



Project Appraisal Report

Authority Scheme Reference	IMAN000968
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Defra / WAG LDW Number	40687
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Promoting Authority	Environment Agency
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Scheme Name	Boston Combined Strategy
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Date	September 2007 v7
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Defra Project Appraisal Report-Data Sheet

Boston Combined Strategy

EA APPROVAL HISTORY SHEET			
Project Title: Boston Combined Strategy		Agency Project Code: IMAN000968	
Agency Project Manager: Jim Anderson		Date of Strategy: June 2006	
Consultant Project Manager: Jenny Williams		Consultant: Jacobs Babbie	
AGENCY STAFF INVOLVEMENT			
Position	Name	Signature	Date
"I have reviewed this document and confirm the project meets EA and Defra investment appraisal criteria and recommend approval in the sum of £198,000,000"			
Originator (PM)	Jim Anderson		
Reviewer (Project Executive)	Andy Baxendale		
"I confirm I am content for the project as described in this document to proceed to design and construction, that funding is available and that strategic/project level risks have been identified"			
Client Representative	Martin Shilling		
	Nick Bromidge		
NEAS Team Leader	Dermot Smith		
"I have reviewed this document and confirm that it complies with the current PAR guidelines"			
PAR Reviewer	Lance Dawkins		
"I confirm the project is ready for submission to NRG"			
Operations Manager	Richard Nunn		
NRG – National Review Group (Projects greater than £1.5 million)			
Date of Meeting: June 2006	Chairman:	PAR Amendment No:	
Project Presenter(s): J Anderson and J Williams			
Detailed record of any comments/actions required/additional information provided, to be appended to the PAR for onward transmission			
Recommended for approval: In the sum of £198,000,000		Date:	
PROJECT APPROVAL			
AGENCY	Officers in accordance with the Agency's SoD: Specified Officer; Regional Director; Director of Operations; Chief Executive or Director of Finance: Agency Board		
Strategic PAR Submitted		Date:	
Project Approval	By: In the sum of: £198,000,000	Date:	
Defra APPROVAL (Delete as appropriate)			
Submitted to Defra		Date:	
PAR Amendment No. (if different):			
Defra		Date:	
Comments:			

Boston Combined Strategy

FINANCIAL SCHEME OF DELEGATION (FSoD) COVERSHEET

1.	Project name	Boston Combined Strategy		Start date	June 2006
				End date	March 2012
	Business unit	FRM & Waterways	Programme	Northern RFDC & Anglian Waterways	
	Project ref.	IMAN000968	Regional FSoD ref.	Head Office FSoD ref.	

2.	Role	Name	Post Title
	Project Sponsor	Ian Russell	Area Flood Defence Manager (Acting)
	Project Sponsor	John Adams	Anglian Waterways Manager
	Project Executive	Andy Baxendale	Area Manager
	Project Manager	Jim Anderson	Project Manager 1

3.	Outline Risk Assessment (ORA) Category	Low	<input type="checkbox"/>	Medium	<input checked="" type="checkbox"/>	High	<input type="checkbox"/>
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4.	FSoD schedule	Description	Delegation		
			Regional – up to	Environment Agency – up to	
	A1	<input type="checkbox"/>	Non FRM project	£5m	£5m
	A2	<input type="checkbox"/>	FRM project within approved strategy	£5m capital	£50m WLC Defra/£5m capital NAW
	A3	<input type="checkbox"/>	FRM project outside of approved strategy	£5m capital	£50m WLC Defra/£5m capital NAW
	A5	<input type="checkbox"/>	Consultancy project	£300k	£500k
	A9	<input checked="" type="checkbox"/>	FRM Strategy	£500k	£50m WLC Defra/£5m capital NAW
	O1	<input type="checkbox"/>	IS/IT project	--	£5m
	T2	<input type="checkbox"/>	Purchase or lease of land and buildings	£40k purchase/£10k pa lease	£5m

5.	FSoD value	£k
	Preparation costs for Form A/Business Case/PAR/FRM Strategy	262
	Project costs	
	Whole Life Costs (WLC) of FRM Project or Strategy (Cash Cost)	£198,000

6.	Required level of Environmental Impact Assessment (EIA)	N/A	Low	Medium	High
		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

7.	FSoD approver name	Post title	Signature	Date
	FSoD consultee name	Post title	Signature	Date
		PAB/NRG Chair	<input type="checkbox"/> RED <input type="checkbox"/> AMBER <input type="checkbox"/> GREEN	

8.	Form G	Form G value (£k)	Regional FSoD ref.	Head Office FSoD ref.	Latest FSoD authorised cost (£k)
	1				
	2				

Boston Combined Strategy

PRODUCT DESCRIPTION

Project Name	Boston Combined Strategy		
Project Reference	IMAN000968	Project Description Version	1

Product Ref		Date Identified	
Purpose/Objectives of Product			
Determine a 100 year strategic approach to flood risk management and navigation improvements in Boston. Assess the potential value of a number of combined approaches in Boston to flood risk management and navigation issues and determine the preferred option.			
Product Outline			
A combined strategy report drawing together the aims of a flood risk management strategy for the tidal Haven and the navigation aims of the Environment Agency in Boston. An Implementation Plan to accompany the strategy will be produced to fully understand how the preferred option would be delivered and the associated risks and opportunities. An Environmental Report covering the Strategic Environmental Assessment process will be prepared to accompany the strategy.			
Quality Criteria			
Agency NCPMS BMS Procedures Agency NEAS AMS Procedures			
Quality Review Method			
Monthly Progress Meeting to feature Quality Review. Quality reflected in Key Performance Indicators. Project may be subject to internal review and Project Board in place to steer and support. Deliverable documents subject to quality review, internal consultation, and NRG scrutiny			
Business User Representative			
Name	Nick Bromidge and Martin Shilling		
Job Title	Team Leader, Lincolnshire Waterways Team Leader, Asset System Management		
User Acceptance			
Is the product accepted?		Yes	No
If No, Comment:			
Signed		Date	
On behalf of:			

TO COMMIT EXPENDITURE

Anglian Region: Boston Combined Strategy

Approval Sum: £198,000,000 (FSoD A9)

Sponsoring Director: Paul Leinster - Director of Operations

Approval Route

Section A9 of the Financial Scheme of Delegation states that, for whole life costs in a Flood Risk Management Strategy Agency Board approval is required in excess of £50,000,000

Approval Route:	National Capital Programme Manager	Miles Jordan
	National Review Group	Ken Allison
	Regional Director	Paul Woodcock
	Director of Operations	Paul Leinster
	Director of Finance	Nigel Reader
	Chief Executive	Barbara Young
	Board	
	Defra/WAG	Applicable
	Treasury	Applicable

1.0 INTRODUCTION AND BACKGROUND

- 1.1 This paper presents a Flood Risk Management and Waterways Strategy for Boston in Lincolnshire, the Boston Combined Strategy. The strategy considers the tidal length of the Lower Witham that extends for 11.4 km from the tidal limit in Boston to its outfall in The Wash and is referred to as “Boston Haven”. Only the main river channel and the structures that line the channel are being considered by this strategy. Flood protection for the town centre is provided by hard defences that vary in asset condition. Flood embankments line the lower reach of the tidal river and are generally in good condition. For details of the study area see Figure E1 below.
- 1.2 Boston is an historical market town with an important maritime history. It is set in the low-lying and flat landscape of the Lincolnshire fens, much of which is below the level of the mean high water spring tides of The Haven. The tidal river presents a potential flood risk and restricts the type and volume of waterway navigation through the town. Boston has issues of social deprivation and high unemployment and the focus of many of the local development plans are aimed at improving the quality of life within the town.
- 1.3 Flood defence works will in the main be carried out under the powers granted in section 165 of the Water Resources Act 1991. Waterways works will in the main be carried out under the powers granted in SI 1995 No.148 the Town and Country Planning (General Permitted Development) Order 1995. Certain flood defence and navigation works will require express statutory authority for their construction and operation that can be obtained by way of a Transport and Works Act (1992) Order.
- 1.4 The strategy has two main aims: To reduce the risk to people and the developed and natural environment from flooding; To provide a safe and attractive navigation link between the River Witham and South Forty Foot Drain.

Anton's Gowt

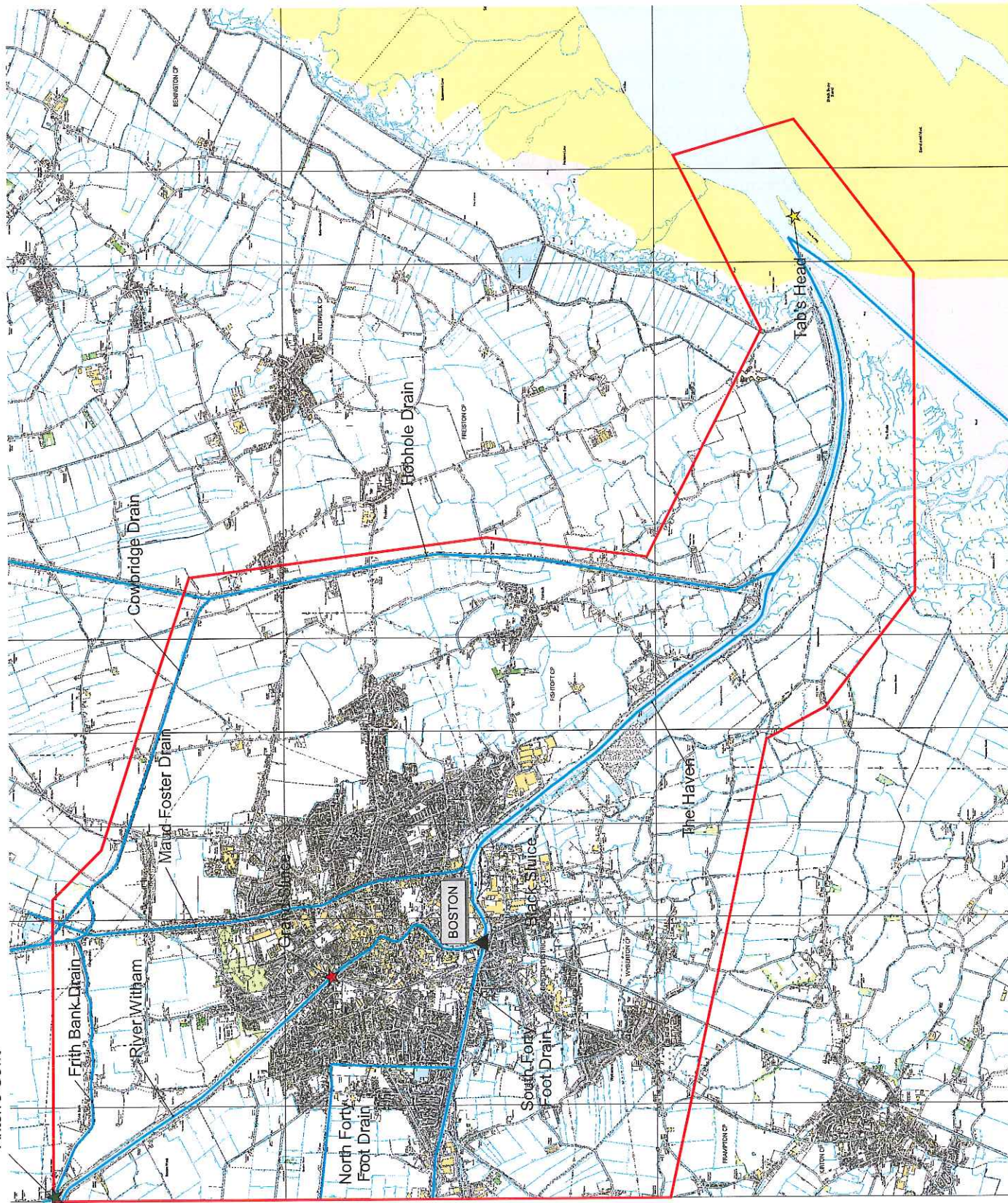


Fig E.1

Key:

- Study Area Boundary
- ★ Grand Sluice
- ★ Tab's Head
- ★ Anton's Gowt
- ▲ Black Sluice
- Watercourse



Do not scale this drawing

This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of the Her Majesty's Stationery Office. The map is reproduced from the 1:40000 scale map of the area of the River Witham and its tributaries, and is not intended to be used for navigation or other purposes. The map is reproduced from the 1:40000 scale map of the area of the River Witham and its tributaries, and is not intended to be used for navigation or other purposes. The map is reproduced from the 1:40000 scale map of the area of the River Witham and its tributaries, and is not intended to be used for navigation or other purposes.



ENVIRONMENT
AGENCY

Boston Combined Strategy

Study Area

Scale	1:40000	Date	September 2005
Drawn	JLB	Checked	PG
Approved	JW		

2. PROBLEM

- 2.1 The Haven has been an integral part of the town of Boston for hundreds of years; the town derives much of its history and present character from the tidal nature of the Haven, the close proximity of the docks to the town, and the working fishing fleet. In addition to receiving fluvial flows from the Lower Witham, there are three other major discharges into the Haven controlled by sluices. One of these is South Forty Foot Drain that has at its outfall the Black Sluice and associated pumping station.
- 2.2 A navigable link between The Haven and South Forty Foot Drain is a fundamental part of the Environment Agency's vision for developing the regional waterways network. This vision is titled the Fens Waterways Link and was publicly launched in May 2004. The tidal range of The Haven limits the type and volume of traffic that can safely navigate this stretch of water, thereby limiting both the tourism and leisure opportunities of this part of the waterways network.
- 2.3 Tidal flooding presents a far greater risk to Boston town centre than the risk from fluvial floods. Evidence of flood risk comes from historical events and predictive modelling. Modelling of future conditions show extensive areas affected should a breach or overtopping of defences occur. Flood risk arises from potential asset failure, overtopping, and increasing sea levels with climate change.
- 2.4 The Haven discharges into The Wash, which is designated as a Site of Special Scientific Interest, a Special Protection Area, and a Ramsar site. The main conservation interest of The Wash is the extensive mosaic of intertidal habitats that support an abundant and diverse bird community. The Wash and North Norfolk Coast is also designated as a candidate Special Area of Conservation, the main conservation interest being mudflats, sandflats, lagoons and saltmarshes. In addition to The Wash the study contains a number of local sites of nature conservation interest (Lincolnshire wildlife sites).
- 2.5 The existing flood defences in Boston provide a standard of protection of a 1 in 50 chance (2% chance) of flooding in any year from a tidal surge. Analysis has shown that approximately 900 commercial properties and 10,000 residential properties are at threat from a tidal surge with a 1 in 100 chance (1% chance) of flooding in any year. This is a regional priority for flood risk management.
- 2.6 Fluvial flooding from the River Witham is not a significant threat for Boston as any fluvial flows with a greater than 1 in 10 chance (10% chance) of flooding in any year will overtop the flood banks of the Lower Witham system far upstream of Boston.
- 2.7 The Black Sluice catchment discharges via South Forty Foot Drain into The Haven. Fluvial flood risk to Boston town from South Forty Foot Drain is negligible as any fluvial flows with a greater than 1 in 10 chance (10% chance) of flooding in any year will overtop the flood banks in rural areas before reaching Boston.
- 2.8 The total area of land considered to benefit from the existing defences is 3060ha. Of this 800ha is developed and 2260ha is agricultural. The area that will benefit from this strategy is categorised in Defra FCDPAG3 as Land Use Band A, being typically an intensively developed urban area at risk from flooding.

3. OPTIONS

- 3.1 Preliminary screening of separate flood risk management and navigation options was carried out using technical and functional criteria, together with strategic environmental assessment, and the valid approaches were combined into six strategic options.

A number of the strategic options involve the construction of a barrier or barrage, or a structure that combines the functionality of a barrier and a barrage. A barrier would operate only during storm tidal surges to prevent inland flooding. A barrage would allow tidal water to overtop, or pass the barrage at certain tidal ranges.

Option I - Maintain defences and western waterway. Pro-active maintenance of FRM assets and a channel linking the River Witham (via North Forty Foot Drain) to South Forty Foot Drain. The standard of flood protection will decrease over time from a current standard of 1 in 50 years to approximately 1 in 10 years.

Option II - Maintain defences, new barrage and navigation link. Pro-active maintenance of FRM assets, a partial exclusion barrage to control the tidal range within Boston, and a new lock through, or adjacent to, Black Sluice. The standard of flood protection will decrease over time from a current standard of 1 in 50 years to approximately 1 in 10 years.

Option III - Maintain defences and western waterway. Sustain the current standard of protection (1 in 50 years) into the future by raising the levels of existing FRM assets to cater for the effect of climate change and create a new channel linking the River Witham (via North Forty Foot Drain) to South Forty Foot Drain.

Option IV - Maintain defences, new barrage and navigation link. Sustain the current standard of protection (1 in 50 years) by raising the levels of existing FRM assets to cater for the effect of climate change, and create a new partial exclusion barrage to control the tidal range within Boston and a new lock through or adjacent to Black Sluice.

Option V - Flood barrier and western waterway. Provide a flood tide barrier (advancing the line of defence) to increase the standard of protection to a minimum of 1 in 300 years and a channel linking the River Witham (via North Forty Foot Drain) to South Forty Foot Drain to the west of the town centre.

Option VI - Multi purpose barrier and navigation link. Provide a flood tide barrier (advancing the line of defence) to increase the standard of protection to a minimum of 1 in 300 years, combined with a partial exclusion barrage to control the tidal range within Boston, and a new lock through or adjacent to Black Sluice.

The preferred option for a stand alone flood risk management strategy was also assessed and would be to advance the line of defence and increase the standard of protection to a minimum of 1 in 300 years with a tidal flood barrier.

PREFERRED OPTION

- 4.1 The preferred option is Option VI and comprises five phases of work to address flood risk and achieve navigational aims within Boston. The five phases of work comprise:
- New navigation link between The Haven and South Forty Foot Drain at Black Sluice
 - Improvement works to flood assets at risk of failure within Boston town centre
 - Multi-functional barrier within Boston Haven: dual function of partial tidal exclusion barrage for water level control to enable safe navigation and tidal surge barrier
 - Waterways facility works (moorings etc)
 - Raising of embankment levels downstream of barrier at appropriate future time.
- 4.2 The whole life cost of the strategy is £198,000,000 including maintenance costs.
- 4.3 Currently the flood defences in Boston provide a standard of protection of a 1 in 50 chance (2% chance) of flooding in any year. The preferred option will deliver a standard of protection of a 1 in 300 chance (0.33% chance) of flooding in any year allowing for the predicted effects of climate change over the next 100 years.
- 4.4 The strategy fits well with regional and local planning policy and provides identifiable opportunities for external partners to carry out complementary schemes. Key enhancement opportunities that have been identified relate primarily to landscape and cultural heritage and include:
- The reduction of the level of flood defences upstream of the new tidal barrier
 - Improvement in local and regional waterways links
 - Improvements in public access to the river
 - Opportunities for protection and enhancement of biodiversity
 - Inclusion and integration of the local community in improvements of waterway and frontage
 - Development of working in partnership with other organisations
 - Provision of an innovative superstructure for the multifunctional barrier that could be promoted as a new tourist attraction.

5. ECONOMIC CASE AND PRIORITY SCORE

- 5.1 The present value (PV) cost for the preferred combined option for Flood Risk Management and Waterways is £93 million over the 100 year appraisal period. Benefits with a PV of £1,003 million result in a benefit cost ratio of 10.8 and a net present value of £910 million (Table 1 Combined Improvements).

Should a Flood Risk Management strategy and a waterways strategy be progressed separately (Table 1) the benefit cost analysis for investment in Flood Risk Management assets alone has a present value (PV) cost of £72.7 million over the 100 year appraisal period. Benefits with a PV of £938 million result in a benefit cost ratio of 12.9 and a net present value of £865 million. The Waterways strategy as a separate investment has a present value (PV) cost of £48 million over the 100 year appraisal

period. Benefits with a PV of £66 million result in a benefit cost ratio of 1.4 and a net present value of £18 million.

The benefit cost ratio of a combined strategy is lower than that of flood risk management alone. However, delivery of the combined strategy presents PV savings of almost £28 million. The combined strategy has the potential to stimulate the local and regional economy and generate other benefits such as jobs that are not appropriate for inclusion in the benefit cost analysis, but are of interest to external funding partners.

- 5.2 The priority score for the FRM elements of the preferred option is 30, indicating the regional priority of this strategy. A breakdown of the score is shown in the table below.

Table 1: Economic Analysis of Separate and Combined Improvements and Priority Score of Preferred Option

Location	Waterways Improvements	FRM Improvements	Combined Improvements
Present Value benefits	£66 million	£938 million	£1,003 million
Present Value costs	£48 million	£73 million	£93 million
Net present value	£18 million	£865 million	£910 million
Benefit cost ratio	1.4	12.9	10.8
Cost per property	NA	£6481	NA
Defra priority score			
Economics	NA	20	NA
People	NA	8	NA
Environment	NA	2	NA
Total	NA	30	NA

- 5.3 A discount rate of 3.5% in years 0 to 30, 3% in years 31 to 75, reducing to 2.5% for the remainder of the 100 year appraisal period has been used.
- 5.4 The approval being sought for this strategy is an A9 approval: Business Case justification for a Flood Risk Management and Waterways Strategy. The whole life combined cost for FRM and Waterways is £198 million. This includes £25.5 million maintenance cost and £64.6 million contingency.
- 5.5 Following the FSoD A9 approval of the Boston Combined Strategy other approvals will be required for each project to improve FRM and Waterways assets in Boston.

6. ENVIRONMENTAL CONSIDERATIONS

- 6.1 Strategic Environmental Assessment (SEA) has been applied to the strategy and an Environmental Report produced.
- 6.2 Within the study area there are several local and regionally designated sites. The Haven enters The Wash which is designated as a Site of Special Scientific Interest, a

Special Protection Area and Ramsar site. The studies carried out to date have satisfied Natural England that the options assessed are likely to lead to an environmentally acceptable solution in terms of the designations, and that Appropriate Assessment is unlikely to be required. Their letter of agreement is appended to this report.

- 6.3 The landscape setting of Boston is typical of the Fens, being predominantly flat (below 10m AOD), with vast open expanses of land. It is a distinctive landscape. Boston town and the surrounds feature significantly as an urban zone within the large expanse of farmland. A characteristic of the entire stretch of The Haven is the exposure of mud and sediment at low tide. Cultural heritage within the study area includes three Scheduled Ancient Monuments and an operative Townscape Heritage Initiative Scheme. There are over 300 listed buildings within this Conservation Area.
- 6.4 The impacts of the preferred option are documented in the strategy. Where an effect has been described as having the potential to be adverse, appropriate mitigation measures have been recognised and documented and include:
- Design features that would minimise localised sedimentation and scouring
 - Provisions for compensatory inter-tidal and freshwater habitat
 - The design of new assets to minimise visual impact and where possible, create positive landmarks in the study area
 - The combined option is likely to affect outfalls within the upper Haven and work will be necessary on the affected outfalls to prevent backflows of water.

Enhancement opportunities have been identified that relate primarily to landscape and cultural heritage and are outlined in section 4.4.

- 6.5 There are a number of footpaths that run along the banks of the The Haven, these include the Macmillan Way that is a national trail that runs from beyond the town of Boston to The Wash. There are several cycle routes along the riverbanks that run through the town. One aspect of the preferred option is to improve access to The Haven by improving the existing system of footpaths and cycleways.
- 6.6 On the 12th October 2005 outline planning permission was granted by Boston Borough Council for the construction of the navigation link and the barrier/barrage outlined in the preferred option. There are several legal and planning issues still to be resolved associated with delivering the strategy:
- Planning consent under the Town and Country Planning Act will be required for the barrier/barrage, locks and other new Waterways assets
 - Planning consent will also be required for any works to the existing flood assets
 - Authorisation under the Harbours Act 1964 will be required
 - An order under the Transport and Works Act will be required to implement new navigation works
- 6.7 Natural England (English Nature) support the strategy and has provided the standard 'comfort' letter. In addition they have provided a more detailed response wholeheartedly supporting the strategy. English Heritage is in general happy with the proposed strategy. Boston Borough Council wholly supports the strategy and the preferred option that arises from it.

7. RISKS

- 7.1 A detailed risk assessment has been undertaken. The top five risks and how they will be mitigated are shown in the table below.

Table 2: Key Risks and Mitigation Measures

Risk	Key Mitigation
The extent of planning conditions and legal challenge for the barrier/barrage	<ul style="list-style-type: none"> • Liaison with Boston Borough Council • Strategy in place with legal department and parliamentary agent to target complex planning issues and requirements for a Transport and Works Act Order. • Tangible studies in place to address conditions of outline planning consent • If Transport and Works Act order is opposed, defend application either at public inquiry or hearing, or carry out 'exchanges of written representations' as directed by the Secretary of State.
Port of Boston, fishermen, boat users or British Waterways object to Harbour Revision Order (HRO)	<ul style="list-style-type: none"> • Carry out navigation study • Prepare an operational plan for the barrier/barrage • Strategy in place with legal department and parliamentary agent to target requirements for a HRO • If a HRO is opposed, defend application either at public inquiry, or carry out 'exchanges of written representations' as directed by the Secretary of State.
External funding for the navigation link or the barrier/barrage stops due to change in political priorities	<ul style="list-style-type: none"> • Prove deliverability of strategy and strengthen business case • Identify all potential sources of funding • High level liaison with fund holders • Waterways match funding
Changes to the sedimentation regime results in unfavourable impacts, reputation damage, combined scheme stops	<ul style="list-style-type: none"> • Geomorphology study based on sound science and reasoning • Ensure key stakeholders have a role to play in defining scope of geomorphological study and acceptance of findings
Objections from riparian owners, land owners, public bodies, or partners	<ul style="list-style-type: none"> • Ensure proposals are acceptable through community planning (Building Trust with Communities) • Create stakeholder liaison group and ensure they are regularly briefed on proposals.

8. IMPLEMENTATION

- 8.1 This paper is seeking a FSoD A9 approval for the whole life costs of the Boston Combined Strategy of £198 million. Defra and Treasury approval will also be sought for the strategy. Following approval of the Boston Combined Strategy further A2 approvals may be sought either for a six year programme of works to implement the strategy, or individual approvals for each scheme within the strategy. A number of technical studies for the waterway link were started in 2006/07 in order to satisfy

external funding timeframes. These studies were progressed under a separate FSoD A1 approval.

- 8.2 Funding bids to deliver the first phase of the Boston Combined Strategy, the navigation link between The Haven and South Forty Foot Drain have been submitted and the following funds have been approved:

- Lincolnshire County Council (LCC) - £4m confirmed subject to legal agreement;
- East Midlands Development Agency (EMDA) - £1.2m confirmed subject to legal agreement;
- Lincolnshire Enterprise (LE) - £800k confirmed subject to legal agreement;
- Government Office for the East Midlands (GOEM) - £2m confirmed subject to legal agreement.

This £8m will cover the capital costs of the first construction phase, the navigation link through Black Sluice.

LCC and Boston Borough Council (BBC) have indicated that they are interested in investing further in the Boston Combined Strategy.

None of the approved funding is dependant on subsequent phases of the Boston Combined Strategy going ahead. However LCC, BBC and EMDA have all indicated that they are interested in investing in subsequent phases of the Boston Combined Strategy.

- 8.3 Each phase of the Combined Strategy is independent in terms of the benefits it delivers. The improvement work to flood risk assets at risk of failure in Boston town centre, the multi-functional barrier and other waterways works such as new moorings on the Haven, can all be progressed on their own economic case. However, delivery of all these elements increases the benefits by co-ordinating the investment and delivering results sooner. Each phase of the strategy will be subject to a detailed project appraisal that will include a funding plan. The funding plan will be clearly established before authorisation for construction is given. Should funding of the future Waterways components not be secured, the FRM strategy can progress independently.
- 8.4 All of the works could be procured through existing framework agreements e.g. NEECA2, NCF2. There is however potential to explore alternative contracts such as Design Build Finance and Operate that could include a number of the new assets to be created such as the barrier/barrage and existing assets in Boston such as the Black and Maud Foster gravity sluices. This would be examined after the strategy approval.
- 8.5 The Contingency (Risk allowance) for the FRM and Waterways programme of works is £64.6 million This is split into £50.3 million contingency for FRM works and £14.3 million contingency for Waterways works. New navigation and FRM structures include an uplift of 60% to compensate for over optimistic estimation. FRM asset repair work is based on historical data and includes an uplift of between 50 and 60%.
- 8.6 The period of the whole life cost is 100 years.
- 8.7 The capital cost of the strategy/scheme over the 100 year appraisal period is shown in Table 3 (as per template) with initial capital investment (<10 years) and future capital

investment (10 to 100 years). Maintenance costs over the 100 year period are also shown. All costs are shown in detail in Table 3.1 of the report with more information in Appendix I. The future (after year 10) capital costs comprise improvements to flood assets along the Haven, refurbishment and replacement of the mechanical and electrical works at the multi function barrier and navigation link at 25 year intervals. All costs include optimism bias.

Table 3: Costs of the Strategy over 100 years

Item	Waterways Works £	Barrier / Barrage £	Navigation Link £	FRM Asset Works £	Total £
	Waterways	FRM 70%/ Waterways 30%*	Waterways	FRM	
Agency costs (including surveys)	44,000	1,020,000	256,000	286,000	1,610,000
Preliminary costs	60,000	107,000	58,000	0	225,000
Consultants fees	30,000	1,330,000	821,000	651,000	2,830,000
Construction costs	824,000	18,800,000	4,880,000	1,570,000	26,100,000
Cost consultant fees	Inc	Inc	Inc	Inc	Inc
Compensation	17,000	918,000	136,000	130,000	1,200,000
Contingency (50 - 60% of costs)	585,000	13,300,000	3,690,000	1,580,000	19,200,000
Inflation @ 5% per annum	530,000	12,100,000	3,350,000	1,430,000	
Total capital cost (including inflation)	2,090,000	47,600,000	13,200,000	5,650,000	68,500,000
Total capital cost (without inflation)					51,200,000
Future construction costs					121,000,000
Maintenance costs over period of strategy					25,500,000
Whole life cash cost (inc. maintenance but without inflation)					£198,000,000

*see next section on funding

Details of capital costs can be found in Table 3.1 of the report. Appendix I contains details of maintenance costs.

9. CONTRIBUTIONS AND FUNDING

9.1 Expenditure will be required from Flood Risk Management and Waterways. The apportionment of the capital costs was explored in three possible ways:

1. Allocate costs in proportion to benefits.
2. Proportional share of savings on the cost of the barrier/barrage (52% Waterways, 48% FRM).
3. FRM investment with Waterways payment of the difference in capital cost to provide the functionality of a barrage in the FRM barrier structure (30% Waterways, 70% FRM).

It is recommended that the most pragmatic approach is method 3, to allocate capital cost on the basis of those justified for Flood Risk Management needs, Waterways

investment in navigation improvement works and Waterways providing the difference in cost to ensure the barrier structure can be multi-functional.

FRM works will use FDGIA to fund their work and there may be opportunities to seek external contribution that should be explored. Waterways have a limited amount of capital funds the majority of which is allocated to essential operational and health and safety works on existing assets. All of the funds for the Waterways works will be sought from external contributions.

The opportunity for external contribution towards waterways works has been identified through existing partnership arrangements with Lincolnshire County Council. Funds have been agreed by the Council, an application for EMDA funds has been successful and an application for European Regional Development Funds is being assessed. These funds are for the navigation link adjacent to or through Black Sluice.

There may be further funding opportunities from Lincolnshire County Council and East Midlands Development Agency in the future and there are other sources of external contribution identified in the Implementation Plan that should be explored further. Allocation of costs are summarised in the following table.

Table 4: 100 year Strategy Approval Amounts

	Waterways	FRM	TOTAL
	Whole life cash cost £ (100 years)	Whole life cash cost £ (100 years)	Whole life cash cost £ (100 years)
Costs to Strategy:			
Agency Staff	SUNK COSTS	SUNK COSTS	SUNK COSTS
Consultants	SUNK COSTS	SUNK COSTS	SUNK COSTS
Strategy to Construction:			
Agency Staff	507,000	5,520,000	6,030,000
SI Costs	385,000	7,370,000	7,760,000
Consultants & Contractor	845,000	10,900,000	11,700,000
Other Costs	388,000	71,000	459,000
Construction:			
Construction costs (incl. supervision & cost consultants)	20,500,000	52,100,000	72,600,000
Agency staff	387,000	2,770,000	3,160,000
Compensation	565,000	4,010,000	4,580,000
Environmental enhancement	254,000	1,120,000	1,370,000
Contingency:			
Uplift for optimism bias 60%			
Risk contingency 60%	14,300,000	50,300,000	64,600,000
Other Costs:			
Maintenance	13,300,000	12,200,000	25,500,000
TOTAL	51,400,000	146,000,000	198,000,000
Contributions	8,000,000	0	
Future Contributions to be sought	43,400,000	Opportunities	

Price date Q2 2007

Operation and maintenance costs will be the responsibility of the asset owners and have been allocated in the strategy to either FRM or Waterways. All FRM asset

operation and maintenance (£12.2M) will be funded directly by the area team. The navigation link will be managed by Waterways and the required funding for operation and maintenance of waterway assets (£13.3M) will be generated through increased boat licence revenue and other income derived from moorings, redevelopment etc or external funding.

10. STATUS

- 10.1 The preferred option is a multi-purpose barrier and navigation link. This comprises of a flood tide barrier to increase the standard of protection combined with a partial exclusion barrage to control the tidal range within the town of Boston and a new lock through, or adjacent to, Black Sluice on South Forty Foot Drain. The FRM assets will increase the standard of protection against tidal flooding from a less than 1 in 50 chance (2% chance) of flooding in any year to a less than 1 in 300 chance (0.33% chance) of flooding in any year. The new Waterways assets will greatly improve access for boats to The Haven and provide a new link into South Forty Foot Drain.

- 10.2 The Boston Combined Strategy has strong links to Creating a Better Place. It will allow more people from more backgrounds to enjoy water-related recreation. It will reduce the risk of flooding for a significant number of people by improving the existing flood defences. The strategy also plans ahead for flood risks, adapting to the effect of climate change.

The Fens Waterway Link is a partnership project led by the Environment Agency to develop a new navigation network within the Fens, starting in Boston and ending on the Great Ouse, Cambridgeshire. The Boston Combined Strategy will be the first step in creating the largest waterway enhancement scheme in Europe

- 10.3 The Strategy will contribute towards Flood Risk Management future housing targets. It will also contribute towards a number of Waterways targets including implementing better facilities, increasing external funding and charge income and increasing participation.
- 10.4 983 commercial properties and 10,234 residential properties will benefit from reduced flood risk.
- 10.5 Defra and Treasury approval will need to be sought for the strategy.

11. RECOMMENDATIONS

- 11.1 This paper is seeking a FSoD A9 approval for the whole life costs of the Boston Combined Strategy of £198,000,000 over the next 100 years.
- 11.2 Following approval of the Boston Combined Strategy other approvals will be required for each component of the strategy. The first approval to be sought will be a stand alone approval for the navigation link between The Haven and South Forty Foot Drain. A number of technical studies were started in 2006/07 for the waterway link to satisfy the external funding timeframe.
- 11.3 High level liaison with funding partners will be required to maximise the potential of securing funds to deliver the remaining Waterways elements. Legally binding

agreements with bodies that will provide funding contributions will be in place before entering into contracts under this strategy.

2. BUSINESS CASE

2.1 Introduction and Background

This report identifies and assesses strategic options that could deliver a combined approach to flood risk management and navigation issues for Boston Haven.

The aim of this strategy is to establish whether investment in a plan of schemes within Boston will deliver a number of Environment Agency business objectives in a cost effective manner. Sufficient assessment will be presented to justify key decisions about managing the risk of flooding to Boston and to demonstrate how the Environment Agency can invest in navigation improvements, both of which will significantly contribute to improving the future quality of life within Boston.

Defra's Flood and Coastal Defence Project Appraisal Guidance, Volume 2 has been used to inform the content of the option assessment. Volume 3 has been used as a methodology to assess the economics. The comprehensive cost benefit relationship of combined options has been evaluated to discover the most economically beneficial option for society. The investment economics related to the separate components of flood risk management and navigation are also presented in order to identify different contribution streams. The potential for external contributions to implement the strategy is explored.

This is the first version of this strategy and it should be reviewed in six years time.

Strategic Environmental Assessment has been undertaken voluntarily in conjunction with the development of this strategy and an Environmental Report produced. The timeframe of the strategy will cover 100 years as appropriate to the asset life of the investment being considered.

- "Boston Haven" describes the tidal reach of the River Witham. It has been an integral part of the town for hundreds of years; the town derives much of its history and present character from the tidal nature of the Haven, the close proximity of the docks to the town, and the working fishing fleet.
- In addition to receiving fluvial flows from the Lower Witham, there are three other major discharges into the Haven controlled by sluices.
- The Haven discharges into The Wash where there are protected environmental sites of national and international importance.
- Existing tidal defences comprise approximately 4.8 km of hard defences and 17.5 km of earth embankments between the tidal limit (Grand Sluice) and The Wash.
- Approximately 900 commercial properties and 10,000 residential properties are being protected from flooding by the existing defences.
- The tidal Haven restricts the type and numbers of vessels that can safely navigate that stretch of water.

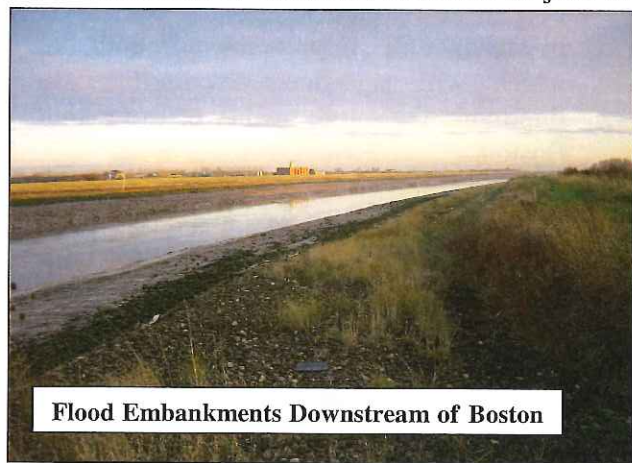
2.1.1 Background to the Study Area

The town of Boston has a population of approximately 27,000 people and comprises residential, commercial and industrial buildings, including an important regional port. With adjacent parishes the built up area of the town has a population of over 35,000. The Port of Boston and the fishing industry are key river-related industries relevant to the development of this strategy. The town of Boston has been afforded special recognition by the European Union that give access to specific funds to support socio-economic growth.

Boston has an important history as a trading port and later as a centre of religious non-conformism. The low degree of town centre redevelopment has enabled the preservation of a rich architectural heritage. A significant extent of the study area, mainly through the town centre lies within a Conservation Area.

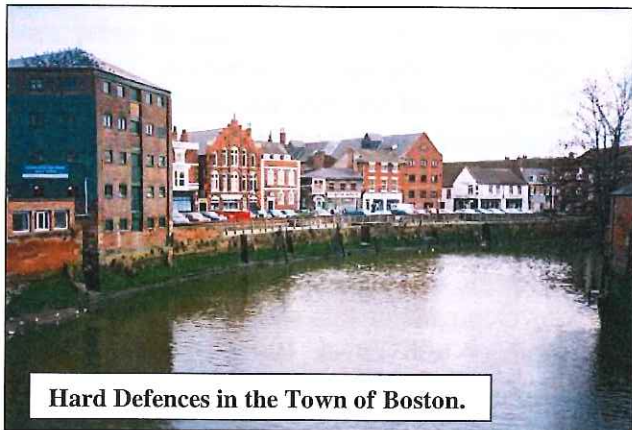
The study area is based on the potential area that could benefit from the implementation of the combined flood risk management and navigation strategy. This is effectively dictated by the area impacted by flooding, allowing for neighbouring studies on the Lower Witham catchment, the Black Sluice catchment, the Wash Banks Strategy, and the Wash Shoreline Management Plan to avoid double counting of benefits. The study area for economic assessment is smaller than that used for environmental assessment because of the limits of these other studies.

The River Witham flows through Boston in a northwest to southeast direction to join the North Sea at The Wash. Grand Sluice dictates the change from the fluvial River Witham to the tidal waters of The Haven and is positioned to the north of the town centre. As the tidal river leaves the town, the estuary follows the course dictated by maintained earth flood embankments and wide berms before entering The Wash at Tab's Head. A location map showing key features and the study area and some illustrative photographs of the area is included in Appendix A.



Flood Embankments Downstream of Boston

The River Witham (fluvial and tidal) is a high level carrier. This means the general ground level surrounding the tidal river lies below the level of the mean high water spring (MHWS) tide. This is common in the Fens where the surrounding land is generally low lying and flat.



Hard Defences in the Town of Boston.

The town of Boston and the surrounding land is currently protected from flooding by a variety of defences. Typical defences within the town comprise steel sheet piling, concrete and masonry walls. Out of the town, the estuarine defences generally comprise earth embankments set back from the main channel.

2.1.2 Designated Sites

The Haven discharges into The Wash, which is designated as a Site of Special Scientific Interest, a Special Protection Area, and a Ramsar site. The main conservation interest of The Wash is the extensive mosaic of intertidal habitats which support an abundant and diverse bird community. Environmental constraints such as designated sites are shown in Appendix A and discussed in more detail within the Environmental Report (Appendix G).

The Wash and North Norfolk Coast is also designated as a candidate Special Area of Conservation, the main conservation interest being mudflats, sandflats, lagoons and saltmarshes. In addition to The Wash there are a number of local sites of nature conservation interest (Lincolnshire wildlife sites).

2.1.3 Legal Framework

Flood defence works will in the main be carried out under the powers granted in section 165 of the Water Resources Act 1991. Waterways works will in the main be carried out under the powers granted in SI 1995 No.148 the Town and Country Planning (General Permitted Development) Order 1995. Certain flood defence and navigation works will require express statutory authority for their construction and operation that can be obtained by way of a Transport and Works Act (1992) Order.

Two main legal frameworks cover the waters between Grand Sluice and The Wash:

- The Boston Port and Harbour Act and Orders
- The Witham Act and Orders

The powers of Boston Port and Harbour Act have largely been passed to the Port of Boston and include such matters as powers to make sea walls, jetties, wharves and lights etc. The Port is the navigation authority for the harbour, up to Grand Sluice.

Relevant powers of the Witham Act and Orders have now been passed to the Environment Agency. Of particular relevance is the River Witham Improvement Act 1880 that includes such matters as “the exclusive control and management” of the River Witham seaward of Grand Sluice and of unembanked lands, fascine walls, foreshores etc of the River Witham seaward of Grand Sluice.

Legal review of the local legislation has concluded that there is nothing there which would particularly impact on the Environment Agency’s ability to deliver any of the works considered in this strategy.

2.1.4 Context with Other Plans

The strategy must consider the aims of other Environment Agency plans in the area and consider the context and interaction with other regional and local plans. A comprehensive review of strategies and plans which interact with or influence this strategy is included in the Environmental Report (Appendix G). This includes:

- Regional Spatial Strategy for the East Midlands (RSS8), 2005
- Lincolnshire Structure Plan, adopted 2006
- Boston Interim Plan, 2006

Plus the emerging development plan, Boston Borough Local Plan, Redeposit Draft, 2005.

Also of importance is the Boston Masterplan which presents a vision of Boston as an accessible, vibrant and attractive historic town with a good quality tourism offer, a good range of employment opportunities and a high quality of life for residents.

A full assessment of the planning context of this strategy is presented in Appendix C. From this, the planning issues relevant to this application are:

- The economic role of Boston and its waterways
- Port of Boston

- Environmental considerations
- Residents and land user considerations
- Tourism and recreation aims.

The Fens Waterway Link is a partnership project led by the Environment Agency to develop a new navigation network within the Fens, starting in Boston and ending on the Great Ouse, Cambridgeshire (see Appendix E for detail). This navigation link will open up 240 km of waterway creating the largest waterway enhancement scheme in Europe. The entire strategy aims to deliver rural regeneration on a major scale through water-based tourism.

The combined approach of this strategy could benefit the town of Boston in the following key ways:

- Manage the risk of flooding from tidal surge
- Open up the town centre and surrounds to waterway traffic
- Act as a catalyst for regeneration and renewed focus on the town centre
- Act as a catalyst for new businesses to support the waterway, tourism and leisure interest
- Provide confidence in the future of Boston to potential investors
- Improve the quality of life for Boston residents

2.1.5 Strategy Objectives

The objectives were established by holding a workshop comprising key business users and the core project team. The business requirements were developed and the aspirations for the project discussed. The resulting agreed objectives are:

Strategic Objective:	To reduce the risk from flooding while enabling opportunities for regeneration in Boston.
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This will be achieved by developing a sustainable solution that will be shaped by applying the following four project specific objectives:

Navigation:	To provide a safe and attractive navigation link between the River Witham and South Forty Foot Drain.
Flood Risk Management:	To reduce the risk to people and the developed and natural environment from flooding.
Economics:	To maximise amenity, social and economic opportunities.
Environment:	To minimise the adverse impacts on the natural and built environment of the area and to maximise opportunities for environmental enhancement.

These objectives were explored and developed further as part of the Strategic Environmental Assessment process, documented in the Environmental Report (Appendix G), and summarised in Section 2.4.

Summary

This introductory section provides background information to the strategy by giving an overview of the area and some context for the following sections and decision making. Boston is an historical market town with an important maritime history. It is set in the low-lying and flat landscape of the Lincolnshire fens, much of which is below the level of the mean high water spring tides of The Haven. The tidal river presents a potential flood risk and restricts the type and volume of waterway navigation through the town. Boston has socio-economic issues and the focus of many of the local development plans are aimed at improving the quality of life within the town.

2.2 Problem

2.2.1 Flood Risk

Historic Flooding. A number of historic flood events have affected Boston, such as the 1953 East Coast Flood, which has been documented as one of the worst natural disasters to strike Britain. Subsequent flood events have occurred in 1976, 1978, and 2001. The 1978 event was the result of a severe NNE gale in the North Sea that produced a storm tide surge along the east coast of England (surge height of 1.2m in The Wash). This coincided with a high spring tide resulting in a peak tide at Boston of approximately 5.6m AOD. This caused localised flooding due to overtopping and led to the failure of the defences in front of St Botolph's Church ('The Stump') and resulted in significant flooding in the town. Records for this event indicate that 175 houses and 30 commercial premises were flooded.

Fluvial flood risk. The discharge of fluvial flows from the River Witham is controlled by Grand Sluice. The Lower Witham Strategy Study is currently being reviewed and this review has indicated that fluvial flows pose negligible risk to the town of Boston; the risk from tidal water level and tidal surge is far greater than the fluvial risk. The fluvial system operates at larger flood events such that flood flows overtop within the upper system and are not all conveyed to the town of Boston. In addition, the tidal defences in place along the Haven will contain fluvial flood flows far in excess of those passed through Grand Sluice.

The Black Sluice catchment discharges via South Forty Foot Drain into The Haven. Fluvial flood risk to Boston town from South Forty Foot Drain is negligible (refer Black Sluice Catchment Study). It is important to note that some options for creating a navigable waterway in Boston will potentially affect the discharge of Black Sluice and this must be considered in evaluation and design.

Navigation and flood management place different requirements on operation of the waterway, some of which may be perceived as conflicting. However, limitations of season (weather) and high flows on navigation mitigate these potential conflicts in most cases. Clear operational priorities on the watercourses will be required to ensure a successful combined strategy.

Tidal flood risk. Hydrodynamic conditions were analysed using a Mike 11 model and then floodplain mapping software. Preliminary runs confirmed that Boston is at risk of tidal flooding from The Haven and the fluvial flood risk in these areas is negligible in comparison. Based on the historical information and the modelling, flood risk management for Boston is focussed on the risk from tidal flooding and surge tides however, the strategy must not impair fluvial discharge or increase fluvial flood risk. Managing the risk of tidal flooding to Boston is a regional priority.

Flood Warning. Flood warning procedures are in place for Boston comprising a system of seven sirens placed around the central business and residential area of the town. The warning is triggered by a combination of tidal gauge information and weather prediction. A direct flood warning system (automatic dialler) is in place to warn properties close to Maud Foster Drain. Liaison with the Emergency Planning Committee (evacuation plans etc) is triggered by a level on the gauge at Grand Sluice.

2.2.2 Existing Standard of Flood Risk Management.

Detailed survey work was used to provide channel profile information for a hydraulic model and the resulting water level predictions at different tidal flood events were compared to existing defence levels. The results indicate that the current defences will offer protection from a tidal event with a 2% probability of occurrence in any one year (1 in 50 year return period). This does not allow for any freeboard to accommodate overtopping from locally generated waves. The minimum standard of protection for each bank is consistent through the town. Appendix D shows more detail of predicted water levels compared to a long section of each bank (Figure D.1).

Three main sources of flood risk have been identified using asset information and hydraulic modelling: structural failure, overtopping and the impact of climate change on the Standard of Protection.

1. Structural failure of the defences. A visual engineering inspection (2003) concluded that the defences were generally in good condition however, there were a number of specific locations where urgent attention is required to prevent structural failure in the next five years. Immediate needs have been addressed with works in the Haven. The report of this inspection and details of these locations can be found in Appendix B.

2. Overtopping of defences. Lower areas in the current defences only provide protection from a tidal event with a 2% probability of occurrence in any one year (1 in 50 year return period). The majority of these lower points are within the urban town. The effect of overtopping is reflected in the flood extent maps that show significant flooding beginning with a 1 in 100 year tidal event (1% chance of occurring in any one year) and show the inundated area increases as the tidal event intensity increases. The maps show more flooding on the floodplain to the left of the Haven due to lower defence heights in this location. Maps are included as part of Appendix D.

Overtopping of embankments can cause erosion and can increase the chance of a breach. A breach failure along any of the earth embankments downstream of Boston town centre would lead to significant damage to the town of Boston as well as the surrounding agricultural land because there are few or no topographical features to contain flood flows across land.

3. The Impact of climate change. The effect of rising sea levels, combined with a lowering of ground levels, and more intense weather conditions, means the existing Standard of Protection within the study area will reduce over the next 100 years. By 2104 the current defences are predicted to be overtopped by a tidal event with less than a 10% probability of occurrence in any one year (below a 1 in 10 year return period).

2.2.3 Future Tidal Water Levels and Flood Risk

The predicted extreme tide water levels in Boston Haven that have been used to assess future flood risk and damages are shown in Table 2.1. These water levels allow for increased sea

level rise as a result of climate change. It is important to note that water levels vary along The Haven and those shown in the table are adjacent to the Port of Boston.

Table 2.1: 2004 and 2104 Extreme Water Levels for the Town of Boston (mAOD)

Year	1 in 50 yr 2% chance	1 in 100 yr 1% chance	1 in 200 yr 0.5% chance	1 in 300 yr 0.33% chance
2004	5.90	6.12	6.26	6.33
2104	6.50	6.70	6.83	6.90

Should there be no active intervention to maintain and/or repair tidal defences, breaches are likely to occur at points of poor condition with consequent inundation of the floodplain. The flat and low lying topography of the study area means inundation will be widespread. Appendix D includes flood extent maps showing the area flooded when a breach occurs for tidal events with different probabilities of occurrence (Figure D.2). A tidal event with a 1% probability of occurrence in any one year (1 in 100 year return period) would affect over 11,000 properties.

Numerical modelling predicts that a breach will lead to a reduction in water levels in the main channel. The breach width is the same for all predicted breach locations however, the depth of the breach is different and ground levels in the town are slightly higher therefore there are larger flood envelopes resulting from breaches downstream of the Port on either the right or left bank. The flood envelopes resulting from breaches of hard defences within the town are nonetheless significant as they include a large part of the town centre and there is significant economic damage irrespective of where a breach may occur.

Should existing flood defences be maintained in good condition but with no increase in height, the chances of a breach occurring are managed and the mechanism of flooding is overtopping. The extents of a flood caused by overtopping of current defences is shown on Figure D.3, Appendix D. Flooding as a result of a breach in defences may occur when overtopping leads to erosion of embankments. Most of the overtopping is predicted to occur on the left bank between Grand Sluice and Hobhole outfall due to slightly lower defence heights.

There is uncertainty about the legal responsibility for maintenance of the river, its banks, and nearby land. In some cases a single flood defence can have split ownership and over the years the Environment Agency has undertaken maintenance or repair work on the majority of the defences. Eight properties are the subject of Section 27 Notices that restrict the rights of owners to remove or alter the property because of their role in forming part of the flood defences.

2.2.4 Navigation

The Fens sit between two important leisure and tourism destinations, the midland canal network in the west and Norfolk and Suffolk Broads in the east. Historically the waterways in the Fens were extensively used for the transport of freight, but with the appearance of the railways and the development of the highway network, commercial use of the waterways declined and waterway use is now fragmented and largely for leisure.

The Fens Waterways Link is a navigation strategy that aims to provide a focus for new investment in the east of England at the same time as supporting leisure and tourism interests within the area. The Environment Agency is a key partner in this plan. It will be formed largely from existing waterways through the Fens, however approximately 80 km of new

waterway will be required, including a navigable link between the River Witham and South Forty Foot Drain in Boston. More details of this strategy are contained in Appendix E.

The new link at Boston is a key element of the Fens Waterways Link, as it passes through Boston and this provides an interesting cruise in its own right. In order to attract additional boaters and visitors the ability to navigate safely is paramount. Tidal waters restrict the safe access of novice boaters and limit the potential for rental boats, therefore the tidal Haven restricts leisure navigation.

Current traffic on the Haven includes commercial vessel access to the Port and external wharves, commercial fishing fleet (fish and shellfish catches), sea going leisure cruisers and yachts that currently (generally) moor upstream of Grand Sluice. An aim of the link is to attract more leisure vessels into the town, to promote freight use of the waterways, and to allow rental and other business vessels to develop on the waterway (water taxi, restaurant boat, bird tours etc).

Tourism and development plans for Boston include the potential navigation improvements with a focus on the town centre and feature Boston Stump, the cultural heritage of Boston's maritime past, and the town's association with Boston Massachusetts and the Pilgrim Fathers.

Key information and terminology about navigation water levels, tidal levels and the design implications for headroom (air draft) under bridges, and the type of lock gates required is outlined in Appendix E.

Navigation rights. Navigation is administered on The Haven by the Port of Boston (via the harbourmaster). Upstream of Grand Sluice (River Witham) they are administered by British Waterways. The Environment Agency had navigation rights on South Forty Foot Drain and it is believed that these were never revoked. Legal confirmation of this is being sought.

Regeneration. The objectives of this strategy are aligned with the impetus for waterways regeneration following the Governments publication of 'Waterways for Tomorrow' (Defra) and the Environment Agency's navigation strategy 'Rivers for Life'. These recognise that development of the waterways can deliver gains in economic terms and opportunities for river transport, social inclusion, and environmental enhancement.

Summary

Tidal flooding presents a far greater risk to the town centre than the risk from fluvial floods. Evidence of flood risk comes from historical records and predictive modelling. Modelling of future conditions show extensive areas affected should a breach or overtopping of defences occur. Flood risk arises from potential asset failure, overtopping, and increasing sea levels as a result of climate change.

The navigational potential of The Haven is not being realised. The tidal range limits the type and volume of traffic that can safely navigate this stretch of water and a link to South Forty Foot Drain is a fundamental part of the Environment Agency's vision for the regional waterways network.

2.3 Options Considered

The strategic approaches that were considered to deliver flood risk management and to deliver navigation improvements are explained below along with options to implement each. The separate flood risk management and navigation options are shown on Figures 1 and 2.

These component options were screened using multiple criteria such as technical viability, environmental, and social impacts before combined options for delivery were formed and then assessed.

Barrage or Barrier?

Four types of structure are widely recognised:

- Tidal exclusion barrage: water is impounded and is freshwater at all times
- Partial tidal exclusion barrage: tidal water is allowed to overtop, or pass the barrage at certain tidal ranges
- Tidal power barrage: using the tidal flow, ebb and/or flood, to generate power using turbines within the barrage structure
- Tidal surge barrier: operates only during storm tidal surges to prevent inland flooding.

2.3.1 Flood Risk Management Approaches (see Figure 1)

1) Hold the Existing Line of Defence.

1a)	Reactive maintenance to repair or maintain the defences to the existing level following a breach, or when on the verge of failure.
1b)	Pro-active maintenance to maintain the defences at the current level to ensure that a breach does not occur. Sea level rise due to climate change and long term ground settlement in the region will cause a gradual reduction in the Standard of Protection (SoP). Taken as the Do Minimum flood management option.
1c)	Sustain SoP against climate change. Raise level of defences in their current position to cater for the effect of climate change and settlement whilst maintaining the current Standard of Protection.
1d)	Increase SoP. Raise the level of defences to increase the Standard of Protection above the present level.

2) Advance the Existing Line of Defence.

2a)	Advance the line of the defences by positioning a tidal surge barrier at a position to be determined within The Haven. The function of such a barrier would be to prevent high tide water levels flooding the low lying land upstream. Defence levels downstream may need raising depending on the SoP.
2b)	Relocate tidal limit. A new barrage in The Haven to maintain upstream water levels similar to the current levels upstream of Grand Sluice, effectively replacing the tidal exclusion role of Grand Sluice. Defences downstream may need raising depending on the SoP.

3) Managed Realignment.

3a)	Setting back the line of the defences and allow for a managed breach to create a storage reservoir in a suitable location downstream of the town of Boston.
3b)	Setting back the defences from the existing position, allowing natural processes to breach the old line of the defences.

4) No Active Intervention (“Do-nothing”). Under this approach the Environment Agency will continue to monitor the defences in accordance with its current obligations. There will be no active intervention to maintain and/or repair the defences, resulting in eventual failure of the defences at locations where the current condition is poor.

2.3.2 Navigation Approaches (see Figure 2)

A) New Channel to the west of Boston. This approach would create a new navigation channel from the River Witham, connecting North Forty Foot Drain and South Forty Foot Drain and creating a new waterway to the west of Boston town centre. Two new locks and four bridges, plus channel widening works would be required to achieve the navigation.

B) Tidal Lock in isolation at Black Sluice. A new tidal lock would be created in Black Sluice, ideally using some of the historical lock facilities modified in the 1970’s. This would mean that waterway traffic would have to navigate a tidal stretch of the Haven within the town centre between Grand Sluice and Black Sluice.

C) Water level control barrage with navigation link. This approach would create a new barrage with the purpose of controlling tidal water levels within Boston town centre to ensure waterway navigation was safe. A barrage could either totally exclude the tide (static, freshwater environment created upstream) or partially exclude the tide (controlled tidal range). In addition to a barrage, a new navigation link is required to allow waterway traffic to bypass Black Sluice and enter South Forty Foot Drain:

C1)	Relocate the tidal limit in The Haven. A new barrage structure would fully exclude the tide and maintain a permanent upstream water level.	New lock in Black Sluice
C2)		New channel to the north of Black Sluice with new lock access
C3)	A new barrage structure would maintain an upstream water level similar to the current levels upstream of Grand Sluice, but only partially exclude the tide from the town centre.	New lock in Black Sluice
C4)		New channel to the north of Black Sluice with new lock access

D) Do Nothing. Under this approach the Environment Agency would not deliver a navigation link between the tidal River Witham and South Forty Foot Drain. This would limit the delivery of the Fens Waterways Link plan and curtail opportunities for environmental and social improvement achieved through either of the Fens Waterways Link vision or this strategy.

Figure 1

Key:

Option 1: Hold existing line of defences

0.0-0.2m Wall Raising

0.2-0.4m Wall Raising

0.4-0.6m Wall Raising

0.6-0.8m Wall Raising

Option 2: Advance line of defences

Location Range of Surge Barrier in Haven

Option 3: Realignment and Storage

Potential Managed Realignment Areas and

Potential Offshore Storage Zone

Notes:

1) Wall raising heights = minimum to sustain standard of protection for future climate change. Additional height required to increase standard of protection.



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Project

Boston Combined Strategy

Title

Flood Risk Management Options

Date June 2006
Drawn PQ

Checked JLB
Scale 1:24000 (A3)

Approved JMW
Drawing Ref: 0018976/3

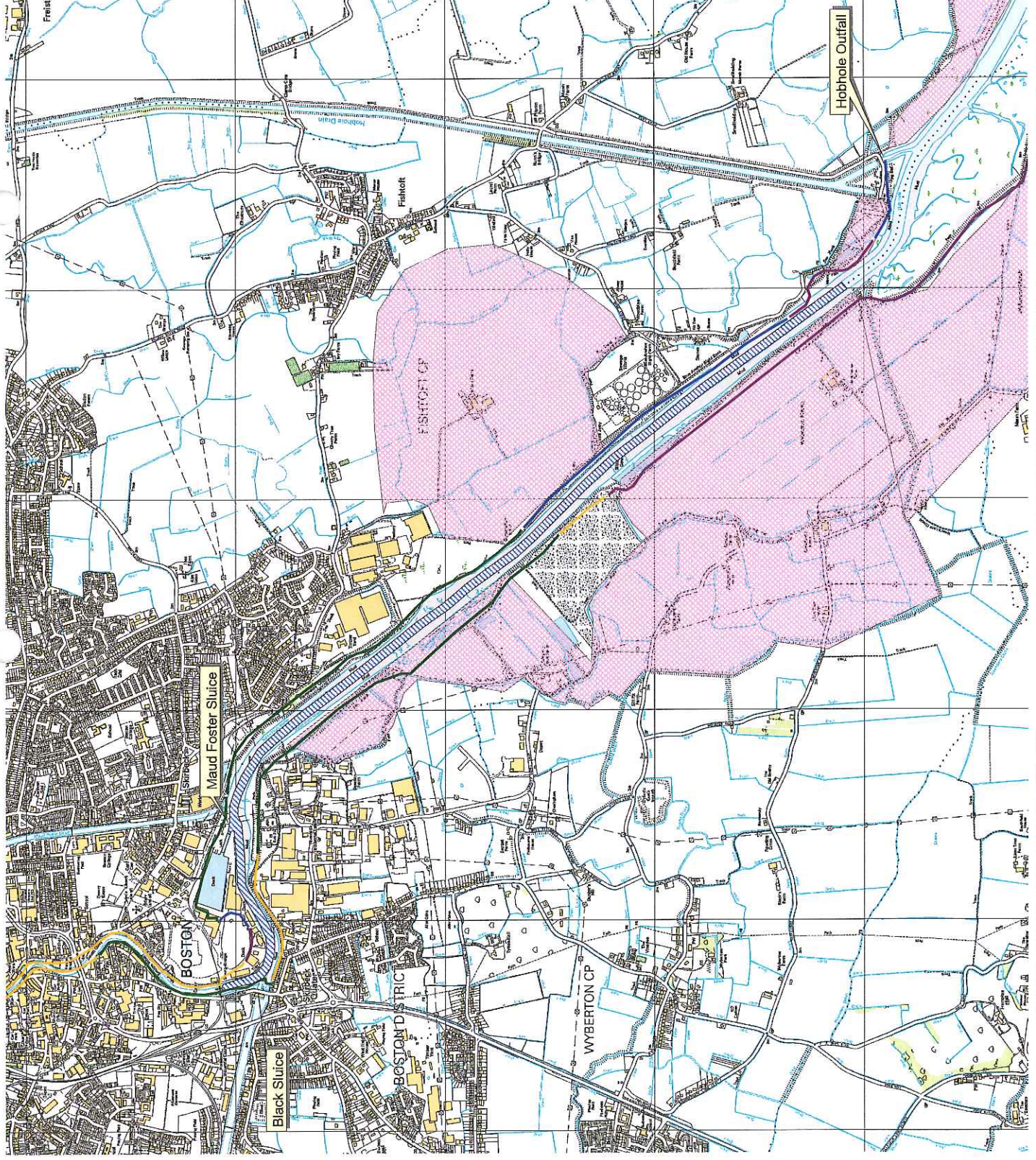


Figure 2

Key:

- Channel Edge
- Option A: Channel West
- Option B: Tidal Lock at Black Sluice
- Option C: Route of New Navigation Link with Barrage
- Boston Haven to South Forty Foot Drain
- Cooke's Lock Pumping Station
- Location Range of Barrage in Haven



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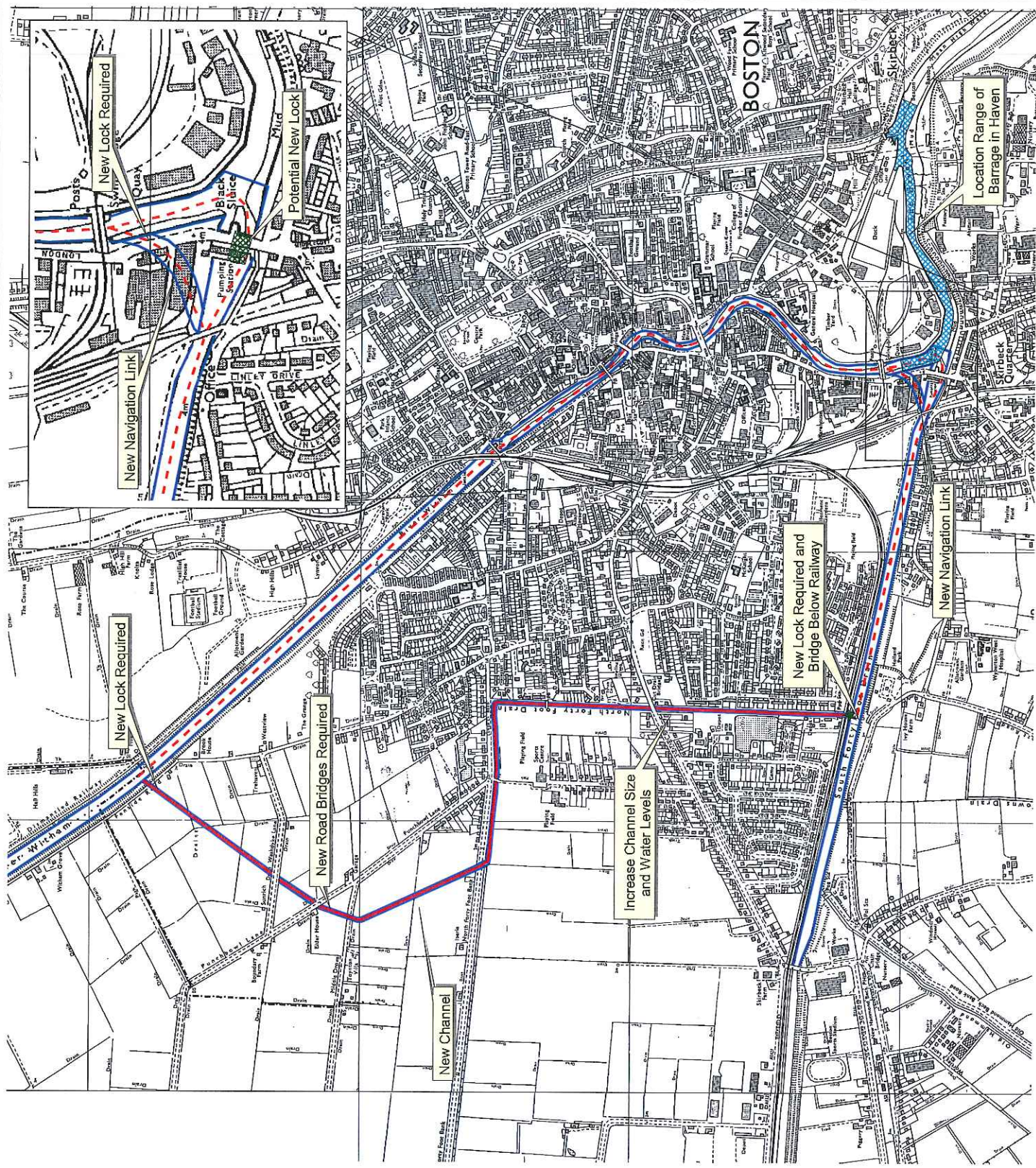
Project

Boston Combined Strategy

Title

Navigation Options

Date: November 2005
Checked: JLB
Scale: 1:18000 (A3)
Approved: JW
Drawing Ref: 0018076/2



2.3.3 Technical and Environmental Screening of Options

A preliminary screening exercise on both the flood risk management approaches and the navigation approaches identified those that would not be technically favourable due to functional or physical constraints. The Strategic Environmental Assessment (SEA) process assessed each separate approach to flood risk management, or providing safe navigation, against the environmental objectives and identified those that were environmentally favourable. Full details are given in the Environmental Report. Screening details are given in Appendix F, Table 1.

Where approaches for flood risk management and navigation are technically and environmentally acceptable, they have the potential to offer a sustainable combined strategic solution. A summary of the key technical and environmental issues of each separate approach, considered when making a screening decision, is presented below.

Table 2.2: Screening of Flood Risk Management Approaches

Approach	Option	Description of Management Option	Issues	Status
Hold the Line	Option 1a	Reactive maintenance	Does not deliver objectives regarding flood risk management and development control. Not supported by Boston Borough Council (BBC) or other Boston Haven FMS Scoping study responses.	No further consideration
	Option 1b	Pro-active maintenance.	Not supported by BBC. Flood risk arising from asset failure needs addressing.	Take forward to economic assessment
	Option 1c	Raise defence level for climate change.	Concerns about social acceptability of height of stretches of wall in relation to landscape. May be possible to mitigate. English Heritage and BBC concerns.	Take forward to economic assessment
	Option 1d	Increase SoP	Visual intrusion of raised hard defences within town centre. Opposes key social objectives of the strategy. Not supported by BBC within town. English Heritage concerns.	No further consideration
Advance The Line	Option 2a	Flood Barrier between Hobhole outfall and Swing Bridge	Preferred option of number of consultees. Specific local issues about potential location and appearance.	Take forward to economic assessment
	Option 2b	Barrier to move tidal limit of river	Loss of cultural heritage unacceptable to English Heritage. Does not fit with BBC plans for Boston. EN concerns about impact on the Wash. Ecological concerns about change to fluvial limit of river and effect on biodiversity, water quality, etc. Adverse effects on geomorphology and water level regime.	No further consideration
Realignme nt	Option 3a	Managed realignment – storage areas	Does not deliver flood risk management. Rejected on technical grounds due to bank works and landfill site constraints, plus geomorphology concerns.	No further consideration
	Option 3b	Managed realignment - retreat the line	Does not deliver flood risk management. Major managed realignment may not improve the functioning of the estuary system and may hinder navigation.	No further consideration

Table 2.3: Screening of Navigation Approaches

Approach	Option	Description of Management Option	Issues	Status
New channel to west	A	Channel linking North Forty Foot Drain to South Forty Foot Drain	Does not support regeneration opportunities for partners as it bypasses town centre. Supported by Black Sluice IDB as does not affect Black Sluice.	Take forward to economic assessment
Tidal Lock	B	New tidal lock in Black Sluice	Rejected as stand alone option as Haven still full tidal navigation.	No further consideration
New barrage and navigation link	Option C1 and Options C2	Barrage to move tidal limit of river plus New navigation link (Black Sluice lock or new cut)	Loss of cultural heritage unacceptable to English Heritage. Does not fit with BBC plans for Boston. English Nature concerns on Wash. Ecological concerns about change to fluvial limit of river and loss of biodiversity, water quality, etc. Adverse effects on geomorphology and water level regime.	No further consideration
	Option C3 and Option C4	Barrage to control tidal range plus New navigation link (Black Sluice lock or new cut)	Location of barrage concerns Port. Some location options of concern to English Nature because of Wash. Gravity discharge of Black Sluice possibly impaired.	Take forward to economic assessment

Key decisions in the selection of the combined options informed by this screening appraisal can be summarised as:

- Managed realignment would not sufficiently reduce flood risk and may have geomorphological impacts on the estuary and the Wash and so was rejected on both technical and environmental grounds.

There are concerns that any large-scale realignment along the Boston Haven will adversely alter the siltation regime in The Haven. Principal amongst those concerns is that it will have a detrimental effect on the ability to navigate The Haven safely. Aside from issues relating to navigation the lengths of defence and areas that could potentially be realigned are not large enough to deliver the full spectrum of benefits that other options can. A combination of realignment and another option is not believed to offer a cost-effective solution.

Some smaller scale realignment will be required to mitigate the impact of the preferred option. It is envisaged that this work will be extended to make a net (BAP) habitat gain.

There is also a reasonable possibility that a dedicated construction facility known a 'graving yard' could be developed behind an existing flood defence for the construction of the larger components of the proposed barrier. During the course of constructing these components a new flood defence would be constructed on a retreated line on the periphery of the 'graving yard'. Once all work was complete the original front line of flood defence would be removed and the barrier components floated to site on an appropriate high tide. The advantage of pursuing this form of construction is that it is a far more controlled environment than constructing these larger barrier components in the river. This would help manage financial, H&S and environmental risks and as a legacy would lead to a realignment of the flood defences within the general costs of the scheme.

- There is a need to invest in the repair and maintenance of existing flood assets to manage the risk of flooding due to asset failure. Pro-active maintenance of existing flood defences has been carried forward for economic assessment.
- The additional height required on existing defences to increase the Standard of Protection as a 'hold the line' approach, would have impacts that could not be mitigated in some locations sufficiently to make the option acceptable to the planning authority or community.
- A navigation barrage or tidal exclusion barrier that removed the tidal nature of the Haven would not be acceptable to key consultees such as English Heritage and English Nature.
- The potential location of either a flood barrier, a navigation barrage, or a multi-functional structure is constrained by potential environmental impacts. In particular the sensitive environment of the Wash, the operation of Black Sluice, and the continued commercial operation of the Port define an acceptable location range.
- Some of the regeneration benefits identified will not occur with the hold the line options. This is because the level of defences through the town of Boston will be raised and therefore cut off the town from the Haven. This option is already not taken forward for consideration for reasons stated in Table 2.2 above. The additional benefits which would not occur are Consumer Surplus of £81,000 per year and the increase in house prices along the waterways of 4%.

The combined options that will be taken forward for economic assessment are in Table 2.4.

Summary

A number of strategic approaches were developed and the options to deliver these approaches considered. Preliminary screening of approaches was carried out using technical and functional criteria together with strategic environmental assessment to screen out any approaches or options that were not environmentally acceptable. The remaining valid approaches were combined into six strategic options which were then taken forward for environmental and economic assessment.

Table 2.4 – Strategic Combined Options Considered for Economic Assessment

Combined Strategic Option		Flood Risk Management			Navigation		
		Approach	Option	Brief Description of Management Option	Approach	Option	Brief Description of Management Option
I	Maintain defences and western waterway	Hold the Line	Option 1b	Pro-active maintenance	New channel to west	Option A	Channel linking North Forty Foot Drain to South Forty Foot Drain
II	Maintain defences, new barrier and navigation link	Hold the Line	Option 1b	Pro-active maintenance	New barrage and navigation link	Option C3	Barrage to control tidal range within town. New lock in Black Sluice
						Option C4	Barrage to control tidal range within town. Channel with new lock.
III	Maintain defences and western waterway	Hold the Line	Option 1c	Sustain standard of protection	New channel to west	Option A	Channel linking North Forty Foot Drain to South Forty Foot Drain
IV	Maintain defences, new barrier and navigation link	Hold the Line	Option 1c	Sustain standard of protection	New barrage and navigation link	Option C3	Barrage to control tidal range within town. New lock in Black Sluice
						Option C4	Barrage to control tidal range within town. Channel with new lock.
V	Flood barrier and western waterway	Advance The Line	Option 2a	Flood Barrier to increase the standard of protection	New channel to west	Option A	Channel linking North Forty Foot Drain to South Forty Foot Drain
VI	Multi purpose barrier and navigation link	Advance The Line	Option 2a	Flood Barrier to increase the standard of protection	New barrage navigation link	Option C3	Barrage to control tidal range within town. New lock in Black Sluice
						Option C4	Barrage to control tidal range within town. Channel with new lock.
	Baseline comparison	No Active Intervention	Option 4	This option forms the basis for the assessments of benefits.	Do Nothing	Option D	This option forms the basis for the assessments of benefits.

2.4 Strategic Environmental Assessment

The Strategic Environmental Assessment (SEA) process is an integral part of the combined strategy. The purpose of undertaking SEA is to ensure that environmental and sustainability issues are taken into consideration at an early stage of strategy development. The Environment Agency has voluntarily undertaken SEA in accordance with internal policy and Defra guidance, to accompany the Combined Strategy and this is documented in an Environmental Report included as Appendix G and summarised below.

2.4.1 Environmental Opportunities and Constraints

Baseline data provides an account of the existing environment prior to implementation of any strategic action of the Boston Combined Strategy. Using the environmental indicators as a framework, information on the baseline environment of the study area was collated. Consideration was also given to the recognition and understanding of future environmental trends within the study area.

Key requirements of internal and external plans and programmes were considered and integrated into the strategic environment assessment. The responses received during associated consultation exercises were also an important part of understanding the issues.

The review of data identified the following key constraints and opportunities for the development of a strategic approach that addresses flood risk management and navigation within Boston. Figure 3 is a strategic Indicative Landscape Plan that highlights the key issues within the study area. It is essential that any strategic approach seeks to address these constraints and maximise potential enhancement/improvement opportunities.

Opportunities

- ✓ Regenerating the Boston waterfront to encourage business opportunities within the town centre and to optimise economic benefits.
- ✓ Potential for increased tourism in Boston from a more diverse source.
- ✓ Improvement in local and regional waterways links to encourage regular use for navigation.
- ✓ Potential for improved flood management to benefit human beings and properties.
- ✓ Restoring the river to regular through navigation may provide opportunities to re-establish the link between the town and the river, which would improve its townscape and historic character.
- ✓ Potential for increased access to the riverside, with improvements in riverside recreation and amenity including opportunities for walking, cycling, angling and the provision of marinas, moorings etc.
- ✓ Improved economic prosperity through increased use of existing facilities and opening up potential for new developments such as marinas and mixed-use developments.
- ✓ Opportunities for water-based freight movements.
- ✓ The implementation of strategic approaches should seek to preserve and where possible improve biodiversity.

Figure 3

Key:

General Features

Study Zone

Water Features

Location of Preferred Strategic Option

Landscape Features

Urban

Agricultural

Mud Flats

Marsh Ground

Landfill Site

Woodland

Other Land Use Designations

Havenside Country Park

Local Nature Conservation Sites

Boston Haven Conservation Area

Ancient Sea Bank

Macmillan Way



Do not scale this drawing

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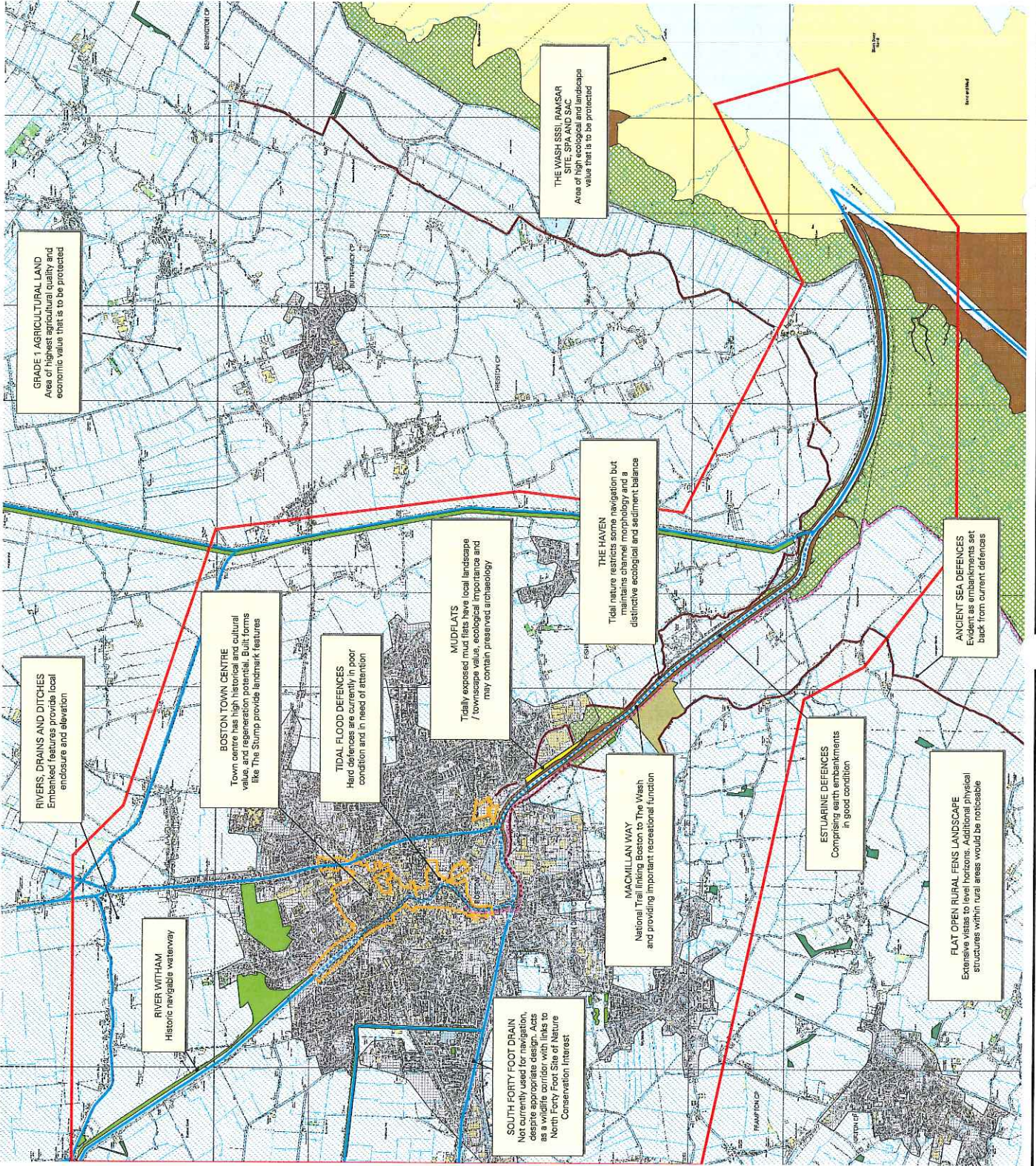
Project

Boston Combined Strategy
Strategic Environmental Assessment

Title

Indicative Landscape Plan

Scale	1:40000 (A3)	Date	March 2006	Drawing Ref.	18076/3
Drawn	PG	Checked	JLB	Approved	JW



Constraints

- ✗ The location, operation and historical status of the Grand, Black and Maud Foster Sluices.
- ✗ Additional land requirements for approaches that require new structures.
- ✗ Historical landscape character and visual significance of tidally exposed mud banks.
- ✗ Ecological constraints such as The Wash, designated as a SSSI, Ramsar, SPA, SAC and North Forty Foot Drain as a designated local conservation area.
- ✗ Preserved and unknown archaeology.
- ✗ Operational implications of alterations in water levels.
- ✗ Potential adverse implications with regard to water transfer (TWAS). Potential that water resources would be insufficient.
- ✗ Size and condition of existing drainage outfalls into The Haven. Some of these may be vulnerable to back flows in their current state, should water levels be altered.
- ✗ Unfavourable changes in the sediment regime of The Haven.
- ✗ The threat of climate change and the associated effects

2.4.2 Consultation

Consultation has been undertaken for both the Fens Waterways Link and Boston Haven Flood Management Strategy as they have developed. Consultation has also been undertaken as part of the Boston Waterways Link project which developed an option for outline planning permission as part of a bid process for European funds. A communication plan is used to coordinate and plan consultation on the strategy.

Consultees were supplied with information about the means to manage the risk of flooding in Boston (May & Oct 2004) and about new navigation proposals (2003, Nov 2004). They have been provided with the opportunity to express their opinions and provide comment at key stages of these studies. Public consultation of the strategy and Environmental Report was undertaken in April 2006. An overview of the opportunities that consultees have been provided with to contribute and/or comment is included in Appendix H.

Common interests and concerns have been extracted from the all the consultee responses and Table 2.5 provides an indication as to how these concerns and interests will be addressed within the combined strategy.

Table 2.5: Addressing Consultee Comments/Interests

Theme	Consultees	How consultee comments will be addressed within the strategy
Regeneration and leisure opportunities	Boston Borough Council Countryside Agency Port of Boston Environment Agency Fosdyke Yacht Club	Strategic environmental objective to provide an opportunity for investment, leading to long-term economic improvements and employment benefits.
Environmental (natural and cultural) protection/enhancement	Environment Agency English Heritage Countryside Agency Lincolnshire County Council RSPB English Nature	Strategic environmental objective to protect and enhance biodiversity and designated areas/sites. This objective is supported by indicators and targets that take into consideration comments that have been made during consultation. Development of a strategic approach that preserves and enhances the heritage value of Boston and the surrounding area.

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Theme	Consultees	How consultee comments will be addressed within the strategy
Challenges posed by uncertainties about future climate change	Boston Borough Council Fens Waterways Link Group Environment Agency	Incorporation of a single strategic objective that brings consideration of climate change high on the agenda in terms determining an appropriate strategic approach. The latest climate change predictions are to be integrated into decision making regarding future strategic action within Boston.
Navigation including preservation and enhancement of waterways	Port of Boston British Waterways Environment Agency Fens Waterways Link Group Boston Borough Council	Development of a strategy that from the outset has had a single vision which includes preservation and enhancement of waterways. Provision of strategic environmental objectives that include the facilitation of waterborne traffic and recreational navigation improvements.
Flood defence and flood risk management	Boston Borough Council Environment Agency Port of Boston Black Sluice IDB South Holland IDB Witham Fourth IDB	Advancement of a strategy that has a single vision which includes the future protection of Boston and the surrounding area from flooding. Development of realistic indicators and measurable targets that can be monitored in the future.
Farming	Environment Agency NFU	Development of strategic approaches that take into consideration farmland sensitivity to water management within the area. Target has been set within the SEA to maintain existing Agricultural Land Classification grades and to preserve desirable land cover typologies.

A full list of external consultees is included in Appendix H along with the distributed information and a record of responses to the consultation exercises undertaken for the Fens Waterways Link (where applicable to Boston), the Boston Haven Flood Management Strategy, and the Boston Waterways Link.

The detailed action plan of consultee participation can be found in Appendix H in the Communication Plan. The involvement of stakeholders provided the SEA and strategy with invaluable input and information about issues and opportunities. Internal Agency and external stakeholder consultation took place in January and April 2006 respectively. Issues raised during these consultations have been taken into due consideration and where action is taken following comment, the changes are documented in Appendix H.

2.4.3 Environmental Assessment of Options

The Combined Strategy and the accompanying SEA has adopted an objective led approach to the assessment of combined flood risk management and navigation approaches in accordance with the Environment Agency's AMS Guidance. The strategic environmental objectives are supported by performance indicators and targets that can be used for assessing performance over the life-time of the combined strategy.

The separate strategic approaches to flood risk management and navigation were assessed against the objectives, and those solutions that were not environmentally acceptable were identified and not considered further as described in section 2.3.3. In particular those approaches that were considered to adversely affect the Wash SSSI/SPA/Ramsar site were not carried forward. Full details of this screening assessment are given in the Environmental Report in Appendix G.

The strategic environmental appraisal of the combined options is summarised below in Table 2.6. The assessment of the significance of impacts of options was based on predicting the effects of alternatives on the environmental objectives. The significance of an impact is defined by a combination of the magnitude of the effect and the importance of the receptor. This was summarised by assigning a grading as follows:

- xx** *Major Adverse Effect:* effects arising from carrying out this option have potential to cause severe environmental damage or destruction, are non-reversible and difficult to alleviate.
- x** *Moderate Adverse Effect:* effects arising from carrying out this option have the potential to cause a moderate level of environmental damage, however mitigation could potentially reduce this damage.
- o** *Insignificant Effect:* implementing the option in the area is unlikely to pose a threat to the quality of the environment. In the event of a minor threat, mitigation may be necessary. Likewise, including the option could lead to minor improvement opportunities, or a chance to maintain current environmental standards.
- ✓** *Moderate Beneficial Effect:* implementing the option in the study area could lead to opportunities to improve the environment.
- ✓✓** *Major Beneficial Effect:* implementing the option in the study area could lead to an important opportunity, or series of long term opportunities to improve the environment.

Table 2.6: Environmental Appraisal Summary of Combined Options

	Maintain Defences & Western Waterway	Maintain Defences, Barrage & Nav Link	Maintain Defences for Climate Change & Western Waterway	Maintain Defences for Climate Change & Barrage & Nav Link	Flood Barrier to increase SoP & Western Waterway	Flood Barrier to increase SoP & Barrage & Nav Link
Objective	I	II	III	IV	V	VI
Reduce the risk of flooding to people, property and the environment	xx	xx	o	o	✓✓	✓✓
Provide an opportunity for investment, leading to long-term economic improvements and employment benefits	xx	x	x	o	o	✓✓
Be an important recreational resource and contribute to the health and wellbeing of local communities	xx	✓	o	o	✓	✓✓
Conserve and enhance the landscape character of the area	x	x	x	x	x	x
Protect and enhance features of archaeological importance and historic character throughout Boston	x	x	x	x	x	x
Protect and enhance biodiversity and designated sites of local, national and international importance	x	o	x	x	x	x
Ensure the strategy is sustainable in terms of long-term climate change	xx	xx	o	o	✓	✓
Ensure there are no adverse changes in water levels, quality and flows within the study area	x	o	x	x	o	o
Ensure favourable geomorphological regimes are maintained	o	x	x	x	o	o
Provide functional local and regional transport routes including a waterborne transport corridor for people and freight	xx	xx	x	x	o	✓✓
Ensure the strategy does not conflict with existing land use	x	x	x	x	x	o

The key advantages and disadvantages of the combined strategic options are summarised in Table 2.7. The full details of this assessment can be found in the Environmental Report included as Appendix G.

The studies carried out to date have satisfied Natural England that the options assessed are likely to lead to an environmentally acceptable solution in terms of the designations, and that Appropriate Assessment is unlikely to be required. Their letter of agreement is appended to this report.

2.4.5 Preferred Environmental Option

The most favourable option in environmental terms is Option VI, a multifunctional barrier to improve the standard of protection and control water levels within the Haven, accompanied with a new navigation link.

The predicted environmental effects of the preferred environmental option are shown in Table 2.8 against each of the strategy objectives. Where adverse effects have been identified the measures to mitigate these have been developed and opportunities for enhancement have also been identified.

Table 2.7: Potential Adverse and Beneficial Effects of Options.

Approach	Key Beneficial Effects	Key Adverse Effects
No active intervention	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Increase in magnitude and frequency of flooding. Loss of land based infrastructure, high grade agricultural land and reduction in historic character. Would not provide any future opportunities for investment and employment. Would not make provision for recreation and infrastructure improvements.
Maintain Flood Defences and Western Waterway	<ul style="list-style-type: none"> Least environmentally intrusive flood risk management option in the short term. Provision of new recreational facilities. Improved access to wider waterway network 	<ul style="list-style-type: none"> Option is not sustainable against climate change Provides little opportunity for securing the future of and improving recreational facilities, infrastructure and agricultural land. Significant land acquisition required. Channel bypasses the town centre therefore opportunities would be missed to encourage visitors to Boston. Disturbance of North Forty Foot Drain which is a designated site.
Maintain Flood Defences, New Barrage and Navigation Link	<ul style="list-style-type: none"> Least environmentally intrusive flood risk management option in the short term. Encourages long term investment opportunities. Approach would provide an important recreational resource. Would allow safe navigation of The Haven and wider waterway network. 	<ul style="list-style-type: none"> Option is not sustainable against climate change Limited opportunity for securing the future of and improving recreational facilities, infrastructure and agricultural land. A barrage to control the tidal range will result in some loss of mudflat habitat and mitigation would be required.
Maintain Defence Standard in Line with Climate Change and Western Waterway	<ul style="list-style-type: none"> Provides a contribution to reduction in frequency and severity of flood risk within Boston. Provisions of future investment opportunities due to management of flood risk however, this would be limited to the short term. Minimises environmental intrusion in the short term. Provision of new recreational facilities. Improved access to wider waterway network. 	<ul style="list-style-type: none"> Provides little opportunity for securing the future of and improving recreational facilities, infrastructure and agricultural land. Adverse effects on heritage, landscape and biodiversity with higher defences, although mitigation possible in places. Significant land acquisition required. Channel bypasses the town centre therefore opportunities would be missed to encourage visitors to Boston. Disturbance of North Forty Foot Drain which is a designated site.

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Approach	Key Beneficial Effects	Key Adverse Effects
Maintain Defence Standard in Line with Climate Change, New Barrage and Navigation Link	<ul style="list-style-type: none"> Provides a contribution to reduction in frequency and severity of flood risk within Boston. Provisions of future investment opportunities due to management of flood risk however, this would be limited to the short term. Minimises environmental intrusion in the short term. Encourages long term investment opportunities. Approach would provide an important recreational resource. Would allow safe navigation of The Haven and wider waterway network. 	<ul style="list-style-type: none"> Provides limited opportunity for securing the future of and improving recreational facilities, infrastructure and agricultural land. Adverse effects on heritage, landscape and biodiversity, although mitigation possible in places. A barrage to control the tidal range will result in some loss of mudflat habitat and mitigation would be required.
Flood Barrier to Increase Standard of Protection and Western Waterway	<ul style="list-style-type: none"> Provides a significant contribution to reduction in frequency and severity of flood risk within Boston. Provides long term security of existing and future investments. Encourages long term investment opportunities. Provision of new recreational facilities. Improved access to wider waterway network. 	<ul style="list-style-type: none"> Barrier may have some adverse effects on heritage or landscape, although mitigation possible through design. Significant land acquisition required. Channel bypasses the town centre therefore opportunities would be missed to encourage visitors to Boston. Disturbance of North Forty Foot Drain which is a designated site.
Multi-Purpose Barrier to increase standard of protection and control water levels, and Navigation Link	<ul style="list-style-type: none"> Provides a significant contribution to reduction in frequency and severity of flood risk within Boston. Provides long term security of existing and future investments. Encourages long term investment opportunities. Approach would provide an important recreational resource. Would allow safe navigation of The Haven and wider waterway network. 	<ul style="list-style-type: none"> The barrier may have adverse effects on the landscape character and historic character of the study area, although mitigation through good design is possible. A barrier to control the tidal range will result in some loss of mudflat habitat and mitigation would be required.

Table 2.8: Predicted Significant Environmental Effects of the Preferred Environmental Option

SEA Objective	Potential Impacts	Significance Of Predicted Effects	Mitigation
Reduce the risk of flooding to people, property and the environment.	Increase in the standard of protection against tidal inundation.	Major beneficial.	N/A
Provide an opportunity for investment, leading to long-term economic improvements and employment benefits.	Provides a catalyst for regeneration. Has the potential to afford the study area with economic and employment improvements.	Major beneficial	N/A
Be an important recreational resource and contribute to the health and well-being of local communities.	Improvements to navigational access provide for greater recreational use of the river. Improvements in public access to the river. High quality design to enhance the townscape. The barrier and link have the potential to provide the area with a new tourist attraction. Increased standard of protection from tidal inundation is significant contribution to health and well-being of the community.	Major beneficial	N/A
Conserve and enhance the landscape character of the area.	Change in water levels in The Haven will reduce the area of tidally exposed mudflat. The mudflats are an important component of the town and reflect its tidal history as a Port. High quality and innovative design of the barrier would provide a new landmark feature. Increase in boat activity will provide greater vitality to the area and strengthened local landscape character.	Moderate adverse. Major beneficial.	A modified tidal regime is being retained. However, there is no mitigation for the visual loss of mudflat at the lowest tidal level. Consequently, the residual significance of this impact remains.
Protect and enhance features of archaeological importance and historic character throughout Boston.	Change in water levels has the potential to beneficially affect the preservation of archaeological remains buried within the mud. Change in water level may also be perceived however as a loss of historic character due to rise in minimum water level through the town centre.	Moderate beneficial. Moderate adverse	N/A A modified tidal regime is being retained however there is no mitigation for the change to the historic character of the town through the loss of mudflat at the lowest tide level.

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SEA Objective	Potential Impacts	Significance Of Predicted Effects	Mitigation
Protect and enhance biodiversity and designated sites of local, national and international importance.	No impacts on The Wash anticipated. Change in water levels will result in loss of mudflat. Small area of saltmarsh may be lost (footprint of barrier but depends on location.) Impact on biodiversity of South Forty Foot drain due to disturbance from increased boat usage and recreational use.	Moderate adverse.	Provision will be made for compensatory salt-marsh and mudflat habitat in The Haven. Habitat creation, particularly along the South Forty Foot Drain, to prevent no net loss and to create and enhance BAP habitat Requirements for compensatory habitat logged with the Agency's Regional Habitat Creation Database.
Ensure the strategy is sustainable in terms of long-term climate change.	The barrier provides for flood risk management in response to a changing climate.	Moderate beneficial.	N/A
Ensure that there are no adverse impacts on water levels, quality and flows within the study area.	Impact on water quality as a result of increased usage of The Haven and the South Forty Foot. Mixing of fresh and saline flows within the lower sections of the Witham and the South Forty Foot. Impacts on outfalls in The Haven due to increased low tide water levels.	Insignificant effect.	Ensure users and maintenance procedures are in accordance with EA PPGs (in particular PPG 14 Marinas and Craft). Localised impacts of mixing of fresh and saline will require monitoring. Mitigation may involve use of bubble curtains. Incorporation of tidal flap valves to prevent backflows.
Ensure favourable geomorphological regimes are maintained.	Retention of a modified tidal regime is predicted to have negligible impact on the existing sediment regime. Localised sedimentation and scouring around the barrier.	Insignificant.	Localised dredging may be required.
Provide functional local and regional transport routes including a waterborne transport corridor for people and freight.	Infrastructure to be provided to facilitate increased waterborne traffic. Increased standard of flood protection for existing infrastructure.	Major beneficial	N/A
Ensure the strategy does not conflict with existing land use.	Changes to land use associated with the link works at Black Sluice and the construction of the barrier.	Insignificant.	N/A: improvements to existing landuse.

2.4.6 Environmental mitigation / Environmental Action Plan

Where an effect has been described as having the potential to be adverse, appropriate mitigation measures have been recognised and documented. A strategic Environmental Action Plan has been prepared to record these measures in detail and can be found in the Environmental Report. Key mitigation measures include:

- Design features that would minimise localised sedimentation and scouring to minimise adverse effects on biodiversity, water quality and buried archaeological remains however there still may be a requirement for dredging activities and sediment replenishment;
- Provisions will be made for compensatory inter-tidal and freshwater habitats;
- Design of superstructure, channel and lock will seek to minimise visual impact and where possible, create positive landmarks in the study area;
- The preferred environmental option is likely to affect outfalls within the upper Haven due to an increase in minimum water levels. To prevent backflows of water it would be fundamental that work is carried out on the affected outfalls; and

The mitigation measures documented above are highly strategic and will be developed as part of the Environmental Impact Assessment of the individual phases of work. Environmental Impact Assessment would be required for the design and location of the barrier structure and navigation link, and in addition, for the work on flood assets within Boston and downstream of the barrier.

2.4.7 Key Enhancement Opportunities

A number of opportunities for environmental enhancement have been recognised and are vital to the acceptance of the preferred option. Enhancement opportunities that have been identified relate primarily to landscape and cultural heritage and include:

- Improvements in public access to the river through the enhancement of existing footpaths and the creation of walk-ways, lower level quaysides, and moorings with benefits to tourism and landscape character. There is opportunity to seek a reduction in the level of flood defences upstream of the barrier with particular benefits to landscape character through the town centre;
- The opportunity to use high quality design detail to provide a catalyst for further development and to establish design principles for the area e.g. working with partners to achieve high quality urban design and landscaping;
- Generation of significant opportunities for enhancement of biodiversity, including facilitating movement of migratory fish and creation of habitat along South Forty Foot Drain and around Black Sluice. In particular, the potential to develop washland habitat to create and enhance BAP habitats is being investigated along South Forty Foot Drain;
- Inclusion and integration of the local community e.g. by advancement of community art projects to give identity to the frontage and a sense of ownership by the local community;
- Development of working in partnership with other organisations to recognise and maximise enhancement opportunities from every aspect;
- Improvement in local and regional waterways links encourages regular use for navigation and would provide opportunities for water-based transport of freight and people; and
- Provision of an innovative superstructure that could be promoted as a new tourist attraction.

The enhancement opportunities identified are highly strategic and will principally be developed as part of the Environmental Impact Assessment process of the individual phases of work. However, investigations are underway to identify potential sites and related possibilities for the creation of BAP habitat within the study area.

Implementation of the strategy means the realisation of the programme of works. This includes both the construction and operation. To ensure good and sustainable design and in order to undertake Environmental Impact Assessment, a number of environmental studies will be required in areas such as ecology, fisheries, landscape, sedimentation and water quality. Other aspects of implementation will include the development of waterway traffic plans, procurement plans, legal and consent issues, operational issues.

Monitoring provides the means by which the Environment Agency can measure the performance of the strategy. Monitoring also provides the opportunity to determine whether the mitigation of significant environmental effects identified during the strategic environmental assessment is being carried out, and allows any further significant effects that may arise during the plan period, to be identified and addressed. A strategic level Environmental Action Plan (EAP) has been developed which outlines the recommendations for environmental implementation of the Strategy.

Summary

Strategic options were assessed against environmental objectives and an environmental preferred combined option was recommended. The preferred option is assessed as having some long term beneficial effects on quality of life issues for the town, as it allows development and economic investment in the future, reduces flood risk and opens up recreational and amenity opportunities.

There are some potential negative environmental impacts of this strategic option however, it is felt that these could be managed or mitigated for. A number of environmental enhancement opportunities have been identified and issues for implementation and monitoring developed.

2.5 Costs of Options

The costs apply to the second quarter of 2007. Cost data was compiled from a variety of data sources with the aim to identify the best estimates of capital, operating and maintenance expenditure and have been validated by cost consultants. The assumptions made to apply the data to cost estimates are given in Appendix I. Cost estimates were compiled for:

- channel works: replace / repair hard defences
- channel works: small scale maintenance of embankments
- raising height of existing flood defence
- tidal surge barriers
- water level control structure (navigation barrage)
- sluice refurbishment
- new channel construction costs
- new lock structures
- waterway moorings etc
- environmental enhancement costs
- operational and maintenance costs
- environmental mitigation and monitoring costs

A cost benchmarking and validation exercise was carried out by Cost Consultants. Barrier/barrage costs were benchmarked against a construction estimate for the Colne Barrier. Navigation elements and barrier costs were based on take-off estimates from preliminary designs, checked, then rates from three pricebooks were applied and an average total cost

estimate was formed. Linear FRM replacement and repair costs were based on historical data compiled for the Thames embayment study.

2.5.1 Site Specific Issues at Boston

Risk of asset failure has been based on a visual inspection survey carried out in 2003. Where failure of hard defences within the town is identified, costs have been included to address this risk even when a flood barrier is proposed. A few assets have been identified as in need of urgent attention in the next five years.

Large-scale replacement and repair works of the estuarine embankment defences is not anticipated as their present condition is good, and wide berms between the channel and embankments removes immediate pressure from scour. The visual inspection and maintenance records suggest that only minor works such as replacement of revetment protection would be necessary throughout the appraisal period in order to maintain their present condition. These costs have been included in the economic assessment.

2.5.2 Application of Uplift to allow for Optimism Bias

Where costs have been developed from first principles they are increased by 60 percent to compensate for over optimistic estimation. Where historical project information has been used (channel asset repair work), the level of uplift varies depending on the reliability and accuracy of the cost data. For example, if cost data has been extracted from an actual project that has been completed and the work is similar to that being considered at Boston, and within the last five years, a reduced uplift has been applied. The optimism bias in for linear FRM assets is between 50 to 60%.

2.5.3 Environmental Mitigation and Enhancement Costs

All costs for environmental mitigation works are included within the cost build up.

The costs for environmental enhancement works have been estimated separately for each option and are included in the overall option cost used in the economic analysis. Costs for compensatory habitat is included. The environmental enhancement costs included in the preferred option are presented in Section 3.0, showing the cost per annum over the first six years.

2.5.4 Summary of Costs

The method and assumptions used to build up the complete cost estimate is demonstrated in Table 2.9.

Table 2.9: Build up of costs for strategic options

	Structures (Navigation and FRM)	Linear FRM assets
Materials, labour, preliminaries	Take off estimate	Historical analysis
Site investigation	At 1.5 - 3.7% of materials, labour and preliminaries depending on marine input	Included in engineering fees
Construction Cost (CCost)		
Compensation	At 3 or 5% of CCost	Included in CCost
Landscaping and env. mitigation	Estimated per option	Included in EA costs
Env. enhancements	2.75% of FRM CCost, estimated per option for Waterways	2% of CCost
Land purchase	£6.5k/ha agricultural £65k/ha urban	None, replacement costs only
Sub-total		
Engineering fees	At 10% of CCost	(incl SI) at 30% CCost
Special legal fees	Estimate at £300/hr	Not required
EA costs	At 5% of sub-total	At 11% of CCost
Total Cost		
Optimism bias	At 60%	At 50 to 60%

Whole life costs for each combined option are shown in Table 2.10 and show each component of the options for clarity. Appendix K shows the location range of the asset works included in the cost estimates. Special legal fees have been included to cover the input that will be required to deliver a Harbour Revision Order, a Transport and Works Act order, and a possible public enquiry associated with achieving approval for the barrier structure.

2.5.5 Risk Allowance and Sensitivity

The effect of risk on the strategy cost estimation has been incorporated by applying an uplift to allow for over optimistic estimation of costs. A quantified risk assessment using a statistical data set such as 'Monte Carlo' has not been applied.

The sensitivity of the economic conclusions to certain assumptions in the cost estimates (and benefits) is included in Appendix K. The sensitivity of options has been tested in response to:

- increase or decrease in flood construction costs (walls and barrier)
- increase or decrease in navigation infrastructure construction costs
- increase or decrease in both flood and navigation construction costs
- residual life of assets (delay expenditure)

The sensitivity of the benefit cost analysis is discussed in section 2.7.4.

2.5.6 Possible Contributions to Funding

There is a strong possibility of external contribution from a number of organisations. Funding could be attracted from local and county councils, East Midlands Development Agency, and European Regional Development Funds as elements of the strategy offer good opportunities for improving socio-economic conditions within the town. This is discussed in section 3.

Summary

Cost estimates apply to second quarter 2007. A 60% uplift for optimism bias has been applied. Costs are presented in five distinct phases that each represent a programme of works to deliver the preferred strategic option. Cost estimates allow for environmental mitigation and enhancement. The sensitivity of the cost benefit analysis to changes in the cost estimates has been considered.

Table 2.10: Summary of whole life costs for each strategic option

Options	Whole Life, 100 year Cash Costs					Annual Op & Maintenance Costs	
	Haven flood assets £k	Barrier costs £k	Channel construct £k	Waterways works £k	Total strategy costs £k	Flood £k per annum	Navigation £k per annum
Option I Maintain flood defences and western waterway	113,000	0	57,000	1,560	172,000	74	46
Option II Maintain flood defences, new navigation barrage and link	113,000	44,000	13,000	1,560	172,000	74	190
Option III Sustain SoP and western waterway	132,000	0	56,800	1,560	190,000	74	46
Option IV Sustain SoP, new navigation barrage and link	132,000	44,000	13,000	1,560	191,000	74	190
Option V Increase SoP (surge barrier) and western waterway	113,000	34,700	56,800	1,560	206,000	127	46
Option VI Increase SoP with multi-purpose barrier and navigation link	113,000	37,100	20,000	1,560	172,000	127	143

All costs at Quarter 2 2007.

2.6 Benefits of Options

2.6.1 Flood Damage Assessment

Predictive modelling, flood mapping and the MDSF software were used to calculate economic flood damages for a range of flood events. The detailed methodology of the flood damage assessment is included in Appendix D. Economic damages concentrate on flood damage to property and do not include:

- agricultural losses, which are insignificant in value in the context of this strategic appraisal compared to property damage values
- values for environmental losses, indirect damages (such as transport links), and intangible damages arising from flooding.

Validation was made on the top 1% of properties with the highest ranking damages. All benefits are given at second quarter of 2007.

Economic area boundaries have been drawn to ensure benefits are not double counted with studies in adjacent catchments and these are illustrated in Appendix K. LiDAR data was used to assess whether natural features would result in flood compartments within this economic study area that should be taken into account when applying the overland flow mapping software. South Forty Foot Drain embankments are the only natural features that form a barrier to overland flow and a breach in any other location can result in widespread inundation across the flat topography that is below mean tidal water level. Consideration of the economic damages that could arise on either side of South Forty Foot Drain quickly demonstrated that both compartments resulted in considerable economic damages that were of sufficient magnitude to justify an increase in standard of protection and this was agreed with Defra. It was also agreed that a single standard of protection for the community of Boston is appropriate for both the left and right banks of The Haven which are presented with the same flood risk and mechanism, have the same topography, and have the social aspects of a single community. Justification for adopting a single standard of protection is provided in Appendix P.

2.6.2 Flood Damage in the No Active Intervention (Do Nothing) case

Results are split into those for the right bank and left bank and show the properties affected by tidal flooding. Flood damages as a result of breach or overtopping of existing defences (Do Nothing case) would first occur in year 15. Visual inspection of asset condition, LiDAR data, and modelling techniques were used to establish this onset.

Inundation due to a breach caused by a 1 in 3 year event (33.3% chance) is considered sufficiently frequent to lead to abandonment of properties and so write off values have been adopted in this case. Inundation from events with a lower probability of occurrence result in recurrent damages, but are capped at write-off values of the flood extents.

Table 2.11: No Active Intervention - Number of Properties affected by a 1 in 100 year Event

No active intervention: 1% chance event, number of flooded properties							
MDSF output	AAD			Write -off			Total properties
	Commercial	Residential	Total	Commercial	Residential	Total	
Total Left Bank	224	2345	2569	277	2061	2338	4907
Total Right Bank	142	2777	2919	340	3051	3391	6310
Total	366	5122	5488	617	5112	5729	11217

Table 2.12: No Active Intervention - Value of Damages

No active intervention: damages (£million) 1% chance event						
MDSF output	AAD			Write -off		
	Commercial	Residential	Total	Commercial	Residential	Total
Total Left Bank	7.9	15.8	23.6	83.0	252.9	335.9
Total Right Bank	4.1	15.1	19.2	65.3	374.3	439.6
Total	12.0	30.9	42.8	148.3	627.2	775.5

A predominance of social grade DE within the central wards of Boston that are subject to flooding can be demonstrated using census data, and this justifies the inclusion of a distributional impact weighting factor to allow for social equity issues (PAG3 supplementary note July 2004). Different distributional impact weighting factors have been applied to residential flood damages according to the mix of social grade. Sensitivity testing shows the effect of this weighting on the benefit cost analysis (see 2.7.4).

Table 2.13: No Active Intervention - Value of Damages including Distributional Impact Weighting

No active intervention: damages (£million) 1% chance event						
MDSF output	AAD			Write -off		
	Commercial	Residential	Total	Commercial	Residential	Total
Total Left Bank	7.9	20.7	28.6	83.0	331.3	414.3
Total Right Bank	4.1	19.8	23.9	65.3	489.7	555.0
Total	12.0	40.5	52.5	148.3	821.0	969.3

2.6.3 Flood Damage in Do Something Scenarios

'Do Something' flood damages result primarily from overtopping of defences or from a breach of embankments as a consequence of an overtopping event. It is assumed that overtopping results in flood flows for one tide cycle only, whereas breach of defences results in flood flows for a day (two tidal cycles). Annual Average Damages have been calculated for the following situations:

- **Do minimum:** maintain the current defences, but the amount of damages accrued each year increases as the standard of defence reduces in response to climate change effects.
- **Hold the Line options to improve standard of protection:** the improved standard of protection will reduce the probability of overtopping from year 10 onwards. The defences will be maintained and therefore a breach will only occur as a result of an overtopping event of an embankment.
- **Advance the Line (tidal surge barrier) to improve the standard of protection:** the improved standard of protection will reduce the probability of overtopping upstream of the barrier from year 6 onwards. Defences downstream of the barrier will be raised in approximately year 50 in response to climate change impacts to achieve the same standard of protection. The defences will be maintained and therefore a breach will only occur as a result of an overtopping event of an embankment (downstream of the barrier). The siting of the tidal surge barrier has been limited to a location range in keeping with the navigation barrage.

2.6.4 Non-monetary Flood Management Benefits

The preferred strategy would generate a number of non-monetary benefits as a consequence of flood risk management that have not been valued at this stage:

- Reduced likelihood of injury or loss of life
- Reduced anxiety of local residents and businesses

The cost benefit analysis for the combined strategy is robust and benefits are not marginal, therefore it was felt that the additional work to quantify these benefits would not be justified at this strategic level.

2.6.5 Navigation Benefits

The navigation economic benefits are generated from increased numbers of both boat and non-boat based visitors to Boston and also from the increased amenity value to informal users of the waterside (anglers, walkers etc). The methodology and results of the quantified benefit assessment is included as Appendix J. Values for informal user benefits are derived from a contingent valuation study into informal users of restored waterways carried out for British Waterways. The estimates are summarised below.

Table 2.14: Quantified benefits from navigation barrage and link

Impact Area Boston	£ per annum
Fishing fleet	Marginal
Port and port-related	No net change
Boat-related expenditure (£000's)	£297 - 520
Non-boat tourism expenditure (£000's)	£1,050 - 2,100
Informal user benefit (consumer surplus £000's)	£81

The benefits shown to Boston are the net benefits applicable to the strategy study area after allowing for displacement effects (pulling visitors from elsewhere etc), the anticipated baseline increase in the area (deadweight), leakage of benefits to other areas, and multiplier effects allowing for induced and indirect contributions. The following assumptions have then been applied:

- A new navigation channel to the west of the town will deliver 25% of the visitor and amenity benefits associated with a barrage scheme that brings visitors into the town centre. This may be generous, but the economic results are not sensitive to this assumption.
- Increasing the height of flood defences on the existing line to maintain the Standard of Protection against sea level rise will reduce the amenity benefit that can be delivered to informal users as visual and physical connection with the water is lost (assumed at 50%).

An estimate of the income and expenditure from the operation of the navigation link are included in Appendix Q. The new Waterways assets will produce both direct and indirect income from increased boat numbers (includes allowances for dead weight, displacement and leakage effects). Direct income is by way of fees payable to the Agency by boaters who will use the new waterway. Indirect income relates to the net additional tax revenues that will occur through increased boat numbers. It would be reasonable for the Environment Agency to make a case for these additional revenues to be used to support the new waterways assets. It is estimated that on average the sum of the direct and indirect income from boats alone will on average equate to around 75% of the operating and maintenance costs of the new Waterways assets. It should also be noted that the Ecotec report on the Regeneration Benefits of the Boston Waterway Link provides very conservative estimates of increased boat numbers. Much larger regeneration and tourism benefits will arise because of the new Waterways assets.

2.6.6 Other Benefits not included in the Economic Analysis

The combined options would contribute towards and support regeneration plans for Boston and an estimate of these benefits is summarised in Appendix J. Some economic benefits

generated from improved amenity and leisure are included above, but in addition the strategy would:

- create permanent jobs
- increase confidence in investment and waterside development
- create temporary construction employment
- contribute to increased waterfront house prices (estimated at 4% uplift).

Construction of a navigation barrage would create 40 – 79 Full Time Equivalent jobs and 260 Person Years of Employment during construction. An assessment of waterside development identifies ten relevant, immediate schemes on 73 hectares of land (including two marinas) with private investment of between £32-48 million that would benefit to some extent from the improved waterfront amenity. Benefits that can be attributed to the combined strategy (allowing for displacement effects etc and dependent on selection of strategy option) total 44 Full Time Equivalent (FTE) jobs. External organisations have been identified which are interested in providing investment in order to realise these additional socio-economic benefits in the community.

2.6.7 Sensitivity

The sensitivity of the economic conclusions to certain assumptions in the estimates of both benefits and costs has been explored and the details are included as Appendix K. The sensitivity of option selection has been tested in response to:

- change in probability of breach
- reduce value of annual average (overtopping) flood damages
- reduce value of write-off (breach) flood damages
- reduce the value of navigation benefits

The sensitivity of the benefit cost analysis is discussed in section 2.7.4.

Summary

The combined strategy generates economic benefit to society by avoiding flood damage in the future, by improving waterside amenity, and by increasing the amount of boat and non-boat based tourism in Boston.

All benefits shown are net benefits to Boston and apply to the second quarter 2007. Socio-economic weighting of benefits has been applied in line with Defra guidance July 2004. Flood benefits derive primarily from reduction of overtopping damages to the urban centre of Boston.

There are other benefits that have not been quantified at this strategic level, and there are socio-economic benefits (such as job creation and other regeneration outputs) arising from, or related to, the strategy that are not included in the economic analysis but are of interest to external funding partners.

2.7 Choice of Preferred Option

The objective of this strategy is to manage the risk to Boston from tidal flooding and also to deliver a key stage in navigation improvements for the region. Option VI is the preferred technical and environmental option to deliver these objectives and the decision process to reach this choice is explained in the previous sections.

Key decisions in the selection of this option were informed by the technical appraisal, the environmental assessment, and the consultation carried out, and can be summarised as:

- Managed realignment would not sufficiently reduce flood risk and may have geomorphological impacts on the Wash and so was rejected on technical and environmental grounds.
- There is a need to invest in the repair and maintenance of existing flood assets to manage the risk of flooding due to asset failure. This has been included in all options.
- The additional height required on existing defences to raise the standard of protection would have impacts that could not be mitigated in some locations sufficiently to make the option acceptable to the planning authority or community.
- A navigation barrage that removed the tidal nature of the Haven through Boston town centre is not acceptable to key consultees such as English Heritage and English Nature
- The potential location of either a flood barrier, a navigation barrage, or a multi-functional structure is constrained by potential environmental impacts (in particular the sensitivity of the Wash) and other issues raised by consultees such as the commercial operation of the port.
- A multi-functional barrier presents whole life cost savings over other strategic options

Table 2.16 summarises the economic analysis and demonstrates that Option VI is the preferred combined option in economic terms and this is discussed in section 2.7.2. The comparison of the benefit cost relationship of different options is a key decision tool in determining the appropriate standard of flood protection and this is discussed first in section 2.7.1.

2.7.1 Economic Analysis: Flood Risk Management and Standard of Protection

A benefit cost analysis covering only the flood risk management investment in Boston has been carried out in order to satisfy the investment in this area of the strategy and to assess the appropriate standard of protection. The decision was made that a single standard of protection was appropriate and justifiable for Boston town centre. Therefore the economic assessment of the Hold the Line options can be directly compared to the Advance the Line options.

All flood risk management costs are included in this economic analysis, therefore advance the line options also include for asset repair work along the Haven as well as the tidal surge barrier. This may be conservative as flood risk from asset failure upstream of a tidal barrier will change with implementation of the strategy. All barrier options include for raising embankments downstream of the barrier in future years.

It is important to remember that the delivery of comparable standards of protection to Boston by Hold the Line options is not considered to be viable on environmental and planning grounds. The delivery of standards of protection of 1 in 100 years or less to Boston using a barrier are not as economically robust.

Table 2.15: Summary Benefit Cost Ratio for Flood Risk Management Options

FRM Option	Do Nothing	Hold the Line				Advance the line		
SoP	Do Nothing	Do min: Pro-active maintenance	Sustain SoP (1 in 50)	Improve SoP (1 in 100)	Improve SoP (1 in 300)	Improve SoP (1 in 100)	Improve SoP (1 in 200)	Improve SoP (1 in 300)
Total PV Cost (£m)		45	56	58.6	59.3	67.5	69.8	72.7
Total PV Damages	1014	412	233	213	142	213	88	76
Total PV Benefit (£m) (damage avoided)		602	781	801	872	801	926	938
Benefit Cost Ratio		13.4	14.0	13.5	14.7	11.9	13.3	12.9
NPV (£m)		557	725	741	812	733	856	865
Incremental BCR			16	6	101		54	4

All costs include optimism bias

The benefit cost ratios for the flood risk management options indicate that it is appropriate to recommend an increased standard of protection. A tidal surge barrier (advance the line) is the preferred option for flood risk management in Boston with a robust benefit cost ratio of almost 13. Although the Advance the Line options demonstrate a marginally lower benefit cost ratio than the Hold the Line options, delivering the same standard of flood protection to Boston with a Hold the Line option would result in a significant increase in height of hard defences within the town centre (up to 1.5m additional height in places) severing any visual connection with the river in certain locations. The results of consultation and the Strategic Environmental Assessment indicate that raising walls would not be a sustainable solution to flood risk management in Boston and is unlikely to be a deliverable option due to significant concerns from the local council and community.

The highest benefit cost ratio of the Advance the Line options is a tidal barrier delivering a standard of protection of 1 in 200 years. The incremental benefit cost ratio to the next highest standard of protection is 4 and this justifies the recommendation of the higher standard of protection of 1 in 300 years.

A large proportion of the costs of constructing a tidal surge barrier occur in the design and build of the superstructure and this does not vary greatly between the barrier options. A higher standard of protection can therefore be achieved with only a small increase in cost associated with larger gates and marginal increases to the superstructure costs. This is reflected in the high incremental ratios. The sensitivity of the benefit cost ratio to changes in cost is shown in Appendix K.

It may be possible to justify expenditure for flood defences to provide a standard of protection above a 1 in 300 year return period as marginal costs and benefits are aligned. Two factors make this difficult to assess:

- Lack of confidence in the modelling assessment of higher order events (1 in 500 years and above) due partly to scarcity of validation data.
- Limits of technical confidence in barrier gate size and operational efficiency. Barrier gate design could be changed at higher standards of protection e.g. a radial gate similar to the Thames barrier may be more appropriate than a flap gate.

2.7.2 Economic Analysis of Combined Option

In delivering a combined strategy it would be anticipated that economic savings could be realised by delivering both flood risk management aims and navigational improvements together in Boston. The economic analysis of the combined options is shown in Table 2.16. Each combined option comprises:

- Works on existing flood assets to reduce flood risk from failure (asset repairs)
- Flood risk management improvements
- Navigation works to connect The Haven to South Forty Foot Drain
- Waterways works (moorings etc) for services to new boat users

The costs are the total costs for all works comprising the build up as shown in Table 2.9 in the discussion of cost estimation.

The total benefits for each combined option are presented, comprising of a number of component benefit streams as discussed in section 2.6.

The preferred combined strategic option is Option VI which demonstrates the highest cost benefit ratio of 9.5.

Table 2.16: Economic Analysis Combined Options

Combined Option	N/A	Option I	Option II	Option III	Option IV	Option V	Option VI
FRM	Do Nothing	Do minimum		Sustain SoP		Increase SoP (1 in 300)	
Navigation route	N/A	western waterway	barrage + nav link	western waterway	barrage + nav link	Western waterway	barrage + nav link
	£/m	£/m	£/m	£/m	£/m	£/m	£/m
Total PV Cost		94	93	105	104	123	93
PV Damage	1014	412	412	233	233	76	76
PV Damage avoided		602	602	781	781	938	938
PV recreation & amenity		-	2	-	1	-	2
PV tourism benefits		16	64	16	64	16	64
Total PV benefits		618	668	797	846	954	1,003
Net Present Value		523	575	692	742	830	910
Average b/c ratio		6.5	7.2	7.6	8.1	7.7	10.8
SoP 2005	1 in 50	1 in 50	1 in 50	1 in 50	1 in 50	1 in 50	1 in 50
SoP 2105		<1 in 10	<1 in 10	1 in 50	1 in 50	1 in 300	1 in 300

The preferred strategic option comprises five phases of work within Boston over the next 100 years:

- repair and improvement works on flood assets within Boston to address the risk of flooding from asset failure
- new navigation link to safely connect The Haven and South Forty Foot Drain
- multi-functional barrier acting as a tidal surge barrier and water level control structure
- waterways works to provide moorings, and visitor facilities
- raising embankments downstream of barrier to provide a continuous standard of defence in response to climate change effects

2.7.3 Economic Analysis: Navigation

A navigation barrage and new physical link to South Forty Foot Drain can be demonstrated as the best technical, environmental and economic option to deliver the navigation objectives.

Benefits are generated from increased amenity value and the increased tourism and leisure spend of inland boaters and non-boaters. The navigation scheme alone offers a cost benefit ratio of 1.4. All costs include for 60% optimism bias.

The alternative navigation option, providing a channel to the west of Boston, does not deliver the same economic benefits as it bypasses the town centre. There are environmental concerns about a new channel to the west of Boston such as land take.

Table 2.17: Economic Analysis Navigation only

Navigation Option	Channel to west /£m	Navigation barrage and link /£m
Total PV Cost	49	48
PV amenity benefits	0	2
PV tourism benefits	16	64
Total PV benefits	16	66
Net Present Value	-33	18
Average b/c ratio	0.3	1.4

Delivery of the combined strategy presents savings of £28 million to deliver the same economic benefits. In addition, the opportunity to attract external funds to such a scheme is high due to the potential to stimulate the local or regional economy and generate other benefits such as jobs that are not appropriate for inclusion in this benefit cost analysis. Discussions with potential partners to explore these funding opportunities are already being pursued and developed.

2.7.4 Economic Sensitivity of Preferred Combined Option

The economics of the scheme demonstrate that the combined option selected has a robust benefit/cost relationship of 10.8 and this is the highest ratio of any of the combined options.

The sensitivity of this economic assessment to assumptions made in the costs and benefits is shown in Appendix K. This testing does not change the selection of the preferred option, although the combined option with the next highest benefit cost ratio does vary between options II, IV and V.

Sensitivity testing shows that the inclusion of Distributional Impact weighting does not affect the choice of preferred option. Without this weighting of residential benefits Option VI has a benefit cost ratio of 9.0 and this remains the highest benefit cost ratio of any combined option.

2.7.5 Climate change

Future flood risk and flood damages have been based on extreme tide water levels that allow for predicted increase in sea level and intense weather conditions as a consequence of climate change in conjunction with land movement. This figure has been taken as 6mm per year in accordance with current Defra guidance for the north Anglian coast.

While there has been a general acceptance that the level of the sea is rising, the predicted change in levels due to climate change and land movement are a point of debate and research. The current estimates that have been applied are conservative and we can be confident that the response for flood risk management is robust. It may be that this risk is not as significant as predicted within 100 years and this would mean that the Standard of Protection provided by the barrier was greater than predicted for a longer length of time. Sea level rise is a key driver of the investment in flood risk management in Boston.

Climate change is also predicted to lead to more intense weather conditions and this will have an effect on fluvial flood risk. The increased fluvial flows entering the Haven from the Witham and South Forty Foot Drain were considered in the preliminary assessment of flood risk in Boston using numerical modelling. Fluvial flows from these rivers will not pose a significant risk to Boston town centre compared to the tidal flood risk. Increased flows will result in changes of operation such as increased pumping requirements at Black Sluice, however this is considered as part of the Black Sluice catchment study.

The impact of increased flows at Maud Foster may increase the flood risk to residents close to the drain, however the existing flood warning system and the ability to divert flows to other watercourses north of the town centre before they reach Maud Foster (so allowing extreme flows to be carried to Hobhole Drain) should allow for continued management of the flood risk in this area.

2.7.6 Residual Risk

Project risks. Risks that could influence the implementation of the strategy have been established using scenario testing, for example legal risks, stakeholder risks, funding risks. It is important to determine how robust the strategic decision is to these risks during project implementation in order to assess business exposure. Components of the strategy are inter-dependent and the scenarios test that flood risk can be delivered either in conjunction with or independently from navigation elements. This is discussed in full details in the Implementation Plan (Appendix N).

Strategic project risks have been captured and appropriate management or mitigation measures identified. This is fully documented in the Implementation Plan. These measures have informed the programme of works and where it is realistic to do so, costs have been allowed to undertake these measures. The measures include specific consultation effort, specific scopes of technical studies, or the input of legal specialists for example.

Flood Risk. Residual flood risk remains due to either over design events, or failure of the gate mechanism in the open position. Consequences of either of these events would increase with time as sea level rise affected the Standard of Protection offered by the existing defences.

An over design event would result in overtopping of the flood embankments downstream of the barrier and some overtopping around the location of the barrier itself. This would result in inundation of the rural areas along the left bank, south of Skirbeck. The greatest consequence would be an overtopping event on the left bank around Maud Foster drain as this allows inundation into the east of Boston. Figure D.4 shows the indicative residual flood risk from overtopping of a 1 in 300 year tidal barrier.

If the barrier gate(s) failed in the open position, flood protection would be reliant upon the existing line of defence including Grand Sluice. This risk needs to be fully evaluated before any decision to lower or remove existing defences upstream of the barrier is made.

Navigation Risk. The Haven is currently used for both commercial and leisure navigation. Implementation of this strategy aims to increase the amount of waterway traffic and navigational safety will be explored in detail. This will include the development of a waterway traffic plan and operational agreements with the other navigational authorities and in consultation with key waterway users.

2.7.7 Defra Priority Score

The preferred strategic option has been assessed in accordance with the Scheme Prioritisation System issued by Defra. This priority score is relevant to the flood risk management element of the strategy.

The economics component is measured by the benefit cost ratio as calculated above. The people component was derived from the number of residential properties with a reduced risk of flooding. The situation is not considered exceptional in terms of public safety.

No designated areas are protected from flooding as a result of the implementation of this strategy. There are five Scheduled Ancient Monuments in the 'Do nothing' inundation area and numerous listed buildings, including St Botolphs Parish Church ('Boston Stump'). A heritage score of two has been applied in the environmental component.

Table 2.19: Defra Priority Score

Option	Economic Score	People Score	Environmental Score	Total
VI	20	8	2	30

2.7.8 Conclusion

It is recommended that a strategy to deliver a sustainable and combined approach to flood risk management and navigation for the town of Boston is approved comprising:

- New navigation link between The Haven and South Forty Foot Drain
- Improvement works to flood assets at risk of failure within Boston town centre
- Multi-functional barrier within Boston Haven: dual function of partial tidal exclusion barrage for water level control to enable safe navigation and tidal surge barrier
- Waterways facility works (moorings etc)
- Raising of embankment levels downstream of barrier at appropriate future time.

The preferred option is shown on Figure 4.

The risk of flooding from failure of current assets due to poor condition will be managed by improvement and repair works on channel assets within the urban centre of Boston in the early years of the strategy and with an ongoing programme of asset maintenance.

A multi-functional barrier structure will provide protection against a tidal surge event with a 0.33% probability of occurring (a 1 in 300 year event) and be designed to allow for the future effects of climate change. This will deliver an improved standard of protection to over 11,000 properties in the next 6-10 years.

The same structure will partially exclude the tide to control water levels upstream in The Haven and allow safe navigation for a greater range of vessels. Consultation with key parties and preliminary Environmental Assessment has informed the proposed method of operation and location of this structure. The barrier will only partly exclude the tide during normal operating conditions in order to preserve the estuarine ecology and maritime cultural heritage of The Haven within the town. At times of tidal flood risk, the structure will fully exclude the tide to protect the town from flooding. The location of the multi-functional barrier will be in a zone between the swing bridge and Maud Foster drain. There is the potential to attract external contribution towards this part of the strategy.

The strategy will also deliver a new navigation link to enable inland waterway traffic to pass through Boston town centre and onto the Fens waterways. Further appraisal is required as to

whether this is a new cut and link to the north of Black Sluice, or whether Black Sluice can be modified to allow lock access. Discussions are currently underway to secure external contribution for this part of the strategy.

To complete the continuous line of defence to an improved standard of protection, the crest level of the embankments downstream of the barrier will need to be raised at a future date (estimated as year 50) in response to predicted increases in sea level.

It is also anticipated that there will be waterways infrastructure to help realise the navigation and socio-economic benefits of the strategy. These will comprise moorings and some access landscaping, interpretative signage and other works to support visitors to the barrier structure and navigation link. Funding for this part of the strategy has been identified from an external partner.

There are risks to implementation of the strategy such as funding. Components of the strategy are inter-dependent and scenario testing was carried out to ensure that if necessary, a flood risk strategy can be delivered independently from navigation elements. The preferred option for a stand alone flood risk management approach would be to improve the flood assets at risk of failure within Boston town centre and to construct a surge tide barrier in the Haven. Management of the funding risk includes a requirement for a detailed funding plan to be in place as part of the detailed project appraisal of each component of the strategy.

Operational issues will be of particular importance in the delivery of the strategy in order to achieve a successful outcome for:

- Commercial boat users (Port and fishing fleet)
- Leisure waterway users
- Continued operational practices of the IDB's
- Continued fluvial flood management

The implementation of a multi-functional barrier and navigation link would contribute to partnership aims for the regeneration of Boston, and indeed this has been identified as a strong basis for attracting external contributions to funding parts of the strategy. Whilst the Environment Agency will not encourage development within the flood plain, other government bodies have invested in, and wish to invest further in, the redevelopment of the town centre.







Summary

The recommended option comprises five phases of work to address flood risk and achieve navigational aims within Boston. This option is the favoured strategic solution in technical and environmental terms and demonstrates a robust benefit cost relationship of 10.8.

By considering the flood components of the strategy only, a 1 in 300 year standard of protection for Boston can be justified. Economic savings of around £28M can be demonstrated by adopting a combined approach to delivery, and other non-quantified benefits may be achieved by the strategy that are of interest to external partners.

Figure 4

Key:

-  Location Range of Multifunctional Barrier in Haven
-  Location Range of Potential Waterway Works
-  Moorings, Interpretive signs
-  Navigation Link (new link waterway or lock in Black Sluice)
-  Repair and Maintenance Work on Flood Assets
-  Embankment Raising in Future



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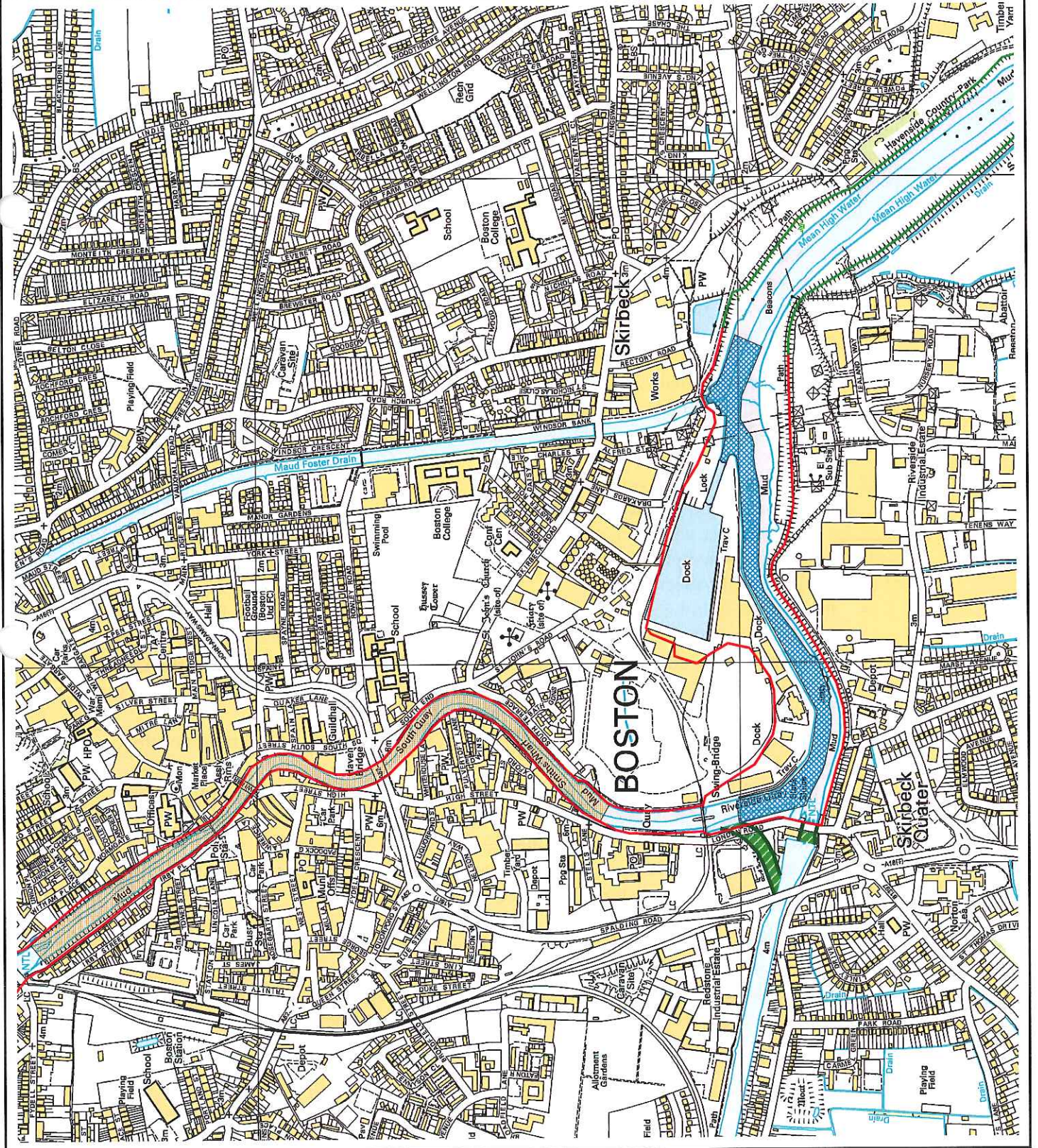
Project

Boston Combined Strategy

Title

Preferred Combined Option

Scale	1:7500 (A3)	Date	Jan 2005	File Ref No.	0018076.7
Drawn	PG	Checked	JW	Approved	JW



2.8 Other Considerations

2.8.1 Benefit Boundaries

The recommendation of this report has been checked for compatibility with the current understanding of the likely outcomes from other recent or current Environment Agency projects in the proximity of Boston Haven (see figure Appendix K):

- Lower Witham Strategy Study Review
- Black Sluice Catchment Study
- The Wash Banks Strategy Study Review
- Grand Sluice Outfall Project

The Lower Witham Strategy study deals with fluvial flood risk from the River Witham and relies on the continued functioning of Grand Sluice. The flood risk management benefits do not duplicate those included in this strategy. Grand Sluice requires capital investment and ongoing maintenance to ensure the longevity of the structure which plays a key role in preventing saline intrusion up the River Witham and maintains upstream water levels for both navigation and water abstraction.

Similarly, Black Sluice Catchment Study includes the function and costs of Black Sluice pumping station. Flood risk and consequential damages arise in this catchment as a result of fluvial flooding. The decisions about the future investment in Black Sluice pumping station are directly relevant to the implementation of this strategy.

An economic boundary has been agreed between this strategy and the Wash Banks Strategy as Hobhole drain. Costs for the maintenance and operation of Hobhole pumping station are met by Witham IV IDB.

2.8.2 Interaction with Fluvial Flooding

The system comprising the River Witham, Boston Haven and South Forty Foot Drain is complex and dynamic, with each element being subject to different influences of climate and with differing functional pressures. The following issues must be considered during the design of a multi-functional barrier:

- It is highly improbable that risk of tidal flooding and high risk fluvial flooding will coincide (demonstrated in the Boston Haven Flood Management Hydraulic Report).
- When there is a risk of tidal flooding, this risk is far greater than that from fluvial flooding. It is a less frequently occurring event but with far greater consequences for Boston.
- Fluvial flood flows on the SFFD will continue to be managed by operation of the Black Sluice pumping station.
- The partial exclusion of the tide will affect the current gravity discharge operation of Black Sluice and this will be addressed either through alternative discharge arrangements or with increased pumping.
- A small number of surface drains have been identified that will be affected by the implementation of this strategy and require works.

Fluvial flood management of Black Sluice Catchment relies on the continued operation of Black Sluice pumping station which is impacted by this strategy. A fluvial flood event in the Black Sluice catchment with a 20% probability of occurring (1 in 5 year event) causes overtopping along South Forty Foot Drain. The role of the Black Sluice pumping station is crucial in alleviating water levels at these low order events.

Black Sluice operates in two ways:

- Gravitational discharge at low tide level 60 – 134 m³/s through the tidal sluices
- Pumping to a maximum discharge of 60 m³/s using five pumped culvert discharges

The design and operation of a multi-functional barrier must ensure that the operational water levels of South Forty Foot Drain are not affected and the management of fluvial flood discharge is also a priority. If the fluvial levels or flows in South Forty Foot Drain (or similarly in River Witham through Grand Sluice) are sufficient to cause flood risk concern, the barrier could be lowered and not used to retain low water levels for navigation, so allowing maximum pumping discharge and maximum fluvial discharge as per the existing situation.

If fluvial flow is sufficiently high to cause flood concerns, whether South Forty Foot Drain or the River Witham, and action is required to manage the risk, navigation is unlikely to be safe under these conditions. Higher flows will be associated with higher velocities and warnings would be issued about navigation safety. Perceived potential conflicts between navigation access and flood risk management are therefore unlikely to actually occur and can be managed operationally.

2.8.3 Future Maintenance and Operation of the Scheme

The Environment Agency would be wholly responsible for the operation and maintenance of all flood assets, including the multi-purpose barrier and will also be responsible for the navigation link. These costs have been identified as FRM or Waterways as appropriate to function.

An operational plan, including navigation issues, must be established in conjunction with the Boston harbourmaster (representing all users of the harbour), Port of Boston, and British Waterways. Operational priorities will be set and appropriate operational warning levels established to activate the barrier for tidal surge protection. The barrier and possibly the navigation link will require manned operation and this has been included for in the operational costs.

The multi-purpose barrier could be operated to offer complete flexibility of upstream water levels: allow the full tidal range (full open barrier), partial tidal exclusion (hold low water for navigation), or exclude full tidal range for maintenance inspections/issues. This operational flexibility can be used to assist flood risk management.

There is an opportunity for environmental enhancement by removing or reducing the height of the flood assets upstream of the barrier. This will deliver significant landscape and visual improvements in places and may remove some burden of operational maintenance from the Environment Agency. Further discussions between the local council, riparian owners, Development Control, and Flood Risk Management is required before the decision to remove or lower any of the flood assets is taken.

All costs for maintenance and periodic replacement of assets (such as lock gates, barrier gates etc) over the 100 year strategy timespan have been included. A conservative assumption has been made that full maintenance of the flood assets upstream of the barrier will continue.

The Environment Agency will also be responsible for the maintenance and operation of any new moorings within the town.

2.8.4 Planning Policy

The planning issues relevant to this strategy are:

- The economic role of Boston and its waterways
- Port of Boston
- Environmental considerations
- Residents and land user considerations
- Tourism and recreation.

The economic role of Boston and its waterways. The economy of Boston is centred around the port. Unemployment within Boston is below the national, regional and county average but low wage levels, low skill levels and low aspirations are a continuing challenge for the town. The Borough is placing more emphasis on attracting high technology, tourism and service sector businesses to the area and the provision of better infrastructure is seen as vital for economic development.

Port of Boston. Rail and water are encouraged as alternatives to reduce reliance on road based freight movements by PPG13, Transport and Regional Transport Objectives reinforce this. A barrier scheme could provide a catalyst for the upgrading of the infrastructure at the Port of Boston.

Environmental considerations. Regional Planning Guidance Policy 34 states that *‘Strategic River Corridors including the Witham and their tributaries should be protected and enhanced and agencies should maintain and enhance the multi-functional importance of strategic river corridors for wildlife, landscape and townscape, regeneration and economic diversification, education, recreation and managing flood risk’*.

The policies relating to the site-specific allocations aim to promote and protect the allocations along the river corridor. In particular policy ED2 of the adopted local plan focuses on the protection of The Wash SSSI and SNCI in areas of port related development and the protection of land adjacent to the River Witham or The Haven (the tidal stretch of the river) to ensure well designed and visually attractive development.

Residents and land user considerations. National planning guidance highlights a range of factors that can affect the living conditions of residents and land users from harm. Planning guidance on noise and pollution highlight key considerations.

Tourism and recreation. Boston has an historic association with water and is perhaps most famous for its connections to Boston Massachusetts and the Pilgrim Fathers. The strategy would improve navigation of The Haven to open up the waterways for leisure craft and encourage other activities such as informal use of the waterways including use by walkers, cyclists and anglers, which should increase the number of visitors to Boston.

The proposed scheme will also *‘enhance the attractiveness of the waterway running through Boston town centre and provide a new focus for the town’*. The enhancement of the Region’s waterways for tourism and recreation is supported by national and local policy, particularly in areas requiring economic diversification and regeneration such as Boston.

2.8.5 Development Control

The Environment Agency regards the infrastructure proposals as being with Zone 3c, functional floodplain. Given that flood defence structures by definition have to be in functional floodplain, the proposal is considered ‘wholly exceptional’ in PPG25 terms. It also satisfies the flood risk sequential test set out in paragraph 30 as the function of the barrier, or other flood works, prevents it from being sited in a lower risk area. Paragraph 23 of PPG25

gives a strong presumption in favour of flood defence works: *“Local planning authorities should give due weight to the need to avoid adding to the risk of flooding or restricting the ability of an operating authority to construct, operate and maintain flood control works.”*

The town of Boston is generally not protected to PPG25 standards, therefore a significant amount of development is prevented from taking place in areas at risk. Whilst defences can only reduce risk and cannot eliminate flood risk, it is considered that the standards of tidal protection provided by the barrier over a 100 year timeframe would provide an appropriate standard of protection for the town. The Environment Agency will not encourage development within the flood plain however, the historical development of Boston means there is significant interest by other government bodies in the redevelopment of Boston town centre.

Summary

The preferred strategic option interacts with other plans in the area, some of which will have an influence on implementation decisions as the programme of works is progressed during appraisal. Sufficient exploration of these issues has been undertaken to inform the implementation of the strategy and to gauge the risks to realisation of the strategy in the future.

The strategy fits well with regional and local planning policy and provides identifiable opportunities for external partners to carry out complementary schemes.

Operational issues will be complex but priorities and the needs of different partners have been identified and agreed method plans can be developed. The Port of Boston and Black Sluice IDB have both agreed in principle to the implementation of a multi-functional barrier in The Haven.

3. PROJECT PLAN

The project plan outlines how the Boston Combined Strategy will be implemented and the key issues that need to be addressed during the planning and implementation of the strategy. Appendix N contains a detailed plan to implement the first projects of this Strategy and informs all the issues discussed in this section. The strategy will be a success if it delivers:

- Within estimated budget
- To the programmed timeframe
- Beneficial partnerships with other organisations
- Key business goals of the Environment Agency:
 - a better quality of life.
 - improved and protected inland and coastal water management
 - contribution to national and regional business strategies
 - reduced flood risk
 - manages climate change

In order to plan and programme the delivery of the strategy, studies and investigations are required to address technical, environmental and social issues. These studies will be used in decision making, project planning and procurement decisions.

3.1 Environmental Products

Environmental studies will need to be undertaken to establish the baseline for detailed environmental assessment. Desk-top studies and other site walkovers have already identified and informed the scope of these studies. Studies will be produced in:

- ecology
- fisheries
- water quality
- archaeology
- landscape/visual amenity to ensure appropriate design and mitigation
- geomorphology.

The comprehensive study of the potential change to the geomorphology regime will include modelling of sediment transportation, analysis of dredging records and possibly site sampling of sediments. Preliminary consideration of the available data on sedimentation in The Haven and discussions with English Nature, concludes that it is not anticipated that the scheme will have any detrimental impacts on any designated ecological sites and in particular The Wash.

These studies will also confirm the extent of compensatory habitat required, allow mitigation measures to be designed in detail and allow environmental enhancements to be implemented.

Environmental enhancements have been identified for the preferred option and the cost estimate to implement these works over the next six years (including optimism bias) is shown below.

Year	1	2	3	4	5	6	TOTAL £
Environmental enhancement works	2,050	60,000	23,200	3,410	810,000	2,050	901,000

3.2 Legal, Planning and Consents

There are some key legal and planning issues associated with delivering this strategy relating to working within a harbour and changes to navigation. The political and planning sensitivities that are likely to be involved in securing development consents and other

necessary authorisations emphasises the desirability of establishing a fully resourced project team that will include on-going legal input to progress the project.

At the outset the Anglian Region Legal team have been actively involved in providing advice on the development and implementation of the strategy. Sarah Ward, Principal Solicitor, is a project board member and Helen Sillitto, Solicitor is a project team member. Due to the complexity of the legal issues being considered one of the Environment Agency's Parliamentary Agent's, Paul Thompson at Bircham Dyson Bell has been contracted to provide advice to the project team. Paul Thompson's brief focused on the need for securing the necessary statutory authority to deliver the preferred Flood Risk Management and Waterways strategy for Boston.

Paul Thompson has played an integral role in the development of an implementation plan for the Boston Strategy. He has provided detailed advice on the programming, tactical, procedural and other implications of securing the following development consents and other necessary authorisations:

- Planning consent under the Town and Country Planning Act will be required (although this can be requested for the barrier directly from the Secretary of State at the same time as applying for a Transport and Works Act Order)
- Planning consent will also be required for any works to the existing flood assets
- Compliance with the Habitats Directive
- Authorisation under the Harbours Act 1964 will be required if authority is needed to interfere with navigation, or a change of the power of duty of the harbour authority (Port of Boston) is required (achieved through a Harbour Revision Order).
- In addition, an order under the Transport and Works Act will be required to implement new navigation works.
- The navigation right of the Environment Agency on South Forty Foot Drain needs to be confirmed.

Other permissions and consents such as land drainage consent and FEPA licence will be required prior to commencement of any works on site. Consent under the Coast Protection Act 1949 is not required if work is covered by a harbour order. Agreement under the Sea Fisheries (Wildlife Conservation) Act 1992 may be required.

At this strategic level, English Nature does not require 'appropriate assessment' in accordance with The Conservation (Natural Habitats, &c.) Regulations 1994 (SI 2716). An appropriate assessment will be undertaken at the detailed project stage.

Consents or agreements will need to be in place with landowners affected by any works and this will include Crown Estates who own the river bed. If a navigation link through the Somerfield site adjacent to Black Sluice is pursued, a private land acquisition deal will be required.

3.3 Technical Products

A greater level of detail about navigation traffic, movements and requirements of different vessels will be required for good design of the waterway link, barrier and the positioning of new mooring facilities. This information will also form the basis of a navigation plan for the operational phase that must be agreed with the harbour authority (Port of Boston) and British Waterways.

Site investigation work must be carried out to inform structural design, final location choice of the barrier, and to inform the selection and design of the navigation connection to South Forty Foot Drain. This work should include an assessment of contamination to refine material/dredging disposal requirements and costs.

The location of the barrier will be within a zone defined upstream by the Swing Bridge and downstream by the Port Dock entrance. This area has been defined through preliminary consultation and consideration of environmental constraints. Further assessment and information, including sedimentation studies along with specific consultation and negotiation is required before the final location of the barrier can be determined. Compensatory habitat will be required as there will be a small loss of intertidal mudflats within the town centre.

Hydraulic studies to fully understand the flows in South Forty Foot Drain is required, in conjunction with an assessment of Black Sluice discharge capacity (both gravity and pumping) in order to inform the preferential means of connecting The Haven and South Forty Foot Drain. Should the barrier be positioned downstream of the Black Sluice discharge, which is likely, arrangements for the continued gravity discharge and water level control in South Forty Foot Drain must be implemented. Preliminary discussions with Black Sluice IDB about potential solutions have already been undertaken.

Water levels in the upper Haven would be controlled by the multi-functional barrier in order to maintain a hydraulic gradient from Grand Sluice. The retained water level upstream of Grand Sluice is set on the reference water level at Bardney (approximately 30km upstream) where the required level is set at 1.0m AOD in winter and 1.5m AOD in summer to allow for navigation and water abstraction needs. Appendix E contains a conceptual figure of how a partial tidal exclusion barrier could operate in Boston to illustrate the interaction of tidal cycle and retained water. A rising flap gate mechanism has been used as the basis of the cost estimates and would allow both navigation and flood risk management roles to be achieved by one structure.

Site investigation, consultation and specific environmental impact studies are required before any waterways infrastructure (moorings etc) works are implemented.

The improvement and repair of existing flood assets will be informed by the visual condition survey already undertaken. This will form the basis of a planned asset maintenance programme. Further site investigation, environmental studies and consultation will all be required as part of the implementation of this work.

All of these products have been included in the costs and programming for implementation of this strategy. Full details of all of the products that will be required to deliver the strategy, the drivers of these products, and the programming of these products is included in the Implementation Plan in Appendix N.

3.4 Project Management

The team that delivered this strategy was drawn from NCPMS, NEAS, National Engineering and Environmental Consultancy Framework, and the National Cost Consultants Framework. A Project Board was established from EA functions and also included a Lincolnshire county Council representative in order to coordinate Flood Risk Management and Waterways requirements, to steer the strategy and ensure internal interfaces are maintained, and to address partnership relationships at a regional level.

A core team has been identified comprising the Environment Agency, consultants and key individuals with specialist experience of barriers and navigational issues for ongoing involvement in preliminary studies to implement this strategy.

External involvement and the development of partnership relationships is identified as of key importance to both deliver this strategy and to realise opportunities for success in conjunction with other organisations. Key partners will be:

- Lincolnshire County Council (Lincolnshire Development)
- Boston District Council
- East Midlands Development Agency
- East Midlands Government Office

The Port of Boston and the Black Sluice IDB are key organisations in addition to the statutory stakeholders which may also be partners to delivering this strategy.

3.5 Timing of Works

The timing of investment is linked to the flood risk that has been assessed. The visual condition survey of existing flood assets highlighted that there is repair work required within the next five years in order to ensure the integrity of the defences within Boston. Where any works have already been identified and granted Scheme of Delegation approval (such as works at Grand Sluice), they have not been included in this strategy.

The investment in waterways structures is driven by the opportunity to work with external funding partners and the commitment of the partners, including the Environment Agency, to effect change in the regional waterways network. The complete capital expenditure for the new navigation link, the new multi-purpose barrier structure, and the waterways facilities is all incurred within the first six years.

The investment in the flood barrier is as a response to the assessment of tidal flood risk within Boston. The current system for allowing this risk to be compared across the country is the Defra priority score and the priority score of this system is high and indicates that the current standard of defence of 1 in 50 years at Boston means the community at Boston could suffer major consequences such a tidal surge occur.

Table 3.1 summarises the undiscounted capital costs (including optimism bias) for each phase of the strategy in the first six years.

A summary programme is shown in Figure 3.1 with detail of each strategy phase shown in Appendix L. The current applications for external funding have certain time constraints on placement of contract and final spend that are reflected in this programme.

The programming of channel asset work has been based upon a condition survey and this identifies where urgent works are required. The programme for all works is identified in detail in the Implementation Plan.

Table 3.1: Capital Expenditure Profile

Year	1	2	3	4	5	6	7-10	11-20	21-30	31-40	41-50	51-75	76-100	TOTAL £
Channel asset works	0	173,000	2,010,000	1,400,000	288,000	173,000	2,230,000	36,200,000	9,650,000	1,830,000	8,320,000	44,300,000	7,000,000	114,000,000
Multi-purpose barrier	0	549,000	703,000	549,000	16,000,000	15,200,000	2,500,000	0	0	200,000	0	1,160,000	200,000	37,100,000
Navigation link*	789,000	7,890,000	858,000	0	0	0	0	0	3,080,000	0	0	4,040,000	3,080,000	19,700,000
Waterways works	0	191,000	652,000	688,000	29,300	0	0	0	0	0	0	0	0	1,560,000
Total Cash Value £	789,000	8,800,000	4,220,000	2,640,000	16,300,000	15,400,000	4,730,000	36,200,000	12,700,000	2,030,000	8,320,000	49,500,000	10,300,000	172,000,000

Key to Capital Funding Sources

FRM Capital GiA
External Sources
Combination of FRM GiA & External

*The new navigation link includes a new combined Waterways lock and FRM sluice structure.

The initial capital expenditure for the the new lock and sluice structure will come from external sources

In the future capital replacement costs for the new lock and sluice structure will be met by a combination of FRM GiA and external sources

Year	1	2	3	4	5	6	7-10	11-20	21-30	31-40	41-50	51-75	76-100	TOTAL £
Channel asset works	74,000	74,000	74,000	74,000	74,000	74,000	296,000	740,000	740,000	740,000	740,000	1,850,000	1,780,000	7,330,000
Multi-purpose barrier	0	0	0	0	0	0	210,000	525,000	525,000	525,000	525,000	1,310,000	1,260,000	4,880,000
Navigation link*	0	0	15,000	15,000	15,000	15,000	490,000	1,230,000	1,230,000	1,230,000	1,230,000	3,060,000	2,940,000	11,450,000
Waterways works	0	0	0	0	0	0	80,000	200,000	200,000	200,000	200,000	500,000	480,000	1,860,000
Total Cash Value £	74,000	74,000	89,000	89,000	89,000	89,000	1,080,000	2,700,000	2,700,000	2,700,000	2,700,000	6,720,000	6,460,000	25,500,000

Key to Operation and Maintenance Funding Sources

FRM Revenue GiA
Waterways Revenue
Combination of FRM & Waterways Revenue

3.6 Procurement

Data collection studies and investigations, option appraisal, outline and detailed design, and contract documentation can be procured through the Environment Agency's National Environmental and Engineering Consultancy Agreement (NEECA2) framework.

All design works will need to comply with the Construction (Design & Management) Regulations 1994 and a Planning Supervisor should be appointed by the Environment Agency during the appraisal stage. This role can also be procured using the NEECA2 framework.

Much of the construction works and early contractor involvement in buildability and cost estimate issues could be procured through the Environment Agency's National Contractor Framework (NCF2).

Package 1	Waterways navigation link	NEECA2	NCF2
Package 2	Channel asset works	NEECA2	NCF2
Package 3	Multi-functional barrier	NEECA2 / Other	NCF2 / Other
Package 4	Waterways facility schemes	NEECA2	NCF2
Package 5	Future Defence raising	Future procurement	

Should external funding be successfully attracted to the scheme, there may be timing constraints on elements of the programme. European funds will require a contract to be let by the end of 2006 and for funds to be spent by end 2008.

The inclusion of specialist mechanical and electrical needs in the multi-purpose barrier and the variety of type of works required to deliver the overall strategy, suggest that procurement should be explored carefully for different phases of the strategy. This should include whole, or partial, Design and Build contracts and the consideration of a Private Public Partnership such as Private Finance Initiative or Build Own Finance Operate schemes. Procurement options and constraints for the six year programme of works are explored in some detail in the Implementation Plan in Appendix N.

3.7 Funding

Expenditure will be required from Flood Risk Management, Waterways, and other sources. The apportionment of the capital costs between Flood Risk Management and Waterways was explored in three possible ways:

1. Allocate costs in proportion to benefits. This approach would not be appropriate as benefits are assessed over 100 years to provide the economic justification for investment. They do not reflect a suitable basis for calculation of allocation of cash cost spend over six years. A willingness to pay concept may be of more validity, effectively establishing the value the community would place on navigational improvements, or on flood defences however, these studies are very time consuming to undertake and were not available for Boston.
2. Proportional share of savings. Many of the strategic components are clearly FRM investment or navigational works. The only shared structure is the barrier and the costs for construction of the superstructure for a water level control barrage, a tidal flood barrier, or a combined structure are not significantly different. Differences in cost are incurred in flood tie-ins, barrage bypass lock, Black Sluice discharge issues, and legal/permit costs. This results in an overall split of costs for the six year programme of works as 52% Waterways, 48% FRM.
3. FRM investment with waterways payment of the difference. There is a robust case for flood defence work in Boston and to achieve this, the preferred option is a tidal surge

barrier, tie-in works to the Port, and replacement of flood assets in the Haven. Without the navigation works, this work will still be progressed. Waterways contribution can be taken as costs for stand alone navigation work plus the difference of making the barrier multi-functional. This results in an overall split of costs for the six year programme of works as 30% Waterways, 70% FRM.

It is recommended that the most pragmatic approach to split costs from a functional point of view is approach number 3. This approach helps to manage the risk of business delivery of a strategy in Boston. The FRM funding, once approved, is robust and will cover the costs of implementing the required flood management works. Waterways funding will be approached in stages and will need the input of external funds. Funding plans will be required for each stage. There is a risk to implementation of the combined strategy should funding not be forthcoming however, if necessary, a FRM only strategy could be delivered in Boston for the approval amounts based on method 3.

The timing of expenditure also needs to be considered. Currently Waterways propose investment as early as possible to ensure that Waterways benefits are realised as soon as possible. FRM investment could quite reasonably be delayed several years. To bring all of the investment in line, contributions would be required from Waterways to construct the barrier earlier i.e. at the optimum time for Waterways to also use the surge tide barrier as a barrage. Investment will then occur on the following basis:

- Investment justified for flood risk management needs met by FRM
- Investment in navigation improvement works met by Waterways
- Additional investment to ensure the barrier structure operates in a multifunctional manner is met by Waterways
- Additional investment to ensure the barrier structure is constructed to meet Waterways time-scales is met by Waterways. This will reduce FRM investment by a corresponding amount.

The maintenance and operation costs over the 100 year assessment period have also been apportioned between Waterways and FRM. FRM maintenance costs would be derived from funding on the basis of improved social benefit (avoidance of flood damage). Waterways will meet the costs directly from increased revenue from additional boat licences. A forecast has been made that indicates a strong increase in visitor numbers in year 1 due to novelty interest, followed by a lull and then a steady growth in boat numbers and therefore additional licences. Additional visitors and boat users also generate indirect income for the boating community and Boston's local economy and this indirect income forms the justification for external and government funding based on improved social benefits.

FRM will seek FDGIA funds for their work as well as identify opportunities for external contribution should they arise. Waterways have a limited amount of capital funds, the majority of which is allocated to essential operational or health and safety works on existing assets. The majority of the funds necessary for the Waterways works will be sought from external contributions.

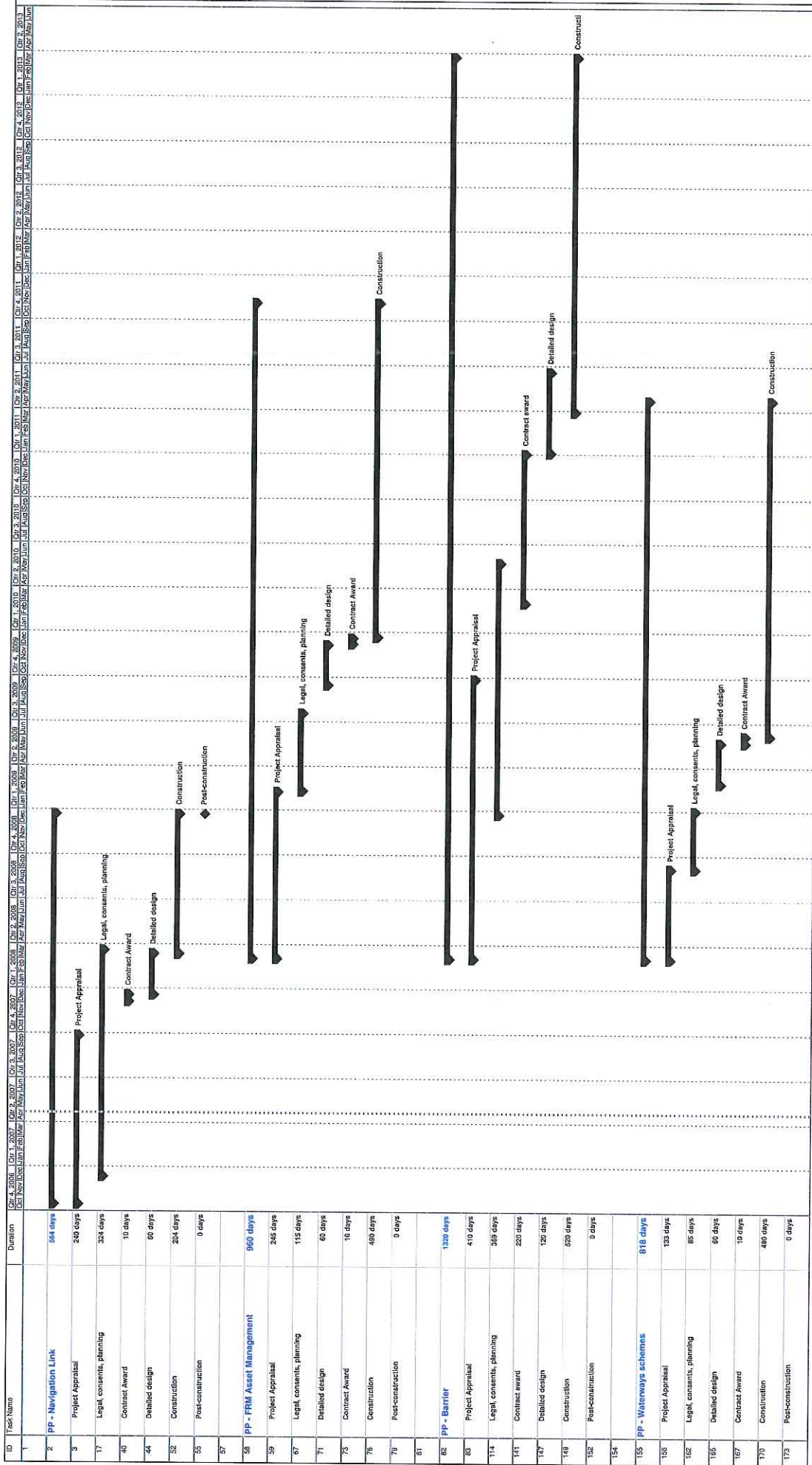
An opportunity for external contribution has been identified through existing partnership arrangements with Lincolnshire Development (Lincolnshire County Council). The town of Boston has been recognised as eligible for access to European structured funds under 'Objective 2'. This objective aims to revitalise areas by supporting restructuring of the regional economy whether industrial, rural, urban or dependent on fisheries. Such areas are

faced with different types of socio-economic difficulties that are often the source of high unemployment.

An application for this European Regional Development Fund (ERDF) has been prepared that matches funds from Lincolnshire County Council and East Midlands Development Agency against an ERDF grant. The total maximum contribution that is possible from this route of combined sources is £8 million.

There are indications that there are further funding opportunities from Lincolnshire County Council and East Midlands Development Agency in the future. There are other sources of external contribution, such as freight facility grant available to the Port of Boston, or private contributions that should be explored during project appraisal. The potential sources and work required to explore future external funding contributions to assist in financing the Strategy is explored in more detail in the Implementation Plan in Appendix N.

Legally binding agreements will be obtained to secure the external contributions before the EA enter into contracts for the delivery of this strategy.



4.0 RECOMMENDATIONS/ APPROVAL SIGN OFF

Boston Combined Strategy

This report describes the assessment and decisions made to develop a combined flood risk management and navigation strategy for Boston. The recommendations of the report are to implement a combined strategy that delivers:

- New navigation link between The Haven and South Forty Foot Drain
- Capital improvement works to flood assets at risk of failure within Boston town centre
- Multi-functional barrier within Boston Haven: dual function of partial tidal exclusion barrage for water level control to enable safe navigation, and tidal surge barrier to increase the standard of protection to 1 in 300 years
- Waterways facility works (moorings etc)
- Raising of embankment levels downstream of barrier at appropriate future time.

It is recommended that A9 SoD approval is granted for this combined approach to works within Boston to be pursued based on the strategic whole life cash cost required for 100 years shown in Table 4.1 of £198,000,000.

Following the A9 approval, other approvals will be required for each component of the strategy. The first approval to be sought will be a stand alone approval for the navigation link between The Haven and South Forty Foot Drain. This submission will be supported by detailed planning and programming, a procurement approach, and risk assessment.

A number of technical studies linked to the delivery of the strategy were started in 2006/07 to meet external funding opportunities.

High level liaison with fund holders will be required to maximise the potential of securing funds to deliver the remaining Waterways elements of the strategy.

Table 4.1 Whole life strategy cash costs

	Waterways	FRM	TOTAL
	Whole life cash cost (100 years)	Whole life cash cost (100 years)	Whole life cash cost (100 years)
Costs to Strategy:			
Agency Staff	SUNK COSTS	SUNK COSTS	SUNK COSTS
Consultants	SUNK COSTS	SUNK COSTS	SUNK COSTS
Strategy to Construction:			
Agency Staff	507,000	5,520,000	6,030,000
SI Costs	385,000	7,370,000	7,760,000
Consultants & Contractor	845,000	10,900,000	11,700,000
Other Costs	388,000	71,000	459,000
Construction:			
Construction costs (incl. supervision & cost consultants)	20,500,000	52,100,000	72,600,000
Agency staff	387,000	2,770,000	3,160,000
Compensation	565,000	4,010,000	4,580,000
Environmental enhancement	254,000	1,120,000	1,370,000
Contingency:			
Uplift for optimism bias 60%			
Risk contingency 60%	14,300,000	50,300,000	64,600,000
Other Costs:			
Maintenance	13,300,000	12,200,000	25,500,000
TOTAL	51,400,000	146,000,000	198,000,000
Contributions	8,000,000	0	

* Price date Q2 2007

4.1 Operating Authority: Environment Agency

Strategy recommended for approval &
submission to Defra for approval at a cost of

£198,000,000

Project Manager

Name	Jim Anderson	Signature	
		Date	

Strategy recommended for approval &
submission to Defra for approval

Project Executive

Name	Ron Linfield	Signature	
		Date	

Strategy recommended for approval &
submission to Defra for approval

*Budget Manager
FRM*

Name	Martin Shilling	Signature	
		Date	

*Budget Manager
Waterways*

Name	Nick Bromidge	Signature	
		Date	

4.2 Department for Environment Food and Rural Affairs.

Strategy recommended for:-
 further study/rejection/approval for:-
 Fin.Mem. agreement/agreement/approval at a cost of

£198,000,000

Senior Engineer

Name		Signature	
		Date	

Strategy recommended for:-
 further study/rejection/approval for:-
 Fin.Mem.agreement/agreement/approval at above cost.

Regional Engineer

Name		Signature	
		Date	

Strategy recommended for:-
 further study/rejection/approval & submission to DEFRA for:-
 Fin.Mem.agreement/agreement/approval at above cost.

Chief Engineer

Name		Signature	
		Date	

5.0 APPENDICES

A	Study Area and Photographs
B	Flood Asset Condition Survey
C	Planning Context
D	Flooding Information
E	Navigation Information
F	Flood Risk Management and Navigation Options
G	Environmental Report: Non-technical Summary and English Nature 'Comfort letter'
H	Consultation
I	Cost Breakdown
J	Assessment of Economic Benefits for Navigation Scheme
K	Economic Appraisal
L	Programme
M	List of Reports
N	Implementation Plan
O	Clarification report
P	Standard of Protection Justification
Q	Profit and Loss Account Waterways

Project Appraisal Report - Data Sheet

GENERAL DETAILS

Authority Project Ref. (as in forward plan):	IMAN000968	LDW/CPW
Project Name (60 characters max.):	Boston Combined Strategy	
Promoting Authority:	Defra ref (if known)	
	Name	Environment Agency, Anglian Region
	RE Region:	
Emergency Works:	(Y/N)	N
Strategy Plan Reference:	LDW 40687	LDW/CPW
Shoreline Management Plan:	N/A	LDW/CPW
Project Type:	Strategy Plan	
Shoreline Management Study/ Preliminary Study/ Strategy Plan/Prelim. Works to Strategy/ Project within Strategy/Stand-alone Project Coast Protection/Sea Defence/Tidal Flood Defence/Non-Tidal Flood Defence/Flood Warning - Tidal/Flood Warning - Fluvial/Special		

CONTRACT DETAILS

Estimated start date of works/study:	Jan 2006	
Estimated duration in months:	24	
Contract type	Framework	
Direct labour, Framework, Non Framework, Design/Construct		

COSTS

	APPLICATION (£)	Defra ADJUSTMENT (£)
Appraisal:	£262,000	
Costs for Agency approval:	£198,000,000	
Total Whole Life Costs:	£198,000,000	

For breakdown of costs see Table in Section 2.4

CONTRIBUTIONS:

Windfall Contributions:	0	
Deductible Contributions:	0	
ERDF Grant:	0	
Other Ineligible Items:	0	

Defra use only, below this line on this page

Application submission date:		
Date application received:		Last papers received:
Recommendation:	Action Office:	
Formal Approval/Agreement/Agreement to Strategy/Without Prejudice/Refer Back	(HQ/Region)	
Special Conditions required? (Yes, only if conditions required on approval letter):	Y/N	
Special Conditions:		
Progress:	Officer (Surname)	Start (date)
Senior Engineer:		Complete (date)
Regional Engineer:		Days

LOCATION - to be completed for all projects

EA Region/Area of project site (all projects):

Name of watercourse (fluvial projects only):

District Council Area of project (all projects):

Grid Reference (all projects):

(OS Grid reference of typical mid point of project in form ST064055)

Specific town/district to benefit:

Anglian	Ref.
Boston Haven	
Boston Borough Council	Ref.
TF 33X 43X	
Boston	

DESCRIPTION

Brief project description including essential elements of proposed project/study

(Maximum 3 lines each of 80 characters)

Barrier providing partial tidal exclusion for safe navigation and protection from tidal flood events.
 Navigation connection between two waterways.
 Asset improvement work to protect integrity of flood defence assets.
 Waterways facility works in town centre.

PE21

DETAILS

Design standard (return period):

Existing standard of protection (return period)

Design life of project:

Fluvial design flow (fluvial projects only):

Tidal design level (coastal/tidal projects only):

Length of river bank or shoreline improved:

Number of groynes (coastal projects only):

Total length of groynes* (coastal projects only):

Beach Management Project? Y/N

Water Level Management (Env) Project? Y/N

Defence type (embankment, walls, storage etc

300 yrs	yrs
50 yrs	yrs
100 yrs	yrs
N/A	m ³ /s
6.9 m	m
15,000 m	m
none	
0 m	m
N	
N	
Surge Barrier	

* i.e. total length of all groynes added together, ignore any river training groynes

ADDITIONAL AGREEMENTS:

Maintenance Agreement(s):

EA Region Consent (LA Projects only):

Non Statutory Objectors: Y/N

Date Objections Cleared:

N/A	Not Applicable/Received/Awaited
N/A	Not Applicable/Received/Awaited
N	
N/A	

COSTS, BENEFITS & SCORING DATA

Benefit type (DEF: reduces risk (contributes to Defra SDA 27); CM: capital maintenance; FW: improves flood warning; ST: study; OTH: other projects)	DEF, CM, OTH		
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LAND AREA

Total area of land to benefit:

of which present use is:

Agricultural:

Developed:

Environmental/Amenity

Sched. for development:

	3060 ha
FD	CE
2260 ha	ha
800 ha	ha
ha	ha
ha	ha

	ha
FD	CE
ha	ha
ha	ha
ha	ha
ha	ha

PROPERTY PROTECTED

	Number		Value (£'000s)	
	FD	CE	FD	CE
¹ Resid.	10,234		861,500	
Comm./ind.	983		160,300	
Other:				

(description below)

Description:

	Number		Value (£'000s)	
	FD	CE	FD	CE

Description:

COSTS AND BENEFITS

¹Present value of total project whole life costs (£'000s):

Project to meet statutory requirement? Y/N

Present value of urban benefits:

Present value of agricultural benefits:

Present value of environmental/amenity benefits:

¹Present value of total benefits (FD & CE)

Net present value:

Benefit/cost ratio:

Base date for estimate:

Project Appraisal Guidance used: Y/N

PAG Decision rule stages III and IV applied: Y/N

OTHER PRIORITY SCORING DETAILS¹

Economics

Non-works study, eg coastal process (Y/N)?

N

People

Risk*:

Vuln**:

Normal

0

Environmental

BAP net gain (Ha):

SSSI protected (Ha):

Other habitat (Ha):

Heritage sites***:

0

0

0

I or II

*(VH, H or N/A); ** (from ODPM website) *** ("I or II*", "II or other" or "N/A") See back page for score calculation details

Exemption Details (if exempt from priority scoring system)

Exempt from Scoring (Y/N):

Reason (max 100 chars):

¹Highlighted fields all used to generate priority score - see Annex for calculation flowchart

PRIORITY SCORE CALCULATION FLOWCHART

ECONOMIC SCORE

	Benefits (£'000s)		Costs (£'000s)		Economic Score
	938,000	by	72,700		20
Divide					multiply by 2 and subtract 1 =

$$\text{Economic score} = (\text{benefits} / \text{costs} * 2) - 1$$

PEOPLE SCORE

No of residences	Cost (£'000s)	Base People Score	Risk factor very high = 2 high = 1	Affluence factor:	Add:	People Score
10,234	72,700	8	0	plus	0	8
		=	plus			=

	(Max. is 8)	(Max. is 12)
--	-------------	--------------

ENVIRONMENTAL SCORE

BAP (Ha)	SSSI (Ha)	Other (Ha)	Cost (£'000s)	Heritage I or II* = 2 II or other = 1	Environmental Score
(0	multiplied by 2)	(0	multiplied by 25 divided by	2	2
((0)	plus	0	plus	=
Environmental score = (((BAP area created *2) + (SSSI area protected * 1.5) + other designated area protected) * 25 / cost) + heritage factor (Max is 12)					

TOTAL SCORE

Economic + People + Environmental =	30
-------------------------------------	----

Studies should be scored as for the works to which they relate; studies not related to works (eg coastal process studies for SMPs) score 20.

Please note there is an Internet Score Calculator at <http://www.defra.gov.uk/environ/fcd/policy/grantaid.htm>