agency will be responsible for implementing and obtaining funding for the Northern Frontage schemes. HBC will be responsible for implementing and obtaining funding for the southern frontage studies and schemes.

### **1.10 STATUS**

The current standard of protection on the Peninsula varies between 10% and 5% for uncompleted works.

The preferred strategy option is to provide a 0.5% SOP shingle beach along the southern frontage and a 1% SOP flood defence wall along the northern frontage. These standards are maintained throughout the 100 year appraisal period of the strategy, including the predicted impacts of sea level rise.

Further investigations are required for the Eastoke Point section of the Southern frontage to determine whether 'Hold the Line' or 'Retreat to an Inland Line' is most appropriate.

The strategy is in line with the recommendations of the East Solent Shoreline Management Plan.

The strategy contributes to the Defra and Environment Agency Service Delivery Agreement target to protect houses. 1,743 residential properties will be protected through the recommendations of the strategy.

The strategy whole life cost is less than £50 million and Natural England have advised that the strategy will lead to an environmentally acceptable solution, therefore the Environment Agency does not require Defra approval. However as works proposed by Havant BC to the Southern Frontage will be undertaken under the Coast Protection Act (1949), the strategy must be submitted to Defra on behalf of Havant BC by the Environment Agency as Lead Authority.

### **1.11 RECOMMENDATIONS**

The Environment Agency Chief Executive is recommended to approve under A9 scheme of delegation, the Hayling Island, Eastoke Sectoral Strategy Study at a whole life cost of £44,109,000. The cost includes £12,480,000 of contingency, and includes maintenance.

HBC is responsible for the Southern Frontage and will obtain £29,053,000 of the cost, including maintenance and £8,066,000 of contingency.

## **2 BUSINESS CASE**

### **2.1 INTRODUCTION AND BACKGROUND**

#### **2.1.1 Location**

The Eastoke Peninsula is a low lying area situated on Hayling Island protected by a beach to the south and sea defences to the north (Figure 1). It is bounded to the south by the English Channel, to the east by the entrance to Chichester Harbour and to the north by inlet of Eastoke Creek within Chichester Harbour. The Peninsula is entirely surrounded by a Candidate Special Area of Conservation (cSAC), whilst Chichester Harbour is designated as a Site of Special Scientific Interest (SSSI), a Special Protection Area (SPA)/ RAMSAR site and an Area of Outstanding Natural Beauty (AONB).

#### **2.1.2 Purpose of Report**

This report is seeking strategic approval of works to protect the Peninsula from coastal erosion and flooding. The application is made in accordance with the Defra Flood and Coastal Defence Project Appraisal Guidance. Works would be undertaken by Havant Borough Council (HBC) acting under the Coast Protection Act 1949 and by the Environment Agency acting under the Water Resources Act 1991.

Approval is sought via the Environment Agency's Scheme of Delegation for this Strategy. This approval would retrospectively support the Environment Agency's previous investment in flood defence works to the northern frontage and the provision of flood defences to the Bracklesham Road frontage, as well as creation of habitat to offset potential losses due to coastal squeeze.

#### **2.1.3 Previous History**

A number of reports have been completed establishing the background and requirements for this strategy, these are as follows:

- East Solent Shoreline Management Plan, Report EX 3441 HR Wallingford, High Point Rendel, 1997.
- Hayling Island Coast Defence Strategy, Atkins, 1997.
- Strategic Environmental Assessment for Hayling Island, Atkins, 1997.
- Beach Management Strategy Plan (BMSP) for the Southern Frontage of Eastoke Peninsula: Appraisal Report, Havant Borough Council, 1999.
- Eastoke Northern Frontage, Hayling Island; Sub-Strategy Report, Atkins, 2000.
- Eastoke Sectoral Strategy Report, Atkins. 2002
- The Solent Coastal Habitat Management Plan, Final Report, Royal Haskoning, 2003.

A strategy report was prepared for the Peninsula in May 2002 and subsequently submitted to the Environment Agency's National Review Group in November 2003 prior to submission to Defra. The flood defences along the main northern frontage were in urgent need of upgrading to defend the local community from the risk of flooding. To address this need the Environment Agency implemented a sea defence scheme for the northern frontage in February 2004, by taking forward the preferred option from the May 2002 strategy. The preferred option was to upgrade on the existing line by upgrading and replacing the existing vertical sea walls. The scheme was described in the Eastoke Northern Frontage Project Appraisal Report (Atkins, 2004).

The outturn construction costs for the work substantially exceeded the estimates made in the 2002 strategy necessitating this revision of the strategy. In addition to the flood defence works along the northern frontage, the shingle recycling for the southern frontage continues in line with the recommendations in the 2002 strategy. A capital recharge scheme will be required to support the recycling activities and further work to protect Eastoke Point. This revised strategy will support HBC's application for grant-in-aid. Further information on beach management can be found in the BMSP referenced above.

## **2.2 PROBLEM**

### **2.2.1 History of Flooding**

The Peninsula has been subject to coastal flooding on a number of occasions (1978, 1979, 1985 and recently in 2005) and flooding from an extreme surge in 1989. The key concern along the coastal frontage is that, if unmanaged, the shingle beach would erode leading to a breach causing widespread damage to properties, the loss of the main feeder road into the Peninsula and frequent flooding to the many properties constructed below Mean High Water (MHW). Equally, surges within Chichester Harbour have historically threatened to overtop the poorly maintained seawall, which if breached would lead to widespread flooding.

Both HBC and the Environment Agency have been evolving a strategic approach to the Peninsula because of the magnitude of the flood and erosion risks. HBC closely monitors the beach and has strong evidence of the importance of continuing to manage the beach. A coastal storm in 1985, prior to a major shingle recharge of the beach, caused widespread flooding and nearly breached the buried seawall. Since then the beach has been well managed (through shingle recharge, recycling and monitoring), such that similar storms are managed and flooding is limited. Their records indicate that the beach would be lost within 10 years if the current programme of management was to be stopped.

The Environment Agency has had major concerns about the risk of flooding from within Chichester Harbour. Trial pit inspections and structural inspections of the privately constructed walls (forming a sea defence) along the Eastoke Creek produced evidence that these walls lacked any structural integrity and in many cases were in very poor condition. Without action, there is no guarantee that the defences would sustain an extreme surge. Figures 2A, 2B and 2C show the extent of erosion and frequent flooding which would occur across the Peninsula should no action be taken.

### **2.2.2 Assets at Risk**

The purpose of coastal and flood defence to Eastoke Peninsula is to protect a large community of residential properties, community support services, business, tourism and recreation. The assets at risk and being considered for protection by this strategy are as follows:

- The primary road network on the Peninsula.
- 1743 residential properties.
- Sparkes Marina.
- Sandy Point Local Nature Reserve.
- Hayling Island Sailing Club.
- Extensive holiday chalets and caravan parks.
-

### **2.2.3 Why a Strategy is Required**

The extent of the Eastoke Peninsula is shown in Figure 1. The south west limit is the junction of Sea Front Road and Bound Lane, and progressing in an anti clockwise direction includes: the southern shingle beach; Eastoke Point; the shingle beach adjacent to Chichester Harbour entrance; Black Point Spit; the inlet adjacent to Wittering Road, Sparkes Marina; and the northern defences overlooking Eastoke Creek. The north west limit is at the head of Eastoke Creek.

The study boundaries are deemed appropriate as ground levels rise at the western end of the Peninsula above the level of flood risk identified by this study, and are coincident with adjacent strategic management units, for example the Selshire and Mengham frontage.

A strategic approach is highly desirable for the Peninsula in order to optimise the environmental opportunities and to ensure that the combination of investments in coastal protection and sea defence are both sustainable and meet Treasury requirements for national funding.

The strategy economically justifies its recommendations for an appraisal period of 100 years based on an assessment of flood and erosion damages to the whole Peninsula. Consideration is given to the different technical and environmental options required at the different locations along the coastline. These are as follows:

#### Southern Frontage

- Main – from Bound Lane to Eastoke Point.
- Eastoke Point – from Eastoke Point to the southern end of Black Point Spit.

#### Northern Frontage

- Main – from Black Point Spit to the head of Eastoke Creek.
- Bracklesham Road / Black Point Spit - in the east of the study area.

### **2.2.4 Environmental Constraints and Objectives**

The Peninsula is subject to a number of environmental constraints as describe in Figure 3.

There is no statutory requirement to carry out Strategic Environmental Assessment (SEA) as part of this strategy. Environment Agency policy from 2004 is to complete SEA for Flood Risk Strategies. However, a full SEA was not produced as part of this strategy update as the strategy commenced in 2000 and was largely complete by 2003.

Instead a Strategic Environmental Framework Report (SEFR) has been completed. The SEFR summarises the project team's recognised environmental constraints and decision making but does not comprise a formal SEA document. Subsequent projects resulting from the Eastoke Sectoral Strategy will be subject to Environmental Impact Assessment.

The current status of flood defence policies on the Peninsula is well developed (with policy options for schemes along the southern and northern frontage already having been developed and implemented). The environmental objectives of the strategy are listed below and the detailed sub-objectives are outlined in Appendix 9, the SEFR. The environmental objectives are to:

- Avoid damage to human health and population and where appropriate enhance human environment (Human Health, Population).

- Protect and enhance biodiversity (Biodiversity, Flora and Fauna).
- Protect and enhance land quality (Soils).
- Protect and enhance water quality (Water).
- Protect existing infrastructure (Material Assets).
- Protect and enhance cultural heritage features (Cultural Heritage).
- Protect and enhance landscape character / visual amenity (Landscape).

These constraints have been considered in detail within the SEFR which has informed the selection of the preferred option. In addition, Environmental Statements and Appropriate Assessments further support the preferred option for the works that have already been completed or are being progressed for 2006.

The SEFR assessment identified that the most significant environmental effects from implementation are as follows:

- Coastal squeeze caused by the ‘hold the line’ option along Eastoke Creek where the foreshore is an important area of mudflat used extensively by over wintering birds. This is addressed within the scheme’s Environmental Statement and supporting Advice on Appropriate Assessment (Atkins, 2004). Through the Southern Region Habitat Creation Programme the Environment Agency is actively seeking compensation land to offset predicted 1.0ha loss of habitat due to 100 years of future coastal squeeze.
- Coastal squeeze caused by the “hold the line” option at the Sandy Point Local Nature Reserve, behind Eastoke Point may occur over the 100 year period, amounting to a potential loss of 0.4ha of the designated intertidal habitat.

In terms of landscape and amenity, the use of sustainable soft engineering management techniques is preferred on the southern frontage.

### **2.2.5 Climate Change**

Climate change is a key issue in developing a strategy for the Eastoke Peninsula. Sea level rise is incorporated at 6mm per year (i.e. 600mm over the appraisal period). The impacts of climate change on the wave climate affecting the southern beach are less predictable. However, in discussion with HBC, the recommendations for this frontage are adaptable to changes and a key element of the plan is the ongoing investment in monitoring and research.

### **2.2.6 Technical Objectives**

The strategic aims of this study are as follows:

- To reduce the risk of coastal erosion by providing protection against breaching of the defences and a reduction in coastal flooding.
- To reduce the risk of flooding from extreme surges.
- To provide clearly defined defences with good access for maintenance.
- To provide solutions which limit the impact on people and property.
- To provide solutions which are adaptable to sea level rise and climate change
- To provide amenity value.

## **2.3 OPTIONS CONSIDERED**

### **2.3.1 Overview**

In selecting a preferred option, this strategy has drawn on the technical analyses of a number of previous studies; these are described in Appendix 1. A summary of the technical baseline is included in Appendix 2. Options have been developed in light of the technical and environmental information such that viable options can be progressed. Consideration has been given to the following options:

- ‘Do Nothing’ option – assume no further action is taken.
- ‘Do Minimum’ options– a series of actions is taken to continue with the existing policy of protection.
- ‘Do Something’ options including:
  - Hold the line option.
  - Retreat to an inland line option.

The consequences of the ‘Do Nothing’ scenario are presented in Figures 2A, 2B and 2C. Figure 4 presents a summary of the preferred option, while Figures 5 and 6 show the options considered for the southern and northern frontages respectively. Further details of the Do Nothing scenario are contained in Appendix 3.

These options are now discussed.

### **2.3.2 ‘Do Nothing’ Option**

During the first 25 years, a total of 222 properties are written off due to erosion on the Southern Frontage and another 626 properties become unusable due to the frequency of flooding (greater than once in 5 years). In addition, 67 properties suffer some flood damage. The Sandy Point Local Nature Reserve is breached and routinely inundated. There is serious loss of amenity and commercial activities at the sailing club and marina are detrimentally affected.

In fifty years, 448 properties are written off due to erosion along the Southern Frontage. 979 properties in Eastoke are written off due to the frequency of flooding. 184 properties are written off due to blight from the loss of the only road access onto the Peninsula. There is extensive environmental loss due to the erosion of the beach, and loss of Sandy Point Local Nature Reserve. The sailing club and marina are unable to operate.

By the end of the appraisal period (100 years), erosion on the Southern Frontage has written off a total of 567 properties. 992 are written off due to the frequency of flooding on the Northern Frontage. 184 properties are written off due to blight from the loss of the only road access onto the Peninsula. The environmental damage is widespread as the Peninsula suffers significant erosion damage and frequent flooding. No commercial activity remains.

### **2.3.3 ‘Do Minimum’ Option**

A ‘Do minimum’ option would comprise limited works to continue with the existing defences, but no effort would be made to extend or improve the level of defence. With increasing sea level rise, the SOP would decline such that by the end of the appraisal period, the majority of the Peninsula would be at risk of flooding with a return period of less than 1 in 5 years. The Do Minimum options are as follows:

- Southern Frontage: Minimum beach recycling / recharge: This option involves the management of the existing shingle beach such that it provides a minimum standard of protection against erosion and overtopping. The beach would be maintained by recycling shingle from areas of accretion to depleted areas as required (approximately yearly), with occasional capital recharge when the beach is depleted.
- Northern Frontage: limited repairs to existing walls and deployment of sandbags as required. This option would see the continued maintenance of the existing walls as necessary. Failed walls would be repaired as required, but no effort would be made to upgrade the defence level. Where there are no current defences, flooding will become more frequent with climate change, and sandbags will be deployed during flood warnings.

### 2.3.4 'Do Something' Options

A range of 'Do Something' options have been considered for each section of the frontage. These include 'hold the line' options and 'retreat to an inland line' options. Appendix 3 contains details of the options and the selection process. There now follows a summary of the Do Something options by frontage/section.

### 2.3.5 Southern Frontage – Main Section

Currently the Southern Frontage is a shingle beach with a wide top crest running in front of an old seawall situated directly in front of residential properties. As discussed earlier, HBC implements a programme of beach management in order to maintain the width and height of the beach.

A wide number of options have been considered and are discussed below, however, the main issue along this frontage relates to the performance expected of the beach. HBC seeks to ensure that any coast protection measure is capable of withstanding the full force of a coastal storm with risk of a breach in the defences. In addition, such defences will limit wave overtopping. However, due to the occasional extreme waves within any storm, some water can be expected to overtop the defences in the form of spray or swash. To this end, HBC maintains a splash wall which limits overtopping water. Should the splash wall be overtopped, the surface water drainage along the inland roads is 'oversized' in order to dissipate surface flooding. HBC operates flood boards along the frontage and promotes a programme of education of property owners to provide local protection against spray and swash.

The options considered for the Southern Frontage are discussed below.

**Beach Management:** This option involves the management of the existing shingle beach such that it provides an adequate SOP against erosion and overtopping. The beach would be maintained by recycling shingle from areas of accretion to depleted areas as required (approximately yearly), with occasional capital recharge to replace losses (approximately 5 yearly). A beach management strategy would continue to operate detailed monitoring of performance so that management actions can adapt to seasonal variations and climate change. The current understanding of future climate change is that the wave climate could increase in severity and there is a potential change in the predominant wave direction. This matter has been considered for the long term, with some potential increase in recycling / recharge, being partly offset by improvements in operational efficiency being achieved year on year.

**Revetment / Rock Groynes:** This option would require the construction of rock revetment and rock groynes along the entire length of the Southern Frontage. The groynes would reduce longshore drift and provide a 'limited' beach, whilst the revetment would provide defence against erosion and overtopping. The initial design would defend against the impacts of climate change over a period of 50 years. A scheme upgrade would be undertaken in year 50. This option would have negative effects on the amenity value of the beach and potentially reduce shingle movement to the adjacent frontage.

**Seawall:** This option considers the construction of a new sea wall along the entire length of the Southern Frontage. The new structure would require a programme of ongoing maintenance with a significant refurbishment to be undertaken within the design life of the structure. This option would have significant negative effects on the amenity value of the beach and significantly reduce shingle movement to the adjacent frontage.

**Offshore Breakwater:** The creation of offshore breakwaters at a series of locations along the Southern Frontage would provide direct protection from wave attack and allow the formation of headland controlled beaches which would be resistant to longshore drift and provide protection to the backshore properties.

**Inland Flood Defence:** Under this option it is envisaged that defences would be left to fail and the beach would migrate as required to a natural retreated line. This option is similar to the "Do Nothing" scenario except for the use of management intervention to reduce health and safety risks.

A 'Do Nothing' option for this frontage (with works along other frontages) has been ruled out due to the extent of damages that would occur to the Peninsula.

### **2.3.6 Southern Frontage – Eastoke Point**

Eastoke Point is situated at the eastern end of the Peninsula, sweeping around from the south facing beach into the entrance to Chichester Harbour. The Point is important in retaining material for recycling on to the main frontage. However, the Point also suffers from extremes of material movement depending on the wave direction at any given time. The Eastoke Point frontage does not back onto properties but protects the Sandy Point Local Nature Reserve. There are a number of issues which HBC is considering along this frontage, which are as follows:

- A breach in the Eastoke Point defences would directly flood a significant area of Eastoke, therefore consideration needs to be given to providing a robust coastal defence.
- Options to retreat the line of defence within the Sandy Point Local Nature Reserve can be considered.
- There is a need to consider beach structures which improve the recycling opportunities for the main beach. This is of particular concern with regards to potential climate change scenarios.

The options considered for this location (similar to those presented above) include:

- Beach Management.
- Revetment / Rock Groynes.
- Inland Flood Defence.

### **2.3.7 Northern Frontage – Bracklesham Road / Black Point Spit**

A key constraint on the options available at this location is the ownership of Black Point Spit. As an area of single ownership private land, it would not qualify for Defra grant aid. However, the impact of ‘no action’ has been considered. Currently the Spit is considered to be morphologically stable and unlikely to change in its orientation in the foreseeable future. Therefore, this strategy is unable to promote a ‘hold the line policy’ (through public funding) for Black Point Spit. That said, there is a need to ensure that the future revision to the East Solent Shoreline Management Plan considers the private interests of the sailing club, which is situated on the north of the Spit, when determining the future current coastal protection policy for the Spit.

The risk of flooding on to the Peninsula from the Bracklesham Road area is not as high as elsewhere because ground levels are relatively high with a current SOP (with no flood defences) in excess of 1 in 20 years. However, with increasing sea levels, the risk of flooding from this location increases.

**Full Scheme of Embankments and Road Raising:** The inland line would provide a line of defence immediately in front of the residential properties along Wittering Road, Bracklesham Road, and the old hospital site to the life boat station. The initial scheme would include for 50 years of sea level rise, at which point the defences would be raised and extended.

**Phased Scheme of Embankments and Road Raising:** The same alignment as the full scheme, however, the initial works would be at a lower cost, through raising earth embankment and undertaking minor works to the road. A more significant scheme is proposed in 15 years, when sea level rise has greater effect. The scheme would then include for sea level rise to 50 years at which point the defences would be raised and extended.

Due to the limited nature of the flood risk at this location, a ‘Do Nothing’ option specific to this section has been considered alongside works to other frontages. An economic assessment for this scenario has been completed.

### **2.3.8 Northern Frontage – Main Section**

The existing line of defences (constructed by individual land owners) is situated between heavily developed private land with many types of accommodation including bungalows, houses, caravans and park homes under permanent and holiday type occupancy. In many cases, the properties are situated less than 5m from the foreshore. Additionally, most owners have some access onto the foreshore either in the way of a slipway or steps.

The existing defences face directly onto the boundary of the mudflats forming part of the cSAC, the SPA and RAMSAR site. To this end, there are major constraints on the options to upgrade or replace the existing defences.

A ‘hold the line’ option would require consideration of coastal squeeze. This is addressed within the scheme’s Environmental Statement and supporting Advice on Appropriate Assessment (Atkins, 2004). In accepting a preferred ‘hold the line’ option, the Environment Agency is actively seeking compensation land to offset predicted coastal squeeze losses of 0.5ha over the next 50 years.

The options considered are as follows:

**Full Scheme of Flood Defence Wall Raising:** This option would replace and extend the line of the existing defences along Eastoke Creek. There is limited working area as the foreshore is protected, and the hinterland is heavily developed up to the back of the existing walls. The option would see the construction of walls providing for sea level rise up to year 50 at which point the walls would be raised and extended.

**Phased Scheme of Flood Defence Wall Refurbishment, Upgrading and Wall Raising:** This option would replace and extend the line of the existing defences along Eastoke Creek. There is limited working area as the foreshore is protected, and the hinterland is heavily developed up to the back of the existing walls. The option would see the phased construction of flood defences upgrading the existing structures where possible and constructing replacement walls where the existing walls have failed. The approach would extend the life of the existing walls by 15 years, at which point they would be replaced to provide for sea level rise up to year 50. Beyond this point the walls would be raised and extended.

**Full Scheme of Raising Inland Road:** This option would provide an inland line consisting of new works aimed at protecting the properties to the south of a defined line on the Peninsula. Along the Main Northern Frontage, the location would be along the line of high ground behind the existing defences. This would consist of a combination of flood bunds, flood walls with ramped access, road raising and general ground raising. In locations of low ground there would be a need for provision of relatively substantial ground raising.

A 'Do Nothing' option for this frontage (with works along other frontages) has been ruled out due to the extent of damages that would occur to the Peninsula.

### **2.3.9 Screening of Options and Selection of the Preferred Option**

A process of selection and testing has been undertaken to determine the preferred option. The process is as follows:

- Initial consideration of options for 'Do Nothing', 'Do Minimum', 'Retreat to Inland Line' and 'Hold the line'.
- Undertake a 'reality check' on the initial options and reject any options which clearly fail on technical, environmental or economic grounds.
- Assess requirements for capital investment and maintenance for an appraisal period of 100 years, taking account of sea level rise and estimate costs each option.
- Compare whole life costs for options offering the same outcome (i.e. where two options offer the same benefits) and select the best value option for further consideration.
- Undertake full economic appraisal of options to determine best value option based on economic performance (in line with PAG3 decision model).
- Optimise the SOP for the preferred option.
- Complete sensitivity assessment on preferred option in consideration of the following:
  - Uncertainty in WL predictions.
  - Uncertainty in erosion rate along southern frontage.
  - Consideration of inflation on property valuations since assessment of 'Do Nothing' damages.

Details of this process are presented in Appendix 3 and are summarised below:

### 2.3.10 Screening: Southern Frontage – Main Section

- **Beach Management:** This option is considered viable on technical, environmental and initial economic screening.
- **Revetment / Rock Groynes:** Whilst this option is less attractive with regards to the environment impacts, it is considered viable for further consideration based on technical, environmental and initial economic screening.
- **Seawall:** This option is likely to have negative environment impacts, but is considered for the next stage of screening.
- **Offshore Breakwater:** This option is not considered after initial screening due to concerns over performance, safety and likely costs. Additionally, it is less attractive than beach management with regards to the environmental impacts.
- **Inland Flood Defence:** This option is not considered after initial screening due to the difficulties in finding a suitable location and concerns over the high costs for construction associated with significant impact of properties and the economic justification.

### 2.3.11 Screening: Southern Frontage – Eastoke Point

At this stage, all options discussed above are considered to be potentially viable. HBC acknowledges that further understanding of the processes is required, through long term studies to help develop our understanding of the geomorphological processes. The results will inform the next review of the strategy

For advancing this strategy, cost estimates for two options: Beach Management and Revetment / Rock Groynes have been undertaken so that future costs can be considered in the preferred scheme.

### 2.3.12 Screening: Northern Frontage – Bracklesham Road / Black Point Spit

- **Full Scheme of Embankments and Road Raising:** This option is considered viable on technical, environmental and initial economic screening.
- **Phased Scheme of Embankments and Road Raising:** This option is considered viable on technical, environmental and initial economic screening.

### 2.3.13 Screening: Northern Frontage – Main Section

- **Full Scheme of Flood Defence Wall Raising:** This option is considered viable on technical, environmental and initial economic screening.
- **Phased Scheme of Flood Defence Wall Refurbishment, Upgrading and Wall Raising:** This option is considered viable on technical, environmental and initial economic screening.
- **Full Scheme of Raising Inland Road:** This option is considered viable on technical, environmental and initial economic screening.

## 2.4 COSTS OF OPTIONS

Note: Figures struck through and replaced originate from the July 2006 Addendum located in the Appendix. They include price date of 2006Q2

### 2.4.1 Summary of Options Costs

The cost estimates prepared for this submission are based on a price date of 2005Q3. As far as possible, costs items have been obtained from direct reference to work completed (Northern Frontage Scheme) or from quotes for future works (HBC Beach Recharge). For other items where there is no direct data, cost estimates have been obtained from Contractors. Full details are provided in Appendix 4. There is now a summary of the screened options, with the PV and whole life costs, the preferred option for each frontage is highlighted.

**Table 2.1**

	Frontage / Section	Action	PV Cost	Whole Life Cost	Selected for Economic Appraisal
<b>Do Minimum</b>					
	All Sections	Minimum beach recycling / recharge to southern frontage. Repairs to existing walls and deploy sandbags as required along northern frontage.	£13,321k	£36,209k	Yes
<b>Do Something</b>					
	Southern Frontage: Main Section	Beach Management	<del>£9,017k</del> £8,867k	£25,793k	Yes
		Revetment / Rock Groynes	£20,392k	£28,661k	No
		Seawall	£20,392k	£28,661k	No
	Southern Frontage: Eastoke Point	Beach Management	£2,824k	£8,200k	
		Revetment / Rock Groynes	£2,681k	£3,260k	Cost used in preferred option
	Northern Frontage: Bracklesham Road	Full Scheme of Embankments and Road Raising	£948k	£1,245k	No
		Phased Scheme of Embankments and Road Raising	<del>£777k</del> £770k	£1,306k	Yes
		Do Nothing	£0k	£0k	Yes
	Northern Frontage: Main Section	Full Scheme of Embankments	£7,038k	£12,879k	No
		Phased Scheme of Embankments	£6,719k	£13,751k	Yes
		Full Scheme of Raising Inland Road	£9,050k	£14,530k	No

Where similar options provide the same economic benefit, then only the option with the lowest PV cost is considered further in this economic appraisal (i.e. more expensive options are rejected).

#### **2.4.2 Application of Risk to Cost Estimates**

Optimism bias has been applied to all elements of the options. There now follows a brief summary of its application:

- 30% optimism bias has been assigned to beach management options up to year 50, on the basis that the proposed option is a continuation of previous works for which designs, prices and implementation have already been completed. Beyond year 50, optimism bias has been raised to 60%.
- 60% optimism basis has been applied to all hard defence solutions. This is on the basis that further site investigation is required and there are many additional considerations e.g. H&S, amenity requirements, additional design requirements etc.

#### **2.4.3 The Preferred Option Costs**

In advance of the option selection presented in section 2.5, the costs for the preferred option are now provided as a point of reference.

The following table summarises the costs for the preferred option. Please note this table shows the combined HBC and Agency costs for the strategy as a whole. Specific costs for the Environment Agency and HBC are included in Appendix 4.

**Table 2.2**

<b>Eastoke Strategy Total Costs</b>		
	<b>Economic Appraisal (PV)</b>	<b>Whole Life</b>
Costs pre SAR		
Costs post SAR		
Environment Agency / HBC Costs	£372k £365k	£386k
Fees	£722k £717k	£727k
Investigations	£167k	£170k
Construction	£5,152k £5,045k	£5,199k
Compensation	£147k	£160k
Contingency	£1,958k £1,924k	£1,995k
Inflation (at 5%)		
Future Costs	£7,605k	£24,987k
Future Contingency	£3,069k	£10,485k
<b>Total</b>	<b>£19,194k £19,038k</b>	<b>£44,109k</b>

The price date is Q3 2005. PV is calculated in accordance with Defra guidelines for an appraisal period of 100 years. Interest has been calculated at 5% per annum.

#### **2.4.4 Environmental Mitigation and Enhancement**

The preferred option includes for environmental mitigation in the form of accommodation works within private land, allowances for obtaining materials from environmentally sustainable sources and working practices which take account of environmental constraints. In addition, the strategy includes an allowance for the management and implementation costs for creating habitat due to coastal squeeze as part of a wider regional project.

#### **2.5 BENEFITS OF OPTIONS**

Note: Figures struck through and replaced originate from the July 2006 Addendum located in the Appendix. They include price date of 2006Q2

Appendix 5 contains full details of the economic appraisal.

##### **2.5.1 Background**

The economic appraisal only considers the strategic performance when agreed works to all frontages are implemented thus protecting the properties and assets as a whole. No consideration is given to the performance of individual frontages.

For each frontage, options which are more expensive than others offering an equivalent performance have been rejected. The strategy only considers options which give differing economic benefits. For all frontages, except 'Northern Frontage: Bracklesham Road', there is a single best value cost 'Do Something' option. At Bracklesham Road, two potential options exist, either to do 'phased works' or to do 'Do nothing'.

The economic appraisal therefore considers the following strategic scenarios only:

- Do Nothing.
- Do Minimum.
- Do Something (1):
  - Southern Frontage – Main: Hold the Line - Beach Management.
  - Southern Frontage – Eastoke Point: Hold the Line.
  - Northern Frontage – Bracklesham Road: Do Nothing.
  - Northern Frontage – Main: Hold the Line: Phased Works.
- Do Something (2):  
(The principal difference being works to protect the Bracklesham Road Area)
  - Southern Frontage – Main: Hold the Line - Beach Management.
  - Southern Frontage – Eastoke Point: Hold the Line.
  - Northern Frontage – Bracklesham Road: Inland Line – Phased Works.
  - Northern Frontage – Main: Hold the Line: Phased Works.

These options offer the following standards of protection:

- 'Do Nothing' - following failure of the existing defences, the SOP would be zero.
- 'Do Minimum' – This option would provide an approximate standard of protection of 1 in 20 years Return Period in year 0, reducing to less than 1 in 5 years by year 50.
- 'Do Something (1)' – This option would not provide a minimum standard of protection through out the appraisal period, as flooding could occur from the Bracklesham Road area. The initial standard of protection would in excess of 1 in 20 years Return Period in year 0, reducing to less than 1 in 5 years by year 50.

- Do Something (2)' - This option would provide a minimum standard of protection of 1 in 200 years for southern frontage and 1 in 100 years for the northern frontage. Further assessment (discussed later) explains the selection of the SOP for the separate frontages.

### **2.5.2 Methodology – General Guidance**

Damage calculations were undertaken in accordance with the Defra guidance PAG3, as updated by the new Treasury Green Book, and according to the Multicoloured Manual (MCM) as published by the Flood Hazard Research Centre. The price date used for the damages database is May 2004 (as this was the date when the 'Do Nothing' Appraisal was completed (in support of the Northern Frontage PAR). However, an assessment of the increase in property prices between May 04 and Nov 05 has been considered by providing a sensitivity test on the preferred option against current property values.

A variable discount rate has been included; this is 3.5% for years 0 to 30, 3% for years 31 to 75, and 2.5% for years 76 to 99. This results in the PV factor of 29.9 according to the Defra Supplementary Note to Operating Authorities March 2003.

According to the Defra Supplementary Note of March 2003, 6mm per year should be allowed for sea level rise in the Southern Region of the Environment Agency. This has been included over the appraisal period of 100 years.

The economic appraisal accounts for the following sources of damage:

- Breach erosion (in the 'Do Nothing' option) leading to a breach of the defences in approximately 10 years time.
- Wave overtopping of the southern frontage, increasing if the beach is not maintained.
- Overtopping of the sea defences accounting for extreme surges and inundating the low areas behind the defences.
- Failure of the sea defences using a breach probability curve, which results in failure by year 15.
- The extent of flooding due to ponding within the Peninsula, by assessment of the volume of overtopping flow linked to the storage area of the low lying land.
- Sea level rise at 6mm per annum.
- Write off due to blight from the loss of the only road access.

### **2.5.3 Results of the Economic Appraisal**

The following table presents the benefits for each scheme based on scheme costs and damages avoided.

**Table 2.3**

	Do Nothing	Do Minimum	Do Something (1)	Do Something (2)
PV Costs	£0k	£13,321k	£18,417k £18,267k	£19,194k £19,037k
PV Damages	£80,133k	£47,425k	£12,097k £13,450k	£2,565k £2,556k
PV Assets	£56,826k	£4,954k	£4,954k	£4,954k
Total PV Benefits	£0k	£84,580k	£119,980k £118,555k	£129,440k £128,086k
Benefit Cost Ratio (BCR)		6.35	<del>6.51</del> 6.49	<del>6.74</del> 6.73
Incremental Benefit Cost Ratio (IBCR)			<del>6.93</del> 6.87	<del>12.27</del> 12.38

The level of benefits shown is indicative of the value of the schemes. The ‘Do Minimum’ achieves a high level of performance, as maintenance of the beach prevents erosion and the risk of the Peninsula being cut off. However, it does little to reduce the long term impacts of flooding and ultimately leads to loss of properties due to frequency flooding and does not provide protection to the indicative SOP.

The ‘Do Something (1)’ is effective in the short term, but is affected by sea level rise. Whilst it is effective, the flood route through Bracklesham Road would lead to frequent flooding of approximately 60 properties as sea level rise takes effect during the later part of the appraisal period. It does not provide protection to the indicative SOP.

‘Do Something (2)’ offers significant benefits and good management of the coastal and flood risk. Not only does this option provide the Peninsula with protection from erosion but, offers a high standard of protection from overtopping. This option is considered in further detail below for varying SOPs.

#### 2.5.4 Decision Rule

The risk area is defined as land use band A and therefore an indicative standard of protection recommended by the PAG3 is 100 to 300 years for coastal waters.

An assessment of the preferred SOP for the southern and northern frontages has been completed based on assessing the benefits which apply to each frontage without double counting. Scheme costs for the different SOP have been used taking account of the need to increase the extent of the works in order to provide a greater standard of protection throughout the 100 year appraisal period.

The decision rule has been applied to the southern frontage as follows:

**Table 2.4**

Southern Frontage	
<i>Decision Process</i>	<i>Response</i>
Consider option with highest BCR.	'Do Minimum' highest BCR 7.12
Is Standard within Indicative range.	No
Does next highest option have IBCR >1 robustly	Yes 1 in 50 years. IBCR 3.30
Is Standard within Indicative range.	No
Does next highest option have IBCR >1 robustly	Yes 1 in 100 years, highest IBCR 41.55 20.06
Is Standard within Indicative range.	Yes
Does next highest option have IBCR >3	Yes 1 in 200 years has an IBCR of 4.24 4.43
Does next highest option have IBCR > 3	No 1 in 300 years has an IBCR of 0.35 2.07
Southern Frontage Recommended Option 1 in 200 years	

The decision rule has been applied to the northern frontage as follows:

**Table 2.5**

Northern Frontage	
<i>Decision Process</i>	<i>Response</i>
Consider option with highest BCR	1 in 50 years BCR 7.70
Is Standard within Indicative range	No
Does next highest option have IBCR >1 robustly	Yes 1 in 100 years has an IBCR of 1.72
Is Standard within Indicative range	Yes
Does next highest option have IBCR > 3	No 1 in 200 years has an IBCR of 0.64
Northern Frontage Recommended Option 1 in 100 years	

This table demonstrates that delaying the works to the Northern Frontage Bracklesham Road from 2006/7 to 2007/8 does not alter the results of the decision rule.

### 2.5.5 Priority Score

The priority Score for the preferred option is:

• Economics	<del>12.5</del> 12.4
• No of People / Risk	<del>8.7</del> 8.9
• Environment	0.0
<b>Total</b>	<b><del>21.2</del>21.3</b>

### 2.5.6 Sensitivity Tests

Three sensitivity tests have been completed, these are as follows:

- Reduced extreme water levels: A sensitivity test has been completed to investigate the consequences of using extreme water levels which over estimate the risk.
- Reduced coastal erosion rate: A sensitivity test has been completed to consider a greater level of resistance to coastal erosion along the southern frontage.

- Inflation in house prices and rentals since economic baseline: A sensitivity test to consider the increase in house values is undertaken to consider the difference in economic performance between the base date used in the economic analysis (May 2004) and the current submission. ‘Do Nothing’ and ‘Do Something’ damages to assess the impact on these revised benefits.

The results for the three sensitivity tests are as follows:

**Table 2.6**

	BCR	Priority Score
Reduced Extreme WLs	<del>7.1</del>	<del>20.9</del>
	6.68	21.6
Reduced Coastal Erosion	6.0	19.9
Price Revision to <del>November 2005</del> May 2006	<del>7.3</del>	<del>22.3</del>
	7.19	22.0

In all cases, the sensitivity test would not change the selection of option and confirms that a healthy priority score is achieved across this range of alternative assumptions. Refer to Table 1 in the Addendum for the results of delaying the Southern Frontage Recharge until 2011/12.

#### **2.5.7 Environmental Benefits**

The preferred option is supported by the SEFR. The proposed mitigation and compensation measures identified in this SEFR and Advice on Appropriate Assessment are to:

- Offset coastal squeeze losses through the creation of new intertidal habitat.
- Avoid retreat into protected SPA terrestrial habitats.
- Restrict access across vegetated shingle habitats.
- Ensure that imported beach replenishment material is similar in geology, and grading as the existing shingle.
- Avoid deterioration of landscape value by maintaining or removing degraded defences.

## 2.6 ENVIRONMENTAL ASSESSMENT

### 2.6.1 Application of SEA legislation

There is no statutory requirement to carry out Strategic Environmental Assessment (SEA) as part of this strategy. Environment Agency policy from 2004 is to complete SEA for Flood Risk Strategies. However, a full SEA was not produced as part of this strategy update as the strategy commenced in 2000 and was largely complete by 2003.

Instead a Strategic Environmental Framework Report (SEFR) has been completed. The SEFR summarises the project team's recognised environmental constraints and decision making but does not comprise a formal SEA document. Subsequent projects resulting from the Eastoke Sectoral Strategy will be subject to Environmental Impact Assessment.

For consultation purposes the SEFR is a short, stand-alone report, included in Appendix 9.

### 2.6.2 Compliance with the Habitat Regulations (1994)

Where a plan or project could impact on a European Natura 2000 site (Special Area of Conservation, Special Protection Area, Ramsar) there is a requirement to undertake an Appropriate Assessment to ascertain adverse effect. At the strategic stage, the Environment Agency undertakes the role of Competent Authority for the purpose of making the Assessment. The Appropriate Assessment is included in the SEFR (Chapter 6).

### 2.6.3 Setting of Environmental Objectives

Environmental objectives for the Peninsula were set following a brief review of existing baseline information for the study area. The objectives were developed using the list of general objectives provided within the Environment Agency's SEA Agency Management System (AMS) procedures, with specific objectives relating to the study area being developed for any areas that were relevant. In developing the objectives, the consideration at the forefront was whether or not the strategy could realistically contribute to fulfilling the objectives listed below. This helps to ensure that the assessment of the strategic options at the next stage remains focussed.

The objectives and indicators were circulated to key external consultees for review in October 2005, and were revised in accordance with any comments received. The summary list of objectives is shown below. A full list (including sub objectives and targets) is contained in SEFR.

**Table 2.7**

Agency's Vision	Objective
"a better quality of life"	Avoid and enhance where possible effects on human health and population
"An enhanced environment for wildlife, a better quality of life"	Protect and enhance biodiversity.
"Restore protected land with healthier soils"	Protect and enhance land quality.

“Improved and protected inland and coastal waters”	Protect and enhance water.
No Agency vision applicable	Protect existing infrastructure.
“A better quality of life”	Protect and enhance cultural heritage features.
“A better quality of life”	Protect and enhance landscape character / visual amenity.

#### **2.6.4 Consultation with Stakeholders**

Written consultation with key external consultees has been carried out for previous revisions of the strategy. Consultation has previously been carried out with the following organisations:

- Defra Marine Consents Unit.
- English Nature.
- English Heritage.
- The Countryside Agency.
- Chichester Harbour Conservancy.
- Royal Society for the Protection of Birds (RSPB).

Consultation for the 2005 revision of the strategy has been with the following organisations:

- English Nature.
- English Heritage.
- The Countryside Agency.
- Chichester Harbour Conservancy.
- Havant Borough Council (Planning Department).
- RSPB.

In summary, all responses have supported the selection of the preferred option, further details of their responses are contained in Appendix 8.

#### **2.6.5 Key Issues, Constraints and Opportunities**

These existing data sources have been heavily drawn on in order to avoid duplication of effort in producing the SEFR. The key documents used were:

- Eastoke Beach Renourishment Scheme: Environmental Statement, Halcrow (2005).
- Eastoke Beach Renourishment Scheme: Study to inform Appropriate Assessment, Halcrow (2005).
- Eastoke Northern Frontage Flood Defence Scheme: Addendum to Appropriate Assessment and Environmental Statement, Atkins (2004).
- Eastoke Northern Frontage Flood Defence Scheme: Environmental Statement, Atkins (2003).

Other sources of baseline information have included local plans, information from the websites of statutory authorities, other internet searches and information provided by consultees about the study area. The information included in the SEFR has focussed on high level data about the Peninsula rather than specific details.

## 2.6.6 Summary and Conclusions of SEFR

The SEFR recommends the following options from an environmental point of view:

- Southern Frontage (Main): **Beach management** has already been selected as the preferred option for this area and has been subject to subsequent environmental assessment at scheme level.
- Southern Frontage (Eastoke Point): **Beach management** is the environmentally preferred option at this location, based on the potential impacts on the European sites, the need to provide compensatory habitat and the potential issues associated with locating a site to create a similar habitat. Future studies for this location may draw alternative conclusions that will inform a subsequent review of the strategy.
- Northern Frontage (Main): **Realignment on an Inland Line** is the environmentally preferred option, in order to avoid impacts on the European sites, however, it would have significant adverse impacts on the human environment, be technically complex to achieve and involve far higher costs. The option subsequently selected for the Northern Frontage Main is to **Upgrade on the Existing Line**, because it achieves significant benefits for the human environment and is suitable from an engineering perspective.
- Northern Frontage (Bracklesham Road): **Realignment on an Inland Line** is the environmentally preferred option to avoid impacts on the European sites.

## 2.6.7 Summary and Conclusions of Appropriate Assessment

**Southern Frontage Main:** The SEFR assessment has been undertaken at a strategic level for a strategic beach management policy along the Southern and Eastoke Point frontages. The assessment has concluded that at this level, beach management is the most sustainable option and undertaken correctly, may not impact designated habitats. The Appropriate Assessment has also identified mitigation to protect the European site and nationally important Biodiversity Action Plan habitat, advising that aggregates used for beach nourishment should be free from contaminants that could adversely impact on the annual strand line vegetation.

**Southern Frontage: Eastoke Point:** The Appropriate Assessment has also concluded that retreating the line at Eastoke Point would result in a significant adverse impact upon the integrity of the European sites. Any proposal to retreat to an inland line would require consideration of alternative options and a justification of over-riding public interest and habitat compensation under the Habitats Regulations. Retreat would impact the terrestrial habitats at Sandy Point Local Nature Reserve protected under the SPA/Ramsar designation and result in a loss of feeding and high roost area for the over-wintering wildfowl and wader populations. The option to hold the line may cause impact through coastal squeeze over the 100 year period, resulting in a potential loss of 0.4ha of designated inter tidal habitat.

**Northern Frontage: Bracklesham Road:** The solution at Bracklesham Road would not result in any adverse impact upon the European sites

**Northern Frontage Main:** Retreating the line along the Northern Frontage Main is the most sustainable option in environmental terms. However, implementation of the hold the line policy has been implemented in 2004/5 following a review of the technical and economic factors and consultation with the local community. The Appropriate Assessment for the scheme concluded that the scheme would result in a significant impact to the European site due to coastal squeeze. The Environment Agency provided justification that the scheme was the most appropriate for the frontage due to reasons of overriding public interest. An area of

0.5ha of intertidal saltmarsh and mudflat habitat is therefore required to be created to offset coastal squeeze losses. The Environment Agency is actively seeking to obtain suitable land for habitat creation through the Southern Region Habitat Creation Programme and individual habitat creation studies. Once this habitat has been created, it can be concluded that there will be no net loss to the European site.

### **2.6.8 Recommendations**

All frontages are currently the subject of scheme stage detailed environmental assessments or, in the case of the Northern Frontage Main, constructed. In view of this position it is unnecessary to undertake strategy stage monitoring. In addition to the recommendations made in the previous two sections (2.6.6 and 2.6.7) the following actions are recommended:

- The Appropriate Assessment has identified a number of further mitigation measures that need to be put in place to protect the European site and national BAP habitats. These include ensuring that the extracted aggregate for placement on the beach does not contain contaminants and to ensure that the impact of the extraction area at Sandy Point Local Nature Reserve does not impact on the adjacent vegetated shingle.
- Take full account of the impacts on the terrestrial acid grassland, dune and vegetated shingle habitats when investigating options which re-align the crest within the Sandy Point Local Nature Reserve at Eastoke Point and the subsequent need to fully compensate for loss of these BAP/SPA/Ramsar habitats.

## **2.7 CHOICE OF PREFERRED OPTION**

Note: Figures struck through and replaced originate from the July 2006 Addendum located in the Appendix. They include price date of 2006Q2

### **2.7.1 Selection of the preferred option**

Appendix 3 provides a detailed table of the selection process leading to the preferred option which has been selected. The selection process used is as follows:

1. Initial consideration of options for 'Do Nothing', 'Do Minimum', 'Retreat to Inland Line' and 'Hold the Line'.
2. Undertake a 'reality check' on the initial options and reject any options which clearly fail on technical, environmental or economic grounds.
3. Assess requirements for capital investment and maintenance for an appraisal period of 100 years, taking account of sea level rise and estimate costs for each option.
4. Compare whole life costs for options offering the same outcome (i.e. where two options offer the same benefits) and select the best value option for further consideration.
5. Undertake full economic appraisal of options to determine best value option based on economic performance (in line with PAG3 decision model).
6. Optimise the Standard of Protection for the preferred option.
7. Complete sensitivity assessment on preferred option in consideration of the following:
  - Uncertainty in water level predictions.
  - Uncertainty in supply of shingle to southern frontage.

Following this process, a preferred option has been identified as is now described.

### **2.7.2 Description of the Preferred Option**

The preferred option is presented in figure 4 and described below:

- Southern Frontage: Main Section. Hold the Line to a 1 in 200 Return Period standard of defence through beach recharge and annual recycling.
- Southern Frontage: Eastoke Point. Hold the Line to a 1 in 200 Return Period standard of defence. Havant Borough Council is currently carrying out a further study that will inform a subsequent review of this strategy.
- Northern Frontage: Blackpoint Spit. No action is proposed for Black Point Spit as no public assets are at risk and the future policy should be addressed by the next production of the Shoreline Management Plan.
- Northern Frontage: Bracklesham Road. A phased scheme of embankments and road raising is proposed to a 1:100 year standard of protection throughout the appraisal period. Low cost works are proposed in the short term to provide protection for the next

15 years (see table below). In year 15 (along with other works to the Northern Frontage) a larger project to provide a long term solution to the road access is proposed. Further raising is planned for year 50 to extend and raise the defences to account for sea level rise.

At Bracklesham Road the initial works for implementation are now summarised.

**Table 2.8**

Location	Works
North of Bracklesham Road	Working in the gardens of 2 and 4 Wittering Road, construct a 40m low earth bund approximately 300mm above existing ground level to tie into higher ground.
Bracklesham Road	Between 2 Wittering Road and 'The Winners' build a low ramp along the road linking the walls of the two properties raising the road level by 250 to 300mm.
The Old Hospital Site	Between 'The Winners' and the Lifeboat station construct a 60m low earth bund approximately 300mm above existing ground level to tie into higher ground. This will include a low ramp for vehicular access into the sailing club overflow car park.

The final requirements for this work are subject to refinement of the tie in points and consultation with stakeholders and land owners.

- Northern Frontage: Main Section. Phased upgrade of the defences along the existing line of defence to a 1:100 year standard of protection. Works completed in 2004/5 provide protection for 15 years. In year 15 the works are to be extended to provide protection to year 50. Further raising is planned for year 50 to extend and raise the defences to account for sea level rise. Additionally, the Environment Agency will be required to provide compensatory habitat for losses due to coastal squeeze, this is planned for year 5.

The standard of protection offered by a scheme is the minimum standard offered throughout the 100 year appraisal period.

The preferred option has a benefit cost ratio of ~~6.6~~ 6.73 and achieves a priority score of ~~20.8~~ 21.3. For strategic purposes an incremental appraisal has been completed which identifies the SOP for the frontages as 1 in 200 years Return Period for the Southern Frontage and 1 in 100 years for the Northern Frontage. These figures should be re-confirmed at project implementation phase.

### 2.7.3 Residual Risks

At a strategic level there are a number of issues which HBC and the Environment Agency will need to address, these are as follows:

**Table 2.9**

Risk	Mitigating Action
Damage to the environment due to works.	Much work has been completed on the production of Environmental Statements and Appropriate Assessment for the planned works. Work is ongoing to continue to look for environmental enhancement and address the need for habitat creation, including research through the Solent Dynamic Coast Project.
Operation of the defences. There are a large number of flood gates on the Peninsula which require closing in advance of any flood event.	There is a need for both the Environment Agency and HBC to continue to operate flood management plans with call out of staff to ensure all gates are closed when flood warnings are issued.
Reliance on regular capital funding through appraisal period. The beach management plan requires funding for capital works every five years. There is a risk that the Treasury may alter the rules concerning such funding.	Maintain a 5 years rolling programme for approval by the Environment Agency.
Economy of Peninsula: Should the economy of the Peninsula decline (in particular property values), then the economic justification of the provision of flood defence declines.	There is a need for the Environment Agency and HBC Planning to develop guidance which seeks to reduce flood risk to homeowners whilst not creating housing blight.
Climate change, uncertainty in weather patterns. There is a continued risk of increasing storminess due to climate change. This may affect the management of the southern beach or require future increases in defence levels.	Whilst the selected option has the potential to be responsive to climate change, There is an ongoing monitoring of the defences and further technical assessment of the impact of any changes in climate on the defences, such that the beach management programme will improve and adapt.
Delays to implementation.	INCREASED RISK OF BREACH AT THE SOUTHERN FRONTAGE. Continued management of implementation programme by Havant BC /Environment Agency.

These are further discussed in Appendix 7.

## **2.8 OTHER CONSIDERATIONS**

### **2.8.1 Flood Warning Service**

Hayling Island is covered by the Environment Agency Flooding Warning Service. The service was effective on the 3<sup>rd</sup> November 2005, with flooding warnings being issued by auto-telephone message at 08:30, in advance of the extreme weather and high tide at approximately 13:00 hours. Many properties are already signed up to receiving messages, following on from the storm, the Environment Agency and HBC are completing a mail shot to encourage further sign up.

### **2.8.2 Sustainability and Future Maintenance**

To date, all works completed by the Environment Agency and HBC conform to their accepted Sustainable Construction Policies and environmental sustainability targets. Future work will be continued to conform to these policies and where appropriate, included design specifically reduce risks during construction and maintenance, and in particular to public safety.

Due consideration has been given to the future maintenance arrangements and management/construction requirements. In particular, it is acknowledged that the beach management for the southern frontage is an ongoing and evolving process. The cost estimate provided for this beach management is considered realistic in the knowledge that there is some uncertainty of performance the beach structures and there will be continued variability in prices of materials.

### **2.8.3 Health and Safety**

A key element in the consideration of the preferred option is the approach to Health and Safety. The preferred option has significant health and safety advantages over the rejected options. Along the southern frontage, the management of the beach minimises the need for dangerous structures. Along the northern frontage, the recommended option protects the highest number of properties and therefore minimises the residual risk to people and properties. There are a number of residual health and safety risks which have been addressed through the previous design process and will need to be addressed during future phases of work. These include:

- Continued implementation of the Environment Agency's Operation Public Safety (OPUS) and Public Safety Risk Assessment (PSRA) procedures to consider public risk associated with structures.
- Site management of the southern frontage beach management works.
- Clear and effective evacuation route from Black Point Spit under all operating conditions.
- No impact on the access to the Life Boat Station.

### **2.8.4 Planning Permission**

The principal proposals recommended in this strategy are supported by the Environment Agency and HBC and have received planning permission from the local planning authorities. The two exceptions to this are the Eastoke Point and Bracklesham Road. For both locations future works will be subject to all planning authority requirements.

### **2.8.5 Technical Aspects**

Technical aspects of design including details of the extreme wave and water levels, coastal morphology, details of previous storms and beach management are included in Appendix 2 Baseline Information.

When HBC began the beach management in 1985, it was one of the first programmes of recharge and recycling undertaken in the UK. The performance of the beach and the techniques of recycling, monitoring have been developed effectively during that time and form the basis of a positive and innovative process which with time can be seen to improve in performance and efficiency.

### 3 PROJECT PLAN

Note: Figures struck through and replaced originate from the July 2006 Addendum located in the Appendix. They include price date of 2006Q2

#### 3.1 5 YEAR PROGRAMME

In order to implement this strategy, HBC and the Environment Agency will take responsibility for their frontages and undertake to obtain project specific approval for works as necessary to protect the Peninsula whilst achieving the environment and public safety objectives for the scheme.

The plan of action recommended by this strategy is shown on Figure 4 and summarised in the table below. A cash flow itemising the works for the next 5 years is provided below and further details for the next 100 years is included in Appendix 6.

**Table 3.1**

EASTOKE STRATEGY 5 YEAR ACTION PLAN						
Year	2004	2005	2006	2007	2008	2009
Appraisal Year	1	2	3	4	5	
<b>SOUTHERN FRONTAGE</b>						
1			<del>Capital Recharge</del>	<i>Capital Recharge</i>		
2				Eastoke Point Works		
		Monitoring	Monitoring	Monitoring	Monitoring	Monitoring
		Groyne/ Splash wall Maint.	Groyne/ Splash wall Maint.	Groyne/ Splash wall Maint.	Groyne/ Splash wall Maint.	Groyne/ Splash wall Maint.
		Recycling	Recycling	Recycling	Recycling	Recycling
<b>NORTHERN FRONTAGE</b>						
3			<del>Bracklesham Road Works</del>	<i>Bracklesham Road Works</i>		
4	Northern Section Flood Defences					
5			Solent Dynamic Coastline Study			
						Habitat Creation
		Maintenance	Maintenance	Maintenance	Maintenance	Maintenance

Notes

1. Havant BC will submit a funding application and scheme Project Appraisal Report (under Coast Protection Act) to Defra seeking grant aid for this work.
2. Long term study costs approved (HBC / Defra).
3. Scheme Project Appraisal Report will be submitted to Environment Agency Regional Project Appraisal Board seeking approval to the business case. The project will only proceed if funds are available.
4. Works were approved by Environment Agency in September 2004 and completed in 2005.
5. Separately funded regional study.

Works on the southern frontage will be managed and procured in accordance with HBC's procurement rules. HBC may procure works through the Environment Agency National Contractor Framework where this is appropriate. The completion of the works to Bracklesham Road will be developed through the NCPMS using a framework consultant and framework

contractor. In particular further development of the preferred options will be completed through consultation with the landowners affected. Where the programme allows, the works may be procured in association with HBC nourishment/recycling works to optimise cost savings although the relatively small scale and different nature of the works at Bracklesham Road is unlikely to generate significant savings.

It has been identified that there is a need to offset the loss of intertidal habitat along the northern frontage resulting from coastal squeeze against the held line and amounting to 1 ha over the 100 year evaluation period of the strategy. It has also been identified that there is a need to compensate for loss of intertidal habitat adjacent to Sandy Point, resulting from coastal squeeze, amounting to 0.4ha over 100 years. Replacement habitat will be identified through the Southern Region Habitat Creation Programme. Expenditure has been allocated to year 5 of the appraisal period sufficient to meet the cost of provision of 1.4 ha replacement habitat. This is commensurate with the undertaking given by the Environment Agency to English Nature prior to the start of the northern defences scheme in 2004, to provide suitable replacement habitat retrospectively.

### 3.2 5 YEAR INVESTMENT PLAN

All schemes and studies arising from this strategy will be the subject of applications for funding and will not proceed unless a robust business case is proven and funds are available. The following tables give an indication of the funding profile between 2004 and 2009, when it is anticipated that the strategy will be reviewed for the following five year period.

**Table 3.2**

<b>Havant Borough Council Costs</b>	
	<b>Strategy Approval</b>
Costs pre SAR	£100k
<i>Costs post SAR</i>	
HBC Costs	£230k
Fees	£198k
Investigations	£70k
Construction	£3,004k
Compensation	£30k
Contingency	£1,530k
Inflation (at 5%)	£247k
<b>Total</b>	<b>£5,408k</b>

**Table 3.3**

<b>Environment Agency Costs</b>	
	<b>SoD Approval</b>
Costs pre SAR	£100k
<i>Costs post SAR</i>	
Agency Costs	£155k
Fees	£530k
Investigations	£100k
Construction	£2,196k
Compensation	£130k
Contingency	£466k
Inflation (at 5%)	£132k
<b>Total</b>	<b>£3,808k</b>

The annualised spend profile is as follows:

**Table 3.4**

Year	2004	2005	2006	2007	2008	2009
Appraisal Year	-	1	2	3	4	5
HBC	£0k	£292k	<del>£2,071k</del> £203k	<del>£2,649k</del> £4,517k	£145k	£151k
Environment Agency	£2,605k	£10k	<del>£377k</del> £130k	<del>£10k</del> £257k	£10k	£689k

**4            RECOMMENDATIONS/ APPROVAL SIGN OFF**

The Environment Agency Chief Executive is recommended to approve under A9 scheme of delegation, the Hayling Island, Eastoke Sectoral Strategy Study at a cost of £44,109k. The cost includes £12,480k of contingency and includes maintenance.

HBC are responsible for the southern frontage and will obtain £29,053k of the cost, including £8,066k of contingency.

**Department for Environment Food and Rural Affairs.**

Strategy recommended for approval

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*Senior Engineer*

<i>Senior Engineer</i>	Name		Signature	
			Date	

Strategy recommended for approval

*Regional Engineer*

<i>Regional Engineer</i>	Name		Signature	
			Date	

Strategy recommended for approval

*Chief Engineer*

<i>Chief Engineer</i>	Name		Signature	
			Date	